B O N N E V I L L E   P O W E R   A D M I N I S T R A T I O N

Steigerwald Floodplain Restoration Project

Final Environmental Assessment

January 2019

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ACRONYMS

7-DADMax	7-day average of the daily maximum temperatures
ACS	American Community Survey
ADA	Americans with Disabilities Act
APE	area of potential effect
BMP	best management practice
BNSF	Burlington Northern Santa Fe
BP	before present
BPA	Bonneville Power Administration
°C	degrees Celsius
CAA	Clean Air Act
CCP	Comprehensive Conservation Plan
CCS	cryptocrystalline silicate
CFR	Code of Federal Regulations
cfs	cubic feet per second
CH_4	methane
CLOMR	Conditional Letter of Map Revision
cmbs	centimeters below surface
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
Corps	U.S. Army Corps of Engineers
CRDT	Columbia River Dike Trail
CWA	Clean Water Act
dB	decibels
dBA	A-weighted decibels
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
DO	dissolved oxygen
DPS	distinct population segment
EA	environmental assessment
Ecology	Washington Department of Ecology
EFH	Essential Fish Habitat
EIS	environmental impact statement

EPA	U.S. Environmental Protection Agency
ERTG	Expert Regional Technical Group
ESA	Endangered Species Act
ESU	evolutionarily significant unit
°F	degrees Fahrenheit
FCRPS	Federal Columbia River Power System
FDR	Flood Damage Reduction
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FHWA	Federal Highway Administration
FIRM	Flood Insurance Rate Map
FMP	Fishery Management Plan
FONSI	finding of no significant impact
FR	Federal Register
ft.	feet
FWCA	Fish and Wildlife Conservation Act
g	The acceleration of gravity on the surface of the earth at sea level, which is 9.8 meters/second^2
GHG	greenhouse gas
GIS	Geographic Information Systems
H	horizontal
HD	House Document
HIP	Habitat Improvement Program
HPA	Hydraulic Project Approval
HRA	Historical Research Associates
Land Trust	Friends of the Columbia Gorge Land Trust
lbs/day	pounds per day
LCEP	Lower Columbia Estuary Partnership
LCFRB	Lower Columbia Fish Recovery Board
LCR	Lower Columbia River
Leq	equivalent sound level
Lmax	maximum sound level
LOMR	Letter of Map Revision
MBTA	Migratory Bird Treaty Act
mg/L	milligrams per liter
MMPA	Marine Mammal Protection Act

N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NAVD88	North American Vertical Datum of 1988
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NO_2	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
Northwest Power Act	Pacific Northwest Electric Power Planning and Conservation Act
NO_x	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NSA	National Scenic Area
NTU	Nephelometric Turbidity Unit
NWP	Nationwide Permit
NWR	National Wildlife Refuge
O&M	Operations and Maintenance
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
PAH	polynuclear aromatic hydrocarbons
PCB	polychlorinated biphenyls
PCE	primary constituent elements
PGA	peak ground acceleration
pH	measure of Acidity or Alkalinity
PIT	passive integrated transponder
PM	particulate matter
PM_{10}	particulate matter 10 micrometers or less in diameter, or fugitive dust
$PM_{2.5}$	particulate matter 2.5 micrometers or less in diameter
Port	Port of Camas-Washougal
Refuge	Steigerwald Lake National Wildlife Refuge
RM	River Mile
RMU	Recovery Management Unit
ROG	reactive organic gases
RPA	Reasonable and Prudent Alternative
RRT	Restoration Review Team
SBU	survival benefit units

SDP	Substantial Development Permit
SO_2	sulfur dioxide
SPCC	Spill Prevention Control and Countermeasures
SR14	Washington State Route 14
SWCAA	Southwest Clean Air Agency
SWPPP	Stormwater Pollution Prevention Plan
TDG	total dissolved gas
TMDL	total maximum daily load
USC	United States Code
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
V	vertical
WAC	Washington Administrative Code
WCRL	Washougal-Columbia River Levee
WDFW	Washington Department of Fish and Wildlife
WISAARD	Washington Information System for Architectural and Archaeological Records Data
WSDOT	Washington State Department of Transportation
WSEs	water-surface elevations

CHAPTER 1 INTRODUCTION

1.1 Background

The Bonneville Power Administration (BPA) is deciding whether to fund the Steigerwald Floodplain Restoration Project (project) at the Steigerwald Lake National Wildlife Refuge (Refuge) near Washougal, Washington (Figures 1-1 and 1-2). The project is co-sponsored by the Lower Columbia Estuary Partnership (LCEP) and the Port of Camas-Washougal (Port). The Refuge is owned and managed by the U.S. Fish and Wildlife Service (USFWS). A levee along the Columbia River at the Refuge is authorized by the U.S. Army Corps of Engineers (Corps) as part of the Washougal Flood Damage Reduction (FDR) Project; the Port owns the levee system, referred to as the Washougal Levee System, and is responsible for levee operation and maintenance. The Washougal Levee System has two segments, referred to as the Washougal-Columbia River Levee (WCRL) and the Washougal-Lawton Creek Levee. The 5.1-mile WCRL segment runs west to east directly along the Columbia River and provides flood protection to parts of the town of Washougal, the Port, and the Refuge. The Washougal-Lawton Creek Levee segment is approximately 1,800 feet (ft.) and runs north to south at the east end of the Refuge. The Washougal Levee System was built over naturally-occurring levees that formed as a result of Columbia River fluvial actions such as erosion and sediment deposition.

The project would involve reconnecting Gibbons Creek and the Steigerwald Lake floodplain to the Columbia River by breaching the WCRL as well as the naturally-occurring levee upon which the WCRL was constructed; constructing two new setback levees; removing a diversion structure, fish ladder, elevated channel, and water control structure; relocating the Refuge parking lot and bathrooms; reconfiguring refuge trails; enhancing wetland channels; and re-establishing the site's historic riparian vegetation. Goals of the project include restoring floodplain connectivity to the Columbia River; improving water quality and habitat to benefit fish; maintaining required levels of flood protection and reducing outputs of contamination to the Columbia River; eliminating the need to dredge the Gibbons Creek channel to maintain water flow capacity; and reducing annual costs associated with pumping water at the Port. BPA is the lead agency and prepared this draft environmental assessment (EA) pursuant to the National Environmental Policy Act of 1969 (NEPA) (42 United States Code [USC] 4321 et seq.) and its implementing regulations. NEPA requirements necessitate federal agencies to assess the effects of proposed actions on the environment. BPA is joined in this project by the Corps and USFWS, which are acting as cooperating agencies.

This EA was prepared to determine if the Proposed Action would be likely to significantly affect the environment, warranting preparation of an environmental impact statement (EIS), or whether it is appropriate to prepare a finding of no significant impact (FONSI).

This chapter describes BPA's need to take action and the purposes that BPA seeks to achieve in addressing this need. The chapter also provides project background information, identifies the entities involved in the development of this EA, and summarizes the public scoping process and comments received.

Figure 1-1
Project Location
Steigerwald Floodplain Restoration
Clark County, WA

Figure 1-2
Project Vicinity
Steigerwald Floodplain Restoration
Clark County, WA

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1.2 Purpose and Need

BPA's decision is whether to fund the proposed Steigerwald Floodplain Restoration Project.

In meeting the need for action, BPA seeks to achieve the following purposes:

- Assist in carrying out commitments related to estuary habitat actions contained in the State of Washington's Memorandum of Agreement (Washington Fish Accord) to conserve salmon and steelhead through improvement of conditions in the estuary.
- Support efforts to mitigate for the effects of development and operation of the Federal Columbia River Power System (FCRPS) on fish and wildlife in the mainstem Columbia River and its tributaries, pursuant to the Pacific Northwest Electric Power Planning and Conservation Act of 1980 (Northwest Power Act) (16 USC 839b (h)(10)(A)), in a manner consistent with the Northwest Power and Conservation Council's Fish and Wildlife Program.
- Secure and claim survival benefits to help fulfill BPA's commitments to implement the Reasonable and Prudent Alternative (RPA) No. 37 listed in the 2008 FCRPS Biological Opinion (FCRPS BiOp), as amended in 2010 and 2014 (NMFS 2008a; 2010; 2014), which directs BPA and the other FCRPS Action Agencies, which includes BPA, the Corps, and the Bureau of Reclamation[1], to develop projects that improve fish habitat quality and fish survival in the Columbia River estuary.
- Minimize adverse effects to the human environment, avoid jeopardizing the continued existence of Endangered Species Act (ESA)-listed species, and avoid adverse modification or destruction of designated critical habitat.
- Implement BPA's Fish and Wildlife Implementation Plan EIS and Record of Decision policy direction which calls for protecting weak stocks, such as ESA-listed salmon and steelhead, while sustaining overall populations of fish for their economic and cultural value (BPA 2003).

1.3 Background

1.3.1 Statutory Context

BPA is a federal power marketing agency under the U.S. Department of Energy. BPA's operations are governed by several statutes, including the Northwest Power Act, which directs BPA to protect, mitigate, and enhance fish and wildlife and their habitats affected by the development and operation of the FCRPS. To accomplish this, BPA funds fish and wildlife protection, mitigation, and enhancement actions consistent with the Northwest Power and Conservation Council's Fish and Wildlife Program. Under this program, the Northwest Power and Conservation Council makes recommendations to BPA about which fish and wildlife projects to fund. BPA implements its Northwest Power Act and ESA obligations through the

[1] While all three federal agencies are FCRPS Action Agencies for the FCRPS BiOp, BPA and the Corps have agreed to develop the survival benefits in the Columbia River estuary.

Fish and Wildlife Program, including funding projects to help fulfill its commitments under the FCRPS BiOp.

In the Columbia River estuary, the Northwest Power and Conservation Council's Fish and Wildlife Program includes strategies to protect, mitigate, and enhance salmon and steelhead spawning and rearing habitat. For example, the Northwest Power and Conservation Council recommends habitat restoration work to reconnect ecosystem functions, such as removing or lowering dikes and levees that block access to habitat, and protecting or restoring off-channel habitat. BPA's FCRPS BiOp commitments include providing for improved survival of listed salmon and steelhead species in the Columbia River estuary and focuses on current and future restoration project implementation over a wide range of site characteristics and sizes throughout the Columbia River estuary. Considerations in the selection of restoration sites include proximity to the mainstem Columbia River, size of the restored habitat, certainty that the restoration design would provide habitat benefits, and availability of the land for restoration.

1.3.2 Federal Columbia River Power System Biological Opinion

In addition to the Northwest Power Act obligations, BPA, as a federal agency, also must comply with the ESA. Under the FCRPS BiOp developed through interagency consultation with the National Marine Fisheries Service (NMFS), BPA and the other action agencies have committed to implementing actions to improve Columbia River estuary habitat for salmon and steelhead, as specified in RPA Action 37. Beneficial estuary habitat actions include increasing available rearing habitat, cover and forage opportunities, and high flow refugia habitat in the Columbia River estuary.

1.3.3 Project Review

The Proposed Action has been developed by LCEP. The Proposed Action has been reviewed by the Expert Regional Technical Group (ERTG), which evaluates restoration proposals to determine the amount each project would benefit the survival of ESA-listed salmon and steelhead. This group is also made up of regional scientists specializing in estuarine, riverine, and ocean ecology, fisheries biology, and restoration science. Based upon current knowledge of how juvenile salmon and steelhead use and transit through the estuary, the ERTG evaluates proposed restoration projects and evaluates the relative contribution each project makes toward improving the survival and production of juveniles, using a biological crediting tool referred to as a "survival benefit unit" or SBU. *The History and Development of a Method to Assign Survival Benefit Units* provides additional details on the history and development of the ERTG and its relationship to the agencies (ERTG 2010b).

The ERTG developed criteria for scoring three factors: certainty of success, potential benefit for habitat access/opportunity, and potential benefit for habitat capacity/quality. The *ERTG Scoring Criteria* provides additional details on the scoring criteria used to assign SBUs for independent project actions. The purpose of the *ERTG Scoring Criteria* is to provide standard criteria for the ERTG to apply when it scores projects as part of the process to assign biological credit to proposed restoration projects (ERTG 2010a). Scores were developed for ocean-type and stream-type habitat characteristics. The total project SBUs were 5.0 ocean-type and 1.6 stream-type.

1.4 Roles of Other Entities

1.4.1 U.S. Army Corps of Engineers

The Proposed Action involves alterations to a federally-authorized levee managed by the Port. Alterations to federally-authorized levees require Corps (Civil Works) review and approval under Section 14 of the Rivers and Harbors Act of 1899 (33 USC 408) (herein referred to as Section 408). The Corps may approve the alterations as long as they will not impair the usefulness of the project or be injurious to the public interest. Due to its responsibilities under the Section 408 process, the Corps is participating as a cooperating agency on this EA. The Corps also has jurisdiction over the project under Section 404 of the Clean Water Act (CWA) and Section 10 of the Rivers and Harbors Act.

1.4.2 U.S. Fish and Wildlife Service

The Refuge is owned and managed by the USFWS. When the second powerhouse at Bonneville Dam was constructed in the 1970s and 1980s, the course of the Columbia River was altered and lowland habitat was lost. The Refuge was created in 1987 to mitigate for these impacts, and to create habitat for migrating and resident wildlife. USFWS staff actively manage habitat within the Refuge, and have been involved in the design of the Proposed Action. They also maintain facilities that would be affected by the Proposed Action, including a water diversion structure on Gibbons Creek near the State Route 14 (SR14) Bridge, an elevated canal that conveys Gibbons Creek flows across the floodplain, and a fish ladder on the south side of the WCRL. USFWS also has responsibilities for ensuring compliance with ESA. As a result, USFWS is participating as a cooperating agency on this EA.

1.4.3 Lower Columbia Estuary Partnership

The mission of LCEP is to improve the lower Columbia River by protecting and restoring ecosystems and enhancing clean water for current and future generations of fish, wildlife, and people. LCEP is operated as a nonprofit corporation representing the tidally influenced portion of the Columbia River, which extends 146 miles from Bonneville Dam to the Pacific Ocean. LCEP developed the concept and design for the Proposed Action and has applied to BPA for funding.

1.4.4 Port of Camas-Washougal

The Port is a co-sponsor of the Proposed Action. The Port's property is located adjacent to the west of the Refuge. Overflow over the Gibbons Creek diversion structure flows into the Port's property, and is then pumped to the Columbia to alleviate interior flooding. The Port is the designated owner of the WCRL at Steigerwald, and is responsible for its maintenance. The Port manages leases of its 430-acre industrial park, which is currently located within a FEMA mapped Special Flood Hazard Area and which was threatened, but not inundated, during the 1996 flood. The Port is interested in reducing overall operations and maintenance expenses associated with pumping and levee maintenance.

1.4.5 Cities of Camas and Washougal

The cities of Camas and Washougal own a portion of the property in the study area. Although this land is undeveloped, the cities plan to construct a groundwater supply project to supply water to the cities. As a result, the cities have an interest in the design and operation of the

Proposed Action. The City of Washougal's Waste Water Treatment Plant (WWTP) is located within the FEMA-mapped Special Flood Hazard Area.

1.4.6 Friends of the Columbia Gorge

Friends of the Columbia Gorge Land Trust (Land Trust) was created in 2005 to protect and enhance critical landscapes through acquisition and stewardship. A primary function of the Land Trust is to purchase or receive through donation properties within the Columbia River Gorge National Scenic Area (NSA), with the goals of protecting scenic and natural resources, as well as promoting recreational opportunities. The Land Trust has worked with a private landowner east of the Refuge to purchase a portion of this property. The proposed east setback levee would run along the eastern boundary of this acquired property.

1.5 Public Scoping and Key Issues

Formal public scoping for the Steigerwald Floodplain Restoration Project EA was initiated on December 28, 2015, and closed on January 27, 2016. BPA initiated the scoping period for the EA by mailing public letters and maps to interested parties and creating a project webpage (https://www.bpa.gov/efw/Analysis/NEPADocuments/Pages/Steigerwald_Floodplain_Restoration.aspx). A public meeting was conducted for the project in Washougal, Washington on January 14, 2016, with attendance from a total of 32 members of the public. Attending the public meeting were representatives from BPA, the Corps, the USFWS, LCEP, the City of Washougal, and the Land Trust. BPA also met with natural resources and tribal staff members of the Confederated Tribes of the Grand Ronde in Grand Ronde, Oregon on January 26, 2016. During the scoping period, BPA received 19 comments, either at the scoping meeting, electronically, or by mail. Comments are posted in their entirety at the project website above and are provided in the Scoping Summary Report (Appendix A).

Issues raised during the scoping process were generally divided into the following issue categories:

1.5.1 Fish

BPA received several comments on the anticipated effects of the project on fish species using Gibbons Creek and the Steigerwald Lake system. Certain commenters requested information on types of fish currently using the area, while others requested information on types of fish anticipated to use the area for refugia or spawning after project completion.

1.5.2 Wildlife

Commenters requested that BPA consider the impacts of the proposal on wildlife either currently within the project area or anticipated to return to the project area post-completion. Certain commenters requested that surveys be conducted to determine population trends of various wildlife species both before and after the project.

1.5.3 Cultural/Tribal Resources

BPA had the opportunity to meet with and receive comments from the Confederated Tribes of the Grand Ronde. Interests of the tribe included ensuring that notification and consultation be completed for any cultural resources found in the area, and raising the possibility that the project could create new opportunities for partnerships.

1.5.4 Vegetation

Certain commenters requested evaluation of impacts of the project on existing vegetation and potential new vegetation within the Refuge.

1.5.5 Flood Risk/Flood Potential

Neighboring residents and landowners in the City of Washougal requested information on whether the project would lead to increased flood risk associated with the project.

1.5.6 Water Resources

Some commenters requested that the EA consider the impact of the project, both positive and negative, on water quality both in Gibbons Creek and in the Refuge. Additionally, comments raised issues regarding the project and the relationship to municipal water supplies.

1.5.7 Project Design

Commenters requested specific inclusions in the project design, both in terms of recreation and access and in terms of the floodplain and stream channel reconstruction. One commenter requested consideration of a new alternative that would maintain the existence of the Gibbons Creek elevated channel and the fish ladder.

1.5.8 Proposed Camas/Washougal Water Well Field

Comments submitted by the cities of Camas and Washougal indicated that they have purchased property that is proposed to be bisected by the western setback levee for the project. This property is the site of the future Steigerwald Well Field, which is a groundwater supply project intended to provide future water supply needs.

1.5.9 Other Comments

Members of the public also raised issues not falling into any of the categories described above. These comments reflected concerns about air quality, noise, costs to local communities, traffic, changes to zoning, visual resources, and relationship to other entities, lessons learned from other restoration projects, and potential effects to utilities.

All comments and additional details of the public scoping process appear in the Scoping Summary Report, which is provided in its entirety as Appendix A to this EA.

1.6 Public Review of the Draft EA

The Draft EA was released to the public on January 26, 2018, for a 30-day comment period that ended on February 26, 2018. A public meeting was held from 6:00 to 8:00 PM on February 12 at the Port of Camas-Washougal. The DEA was posted to BPA's project webpage, and display advertisements announcing the availability of the DEA and the public meeting were placed in *The Columbian* and *Camas-Washougal Post-Record* newspapers. BPA also placed a notice of the meeting on its external events calendar and posted an overview of the project and a meeting notice in its online publication, the *BPA Journal*. Notices of availability and of the public meeting were sent to anyone who had added their name to the project mailing list maintained by BPA.

The public meeting was primarily open-house style, and representatives from LCEP, BPA, the Corps, and the Port were in attendance to address questions. The project manager from LCEP gave a summary presentation of the proposed project, and BPA's environmental manager briefly discussed the environmental review process. Forty-six members of the public signed the sign-in sheet, and an informal count indicated that approximately 60 members of the public attended the meeting. Although some members of the public gave verbal comments at the meeting, all attendees were encouraged to submit written comments to ensure their entire comment was captured and recorded.

Twenty-six respondents submitted a total of 192 discrete comments on the DEA during the 30-day comment period. Respondents included individuals from the community, representatives of waterfowl conservation organizations and hunter's groups, environmental organizations, Friends of the Columbia Gorge, and the U.S. Forest Service, which administers the Columbia Gorge National Scenic Area. The comments generally fell into the following broad categories:

- Support for the proposed action,
- Support for the no-action alternative,
- Concerns about altering the authorized uses of the Refuge,
- Concerns that the proposed project would replace waterfowl habitat with fish habitat,
- Concerns regarding operational effects of the project, including potential for downstream erosion and sediment deposition in the constructed channels,
- Questions about access to the Refuge during construction, and
- Requests for minor changes to some of the information displayed in the figures and clarifications to language in the EA or description of project features.

All comments were considered and the EA was updated after discussion among the various members of the project team. A list of all comments and BPA's responses is provided in Appendix B.

1.7 Changes Made Between the Draft and Final EAs

Based on the comments received during the public comment period, numerous minor changes were made to the EA between the draft and final versions. The project team's approach to addressing specific comments in the EA is generally described in the "Response" column of the comment form provided in Appendix B. Those changes are as follows:

1. Figures 2-1, 2-2, and 3-6 were amended to show the correct location of Lawton Creek.
2. Figures 2-1 and 2-2 were amended to change the reference to the Gibbons Creek elevated channel and to show the location of the locked gates and end of public access near the east end of the WCRL.
3. Figure 3-6 was amended to show the location of private property along Gibbons Creek, north of SR14.
4. Clarified closure of parking areas during construction (Table 2-6).
5. Reference to the utility trench in Section 3.9.1 has been removed, as its existence could not be verified or its location identified.

6. Added text to Section 3.15.2.1.1 indicating that removal of trees within the great blue heron rookery would be limited to the period between September and December.
7. Added text to Section 3.15.2.2.1 regarding possible impacts to purple martins and measures that USFWS will take to minimize impacts.
8. Numerous instances of minor text rewording.
9. Clarified in Section 2.1.3.1.1 that organic materials excavated during construction would be reused or disposed of onsite.
10. Added details regarding monitoring to Sections 3.6.2.2, 3.13.2.2, and 3.15.2.2.1.

1.8 Issues Beyond the Scope of this EA

Some comments provided by the public during the scoping process presented issues that were beyond the scope of this EA, either because these comments raised issues not relevant to the Proposed Action, are outside of BPA's ability to address or modify, or are more appropriately addressed in separate forums. Issues considered beyond the scope of this EA included:

1. Potential effects in the context of broader goals associated with regional plans.
2. Insertion of passive integrated transponder (PIT) tags into outmigrating juvenile fish.
3. Pre- and post-construction wildlife surveys.
4. Questions or comments regarding specific plantings, access, or interpretive features associated with area tribes.
5. Development in the Gibbons Creek watershed.
6. Questions/comments regarding project design features.
7. Lessons learned from other restoration projects.

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CHAPTER 2 ALTERNATIVES

This chapter describes the Proposed Action and the no action alternatives, and compares the alternatives by project purposes and their potential environmental consequences. This chapter also includes alternatives that were considered but eliminated from further study.

2.1 Proposed Action

Under the Proposed Action, BPA would fund the Steigerwald Floodplain Restoration Project. The Proposed Action would include restoring floodplain processes including provision of off-channel rearing habitat, flood storage, and increased habitat complexity in the Columbia River Estuary. Primary actions would include breaching natural and constructed levees on the Columbia River, developing floodplain channels, realigning Gibbons Creek, constructing setback levees, an emergency closure structure on SR14, and a floodwall, and revegetating with native riparian and wetland vegetation. Infrastructure associated with Gibbons Creek includes a structure that diverts water away from the historic Gibbons Creek channel, an elevated canal that carries water across the Steigerwald floodplain, and a fish ladder at the mouth of Gibbons Creek that would be removed. The trail network at the Refuge would be improved by reconfiguring and lengthening it by approximately 1 mile. The project would also include relocating infrastructure associated with USFWS management of the area, including the parking area and kiosk, and raising SR14 to 38.5 ft. North American Vertical Datum of 1988 (NAVD88), which would reduce flood risk to the SR14 base and roadway. All components of the completed project, other than the FDR system (described in section 3.14.1.2) and SR14, would be owned by USFWS and maintained in a manner consistent with current Operations and Maintenance (O&M) practices. The Gibbons Creek channel, the setback levees, and closure structure would be owned and maintained by the Port, which would update its O&M manual to reflect the changes to the FDR system. The Port would also deploy the closure structure when the Columbia River approached its 500-year flood stage, and remove it when the threat of flooding had passed. SR14 and all components of the road prism beneath it would continue to be owned and maintained by WSDOT.

2.1.1 Project Area

The project area encompasses 1,055 acres, which includes much of the Refuge. The Refuge is managed by USFWS as part of the Ridgefield National Wildlife Refuge Complex, which is comprised of four National Wildlife Refuges (NWRs) in southwestern Washington State – Steigerwald Lake, Ridgefield, Pierce, and Franz Lake. The Refuge occupies the north bank of the Columbia River approximately between River Miles (RM) 124 and 128. It is managed as habitat for migratory waterfowl, and is protected from Columbia River flood flows by the Corps-certified WCRL. Additional lands within the project area but outside of the area managed by USFWS include public and private lands that would either be acquired in fee title or a flood easement.

The project area is a historic floodplain dominated by grasslands and wetlands. Aerial photographs from 1935 show the lands between RMs 123 and 128 as a series of seasonally flooded open water areas surrounded by vegetated marsh and connected by meandering channels. Flood protection levees installed in the mid-1960s isolated Steigerwald Lake and the surrounding floodplain from periodic flooding and blocked fish access to these areas. Gibbons Creek is a perennial stream that flows through the site in an elevated and engineered channel built by the Corps in 1992 (Figure 2-1). It does not interact with the floodplain habitats except under high flow conditions.

Habitat value in the floodplain wetlands and ponds may be impaired by seasonally high water temperatures and minimal vegetative and structural diversity. Fish access from the Columbia River is highly impaired, with fish access to Gibbons Creek only through a fish ladder that does not meet Washington Department of Fish and Wildlife (WDFW) fish passage requirements.

The project area is located approximately 17 RMs downstream of Bonneville Dam, within the tidally-influenced stretch of the Columbia River. The tidal range at this location is relatively minimal, and generally fluctuates no more than 2 ft. The estuary in this reach is well upstream of the saline or brackish areas.

The primary influence on water-surface elevations (WSEs) in this reach are releases from Bonneville Dam. Prior to dam and levee construction, spring flows inundated up to 300,000 acres of the lower Columbia River floodplain. Regulation of the river has reduced peak flows from approximately 600,000 cubic feet per second (cfs) to about 350,000 cfs (Christy and Putera 1993).

Lands within the Refuge are managed primarily for waterfowl habitat, and the Refuge has signed on as a partner in the Pacific Northwest Goose Management Plan, which is designed to reduce depredation of geese on private agricultural lands. Under this partnership, the Refuge has agreed to maintain grasslands for geese. Habitat requirements for the target waterfowl species include shallow wetland areas and grasslands for forage, with access to upland refugia during high water events. The wetland components are found primarily throughout the center of the Refuge, in a complex of seasonal and permanent wetlands that includes Steigerwald Lake, Scaup Pond, and Straub Lake (Figure 2-1). Due to the low topographic relief found throughout much of the site, relatively minor changes in the WSEs of the lakes can produce substantial increases in wetland habitat area, resulting in the formation of approximately 617 acres of wetland habitat (LCEP 2016). 293 acres of the fields surrounding the wetlands are maintained by mowing and grazing for waterfowl grazing and upland refugia. Additional fields are unmanaged (USFWS 2005). The remainder of the Refuge lands consist of lesser amount of riparian forest, scrub-shrub, abandoned farm fields and outbuildings, infrastructure including part of the WCRL, and visitor facilities.

2.1.2 Project Elements

The primary proposed restoration elements associated with the Proposed Action are shown on Figure 2-2 and would include:

- Floodplain channel enhancement and creation,
- Removal of infrastructure including water diversions, an elevated canal, and fish ladder,
- Reconfiguring existing flood protection infrastructure and constructing new levees,
- Wetland enhancement and creation,
- Flood damage reduction,
- Revegetation, and
- Reconfiguration or replacement of recreational features.

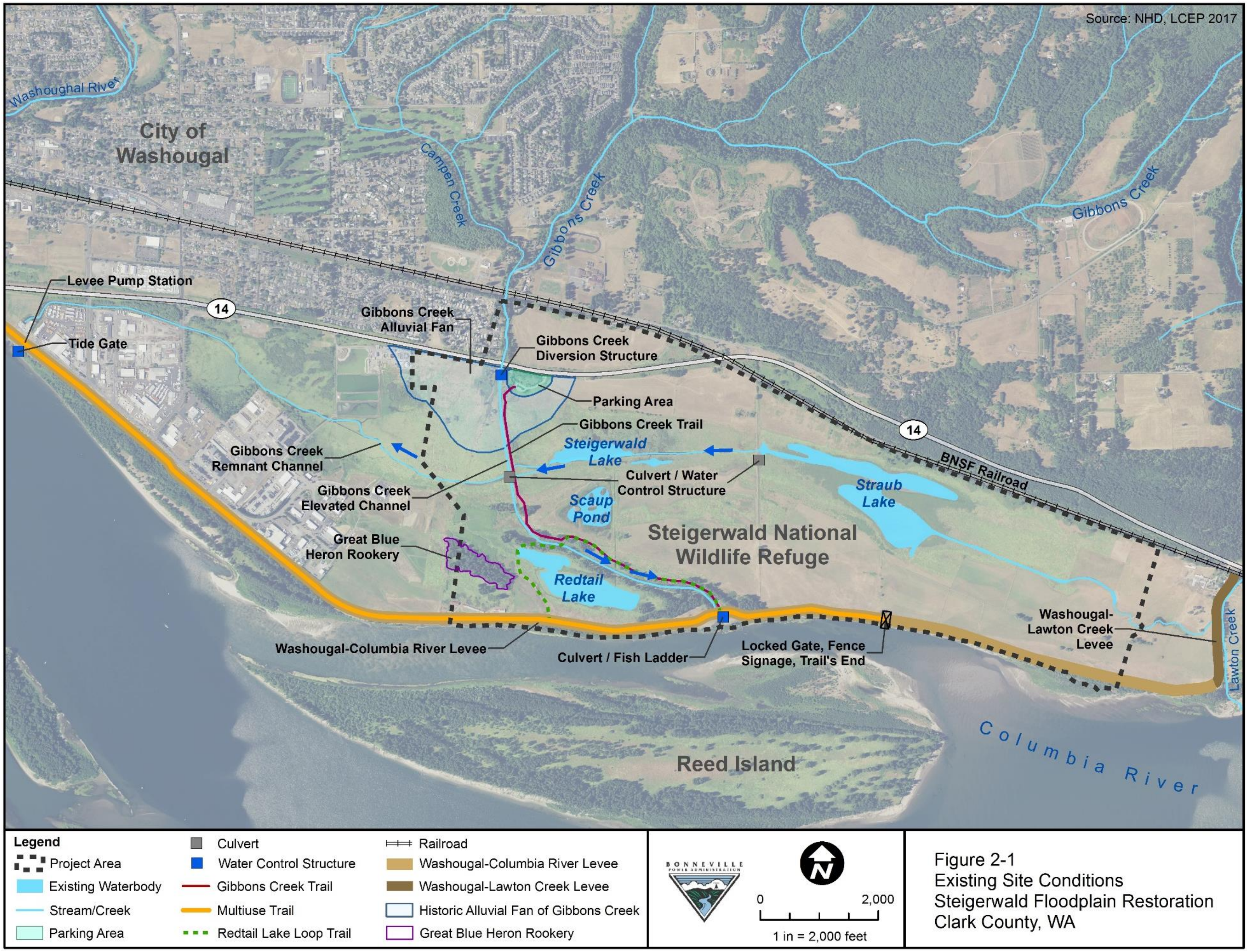

Figure 2-1
Existing Site Conditions
Steigerwald Floodplain Restoration
Clark County, WA

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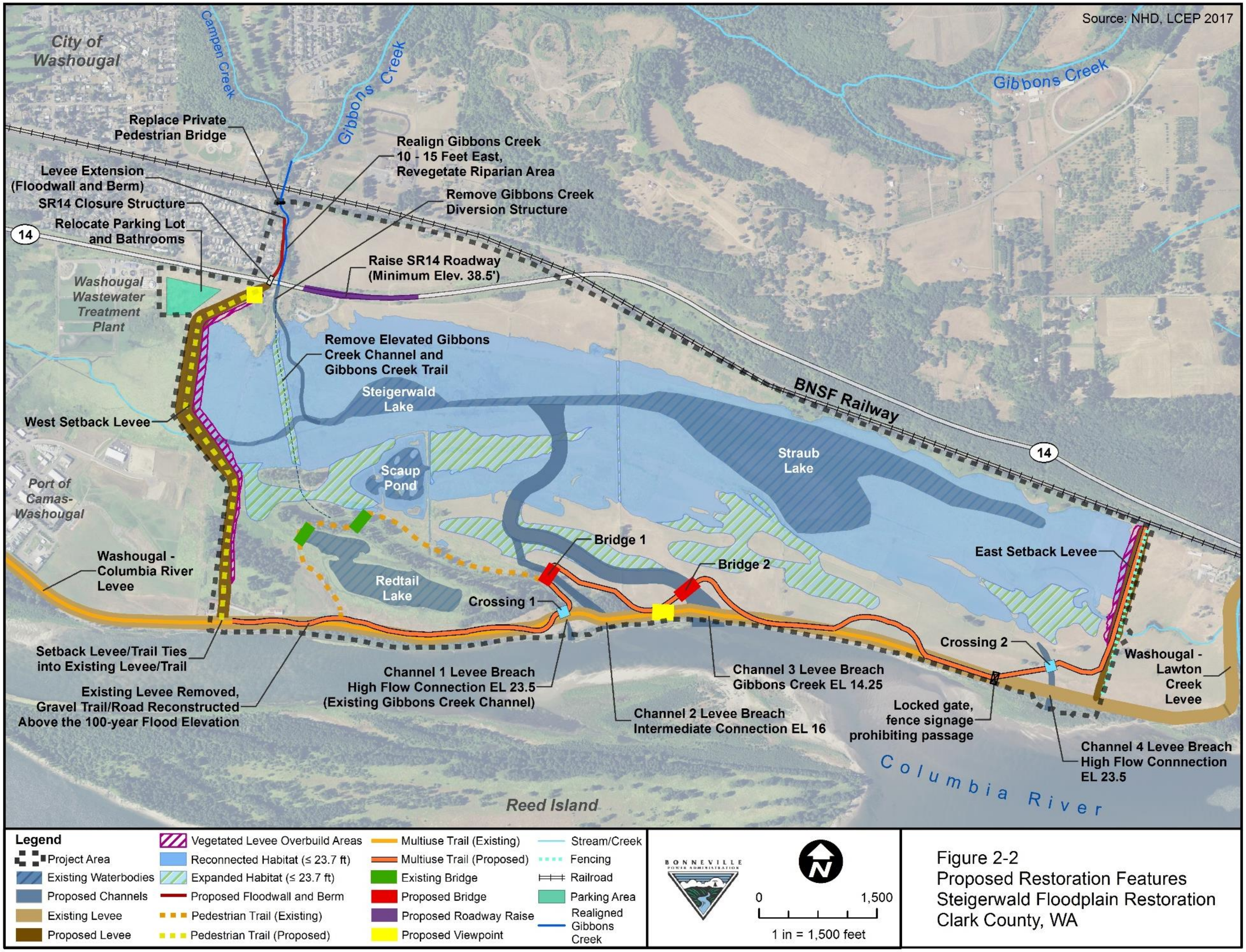

Figure 2-2
Proposed Restoration Features
Steigerwald Floodplain Restoration
Clark County, WA

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2.1.2.1 Floodplain Channels

Hydraulic connectivity between the Columbia River and the Refuge would be restored by completely removing 2.2 miles of the WCRL and excavating four deeper floodplain channels through the natural fluvial levee to the interior floodplain. Channel design was based on stream simulation design principals that consider hydraulic, sediment, and biological transport processes and functions.

The dimension and connection elevation of each channel varies with the intended function and purpose. The four channels are described below and the four breach locations illustrated on Figure 2-2. Proposed channel geometry is summarized in Table 2-1.

Table 2-1: Floodplain Channel Geometry

Floodplain Channel/ Connection Type	Connection Elevation (ft. NAVD88)	Bottom Width (ft.)	Slope Through Channel (%)	Slope at River Connection (%)	Total Length (ft.)	Notes
Channel 1 High Flow	23.0	15	Flat	2.0 – 3.5	3,400	Old Gibbons Creek outlet
Channel 2 Intermediate Flow	17.0	10	Flat	0.5 – 1.0	4,480	Connected during typical winter flows
Channel 3 (New Gibbons Creek Outlet)	14.5	15	Flat	1.0 – 2.0	5,000	Primary, perennial connection
Channel 4 High Flow	23.0	10	Flat	2.0 – 3.5	3,900	Upstream-most connection

2.1.2.1.1 Gibbons Creek Restoration (Channel 3)

The primary floodplain connection would be via Gibbons Creek, which, when completed, would become Channel 3 (Figure 2-2). Currently, Gibbons Creek discharges through Channel 1. Channel 3 would accommodate Gibbons Creek flows during periods when the Columbia River does not backwater into the Refuge. The channel is designed to accommodate natural geomorphic changes due to variations in:

- Rainfall-runoff hydrology of Gibbons Creek watershed and the Refuge
- Seasonal sand bedload transport conditions in the Columbia River
- Vegetation establishing within the floodplain channels and the adjacent sand flats

At 14.5 ft. NAVD88, this channel would have the lowest bottom elevation of any of the channels. This elevation is intended to replicate existing inundation depths and extents in Steigerwald and Straub Lakes during dry seasons, when Gibbons Creek would flow into these depressions, through this channel, and to the Columbia River. Channel 3 would also accommodate wide ranges in creek and floodplain processes: perennial drainage of Gibbons Creek under low Columbia River flows (stages), and backwatering (inflow/outflow) from the river during the spring freshet and winter flow events. The channel would have a 120-ft. wide floodplain, and a narrower 15-ft. wide inset channel at non-backwatered conditions. The connection reach would be a shallower gradient channel designed at a slope of less than half a percent through most of this reach. The channel gradient would increase at the confluence, with the final 600 ft. sloping to the river at slope of less than 2 percent.

2.1.2.1.1.1 Channel Geometry

The mouth of Channel 3 would be located at the inside of a Columbia River side channel meander bend which is an area that can be prone to sedimentation. Gibbons Creek is a perennial creek with substantial typical summer and winter flows. The morphology of the connection channel would be a result of the interaction of these two processes.

The following channel dimensions were determined for Gibbons Creek from the sediment balance results:

- Bed slope: 0.5 percent to 1.2 percent is in-line with the alluvial fan slope and thus would be consistent with historic channel slope.
- Channel bottom width: 18 – 20 ft.; Channel side slopes would be 3 ft. horizontal (H) to 1 ft. vertical (V) (3H:1V), which is similar to what was observed on Gibbons Creek upstream of SR14.
- Channel top width: 25 – 30 ft.; this top width coincides with the existing channel top widths upstream of the SR14 Bridge.
- Channel depth: 1 to 2 ft.; low channel depths as a conservative estimate intended to increase bank overtopping, floodplain inundation, and sediment deposition.
- Width to depth ratio: greater than 10.

Excavation of the new alignment could unearth alluvial deposits that would provide for an initially stable channel bed material. However, the potential to unearth sufficient alluvial deposits lessens with the channel downstream distance, as the new alignment extends to the edges of the alluvial fan. As needed, the realigned channel would be lined with coarser bed materials from the existing channel and remnant overflow channel. Additional stability would be added adjacent to the west setback levee and Gibbons Creek north flood protection berm by constructing cobble riffles to prevent damage to these critical pieces of infrastructure.

2.1.2.1.2 High Flow Connections (Channels 1 and 4)

Channels 1 and 4 would be high flow channels with a connection elevation of 23.0 ft. NAVD88 located along the northern side of the natural levee. These channels would provide additional floodplain connection at 2-year or greater flow events. Channel 1 would primarily consist of the existing Gibbons Creek channel along Redtail Lake with a relatively small amount of grading at the breach to cross the natural levee. Channel 4 would connect to an existing low flow path that extends southeast of Straub Lake through low floodplain topography at a channel elevation of 23.0 ft. NAVD88. From this high point, the channel would slope towards the Columbia River, requiring channel grading through the final 1,200 ft. of natural levee. The majority of Channel 4 would be gently sloped (less than 1 percent) into the project site.

2.1.2.1.3 Intermediate Flow Connection (Channel 2)

Channel 2 would provide an intermediate connection to the Columbia River with a maximum channel elevation of 17.0 ft. NAVD88 located at Steigerwald Lake. This lower elevation would provide for an additional outlet for site drainage during intermediate Columbia River stages. The proposed channel alignment avoids Scaup Pond in order to preserve its current hydrology and reduce potential impacts to the waterbody.

2.1.2.1.4 Other Channel Elements

The following elements have been incorporated into the design to provide additional channel complexity:

- Pool and riffle morphology
- Wood habitat structures along the banks
- Live stake planting to increase channel bank stability
- Riparian vegetation planting as described in Section 2.1.2.6

Floodplain channels would cross the Columbia River riparian zone and would also have their own riparian zones, each of which would be planted with riparian, willow scrub, and native seed as appropriate. Proposed revegetation is discussed in more detail in Section 2.1.2.6.2. The restored riparian area is intended in part to create suitable beaver habitat and encourage dam building which would further improve the quantity and quality of off-channel fish and wildlife habitat. It is also intended to provide shade, organic matter input, and habitat for terrestrial species.

Wood habitat structures would be placed throughout the restored channels to increase cover habitat and channel/hydraulic diversity, and provide substrate and organic food source to support the food web. Up to 1,750 logs for wood habitat structures would be placed in areas where they would naturally occur in a manner that closely mimics natural accumulations for that particular habitat type.

Small one- and two-log structures would be constructed, with the top log keyed into the native subgrade to resist buoyancy and scour forces and secure the footer log in place. Pier logs would also be used to naturally anchor logs in place where scour risk is expected, particularly upstream of SR14. Habitat logs would also be placed throughout the expanded habitat areas for general enhancement of micro-habitat features. These logs would either have root wads attached or have limbs partially intact for additional habitat and organic input. Furthermore, most of the large woody structures include vertical logs. They are designed to ballast the horizontal (habitat) logs, but also will provide snag habitat for birds. It is anticipated that during construction of the project, all trees removed during clearing would be salvaged and incorporated into wood habitat structures.

2.1.2.2 Upstream Gibbons Creek Restoration

Realignment of the northern Gibbons Creek channel, which includes most of Gibbons Creek between Steigerwald Lake and Evergreen Highway, would be focused on providing for natural function while maintaining existing and proposed infrastructure. Review of historic photos and topographic maps (USGS 2015) from the 1930s to early 1960s indicated that the historic channel sinuosity north of SR14 was generally low, with sinuosity increasing closer to the connection with Steigerwald Lake. The proposed channel alignment has been designed to follow a similar pattern.

The new channel alignment north of SR14 would restore natural planform variation to the system while increasing floodplain storage along the western bank within the vicinity of the new floodwall. This would be accomplished by realigning a roughly 400-ft. stretch of Gibbons Creek by moving it approximately 10 ft. to the east of its current location and sloping the west bank at a gentler angle than is currently found there (Figure 2-2). The realigned stretch starts approximately 150 ft. north of the SR14 Bridge.

A new pedestrian bridge would be constructed over Gibbons Creek to replace two failing bridges on the northernmost private property, approximately 100 ft. south of Evergreen Highway. A 15-ft. roughened rock toe would be installed under it to prevent bed scour and provide velocity refugia for fish passage. Because the bridge and rock toe have been designed using WDFW stream simulation criteria, they would not restrict flood passage or alter the geometry of the streambed.

At the SR14 Bridge the straight channel alignment (approximately 150 ft. upstream and 200 ft. downstream of the bridge) would be maintained. Downstream of the SR14 crossing, the channel would meander towards Steigerwald Lake and would be constructed as a shallow inset channel with a low floodplain to mimic historic alluvial fan conditions.

Restoring the northern portion of Gibbons Creek south of SR14 would involve removing the diversion structure and elevated canal, and re-aligning portions of the Creek. This approach would allow the stream to migrate across a portion of its historic alluvial fan, and it would eliminate the need for removal of creek deposits at the diversion (LCEP 2014; USFWS 2013b). It is designed to provide natural sediment transport while reducing flood and erosion risks for adjacent properties and infrastructure. Sediment from Gibbons Creek watershed is anticipated to be carried downstream to a point where the slope flattens, a point at which deposition would occur on the relic Columbia floodplain. Gibbons Creek would flow through Steigerwald Lake and out through Channel 3, having a direct connection to the Columbia River, thereby providing unimpeded fish passage. The new Gibbons Creek channel would be designed to meet the following design criteria:

- Fish passage – provide fish passage for all salmonid life stages at the full range of hydrologic conditions
- Habitat – improve in-stream habitat quality through the re-establishment of natural processes and active restoration, e.g., riparian plantings, placement of large wood, and restored floodplain connectivity
- Channel stability - maintain the integrity of the SR14 Bridge crossing by providing stable channel design within the vicinity of existing and proposed infrastructure.

- Channel mobility – restore the ability for the creek to meander across its alluvial fan at its connection to Steigerwald Lake
- Maintenance – Minimize or eliminate the need for stream maintenance, including dredging

The channel design is geomorphically appropriate and takes into account the existing and new infrastructure within this reach. This infrastructure includes the existing SR14 Bridge and embankments, adjacent properties, the railroad bridge and embankments, the proposed floodwall, and the proposed west setback levee. Consequently, the design of this reach involves developing a stable channel geometry and alignment near infrastructure, while maintaining the ability for the channel to move across its alluvial fan at its connection to Steigerwald Lake. The infrastructure protection design criteria are summarized in Table 2-2.

Table 2-2: Infrastructure Protection Design Criteria for the North Reach of Gibbons Creek

Infrastructure Concern	Hydraulic Criteria	Reference
Flooding	No increase to flood water levels up to the 500-year event for adjacent landowners	Corps of Engineers staff direction
Bridge flow passage	Meet existing or improve flow passage	Design team coordination with Washington State Department of Transportation (WSDOT) (WSDOT 2014a)
Bridge foundation scour	Gibbons Creek 100-year event flow	WSDOT Hydraulics Manual (WSDOT 2014b)
Floodwall bank protection	Gibbons Creek 100-year event flow	To be coordinated with Corps of Engineers
Levee bank protection	Gibbons Creek 100-year event flow	Federal Emergency Management Agency [FEMA] 44 Code of Federal Regulations [CFR] 65.10 (b)(3)

2.1.2.3 Wetland Enhancement and Creation

Restoring hydrologic connectivity between the Columbia River and its historic floodplain would reconnect existing low-lying regions of the Refuge land. Further excavation would create new wetland areas. Together, these reconnected and extended wetland habitats would provide higher-velocity refuge, cover and an important food source for rearing juvenile salmonids, as well as other species of fish and wildlife.

Low elevation areas in the floodplain would be reconnected hydrologically to the Columbia River if the levees were breached, including all areas below 23.7 ft. NAVD88 in elevation. These areas would be inundated during the spring freshet, resulting in the enhancement of 455 acres of wetland (Figure 2-2).

Additional excavation and grading would create 115 acres of new wetland habitat, including the area covered by the creation of new floodplain channels. These are areas that are currently above 23.7 ft. NAVD88, which represents the elevation of the 2-year flow, but which would become seasonally inundated wetlands when excavated below that elevation. Proposed wetland areas are shown in Figure 2-2. Table 2-3 summarizes the proposed reconnected and expanded habitat areas.

Table 2-3: Summary of Expanded Habitat Areas

Description	Area (acres)	Notes
Reconnected Habitat Area	455	Existing areas below elevation 23.7 ft. NAVD88
Expanded Habitat Area	115	New area below elevation 23.7 ft. NAVD88 (Includes channel excavation)
Total	**570**	

To maximize expanded habitats and habitat connectivity, the proposed grading areas would be located immediately adjacent to existing low areas. Much of the existing low land is dominated by reed canarygrass cover and would benefit from excavation of surface vegetation. After excavation, expanded habitat areas would be densely seeded with a native wetland seed mix. In areas near proposed channels, revegetation could also include installation of willow scrub species. Revegetation is discussed in more detail in Section 2.1.2.6.

2.1.2.4 Public Access and Recreation

2.1.2.4.1 Existing and Proposed Public Access Facilities

Public access to the Refuge is provided from a parking lot south of SR14 and east of Gibbons Creek. The lot provides parking for 20 cars (2 Americans with Disabilities Act [ADA] parking spots) and 1 bus/RV. Facilities include a waterless restroom with two vault toilets, bike racks, kiosk and trailhead. The trailhead provides access to a pedestrian-only trail with a number of interpretive art elements that connects to the seasonally-closed Redtail Lake loop trail and a multi-use trail (pedestrians, dogs on-leash, bikes, and horseback riders), which follows along the top of the WCRL, formally called the Columbia River Dike Trail (CRDT). Maintenance vehicle access to the Refuge and WCRL is provided from this lot via a gated road along the Gibbons Creek elevated channel.

The restoration project would remove sections of the WCRL and the natural levee, the Gibbons Creek elevated channel, and an interior access road embankment. These actions would result in the removal of a portion of the CRDT and access road network as well as seasonal inundation of portions of the pedestrian trail and additional access road.

The proposed public access area is shown on Figure 2-2. The parking lot, bike parking, trailhead, and restroom would be relocated to Refuge property on the west side of the west setback levee. Relocation is prudent to prevent impacts from relatively rare Columbia River and Gibbons Creek floods, to allow more room for Gibbons Creek alluvial fan restoration, and to concentrate development and maximize the contiguity of the restored area.

The new trailhead would provide access to a public pedestrian-only trail that would also function as a maintenance vehicle access road. Interpretive art elements would be relocated to this trail where appropriate. The trail would connect to the CRDT where the west setback levee meets the existing WCRL (Figure 2-2).

The CRDT would be reconstructed at a lower elevation where the WCRL was removed and would meander across the broad natural fluvial levee. This trail would include at-grade crossings of Channels 1 and 4, and two bridges (Table 2-4) to allow users to cross Gibbons Creek (Channel 3) and Channel 2. The seasonally-closed Redtail Lake loop trail would not be impacted during construction. Access to this trail would be provided from the CRDT. Bridge design would be refined in the next phase of the project.

Table 2-4: Preliminary Characteristics of Proposed Bridges

Bridge	Nominal Length (ft.)	Location	Low Chord Elevation (ft. NAVD88)	Type	Deck Elevation (ft. NAVD88)
Bridge 1	100	Channel 2	TBD	Pre-engineered clear span	30
Bridge 2	150	Gibbons Creek	TBD	Pre-engineered clear span	27

2.1.2.4.2 Public Access Design Intent and Criteria

The intent of the public access design is to provide similar site access and an improved and diversified visitor experience following restoration actions. The design criteria shown in Table 2-5 were established collaboratively with input from USFWS, LCEP, the Port, and other stakeholders. The parking lot and access trail would be moved to the west side of the west setback levee where it would be protected from seasonal flooding from the restored Gibbons Creek. This action would include increasing the number of available parking spaces from 20 (2 ADA accessible) to 30 (2 ADA accessible), maintaining parking for one bus or RV, and salvaging and relocating interpretive art components.

In addition to access features, features intended to enhance the visitor experience would be installed. A new overlook would be installed on the west setback levee to provide visitors with their first expansive views of the Refuge, including the restored Gibbons Creek alluvial fan. A second Columbia River overlook, similar to the existing one near the fish ladder, would be installed between the Channel 2 and Channel 3 crossings. New fences would be installed to replace old fences or to keep sensitive areas off limits. New and updated interpretive and wayfinding signs would be installed, and rock benches and bike racks would be relocated.

Table 2-5: Linear Access Element Design Criteria

Linear Access Feature	Width (ft.)	Surface	User	Max Slope	Min Radii (ft.)	Trail Elevation[1] (ft. NAVD88)
Entrance Road	24	Gravel	Car, RV, Emergency Services, Tractor	NA	NA	NA
Maintenance Access Road	12	Gravel	Car, Emergency Services, Tractor (could be used as interior trail)	5%	40	Varies
Multi-Use CRDT	10	Gravel	Pedestrians, Horses, Bicycles, Dogs on-leash, Polaris-style maintenance vehicle	5%	36	33 - 38
CRDT Channel Crossing	10	Gravel	Pedestrians, Horses, Bicycles, Dogs on-leash, Polaris-style maintenance vehicle	5%	NA	23 Min.
CRDT Bridges	12	Timber or other Non-Slip Decking	Pedestrians, Horses, Bicycles, Dogs on-leash, Polaris-style maintenance vehicle	NA	NA	27 to 30
Interior Trails	6	Gravel	Pedestrians only	5%	--	Varies

[1]Span and channel crossing elevations minimize periodic inundation. Based on a 10-year record, the CRDT crossing elevations of 23 ft. NAVD88 would be inundated an average of 12 days per year.

2.1.2.5 Flood Protection

2.1.2.5.1 Levees

To provide the more frequent exchange of water in and out of the area while providing the current level of flood protection, the levees and infrastructure would be reconfigured as follows:

1. The 2.2 mile stretch of the WCRL between the east and west setback levees would be excavated by approximately 10 ft. to the approximate elevation of surrounding ground and the natural fluvial levee, which is generally close to the 100-year flood event level,
2. The natural fluvial levee beneath the WCRL would be excavated at four locations to allow for connection of floodplain channels to the Columbia River,
3. Two new setback levees would be constructed, one at the east end (crest elevation 46.3 ft. NAVD88) and one at the west end (crest elevation 45.7 ft. NAVD88) of the project area,
4. A floodwall and berm would be constructed on the west bank of Gibbons Creek upstream of Highway 14 (Figure 2-2) to form the northern portion of the west setback levee, and
5. A 1,200-ft. stretch of SR14 would be raised so that the entire affected portion of the road would be at or above the Columbia River's 500-year flood elevation of approximately 38.5 ft. NAVD88.

Design of the two setback levees was performed following the principles presented in the Corps Manual *Design and Construction of Levees* (Engineering Manual 1110-2-1913) and other Corps resources. Corps' guidelines recommend that levee designs consider and analyze: (i) underseepage and through seepage; (ii) slope stability; and (iii) settlement (i.e. loss of freeboard) of representative sections of the levee. These analyses were performed on eight levee sections that represent the various foundation conditions and embankment height combinations along the two levee alignments. Setback levee foundations would be constructed using borrow materials from the WCRL as one of the first construction actions in Year 2.

Setback levees constructed using 12-ft. wide crests with 4H:1V (horizontal: vertical) landward side slopes and 3H:1V riverward side slopes would satisfy the conditions of stability and seepage outlined by the Corps. The geotechnical investigations that were performed to verify these conclusions are described in the Geotechnical Investigations Report (CCI 2016).

Levee construction would include preparation of the levee foundation, placement of geogrid at the base of the levee fill, embankment and compaction of suitable levee fill material, and construction of a gravel access road on top of the levee.

2.1.2.5.2 Gibbons Creek Floodwall and Berm

The Gibbons Creek floodwall would align with the western levee and extend approximately 600 ft. upstream from SR14, on the west bank of Gibbons Creek. At this point, the floodwall would tie into an earthen berm that would be installed to extend approximately 180 ft. to the northern end of the project site (Figure 2-2). The proposed floodwall is a permanent, cast-in-place reinforced concrete structure that, in combination with the berm, would extend the project's flood protection from the north side of SR14 to the point where the existing natural ground has risen sufficiently to protect against flooding related to changes from this project. The top of wall would be the greater of the authorized flood elevation or 2 to 3 ft. above Gibbons Creek design flood elevation. The bottom of the wall is preliminarily designed to be 3 ft. below the invert of Gibbons Creek to provide the necessary "cutoff" and seepage barrier against flood events.

The bottom elevation of the wall would be 34 ft., 4 ft. below the ground surface elevation of 38 ft. at the downstream end. The top of the wall would be at 45.7 ft., making the wall almost 8 ft. tall at the downstream end and tapering to 2-3 ft. tall at the upstream end. The reinforced concrete wall has been designed with landowner input to be visually appealing and meet the Columbia River Gorge NSA standards. The site of the floodwall would be cleared of vegetation, graded, and a 2-ft. wide trench between 3 and 8 ft. deep would be excavated for the floodwall foundation. Excavated materials would be used to construct the earthen berm or incorporated into the west setback levee. A gated gravel road approximately 10 ft. wide would be constructed between the floodwall and Gibbon Creek to allow access for maintenance and operations, and would be accessed via an entrance on SR14. The earthen berm is proposed to meet landowner preferences. The berm's crest elevation would be 45.3 to 46.0 ft. NAVD88, and would meet minimum required freeboard. It would be revegetated with dense native grasses, consistent with other habitat planting areas.

2.1.2.5.3 SR14 Modifications

Modifications to SR14 would include the construction of an emergency flood closure structure (closure structure) and roadway reconfiguration around the structure. Modifications would also include raising a portion of SR14 to the Columbia River 500-year flood elevation of approximately 38.5 ft. NAVD88.

2.1.2.5.3.1 SR14 Closure Structure

The closure structure would connect the west setback levee, at the levee abutment wall, to the floodwall north of SR14 (Figure 2-2). The closure structure would be approximately 73 ft. long and 7.5 ft. to 8.5 ft. high above the roadway. The foundation has preliminarily been designed to be 5 ft. below the roadway to effectively limit groundwater seepage from the flood event below the wall. Steel sockets, or sleeves, would be cast into the foundation which would receive the temporary steel posts to be erected across and above SR14 in the case of flood. Pre-cast concrete panels would slide down between the posts and serve as the flood barrier. The panels would be stored nearby on Refuge property in a fenced gravel area located close to SR14. The above grade elements of the closure would be installed only when the Columbia River approached its 500-year flood stage, otherwise allowing SR14 traffic to pass unimpeded across the eventual flood protection line. Crews from the Port would be responsible for erecting the temporary and emergency portions of the structure in advance of the flood event. Prior to installation, the Port or WSDOT would erect signs warning of the planned closure and describing an alternate route. The temporary pieces have been sized for a maximum weight of 5,000 pounds, which the Port determined was the maximum pick weight for their equipment. A 25-ft. long Washington State Department of Transportation (WSDOT) standard concrete approach slab would be installed on each side of the closure structure along SR14. The approach slabs would be meant to minimize effects from foundation or roadway settlement and help to reduce flood seepage rates around the wall. Per the Port's O&M Manual, the Port would operate the closure structure regularly to test the operation of the structure.

2.1.2.5.3.2 SR14 Roadway Raising

The SR14 roadway would be raised at a point beginning approximately 300 ft. east of the Gibbons Creek Bridge. Approximately 1,200 linear feet of the roadway would be raised to a centerline elevation of approximately 38.5 ft. NAVD88, which is equivalent to the 500-year flood stage for the Columbia River. The Gibbons Creek Bridge itself would not need to be raised, as the elevation of the roadway surface on the bridge is already 38.5 ft. NAVD88. Raising the SR14 roadway would not require any alteration of the existing roadway prism. Thus, land immediately adjacent to SR14 to the north and south would not be impacted. Two existing 24-inch culverts in the roadway prism would require retrofit with backflow prevention valves, but would not otherwise require modification, as the roadway prism would remain unchanged. New fill and paving required to raise the height of the roadway would be contained on top of the existing prism. The change in elevation of the road surface would be at maximum 3.5 – 4 ft., and would average 1.5 ft. The anticipated duration of construction of the roadway raise would be 2 – 3 months, with 3 weeks of intensive material placement.

2.1.2.5.3.3 SR14 Roadway Improvements

Relocation of the visitor access parking lot and construction of the SR14 closure structure would require restriping of travel lanes on SR14 including new westbound left turn striping at 45th Street. At the closure structure, the main roadwork elements would include removal of asphalt and base rock, widening of the gravel shoulders to accommodate the closure structure, installation of guardrail, paving, and striping. Other miscellaneous items would include installation of access gates to the Gibbons Creek side of the floodwall and levee, centerline rumble strip, and pavement markers.

2.1.2.5.3.4 Traffic Control for SR14 Modifications

Traffic control would be substantial at times during construction, including partial or full road closure on SR14 during construction of the closure structure immediately west of the SR14/Gibbons Creek Bridge. A three-stage construction staging plan is proposed for construction of the closure structure across SR14. The staged construction is intended to keep one lane of traffic open in each direction at all times, while construction of the closure occurs in the other lane. WSDOT must concur that either 1-ft. wide shoulders or 10-ft. wide travel lanes would be acceptable during temporary traffic control since these widths are below their standards. If not acceptable to WSDOT, either a full closure of SR14 with detour or continuous flagging would be required during construction. If required, the construction detour would use the same route as required for the flood event detour (see section 3.12.2.1 for details). The detour route would be partially located inside the Washougal city limits and partially located within Clark County's boundary. Therefore, coordination with these jurisdictions and WSDOT would be required to obtain an agreement for the use of the detour route during the flood event and possibly during construction.

Construction associated with the roadway raise would occur one lane at a time. The existing roadway is 4-5 lanes wide through this stretch due to the presence of slow-down lanes. Traffic would be shifted into these additional lanes during construction to preserve one lane of travel in each direction for the 2- to 3-month construction period during the first construction season. Traffic control measures would include a speed reduction to 20 miles per hour, jersey and continuation barriers, and flaggers for construction vehicles and trucks entering or leaving the construction site. It is possible that the full roadway would need to be closed for short periods of time. To the extent feasible, these closures would be timed to occur during off-hours and would be limited to half-day periods. During such closures, traffic would be re-routed along the detour route planned for use with the proposed SR14 closure structure.

2.1.2.6 Revegetation

The intent of wetland and riparian revegetation on the Refuge is to restore historic native vegetation communities to the extent possible, while also considering long-term vegetation maintenance requirements established for the Refuge. Key historic vegetation communities include vegetated open water and wetland, dry and wet prairie, and riparian and wetland forest. Managed vegetation includes agricultural areas used as food and cover for migrating Canada and cackling geese.

2.1.2.6.1 Vegetation Community Composition

Though this project breaches the natural fluvial levee to reconnect the historic floodplain to periodic inundation, dam control would still moderate flood processes, removing the highest and lowest flows. Thus, it is anticipated that shallow backwater flooding would be the dominant post-project flood process, and would drive the formation of wetland and riparian plant communities. A revegetation plan that includes plantings and use of seed mixes that reflect the plant community composition that would be expected to form under the anticipated range of post-project hydrogeomorphic conditions is described in the Basis of Design Report (LCEP 2017).

Specific focal conservation targets for the Refuge are included in the Comprehensive Conservation Plan (CCP) for the Columbia Gorge NWRs (USFWS 2005). The focal conservation target objectives provided a useful point-of-reference for the revegetation types and areal extents, although the community composition could be adjusted upon completion of the project. Target plant community composition from the CCP is as follows:

- Wetland Complex
  - CCP Objective 1.1, maintain up to 237 acres of wetland
- Riparian System
  - CCP Objective 1.2, restore 122 acres of riparian bottomland forest
  - CCP Objective 1.3, restore 101 acres of riparian scrub-shrub
- Oak Woodland and Oak Savanah
  - CCP Objective 1.4, maintain 41 acres of oak woodland
  - CCP Objective 1.5, initiate planting of oak savannah on 93 acres of grassland
- Grasslands
  - CCP Objective 1.6, maintain short (3- to 6-inch) perennial grass as winter forage on 168 acres (71 acres as unmowed field)

Plantings and seed mix composition are described in the Basis of Design Report (LCEP 2017).

Active management at the Refuge would continue to be performed by Refuge staff, cooperative farmers, and friend's groups. This management includes mechanical removal and herbicide application using boom and backpack sprayers as well as mowing, haying, and grazing. Large open areas would continue to be maintained to provide desired habitat conditions and facilitate ongoing management using large farm equipment.

2.1.2.6.2 Proposed Revegetation Priorities and Methods

The first revegetation priority is to plant or seed all areas on the site that would be temporarily disturbed during construction. Disturbance activities would include:

- Levee borrow excavation, expanded habitat excavation, and channel excavation;
- Road embankment, elevated channel, parking lot, and levee removal;
- Raising SR14;
- Constructing the Gibbons Creek floodwall;
- Levee and levee overbuild placement; and
- Construction-related disturbances from hauling.

The riparian communities would be planted along the fluvial levee of the Columbia River (including borrow areas) and along the deeper floodplain channels. This approach would help establish a wide riparian buffer along the Columbia and provide shade and a future source of large wood to newly constructed floodplain channels. These plantings would also be included on the Gibbons Creek alluvial fan.

Willow scrub communities would be planted along shallow floodplain channels and some areas that would be excavated to provide both levee construction materials and additional wetland habitat. These plantings would also occur along the overbuild section of the west setback levee. The remaining excavated areas would be planted with wetland seed. New levees would be seeded with an upland mix.

To reduce construction costs, plant material would be a combination of container plants, live stakes, bare root plants, and seed. Tractor aisles would be incorporated into the planting layout to facilitate mechanical maintenance where appropriate. The project sponsors would coordinate planting plans with USFWS staff to ensure compatibility with USFWS-trust resources and to improve the likelihood of successful plant establishment and set minimum survival rates. Sponsors would monitor vegetation for at least two years after initial plant installation to ensure that minimum survival rates were met. Survival rates below those set by the USFWS and sponsors could necessitate replanting.

2.1.2.6.3 Invasive Species Management

Prior to and after planting, invasive species, such as reed canarygrass and Himalayan blackberry would be treated by Refuge staff through mechanical and chemical means to reduce their densities. Increased inundation due to reconnection of the site to the Columbia River and localized scraping of reed canarygrass would further impede invasive cover and allow native plantings to establish.

2.1.3 Project Construction and Sequencing

Construction would occur under the authority of construction inspectors who would be able to stop work in cases where hazardous materials or other types of contaminants were released or encountered, or when sensitive or protected resources such as cultural artifacts were encountered. Prior to construction, staging areas, equipment and material storage sites, maintenance areas, and other components of the Spill Prevention Control and Countermeasures (SPCC) plan would be identified.

2.1.3.1 Construction Elements

2.1.3.1.1 Clearing and Grubbing

Clearing and grubbing would be required in many areas to remove vegetation and organic material from the top layer of excavated soil, prior to using excavated material for the levee embankment. Organic materials (topsoil and vegetation) removed during construction would be disposed of in one of two areas: (1) in the levee overbuild, which is located on the levees' waterward side and serves as the wind/wave protection berm or (2) in the upland habitat enhancement areas. The exception is medium to large trees, which would be removed intact and used as wood structures in the newly constructed floodplain channels.

2.1.3.1.2 Stream diversions

Management of Gibbons Creek flows would be a critical element of project sequencing. The existing elevated canal provides a built-in stream bypass system that would remain in place until the new Gibbons Creek channel was completed. It would be necessary to divert Gibbons Creek into a temporary stream channel north of SR14 for construction of the new channel and flood wall. Additional work area isolation would likely be required when working in and around the channels and ponds within the Refuge.

2.1.3.1.3 Demolition

The largest items to be demolished would include the Gibbons Creek diversion structure near the SR14 Bridge and the Gibbons Creek fish ladder and culvert at the confluence with the Columbia River. This would include removal and disposal of the concrete and steel elements. Additional culverts would be removed while removing the elevated canal and mid-site berm/road. Recyclable concrete, steel, and aluminum would be disposed of at area recycling facilities, and all other materials would be taken to a landfill.

2.1.3.1.4 Earthwork

Excavation activities would include channel excavation, habitat expansion grading, levee and berm removal, borrow excavation, and trail grading. Embankment activities would include levee construction, vegetated levee overbuild sections, trail grading, and restoring the borrow area. The vast majority of earthwork would be completed by large scrapers, with anticipated use of 2 sets of 6 scrapers each moving approximately 20,000 cubic yards (cy) of material per day. Finish grading of channels and slopes would be completed by bull dozers and backhoe excavators. All excavated soils are intended to be reused to construct the setback levees and the earthen berm north of SR14 along Gibbons Creek.

2.1.3.1.5 Erosion and Sediment Control

Erosion and sediment control measures would include silt fence or straw wattles at the downslope sides of excavation areas where adjacent to wetlands, turbidity curtains installed at the channel connections to the Columbia River, and check dams on all new channels. Erosion seeding would be included on all excavation and fill areas.

2.1.3.1.6 Levee Construction

All levee construction would include preparation of the levee foundation, placement of geogrid at the base of the levee fill, embankment and compaction of suitable levee fill material, use of less suitable materials in the levee overbuild slopes adjacent to the levees to reduce the need for rip rap slope protection, and construction of a gravel access road on top of the levee.

2.1.3.1.7 Interior Drainage Structure

A drainage structure would be constructed within the eastern setback levee to provide drainage for the private property to the east. This structure would include a culvert pipe with tidegate, concrete wing walls, manual canal gate and gate vault, pump station, force main piping, and electrical power from a nearby utility pole on the adjacent private property or by an alternate route determined by Clark County Public Utilities.

2.1.3.1.8 Relocated Parking Lot, Visitor Facilities, Art

Relocating the existing parking lot, visitor facilities, and art installations would require substantial demolition and salvage operations. Relocated features would include the manual and automatic gates, decorative boulders, restrooms, interpretive signage and kiosks. The existing visitor center area has electrical and telecommunications service, which would be restored to the new visitor center area. Water service and irrigation would not be installed at the new visitor center area, but the planting plan would include perennial native vegetation appropriate to the site conditions. The existing visitor area and art trail includes numerous pieces of art and interpretive features that would require careful handling to remove, reinstall, or relocate to a designated USFWS location.

2.1.3.1.9 Pedestrian Trail and Bridges

After removal of the WCRL, a new gravel pedestrian trail would be constructed to replace the levee-top trail. Two bridges would be required to cross High Flow Channel #2 and the new Gibbons Creek channel. The existing Gibbons Creek channel and High Flow Connection Channel #4 would be crossed using at-grade stream fords to eliminate the need for bridges. The two proposed bridges would be prefabricated bridges with guardrails installed on concrete abutments.

2.1.3.1.10 Gibbons Creek Flood Wall North of SR14

The proposed flood wall would be a reinforced concrete T-type structure along the west side of Gibbons Creek, extending from the north end of the SR14 closure structure approximately 600 ft. north. The proposed wall height is elevation 45.7’.

2.1.3.1.11 Closure Structure across SR14

This closure structure would serve as the flood wall across SR14, extending 73 ft. between the levee abutment wall to the south and Gibbons Creek flood wall to the north. The structure would be a permanent concrete strip foundation, with steel sockets that would receive portable steel flange posts. Portable reinforced concrete panels would be erected prior to a flood event.

2.1.3.1.12 Civil/Roadway improvements

The SR14 roadway would be raised to a minimum elevation of approximately 38.5 ft. NAVD88 at the centerline. The roadway would be raised over approximately 1,200 ft. Other proposed improvements related to the SR14 roadway and right-of- way would include striping removal and painting, pavement planing, repaving with hot mix asphaltic concrete, centerline rumble strip, guardrails, impact attenuators, and installation of wire fencing and a gate near the SR14 Bridge.

2.1.3.1.13 Temporary work zone traffic control

During the construction period of up to three months, a two-lane bypass would allow one lane of traffic to pass in each direction. The highway could be closed for short periods (2-3 days) up to 5 times during the construction period, during which time traffic would be diverted to Evergreen Highway. Traffic control would be extensive at times during construction, including partial road closure on SR14 during construction of the closure structure immediately west of the SR14/Gibbons Creek Bridge and the SR14 roadway raise. If full closure were required, a detour route would be utilized. Less extensive traffic control measures including signage and flaggers would be required for trucks entering the roadway and for construction equipment moving between work areas north and south of SR14.

2.1.3.2 Phasing

Construction would occur in two primary seasons during two consecutive years. Construction of the levees is planned for the second season, and would begin with building the levees so that the crests meet the Federal Emergency Management Agency (FEMA) standard for certification (3 ft. above the 100-year water surface elevation). The WCRL would be removed concurrently with construction of the new setback levees, and only down to the same FEMA elevation, thereby maintaining flood risk reduction at all locations during construction.

The main construction actions are listed in Table 2-6, along with the anticipated construction sequence. The key factors influencing the construction sequence are:

- Identifying work that only can be conducted within the in-water work window (June 1 – October 15)
- Ensuring that both the eastern and western setback levees are constructed in the same season as removal of the existing levee to maintain flood risk reduction levels for the surrounding communities,
- Obtaining sandy fill material from the upper several feet of the southern levee to provide ideal fill for use in the foundation lifts of the setback levees,
- Obtaining suitable levee fill material from channel excavation and habitat expansion grading areas,
- Completing the bulk of the excavation and fill activities during one season, utilizing large scrapers, to maximize efficiency and minimize excavation unit prices,
- Construction of the new Gibbons Creek channel and connection to the Columbia River almost completely prior to removing the elevated canal, and
- Minimizing Refuge closures and other interruptions to public use of the Refuge.

The work anticipated during the primary work seasons and a minor third season is outlined in Table 2-6.

2.1.3.3 Construction Access

The Refuge has a fairly extensive network of access roads. The contractor would likely utilize the access roads along the Gibbons Creek elevated canal and southern levee, as well as the north-south access road in the middle of the site. At the outset of the project, the contractor would establish a circuit to allow for efficient movement of the scraper excavators, excavating material from the channel and habitat expansion areas and transporting fill material to be placed at the setback levees.

Many of the existing and temporary access roads would be decommissioned at the end of construction. The setback levees would include a permanent gravel access road at the levee top. The southern levee access road/trail would be replaced with a new gravel road/trail along the Columbia River, including two bridge crossings. The bridges would be designed to pedestrian and equestrian loads and to accommodate light emergency access vehicles such as all-terrain vehicles.

Table 2-6: Construction Sequence for the Two Primary Construction Seasons and Minor Third Season

FIRST CONSTRUCTION SEASON (April – October of first year):
1. Construct new parking lot west of west levee
2. Construct levee test fills, and collect settlement data to guide levee construction in season 2.
3. Construct Gibbons Creek north of SR14 (pedestrian bridge, scour protection, flood wall and berm along the creek, and floodwall abutment north of SR14).
4. Construct closure structure near SR14 Bridge.
5. Raise, stripe, and pave SR14.
(Note that order of work in first year could vary at contractor discretion.)
SECOND CONSTRUCTION SEASON (April – October of second year):
1. Remove old Refuge parking and stockpile art elements at Refuge headquarters for relocation.
2. Construct setback levee foundation using borrow from existing levee. Scrape down WCRL to elev. 39 ft. NAVD88 and use sandy fill material for setback levee foundations.
3. Stop borrow from existing WCRL when crest elevation is lowered to the FEMA standard. Maintain FEMA standard at all times during construction.
4. Construct habitat expansion areas, channels (including wood structures), and use suitable fill for levee construction.
5. Construct setback levees to FEMA standard. Complete all levee segments to this standard prior to building any individual segment higher.
6. Remove remainder of WCRL and continue construction of setback levees.
7. Divert Gibbons Creek from elevated canal to new channel.
8. Remove elevated canal and diversion structure, use material to finish levee overbuild or where otherwise needed.
9. Remove Gibbons Creek fish ladder and culvert, and excavate channel 1 breach after levee construction, allowing use of this crossing as a levee earthwork haul route.
10. Construct trails, access roads, and bridges.
11. Demolish central access road near the outlet of Straub Lake.
(Note that order of items 10 and 11 could vary at the contractor's discretion.)
THIRD CONSTRUCTION SEASON (April – TBD of third year):
1. Survey levees for settlement and place fill to raise embankment to minimum grades if necessary.

2.2 No-Action Alternative

Under the no action alternative, BPA would not fund the Steigerwald Floodplain Restoration Project and LCEP would not construct the project. The Refuge would remain in its current state as a levee-protected floodplain, and USFWS would continue to manage the lands for wildlife habitat. The Port would continue to maintain the WCRL on the south side of the refuge, and operation of pumps at the west end of the floodplain would continue as needed to remove runoff from Gibbons Creek and overland sources. Fish access to Gibbons Creek would continue in its limited state, and maintenance associated with removal of sediments at the Gibbons Creek diversion structure would continue. Refuge facilities including the parking area, interpretive features, vault toilet, and boardwalk would remain in their current location, and SR14 would not be raised.

2.3 Alternatives Eliminated from Consideration

An alternative that would have included replacing the SR14 Bridge at Gibbons Creek was considered, but was eliminated from consideration due to anticipated costs and traffic impacts, and because there is not sufficient room to raise the bridge 7 ft. without substantially expanding the ROW and impacting private properties.

Various alignments of the west setback levee have been considered, but were eliminated in favor of the current alignment. The current alignment best meets the project objectives, provides a high level of flood protection, is the most cost-effective, facilitates the largest area of floodplain restoration, and would allow for development of the Camas-Washougal water supply well fields.

2.4 Comparison of the Alternatives

Table 2-7 compares the Proposed Action to the no action alternative, and provides a summary and comparison of the potential environmental consequences of each alternative. A more detailed summary of possible environmental consequences is provided in Table 2-8, and detailed analysis of environmental consequences is provided in Chapter 3.

2.4.1 Mitigation Measures

To minimize impacts to resources from the Proposed Action, the best management practices (BMPs) and mitigation measures described in Table 2-9 would be implemented during the design and construction of the project.

In addition to the mitigation measures described below, Habitat Improvement Program (HIP) III general conservation measures are applicable to all actions and include guidance for reducing impacts. General measures described in the construction drawings include those associated with site layout and flagging, temporary access and stream crossings, staging and stockpile areas, equipment use, erosion control, timing of in-water work, dust abatement, spill prevention and control, and invasive species management. Conservation measures from BPA's HIP III guidance that are applicable to this project are listed in Section 4.4.1, and the HIP III guidance document is attached as Appendix C.

Table 2-7: Comparison of Proposed Action to the No-Action Alternative

Purpose	Proposed Action	No Action Alternative
Assist in carrying out commitments related to estuary habitat actions contained in the State of Washington's Memorandum of Agreement (Washington Fish Accord) to conserve salmon and steelhead through improvement of conditions in the estuary.	Would help BPA to meet its commitments under the Washington Fish Accord.	Would not help BPA in meeting these commitments.
Support efforts to mitigate for the effects of the FCRPS on fish and wildlife in the mainstem Columbia River and its tributaries, pursuant to the Northwest Power Act.	Would help support the mitigation efforts called for in the Northwest Power Act by enhancing fish and wildlife habitat in the mainstem Columbia River.	Would not support BPA's efforts to enhance fish and wildlife habitat in the mainstem Columbia River.
Secure and claim survival benefits to help fulfill BPA's commitments to implement RPA No. 37 listed in the 2008 FCRPS Biological Opinion, as amended in 2010 and 2014.	Would help fulfill BPA's commitments to implement RPA No. 37 listed in the 2008 FCRPS BiOp.	Would not help fulfill BPA's commitments to implement RPA No. 37 listed in the 2008 FCRPS BiOp.
Minimize adverse effects to the human environment, avoid jeopardizing the continued existence of ESA-listed species, and avoid adverse modification or destruction of designated critical habitat.	Would temporarily affect wetlands, riparian areas, and residents of adjacent areas, and would permanently affect an avian rookery. Would produce long-term benefits to ESA-listed fish species. Other benefits would include: • Would reduce flood risk and potential contamination to the Columbia River by building a west setback levee that removes 124 acres of Port and City property from Gibbons Creek's 100-year flood zone, including the City's wastewater treatment plant. • Would reduce flood risk to SR14 and adjacent residential development by removing Gibbons Creek's diversion structure. Removal of this structure would increase the bridge's hydraulic capacity by 35%, restore self-sustaining sediment transport processes and eliminate the need to dredge Gibbons Creek. • Would eliminate the Port, City, and USFWS's need for approximately $5,000,000 in maintenance and capital improvement projects, including dredging the interior drainage system	Would avoid temporary construction impacts associated with proposed action, but would not produce benefits to ESA-listed fish species.

Purpose	Proposed Action	No Action Alternative
	to maintain its conveyance capacity, repairing (or replacing) the elevated channel and upgrading the Port's pump station. • Would provide access and habitat for five species of ESA-listed salmonids that are documented as using adjacent floodplains in the Columbia River Gorge to rest and feed as they out-migrate to the ocean. • Would improve access and habitat conditions for three species of salmonids (coho salmon, steelhead and cutthroat trout) that are documented as spawning and rearing in the Gibbons Creek watershed. • Would eliminate trapping of state and ESA-listed salmonids behind the WCRL. • Would help recover lamprey, two species of which (Pacific and western brook) are documented as spawning and rearing in the Gibbons Creek watershed. • Would increase the acreage of Columbia River floodplain available to juvenile salmonids and lamprey in the lower Columbia River Gorge and Portland metro area by 14 percent.	
Implement BPA's Fish and Wildlife Implementation Plan Environmental Impact Statement and Record of Decision policy direction which calls for protecting weak stocks, such as ESA-listed salmon and steelhead, while sustaining overall populations of fish for their economic and cultural value.	Would contribute to increased survival of Columbia Basin salmon and steelhead species, which are of cultural value and may provide economic benefits while at the same time protecting ESA-listed fish.	Would not contribute to the protection of Columbia Basin salmon and steelhead species, or sustain populations for economic and cultural values.

Table 2-8: Summary and Comparison of Potential Environmental Impacts of the Alternatives

Resource Category	Proposed Action	No Action
Aesthetics/Visual Resources	• Temporary reduction in visual quality during construction to viewers from SR14, residential areas, and CRDT (moderate). • Permanent minor reduction in view into Refuge from locations north of SR14 due to road raise (low). • Long-term changes to visual landscape due to setback levees and lower surface elevation of WCRL, allowing vistas of Columbia River from numerous vantage points (low). • Long-term visual improvement due to reestablishment of site's historic riparian vegetation (low). • Obscured views of Gibbons Creek due to floodwall (moderate). • Enhanced viewshed from more frequent inundation (low).	• There would be no short-term impacts to visual resources during construction.
Air Quality/Climate Change	• Construction vehicles would temporarily emit pollutants including carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and particulate matter (PM). Emissions would not exceed threshold values, so impact would be low. • Construction vehicles would emit greenhouse gases (GHGs), which can contribute to climate change (low). • Dust would be generated during construction and use of unpaved access roads, but would be minimized by application of water (low). • Completed project would provide refuge to juvenile fish during the higher peak flows that are anticipated under climate change scenarios (moderate). • Completed project would provide flood storage and attenuate higher peak flows anticipated under climate change scenarios (moderate). • Completed project would increase the capacity of the SR14 Bridge, allowing it to pass Gibbons Creek's 500-year discharge projected for 2080. This would also protect adjacent residences from 500-year Gibbons Creek flows (moderate).	• Peak flow refugia and attenuation of higher flood flows predicted under climate change scenarios would not occur (low). • There would be no construction-related emissions. Minor emissions from maintenance vehicles would continue to occur (low).
Cultural Resources	• Excavation for the Proposed Action would result in moderate impacts to one architectural resource, the WCRL. • No archaeological resources were found in locations where surface disturbance would occur, so potential for disturbance is low. • Potential impacts related to inadvertent discovery of cultural resources would be low due to implementation of measures from BPA's *Inadvertent Discovery*	• There would be no impacts to cultural resources.

Resource Category	Proposed Action	No Action
	of Cultural Resources Procedure, which requires that ground-disturbing actions must be discontinued in the event of discovery of cultural resources (low).	
Fish	• Project would increase habitat area, increase habitat diversity, improve channel complexity, improve water quality, and restore/increase access to wetland, floodplain, side channel, and stream habitat for spawning and juvenile salmonid rearing (moderate). • Removal of Gibbons Creek diversion structure would eliminate need for maintenance dredging activities, resulting in improvements to fish habitat (moderate). • Short-term impacts to fish could occur because of turbidity or accidental spills of contaminants (low). • Short-term loss of riparian vegetation during construction could reduce cover and shading (low). • Short-term loss of access to spawning areas in Gibbons Creek would occur if the fish ladder was removed or closed before the spawning period and the Gibbons Creek channel was not yet opened (low). • Injury or mortality of fish would be possible during work area isolation and fish salvage (low).	• Benefits including access to off-channel habitats and improved access to Gibbons Creek spawning area would not occur (moderate). • Possibility of fish stranding during overtopping of Gibbons Creek diversion structure would remain (high).
Geology and Soils	• More natural sediment accretion processes would occur in the floodplain wetlands due to inundation of Columbia River waters and restoration of Gibbons Creek alluvial fan through removal of the diversion and elevated canal (low). • Wind/wave impacts on the constructed levees would be mitigated by construction of vegetated levee overbuild sections (low). • Temporary erosion at levee breach locations and other work areas during construction would cause localized turbidity or surface erosion. Erosion and sediment control measures would be implemented to mitigate this impact (low). • Minor soil loss would likely occur when the natural levee was breached and the floodplain channels were initially inundated (low). • Changes to topography would occur at levees and wetland creation areas (low). • Localized alteration of soil profiles would occur if soils were excavated and	• Localized erosion would continue (low). • Continued sediment deposition at Gibbons Creek diversion structure would require ongoing dredging (moderate).

Resource Category	Proposed Action	No Action
	backfilled in borrow areas, but this would not substantially change soil composition (low). • Hydric soils would form over time in wetland creation areas (low). • A more free-flowing Gibbons Creek alignment would lead to reduced sedimentation at location of Gibbons Creek diversion structure (moderate).	
Land Use and Recreation	• Primary visitor parking area at the Refuge would be closed for the entire construction period. Part of the Refuge and part of the CRDT would be closed to recreational uses from June to October 15 during the first construction season. All of the Refuge and part of the CRDT would be closed to recreational uses for the entirety of the second construction season (April-October) during the 2nd year. In the winter between the two primary construction seasons, the public would have full or near-full access to the Refuge from the Port Plaza parking lot along the Columbia River, although the primary parking area would remain closed (moderate). • Up to 5 private parcels would be placed under flood protection easements (low). • Noise and visual impacts during construction could affect visitor experience (low). • Conversion of grassland to seasonal wetland could affect Prime Farmland (low). • Temporary construction of Gibbons Creek floodwall would occur on private lands, resulting in temporary loss of access (low). • Some access trails would be reconfigured but there would be no long-term net loss of hiking trails or access (low). • Benefit to trail network would be enhanced and lengthened by 1 mile (moderate).	• No changes to land use or recreation would occur.
Noise	• Impacts from noise levels of up 82 A-weighted decibels (dBA) during construction would be a moderate but temporary impact to residents within 100 ft. of the construction area along Gibbons Creek and along SR14 west of Gibbons Creek (moderate). • Temporary noise impacts could occur if temporary flood barriers were installed on SR14 at the Gibbons Creek Bridge (low).	• Noise impacts would be limited to ongoing maintenance actions (low).
Hazardous Substances	• Accidental spills of fuels, lubricants or solvents used by equipment during construction could affect water quality, plants, or animals in the vicinity (low).	• Construction-related releases of hazardous materials would not occur.

Resource Category	Proposed Action	No Action
	• Possibility of releases of herbicides during maintenance would be the same as for the no action alternative (low).	• Use of herbicides for pest plant control during maintenance could result in inadvertent spills of hazardous substances (low).
Public Health and Safety	• The potential for injury to workers during construction would increase for the duration of the construction period (low). • Larger inundated area could increase potential for mosquito outbreaks (low). • Temporary and minimal increase in emergency response times if traffic was impeded during construction on SR14 (low). • Current level of flood protection would be maintained or increased. Benefit of protection from Gibbons Creek flooding would be increased (moderate).	• Potential construction-related impacts would not occur under this alternative. • Current vector control practices would continue to control mosquito populations. • There would be no changes to the configuration of flood control infrastructure.
Socioeconomics and Environmental Justice	• Likely short-term generation of small number of local construction jobs (low). • Some construction funds would likely be spent in the local area for equipment, supplies, and services, providing short-term stimulus for local businesses (low). • Short-term noise, dust, and traffic impacts to residents in an environmental justice Census tract that includes Gibbons Creek (low). • Long-term visual impacts and loss of direct access to Gibbons Creek in environmental justice Census tract (low). • Benefits to fisheries on Columbia River (moderate). • Increased level of protection from Gibbons Creek flooding through installation of Gibbons Creek floodwall and berm (low).	• No socioeconomic or environmental justice impacts associated with construction would occur. • During operations, ongoing pumping needed to remove runoff from the west end of the site would continue, at public expense. This impact is moderate.
Transportation and Infrastructure	• Traffic would be restricted to 1 lane in each direction for the 4-month construction period for the closure structure and for the 2 to 3-month construction period needed to raise SR14, both of which are scheduled for the first construction season (moderate). • If temporary full closures were necessary during construction of the closure structure or construction to raise SR14, traffic would be detoured through Washougal city streets (moderate). • Traffic could be slowed by construction vehicles entering or leaving the construction area (low). • Future installation of temporary flood barriers on SR14 at the Gibbons Creek	• There would be no impacts to transportation facilities under this alternative.

Resource Category	Proposed Action	No Action
	Bridge would delay traffic temporarily, requiring traffic to be re-routed along a detour through Washougal city streets. The barriers would only be installed during rare, large-scale flooding events (low). • The base of SR14 could experience erosion due to wind-wave action during periods of high water levels and would need to be monitored and maintained with dense vegetation (low). • Seasonal inundation of portions of the pedestrian trail and new access road would be expected (low). • Temporary loss of visitor parking at the Refuge (low).	
Vegetation and Wetlands	• Short-term impacts to wetland and riparian vegetation during construction (low). • Non-native plant communities in restored areas would be replaced by native species, increasing habitat diversity and native plant cover (moderate). • Newly created wetlands would create additional habitat diversity (moderate). • Some riparian vegetation would be lost, including mature cottonwood forest that supports great blue heron rookery. The project would create more riparian areas than it would affect, so losses would be temporary (low). • Reestablishing a hydrologic connection to the Columbia River could increase the potential for establishment of aquatic invasive plant species currently found only within the Columbia River (low).	• Existing plant communities, including extensive areas of reed canarygrass, would persist, limiting habitat diversity (moderate). • Recruitment of riparian species would likely be low due to competition from reed canarygrass (low). • No construction impacts would occur.
Water Resources	• Construction actions could lead to temporary increases in turbidity in floodplain wetlands and the Columbia River (low). • Increased exchange with the Columbia River could improve water quality within the floodplain lakes (low). • As new wetlands are inundated and vegetation decomposes, short-term reduction in dissolved oxygen (DO) and changes to pH could occur (low). • Decomposing vegetation could release nutrients including phosphorous and nitrogen on a short-term basis (low). • Restored riparian areas would provide shading of surface waters, and combined with restored wetlands would help to retain groundwater over a longer period of time (low). • Current level of flood protection would remain in place, but the level of protection from Gibbons Creek flooding would benefit by increasing substantially (moderate).	• Moderate warming of surface waters in the floodplain lakes would likely continue (low). • Runoff would continue to flow to the Port and necessitate pumping to the Columbia River (low). • Possible increased gravel deposition if USFWS loses ability to dredge Gibbons Creek (moderate).

Resource Category	Proposed Action	No Action
	• Substantially less pumping would be needed at the Port since flows into the restored area would discharge directly into the Columbia River (moderate). • USFWS would benefit by no longer needing to dredge sediments from Gibbons Creek at the SR14 Bridge (moderate). • Port and City would benefit by having infrastructure removed from FEMA-mapped interior flood zone (moderate).	
Wildlife	• Short-term displacement of terrestrial wildlife and avian species resulting from construction and potential long-term displacement due to inundation (low). • Permanent loss of portion of great blue heron rookery and loss of functionality of entire rookery during construction (moderate). • Long-term increase in riparian habitat for wintering waterfowl and nesting birds (low). • Beneficial increase in extent and diversity of habitat for aquatic wildlife (moderate).	• Current management of wildlife resources would continue, and there would be no new impacts.

Table 2-9: Mitigation Measures

Resource Category	Mitigation Measures
Aesthetics/Visual Resources	• Reseed and plant disturbed areas with appropriate native species and control weeds immediately following construction. • Use water trucks to apply water, as needed, to the construction area for dust control. • Protect and retain native riparian/wetland vegetation, to the extent practicable, by avoiding construction activities in these areas. • Minimize the size of the disturbance area, to the extent practicable. • Clean-up site and remove equipment, as practical, during non-construction periods.
Air Quality/Climate Change	• Apply water from water trucks to excavation areas, access and haul roads, and staging areas as needed to control fugitive dust. • Set a low speed limit on access roads to reduce dust generation. • Restrict idling of construction vehicles and machinery to a maximum of 5 minutes.

Cultural Resources	• Mark known cultural resource sites as avoidance areas on construction drawings and flag as no-work areas in the field prior to construction.
	• Protect any unanticipated cultural resources discovered during construction as follows:
	  ○ Stop all work; cover and protect the ‘find’ in place.
	  ○ Notify Project Manager and BPA cultural resources specialist immediately.
	  ○ Implement mitigation or other measures as instructed by BPA cultural resource specialist.

Fish	• In fish-bearing waters, construct only during in-water work windows specified by WDFW and NMFS. • Seine all in-water work areas on the Columbia River and Gibbons Creek prior to excavating or isolating work areas. • A qualified fish biologist would conduct fish salvage after isolating work areas. • All fish would be handled according to NMFS protocols for handling listed fish. • Grade channels for positive drainage to avoid fish stranding. • Operate machinery used for in-water work from top of bank to the extent possible. • Preserve riparian vegetation to the extent possible during construction. • Implement all conservation measures relevant to listed anadromous fish and bull trout from HIP III. • Construction would occur under the authority of environmental inspectors who could stop work if hazardous materials were encountered or released. • Monitor water quality in floodplain wetlands, particularly for temperature.*
Geology and Soils	• Prepare and implement a Stormwater Pollution Prevention Plan (SWPPP) and an erosion control plan, consistent with National Pollutant Discharge Elimination System (NPDES) requirements and Section 401 consultation.

Resource Category	Mitigation Measures
	• Create a Sediment Control Plan, include daily monitoring during in-water construction, regular inspection, and recording control measures.* • Use sediment barriers, such as silt fences, straw matting, and straw wattles. • Minimize the area of disturbance, use minimum areas for staging, clearing, and grubbing. • Use water trucks to apply water to control dust, as needed. • Apply mulch or straw, or reseed exposed soil areas to reduce erosion and dust after completing work within a given area. • Sequence construction to minimize soil exposure and erosion potential. • Decompact staging areas and decommissioned access roads through disking and replanting. • Continue monitoring channel formation and levee breaches, in particular, to ensure that functioning channels are experiencing sustainable levels of accretion and erosion.* • Use adaptive management measures to respond to unexpected erosion or accretion.*
Land Use and Recreation	• Maintain access to as much of the Refuge as possible during construction. • Install signs to inform the public of the lengths of closures and alternate locations of birdwatching, hiking, or river access.
Noise, Hazardous Substances, Public Health and Safety	• Construction near residences would be limited to the hours between 7:00 a.m. and 10:00 p.m. • Equipment would be fitted with best available sound muffling devices to the extent practicable, and mufflers would be regularly checked to ensure they are functioning properly. • Additional methods of sound dampening or shielding such as noise barriers would be evaluated during construction planning and implemented to the extent practicable. • Construction phasing would be reviewed to minimize the duration of particularly noisy activities and the overall duration of construction near residences. • A description of hazardous materials to be used, and handling procedures would be available on-site.* • Written procedures for notifying environmental response agencies would be posted at the work site.* • Spill containment kits with written instructions for cleanup and disposal adequate for the types and quantities of materials used at the site would be available at the work site. * • Workers would be trained in spill containment procedures and would be informed of the location of spill containment kits.* • Workers would wear protective clothing when working with potentially hazardous materials.* • Any waste liquids generated at the staging areas would be temporarily stored under an impervious cover until they could be properly transported to and disposed of at a facility that is approved for receipt of hazardous materials.
Socioeconomics/ Environmental Justice	• Limit construction near residences or other sensitive receptors to hours specified in the General Plans of the City of Washougal and Clark County. • Work from the east side of Gibbons Creek to the degree possible.

Resource Category	Mitigation Measures
	• Apply water to dirt surfaces as needed to control fugitive dust.
Transportation and Infrastructure	• Coordinate with WSDOT, the City of Washougal, and Clark County to obtain an agreement for the use of the detour route. • Use traffic controls such as flagging, reduced speed limits, signage, and barriers to route traffic through affected areas and at truck entry/exit points. • Prepare a traffic control plan to detail items such as traffic control measures to be used and how they would be implemented.
Vegetation and Wetlands	• Specimens of threatened and endangered plant species populations would be protected during construction. • Refuge staff would monitor the amount of managed and unmanaged grassland to ensure continued compliance with the Compatibility Determination for winter forage area for geese.* • Staging and refueling areas would be established at least 150 ft. away from wetlands and other waterbodies to the extent possible, and they would include containment measures. • To control spread of non-native species, construction equipment would be washed before it was mobilized to and from the Refuge. • Replanting with native seed mix would occur as rapidly as possible following the completion of construction. Plantings would be mulched upon completion if needed. • Work would include developing a plan to monitor and maintain native plant communities and control non-native and invasive plants. It would include mechanical and chemical treatment methods for non-native species.*
Water Resources	• Water and sediment quality would be sampled during project planning to establish the environmental baseline, and post-construction to identify any pollutants that could be released during construction or operations. • Sediments for restoration activities would be obtained on-site to the degree possible. • Staging areas, storage sites (fuel, chemical, equipment, and materials), and potentially polluting activities would be identified and secured using methods identified in the SWPPP, and would be located 150 ft. or more from any natural water body or wetland, or on an adjacent, established road area in a location and manner that would preclude erosion into or contamination of the stream or floodplain. • A Spill Prevention Control and Countermeasures (SPCC) Plan would be developed. • Only use hydraulic fluids approved for work in aquatic environments. • Heavy equipment would be washed before delivery to project site to remove oils, fluids, grease, weed seeds, etc. • Heavy equipment would be regularly inspected and cleaned. • Pollution and control measures identified in the SWPPP would be implemented. • All non-emergency maintenance of equipment would be performed off-site. • All waste (solid waste, hazardous materials, etc.) would be disposed off-site as regulated by the state. • All equipment, materials, supplies, and waste would be removed from project site when complete. • Activities would be scheduled and water flows and levels would be managed to provide dry working conditions as

Resource Category	Mitigation Measures
	much as possible. • Prepare and implement a SWPPP and an erosion control plan, consistent with NPDES requirements and Section 401 consultation. • CWA permit-specific protection measures would be applied. • Erosion control measures would be applied to construction, staging, and access areas (e.g., silt fence or straw wattle along the entire length of levee removal along the Columbia River, turbidity curtains installed at the channel connections to the Columbia River). Erosion control measures would be removed at appropriate times. • BMPs for erosion and sediment control would be applied during operations. • In-water work areas would be isolated from the active river channel. • Levee breeching would be timed with Columbia River flows to minimize erosion. • Stockpiled soils would be covered if they were to be inactive for more than a few days. Remaining soils would be incorporated into Refuge lands or disposed of as deemed appropriate by planners and Refuge staff. • Machinery for in-water work would be operated from atop levees or within adjacent out of water areas as much as possible.
Wildlife	• Construction occurring during October would avoid primary cackling and Canada goose habitat by a minimum of 500 ft. • Recommend in construction specifications that construction should be timed to avoid disturbing the great blue heron rookery during the breeding season of January to August. • If it is not possible to avoid the great blue heron rookery during the breeding season, a hazing program should be implemented in January to discourage birds from establishing broods. • Trees to be removed between January 15 and September 1 would be surveyed for active nests. Trees with active nests would be avoided by 500 ft. to the degree possible. Alternatively, trees to be removed could be removed during the non-breeding season of September to January 15.

* Measures that are intended to address potential long-term impacts, and which would be implemented during both construction and operations.

CHAPTER 3 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

3.1 Introduction

This chapter describes the environmental conditions in and around the project area that could be affected by the Proposed Action or the no action alternative, and evaluates the potential impacts that could arise from implementing either alternative. Impacts, both adverse and beneficial, are evaluated to determine whether they could cause significant impacts to the human environment. For each resource category, mitigation measures and BMPs are designed to reduce the level of impacts.

Impacts are described for both construction and operations. The impact levels are characterized as high, moderate, low, or no impact. Impacts that were determined to be minimal or barely noticeable were characterized as “low”, those that were more than negligible were characterized as “moderate”, and those characterized as “high” were those considered to be noticeable, significant impacts. The impact levels are based on the analysis provided, which incorporates the considerations of context and intensity defined in the Council of Environmental Quality Regulations (40 Code of Federal Regulations [CFR] 1508.27). Mitigation measures and BMPs that would help reduce or avoid impacts are identified in Table 2-9 in Chapter 2.

3.2 Aesthetics and Visual Resources

Visual resources consist of natural and human-made features that give a particular environment its aesthetic qualities. To determine whether a Proposed Action would appear compatible with existing features or would contrast noticeably within the setting, the landscape character needs to be evaluated. Views are considered sensitive when they have high scenic quality and are experienced by relatively large numbers of people (i.e., views from publicly accessible areas). Scenic quality is a measure of the overall impression or appeal of an area created by the physical features of the landscape, such as natural features (landforms, vegetation, water, color, adjacent scenery, and scarcity) and human made features (roads, buildings, railroads, other built elements, and agricultural patterns).

Visual resources represent the aesthetic quality of the environment as perceived through the subjective visual sense only. As such, many people have differing definitions of what constitutes an aesthetically pleasing environment, and there are different methodologies for assessing the visual quality of a particular landscape and potential visual impacts on that landscape. Public lands agencies, such as the U.S. Bureau of Land Management, the U.S. Forest Service (USFS) and the Federal Highway Administration (FHWA), are responsible for managing public lands and public roadways. Part of these responsibilities also include ensuring that the scenic values of these lands are considered before allowing uses that could have negative visual impacts or impacts that contradict current management direction.

Sections 101 (42 USC §4331) and 202 (42 USC §4342) of NEPA mandate that federal agencies recognize the importance of visual resources and include a visual or aesthetic assessment and impact analysis of projects proposed on federal lands or projects supported by federal funds.

3.2.1 Affected Environment

The Refuge occupies most a large, undeveloped floodplain that is readily viewable from a major highway. This landscape situation is rare in southern Washington. Because of its unique position where the Columbia River emerges from a deep gorge into a more open setting with longer views, the Refuge offers unique visual resources. The gently rolling topography and open setting offer a contrast to the more constrained and wooded environment found deeper in the Columbia River Gorge and to the more developed areas found west of the site.

The Refuge lies partly within the Columbia River Gorge NSA (Figure 3-1) and has been designated as the location for a future "Gateway to the Gorge" visitor center. WSDOT has estimated that this facility may be used by as many as 100,000 visitors annually (Carver and Caudill 2013), and Refuge managers estimate that up to 90,000 people now visit the Refuge annually. The Columbia River Gorge NSA Management Plan sets guidelines and goals for new developments including statements that the expansion of an existing development shall be compatible with its landscape setting to the maximum extent practicable (CRGC 2004).

SR14 is managed by WSDOT as the Lewis and Clark Scenic Byway and is located along the north side of the study area. Because of its location at the gateway to the Columbia River Gorge NSA, the scenic byway action committee in the Lewis and Clark Scenic Byway Corridor Action Plan chose the Refuge to install interpretive elements. Goal 3 of this management plan is to design Highway 14 as a national attraction by protecting and enhancing scenic, natural, cultural and recreational resources within the highway corridor (WSDOT 1997). The objectives of that goal are managing highway improvements and vegetation without adversely affecting scenic resources and restoring views and vistas in a manner that does not adversely affect scenic values (WSDOT 1997).

The Clark County Comprehensive Plan states that a view and aesthetic goal is to ensure and protect, to the greatest extent feasible, the public's opportunity to enjoy the physical and aesthetic qualities of state's shorelines, including views of the water (Clark County 2004). The policies to achieve this goal include:

1. Identifying and encouraging the protection of scenic vistas and areas where the shoreline has high aesthetic value.
2. Encouraging development within the shoreline area that provides visual and physical linkage to the shoreline, and enhances the waterfront.
3. Encouraging development design that minimizes adverse impacts on views enjoyed by a substantial number of residences.
4. Maintaining vegetated riparian areas to protect shoreline stability and shoreline ecological functions takes precedence over vegetation clearing to preserve or create views.

From adjacent residential and industrial elements to the open prairie and floodplain of the Refuge, the project site is a juxtaposition of various manmade and natural elements. The Columbia River Gorge is highly regarded for its scenic beauty. Landforms, stratigraphy, and rocks found in the Gorge reflect the collision of crustal plates, eruptions of innumerable volcanoes, enormous landslides and floods. Visitors to the Gorge can see the Columbia River slicing through these landforms and visualize these events (USFWS 1999).

Figure 3-1
Columbia River Gorge National Scenic Area & Steigerwald Lake National Wildlife Refuge
Steigerwald Floodplain Restoration
Clark County, WA

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The Columbia River forms the southern boundary of the project site with Lewis and Clark Highway and Burlington Northern Santa Fe (BNSF) Railroad along the northern boundary. There are moderate and low-density residential areas and industrial land uses to the west of the site boundary. The highest concentration of residences is located along the northwestern boundary. There is also a private landowner east of the site. The Refuge's western boundary is adjacent to the Port Industrial Park.

Most the project site is low in elevation within the historic floodplain of the Columbia River. The site offers distant views of Mount Hood, Crown Point, Larch Mountain, and Pepper Mountain in Oregon. The site is visible from vistas on the Oregon side of the Columbia River, such as the pedestrian overlook near Crown Point and Vista House at Crown Point.

The Refuge consists of pastures (Figure 3-2), riverine floodplain habitat (Figure 3-3), permanent and semi-permanent wetlands (Figure 3-4), and cottonwood-dominated riparian corridors (Figure 3-5). There are three stands of undisturbed riparian woodlands on the Refuge consisting of large cottonwoods, red alder, willows, and red elderberry. One is west of Redtail Lake, a second is on both sides of Gibbons Creek north and east of Redtail Lake, and the third one is between the WCRL and the Columbia River west of the mouth of the realigned Gibbons Creek channel.

Figure 3-2: Pasture lands, eastern half of the Refuge

Figure 3-3: Floodplain wetlands looking north from Gibbons Creek High Rise Channel

Figure 3-4: Permanently ponded wetlands, Redtail Lake

Figure 3-5: Cottonwood riparian forest located in southwest portion of the Refuge. Great blue heron nests are visible in the tree canopy.

3.2.2 Environmental Consequences – Proposed Action

Visual resources impacts include short-term visual impacts associated with construction and long-term impacts associated with changes in the locations of levees, trails, and other features. The USFS's Scenery Management System was used to assess the potential visual contrast on the natural landscape from the Proposed Action. This system broadly defines visual contrast as the degree to which a project or activity affects scenic quality or visual resources as a measure of change to form, line, color, and textures of the existing and potentially modified landscape. Depending on the scale and scope of the Proposed Action, this method employs a contrast rating process. Visual resources in the landscape can vary greatly depending on location, time of year, and human influences. Landscape contrast is determined by the differences in form, line, color, texture, and landscape juxtaposition between the existing conditions and the Proposed Action.

3.2.2.1 Construction Impacts

The Proposed Action would include removing 2.2 miles of the WCRL, excavating channels through the natural levee, constructing new setback levees and associated structures, removing the Gibbons Creek diversion infrastructure, expanding habitat areas, relocating various recreation and public access components, and revegetating with native species (Figure 2-2).

Impacts to visual resources would be moderate in the short term to viewers near restoration sites during construction. Moderate visual impacts would be expected for residential viewers at the northwest corner of the project area, where staging would occur. The staging area would be disturbed during construction, and surrounded by fencing, resulting in temporary, moderate impacts.

Construction activities would be visible from the highway and surrounding areas during the construction seasons. Within and adjacent to the project areas, the view would include construction vehicles, construction materials and fencing, and disturbed areas where project elements were being installed. Because most construction would occur during two primary construction seasons (with minor work [e.g., settlement surveys] during a third season), the impacts on visual resources during construction would be temporary and moderate.

3.2.2.2 Operational Impacts

Long-term impacts on visual resources would occur by modifying, relocating, or removing infrastructure including SR14, the WCRL, the elevated Gibbons Creek channel, and the visitor's area; creating new wetland areas; changing the location of trails; and constructing bridges, setback levees, and the Gibbons Creek floodwall, which would have a 10-ft. wide cleared area on either side. Changes would be localized and site-specific and would likely not be visible across the entire site or from further vistas during the long term. Due to the low elevation of the site, most changes would be subordinate to the overall scenic composition adjacent to the refuge. Changes would be visible from vistas within the Columbia Gorge, but at a distance – and when viewed with surrounding man-made elements – should not draw the attention of the casual observer.

Relocating the refuge parking lot and restrooms, reconfiguring refuge trails, enhancing wetland channels, planting vegetation on the levee overbuild sections, and re-establishing the site's historic riparian vegetation would have a low impact on the visual dynamic of the site and would be considered a visual improvement overall.

Raising SR14 would have a low impact on visual resources as it would result in a permanent minor reduction of the view into the Refuge from areas north of SR14.

Removing or altering levees and water control structures would alter the physical landscape by reducing the amount of infrastructure and create a channel through the site to connect Gibbons Creek directly to Steigerwald Lake. These actions would result in more frequent inundation and would help change the character of the site from a human-altered landscape to a more natural landscape, enhancing the viewshed and making the site more consistent with the natural landscapes surrounding it. Partial removal of the WCRL would also make the project area appear more natural and would allow uninterrupted visibility of the river from numerous vantage points. Impacts associated with these actions would be low.

The Gibbons Creek floodwall would align with the western levee and extend approximately 600 ft. upstream from SR14, on the west bank of Gibbons Creek. At that point, the floodwall would tie into an earthen berm that would be installed to extend to the northern end of the project site. The floodwall would be between 3 and 8 ft. high and would be topped by a fence that would be visually consistent with fencing used for viewing areas elsewhere in the Refuge. The floodwall has been designed to be aesthetically pleasing. Aesthetic features including pigmented sealant and a textured finish have been developed with landowner input, and are consistent with standards of the Columbia River Gorge NSA. However, the floodwall would be likely to obscure views of Gibbons Creek from neighboring residences to varying degrees depending on the height of the floodwall at a given location. In most places, viewers would be able to see over the top of the floodwall, although an interrupted view of the stream and riparian zone would constitute a moderate impact for some viewers closer to the downstream end of the floodwall.

The CRDT would be reconstructed at a lower elevation than the current trail, and it would appear as more of a natural landscape component. Two bridges would be constructed to allow users to cross Gibbons Creek. These structures would be designed to be low-profile, clear-span pedestrian bridges that would appear visually subordinate in the overall landscape composition. The project designs would be consistent with the historical, natural aesthetics of the site and would restore habitat diversity and native vegetation communities. The designs would result in visual conditions more typical of the historical landscape.

Upon completion of construction, the floodplain channels, disturbed ground, and new setback levees would be visible. Over time, as vegetation establishes and matures, the changes would resemble more natural features that occur along large river floodplains and would be consistent with the existing surrounding landscape. Although the setback levees would initially cause a substantial change to the viewshed, particularly from west of the project site, project contrast would reduce over time until the site achieves a more natural state. Consequently, the long-term impacts on visual resources would be low.

3.2.3 Environmental Consequences – No Action

Under the no action alternative, no construction would occur, and the project area would retain its current aesthetic values. Since vegetation is managed at the Refuge, the mix of habitat types would likely remain similar to existing conditions. The current array of infrastructure components, including the internal dikes, visitor facilities, and the levees along the Columbia River would remain the same, and the site would retain the characteristics of a levee-protected floodplain. There would be no impacts to visual resources.

3.2.4 Cumulative Impacts

Past actions that have affected visual resources near the Refuge include operation of upstream dams, logging, agriculture, road construction, and municipal and residential development. Inclusion of the project site in the Columbia River Gorge NSA restricts development projects that would have a substantial effect on the surrounding viewshed. Although some relatively small development projects are proposed on Port lands to the west of the Refuge, these projects are not anticipated to cause a high impact to visual resources in combination with the Proposed Action. Furthermore, by restoring an aquatic connection to the Columbia River, this project would be visually consistent with other restoration projects throughout the estuary and would restore the site's floodplain to a more natural condition. Therefore, cumulative impacts to aesthetic resources from the Proposed Action would be moderate and beneficial.

3.3 Air Quality and Climate Change

This section describes air quality and climate change and discusses potential impacts the Proposed Action could have on those resources. The air quality area of analysis is the air basin administered by the Southwest Clean Air Agency (SWCAA). Greenhouse gases (GHGs) and climate change are described at a regional or global scale.

3.3.1 Affected Environment

3.3.1.1 Air Quality

Ambient (outdoor) air quality standards exist to prevent air pollution from reaching levels that are harmful to public health and the environment. Ambient air quality standards are generally set at the federal and state levels, but at least one local clean air agency has also set a standard for its jurisdiction.

Under the Clean Air Act (CAA), 42 USC §§ 7401 *et seq.*, the U.S. Environmental Protection Agency (EPA) established National Ambient Air Quality Standards (NAAQS) to protect air quality and prevent air pollution from reaching levels that are harmful to public health and the environment (EPA 2016). These standards identify six criteria pollutants that are of particular concern for human health and the environment, including particulate matter (PM), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), ozone, and lead.

The Washington Department of Ecology (Ecology) maintains a monitoring network that measures the levels of these pollutants. If an area's monitoring results do not exceed the NAAQS, the EPA designates this area an "attainment area." According to Ecology (Ecology 2016a), the project area and Clark County are designated as "attainment areas" for all six criteria pollutants.

The air monitoring stations nearest to the project site are in Vancouver, 10 miles or more from the project site. One site is monitored year-round for ozone, wind speed and direction, and temperature, and the other site is monitored for PM. Other criteria pollutants are not measured at these stations because they are not likely to exceed the NAAQS. Recent monitoring data from these stations, which are in a more developed area than the project site, confirm that the area is in attainment of the standards for ozone and PM (Ecology 2016a).

The SWCAA is responsible for enforcing federal, state, and local ambient air quality standards and regulations in Clark County and the other counties of southwest Washington.

GHGs are chemical compounds found in the earth's atmosphere that absorb and trap long-wave thermal radiation emitted by the land and ocean and radiate it back to earth. GHGs include carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). No specific "ambient standards" exist for these pollutants. For context, total U.S. anthropogenic (human-caused) GHG emissions were 6,576 million metric tons CO_2 equivalent (CO_2e) in 2009, and 40 percent of these were from the electric power sector (EIA 2015). Unlike criteria pollutants and air toxics, GHG concentrations have been increasing over time and are continuing to increase. Increasing concentrations of GHGs could result in increases in the earth's average temperature by up to 7.2 degrees Fahrenheit (°F) by the end of the 21st century (EPA 2015a).

3.3.1.2 Climate Change

This section describes existing conditions related to climate and ongoing climate change and identifies potential impacts this project could have on climate change. It also discusses, on a qualitative level, the effect that climate change could have on the long-term success of the project.

Climate is governed by incoming solar radiation and the associated greenhouse effects that influence short-term, seasonal, and long-term weather patterns. Anthropogenic activities, such as the burning of fossil fuels and the clearing of forests, adds additional GHGs to the atmosphere, intensifying natural greenhouse effects, and ultimately causing changes to global, regional, and local climates.

Climate change is widely recognized as a critical issue with potentially wide-ranging impacts on water resources, fish and wildlife species and their habitats, and other natural resources. It has been suggested that the impacts of climate change will exacerbate temperatures; the timing and magnitude of stream flow; habitat loss, isolation and degradation; invasive species; and drought. According to the U.S. Global Change Research Program, the average regional air temperatures have increased by an average of 1.5°F over the last century (up to 4°F in some areas), with warming trends expected to continue into the next century (USGCRP 2009). There is less certainty about precipitation trends during the next century than temperature trends, but increased precipitation is likely to occur during October through March and less during summer, with more winter precipitation falling as rain rather than snow (ISAB 2007, USGCRP 2009).

The rate of change in global average surface temperature during the last century has not been consistent; each of the last three decades has been successively warmer at the Earth's surface than any preceding decade since 1850 (IPCC 2013). The period from 1983 to 2012 was likely the warmest 30-year period of the last 1,400 years in the Northern Hemisphere (IPCC 2013).

Long- and short-term climate fluctuations throughout history have caused natural variations in Columbia River flow. The Pacific Decadal Oscillation alternates between cold and warm phases approximately every 30 years (Fresh et al. 2005). The cold, rainy phase is typical of the Northwest and increases flows, while the warm phase is drier and decreases flows (Fresh et al. 2005). The El Niño/Southern Oscillation is a shorter, three- to seven-year phenomenon that similarly has cold and warm phases that may magnify or reduce the effects of the Pacific Decadal Oscillation.

Climate in the project area is characterized by relatively mild, rainy winters and hot, dry summers. During the long term, winter precipitation is expected to increase and summer precipitation is expected to decrease, accentuating the existing seasonal variations in precipitation (Mote and Salathé 2009; IPCC 2013). Temperatures are expected to rise during the long term, with expected effects including: more precipitation falling as rain rather than snow, diminished snow pack, increased peak flows, reduced dry season (April to September) flows, altered timing of flows, and continued increases in water temperatures.

3.3.2 Environmental Consequences – Proposed Action

3.3.2.1 Air Quality

Impacts to air quality could occur if the project obstructs implementation of an air quality plan, violates any state or federal air quality standard, result in a cumulatively considerable net increase of a criteria pollutant for which the project region is in non-attainment, expose sensitive receptors to substantial pollution concentrations, or create objectionable odors affect a substantial number of people. Air quality impacts arise from tailpipe emissions of equipment and vehicles used during construction, ongoing emissions of pollutants from stationary sources during operations, or from excavation of soils or other materials whose exposure could cause objectionable odors.

3.3.2.1.1 Construction Impacts

Tailpipe emissions include criteria pollutants that are regulated by the EPA, which delegates some authority for regulating air quality to individual states. The states in turn manage air quality as a series of air quality regions or basins. The project area is within the air basin managed by the

SWCAA. Consultation with SWCAA indicated that the air basin is in attainment for all criteria pollutants (Lamoreaux 2016).

Project construction could impact air quality in the project area as a result of the earth moving required to excavate wetlands and construct levees and other features, importing various construction materials or hauling excavated materials offsite, and emissions from employee vehicles. The SWCAA did not expect the Proposed Action to result in violations of regional or federal air quality standards, and did not require emissions modeling to estimate the impacts. However, to confirm this, a model was used to estimate emissions of criteria pollutants and CO_2 for all aspects of construction, including grading, earth moving both on and off the site, worker commuting, and round trips of trucks delivering or removing materials. The Road Construction Emissions Model, Version 7.1.5.1 (SMAQMD 2015), was used to estimate construction emissions and is viewed as an appropriate model for this purpose. The model automatically estimates fuel usage, fuel types, and other emissions factors, and relies on inputs of data based on the project description. Results of the model are included in Appendix D. The amount of fugitive dust (PM 10 micrometers or less in diameter [PM_{10}]) that could be generated on a daily basis was also estimated. As shown in Table 3-1, there would be no exceedances of federal or local air quality standards during construction of the project. Therefore, impacts would be low and would be further reduced by implementation of measures described in Section 2.4.1.

Table 3-1: Estimated Construction Emissions

Emissions Component	**Pollutant Emissions**				
	ROG	**NO_x**	**PM_{10}**	**$PM_{2.5}$**	**CO_2**
Estimated Construction Emissions	8.4 pounds per day (lbs/day) 0.6 ton	80.4 lbs/day 5.5 tons	8.6 lbs/day 0.6 ton	4.3 lbs/day 0.3 ton	10,562.5 lbs/day 714.4 tons
Federal Threshold	50 tons/year	50 tons/year	100 tons/year	n/a	25,000 tons/year
State Threshold	10 tons/year	10 tons/year	15 tons/year	15 tons/year	n/a
Above Threshold?	No	No	No	No	No

Source: Sacramento Metropolitan Air Quality Management District Road Construction Emissions Model, Version 7.1.1, modified for grading/excavation.
$PM_{2.5}$ = PM 2.5 micrometers or less in diameter, NO_x = nitrogen oxides, ROG = reactive organic gases

In some cases, excavation of reduced wetland soils can release sulfidic odors that are commonly found to be objectionable. In instances where these soils are stockpiled for later reuse, this type of effect could be persistent for the duration of construction. In this instance, the wetland delineation (LCEP 2016) indicated few instances of gleyed soils or other hydric soil types that would have high concentrations of sulfides or sulfates that could cause objectionable odors, and most excavation of wetland soils would occur at least one-half mile from the nearest residences. Therefore, this impact would be low.

Dust would likely be generated during excavation and transport of soils. In general, excavated soils would likely be moist as they would be excavated from lower-lying areas where moisture is most persistent, therefore dust from excavation would be minimal. Fugitive dust (PM_{10}) from movements of construction vehicles would be minimized by application of water from a water truck as needed, but at least once per day. Impacts from release of fugitive dust would be low.

3.3.2.1.2 Operational Impacts

There would be no stationary sources of pollutant emissions associated with operations of the Refuge after construction. Minor amounts of emissions would be generated by equipment used to maintain levees and other infrastructure, and to perform the general actions needed to maintain the Refuge. Although management requirements could be increased due to increased potential for invasive aquatic species, channel maintenance, and other considerations, emissions from maintenance equipment would be relatively minimal and this impact would be low.

3.3.2.2 Climate Change

Due to the breadth of the Corps' water-related projects, they have conducted extensive research and developed policy regarding the effects of climate change on their projects and on tidal and riverine projects in general. The Corps identified four categories of climate change effects with the potential to impact its national mission and operations in its 2013 Climate Change Adaptation Plan (Corps 2013). These four categories are: 1) increasing air temperature; 2) changing precipitation; 3) increases in extreme events; and 4) sea level change and associated tides, waves, and surges. The Corps' updated Climate Change Adaptation Plan (Corps 2015) addresses the following priority areas: modernizing Corps programs and policies to support climate-resilient investments, managing Corps lands and waters for climate preparedness and resilience, supporting State, local, and tribal preparedness, providing actionable climate information, tools, and projections, and international leadership provided by Corps supporting climate preparedness.

3.3.2.2.1 Construction Impacts

The Proposed Action would be unlikely to cause measurable impacts on the four categories of climate change during construction. Climate change impacts including changes to temperature and hydrology, and incidences of extreme weather events, will likely occur independent of the Proposed Action. Emission of CO_2 by construction vehicles would not exceed federal air quality standards (Table 3-1). Impacts to climate change associated with construction of the Proposed Action would be low.

3.3.2.2.2 Operational Impacts

The proposed restoration measures are designed to be functional and meet the project objectives under most conditions that are predicted to occur over the expected project lifespan of 50-75 years. The project has been designed with the following climate change adaptability criteria (LCEP 2017):

- Design the levee breach invert elevations to accommodate expected sea level rise over expected project lifespan (approximately 50 to 75 years).
- Design creek floodplain habitats that transition gently to higher elevations to accommodate higher tidal inundation expected from sea level rise.
- The restored creek channel design should accommodate lower flows and depths associated with decreases in spring and summer base flows, and accommodate higher flows and depths associated with increases in peak flows.
- Grading the floodplain with variable topography to enhance inundation in some areas and transition to higher and drier elevations in other areas for improved plant diversity and adaptability.

- Installing wood structures that encourage scour of deep pools for shaded, cold water refugia for overwintering salmonids and other aquatic species.
- Restoring a robust native plant community that adapts to variable hydrologic and groundwater regimes, especially drought conditions.

The Proposed Action would not be likely to affect air temperatures or precipitation patterns. However, it would respond to these changing conditions by increasing off-channel refugia for aquatic species during the high flood flows and increased tidal elevations that are predicted under most climate change models. Elevations of channels and floodplain wetlands developed for the Proposed Action would ensure functional habitat value under these climate change scenarios, as it is expected that wetland and riparian plant communities would respond to higher tidal elevations by forming at higher elevations in the floodplain. Furthermore, the elevations of the tops of the levees would be well above the 100-year flood elevations required for FEMA certification, and would provide flood protection under the predicted higher flows and higher tidal elevations. According to hydraulic models prepared for this project, the Proposed Action would reduce water surface levels during 500-year event flows in the Reed Island channel by roughly 0.1 ft. and would increase the capacity of the Gibbons Creek channel beneath the SR14 Bridge to pass projected 500-year flows (ESA 2015). Operational impacts on climate change would be moderate.

3.3.3 Environmental Consequences – No Action

Under the no action alternative, emissions of criteria pollutants during construction would not occur, but minor emissions from maintenance vehicles would continue. Impacts to air quality would be low. Emissions of GHGs during construction would also not occur. Although this alternative would avoid contributing GHGs, it would also not provide benefits related to climate change, including peak flow attenuation or high-flow refugia for juvenile fish. The impact of the no action alternative on climate change would be low.

3.3.4 Cumulative Impacts

The Proposed Action would result in short-term emissions of pollutants during construction, but would not include a stationary source of long-term emissions. Although the short-term construction emissions may combine with emissions from industrial sources in the nearby communities of Camas and Washougal, the areas' status of being in attainment for all pollutants would not change as a result of these emissions. Therefore, the cumulative impact on air quality would be low.

Numerous human activities have contributed to elevated levels of GHGs globally in the earth's atmosphere and are expected to continue into the foreseeable future. Changes in climate conditions may result in less predictable stream flows than currently occur; however, the existing diversion system and fish ladder in the affected area are already overwhelmed by storm flow events. The Proposed Action could help alleviate some of the stresses on migrating and resident fish species that may occur as a result of changing climate patterns in the region by providing improved access to high quality spawning and rearing habitats. Fish have limited access to off-channel high-flow refugia in the lower Columbia River system, making accessibility to such habitat a highly important feature for Lower Columbia River (LCR) fish populations specifically. Therefore, in combination with other constructed or planned off-channel restoration projects in the estuary, the Proposed Action would cumulatively help to mitigate the impacts of climate change.

3.4 Cultural Resources

Cultural resources are locations of human activity, occupation, or use. They include expressions of human culture and history in the physical environment, such as pre-contact or historic archaeological sites, buildings, structures, objects, districts, or other places. Cultural resources can also include natural features, plants, and animals that are considered important to a culture, subculture, or community or that allow the group to continue traditional lifeways and spiritual practices. This section provides a summary of cultural resource identification efforts completed to date for the Proposed Action, including anticipated impacts on cultural resources under NEPA.

Historic properties, as defined by 36 CFR 800, the implementing regulations of Section 106 of the National Historic Preservation Act (NHPA; 54 USC § 300101 et seq.), are cultural resources that are eligible for inclusion in the National Register of Historic Places (NRHP). Historic properties may be districts, sites, buildings, structures, artifacts, ruins, objects, works of art, natural features important in human history at the national, state, or local level or properties of traditional religious and cultural importance to an Indian tribe.

3.4.1 Affected Environment

The project area is within approximately 1,055 acres of land along the Columbia River in Washington State. For the purposes of this analysis, the project area is considered the study area for cultural resources, although a 0.5-mile buffer was included for the cultural resource survey records search. The project area includes all surfaces and depths that would be affected by the Proposed Action. For the Proposed Action, the project area consists of all 1,055 acres of construction and restoration areas and extends to the maximum depth of disturbance, which would be up to 19 ft. in some areas. Ground-disturbing activities would occur in 260 of the 1,055 acres. The project area extends approximately 1 mile north-south and 2.3 miles east-west. The majority of the project area falls within the Refuge, but the Port owns a small parcel in the southwest corner, the land trust owns a large parcel in the southeast corner, and north of SR14 the project area extends into several small parcels that are privately owned (HRA 2017a).

3.4.1.1 Cultural Resources Setting

The earliest regional evidence of pre-contact populations was documented in the Willamette Valley, located south and west of the project site, and consists of fluted projectile points that are presumed to be associated with Clovis cultures. Clovis cultures have been documented in other parts of the Northwest Coast and are known to have been present between 12,800 and 13,000 calibrated years before present (BP). Much of the archaeological record along the Columbia River Basin was destroyed by the massive Missoula floods that occurred between 19,000 and 13,000 BP. Human occupation following the Missoula floods is better documented, with the earliest evidence of human activity following the floods from approximately 7950 BP. Early artifacts are simple tools and points. Around 3750 BP, sea-level rise tapered off, and more stable societies began to develop. Artifacts from this point forward become increasingly complex and diverse, reflecting the growth of cultural systems and refinement of tools (Ames and Maschner1999, as cited in HRA 2017a).

The project area falls within the territory of the Cascades people, which extended from Washougal, Washington to just west of White Salmon, Washington, along both sides of the Columbia River (French and French 1998, as cited in HRA 2017a). The subsistence practices and material cultural of the Cascades people were centered on fishing. Fish served as the bulk of their diet, and was supplemented with plant resources and, to a lesser extent, with the meat of large and small mammals. Trade items included fish surpluses, animal skins, nets and baskets woven from plant materials, and dentalia shells. Transportation up and down the Columbia River was achieved by means of canoes crafted from single cedar logs. The Cascades people occupied permanent villages located in the vicinity of rivers during the winter months. The closest established village to the project area was a Cascades village called *Waxix* near the mouth of the Washougal Basin, located roughly 2 miles northwest of the project area. Throughout the early part of the 18th century, Chinookan society (including the Cascades people) became more complex as settlements flourished. In the 1770s, however, the regional Native American population was decimated by smallpox, which is estimated to have killed 30% of the regional population (Boyd 1985 and 1990, as cited in HRA 2017a).

The first Euroamericans to approach the project area were those under the command of Lieutenant William R. Broughton, who was sent by Captain George Vancouver in 1792 to explore the Columbia River. According to the records, Broughton’s ship sailed up the Columbia approximately as far as the project area. This voyage established a British claim to the Columbia River region. The project area was next approached by Euroamericans in November 1805 when the Lewis and Clark Expedition passed on its way west. On the return trip east, the party camped in the prairie near the project area, and used the encampment as a base for hunting and for exploration of the Willamette River and the Sandy River. The Lewis and Clark Expedition spread knowledge of the Pacific Northwest, and drew settlers to the region. The mouth of the Sandy River served as a point of debarkation for settlers coming down the Columbia River, but early development in the vicinity of the project area was slow, largely as result of the substantial spring floods generated by spring snowmelt, which made cultivation and travel difficult in lowlands adjacent to the Columbia River. During this time, the society of the Cascades people was shaped by the introduction of Euroamerican trade items such as glass beads, ceramics, musket balls and shot, knives, brass kettles, metal fishhooks, and tobacco. In the 1830s, however, disease again led to major loss of life amongst Native Americans, as outbreaks of malaria killed approximately 75 to 90% of the remaining native population in the region (French and French 1998, as cited in HRA 2017a).

Beginning in 1850, the project area was settled for small-scale farming, and by the late 19th century the nearby community of Washougal was well established (Caldbick 2010, as cited in HRA 2017a). The region was supported by the agricultural and textile industries, and trade was facilitated by the construction of the railroad along the Columbia River beginning in 1882. In 1909, the completed Spokane, Portland, and Seattle railway (today known as the BNSF Railroad) connected Washougal and the project area with the Pacific Coast and eastern Washington. The rail line passed through the northern portion of the project area. Around this time, car travel began to take off nationwide. In response to the need for more improved roads, the Washington State Highway and Transportation Department was created in 1905. One of the first roadways to be incorporated was State Road 8, which ran from Washougal, Washington to Lyle, Washington, and which later became SR14. By the early 20th century, several of the original land claims within the project area had been subdivided into smaller farms and orchards. During the second half of the 20th century, the construction of levees, a diversion dam, and other water control features, such as culverts and earthen berms, stabilized the floodplain and facilitated further human development. By 1961 all of the original claims had been subdivided into smaller 30 – 120 acre lots (Metsker Maps 1961, as cited in HRA 2017a). The WCRL was constructed from 1965-1966 by the Corps along the north bank of the Columbia River from Lawton Creek to the Washougal River, spanning approximately 5.5 miles. In the early 1990's a fish ladder was installed on the eastern portion of the levee to provide salmon access to Gibbons Creek. The WCRL may be associated with the Flood Control Act of 1950 (also known as House Document [HD] 531) in opening lands for development in Clark County, Cottonwood Park, the Captain Clark Trail, Steamboat Landing, and by protecting established industries within, and allowing further development of, the Port of Washougal (Holter 2017:1). The WCRL maybe also be tied to HD 531's subsequent Major Water Plan of the 1960s, which guided water resources development of the Columbia River Basin.

3.4.1.2 Cultural Resources Identification Efforts

BPA initiated surveys of the project area (HRA 2017a and 2017b). The Washington Information System for Architectural and Archaeological Records Data (WISAARD) was searched in order to identify previous cultural resource surveys conducted within the project area or within 0.5 of the project area. In all, 20 previous cultural resources surveys were identified. Most of those conducted within the project area itself were conducted in the western half of the project area near USFWS facilities. Others were conducted in support of the Clark County predetermination process. One was conducted in support of an earlier phase of the Steigerwald Lake Restoration Project. The WISAARD records search indicated that 12 archaeological resources have been documented within 1 mile of the project area (HRA 2017a). These resources are generally pre-contact lithic materials, and were found near streams and creeks. According to WISAARD, no archaeological resources have been documented within the project area. However, a 1985 pedestrian survey not listed in WISAARD did identify two isolated pre-contact resources within the western half of the project area (Minor and Beckham 1985, as cited in HRA 2017a). Further investigation was conducted by auguring near the finds, but no additional resources were found. Thus, the two pre-contact resources were determined to be secondary deposits that originated outside the project area. The survey also identified one historical resource within the project area, but this resource was determined to be not eligible in 2002 (Minor and Beckham 1985, as cited in HRA 2017a).

In support of the current project, Historical Research Associates (HRA) conducted a site-specific archaeological field investigation. The primary field surveys were conducted from May 23 – June 2, 2016 and February 14 – 24, 2017 (HRA 2017a) and a supplemental survey of the Gibbons Creek area north of SR14 occurred on August 24, 2017 (HRA 2017b). The surveys were conducted as pedestrian surveys along east-west transects that were spaced 20 meters apart. Inundated areas and areas of impassible vegetation were not surveyed. Shovel probe excavations were performed as allowed by surface geology, slope, and disturbance in areas where ground-disturbing activities are proposed for the Proposed Action or in order to delineate found resources. The shovel probes were excavated to a minimum depth of 70 centimeters below surface (cmbs), and every fourth probe was augured to 200 cmbs to investigate for potential deeply buried deposits. Any prehistoric or historical cultural material that was identified was recorded following standard procedures, and the area in the vicinity of the find was surveyed thoroughly in order to delineate the boundary of the resource. All found resources were evaluated for eligibility to be listed in the NRHP using standard guidelines established by the

National Park Service, which require significance to be established by specific criteria (HRA 2017a). HRA's initial findings and conclusions are presented below.

The initial survey identified five archaeological resources within the project area. Three (45CL1268, 45CL1269, and 45CL1270) were discovered on the surface, and two (45CL1266 and 45CL1267) were discovered through subsurface sampling. Three of the five (45CL1268, 45CL1269, and 45CL1270) were located in portions of the project area where the ground would not be disturbed (HRA 2017a). Brief summaries of the resources are below:

Site 45CL1266: This site contained three pre-contact artifacts: one cryptocrystalline-silicate (CCS) flaked cobble tool and two CCS flakes. All of the artifacts were identified below the surface using shovel probes. In their initial report, HRA recommended the site as not eligible for listing in the NRHP, as the site did not convey significance under any of the criteria. The site is located in an area where ground disturbance is proposed (HRA 2017a).

Isolate 45CL1267: This resource is a pre-contact CCS flake, which was discovered in a below surface shovel probe. No other artifacts or cultural materials were found in the vicinity. In their initial report, HRA recommended the site as not eligible for listing in the NRHP, as the site did not convey significance under any of the criteria. The site is located in an area where ground disturbance is proposed (HRA 2017a).

Site 45CL1268: This site contained historic period debris such as transferware fragments, earthenware fragments, square nails, and glass fragments. It also contained a single pre-contact artifact – a chalcedony exhausted core or core fragment. 20 of the 21 total artifacts were found below the surface. In their initial report, HRA recommended the site as not eligible for listing in the NRHP, as the site did not convey significance under any of the criteria. Although this site is not in an area where ground disturbance is proposed (HRA 2017a), it is in an area that may be inundated at the most extreme flows in the Columbia River.

Site 45CL1269: This site contained artifacts associated with a historic period homestead. The found artifacts were aqua glass canning jar fragments, a milk glass lid liner fragment, amber glass, yellowware fragment, flat glass, whiteware, brick fragments, a ceramic marble fragment, a possible toilet or chamber pot fragment, metal fragments including a possible fuse box door, sheet metal, wire nails, a railroad bridge construction spike, and scattered chunks of concrete. There were also structural remnants. In their initial report, HRA did not evaluate the site's eligibility for listing in the NRHP since the site is not in an area where ground disturbance is proposed (HRA 2017a).

Isolate 45CL1270: This isolate is a pre-contact fine-grained volcanic flaked cobble tool. It was identified on the surface. Investigation of the surrounding area and subsurface did not identify any additional artifacts or cultural resources. In their initial report, HRA recommended the site as not eligible for listing in the NRHP, as the site did not convey significance under any of the criteria. The site is not in an area where ground disturbance is proposed (HRA 2017a).

During the supplemental survey, one additional site was identified near Gibbons Creek. This site, recorded as Temporary Site 45CL1327, contained two small stone flakes that appeared to have modified edges. Investigation of the surrounding area did not identify any additional artifacts or cultural resources, and HRA recommended the site as not eligible for listing in the NRHP, as it did not convey significance under any of the criteria.

The survey also identified six above-ground historic-period resources within the project area. One of these resources, the USFWS Refuge facilities, had previously been assessed in a separate 2002 survey, and was determined not eligible for listing in the NRHP. Another was part of site 45CL1269 and was not evaluated by HRA, but is not within an area where ground disturbance is proposed. A third, a barn and corral, was evaluated by HRA, and was recommended as not eligible for listing in the NRHP. The fourth resource, a house and associated outbuildings, is located at the north end of the project area, and was determined not eligible for listing as it had been extensively renovated, resulting in an irretrievable loss of integrity. The fifth resource, also located on a parcel at the north end of the project area, is a residence and detached outbuilding. Access to the parcel was not granted, so although the property is unrecorded and unevaluated, it is assumed eligible for listing. The sixth resource, the WCRL, was determined to be eligible for listing in the NRHP (HRA 2017b).

Because of changes to the project design which required additional geotechnical investigations, HRA performed a third survey in 2017 (HRA 2017c). This investigation focused on a previously unsurveyed area along the route of the proposed west setback levee. No new resources were found in this area, and the additional geotechnical investigations were performed in summer of 2017.

3.4.2 Environmental Consequences – Proposed Action

3.4.2.1 Construction Impacts

Although sites containing archeological resources listed in or eligible for listing in the NRHP have been identified within the project area, none are found in locations where surface disturbance would occur. Therefore, the potential for disturbance of archaeological resources is low. Although consultation with DAHP is ongoing, BPA's conclusion is that archaeological resources would not be affected by construction. However, excavation or other ground-disturbing activities would have the potential to unearth previously unrecorded or unknown cultural resources. If any cultural resources were encountered during construction, including archeological artifacts or human remains, excavation activities would immediately cease at that location until the artifacts were evaluated by a cultural resource professional, in accordance with BPA's Inadvertent Discovery Protocols (BPA 2015) and in coordination with the SHPO, as needed. Thus, potential impacts related to inadvertent discovery of cultural resources would be low.

Following review of architectural resources on site, one architectural resource, the WCRL, was determined to be eligible for listing in the NRHP. BPA determined that the levee would be adversely impacted by the Proposed Action (see Section 4.2, Cultural Resources, for details on consultation occurring under Section 106 of the National Historic Preservation Act). Coordination between DAHP and BPA revealed that additional intensive-level investigations into the WCRL are required to clarify the resource's significance, and that these investigations may serve as mitigation and resolution for any adverse effects to the assumed historic property. An additional resource that is assumed eligible for listing, a residence and outbuilding located on a parcel at the north end of the project area, is not in an area where disturbance would occur, and would not be affected. Mitigation measures described in Section 2.4.1 would ensure that impacts to architectural resources would be moderate.

3.4.2.2 Operational Impacts

Although sites containing archeological resources listed in or eligible for listing in the NRHP have been identified within the project area, none are found in locations where new O&M actions would be necessary as a result of the Proposed Action. BPA's consultation with DAHP has been completed. BPA's conclusion is that, although the WCRL would be removed and would be an impact during construction, no other eligible or potentially eligible resources would be affected during operations. Operations would be limited to ongoing vegetation management and maintenance of the levees and other infrastructure. As described for the excavation period, any personnel that discovered potential cultural resources during operations would cease activity and notify USFWS archeological staff. Therefore, impacts to cultural resources during operations would be low.

3.4.3 Environmental Consequences – No Action

Under the no action alternative, there would be no excavation or deposition; therefore, there would be no impacts to cultural resources.

3.4.4 Cumulative Impacts

The Proposed Action would have no impact on known archaeological or historic resources other than the WCRL, and mitigation measures would be implemented to avoid adverse impacts on previously undiscovered cultural resources should they be discovered during construction. Although past development in the towns of Washougal and Camas and at the nearby Port may have affected cultural resources, past land uses of the Refuge were primarily grazing and hay production and would not have caused extensive sub-surface disturbance, so buried cultural resources at the Refuge are likely to be relatively intact. Although other ongoing or planned construction projects in the area such as the proposed wellfields expansion and the City of Washougal bus maintenance yard have a similar potential to affect previously undiscovered archeological or historic resources, it is assumed that mitigation measures are in place to avoid impacts to them. As much of the surrounding area is undeveloped forest and farmland, past impacts to archeological or historic resources are assumed to be low compared to more highly developed areas. Therefore, cumulative impacts to archeological or historic resources would be low.

Although the Proposed Action would have an adverse impact on the WCRL, mitigation agreed upon between BPA and DAHP would reduce the impacts to a moderate level. No other proposed or ongoing projects in the vicinity of the Refuge seem to be affecting or have the potential to affect eligible architectural resources, and no past actions are known to have substantially affected such resources; therefore, the cumulative impact is low.

3.5 Fish

This section describes general and special-status fish species that may reside or migrate through the study area. It also addresses potential impacts on fish from construction and operations.

3.5.1 Affected Environment

The Refuge is located along the Columbia River floodplain from RM 124 to 128, and consists primarily of wetlands, pasture lands, and wooded areas. It also includes the lower portion of Gibbons Creek, a perennial stream that is a tributary to the Columbia River and flows into the

Refuge from the north. The Refuge historically provided rearing and spawning habitat for numerous salmon and other fish species; however, after construction of a flood protection levee in 1966, fish access from the Columbia River to Gibbons Creek and the surrounding floodplain was largely diminished (USFWS 2005). When SR14 was constructed in 1971, Gibbons Creek was channelized and realigned to flow into Steigerwald Lake. In 1992, the creek was further realigned as part of a mitigation requirement for the construction of a second powerhouse at the Bonneville Lock and Dam on the Columbia River from 1974 to 1983, which resulted in the loss of 1,122 acres of floodplain habitat on the Washington side of the Columbia River. Gibbons Creek was directed to flow through a diversion structure/flood gate into an elevated channel, culverts, and a fish ladder prior to flowing into the Columbia River on the south side of the WCRL. Gibbons Creek flattens out at the diversion structure, and much of its sediment load settles out and accumulates at this location. Ongoing maintenance dredging of the elevated channel and diversion structure is required to remove these sediments, and during moderate and high flows, the diversion structure lacks the capacity to pass the entire flow of the stream. At these times, Gibbons Creek jumps its western bank, flowing over a concrete spillway and through a relict overflow channel downstream to the floodplain.

The mitigation efforts implemented in 1992 only partially restored fish access to the upper Gibbons Creek watershed. The elevated channel can pass fish (except chum salmon) at normal flows only, estimated to be at or above the 50 percent flow (USFWS 2005). Dredging often occurs during the fall and winter when salmonids may be migrating or spawning, or their eggs may be present in the gravel and are highly susceptible to this type of disturbance (USFWS 2011). Furthermore, overflow of Gibbons Creek into the floodplain can result in fish stranding and mortality of both juvenile and adult salmonids and other fish, as the floodplain is no longer connected to the channel, provides poor habitat quality, and is subject to high seasonal water temperatures (Brandt et al 2003). The fish ladder sits approximately 2 to 3 ft. above the low stage levels of the Columbia River. This change in elevation impedes access by migrating adult fish, and the fish ladder includes hydraulic drop heights of approximately 12 inches, which exceeds current standards for juvenile and adult fish passage (NMFS 2008b).

Within the project area, fish habitat includes the lower portion of Gibbons Creek, Steigerwald Lake, associated wetlands, and other waterbodies. These waterbodies are connected, to varying extents, by a combination of natural and excavated channels. The wetland habitat within the study area has been altered by previous landowners to drain the land and make it more suitable for grazing. Gibbons Creek produces fewer fish than would be expected for a watershed of its size (USFWS 2005). Factors thought to contribute to lower production include habitat fragmentation, fish passage barriers (both in culvert crossings and a partial anadromous barrier at the mouth), loss of riparian vegetation, simplification of the stream channel, and loss of large wood (contributing to loss of habitat complexity) (USFWS 2005). In the lower reaches of Gibbons Creek, the channel bottom consists primarily of fine sediments (Ecology 2010). The Water Resource Inventory Area 28 Salmon and Steelhead Limiting Factors report identifies excess fine sediment as a limiting factor for salmon habitat in Gibbons Creek (Ecology 2010). Instream habitat consists of pools and riffles with few to no side channels, and average pool depths are shallow, ranging from 1 to 3 ft. (Ecology 2010). Large wood is lacking throughout the Gibbons Creek basin, and when present, consists of predominantly smaller pieces (Ecology 2010). Riparian habitat is poor along the creek with few to no trees shading the stream channel across the diked floodplain south of SR14 (Ecology 2010).

The study area is located along the Columbia River, which provides habitat for numerous fish species. While estimates vary slightly, the Columbia River system is thought to support nearly a hundred fish species, including native and non-native species. Of the native species in the basin, there are both resident and anadromous fishes. In the Columbia River Basin, there are two species of resident fish, 13 runs of anadromous salmonids, and two species of non-salmonid anadromous fishes that are listed as threatened or endangered under the ESA. For the purposes of this EA, "special status" refers herein to species listed under the federal ESA as threatened or endangered, or "species of concern."[2]

Federal protection of fish within the study area also includes management of marine fisheries by the Pacific Fishery Management Council and NMFS under the Magnuson-Stevens Fishery Conservation and Management Act. This Act was passed to prevent overfishing, rebuild fish populations, and conserve essential fish habitat (EFH). EFH is defined as "those waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity" (16 USC § 1802(10)). NMFS manages EFH for species identified in regional fishery management plans. The project area falls within NMFS-designated EFH for Chinook and coho salmon and for groundfish (NMFS 2017). Chum and steelhead are not managed by NMFS because these species are rarely harvested in ocean fisheries.

Other important native game and tribal species that are not federally protected include species such as burbot *(Lota lota)*, westslope cutthroat trout *(O. clarki lewisi)*, rainbow trout *(O. mykiss)*, Columbia River Redband trout *(O. mykiss)*, Pacific lamprey (*Lampetra tridentata)*, western brook lamprey (*Lampetra richardsonii)*, mountain whitefish *(Prosopium williamsoni)*, and northern pikeminnow *(Ptychocheilus oregonensis)*. There is limited research on fish use within the project area, which includes Gibbons Creek and the Refuge's wetlands. Chinook and Chum salmon were documented as having used Gibbons Creek and its floodplain for rearing prior to the construction of the flood control levee in the 1960s (USFWS 2005). The USFWS documented 17 species of fish in the lower reaches of Gibbons Creek between 1997 and 1999 while surveying fish utilization after installation of the fish ladder (Brandt et al. 2003). Coho (*Oncorhynchus kisutch)*, steelhead (*Oncorhynchus mykiss*), and Chinook (*Oncorhynchus tshawytscha)* were documented, although Chinook were only noted in incidental numbers with one adult and two fry observed. These were all assumed to be part of the LCR evolutionarily significant unit (ESU) or distinct population segment (DPS) fish (Brandt et al 2003). One dead adult Eulachon (*Thaleichthys pacificus)* was also documented in the lower reaches. Pacific Lamprey, which are considered a species of concern[2] and brook lamprey were also observed during the survey. Ten other fish species were recorded using the lower reaches of Gibbons Creek, three of which were identified as being non-native species (Brandt et al. 2003).

There are conflicting reports of river lamprey (*Lampetra ayresi*) using the Refuge, despite not being regularly observed in the Columbia River. The Federal Register (FR) notice for preparation of the CCP/EA for Pierce, Franz Lake, and Steigerwald NWRs (65 FR 52121) indicates river lamprey using the Refuge; however, in other reports, the USFWS stated that River Lamprey have not been detected in the Columbia River system since the 1980s (USFWS 2005,

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[2] A "species of concern" is an informal term, not defined in the ESA. The term commonly refers to species that are declining or appear to be in need of concentrated conservation actions.

Brandt et al. 2003). Though not specific to the Refuge, more recent research, involving stomach contents of pikeminnow (Weaver and Kostow 2011) indicates river lamprey presence within the Columbia River system. This research recorded three occurrences of river lamprey within the Columbia River system between 2008 and 2010 (Weaver and Kostow 2011).

Bull trout (*Salvelinus confluentis*) are known to occur in the mainstem Columbia River but have not been documented using habitat within the project area (USFWS 2005). Bull trout are considered unlikely to access Gibbons Creek as they require colder water than is found there.

Table 3-2 identifies fish species that have been observed in Gibbons Creek, as well as those that may be present within or adjacent to the project area. Special status fish species and designated or proposed critical habitat[3] are also noted in the table.

Very little data is available regarding surveys of fish presence in Steigerwald Lake and nearby wetlands. However, reports indicate the presence of peamouth, torrent and riffle sculpin, three-spine stickleback, long-nosed dace, carp and pikeminnow, in those areas (USFWS 1993). Carp and pikeminnow were indicated as being detrimental to fisheries resources (USFWS 1993).

While there is only limited information on fish use of the Refuge, additional studies have been conducted at similar habitats within the vicinity, which suggest that juvenile salmonids would utilize habitats within the project area. Sagar et al. (2011) found juvenile Chinook, coho, and chum were utilizing Franz Lake, Mirror Lake, and Campbell Slough for rearing during their migration downstream. While species abundance varied among sites, juvenile Chinook were the most abundant species found overall, making up approximately 90 percent of all salmon captured (Sagar et al. 2011). Studies found that juvenile chum salmon were present in April and May, with juvenile Chinook and coho salmon being present at some sites from April through August (Sagar et al. 2011).

Another study by Johnson et al. (2011) was conducted in tidal freshwater portions of the lower Columbia River between Longview, Washington, and Bonneville Dam from 2007 to 2010. One of Johnson's study sites was directly across the Columbia River from the Refuge at the Sandy River Delta. This study found that juvenile salmon were present in the system year-round, demonstrating multiple life-history strategies. Overall, Chinook densities varied by season, with the highest observed in the spring and the second highest in winter. Unmarked fish were present year-round but marked fish mostly appeared as a peak in spring, suggesting a possible correlation with hatchery releases (Johnson et al. 2011). This study concluded that restoration of shallow tidal freshwater habitats in the lower Columbia River would aid in the recovery of wild fish populations.

Table 3-3 shows the general life-history timing of anadromous species in the tributary habitats of the Columbia River between the Sandy River and Herman Creek (study area; ODFW 2003). While not specific to the Refuge or Gibbons Creek, this information provides approximate timing of anadromous fish usage of nearby tributary habitat and an indication of when those species may utilize habitats within the affected area.

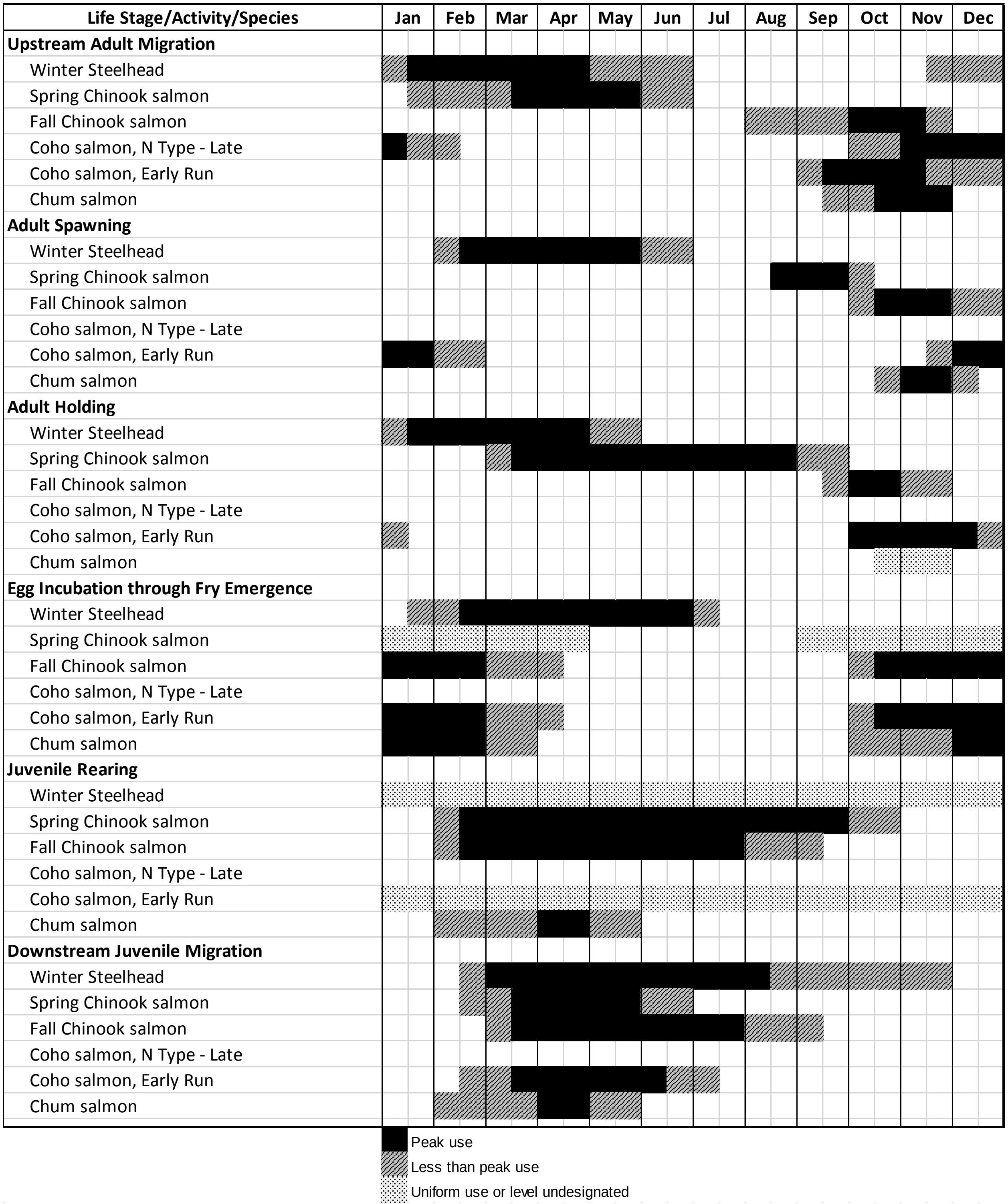
[3] A term defined in the ESA that refers to a specific geographic area(s) that contains features essential for the conservation of a threatened or endangered species and that may require special management and protection.

Table 3-2: Fish species observed in Gibbons Creek and/or species potentially present within or adjacent to (within nearby portions of Columbia River) the project area.

Species	Federal Status	Critical Habitat Status
Chinook salmon (*Oncorhynchus tshawytscha)*		
Lower Columbia River	Threatened 70 FR 37160	Designated 70 FR 52630
Snake River spring/summer	Threatened 70 FR 37160	Designated 58 FR 68543
Snake River fall	Threatened 70 FR 37160	Designated 58 FR 68543
Upper Columbia River spring	Endangered 70 FR 37160	Designated 70 FR 52685
Upper Willamette River	Threatened 70 FR 37160	Designated 70 FR 52685
Steelhead trout (*O. mykiss*)		
Lower Columbia River	Threatened 71 FR 834	Designated 70 FR 52630
Snake River	Threatened 70 FR 37160	Designated 70 FR 52685
Upper Columbia River	Threatened 74FR 42605	Designated 70 FR 52685
Middle Columbia River	Threatened 57 FR 14517	Designated 70 FR 52685
Upper Willamette River	Threatened 62 FR 43937	Designated 70 FR 52685
Chum salmon (*O. keta*)		
Columbia River	Threatened 70 FR 37160	Designated 70 FR 52685
Coho salmon (*O. kisutch*)		
Lower Columbia River	Threatened 70 FR 37160	Proposed 78 FR 2726
Pacific eulachon (*Thaleichthys pacificus*)	Threatened 75 FR 13012	Designated 76 FR 65323
Southern DPS	Threatened 75 FR 13012	Designated 76 FR 65324
Bull trout (*Salvelinus confluentis*)		
Columbia River DPS	Threatened 63 FR 31647	Designated 75 FR 63898
Pacific lamprey (*Lampetra tridentata*)	Species of Concern	None
Coastal cutthroat trout (*O. clarki clarki*)	Species of Concern	None
Cutthroat trout (*O. clarkia)*	NA	NA
Brown trout (*Salmo trutta*)[1]	NA	NA
Western brook lamprey (*Lampetra richardsonii)*	NA	NA
Carp *(Cyprinus carpio)*	NA	NA
Brown bullhead *(Ameiurus nebulosis)*	NA	NA
Reticulate sculpin (*Cottus perplexus)*	NA	NA
Prickly sculpin (*C. asper)*	NA	NA
Largescale sucker (*Catostomus macrocheilus)*	NA	NA
Peamouth (*Mylocheilus caurinus)*	NA	NA
Longnose dace *(Rhinichthys cataractae)*	NA	NA
Speckled dace *(R. osculus)*	NA	NA
Pumpkinseed sunfish (*Lepomis gibbosus)* [1]	NA	NA
Eastern banded killifish (*Fundulus diaphanous)* [1]	NA	NA
Three-spined stickleback *(Gasterosteus aculeatus)*	NA	NA

[1]Species is not native within the project area

Table 3-3: Run timing table for Columbia River tributaries from Sandy River to Herman Creek



Source: ODFW 2016d

3.5.1.1 Special Status Fish and Habitat within Affected Area

Previous studies in Gibbons Creek noted the presence of currently ESA-listed fish species, including Chinook and coho salmon and steelhead trout, all of which were assumed to be part of the LCR ESU or DPS (Brandt et al. 2003). This section provides additional information about species life-history, timing, and habitat for those runs specifically, as well as eulachon, Pacific lamprey, cutthroat trout (all species of concern), and western brook lamprey.

3.5.1.1.1 Lower Columbia River Chinook

The LCR Chinook ESU historically contained three runs: fall, late-fall, and spring. Fall populations are “ocean-type” with juveniles migrating downstream at one to four months of age, making extensive use of river and estuary habitats before entering the ocean. Late-fall and spring populations are “stream-type,” with juveniles rearing in fresh water for approximately one year prior to migrating to the ocean. Returning spring Chinook also generally spawn higher up in larger subbasins than fall Chinook (NMFS 2013b). Only two of the 32 populations of LCR Chinook are considered viable, with most (26 of the 32 populations) having very low probability of persisting in the next 100 years (NMFS 2013b).

Gibbons Creek is located in the Lower Columbia Gorge Tributaries subbasin (LCRFRB 2010), which includes all tributaries between Bonneville Dam and the City of Vancouver, except for Salmon Creek and the Washougal River, which are managed as separate subbasins. The Lower Columbia Gorge Tributary population of fall Chinook is a contributing population for ESU recovery, currently at “very low” status. Floodplains have been substantially altered or disconnected in this population’s range, which includes highly developed areas where flood protection is a key concern (NMFS 2013b). Riparian conditions, channel structure and form, side-channel and wetland conditions, and floodplain conditions are primary limiting factors for tributary habitat in the Lower Gorge. Critical habitat for LCR Chinook includes the Columbia River adjacent to the study area but does not include the Refuge lands other than Gibbons Creek.

3.5.1.1.2 Columbia River Chum

Although Chum (*Oncorhynchus keta*) have not been officially documented in Gibbons Creek, anecdotal evidence indicate that chum have historically occurred in the creek. Critical habitat has been designated (2005) from the mouth of the creek upstream to the crossing of SR14. Columbia River Chum salmon primarily spawn in the lower Columbia River and its tributaries; however, populations used to extend as far as the Walla Walla River (NMFS 2013b). Almost all adult Chum returning to the Columbia River are now fall-run fish, which enter the river from mid-October through November and spawn from early November to late December (NMFS 2013b). Fry emerge from March through May and generally migrate downstream to the estuary soon after emergence (NMFS 2013b).

For Chum in the Lower Columbia Gorge Tributary subbasin, habitat and estuary factors make up more than half of the potentially manageable factors affecting the population (LCRFRB 2010). Habitat degradation is considered a primary limiting factor for these fish (NMFS 2013b). Access to side-channel habitat, accessible wetlands, channel structure, habitat complexity and diversity, and estuary conditions are all considered primary limiting factors for Columbia River Chum salmon (NMFS 2013b), while water quality (contaminants and temperature) is considered a secondary limiting factor (NMFS 2013b).

3.5.1.1.3 Lower Columbia River Coho

LCR Coho salmon (*Oncorhynchus kisutch*) have two general life-history patterns, categorized as early-returning (Type S) and late returning (Type N). Adults in Type S stocks enter the Columbia River in mid-August and begin entering tributaries in early September. Peak spawning occurs from mid-October to early November. Adults in Type N stocks are in the Columbia River from late September through December and enter tributaries from October through January. Peak spawning is between November and January but can occur as late as March. Juveniles in this ESU generally rear in freshwater for over a year (NMFS 2013b). The Lower Gorge Tributary populations are generally late-returning stock, or Type N.

Critical habitat for LCR Coho was designated within Gibbons Creek in February of 2016 from the mouth of the creek to the crossing of SE Hans Nagel Road, a distance of approximately 4.25 stream miles (NMFS 2013b). In general, floodplain habitats have largely been disconnected within the range of Lower Columbia Gorge Tributary Coho. Removal of fish passage barriers and reconnection of floodplains are identified as focus areas in recovery planning documents (NMFS 2013b).

3.5.1.1.4 Lower Columbia River Steelhead

LCR Steelhead can demonstrate both anadromous and resident (which are typically referred to as Rainbow or Redband Trout) life-history strategies (NMFS 2013b). In addition, they can spawn more than once, referred to as iteoparity (NMFS 2013b). Steelhead are the anadromous form of *O. mykiss* and display two distinct timing patterns: summer and winter runs. Summer-run Steelhead enter freshwater between May and October, generally spawning between late February and early April. Winter-run Steelhead generally enter freshwater between December and May, with peak spawning occurring between late April and early May. Fry emergence occurs from March to July, with peak emergence between April and May (NMFS 2013b). Juveniles rear in fresh water for one to four years, with most smolting at approximately two years of age (NMFS 2013b). Smolt outmigration occurs from March to June, peaking in April or May. Winter-run Steelhead are present in the Lower Columbia Gorge tributaries.

Primary limiting factors for the Lower Gorge populations include riparian conditions, channel structure and form, side channel and wetland conditions, and floodplain conditions. Water quantity and water quality (contaminants) are considered secondary limiting conditions (NMFS 2013b). Although critical habitat for LCR Steelhead is not designated within the project area, it is designated in the Columbia River adjacent to the project area.

3.5.1.1.5 Pacific Eulachon

The southern DPS for Pacific Eulachon was listed as threatened on March 18, 2010 (75 FR 13012), with critical habitat designated on October 20, 2011 (76 FR 65324). Pacific Eulachon are small anadromous fish (also called candlefish and smelt) that spend two to five years in the ocean before migrating up rivers to spawning grounds. Upon emerging, juveniles migrate directly out to sea. Pacific Eulachon are found in ocean waters ranging from the nearshore down to nearly 1,000 ft. in depth. Spawning areas are often in the lower sections of large snowmelt-fed rivers. Eulachon typically require water temperatures ranging from 39°F to 50°F for spawning (NMFS 2013c). As with other fish species, they require clean, cool water, clean substrate of suitable size, and sufficient food resources to be successful through their various life stages.

These fish occur only in the eastern Pacific Ocean, with the majority of production in the U.S. coming from the Columbia River (NMFS 2013c). Similar to other anadromous species, Eulachon are highly susceptible to habitat loss and degradation. Dam construction has hindered access to historical spawning areas and reduced the quality of spawning substrates available. Flow management, altered transport of coarse sediments, and siltation have all been attributed to habitat impacts. Although critical habitat for Eulachon is not designated within the study area, it is designated in the Columbia River.

Upstream migration generally occurs between December and June. Spawning occurs over sand or coarse gravel, with eggs incubating for three to eight weeks (NMFS 2013c). The primary factors causing population decline and leading to the listing of the southern DPS were stated as "the destruction, modification, or curtailment of habitat and inadequacy of existing regulatory mechanisms" (75 FR 13018). Key threats in the Columbia River include climate impacts on ocean and freshwater conditions, dams/water diversions, and Eulachon by-catch in other fisheries (NMFS 2013c).

3.5.1.1.6 Pacific Lamprey

Although not an ESA-listed fish species, Pacific lamprey are considered a species of concern by USFWS. While Pacific lamprey are anadromous like salmonids, they spend a greater portion of their life cycle in freshwater streams, with nearly half their lives spent as filter-feeding larvae, or ammocoetes. Lamprey filter water and mud to find food, so they are particularly sensitive to pollutants in the water column and sediments. Additionally, they require cool water to support their food supply. Lamprey depend on low gradient habitats with slow water and muddy bottoms during the juvenile stage, and they require gravel-rich habitats, including pool tail-outs and low gradient riffles for spawning. The habitat needs of lamprey are very specific, making them highly susceptible to habitat modification and loss, as well as altered stream flow regimes (PSMFC 1997).

Like other native anadromous species in the Columbia River Basin, lamprey are susceptible to many of the same threats posed by dams and other fish passage barriers within the region. Limited access to suitable spawning and rearing habitat, degradation of water quality and habitat conditions, mortality of emigrating juveniles at dam facilities, and predation have all been linked with of the decline of Pacific Lamprey in the basin. In addition, fish passage facilities designed for salmon and other species do not necessarily function well for providing lamprey passage.

In the vicinity of the project area, Pacific lamprey are in the Lower Columbia/Willamette Recovery Management Unit (RMU) and would be considered to be in the Lower Cowlitz sub-unit (USFWS 2015). This RMU is considered to be at lower risk that most other RMUs within the Columbia River Basin (USFWS 2012). Key threats in this area are dewatering and flow management, tributary passage, stream and floodplain degradation, and degraded water quality (USFWS 2015).

3.5.1.1.7 Coastal Cutthroat Trout

Coastal cutthroat trout (*O. clarkia)* are listed as a species of concern under the ESA (Table 3-2). Cutthroat were observed in the lower reaches of Gibbons Creek by the USFWS during 1997 and 1999 (Brandt et al. 2003). Unlike all other species of trout, coastal cutthroat trout have numerous small-to-medium irregular spots, and do not develop the typical coloration (USFWS 2017). The life-history forms of cutthroat trout are complex and malleable, but are generally grouped into three forms: non-migratory, which reside in small, headwater streams; freshwater-migratory, which migrate only within freshwater reaches and lakes; and saltwater-migratory, which migrate from freshwater to marine habitats in the spring, and return to fresh water in the winter to spawn. Fish can switch from one form to another within their lifespan. Typically, all forms of coastal cutthroat trout spawn between December and June. When in freshwater habitat, cutthroat prefer deeper pool habitat and cover. They occupy a wide range of freshwater environments, from small to large streams, estuaries, ponds, lakes, and sloughs. Historically, the primary factors that have contributed to species decline have been estuary degradation, urban and industrial development, agriculture, loss of riparian area due to forest management practices, and the installation of dams and other fish barriers. However, cutthroat populations in the Pacific Northwest appear to be relatively resilient to the impacts of these activities on stream habitat, and continue to be present in densities comparable to those observed in other regions. As a result, the species is not listed as threatened or endangered at this time (USFWS 2017).

3.5.1.1.8 Western Brook Lamprey

Western brook lamprey (*Lampetra richardsonii)* were also documented in the lower reaches of Gibbons Creek during the 1997-1999 USFWS surveys (Brandt et al. 2003). Western brook lamprey are not listed. Like Pacific lamprey, western brook lamprey are anadromous, but spend the majority of their lives in freshwater streams, where they require gravel habitat for spawning and silty backwater habitat for rearing of ammocetes. In addition, they require good water quality, as they remain burrowed and relatively immobile as ammocetes. These requirements make them susceptible to decline if water quality deteriorates or their habitat is lost as a result of habitat degradation. Western brook lamprey are also declining in number as a result of predation by non-native species.

3.5.2 Environmental Consequences – Proposed Action

The environmental consequences of the Proposed Action have been evaluated in this section as they relate to fish within the affected area. As used below, the term “fish” refers collectively to all fish in the affected area, including those listed in Table 3-2. Likewise, the term “habitat” includes general fish habitat as well as any designated critical habitat in the affected area.

3.5.2.1 Construction Impacts

Fish and fish habitat can be directly or indirectly impacted by the activities included as part of the Proposed Action. The extent of potential direct and indirect impacts from these activities is dependent on the duration of the activity and the types of protective measures used to minimize impacts. These impacts could include:

- Injury or mortality during work-area isolation and fish salvage
- Short-term loss of access for fish to Gibbons Creek
- Disruption of spawning, rearing, or foraging activities
- Construction-related turbidity
- Construction-related vegetation removal
- Changes in water quality

- Increased habitat area and access (including wetland, floodplain, side channel, and stream habitat) available for juvenile salmonid spawning and rearing

While the Proposed Action could have limited, short-term negative impacts on individual fish or fish habitat, the overall action would result in a net benefit to not only individual fish, but fish populations, and fish habitat. The goals of the Proposed Action are to benefit fish by restoring floodplain connectivity and physical processes, provide access to restored habitats for native fish species, and increase habitat quality of restored stream channels, floodplains and wetland habitats.

Table 3-4 summarizes the activities related to the Proposed Action and the potential impacts of each as they relate to fish and fish habitat. The following sections describe these impacts in more detail.

Table 3-4: Potential impacts to fish and fish habitat resulting from the Proposed Action

Activity Related to Proposed Action	**Types of Impacts**									
	Adverse				**Beneficial**					
	Injury/mortality	*Short-term loss of access*	*Disruption of spawning, rearing, or foraging activities*	*Turbidity*	*Veg removal/conversion*	*Restore/improve hydrology*	*Increased habitat area and diversity*	*Fish Passage*	*Water quality*	*Sediment Transport*
Work area isolation/fish salvage	•	•	•	•						
Remove/breach levee		•	•	•	•	•	•	•	•	•
Remove water control structures and elevated canal		•	•	•		•	•	•		•
Restore wetland and riparian native plant communities					•	•	•		•	
Increase number of wood habitat structures		•	•	•		•	•			
Create additional and improved floodplain habitats		•	•	•	•	•	•			•

The Proposed Action would likely result in some impacts to fish and fish habitat. These would include short-term impacts related to construction, including turbidity resulting from excavation of channels, removal and breaching of the WCRL and natural levee, removal of water-control structures, fish ladder, and culverts, floodplain and channel re-contouring, and other similar actions. Construction-related turbidity could cause fish to temporarily avoid the affected area altogether, alter behaviors such as foraging or breeding, or could affect egg survival. Turbidity-related impacts would be minimized by implementing the appropriate BMPs and adhering to applicable regulatory requirements and permit conditions, and would therefore be low. Work would be conducted during the approved in-water work window to minimize the likelihood of fish being present during construction. Construction activities would comply with an erosion control plan to keep sediment from entering waterbodies. Temporary and permanent erosion and sedimentation control BMPs (Table 2-9) could include, but would not be limited to, turbidity curtains, straw bales, coir wattles, sediment fencing, check dams, coir matting, and erosion control blankets.

Construction equipment (excavators, bulldozers, dump trucks, etc.) pose a risk for accidental spills of fuel, engine fluids, and other contaminants. Additionally, construction-related discharges could occur during vehicle washing, pumping for work-area isolation, or other purposes. Discharge could carry sediments or contaminants to active water bodies, floodplains, wetlands, or riparian areas, potentially exposing fish and fish habitat to contaminants. However, BMPs would be maintained during construction to avoid or minimize potential impacts to fish from accidental spills and/or discharges. These would include, but would not be limited to: maintaining an emergency spill containment kit onsite during all construction activities, developing and adhering to a SPCC Plan, conducting machinery maintenance, staging, and refueling in designated areas away from waterbodies or sensitive areas or in fully contained areas, and conducting regular checks of machinery for leaks prior to starting work. Thus, potential impacts to fish related to accidental spills of contaminants would be low.

In-water construction activities would be required for the Proposed Action, including activities such as the removal/breaching of the levees, removal of water control structures and the elevated canal, channel and floodplain re-contouring and others. To minimize the impacts to fish and their habitats, the work area would be isolated, and fish salvage would be performed prior to in-water construction. Work area isolation and fish removal would be carried out by qualified personnel in accordance with federal and state fish salvage guidelines and all necessary permits. Methods could include the use of cofferdams, screened pumps, seine and dip nets, minnow traps, and/or electrofishing units. These activities could lead to incidental injury or even death of fish within the affected area; however, because the Proposed Action would adhere to limits set by various regulatory permits and guidelines, including incidental take allowed under HIP III, and all fish handling would be conducted by an experienced fish biologist, impacts to fish would likely be low.

As part of the Proposed Action, in some areas, riparian vegetation would be affected. The Proposed Action could reduce the quality of fish habitat in the near term by removing cover elements, and it could lead to localized increases in water temperatures due to reduced shading of the stream channel. Additionally, cleared areas would be more susceptible to erosion and increased runoff into waterbodies or wetlands. Implementing appropriate BMPs in cleared areas could include site stabilization, hydroseeding, or replanting, which would minimize the likelihood and duration of impacts to fish and their habitat, and the impact would be low.

The Proposed Action could result in short-term loss of fish access to spawning areas in Gibbons Creek and adjacent habitats. Passage into Gibbons Creek is currently limited, however, and by conducting work within the approved in-water work window, impacts to fish would be essentially avoided and can be considered low.

As discussed in Section 3.5.1, the area designated as EFH for Chinook salmon, coho salmon, and groundfish includes the Columbia River adjacent to the project area. Because the Proposed Action is intended to improve fish habitat, it would not be expected to have a long-term adverse impact on EFH. Although temporary impacts in the form of turbidity and noise would occur during construction, implementation of mitigation measures and BMPs described in Section 2.4.1 and conservation measures required under HIP III would ensure that these impacts are low.

3.5.2.2 Operational Impacts

The Proposed Action would benefit fish and fish habitat. It could lead to improvements in productivity, abundance and life history diversity within and nearby the affected area. Benefits would include improved passage for all fish species in the affected area, which could result in re-establishment of historic fish populations into the area. It could also allow for increased access to floodplain rearing areas and enhanced off-channel habitat quality.

Reconnecting Gibbons Creek to the floodplain and reconnecting the floodplain to the Columbia River would provide access and passage for native fish species of all life stages. In addition, the quality, diversity, and function of fish habitat within the action area would benefit from the Proposed Action by improving and increasing off-channel habitat for outmigrating juvenile salmonids in need of rearing and overwintering habitat. It would also provide spawning habitat for adult salmonids in the lower Columbia River. By restoring connectivity and function within the action area, hydrologic exchange and processes would improve and provide fish habitat. These operational impacts would be moderate.

Removing the Gibbons Creek diversion structure would result in a moderate impact to fish and fish habitat by eliminating the need for maintenance dredging activities in Gibbons Creek and reducing the potential for smolt loss at the Gibbons Creek diversion. It would greatly improve fish passage, reducing flood risk and fish mortality during overflows, and generally improve the quality of fish habitat.

As described by Ecology (Ecology 2010), the Lower Columbia Fish Recovery Board (LCFRB) has identified key restoration priorities for salmon recovery in Gibbons Creek, including actions such as protecting stream corridor structure and function, protecting and restoring hillslope processes, providing for adequate in-stream flows, restoring riparian conditions, restoring floodplains and channel migration processes, restoring water quality, and restoring access to habitats blocked by artificial barriers (Ecology 2010). Additionally, projects that breach or lower levees within the floodplain of the Columbia River are well recognized as providing valuable access to off-channel habitats and providing increased foraging opportunities and access to refugia for outmigrating juvenile salmonids (NMFS 2008a). Furthermore, NMFS has noted that restoration projects that remove passage barriers and improve access, increase channel complexity, and improve water quality contribute to overall habitat improvements for stream-type juvenile salmonids (NMFS 2008a). The Proposed Action incorporates many of these elements and would contribute to long-term benefits for fish and fish habitat in the region.

3.5.3 Environmental Consequences – No Action

Under the no action alternative, the Proposed Action would not be constructed, and the benefits to anadromous and resident fish would not be realized. Gibbons Creek would remain largely inaccessible to fish passage under most flows, and juvenile fish would not have access to floodplain wetlands during their outmigration. These impacts would be moderate. In addition, sediment deposition would continue to occur at the Gibbons Creek diversion structure, causing overflow into the floodplain and stranding of fish that are in the system. Because it could result in take of listed fish species, this impact would be high.

3.5.4 Cumulative Impacts

Past, present and reasonably foreseeable actions most likely to cause cumulative impacts to fish include: ongoing operations of the FCRPS dams, construction of levees, ongoing hatchery operations, climate change, and aquatic restoration projects throughout the estuary. Although operations of the FCRPS dams have been adjusted over time to reduce impacts on anadromous fish, they will continue to provide a barrier to unrestricted fish passage in the Columbia River and maintain highly modified habitat conditions (i.e. reservoirs). The impacts of climate change are projected to include increases in average water temperatures as well as altered flow patterns.

Completed, ongoing, and planned aquatic restoration actions provide improved habitat for numerous species of fish and wildlife. Considered on a regional basis, these projects, in combination with the Proposed Action, would constitute a beneficial cumulative impact to habitat quality for fish and wildlife in the Columbia River estuary. This project would substantially increase the amount of off-channel rearing habitat for outmigrating juvenile salmonids and improve ecosystem functions including the export of nutrients from wetlands into the greater estuary. Such off-channel wetland projects also help reduce competition amongst juvenile fish as an increasing number of hatchery fish are released from upstream hatcheries in efforts to bolster the Columbia River fishery. This project would help to incrementally reverse some of the impacts of past and ongoing actions, improve survival rates of salmon and steelhead, increase the carrying capacity of the estuary, and improve habitat for wildlife, including thousands of migratory birds that visit the estuary on their seasonal migrations. This impact would be moderate.

3.6 Geology and Soils

This section describes topography, geology, unique physical land features, potential geologic hazards, and soils data, including erosion and compaction risk, for the project area.

3.6.1 Affected Environment

3.6.1.1 Topography

Elevations in the study area range from 5 to 50 ft. NAVD88 (LCEP 2016). Slopes are generally low (0 to 3 percent) with the steepest slopes on the sides of the WCRL. From the Columbia River normal winter water surface elevation of approximately 15 ft., the levees slope upward to 45 ft. at the crest. Terrain on the inboard side of the levees gently undulates from elevations of 15 to 25 ft. through the study area, until reaching higher elevations where the railroad and levees bound the north and east. Around Straub and Steigerwald Lakes, elevations range from 15 to 25 ft. The adjacent railroad is at an elevation of about 50 ft., and the levee crest is at an elevation of 45 to 47 ft. Elevations in the developed Port industrial park, located southwest of the project area, generally range from 20 to 30 ft. The City of Washougal maintains a series of wastewater treatment ponds to the west of the study area. The ponds are protected by berms, with the lowest berm at an elevation of 20 ft.

An unusual feature of the area is the modified Gibbons Creek, which has been diverted into a perched aqueduct that conveys flows over Steigerwald Lake. The aqueduct is connected to the Columbia River through the WCRL via an open, 72-inch culvert. Fifteen “v-shaped” weirs with 1-ft. steps are located below the culvert and are designed to allow adult salmonid passage into Gibbons Creek at higher flows of the Columbia River.

In addition, there are three dikes within the study area, generally running north-south. The westernmost dike is a road connecting the wastewater ponds and the Port, with a crest elevation of about 20 ft. A second dike acts as the channel for Gibbons Creek and has an elevation of about 35 ft. The easternmost dike crests at about 25 ft. and is topped by a gravel road. All three dikes have culverts that allow water to move through the study area.

3.6.1.2 Geology

The study area is located within the Portland Basin, which is part of the Coastal Lowland that separates the Cascade Range from the Oregon Coast Range (Evarts et al. 2013). It is part of the Puget-Willamette Lowland physiographic region, which is a forearc basin of the Cascadia Subduction Zone.

The Refuge is underlain by the gravel facies deposited during the Missoula Floods between 16,000 and 12,000 years ago (CCI 2016). These cataclysmic glacial-outburst floods poured through the Columbia River Gorge, building coarse-grained bars and depositing sand and silt on upland surfaces (Evarts et al. 2013). Younger geologic deposits include alluvium of the Columbia River floodplain and channel (Qac) deposited in the Holocene (last 11,500 years to the present), and tributary stream alluvium (Qa) deposited during the Holocene and Pleistocene (Evarts et al. 2013). Holocene alluvium deposits (Qac) are unconsolidated fine sand, silt, and clay that underlies the historic floodplain of the Columbia River at elevations of less than 30 ft. These deposits are composed primarily of quartz, feldspar, and conspicuous muscovite. Tributary stream alluvial deposits (Qa) include unconsolidated sand, gravel, and organic-rich mud of less than 30 ft. Gibbons Creek alluvium (Qa) overlies Columbia River alluvium (Qac) along the creek and consists of a medium-dense to dense mixture of gravel, rock fragments, and silty sand (CCI 2016).

Recent geotechnical investigations determined the depths of geologic deposits (CCI 2016). Columbia River alluvium varied from 100 ft. to about 20 ft. thick and Gibbons Creek alluvium varied from 15 ft. to 30 ft. in thickness. Underlying the Holocene alluvium deposits was a conglomerate of dense subrounded gravel and cobbles in a matrix of slightly cemented sand, considered to be part of the Troutdale Formation (Evarts et al. 2013). The conglomerate was encountered at depths of 20 to 80 ft. below the ground surface at the north and south ends of the setback levees (CCI 2016).

Geologic hazards resulting from earthquake activity could include ground shaking, soil liquefaction and landslides. According to mapping done in 2013, there are no faults passing directly beneath the study area. However, the Lacamas Lake fault is shown to reach along the center of the Columbia River offshore of the study area (Evarts et al. 2013). This fault may have experienced strike-slip motion in the past, though the most recent activity is estimated to have occurred prior to the Missoula Floods (USGS 2002). Two other unnamed faults are reported by Evarts et al. (2013) to extend northward from Oregon, reaching approximately to the south shore of Reed Island. These unnamed faults are not included in the Quaternary Fault and Fold Database of the U.S., and their status is unknown (USGS 2006). Ground shaking potential associated with earthquakes is estimated to be moderate in the study area (WDNR 2016), while liquefaction potential is moderate to high (Palmer et al. 2004). The National Earthquake Hazards Reduction Program has classified soils in the study area as Site Class D, which are considered moderately to highly susceptible to liquefaction (Clark County 2016c).

3.6.1.3 Soils

Soils were identified using the online Web Soil Survey 3.1, covering the total area of the Refuge as shown in Table 3-5 (NRCS 2013). Soils found in the study area are primarily comprised of silt loams, with smaller areas of gravelly loams, silty clay loams, and cobbly soils (NRCS 2013). Loams in the study area are characteristically poorly drained hydric soils typically associated with wetlands and floodplains.

Table 3-5: Soils of the study area (NRCS 2013)

Map Unit Symbol	Map Unit Name	Acreage
HoA	Hillsboro silt loam, 0-3% slopes	27
HoB	Hillsboro silt loam, 3-8% slopes	20
LgB	Lauren gravelly loam, 0-8% slopes	15
LrF	Lauren gravelly loam, cemented substratum, 20-55% slopes	2.3
NbA	Newberg silt loam, 0-3% slopes	113
NbB	Newberg silt loam, 3-8% slopes	214
Rc	Riverwash, cobbly	2.7
SmA	Sauvie silt loam, 0-3% slopes	455
SnA	Sauvie silt loam, sandy substratum, 0-3% slopes	164
SpB	Sauvie silty clay loam, 0-8% slopes	15
WgB	Washougal gravelly loam, 0-8% slopes	1

Soils in the area have the potential to erode as a result of Gibbons Creek or Columbia River flows. Along the Columbia River shoreline, steep slopes and abrupt cutbanks result in erosion of soils into the river (BPA 2016a). Much of the shoreline along the study area has been armored with large riprap rocks to prevent further erosion. No detailed studies have been made of erosion rates along the Columbia River in the study area (USFWS 2005). Gibbons Creek levels out and flows slow as it reaches the study area, resulting in deposition of sediment and not scour or erosion of the creek bed. Historically, the Columbia River would seasonally scour and deposit sediment along its shorelines, creating and shaping mudflats, estuaries, backwaters, and side channels. Drainage and diking of the study area has altered the influence the river has on these processes. However, deposition of river sediment into the area is still possible at flood flows exceeding the levee height.

Soil subsidence occurs when groundwater levels are lowered and soil particles compact. The overall effect is the loss of ground elevation, which corresponds to the lowering level of the water table. Historically, the study area was more often inundated and likely had a consistently higher water table. Study area drainage through the 1900s has reduced the natural exchange of flood waters, thereby potentially subjecting soils to compaction and subsidence. However, no studies have been conducted in the area to determine if the water table has receded as a result of drainage and levees or if there is evidence of subsidence. Because recent wetland delineations show that much of the project area still has wetland hydrology, it is not likely that there has been an increase in soil subsidence with a reduced exchange of flood waters.

No landslide hazards are identified in the lower reach of Gibbons Creek (Ecology 2010). The Clark County Department of Assessment and Geographic Information Systems (GIS) prepared a map showing active, historical, or potential unstable slopes, and none were found to occur in the study area (Clark County 2011). North of SR14, several historical or potential unstable slopes are found along Gibbons or Lawton creeks (Clark County 2011).

3.6.2 Environmental Consequences – Proposed Action

Project construction would have temporary impacts resulting from increased soil erosion, soil compaction and mixing of soil horizons. These impacts would be mitigated through use of mitigation measures that would reduce impacts below a significant level. Operation of the project would allow water circulation and inundation that more closely resembles natural function, including sedimentation and erosion.

3.6.2.1 Construction Impacts

Construction and operation of the Proposed Action could result in changes to soils and geological features within the Refuge. Construction activities would include earthwork intended to lower levees, breach levees, and realign Gibbons Creek. Once construction was complete, operation of the newly restored Refuge lands could also potentially impact soils and geology. Impacts could include:

- Temporary increases in erosion or sediment deposition within floodplains, channels and the Columbia River
- Localized changes in water circulation patterns, velocity, or flows
- Alterations to natural sedimentation or erosion processes
- Fugitive dust generated during construction
- Increased groundwater exchange that changes soil properties

During construction, up to 1.23 million cy of materials would be excavated at the site. Suitable excavated materials would be used to construct the setback levees and other features and remaining soil would be used to restore borrow pit areas. Earthwork would result in a temporary increase in soil erosion, compaction, and mixing of soil horizons. Soil disturbance would result from excavation to lower the existing WCRL elevation, an action that would span the length of the project area along the margin between the Refuge and the Columbia River. Soil disturbances would also result from breaching the WCRL in four locations, channel excavation, setback levee construction, excavating new wetland habitats, relocating the visitor’s area, and installing the floodwall.

Removal of the top portion of the WCRL would temporarily expose soils, but the soils would be stabilized by compacting them, topping with gravel, and recontouring the crest of the remaining levee segment to discourage erosion from runoff. Silt fences would be used to prevent soils from eroding into the water column, and other erosion and sediment control measures described in Section 2.4.1 would be used to control temporary soils loss, reduce sediment delivery to the river, and minimize turbidity. Similarly, interior portions of the Refuge would be scraped of vegetation and excavated to desired depths, leaving temporarily exposed soils where new wetlands and floodplain channels are created. In this case, little erosion would occur during construction, since these areas are flat and found at low elevations, therefore they would not experience much water circulation until the levees were breached and operation begins. Prior to levee breaching, newly excavated wetland areas would be seeded with native wetland plant species and be given ample time to establish vegetation cover that would reduce soil erosion. Nonetheless, minor soils loss would likely occur upon breaching of the natural levee and initial inundation of the floodplain channels. Excavation of Gibbons Creek (Channel 3) on the south (river) side of the WCRL would occur in the dry, ensuring that erosion would be minimized. With implementation of the erosion control measures discussed above, impacts to soils and geology because of these construction actions would be temporary and low.

Excavated soils would be used to build the new east and west setback levees. This would not represent a substantial change in soil composition, since human and livestock use of the area over the past century have already resulted in disturbance, and also because soils throughout the Refuge are derived from similar parent materials. Relocation of soils from the WCRL and mid-refuge to the new east and west levees would not substantially change the soil conditions in the project area. Impacts to soil composition would be low.

Additional soils impacts would result from clearing and grubbing construction and staging areas, relocating the visitor center, constructing the control structure and associated modifications to SR14, realigning pedestrian trails and bridge construction, and constructing setback levees and the floodwall. Each of these elements would be constructed on dry land and could result in temporary increases in erosion at exposed sites. Mitigation measures and implementation of a Stormwater Pollution Prevention Plan (SWPPP) would ensure that erosion impacts associated with these actions would be low and less than significant.

3.6.2.2 Operational Impacts

Upon completion of construction, restoration of floodplain habitat through levee breaching would result in changes to the local water circulation patterns, water flows and velocity, and duration of inundation. These changes, in turn, could potentially impact soils and localized topography by changing bedload movement, sediment transport and patterns of accretion and erosion. However, as described in Section 2.1.2.1, the channels and breach locations were designed to result in stable channel beds and banks, and to minimize the potential for erosion. As designed, levee breaches would minimize erosion while allowing adequate water exchange during outflow and flood events. Revegetation of levee cuts would also ensure that erosion was minimized, and the long-term impacts would likely include long-term benefits to soils retention and formation from stabilized banks and revegetated wetlands and riparian areas. In addition, wind/wave impacts along the constructed levees would be mitigated by the construction of vegetated levee overbuild sections. As part of its post-construction monitoring program, LCEP would take cross-section measurements of the excavated channels in Years 1, 3, and 5, to identify unanticipated erosion and to ensure proper channel formation. Impacts to erosion and topography would be low.

Levee breaching would restore the hydrologic connection between the Columbia River and the Refuge floodplain. This would reestablish conditions resembling the historic floodplain connections that were lost when levees were constructed. This flood water exchange would allow for seasonal inundation of wetlands, formation of additional areas of hydric soils, and the natural accretion and erosion of sediment throughout the newly connected channels. Impacts to soils and geology as a result of these geomorphic changes would be low.

Construction of setback levees would be likely to result in settlement of up to 3.5 ft. due to compression of soils in the levee footprint (CCI 2016). To account for this, the setback levees have been designed with adequate freeboard to allow for the desired level of protection once the settlement has occurred. Additionally, the levees would be re-topped in year 3 to address areas of settlement, as needed. Impacts to soils and geology would be low.

Removal of the Gibbons Creek diversion structure would allow for more efficient sediment transport through the stream reach just below SR14. The restored streambed alignment would create a more free-flowing current, which would distribute sediments more evenly throughout the floodplain, reducing the extensive sedimentation that occurs at the diversion structure under current conditions. Because this action would greatly reduce maintenance associated with sediment removal, and would eliminate the need for periodic permitting and consultation that now occurs, the impact would be moderate.

Although the proposed setback levee locations were not evaluated for stability during earthquakes, peak ground acceleration (PGA) was calculated using USGS's ground-motion parameter calculator (CCI 2016). This method is considered acceptable under the National Flood Insurance Protection Program if the 100-year return period earthquake produces PGA of less than 0.10 g, where g is the acceleration of gravity on the surface of the earth at sea level (9.8 meters/second^2). The calculator indicated that a 100-year plus earthquake at this site would produce a PGA value of approximately 0.07g, well below the 0.10g threshold. Impacts associated with seismic risk would be minimal.

3.6.3 Environmental Consequences – No Action

Under the no action alternative, no construction would occur. Ongoing sedimentation at the Gibbons Creek diversion structure would persist, and would require yearly maintenance including dredging. This would result in moderate impacts. Localized erosion control would be undertaken as needed by Refuge managers, so impacts from erosion would be low.

3.6.4 Cumulative Impacts

Cumulative impacts of construction include minor and temporary increases in erosion and mixing of soil horizons at other construction projects in the area. It is assumed that for each construction project, a SWPPP would be created and followed, and erosion, sedimentation, and fugitive dust emissions would be minimal from each project. When combined with the past, present, and reasonably foreseeable future actions, these impacts would not result in an increase in natural floodplain sedimentation in the long-term, as these actions would reestablish a more natural hydrologic connection to floodplain habitat. Additionally, there would be an incremental improvement toward functioning wetland habitat resulting from natural inundation of historical wetland areas and formation of hydric soils. This impact would be low.

3.7 Land Use and Recreation

This section describes land use and recreation and the possible impacts of the Proposed Action on these resources. The land use area of analysis is generally restricted to the project footprint and any easements that could be needed for the project, while the recreation area of analysis includes the Refuge and lands around the Refuge where recreational opportunities may be linked.

3.7.1 Affected Environment

The Refuge is located in Clark County adjacent to the town of Washougal. Most of the Refuge lies within the Columbia River Gorge NSA (Figure 3-1), with a relatively small portion located south and west of the adjacent wastewater treatment plant falling outside of the NSA. The Refuge is located 17 miles east of downtown Portland, and is located within the Portland-Vancouver-Hillsboro Metropolitan Statistical Area, home to 1.5 million people. The Refuge's approved boundary includes 1,406 acres, 75 percent of which is owned by the USFWS (USFWS 2005). Private lands comprise part of the eastern end of the Refuge's approved boundary and are used for farming or as part of a conservation trust (Figure 3-6). Surrounding land uses include residential and transportation to the north and west, industrial and infrastructure to the west and southwest, and agricultural to the east (Figure 3-6).

3.7.1.1 Land Use

Land uses in and around the project area are subject to management by various planning agencies. Relevant land use plans are described below.

3.7.1.1.1 Clark County Comprehensive Plan

Clark County's Comprehensive Growth Management Plan (Clark County 2004) designates lands within the project area as "Gorge Small Woodland 40" and as "Open Space." The zoning code provides for the same designations within the Columbia River Gorge NSA.

The Clark County Unified Development Code, Section 40.240, contains the County's regulations specific to the Columbia River Gorge NSA. The regulations are designed:

> "…to protect and provide for the enhancement of the scenic, cultural, recreational, and natural resources of the Columbia River Gorge, and to protect and support the economy of the Columbia River Gorge by allowing future economic development in a manner that enhances the scenic, cultural, recreational, and natural resources of the Gorge."

The regulations specify that:

> "No building, structure or land shall be used and no building or structure shall be hereafter erected, altered or enlarged, including those proposed by state or federal agencies, in the Clark County portion of the Columbia River Gorge NSA except for the uses listed in this chapter, when considered under the applicable procedural and substantive guidelines of this chapter."

Section 40.240.610 stipulates that the following uses, among others, may be allowed on all lands zoned Gorge Management Area Open Space subject to County review: "Low-intensity recreation, fish and wildlife management uses conducted by federal, state or tribal resource agencies."

Within Gorge Small Woodland sites, Section 40.240.510 states that the following may be allowed subject to County review: "Resource enhancement projects for the purpose of enhancing scenic, cultural, recreation and/or natural resources. These projects may include new structures (e.g., fish ladders, sediment barriers) and/or activities (e.g., closing and revegetating unused roads, recontouring abandoned quarries)."

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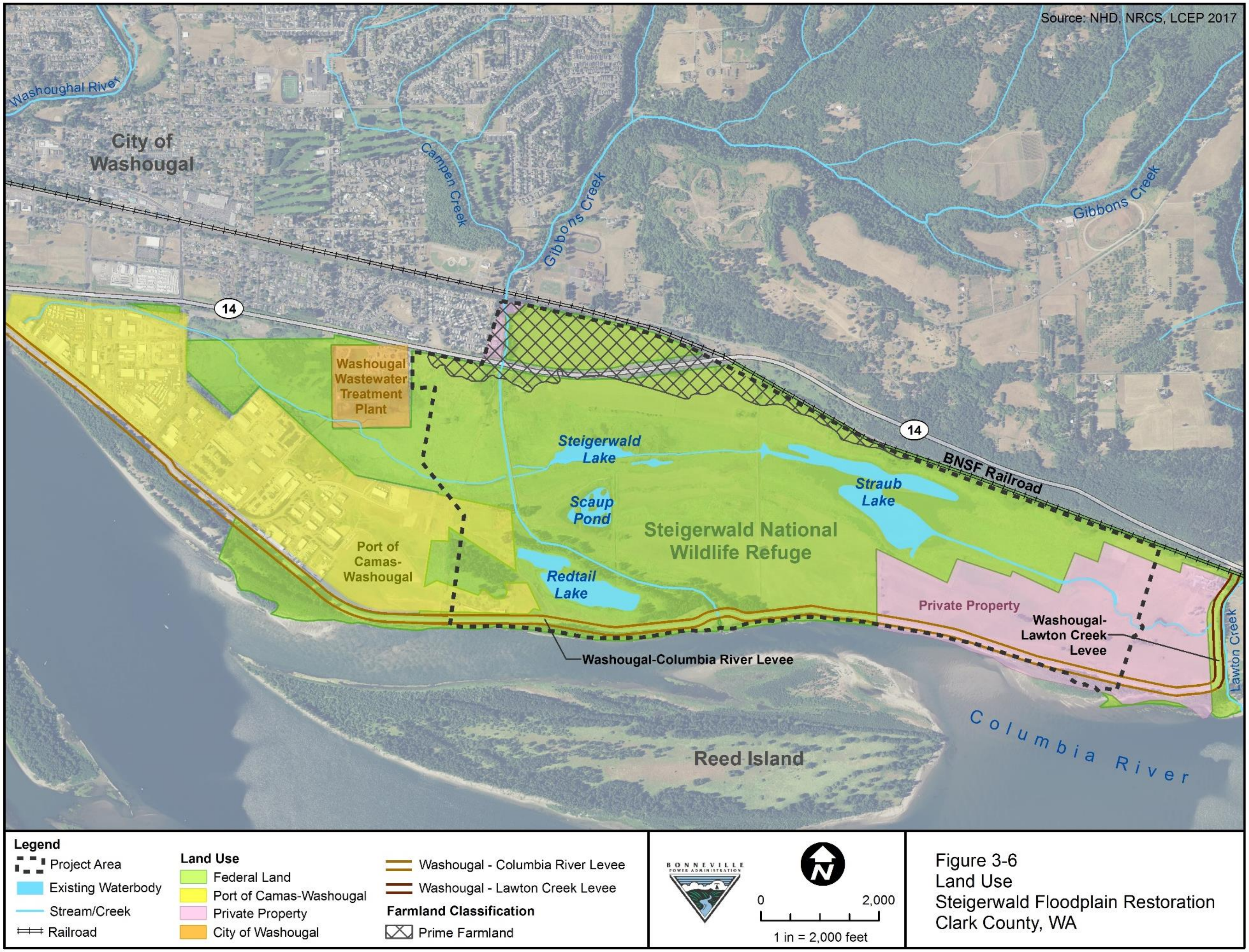
Source: NHD, NRCS, LCEP 2017
Washougal River
City of Washougal
Campen Creek
Gibbons Creek
Gibbons Creek
14
14
Washougal Wastewater Treatment Plant
Steigerwald Lake
Scaup Pond
Straub Lake
BNSF Railroad
Steigerwald National Wildlife Refuge
Port of Camas-Washougal
Redtail Lake
Private Property
Washougal-Lawton Creek Levee
Lawton Creek
Washougal-Columbia River Levee
Reed Island
Columbia River
Legend
Project Area
Existing Waterbody
Stream/Creek
Railroad
Land Use
Federal Land
Port of Camas-Washougal
Private Property
City of Washougal
Washougal - Columbia River Levee
Washougal - Lawton Creek Levee
Farmland Classification
Prime Farmland
BONNEVILLE POWER ADMINISTRATION
0
2,000
1 in = 2,000 feet
Figure 3-6
Land Use
Steigerwald Floodplain Restoration
Clark County, WA

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3.7.1.1.2 Columbia River Gorge Management Plan

The Columbia River Gorge NSA Act called for the creation of the Columbia River Gorge Commission. The Commission has 13 members: three appointed by each of the governors of Oregon and Washington, one appointed by each of the six Gorge counties, and one (non-voting) representative from the USFS.

The Commission sets policy for protecting the non-federal lands in the Gorge through the Scenic Area Management Plan; serves as an appeals board for land use decisions issued by a county or by the Commission's Executive Director and challenged by another party; works with Gorge counties who administer the land use ordinances that implement the Management Plan; and certifies grants and loans by Oregon and Washington's Investment Boards to encourage economic growth in the Gorge (CRGC 2016a).

The Columbia River Gorge Management Plan established designations for all property within the Scenic Area (CRGC 2016b). The rules governing the comprehensive plan designations are not in effect in counties where the county comprehensive plan designations and policies are found consistent with the Commission plans and policies. Such is the case in Clark County.

3.7.1.1.3 Comprehensive Conservation Plan for the Columbia Gorge Refuges

The USFWS prepared a CCP for managing three Refuges in the Columbia River Gorge, including Franz Lake, Pierce, and Steigerwald Lake NWRs (USFWS 2005). The Vision Statement for the (Steigerwald Lake) Refuge states, in part:

"The Service will actively protect, restore and enhance wetland, riparian, and upland habitats on the Refuge to benefit a diversity of native wildlife and plants. … The Refuge will provide opportunities for quality, compatible, wildlife-dependent recreation, education, and interpretation to enhance public appreciation, understanding, and enjoyment of the Gorge Refuges."

The CCP includes specific management goals for the Refuges. Goal 1 is to "protect, restore, and enhance the natural diversity of floodplain, upland forest, and grassland habitats representative of the Lower Columbia River Ecosystem." To meet this goal, a series of objectives with specific elements related to the Steigerwald Refuge were established. These objectives include:

- The restoration, enhancement, and maintenance of up to 237 acres of emergent wetland habitat with Steigerwald Lake, Redtail Lake, and Scaup Pond for waterbirds and other conservation targets
- The restoration of an additional 198 acres of historic riparian bottomland forest
- Provision of 101 acres of high-quality riparian scrub-shrub habitat
- Maintenance of 41 acres of oak woodland habitat
- Initiate restoration of 93 acres of grassland, and
- Maintenance of 168 acres of perennial grass to provide winter forage for Canada geese (USFWS 2005).

3.7.1.1.4 City of Washougal Urban Growth Area Comprehensive Plan

The City of Washougal Urban Growth Area Comprehensive Plan (City of Washougal 1994) covers several parcels on the western edge of the Refuge that lie within the urban growth boundaries of Washougal, though outside the formal city limits. These properties, in or adjacent to the project area, are designated as parks/open space or heavy industrial (part of the Port).

3.7.1.1.5 Farmland

Under the Farmland Protection Policy Act, federal agencies are directed to minimize the extent to which their programs result in the unnecessary and irreversible conversion of farmland to non-agricultural uses. Additionally, the Act seeks to ensure that federal programs are compatible with state, local, and private policies to protect farmlands. Under this Act, NRCS classifies farmlands as either prime farmland, unique farmland, or land of statewide or local importance, based on soils associations. Soil associations are used to classify areas according to their ability to support different types of land uses, including urban development, agriculture, and silviculture. Most of the lands in the Refuge are mapped as "Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season" or "Prime farmland if protected from flooding or not frequently flooded during the growing season" (Clark County 2016a). A very small portion of the Refuge, located along the southern edge of SR14, is classified as "Prime Farmland".

3.7.1.1.6 Developments in Project Vicinity

A search of Clark County, City of Washougal, and Port websites showed two new or proposed developments near the Refuge. The first is the Jemtegaard School Redevelopment. The site, located at 35300 SE Evergreen Way, 0.5 mile north of the Refuge, was recently redeveloped as an elementary and middle school. The project includes two gymnasiums, common areas, administrative space, classrooms, improved recreation facilities for multiuse football and soccer fields, and an elementary school playground. Total building size is 122,000 square ft., with a footprint of 75,000 square ft. Construction began during the summer of 2016 and the Columbia River Gorge Elementary and Jemtegaard Middle School buildings were completed in August 2017 (Washougal School District 2016; Camas-Washougal Post-Record 2017).

The second project is the Washougal School District Bus Maintenance Facility. The school district is proposing to construct a school bus maintenance facility, approximately 1,000 ft. west of the Jemtegaard School project, discussed above. No schedule has been set for this project's development.

3.7.1.2 Recreation

The Refuge is part of a series of wildlife refuges along the Columbia River. It is also the westernmost boundary of the Columbia River Gorge NSA. The NSA encompasses 292,500 acres, running from the mouth of the Sandy River, Oregon to the mouth of the Deschutes River, Oregon and spanning southern Washington and northern Oregon (USFS 2016).

The Refuge is open from dawn to dusk throughout the year. A parking lot and restrooms are located at the entrance to the Refuge. The 2.75-mile-long Gibbons Creek Wildlife Art Trail includes a variety of habitats and wildlife viewpoints. Natural features and man-made art are seen along the trail. Three overlooks are provided along the trail: the Columbia River Gorge

Overlook, at the parking lot and trailhead; the Steigerwald Lake Overlook, located on the north-south trail along the elevated canal; and the Columbia River Overlook, located at the fish ladder. A seasonal spur allows for a circuit of Redtail Lake and includes the Columbia River Overlook. The spur is closed October 1 through April 30 to protect wildlife. The latter overlook can also be accessed from the CRDT. Bird watching is a major draw for visitors to the Refuge. More than 200 bird species have been observed at the Refuge (USWFS 2005). Hunting and fishing are not allowed in the Refuge.

The CRDT follows the Columbia River from Steamboat Landing Park to the eastern end of the Refuge, a total length of 3.2 miles. Along the way, there are views of the river and Mount Hood. Access is provided from trailheads located off the Refuge, as well as from the Gibbons Creek trail and spur. The Port owns a right-of-way to operate and maintain the dike for flood control purposes. The USFWS has management responsibility for other uses of the dike, including public uses where the dike crosses Refuge land.

The USFWS has not conducted a systematic survey of recreational use of the CRDT. However, informal surveys of public use can provide a “snap-shot” of the types of uses occurring on the trail. Observations by C. Dugger reflecting 72 visits during a 12-month period beginning in March 2002, generally in the afternoon or evening, showed that of observed users, 66 percent were hiking, while 17 percent each were bicycling or jogging (Dugger 2003, USFWS 2005).

Reed Island is located immediately south of the Refuge, in the Columbia River, and is home to Reed Island State Park. Owned and managed by Washington State Parks, Reed Island State Park is a 510-acre marine park offering bird watching, boating, beach walking, and picnicking. The park is part of the Columbia River Water Trail and has two picnic sites (Washington State Parks 2016). Historically, two primitive campsites have also been available for public use, but these sites were washed away by floods during winter 2016-2017, and the park is currently day use only (Washington State Parks 2017). Reed Island features a heron rookery on the southwest section of the island. Access to the park is by boat only. Access from the Steigerwald Refuge is unlikely since there are no boat put-in sites within the Refuge (Washington State Parks 2016).

The Columbia River Gorge Interagency Recreation Strategy Team issued an Interagency Recreation Report in 2014 to address the challenges of balancing recreational opportunities and resource management (CRGC 2014). While there were no specific recommendations concerning the Refuge, the report did make several overall recommendations:

- Create a common vision for recreation in the Columbia River Gorge
- Clarify roles and identify the strengths and focus areas of each agency
- Practice working collaboratively toward recreation sustainability
- Develop management strategies to address increasing demand, unmanaged recreation and the capacity needs to meet current and future demand, and
- Increase citizen stewardship.

3.7.1.2.1 Recreation - Developments in Project Vicinity

The Port has prepared and is implementing the Port of Camas-Washougal Waterfront Trail Master Plan. The Port is currently constructing the “Washougal Waterfront Park,” part of what will eventually be an 18.5-mile waterfront trail that will link Vancouver, Camas, Washougal, and the Columbia Gorge, including passing through the Refuge (Port of Camas-Washougal 2014a, 2016).

Steigerwald Lake Refuge is the proposed site for the Gateway Center to the western entrance of the Scenic Area on the Washington State side. A highway turnout with acceleration and deceleration lanes has been constructed to permit future access to the Gateway Center. Projected annual use of the Gateway Center is 125,000 visitors. Construction of the Gateway Center and interpretive trail is awaiting funding. As designed, the Gateway Center would be situated immediately east of Gibbons Creek and south of SR14. The facility would integrate exhibit galleries, elevated viewing decks, interpretative displays, classrooms, and administrative space, and would be fitted tightly into the landscape.

3.7.2 Environmental Consequences – Proposed Action

Impacts associated with land use could include converting maintained upland habitat managed for migratory waterfowl to periodically-inundated wetland habitat, construction of a levee through the site of the proposed Camas/Washougal wellfields, and installation of a floodwall and berm on private lands adjacent to Gibbons Creek north of SR14.

Impacts to recreation during construction could include temporarily reduced access to the Refuge, which would be a moderate impact. Long-term impacts would include changes to site access, parking, and trail network due to the new project components, and would be low.

3.7.2.1 Land Use

3.7.2.1.1 Construction Impacts

Construction impacts on land use would include use of Refuge roads for construction access, possible use of the parking area for staging, and construction on private lands west of Gibbons Creek and north of SR14. Construction staging would occur within the Refuge, and would not encroach onto lands outside the Refuge. Construction of the Gibbons Creek floodwall and berm would occur on private lands, and would constitute a temporary change in land use and loss of access affecting up to 10 residences that border Gibbons Creek. Construction in this area would occur only after the terms of a flood protection easement were developed with the landowners, and the impact would be low.

3.7.2.1.2 Operational Impacts

The land in the Refuge is mapped as “Prime Farmland”, “Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season” or “Prime farmland if protected from flooding or not frequently flooded during the growing season.” Since the USFWS purchased the property on which the Refuge is located (USFWS 2005), some of the land has been managed for livestock grazing and hay production. Conversion of up to 115 acres of unmaintained and maintained grassland to seasonal wetland would not be likely to substantially change this land use, as some of the seasonal wetland would likely be recolonized by grass species that could be grazed or used for hay, and because the converted area would likely only be inundated for a relatively short time during the spring freshet and during high-flow events occurring in the winter and spring. The Refuge is not grazed to capacity, so reduction in livestock grazing numbers would not be needed. Because grazing and haying would still occur, impacts to the livelihood of area farmers or farmworkers would not be likely to occur, therefore impacts associated with changes to Prime Farmland would be low.

Portions of up to five surrounding private real estate parcels (four private, one public) would be placed under flood protection easements. The Port owns the levee so there would be no need for a legal agreement for them to access the levee on their land. Also, a franchise agreement would authorize construction and operation of the levee on WSDOT's ROW. BPA would complete this process prior to construction. No land acquisitions are anticipated and there are no proposed or anticipated changes to zoning ordinances as a result of the Proposed Action, therefore this impact would be low. The Gibbons Creek floodwall and berm would be constructed on land west of the creek, and adjacent to a residential community. The floodwall would be situated within 20 ft. of the creek, which would be shifted to the east, possibly requiring removal of some trees and other vegetation. The impacts would be low, as there would be minimal impact to residences. Prior to construction, the Port and BPA would negotiate easements with any affected landowners, which would specify the amount of land that would be needed for construction, operation, maintenance, and flooding of land located outside the levee system, including the floodwall and berm. The easements would be held by the Port.

No homes or businesses would need to be relocated. Owners of any private property needed for the floodwall and berm would be compensated in a manner consistent with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970. Other than for properties for which the Port and BPA would negotiate easements, the Proposed Action would not affect zoning, access to surrounding lands, or land uses outside of the restoration area.

3.7.2.2 Recreation

3.7.2.2.1 Construction Impacts

Primary construction would occur over two construction seasons, with minor work (settlement surveys) to be completed in a third season. Work would occur from April to October of each year. During the entirety of the construction period, the public would have access to a portion of the Refuge along the seasonal Redtail Lake loop trail, which extends from the CRDT, but the primary Refuge parking lot would be closed. During the first year of construction, the primary entrance to the Refuge would be closed from April through October due to SR14 modifications, and some trails in the Refuge could be closed between June 1 and October 15 to allow for construction of some of the channels. Visitors to the Refuge during this time would have to access the Refuge along the CRDT. The CRDT can be accessed at the Port Plaza parking lot, which is reached from SR14 via South 32nd Street. In the winter between the two primary construction seasons, the public would have the same access to the Refuge as described for the Year 1 construction period, and the new parking lot would not be available for public use. During the second year of construction, the entire Refuge would be closed up to seven months. After the second season, full access to the Refuge would be restored. During the third season, the entire Refuge would be open, although closures of the west setback levee of up to 1 month could occur if levee top-off was required. Overall, construction impacts to recreational access would be moderate and temporary.

During the full construction period, there would be visual and noise impacts that could temporarily lessen the visitor experience. The impact of noise on bird behavior, in particular, could result in fewer birds and/or fewer bird species for birders to observe during construction. Overall, visual and noise impacts would have a low impact on recreation.

Work occurring adjacent to or on SR14 could result in slower traffic conditions as vehicles approach the Refuge. If one lane were open, flaggers or other means of regulating traffic would be in place. If total closure was needed for a short period of time, a detour route would be implemented. Either of these options could result in slower traffic conditions and traffic congestion for recreationalists traveling to or from the Refuge. Overall, temporary impacts to recreation during construction would be moderate.

3.7.2.2.2 Operational Impacts

During operations, public access to the Refuge would be fully restored. The access/parking lot would be relocated west of its current location. Parking would be expanded from 20 to 30 spaces (2 ADA accessible) and continue to provide for one bus or RV. Restrooms, bicycle parking, and the trailhead would also be moved to the new location.

Removal of portions of the WCRL, the Gibbons Creek elevated channel, and an interior access road embankment would alter the trail network. The reconfigured trail network would connect to the CRDT where the west setback levee meets the existing WCRL. Interpretive art elements would be relocated to this trail where appropriate. East of the west setback levee's intersection with the WCRL, the CRDT would be reconstructed at a lower elevation (where the WCRL would be removed) and would cross the broad natural fluvial levee. Two bridge crossings would connect various trail segments. The two bridge crossings would be located at approximately the 25-year flood stage, providing year-round access except during extreme flood events. The seasonal Redtail Lake loop trail would remain in its current location. This reconfiguration would have a low impact on recreation use and access.

While there would be modifications to the trails, the overall trail network linking parking with the Columbia River, along the river, and in the Redtail Lake area would not be reduced in length or quality. In fact, the trail would be lengthened by 1.0 miles and would pass through a much more diverse set of habitats, including interior Refuge wetlands, the Gibbons Creek corridor, more than 2 miles of restored riparian forest, and areas with views of the Columbia River. Portions of the pedestrian trail could be seasonally inundated during spring floods, but this impact would be temporary and other quality walking and bird viewing areas would remain available. With the overall improvements, long-term impacts to habitat, birding, walking, access, and educational activities would be beneficial and moderate.

3.7.3 Environmental Consequences – No Action

There would be no short-term or long-term impacts to land use or recreation under the no action alternative. The proposed project would not be built, current land uses would remain the same, and recreational trails, viewpoints, art, and access would be unchanged; therefore, there would be no impacts under this alternative.

3.7.4 Cumulative Impacts

Past, current, and reasonably foreseeable future projects that may impact land use and recreation include expansion of municipalities, conversion of open space and agricultural lands to commercial and residential development, and other habitat restoration projects. Although many restoration projects can continue to allow multiple land uses to continue, some may convert agricultural lands to wetlands that are unsuitable for grazing or hay production. Under the Proposed Action, the current land uses including provision of habitat for migratory waterfowl, limited agricultural use, and recreation would continue, although limited conversion of land used on the Refuge for hay production may occur. However, since most of the lands used for hay production and grazing are above the areas that would be inundated under most conditions, this impact would be low.

Recently completed or ongoing projects in the area include the Jemtegaard School Redevelopment and the Washougal School District Bus Maintenance Facility. Both of these projects resulted or would result in very minor changes to existing land uses, although the overall nature of the land uses in these locations would not change. The primary foreseeable projects in the area may include the wellfields project and expansion of Port facilities east of their currently-developed area. The wellfields project would result in the installation of several small wellheads and limited above-ground pipes and pumps to convey water over the proposed west setback levee, but would have very little effect on the area's use as habitat for waterfowl or for grazing. Possible expansion of the Ports' facilities near their current facilities west of the project area could convert several acres of grasslands to developed uses, but this area is not used for agriculture and is of limited value as wintering habitat for migratory birds. Therefore, in combination with the Proposed Action, this cumulative impact would be low.

Facilities planned as part of the Port of Camas-Washougal Waterfront Trail Master Plan would still connect to the trail network within the Refuge via the CRDT, so there would be no long-term cumulative impacts. Temporary closure of all or portions of the trail network within the Refuge during construction could affect connectivity of the trail network. The relocation of the parking lot and access point of the refuge to west of Gibbons Creek would affect the potential location of the Gateway Center, which had considered a location adjacent to the current location of the parking lot and Refuge access point. The future location of this facility could be moved to the proposed new parking area. The cumulative impacts on land use and recreation would be low.

3.8 Noise

This section describes baseline conditions related to noise. This section also discusses potential impacts related to noise within the analysis area. This discussion includes any area that could be affected by construction noise.

3.8.1 Affected Environment

Noise is the intrusion of a new sound inconsistent with and above the background level of the existing soundscape. Sound is measured in decibels (dB) on a logarithmic scale. Therefore, a change in sound level of 3 dB or less is barely perceptible by the human ear, while a 10 dB increase or decrease in sound level is perceived as a doubling or halving of sound level (FHWA 2016). The sound levels of some common activities are shown in Table 3-6.

The existing soundscape of the project area is dominated by natural sounds such as flowing water, small waves, wind through vegetation, and wildlife such as birds. Development surrounding the project site influences the existing soundscape. Sound from travel along SR14 is audible in the project site's northern portion. Other sounds from activities on surrounding lands that could be audible on the project site include sounds from railroad travel, agricultural activity, river navigation, and residential or commercial/industrial human activity.

Table 3-6: Example Sound Levels

Sound Level (dB)	Activity
120	Plane take-off
105	Rock concert
100	Lawn mower
70-80	Traffic noise
60-65	Office
35	Library
10	Breathing

Source: Ecology 2016b

Sensitive receptors, as defined by the EPA, are facilities such as hospitals, schools, daycare facilities, elderly housing and convalescent facilities where occupants are more susceptible to noise impacts than the general population. The nearest sensitive receptor is Jemtegaard Middle School, located approximately 1,600 ft. north of the entrance to the Refuge. Residences, which are not normally considered sensitive receptors, are located within 50 ft. of the project site west of Gibbons Creek.

Noise is regulated at the state, county, and city level. Washington Administrative Code (WAC) Section 173-60-050 allows construction noise between the hours of 7:00 am and 10:00 pm. Clark County and the City of Washougal have additional noise regulations; these regulations are in accordance with the state construction noise regulations.

3.8.2 Environmental Consequences – Proposed Action

Noise associated with construction would have temporary, moderate impacts on residences near Gibbons Creek. Mitigation measures described in this section would be implemented to minimize impacts on those residents. Noise from construction in other parts of the Refuge would generally occur far enough away from residences and sensitive receptors. Noise would be relatively similar to ambient noise levels, so impacts would be low. During operation and maintenance, the noise environment would be similar to current conditions, so impacts would be low.

Construction of the Proposed Action would temporarily increase noise in the action area. Increased noise levels could disturb residents along Gibbons Creek and along SR14 near Gibbons Creek. During operation and maintenance, the noise environment would be similar to current conditions.

3.8.2.1 Construction Impacts

Construction activities would result in temporary increases in noise levels. The majority of intensive construction would occur in portions of the Refuge that are relatively far from residences and sensitive receptors. Sound attenuates (lessens) over distance and when it encounters obstacles such as terrain or trees. The majority of construction would occur far enough away from residences and sensitive receptors that noise levels would be relatively similar to ambient noise levels at these receptors. For example, at Columbia River Gorge Elementary and Jemtegaard Middle School, which are 1,600 ft. from the action area, construction noise would be relatively similar to ambient noise levels.

During the first construction season, construction would occur near residences along Gibbons Creek and along SR14. Construction of the floodwall and berm along Gibbons Creek, construction on SR14, and construction of the parking lot and associated infrastructure would be close to these residences. Residents would experience elevated noise levels during construction. Work would be within 50 ft. of residences along Gibbons Creek and within 100 ft. of residences along SR14 near Gibbons Creek. Consistent with allowable construction periods identified in Clark County's General Plan (Clark County 2016a), construction activities near residences would be limited to the hours between 7:00 a.m. and 10:00 p.m., unless there was an emergency. Construction of the Gibbons Creek floodwall and berm is anticipated to last for three months during the first working season. Work associated with SR14 would also be completed during the first work season.

During the second construction year, the majority of construction activities would occur south of SR14, in the main Refuge area, and lower levels of noise would be audible in areas surrounding the Refuge. In addition, because construction equipment would be dispersed over a relatively large area, sound levels would be similar to ambient levels for the majority of the second construction season. As during the first construction season, any work conducted in the vicinity of residences would occur between the hours of 7:00 a.m. and 10:00 p.m., unless there was an emergency.

A mathematical model based on the Federal Transit Administration and FHWA noise modeling and impact assessment methods was used to estimate noise levels associated with project construction near residences (FHWA 2006, FTA 2006). Table 3-7 presents the estimated noise levels associated with construction activities at the two applicable reference distances, 50 ft. and 100 ft. Noise is reported as A-weighted decibels (dBA), with both the maximum sound level (Lmax) of each piece of construction equipment and the composite equivalent sound level (Leq) of all construction equipment reported. In order to provide an upper bound of impacts, the model assumes no equipment mufflers or other sound dampening or shielding effects.

Table 3-7: Estimated Construction Sound Levels Near Residences

Construction Equipment	Count At Peak	Usage Factor (%)	Noise Level at 50 ft., dBA Lmax	Composite Noise Level at 50 ft., dBA Leq	Noise Level at 100 ft., dBA Lmax	Composite Noise Level at 100 ft., dBA Leq
Air Compressor	1	30	80	88	74	82
Backhoe	1	70	80		74	
Bulldozer	1	20	85		79	
Dump Truck	2	30	84		78	
Excavator	1	30	85		79	
Fork Lift	1	20	85		79	
Front End Loader	1	40	80		74	
Fuel Truck	1	10	85		79	
Generator	1	40	82		76	
Water Pump	1	50	77		71	
Water Truck	1	30	82		76	

Source: FHWA 2006; FTA 2006; Tetra Tech staff analysis

Residences within 100 ft. of Gibbons Creek would experience noise impacts of up to 82 dBA during construction (Table 3-7). These impacts would be temporary and would be reduced to moderate with implementation of the mitigation measures described in Table 2-9. In addition, the majority of construction in this vicinity would be limited to the first of the two primary construction seasons. As a result, the impact would be moderate during the first primary season, and low during the second and third seasons.

Workers at the construction site would also experience increased noise levels. Workers would wear adequate hearing protection as appropriate and in accordance with the project health and safety plan and applicable occupational health and safety regulations, so impacts would be low.

3.8.2.2 Operational Impacts

During operation, the noise environment would be similar to current conditions, so impacts would be low. Current noise sources that would continue during operation and maintenance include natural sounds such as wildlife, water, and wind, and intermittent noise from maintenance activities such as operating landscaping equipment or maintenance vehicles. Low noise impacts could occur if temporary flood barriers were deployed on SR14 at the Gibbons Creek Bridge, but these impacts would be limited to a maximum of up to 2 hours while the structures were being installed or removed, and the impact would be low.

3.8.3 Environmental Consequences – No Action

Under the no action alternative, the project would not be implemented. The noise environment would be unchanged, and limited to ongoing maintenance actions. Impacts would be low.

3.8.4 Cumulative Impacts

The primary past action that contributes to ongoing, cumulative noise impacts is the construction of SR14. Traffic noise from SR14 is the main contributor to ambient noise levels in the study area. Other contributions to cumulative noise levels come from area businesses, local traffic, and industrial activities at the Port. Although reasonably foreseeable actions including construction of additional commercial facilities at the Port would likely involve construction activities that would temporarily elevate nearby noise levels, the cumulative impact would likely be low. These projects are located at a long distance from each other, and each would be expected to implement BMPs to minimize noise impacts. It is not likely that construction of the proposed action would coincide with another project in time and physical proximity such that cumulative impacts would occur; therefore, this impact would be low.

3.9 Hazardous Substances

This section describes baseline conditions related to hazardous substances including hazardous materials and hazardous waste. This section also discusses potential impacts related to hazardous materials within the analysis area. This discussion includes any area that could be affected by releases of hazardous substances.

3.9.1 Affected Environment

Multiple sites where hazardous materials are stored, hazardous waste is generated, or releases of hazardous substances have occurred are located in the vicinity of, but outside of, the project site, primarily in the more developed areas to the west (EDR 2016a). Contaminants have been detected in the Gibbons Creek remnant channel, west and outside of the project area (Figure 2-1), and a remnant channel that flows from Steigerwald Lake. Gibbons Creek receives stormwater runoff from upstream urban areas, is on the CWA 303(d) list, and reports elevated levels of nitrates and phosphorous, among other impairments (USFWS 2005).

Historically, the remnant channel was the receiving water body for wastewater from multiple industrial facilities in the vicinity that use a variety of hazardous substances, including wood-preserving facilities. Although many of these sources may have been remediated, contaminants that have been detected in stormwater sewers feeding into the remnant channel include trace amounts of pentachlorophenol, other phenolic compounds, nitrosamines, phthalates, and elevated concentrations of metals (arsenic, chromium, copper, zinc, cadmium, and lead). Water or sediments in channel could contain low levels of these or related contaminants. The volatile compounds detected in the remnant channel are similar to those detected at the Burlington Environmental clean-up site approximately 1 mile west of the project area (USFWS 2005).

The lower Columbia River is known to be impacted by several hazardous substances including dioxins, furans, polychlorinated biphenyls (PCBs), and dichlorodiphenyldichloroethylene (DDE) at concentrations that could affect wildlife (Tetra Tech 1996). However, it is not likely that Columbia River flows near the Refuge would contain detectable concentrations of these substances.

Although part of the project area is still used for agriculture, historical aerial photographs show that additional portions of the project site were used for agriculture from the 1940s until the 1990s (EDR 2016b). Pesticides may have been applied to crops in these areas, and residual pesticides may be present in site soils, including now-banned pesticides such as dichlorodiphenyldichloroethane (DDD), DDE, and dichlorodiphenyltrichloroethane (DDT).

3.9.2 Environmental Consequences – Proposed Action

Construction and operation of the Proposed Action would have low impacts related to hazardous materials and waste. During construction and maintenance, BMPs would be implemented to ensure safe handling and disposal of hazardous materials and petroleum products. The BMPs also ensure prompt responses to spills or releases, so impacts would be low. Residual pesticides, fecal coliform bacteria, and metals could be present in site soil or water and could be encountered during construction and maintenance activities. Although these materials would not be likely to be present at concentrations that would affect workers or the public, BMPs would be implemented to minimize direct worker contact with soil and water. The public would not be exposed to these materials during routine activities such as hiking, biking, and sightseeing.

Construction and maintenance of the Proposed Action would involve the use of common hazardous materials and petroleum products and could generate some waste. Handling and use of these materials must be done safely and in compliance with regulatory requirements. Use of these materials could result in accidental spills or releases that would have to be promptly stopped and cleaned up. Previous on- and off-site contributions from stormwater runoff, contaminant migration in surface or groundwater, or pesticide application associated with past agricultural uses could have contaminated soil or water. Impacts could arise from:

- Improper handling, use, and disposal of hazardous materials and petroleum products
- Accidental spill or releases
- Encountering contaminated soil or water
- Flood events

3.9.2.1 Construction Impacts

During construction, petroleum products and hazardous materials such as fuels, oils, and lubricants would be present onsite, primarily in vehicles and construction equipment. Use of these materials as well as uncured concrete increases the risk of accidental discharge into riparian areas or directly into water bodies, resulting in habitat degradation as well as injury or mortality of aquatic species.

To manage petroleum products and hazardous materials and respond to spills and releases, construction would employ mitigation measures. Workers would be trained so they were aware of petroleum products and hazardous materials onsite and would know how to properly handle and dispose of these materials. The construction contractor would be required to have a written hazardous materials and SPCC Plan to ensure that accidental discharge of hazardous materials and petroleum products would be contained quickly and remediated thoroughly. Workers would be trained on these procedures. With these mitigation measures and other appropriate BMPs in place, the potential impact would be low.

As described in Section 3.14.1, site soil could contain residual levels of pesticides from historical agricultural use, and water could contain fecal coliform bacteria and metals. While levels could be sufficient to make water or soil unfit for drinking, they would not be expected to be present at sufficient concentrations to present an exposure risk. As described in Section 2.4.1, workers would wear gloves and appropriate clothing as part of typical construction site safety practices, and fugitive dust controls would be implemented during construction, which would further minimize potential for exposure.

In the unlikely event that soil or water suspected to be contaminated was encountered, work would stop in that area, a designated manager would be contacted, and work would not resume in the area until appropriate actions were taken to minimize any risks. Appropriate actions could include additional personal protective equipment, such as respirators or additional protective clothing; sampling air, soil, or water to determine contaminant levels; and excavation or *in situ* remediation of contaminants.

For the most part, construction would be expected to occur in dry conditions. However, some in-water work would be necessary to breach the WCRL and natural levee and stabilize the banks of the newly constructed floodplain channels. Any construction equipment that would be used in in-water areas would be cleaned and inspected for leaks of fuels, solvents, or hydraulic fluids before it was deployed. If any leaks of these substances were detected, machinery would be shut down until the leak was remedied.

3.9.2.2 Operational Impacts

During operation and maintenance, it would not be likely that increased amounts of hazardous materials or petroleum products would be routinely stored onsite. Small amounts of hazardous materials or petroleum products such as cleaning products, paint, fuels, oils, and lubricants, would be used at the site during maintenance activities. Workers using these products would be trained in their proper use and disposal. As with construction, maintenance activities would include written procedures for spill response and other accidents involving these materials. Workers would be trained on these procedures. With the implementation of these or other appropriate BMPs for hazardous materials and waste, impacts would be low.

As described in Section 3.9.2, residual pesticides, fecal coliform, and metals could remain in Refuge soil or water during operation. Relatively minor amounts of herbicides approved for use in aquatic areas might be used to control particular infestations of weeds. This ongoing impact would occur even if the project was not constructed, and it would not be worsened by the Proposed Action. Workers that could have extended contact with soil or water would employ BMPs such as wearing gloves and dust masks when working, so impacts would be low. The public would not be likely to be exposed to these materials during routine activities such as hiking, biking, and sightseeing, so there would be no impacts.

3.9.3 Environmental Consequences – No Action

Under the no action alternative, construction-related release of hazardous materials would not occur. Current uses of petroleum products and hazardous materials during operation and maintenance would be unchanged. These practices could include use of herbicides for control of pest plant populations, which could allow for inadvertent releases of such substances into sensitive wetland areas. Due to ongoing BMPs which are designed to reduce the potential for inadvertent releases to the extent possible, this impact would be low. Low levels of contaminants potentially present in site soil or water as described in Section 3.9.2 would be unchanged.

3.9.4 Cumulative Impacts

Most of the past, present, and reasonably foreseeable actions likely involve construction and maintenance activities that use hazardous materials and petroleum products and could generate some waste. These actions would be expected to implement BMPs and mitigation measures to safely manage hazardous materials and waste and minimize impacts. Due to the nature of the action, actions such as logging, mining, and roadway projects may have greater impacts with respect to hazardous materials and waste compared to the Proposed Action. Projects such as restoration and water quality improvement activities may have long-term beneficial impacts. Construction of the Proposed Action would make a low contribution to cumulative impacts on hazardous materials and waste. It would not be likely that construction of the Proposed Action would coincide with another project in time and physical proximity such that cumulative impacts would occur. Likewise, construction activities within the Refuge would be physically separate from other areas such that there would be no cumulative impacts.

Herbicides might be applied during construction and operations to manage invasive vegetation. When combined with herbicide use at other habitat preserves, forestry and agricultural areas, and along transportation rights of way, applications at the Refuge could contribute to cumulative impacts to fish and wildlife, water quality, and public health and safety. This cumulative impact would be expected to be low, as it is assumed that all applications of herbicides would be consistent with guidelines for use in and around aquatic areas and would follow state, manufacturer, and EPA instructions.

3.10 Public Health and Safety

This section describes baseline conditions related to public health and safety. This section also discusses potential impacts related to public health and safety within the analysis area. This discussion includes any area where impacts to public health and safety could occur.

3.10.1 Affected Environment

There are few existing risks to public health and safety on the project site. Although water and soil may contain low levels of contaminants, these are not expected to pose a risk to public health and safety under normal conditions. The area is used by the public for recreation and contains open water, so risks include slips, trips and falls; exposure to the elements (e.g., heat and cold); bites or stings from mosquitoes, snakes, or other wildlife; and water-related accidents such as drowning. Although traffic on SR14 travels at highway speeds, ingress and egress to the site from SR14 is facilitated by turn lanes and merge lanes, so traffic risks are relatively low.

Law enforcement and emergency services at the site are provided by the USFWS law enforcement staff, Clark County Sheriff's Department, City of Washougal Police Department, and the City of Washougal Fire Department. USFWS currently provides law enforcement staff on a regional basis, and stationed a law enforcement officer at the Refuge beginning in June, 2016. This officer serves the entire Ridgefield National Wildlife Complex, which includes Ridgefield, Steigerwald, Franz Lake, and Pierce NWRs.

3.10.2 Environmental Consequences – Proposed Action

Construction of the Proposed Action could present typical construction site safety risks to workers and the public. Operation and maintenance of the Proposed Action would reduce public health and safety risks relative to current conditions, since operations would be comparable to those occurring at the Refuge under current management but the level of flood protection would be increased. Impacts could include:

- Construction accidents
- Impeded emergency response
- Incidents requiring emergency response, including construction accidents or traffic accidents associated with construction equipment or road construction
- Seasonal inundation
- Flood events

3.10.2.1 Construction Impacts

During construction, construction site safety BMPs would be employed. Construction sites would be fenced and signed to prevent public access. A health and safety plan would be developed and implemented. The potential for injury to workers would increase for the duration of the construction period, but workers would practice construction safety measures, such as holding daily safety briefings and wearing appropriate protective footwear, gloves, clothing, and hearing and eye protection. In the unlikely event that contaminated soil or water was encountered, work would stop in that area, a designated manager would be contacted, and work would not resume in the area until appropriate actions were taken to minimize any risks to health and safety. Impacts to worker health and safety would be low.

During construction, regional emergency response times could increase if traffic along SR14 were impeded. However, impacts to traffic flow on SR14 would be temporary and limited in duration, and passage of emergency response vehicles would be addressed and prioritized in the traffic control plan. This impact would be low.

The presence of equipment entering, exiting, or being used on SR14 could increase the potential for traffic accidents during construction. The potential for impacts to public health and safety from traffic accidents related to construction would be mitigated by preparation of a traffic management plan. The plan would include use of flaggers, lights, signs, speed limits, detours, and other methods to control traffic in and around the construction area. This impact would be low.

During construction, the required level of flood protection would be maintained. Construction of the setback levees would begin with building the levees so that the crests meet the FEMA standard for certification (3 ft. above the 100-year water surface elevation). The WCRL would be removed concurrently with construction of the new levee, and only down to the same FEMA elevation, thereby maintaining flood protection levels at all locations during construction. Therefore, there would be no change in flood protection, and there would be no impacts related to flood safety during construction.

With the implementation of these or other appropriate construction site safety BMPs, construction impacts on public health and safety would be low.

3.10.2.2 Operational Impacts

During normal operation, risks to public health and safety would decrease because, although Columbia River flood risk would remain unchanged, the risk that Gibbons Creek would flood the Port, the City's wastewater treatment plant, and private residences would decrease substantially. The project is being designed to provide the same level of flood protection that is provided under existing conditions. Because the setback levees and elevated foundation of SR14 would provide the same level of flood protection as the existing levee, and the floodwall and berm on Gibbons Creek would offer increased flood protection, once the WCRL was breached, there would be an increase in the flood protection level provided to the surrounding community. This increase in flood protection would be a moderate, beneficial impact.

Any emergency 911 calls from the Refuge would be routed to Washougal Emergency Management System for initial response. The channel crossings on the CRDT would provide year-round vehicle response for emergencies except the 12 days per year, on average, when the crossings would be submerged. During extreme flood events, the trail would likely be closed to public use, leaving a small annual window when vehicle access would be precluded. In these limited circumstances, the bridge and trail system would need to serve as the conduit for pedestrian emergency response. This approach is consistent with other trails in the Gorge that do not have motorized vehicle access. The entrance road and maintenance access road could be used by emergency response vehicles, similarly to current conditions, so there would be no reduction in access to emergency providers. Access to other areas would be by trail on foot. This impact would be low.

During operation, seasonal inundation would be likely in some areas, including the CRDT trail. Trail access would be limited during these times and during any potential flood events. Similar to current practices, signage and other closure methods would be implemented as appropriate to warn the public against accessing potentially affected areas.

The larger inundated area could increase mosquito habitat and the potential for mosquito outbreaks. However, the project would increase circulation within the floodplain water bodies, which would discourage mosquito breeding. Also, fluctuation of water levels in the floodplain due to tidal range and variations in discharge from upstream dams would help to offset this impact. USFWS would monitor mosquito populations and work with the local vector control district in the event of increased outbreaks. This impact would be low.

Potential public health and safety impacts related to flood risk would either remain the same or be reduced during operations. The setback levees would offer the same or greater level of flood protection as under current conditions, and the floodwall along Gibbons Creek would offer increased flood protection to residential areas found west of Gibbons Creek. Overall operations impacts related to public health and safety would be low.

3.10.3 Environmental Consequences – No Action

Under the no action alternative, the project would not be implemented and construction-related impacts would not occur. There would be no changes to flood infrastructure or to vector control practices. Public health and safety risks would be unchanged, so there would be no impacts.

3.10.4 Cumulative Impacts

Cumulative impacts of past, present, and reasonably foreseeable actions include commonplace risks to the public and workers such as slips, trips and falls; exposure to the elements (e.g., heat and cold); bites or stings; and water-related accidents such as drownings. Although these types of risks would be associated with most projects, they are relatively discrete, so overall cumulative impacts of this nature would be low.

Cumulative impacts are also associated with broader types of risks, such as changes to traffic safety and flood protection. There are no other ongoing or reasonably foreseeable future actions in the vicinity that would combine with the slightly increased risk of traffic accidents identified above to cause a cumulatively significant impact to public health and safety. Likewise, because the Proposed Action would reduce flood risk, it would not contribute to a cumulative impact related to flooding.

3.11 Socioeconomics

This section describes socioeconomic conditions in the project area. Typical socioeconomic indicators include population and demographics, housing, employment and income, taxes and government revenue, and environmental justice. The socioeconomic resources relevant to the Refuge are further described by considering community character and traditions, especially with regard to sport, commercial, and subsistence fisheries.

3.11.1 Affected Environment

Demographic data used in this section was obtained from the U.S. Census Bureau. The American Community Survey (ACS) program continually collects survey data and publishes an updated dataset annually. The 2010-2014 ACS 5-Year dataset represents data collected during 60 months, ending December 31, 2014, and is considered the most reliable source of information for analysis of small populations (U.S. Census Bureau 2015a).

The Refuge is located in the southeast corner of Clark County, Washington, and about 20 miles from the Portland-Vancouver metro area. The Port borders the Refuge to the west, and the town of Washougal to the northwest. The Refuge itself is contained by Census tract 405.07, though tract 405.08 shares a boundary with the portion of the Refuge which contains Gibbons Creek. Both of these tracts were chosen to be study area tracts in this analysis and were compared to countywide totals for Clark County to provide regional context. Figure 3-7 illustrates the location of the project area and the two tracts.

3.11.1.1 Community Character

Washougal is situated at the interface of the Portland-Vancouver Metropolitan area and the Columbia River Gorge corridor and maintains a small-town feel despite its proximity to Portland-Vancouver. The history of Washougal is rooted in industrial and manufacturing sectors such as pulp and paper processing, shipbuilding, and the historical Pendleton Woolen Mill. More recently, the community has also attracted professional and service sector tenants to local business parks. The community is a hub and jumping-off point for outdoor recreation and related tourism in the Gorge, including boating, fishing, windsurfing, hiking, camping, skiing, and more. The community places emphasis on providing safe and clean public parks and community spaces and fostering local business success (Port of Camas-Washougal 2014b).

3.11.1.2 Population, Demographics, and Housing

Clark County population is concentrated in and around the City of Vancouver, and the County's population history and forecast are largely tied to the Portland Metropolitan Area economy. At the eastern edge of the county, growth in the study area is expected to be linked the growth of the overall county, though it would likely not grow as quickly as central Vancouver. Clark County was the second fastest growing county in Washington in 2015, growing by about 2 percent (U.S. Census Bureau 2015b). Growth is expected to continue at around 1 percent per year based on the 2040 population forecast from the Washington State Office of Financial Management, 2012 Growth Management Population Projections (State of Washington 2012).

The two study area tracts represent about 2 percent of the total current county population, and tract 405.08, which includes a substantial portion of the town of Washougal, is nearly three times as populous as tract 405.07, which includes a residential area, the Port, the Refuge, and other rural lands. Table 3-8 presents a series of demographic characteristics for the two study area tracts, and compares their combined attributes to Clark County as a whole.

When the study area tracts are taken together, as shown in the column of weighted averages in the table, the study area appears to be similar to the County at large, but with a slightly lower minority population, higher median income, and lower poverty. Overall, the study area tracts can be generally described as a fairly typical suburban community in the Portland Metropolitan Area. However, as shown in Table 3-8, the two study area tracts do differ from one another.

Tract 405.08 represents 74 percent of the total study area population and carries the most weight when calculating study area averages, while Tract 405.07 is only 26 percent of the study area population. Both tracts have a lower proportion of minority residents than the County as a whole, but Tract 405.07 has nearly double the number of minority residents as Tract 405.08. In terms of median household income, Tract 405.07 has a median income that is 23 percent lower than the County's, while Tract 405.08 is 31 percent higher than the County. Rates of poverty and unemployment are above county-wide levels for Tract 405.07, while they are not for Tract 405.08. Similarly, educational attainment and health insurance coverage are below county rates for Tract 405.07 but above county rates for Tract 405.08.

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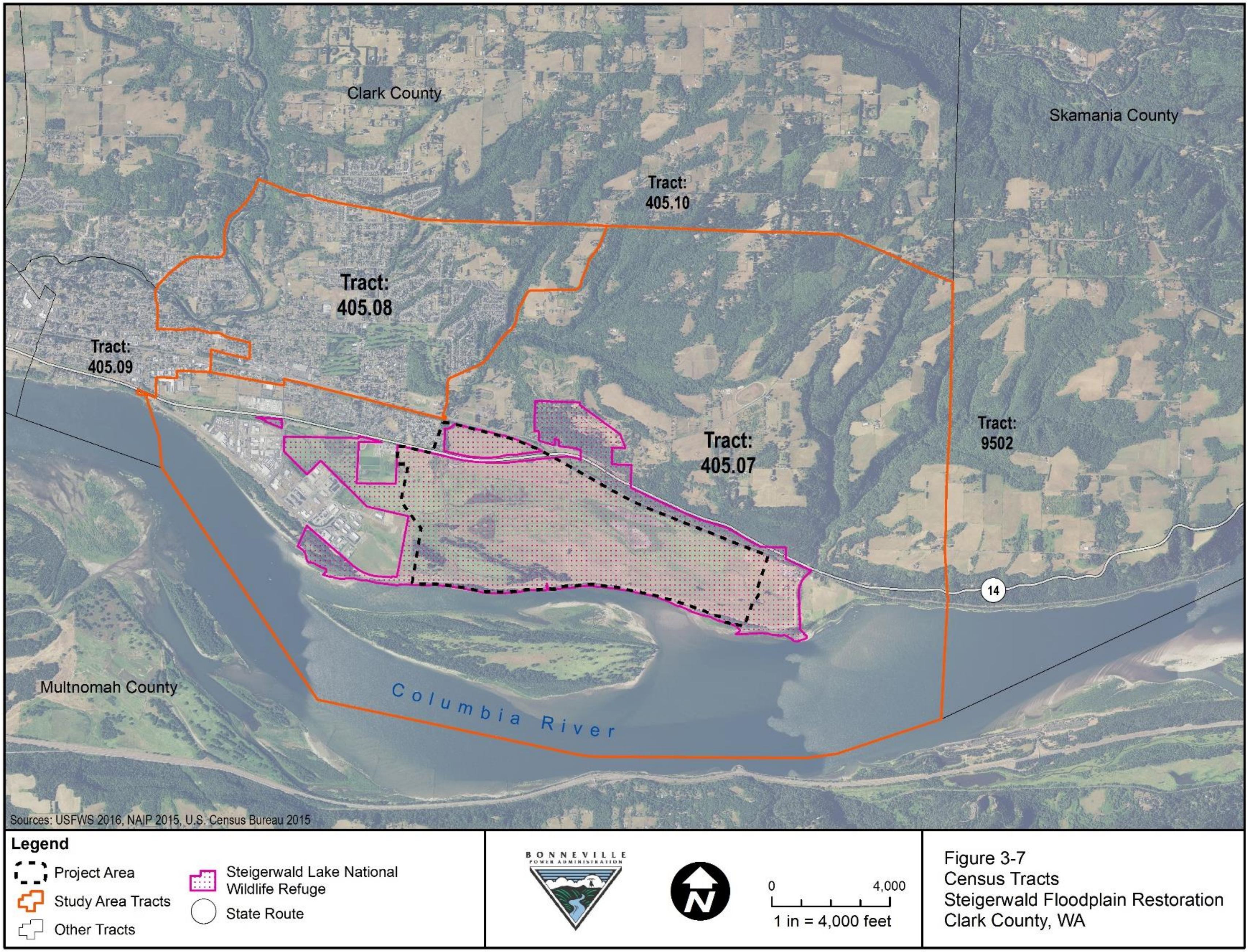

Figure 3-7
Census Tracts
Steigerwald Floodplain Restoration
Clark County, WA

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Table 3-8: Demographic Characteristics

Item	Tract 405.07	Tract 405.08	Study Area	Clark County
Population	2,352	6,530	8,882	438,272 (1)
Median Age	34.5	37.6	36.8 (2)	37.2
Minority Population (3)	15%	8%	10% (2)	19%
Households	823	2,261	3,084	160,492
Average Size	2.86	2.89	2.88 (4)	2.71
Median Income	$45,750	$77,772	$69,227 (4)	$59,551
% One-Unit Structures	43%	94%	81% (4)	73%
% Two-or-More Units	21%	5%	9% (4)	22%
% Mobile Home and Other	36%	1%	10% (4)	5%
Median Home Value	$121,700	$237,300	$206,451 (4)	$228,400
Poverty Rate (5)	17%	4%	7% (5)	12%
Unemployment Rate (6)	15%	9%	10% (6)	10%
With Bachelor's Degree or Higher (7)	10%	23%	20% (2)	27%
With Health Insurance (8)	81%	90%	87%	88%

Source: U.S. Census Bureau 2015a. (1) Clark County population in this table was sourced from the ACS dataset for consistency with the tract level data. (2) Average of tract-level statistics, weighted by population. (3) The minority population includes all persons of Hispanic or Latino ethnicity (of any race) and all other persons who identify their race as Black or African-American, American Indian and Alaskan Native, Asian, Native Hawaiian or Other Pacific Islander, Some Other Race, or Two or More Races. (4) Average of tract-level statistics, weighted by number of households. (5) Poverty rate for all people based on U.S. Census Bureau poverty thresholds. (6) Unemployment rate is the number of unemployed people as a percentage of civilian labor force, as defined by the Census. Combined study area rate is the average of the tract-level statistics, weighted by civilian labor force population. (7) Percentage of the population over 25 having with educational attainment of bachelor's degree or higher. (8) Percentage of the civilian non-institutionalized population with health insurance coverage.

In general, the Census data indicates that Tract 405.07 is a less affluent residential neighborhood, while Tract 405.08 includes higher than average affluence. This is corroborated by the housing unit type and median value information in the table. It shows that over 50 percent of the housing units in Tract 405.07 are in multi-unit or mobile homes, whereas for Tract 405.08, 94 percent of units are single unit. Similarly, the median home value in Tract 405.08 is 47 percent below the County median, and the median value in Tract 405.08 is four percent above the County median. Many of the mobile home units are located in the Gibbons Creek Mobile Home Park, located just across the Gibbons Creek from Refuge lands between SR14 and the railroad.

3.11.1.3 Employment and Income

The largest employment center within Clark County is the City of Vancouver. The City of Portland, on the Oregon side of the Columbia River, is the largest employment center is the greater Portland Metropolitan Area. Within the two study area tracts, the ACS estimates a total active labor force (civilian employed population 16+ years old) of 3,984 people (928 in Tract 405.07 and 3,056 in Tract 405.08). Table 3-9 summarizes the employment by industry for workforce living in the study area and compares it to Clark County.

Table 3-9: Employment by Industry for Study Area Residents

Industry	Study Area		Clark County	
	%	Rank	%	Rank
Educational services, and health care and social assistance	17.8%	1	21%	1
Retail trade	12.5%	2	12%	3
Manufacturing	11.4%	3	13%	2
Construction	9.3%	4	7%	7
Transportation and warehousing, and utilities	9.0%	5	8%	6
Prof., scient., and management, and admin. and waste manag. services (1)	8.2%	6	10%	4
Finance and insurance, and real estate and rental and leasing	7.5%	7	6%	8
Arts, entertainment, and recreation, and accomm. and food services (2)	7.3%	8	8%	5
Wholesale trade	5.5%	9	3%	11
Public administration	4.9%	10	4%	10
Other services, except public administration	4.1%	11	5%	9
Agriculture, forestry, fishing and hunting, and mining	1.2%	12	1%	13
Information	1.2%	13	2%	12

Source: U.S. Census Bureau 2015a. (1) Professional, scientific, and management, and administrative and waste management services. (2) Arts, entertainment, and recreation, and accommodation and food services.

As shown in Table 3-9, the top five industries in which study area residents are employed include education and health care (18 percent), retail (13 percent), manufacturing (11 percent), construction (9 percent), and transportation and warehousing (9 percent). Compared to the county as a whole, the study area is mostly similar, with the largest differences seen in the proportion of people working in the education and health care, construction, professional services, and wholesale trade. As shown in Table 3-8 and discussed previously, median income for the study area as whole is higher than that of the county but varies substantially for the two tracts comprising the study area.

While the ACS data refers to people who are employed and live in the study area, the Census' *On The Map* web application (U.S. Census Bureau 2016) allows generation of a Work Area Profile for each study area tract. This profile estimates the number of primary jobs (generally equivalent to the number of workers) whose place of work was in the tract (though does not estimate place of residence for these workers). The dataset estimated 1,113 jobs located in Tract 405.07, and 373 jobs located in Tract 405.08. Together, the study area tracts account for about 1.1% of Clark County's 129,284 estimated jobs. As shown in Table 3-10, the top five industries for jobs located in the study area include manufacturing; construction; wholesale trade; retail trade; and arts, entertainment, recreation, accommodation and food services. These jobs are concentrated along the highway at the western edge of the study area tracts.

Table 3-10: Employment by Industry for Persons Working in the Study Area

Industry	Study Area		Clark County	
	%	Rank	%	Rank
Manufacturing	48.5%	1	10.2%	4
Construction	13.6%	2	6.5%	6
Wholesale trade	9.5%	3	5.0%	7
Retail trade	8.9%	4	11.5%	3
Arts, entertainment, and recreation, and accomm. and food services (1)	6.9%	5	8.6%	5
Educational services, and health care and social assistance	4.8%	6	27.1%	1
Prof., scient., and management, and admin. and waste manag. services (2)	4.4%	7	13.1%	2
Transportation and warehousing, and utilities	1.3%	8	3.8%	10
Other services, except public administration	1.0%	9	3.0%	11
Finance and insurance, and real estate and rental and leasing	0.9%	10	4.8%	8
Public administration	0.1%	11	3.9%	9
Information	0.1%	11	2.2%	12
Agriculture, forestry, fishing and hunting, and mining	0.0%	13	0.5%	13

Source: U.S. Census Bureau 2016. Values may not add due to rounding. (1) Arts, entertainment, and recreation, and accommodation and food services. (2) Professional, scientific, and management, and administrative and waste management services.

3.11.1.4 Environmental Justice

Executive Order 12898 (1994), Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, was issued with the goal of achieving environmental protection for all communities. It focuses on identifying and addressing disproportionately high and adverse human health impacts on minority and low-income populations. Consideration of environmental justice acknowledges that our environment quality affects the quality of our lives, and that minority and low-income populations should not suffer disproportionately. The Executive Order directs federal agencies to identify and address any disproportionately high and adverse impacts from federal actions on environmental justice communities, and it provides minority and low-income populations with access to public information and public participation in the federal planning process (EPA 2015b).

The characterization of environmental justice in the study area considered both Tract 405.07 and 405.08. Tract 405.08 includes 74 percent of the study area population. Thus, most of the population in the study area is generally more affluent and less diverse than Clark County as a whole, and Tract 405.08 is not considered an environmental justice community. However, the small population in Tract 405.07, while not a minority population, is characterized by lower-than-average income, higher-than-average unemployment and poverty, and relatively low home values. Tract 405.07 may be considered an environmental justice community. To ensure that there are no disproportionate adverse project impacts on residents of this tract, any decisions on project actions should be made with recognition of environmental justice issues in this area.

3.11.1.5 Sport, Commercial, and Subsistence Fisheries

Historically, and before levee construction, the floodplain that contains Steigerwald Lake was an important stopover for juvenile anadromous fish that were migrating downstream. By offering off-channel rearing and refugia habitat as well as floodwater attenuation, and by contributing to the food chain, the floodplain provided numerous benefits to aquatic species habitat. These benefits, and benefits from other off-channel habitat areas, were manifested by large numbers of juvenile fish moving out to the ocean, maturing, and returning to the Columbia River as breeding adults.

The Columbia River supports a thriving sport and commercial fishery, and subsistence fishing occurs along much of its length. Although anglers are not generally found on the banks of the Columbia River at the Refuge, as part of the sport fishery, fish are caught from boats offshore of the Refuge and throughout the lower Columbia River. For fisheries management purposes, the 292-mile stretch of the Columbia River that creates the border between Washington and Oregon is divided into six zones. Zones 1 to 5 are found between the mouth of the river and Bonneville Dam, located at RM 146. These zones are managed by Oregon and Washington, which must set their harvest in Zones 1 to 5 to leave enough fish for harvest in Zone 6. The Zone 6 fishery, which is found between Bonneville Dam and McNary Dam (RM 292), is an exclusive commercial fishing area for the four Columbia River treaty tribes (Yakama, Umatilla, Warm Springs, and Nez Perce). Fishing regulations in Zone 6 are enforced by the Columbia River Intertribal Fish Commission, which also operates 31 fishing access sites set aside for the exclusive use of anglers from the four treaty tribes. Non-commercial sports anglers may still fish in this stretch of the river (CRITFC 2016).

A common economic measure for commercial fisheries is ex-vessel value, i.e. the price per pound paid to fishers upon delivery of their catch multiplied by the total catch weight. For 2015, the commercial ex-vessel value for mainstem Columbia River salmon was approximately $3.5 million dollars, and Select Area (off-channel) commercial ex-vessel value was an additional $1.6 million dollars, for a total ex-vessel value of about $5.06 million dollars (ODFW 2016c). The Oregon Department of Fish and Wildlife (ODFW) non-treaty commercial catch reports totaled 2.06 million pounds, including chinook (88 percent), coho (11 percent), smelt (1 percent), shad (<1 percent), sockeye (<1 percent), and pinks (<1 percent) for 2015 (ODFW 2016a). Dividing the total ex-vessel value by the total catch weight results in an estimated value of $2.45 per pound across all catch species. Not including smelt, for which only weight is reported, there were 160,823 fish caught, which is approximately $31.48 per fish.

The recreational fishery in 2015 included 441,300 angler trips below Bonneville Dam (including Buoy 10 angers at the mouth of the Columbia). Total sport harvest was 103,500 Chinook, 37,900 coho, 4,600 steelhead, and 950 sockeye (ODFW 2016c). The economic value of recreational fishing can be estimated in terms of a willingness to pay for participation. A 2009 ODFW report estimated that of expenditure by anglers, about 56 percent goes towards equipment, 34 percent toward travel, and 10 percent towards spending locally near the recreation site. On average, anglers spent about $149 dollars per trip, in 2008 prices (ODFW 2009). This value was updated to 2015 prices (BLS 2016), resulting in an estimated angler-trip value of $164 dollars. Applied to the 441,300 angler trips below Bonneville Dam in 2015, the resulting estimated value of the recreational fishery is $72.6 million dollars.

Treaty fishing in Zone 6 in 2015 included a total catch of 316,199 fish including Chinook (86.8 percent), sockeye (7.3 percent), steelhead (4.7 percent), coho (0.7 percent), sturgeon (0.4 percent), and walleye (0.02 percent) (ODFW 2016b).

3.11.2 Environmental Consequences – Proposed Action

The Proposed Action could have both short-term and long-term socioeconomic impacts. Short-term impacts would be those related to construction, including increased demand for construction materials; patronage of local restaurants, hotels, and other types of services; employment opportunities; traffic disruptions and other lifestyle disruptions. Short-term impacts related to sport, subsistence, and commercial fisheries are not expected to occur, therefore they are not addressed in Section 3.11.2.1.

Because the operations of the restored area would not change substantially from current conditions, long-term impacts related to community character, population and housing, employment, income, and environmental justice are not expected to occur, and are not addressed in Section 3.11.2.2. Long-term impacts would be primarily related to support for sport, subsistence, and commercial fisheries.

3.11.2.1 Construction Impacts

3.11.2.1.1 Population and Housing

Construction would occur for up to six months during each of two primary construction periods. Settlement surveys would be conducted in a third, limited season. Construction activities would employ up to 30 workers at any given time. Construction crew members from outside the area (assumed to be approximately half of the crew) would likely return to their homes between construction periods, so the Proposed Action would not be likely to result in a permanent population increase in the project area. Short-term increases in rentals of spaces at recreational vehicle parks, apartments, or hotels would be likely, but there are sufficient facilities in the surrounding area to accommodate a relatively small and temporary increase in demand. Therefore, there would be a low impact on population and housing due to construction.

3.11.2.1.2 Employment and Income

The Proposed Action would likely generate a small number of temporary jobs for area residents during the construction period. This number of jobs and the income associated with those jobs would likely represent only a small percentage of the jobs and income in the study area. Therefore, although this impact would be beneficial to those workers who did gain employment, the overall impact would likely be low.

Construction of the Proposed Action is estimated to cost up to $19 million. Some of the construction funds would likely be spent directly in the Camas/Washougal area. Workers would likely spend some of their income on dining, accommodation, entertainment, and other services during the two work periods. The project itself would likely include local purchases of equipment and materials, providing a short-term stimulus to businesses that provide these items. Although this impact would be beneficial, it would likely be low in terms of the overall economy of the study area.

3.11.2.1.3 Environmental Justice

Most construction impacts, including increases in traffic, noise, and emissions, would occur well away from sensitive receptors. However, construction of the proposed floodwall along the west side of Gibbons Creek would require excavation, construction vehicle access, and installation of infrastructure in close proximity to homes in a mobile home park. As indicated in Section 3.11.1, this Census tract is considered to be an environmental justice community due to higher unemployment rates, lower incomes, and lower home values than the community at large. Construction impacts would last for up to two months in any given part of the floodwall construction area, and would include increased noise, dust, and traffic disruption caused by ingress and egress of construction equipment. These impacts would be temporary, and would be mitigated by implementing measures described in Section 2.4.1. The overall impact would be low.

3.11.2.2 Operational Impacts

3.11.2.2.1 Environmental Justice

Long-term impacts would include visual impacts associated with the presence of the floodwall and increased height of SR14, and diminished access to Gibbons Creek. Fewer than ten residences would be directly affected by the presence of the floodwall and raised roadway in this way. The floodwall height would obscure views from some residences at the south end of the floodwall, but the long-range viewshed would remain intact. Also, Gibbons Creek in this reach is a swiftly flowing transport reach, and offers minimal recreation value. In this instance, there is no alternative to placing the floodwall in its proposed location, as it is needed to provide the same level of flood protection that would be provided by the setback levees and temporary floodgates on SR14. The floodwall would be installed only after an easement was developed with the property owners, and construction would follow the terms of the easement. In addition, the presence of the floodwall would comprise a low, beneficial impact to this community by reducing the risk of flooding from Gibbons Creek and ensuring flood protection up to the 50-year flood event. The reduction in access and visual resources would therefore not be disproportionate and the overall impact would be low.

3.11.2.2.2 Fisheries

As a habitat restoration project proposed with the goal of increasing off-channel habitat for anadromous fish, this project would help to offset historical losses of such habitat and the commensurate impacts to fish populations. Although it is not possible to quantify the number of fish that would benefit from the Proposed Action, this would be one of the most important floodplain restoration projects in the upper Columbia River estuary, therefore it would be likely to make an important contribution to survival rates of juvenile anadromous fish that are outmigrating from upstream. Indirectly, this would be likely to have a moderate impact on subsistence, sport, and commercial fisheries, particularly on the Zone 6 fishery at Bonneville Dam, which begins a short distance upstream of the Refuge and which would likely see increased escapement of anadromous fish as a result of higher survival rates of juveniles.

3.11.3 Environmental Consequences – No Action

Under the no action alternative, there would be no construction and therefore there would be no construction-related socioeconomic or environmental justice impacts. The Port would continue to operate pumps to remove runoff from the west end of the site, at considerable annual expense to the public, resulting in a moderate impact from operations.

3.11.4 Cumulative Impacts

No other projects in the study area have been identified that would cause a substantial cumulative impact to socioeconomics or environmental justice in combination with the Proposed Action. However, this project, in combination with other fish habitat restoration projects in the estuary would likely have a moderate beneficial cumulative impact on populations of anadromous fish, which would have an indirect but beneficial cumulative impact on recreational, commercial, and subsistence fisheries.

3.12 Transportation and Infrastructure

This section discusses traffic, transportation facilities, rights of way, and utilities in the project area, and it identifies potential impacts that could occur from implementing the alternatives.

3.12.1 Affected Environment

The primary ground transportation features in the area are SR14, the BNSF Railroad, and roads and streets for residential, agricultural, and business use. Within the Refuge, there are unpaved roads and trails used for maintenance and recreation. South of the project area, the Columbia River provides a travel corridor for large ships and smaller vessels. The site is accessible via Gorge West End Transit, which stops at the visitor's parking lot on the south side of SR14.

SR14, also known as the Lewis and Clark Highway, divides the project area and is the primary throughway in the vicinity. In this area, it has two lanes of travel, one in either direction. Dedicated right- and left-turn lanes are provided at the entrance to the Refuge parking area. The highway contains two bridges in this area, one over Gibbons Creek and another over the railroad.

WSDOT's annual average daily traffic volumes for SR14 in this area are 5,001 to 10,000 vehicles west of the intersection with 45th Street (just east of the wastewater treatment plant) and 2,501 to 5,000 vehicles east of this intersection (WSDOT 2016). The approximate percentages of truck traffic in this area are 5 to 6 percent single unit trucks, 4 to 7 percent double unit trucks, and 1 percent triple unit trucks (WSDOT 2016). The Southwest Washington Regional Transportation Council has traffic count data for several intersections near the project area, as shown on Figure 3-8 and as summarized in Table 3-11. Southeast Evergreen Way is classified as an arterial while the other streets in Table 3-11 are minor collectors.

In the project area, SR14 is designated as a National Scenic Byway and Washington State Scenic Byway. The portion of SR14 in the project vicinity is referred to as both the Columbia River Gorge Scenic Byway (an 80-mile route) and the Lewis and Clark Trail Scenic Byway (a 572-mile route). SR14 is also designated by WSDOT as a Highway of Statewide Significance, meaning that it is needed to connect major communities in the state.

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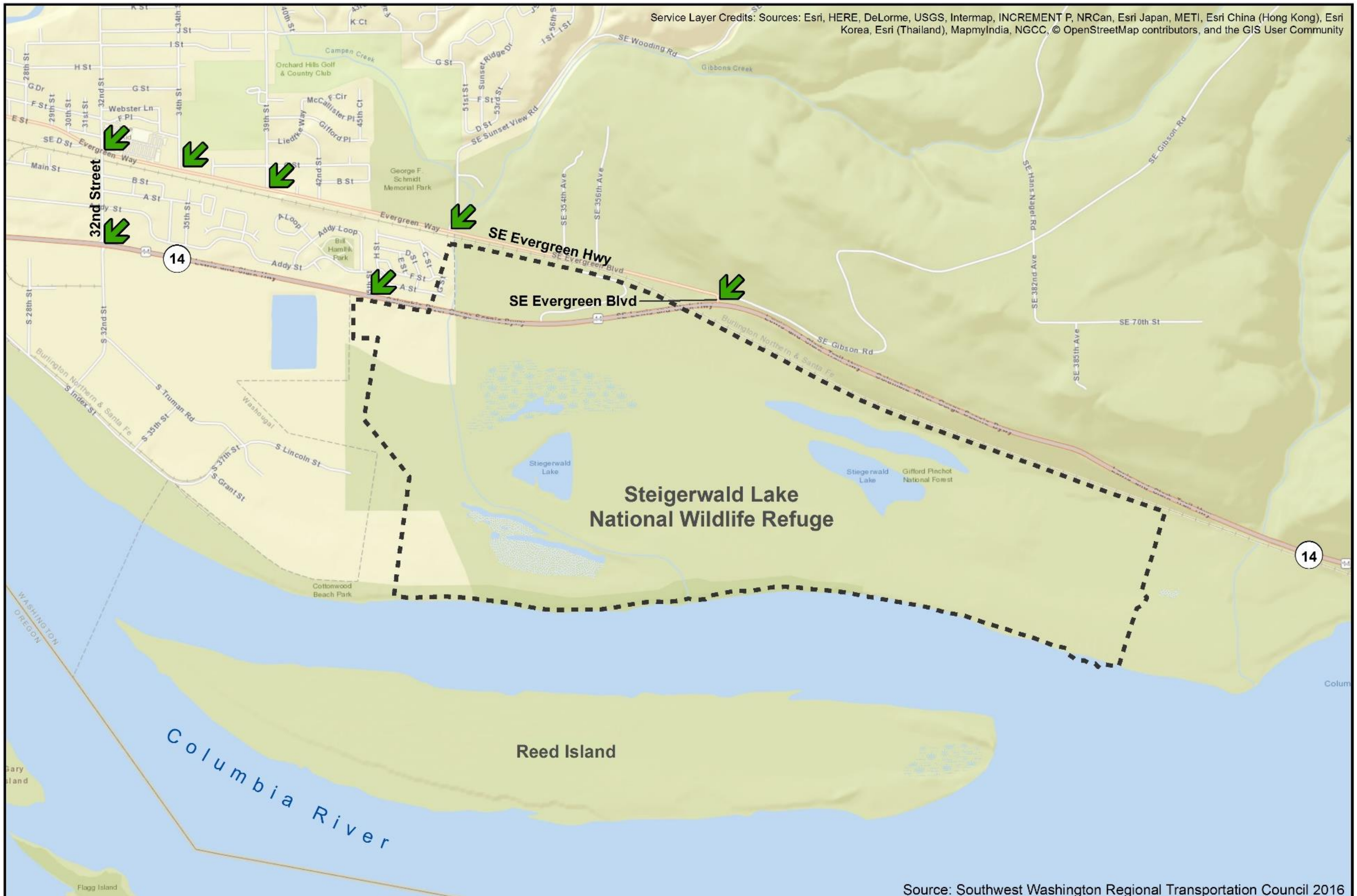

Legend
Traffic Count Locations
Project Area
State Route

0 2,000
1 in = 2,000 feet

Figure 3-8
Transportation Network in the Project Area
Steigerwald Floodplain Restoration
Clark County, WA

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Table 3-11: Average Daily Traffic Count Data

Intersection	North Leg	South Leg	East Leg	West Leg
SR14 / 32nd Street	921	NA	4063	0
SE Evergreen Way / 32nd Street	8,314	12,145	10,530	9,408
SE Evergreen Way / 34th Street	0	NA	0	8,229
SE Evergreen Way / 39th Street	5,255	NA	0	8,707
SE Evergreen Way / SE Sunset View Rd	2,648	NA	0	4,386
SR14 / 45th Street	1,815	NA	4,727	6,332
SR14 / SE Evergreen Boulevard	9,827	1,256	6,230	16,800

Source: Southwest Washington Regional Transportation Council 2016
Notes: Data are from the most recent year available and are reported as the total number of vehicles over a 24-hour period in both directions.
NA = Not applicable; Rd = Road; SE = Southeast

In addition to the aforementioned roadways, railroad, and bridges, infrastructure in the project area includes the WCRL, the Gibbons Creek diversion structure, the elevated Gibbons Creek channel and dike, a culvert and fish ladder, signage, restroom facilities, gates, and pedestrian bridges and walkways. The Washougal Wastewater Treatment Plant is located adjacent to the Refuge but is outside of the project area. Additional infrastructure including shipping, storage, and light manufacturing facilities are located at the Port, southwest of the project area. A corral and barn located at the southwest end of the Refuge, adjacent to the WCRL, are used by ranchers who graze their cattle on Refuge lands on a seasonal basis.

Future planned infrastructure includes development of a well field for drinking water on lands owned by the cities of Camas and Washougal. These lands would be bisected by the proposed west setback levee. Six wellheads would be installed east of the west setback levee, and 4 would be installed west of the levee.

The portion of the Refuge where the primary restoration actions would occur is not served by public utilities such as natural gas or sanitary sewer. Telecom and power are delivered to the existing parking lot from west of the project area, and water for irrigation is provided from a well east of the existing access road. There are no major overhead utilities such as transmission lines in the project area. Utilities are located in or near the 140-ft. right-of-way for SR14 as follows (KPFF 2016):

- Underground Cable - There is a buried cable line approximately 25 ft. south of and parallel to the SR14 right of way line. Markers and/or pedestals were found at approximately the same offset from the new driveway location (south of 45th Street) to the existing parking lot driveway. Pedestals were found at Gibbons Creek and at the existing access.
- Light Pole and Conduit - There is a light pole located just east of the proposed parking lot driveway on the south side of SR14 and another approximately 350 ft. to the west of the proposed parking lot driveway. There is likely an underground conduit between the poles.
- Storm Manhole and Storm Line - A storm manhole is located just south of SR14 and just east of the proposed parking lot driveway. There is a marked storm line entering the manhole from the center of 45th Street.

3.12.2 Environmental Consequences – Proposed Action

Construction and operation of the Proposed Action could result in impacts to transportation and infrastructure. Construction activities would include work in roads and rights of way on SR14 near Gibbons Creek and redesign of transportation features and infrastructure within the Refuge, including the parking area and maintenance vehicle access roads. Once construction was complete, impacts would be realized from transportation and infrastructure improvements. Impacts could include:

- Full or partial closures of roads and parking areas
- Traffic detours
- Increased travel times
- Increased traffic on local roads in Washougal and Clark Counties
- Increased construction traffic
- Erosion of infrastructure
- Reduced potential for flooding on SR14

3.12.2.1 Construction Impacts

Project construction would have temporary moderate impacts resulting from partial and full closures of SR14.

Partial closure of SR14 would be necessary for up to four months during the first construction season during construction of the closure structure immediately west of the SR14/Gibbons Creek Bridge. A three-stage construction staging plan is proposed for construction of the closure structure across SR14. The staged construction is intended to keep one lane of traffic open in each direction at all times, while construction of the closure occurs in the other lane. WSDOT must concur that either 1-ft. wide shoulders or 10-ft. wide travel lanes would be acceptable during temporary traffic control since these widths are below their standards. If not acceptable to WSDOT, either a full closure of SR14 with detour or continuous flagging would be required during construction. If a full closure were needed, SR14 traffic would be rerouted along the proposed detour route as shown in Figure 3-9. The detour would use local roads in Washougal and Clark County. Traffic would travel approximately 0.3 mile on 32nd Street, 1.9 miles on Evergreen Way and less than 0.1 mile on SE Evergreen Boulevard. Traffic controls such as signs, barriers, and, if necessary, flagging, would be used to route traffic through the affected area. The detour route would pass residences, businesses, and the Jemtegaard Middle School. Drivers on the affected roads would experience increased travel time and delays, especially during peak travel times.

BPA would coordinate with WSDOT, the City of Washougal, and Clark County to obtain an agreement for the use of the detour route. BPA would prepare a traffic control plan to describe the use and implementation of traffic control measures. Mitigation measures described in Section 2.4.1 would be implemented to reduce the impacts of a partial or full closure of SR14 to moderate.

Legend

State Route
Proposed Detour Route
Proposed Closure Structure
Project Area

BONNEVILLE POWER ADMINISTRATION

0 2,000
1 in = 2,000 feet

Figure 3-9
Proposed Detour Route
Steigerwald Floodplain Restoration
Clark County, WA

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Partial closure of SR14 would also be required to allow a 1,200-ft. stretch of SR14 to be raised to a centerline elevation of approximately 38.5 ft. NAVD88 (see section 2.1.2.5.3.2 for details). Construction associated with the roadway raise would occur one lane at a time. The existing roadway is 4-5 lanes wide through this stretch due to the presence of slow-down lanes. Traffic would be shifted into these additional lanes during this construction phase in order to preserve one lane of travel in each direction for the 2- to 3-month construction period during the first construction season. Traffic control measures would include a speed reduction to 20 miles per hour, jersey and continuation barriers, and flaggers for construction vehicles and trucks entering or leaving the construction site. Drivers on SR14 would experience increased travel time and delays, especially during peak travel times. It is possible that the full roadway would need to be closed for short periods of time. To the extent feasible, these closures would be timed to occur during off-hours and would be limited to half-day periods. In general, it is expected that such closures would occur for no more than 2-3 days at a time and would occur no more than 5 times during the construction period. During such closures, traffic would be re-routed along the detour route planned for use with the proposed SR14 closure structure. Neither partial nor full closure is anticipated for the second primary construction season or third minor construction season. The overall impact to transportation and infrastructure associated with raising SR14 would be moderate.

Traffic impacts during construction could result from increased numbers of construction vehicles on SR14. Based on the construction plans, construction activities would add a maximum of 20 round trip truck trips per day and 30 round trip worker vehicle trips per day for the duration of the work period. This would be a less than 1 percent increase in daily traffic, so impacts would be low.

Trucks and construction equipment would need to enter and exit SR14 at the construction area and move between the work areas south and north of SR14. Trucks would move slowly relative to other traffic on SR14, which has a speed limit of 55 miles per hour in the project area. The volume of such truck and equipment movements would be relatively low and signage and flaggers would be used to minimize impacts of these movements. Impacts would be low.

The parking area and associated infrastructure (restroom, bike parking, and trailhead) would be relocated and would be closed during its relocation. However, public access to the Refuge would generally not be permitted during construction to ensure public safety, so the temporary parking closure would have a low impact.

3.12.2.2 Operational Impacts

Operation of the project could result in rare impacts to travel on SR14 if temporary flood barriers were installed at Gibbons Creek. During rare flooding events (i.e. 500-year events), the barriers would be installed and traffic would be rerouted along the proposed detour route shown in Figure 3-9. Traffic controls such as signage, barriers, and, if necessary, flagging, would be used to route traffic through the affected area. Drivers on the affected roads would experience increased travel time and delays, especially during peak travel times. Because this impact is considered unlikely to happen under most circumstances, it is low.

Because SR14 would be raised to the 500-year flood elevation, it would not flood under most circumstances and travel on SR14 would not be affected. However, a section of SR14 between

Gibbons Creek and the BNSF railway would become more exposed to water level and wind-wave action. Although overtopping of SR14 would not be a concern as it would be raised, the lowest section of the roadway is at approximately 35 ft. NAVD88, and relatively frequent erosion would be possible. This impact would be mitigated to low by installing gradual slopes on the roadway base, and because flooding at this elevation is relatively infrequent. A vegetated levee overbuild would be installed at the base of the west setback levee, which would be vulnerable to wind-wave erosion (LCEP 2017). This impact would be low.

The City of Washougal's WWTP is currently located within the FEMA-mapped Special Flood Hazard Area, as is the Port's industrial park property. The proposed changes to the WCRL would result in protection of the WWTP and the Port's industrial park, and both areas would be removed from the Special Flood Hazard Area following revision of FEMA flood mapping.

Transportation and infrastructure elements at the Refuge would be reconfigured or relocated during construction. Elements that would be relocated include the parking area and associated infrastructure, visitor facilities, gates, decorative boulders, restrooms, interpretive signage, and kiosks. The new parking area would have 30 parking spaces, which is an increase of 10 spaces over the existing parking area, and would maintain parking for one RV or bus. Maintenance vehicle access roads, trails, and pedestrian bridges would be reconfigured. Some maintenance vehicle access roads would be decommissioned at the end of construction. Seasonal inundation of portions of the pedestrian trail and new access road would be expected, but the impact would be low. Transportation and infrastructure design features would be expected to provide similar site access and visitor experience following restoration actions, so impacts would be minor. Operation of the project would result in increased parking at the Refuge, allowing the parking area to accommodate more visitors. Overall impacts resulting from these changes would be low.

The drinking water well fields proposed by the cities of Camas and Washougal are assumed to remain feasible. Agreements regarding land use of this area are being coordinated among the Port, BPA, USFWS, and the cities of Camas and Washougal. If the project proponents decide to implement this project, they will create design plans and separate environmental documentation.

3.12.3 Environmental Consequences – No Action

Under the no action alternative, no construction would occur. Transportation conditions and infrastructure would be unchanged, so there would be no impacts.

3.12.4 Cumulative Impacts

Cumulative impacts of past, present, and reasonably foreseeable actions may include temporary traffic detours, increased travel times during construction projects, and increased traffic as population in the region increases. These impacts may be offset by transportation and infrastructure improvement projects implemented on area roadways, rail lines, bridges, pipelines, and utilities. The Proposed Action would make a minor contribution to cumulative impacts on transportation and infrastructure during construction, but the impact would be low. As no other large construction projects are foreseen during the construction period for the Proposed Action, it would be unlikely that construction of the Proposed Action would coincide with another project in time and physical proximity such that substantial cumulative impacts would occur. Likewise, construction activities within the Refuge would be physically separate from other areas such that cumulative impacts would be low.

3.13 Vegetation and Wetlands

Vegetation in the study area includes a variety of wetland, riparian, and upland plant communities. Populations of two plant species listed as threatened or endangered under the ESA have been planted by USFWS staff. Non-native invasive plant species have become established throughout much of the study area.

3.13.1 Affected Environment

3.13.1.1 Wetlands

Wetland and riparian communities along the Columbia River have been changing since the beginning of large-scale alteration of the river for navigation, hydropower, agricultural development, and urbanization. Between 1956 and 1993, it is estimated that diking and drainage efforts within the study area reduced the amount of emergent wetlands by 112 acres, riparian forest by 82 acres, and scrub-shrub wetlands by 60 acres (USFWS 2005). Water control structures such as dikes, levees, and tide gates prevent natural water circulation in the study area and reduce the availability of and access to wetlands and seasonal floodplains for fish and wildlife. Hydropower dams on the Columbia River have changed the timing, duration, magnitude, and frequency of seasonal flows, thereby altering the natural processes of sedimentation, accretion, and erosion necessary to maintain wetlands and floodplain habitat (BPA 2016a).

A wetland delineation was recently conducted on the Refuge, and a total of 617.1 acres of wetlands were found in 10 distinct wetland areas within the study area (Figure 3-10, Table 3-12, LCEP 2016). Total acreage includes a 4-acre wetland mapped by the National Wetland Inventory, which was not investigated in the field. The overall area of wetland investigation was larger than the proposed project footprint. Plant communities associated with wetlands are detailed below.

Table 3-12: Wetlands within the study area (LCEP 2016)

Wetland Name	Area (acres)	HGM	Cowardin Class	Wetland Rating
Straub Lake 1.0	219.2	Depressional	PEM	II
Steigerwald Lake 2.0	103.1	Depressional	PEM	I
Steigerwald Lake 2.1	24.3	Slope	PEM	II
Steigerwald Lake 3.0	112.7	Depressional	PEM	II
Steigerwald Lake 4.0	76.4	Depressional	PEM	II
Scaup Pond 5.0	19.3	Depressional	PEM	III
Wetlands 6.0 and 7.0	3.1	Slope	PEM	III
Redtail Lake	44.0	N/A	PEM	II
Wetland 9.0	6.7	Depressional	PEM	III
Wetland 10.0	4.3	Depressional	PEM	III
Total Acreage	617.1			

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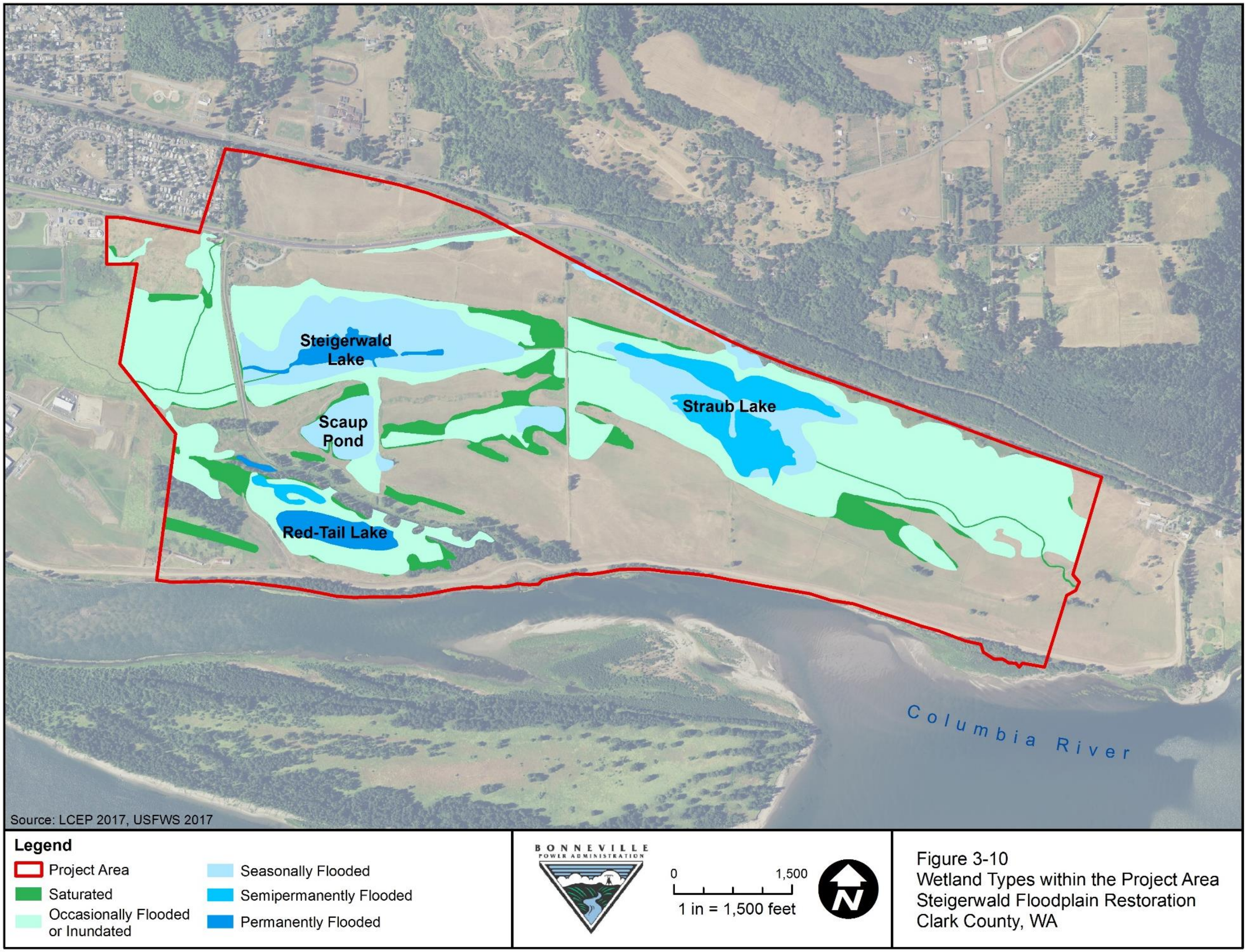

Figure 3-10
Wetland Types within the Project Area
Steigerwald Floodplain Restoration
Clark County, WA

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3.13.1.1.1 Straub Lake

Straub Lake is a depressional, emergent, palustrine wetland. The USFWS manages the water level of Straub Lake for waterfowl habitat using flashboards mounted to culverts that pass water through the internal dikes. The dominant species within and surrounding this wetland is the non-native and invasive reed canarygrass (*Phalaris arundinacea*). Native species around the lake included soft rush (*Juncus effusus*), swamp smartweed (*Persicaria hydropiperoides*), fox sedge (*Carex vulpinoidea*), and narrow-leaf bur-reed (*Sparganium angustifolium*). Other non-native species along the wetland boundary included birds-foot trefoil (*Lotus corniculatus*), Canada thistle (*Cirsium arvense*), field horsetail (*Equisetum arvense*), common velvet grass (*Holcus lanatus*), false ryegrass (*Schedonorus arundinaceus*), and Himalayan blackberry (*Rubus armeniacus*).

3.13.1.1.2 Steigerwald Lake

Steigerwald Lake is comprised of a series of depressional, emergent, palustrine wetlands (Wetlands 2.0, 2.1, 3.0, and 4.0) which are also overwhelmingly dominated by reed canarygrass, with pockets of English plantain (*Plantago lanceolata*), black cottonwood (*Populus trichocarpa*), soft rush, birds-foot trefoil, field horsetail, blackberry, false ryegrass, and swamp smartweed.

3.13.1.1.3 Scaup Pond

Scaup Pond is a depressional, emergent, palustrine wetland dominated by soft rush and reed canarygrass, with substantial areas of native wapato (*Sagittaria latifolia*) in the deeper water areas and scattered stands of broad-leaf cattail (*Typha latifolia*).

3.13.1.1.4 Redtail Lake

Redtail Lake is an emergent, palustrine wetland dominated by reed canarygrass with smaller areas of stinging nettle (*Urtica dioica*) and swamp smartweed.

3.13.1.1.5 Other Wetlands on Site

Two small slope, emergent, palustrine wetlands (Wetlands 6.0 and 7.0) were located south of Scaup Pond. The dominant species was reed canarygrass, along with false ryegrass, and there were smaller areas of bearded wild rye (*Elymus caninus*) and Douglas spirea (*Spiraea douglasii*).

Wetlands 9.0 and 10.0 are small depressional, emergent, palustrine wetlands dominated by reed canarygrass, with lesser amounts of false ryegrass and a small stand of black cottonwood.

3.13.1.2 Vegetation

3.13.1.2.1 Gibbons Creek Vegetation Communities

Gibbons Creek has both stream and wetland characteristics, with areas where flows are imperceptible during portions of the year. Much of the Gibbons Creek alignment is dominated by reed canarygrass. Smaller areas of western touch-me-not (*Impatiens noli-tangere*) were also present. Recent plantings of native woody species including willows *(Salix* sp.) and black cottonwood *(Populus trichocarpa)* have been completed along lower Gibbons Creek.

3.13.1.2.2 Riparian Vegetation Communities

Riparian vegetation communities include those that occur along the Columbia River and form the boundary between wetlands and uplands. Riparian communities include mature cottonwood-ash gallery forests and scrub-shrub dominant communities. The total estimated acres of cottonwood-ash forest at the Refuge is 47 acres (USFWS 2005). Scrub-shrub vegetation communities comprise an estimated 30 acres (USFWS 2005). Figure 3-11 shows vegetation communities mapped as part of USFWS's CCP (USFWS 2005).

The forested cottonwood-ash riparian areas occur along the shoreline of the Columbia River and in areas around Redtail Lake. Mature black cottonwood trees dominate the tree canopy, while blackberry, Scouler's willow, and Pacific willow *(Salix scouleriana* and *S. lasiandra)* are dominant in the mid-story (USFWS 2005, LCEP 2016). Reed canarygrass, thistle and common teasel *(Dipsacus fullonum)* are present in the herb layer. Oregon ash (*Fraxinus latifolia*) is also characteristic of the riparian communities in the area and occurs in both the shrub and canopy layer. These riparian forests are small, fragmented, and interspersed with non-native species (USFWS 2005).

Scrub-shrub riparian communities include woody vegetation less than 20 ft. tall, including true shrubs and young trees. Plant species present typically include red alder (*Alnus rubra*), snowberry (*Symphoricarpos albus*), red-osier dogwood (*Cornus sericea*), willows, blackberry, and nettles (USFWS 2005).

3.13.1.2.3 Upland Vegetation Communities

Two primary upland vegetation communities are present within the Refuge, including a very rare Oregon white oak community, as well as the grasslands maintained for the Grazing and Haying Cooperative Land Management Program (shown as "managed fields" in Figure 3-11). Approximately 50 acres of the managed fields are grazed by cattle between May and October, a practice that would continue during project operations. The grazing area is fenced from the rest of the Refuge.

The Oregon white oak community is comprised of Oregon white oak (*Quercus garryana*), oval-leaf viburnum (*Viburnum ellipticum*), and poison oak (*Toxicodendron diversilobum*) (Chappell 2006). In 2003, the Washington State Department of Natural Resources (WDNR) adopted the 976-acre Washougal Oaks Natural Resource Conservation Area and Natural Area Preserve, located north of the eastern end of the Refuge. Within this preserve is the largest Oregon white oak community in western Washington and one of fewer than 20 total occurrences in the world (USFWS 2005). A very small piece of this community occurs within the project area where it extends south of the railroad track (Figure 3-11). This assemblage is recognized as a globally critically imperiled community because of the small number of occurrences, small global range, and high threats. Other shrub species that may occur within the white oak assemblage include snowberry, oceanspray (*Holodiscus discolor*), serviceberry (*Amelanchier alnifolia*), Indian plum (*Oemleria cerasiformis*), tall Oregon grape (*Mahonia aquifolium*), trailing blackberry (*Rubus ursinus*), and baldhip rose (*Rose gymnocarpa*) (Chappell 2006). Douglas fir (*Pseudotsuga menziesii*) may also occur in the canopy (Chappell 2006).

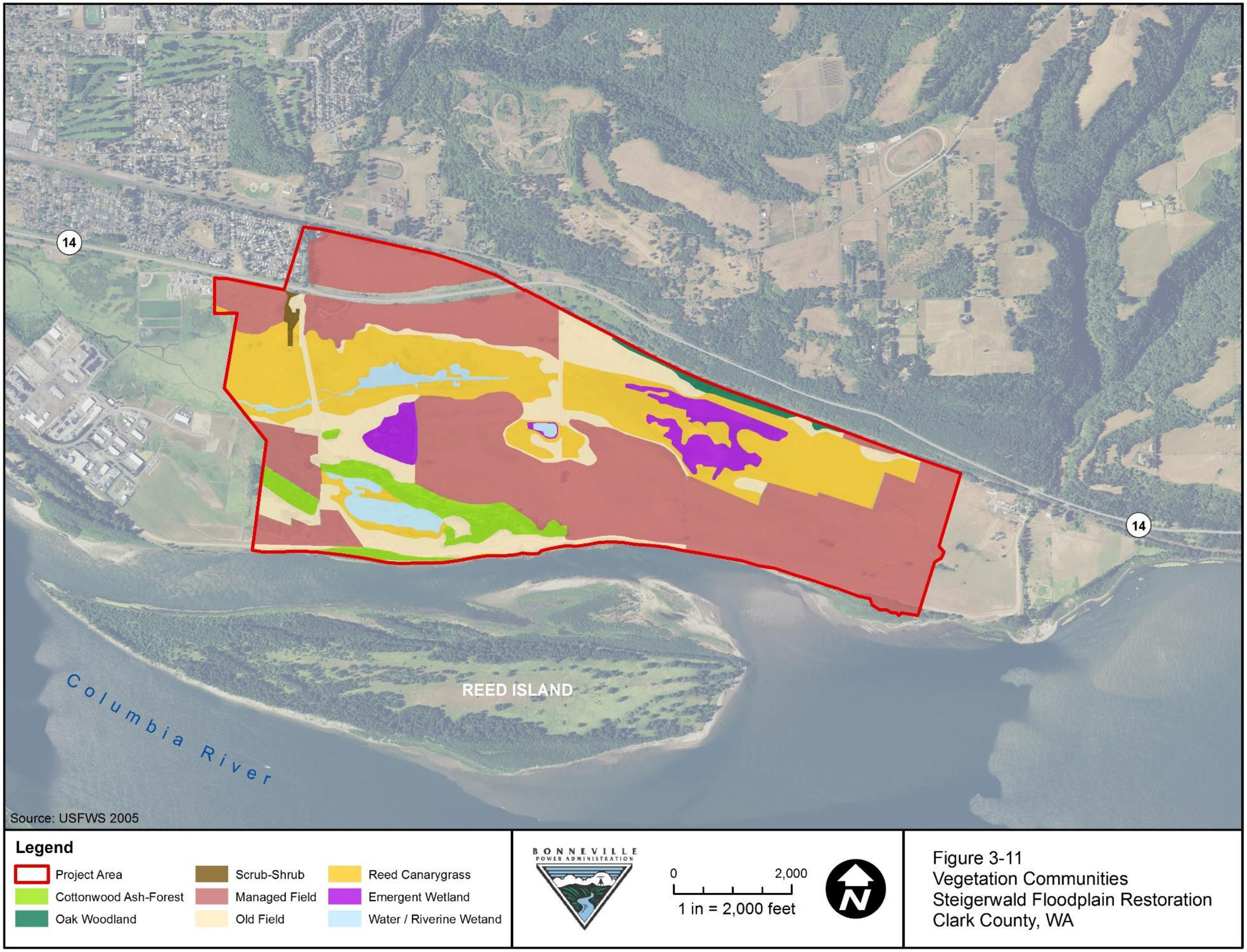

Figure 3-11
Vegetation Communities
Steigerwald Floodplain Restoration
Clark County, WA

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Under a Compatibility Determination included in the CCP (USFWS 2005), a portion of the Refuge is maintained in short (3 to 6 inches tall), perennial grass through mowing, grazing, and haying. The purpose of this land use agreement is to provide food in the form of short grasses for wintering western Canada geese and cackling Canada geese, a population that averages 2,000 birds each winter (USFWS 2005). Ongoing bird surveys determine the number of birds visiting each winter and the areas that are used. To provide habitat for nesting birds and other wildlife, fields that appear to have minimum foraging use have been taken out of short grass management efforts and left undisturbed. The Refuge currently has 293 acres of managed fields and 215 acres of unmanaged fields ("Old Fields") (Figure 3-11) (USFWS 2005).

The managed fields are maintained through mowing and host a mix of pasture grasses and invasive herbs such as rough bentgrass *(Agrostis scabra)*, red fescue *(Festuca rubra)*, reed canarygrass, velvet grass, and various bulrushes (*Juncus* sp.). Areas that are unmaintained appear to be overwhelmingly dominated by reed canarygrass. During the wetland delineation, upland plots were assessed for vegetation characteristics and confirmed typical species composition (LCEP 2016). Reed canarygrass remained the dominant plant species and other herbs and pasture grasses present included Canada thistle (*Cirsium arvense*) nightshade (*Solanum dulcamara*), bentgrass (*Agrostis* sp.) tall fescue (*Schedonorus arundinaceus*), sweet vernal grass (*Anthoxanthum odoratum*), English plantain, and blackberry.

3.13.1.2.4 Special Status Plant Species

Three ESA-listed plant species may occur in the project area, including Bradshaw's lomatium (*Lomatium bradshawii*), golden paintbrush (*Castilleja levisecta*), and Nelson's checkermallow (*Sidalcea nelsoniana*) (USFWS 2016a). The project area is within the historic range of golden paintbrush and Nelson's checkermallow. Two plant populations have been established in the Refuge area, including golden paintbrush and Nelson's checkermallow.

Bradshaw's lomatium is a perennial herb listed as endangered on September 30, 1988 (53 FR 38448). There is no critical habitat designated for this plant. Its range extends from southern Clark County in Washington to Lane County in Oregon. This is a spring blooming plant reproducing exclusively through seeds. Bradshaw's lomatium was formerly common in native prairies of the Willamette Valley and Puget Trough and likely occurred in or near the Steigerwald Lake study area (USFWS 2005). It is not known to occur in the study area (USFWS 2016a).

Golden paintbrush is a perennial herb listed as threatened on June 11, 1997 (62 FR 31740). There is no critical habitat designed for this species. Its range historically included southwest Washington and northwestern Oregon, though most populations are now presumed extirpated from the area. Introduced populations are in Polk and Benton counties in Oregon. This plant does not occur naturally within the study area but USFWS has introduced it into the Refuge.

Nelson's checker-mallow was listed as threatened on February 12, 1993 (58 FR 8235 8243). There is no critical habitat designated for this species. Known populations occur in Clark County, Wash. and several counties in northwestern Oregon. This plant does not occur naturally within the study area but USFWS has introduced it into the Refuge.

3.13.1.2.5 Invasive Vegetation

A 2011 review of the study area notes that invasive plants occurring at the Refuge include reed canarygrass, Himalayan blackberry, and common teasel (Tetra Tech 2011). Each of these species are reported to be present in high densities. Reed canarygrass is dominant and often forms a monoculture. It is extremely difficult to eradicate, particularly given the Refuge’s limited resources. Reed canarygrass and blackberry are the most common invasive species and are most dense along wetland edges and riparian zones. Common teasel is found in unmaintained upland areas. Canada thistle was also found during wetland delineations (LCEP 2016).

A number of additional invasive species that occur throughout the lower Columbia River, and which have the potential to occur in the study area, are listed in the Refuge CCP (USFWS 2005). They include Japanese knotweed (*Reynoutria japonica*), indigo bush (*Amorpha fruticosa*), Scotch broom (*Cytisus scoparius*), purple loosestrife (*Lythrum salicaria*), common reed (*Phragmites australis*), and gorse (*Ulex europaeus*). Other invasive species known to occur in the lower Columbia River region include yellow flag iris *(Iris pseudacorus)*, shiny geranium *(Geranium lucidum)*, false indigo *(Baptisia australis)*, garlic mustard *(Alliaria petiolate)*, and black locust *(Robinia pseudoacacia)*. Invasive aquatic plant species, such as hydrilla (*Hydrilla verticillata*), Brazilian elodea (*Egeria densa*), and Eurasian milfoil (*Myriophyllum spicatum*) also occur throughout the lower Columbia River. Table 3-13 shows the known and potentially occurring non-native invasive plant species in the study area.

Table 3-13: Noxious weeds that are known in the study area or that have the potential to occur (Clark County 2016b)

Noxious Plant Common Name	Noxious Plant Scientific Name	Class	Management
Reed canarygrass	*Phalaris arundinacea*	C	Not Required
Himalayan blackberry	*Rubus armeniacus*	C	Not Required
Common teasel	*Dispacus fullonum*	C	Not Required
Scotch broom	*Cytisus scoparius*	B	Not Required
Japanese knotweed	*Reynoutria japonica*	B	Required in Clark County
Canada thistle	*Cirsium arvense*	C	Required in Clark County
Purple loosestrife	*Lythrum salicaria*	B	Required in Clark County
Indigo bush	*Amorpha fruticosa*	B	Required in Clark County
Hydrilla	*Hydrilla verticillata*	A	Required in Clark County
Brazilian elodea	*Egeria densa*	B	Required in Clark County
Eurasian watermilfoil	*Myriophyllum spicatum*	B	Required in Clark County

The state of Washington recognizes three classes of noxious weeds, each with varying requirements for management (Clark County 2016b). Class A noxious plants are those whose distribution is still limited; preventing new infestations and eradicating existing infestations are the highest priority and management is required for each of these species. Class B noxious plants are limited in portions of the state and are designated for required control in regions only where they are not yet widespread. Class C noxious plants are those that are typically widespread; the decision to require control of these species is delegated to the county. Table 3-13 shows the

Noxious Weed Class for each species known to occur in the study area or which has the potential to occur, along with Clark County's specific determination for management requirements.

Reed canarygrass is managed at the Refuge by mowing, while Himalayan blackberry and common teasel are removed in localized areas through mechanical and chemical means. Additional efforts to control Canada thistle have been undertaken with herbicide treatment (Tetra Tech 2011).

3.13.2 Environmental Consequences – Proposed Action

During construction, vegetation would be cleared to establish staging areas and access roads and to install new project features. During operations, vegetation would be maintained to control invasive plant species and provide wintering habitat for migratory waterfowl. Impacts to vegetation could include:

- Disturbance and/or removal of riparian, wetland, and upland vegetation
- Removal of non-native and/or invasive plant species
- Disturbance and/or removal of agricultural crops used for Canada and cackling geese forage and cover
- Conversion of wetland vegetation communities to floodplain channel
- Conversion of upland habitat to wetland habitat
- Conversion of upland pasture habitat to riparian forest

3.13.2.1 Construction Impacts

During construction, vegetation would be cleared where construction activities are proposed, such as in areas where levee modifications and channel creation would occur and at borrow areas, access roads and staging areas. These actions would result in temporary disruption and loss of wetland and riparian plant communities and could allow for introduction of non-native plant species, which thrive in disturbed areas. When construction was completed, these areas would be restored to native vegetation communities through seeding or by planting with plugs, as described below. Other mitigation measures identified in Section 2.4.1 would ensure that impacts to wetland and riparian plant communities during construction would be low.

Although introduced plant populations are not subject to the same protections as naturally occurring threatened or endangered species, they would be preserved during construction. In the case of Nelson's checker mallow or golden paintbrush, surveys would be conducted prior to construction to ensure that neither species was present in construction areas. If any individuals were identified in the construction footprint or in the area that would be regularly inundated, a qualified biologist would oversee relocating some of the populations of each plant to an alternative and suitable site in numbers sufficient to restore the population at another location.

In some cases, the type of vegetation community could be converted to a different habitat type. In areas where the floodplain channels are proposed, the existing wetlands, dry prairie or agricultural land would become permanently converted to seasonally inundated and partially vegetated channel habitat. This conversion would lead to aquatic plant growth within the channels, and riparian vegetation communities would be planted along the margins of the channels. The overall footprint of the area that would be reconnected to the Columbia River would be 455 acres, and the expanded wetland habitat area would be approximately 115 acres. Throughout these areas, wetland and riparian habitat would be actively restored or would be expected to form over time, and the impact would be moderate.

Where new wetlands are proposed to be excavated, vegetation would be temporarily removed. Though this action could require removing wetland plants, it would largely result in removing non-native reed canarygrass. Once wetland excavation was complete, reseeding and plantings would promote restoration of native wetland vegetation communities.

Revegetation efforts would occur wherever plants have been removed, as quickly as possible after grading and other work has been completed. Immediate reseeding with native species would occur on temporarily disturbed ground, including sites of levee borrow excavation, expanded habitat excavation, road embankments, parking lot relocation, levee excavation and setback, and where disturbances have resulted from hauling.

Reseeding and plantings would promote reestablishing riparian communities along the Columbia River and newly created floodplain channels, including Gibbons Creek. Gibbons Creek north of SR14 would be revegetated with a combination of Oregon ash, black cottonwood, dogwood, stinging nettle, and associated shrubs. Willow scrub communities would be planted along floodplain channels. Wetland plant communities would be reestablished through clearing of reed canarygrass and then native plant seeding. In all restored areas, the increased connectivity to seasonal flood flows resulting in increased inundation and water circulation would be expected to promote native species growth/survival. It would also be expected to result in more diverse, native wetland and riparian vegetation communities.

During construction, Refuge managers would continue to meet the Compatibility Determination requirements. Areas under the cooperative agreement would continue to be controlled for weeds and mowed to provide winter forage for Canada geese. The Refuge currently has 293 acres of managed fields and 215 acres of unmanaged fields ("Old Fields") (Figure 3-11) (USFWS 2005). The objective for grasslands at the Refuge is to maintain at least 168 acres in short perennial grasses.

Construction impacts including disruption of plant communities, direct removal of vegetation, and dewatering would be temporary, and would be low. Impacts would be reduced with implementation of mitigation measures identified in Section 2.4.1 and additional measures described in BPA's HIP III handbook (BPA 2016b).

3.13.2.2 Operational Impacts

Following completion of the Proposed Action, replacement of non-native vegetation with native species would result in an increase in native plant cover and habitat diversity. This would be a moderate impact. Reestablishing a hydrologic connection to the Columbia River would increase the area of functional floodplain wetlands and riparian habitats. The restored connection could increase the potential for establishment of aquatic invasive plant species currently found only within the Columbia River, but this impact is expected to be low. Overall, restoration of a mosaic of floodplain-connected wetland and riparian plant communities would support a greater abundance of fish and wildlife species. There would be an increase in the area and availability of off-channel, shallow water habitat for juvenile salmon and other species. Expansion and diversification of wetland habitats would increase the availability of cover, nesting, and forage for wildlife species. This impact would be moderate. Some riparian vegetation would be lost, including mature cottonwood forest that supports great blue heron rookery. The project would create more riparian areas than it would affect, so losses would be temporary and the overall impact would be low.

A monitoring and maintenance plan would be developed by the Refuge biologist and LCEP to evaluate the success in reestablishing native wetland and riparian plant communities, as well as for controlling invasive species. LCEP would monitor vegetation in Years 1, 3 and 5 after construction, after which monitoring will be the responsibility of USFWS. Continued maintenance targeted towards non-native invasive species would occur through mechanical and chemical control measures. The maintenance would also prevent additional non-native plant species from becoming established, particularly those that could enter the site through the newly connected floodplain channels. Upon completion of the proposed project, it is expected that periodic prolonged flooding (> six weeks in duration) of the historic lakebed will reduce the coverage of reed canarygrass and increase coverage by robust emergent plants like cattail, tule bulrush, water pepper (a smartweed), and wapato.

3.13.3 Environmental Consequences – No Action

Under the no action alternative, no construction impacts would occur. Vegetation communities within the Refuge would remain dominated by non-native species, with continued likely decline in cover and diversity of native plants. Wetland areas would need continual maintenance to control reed canarygrass and other non-native and invasive species. Riparian areas that are low in native tree diversity, age composition and cover might need to be augmented with plantings. Recruitment of riparian species would likely be low due to competition from reed canarygrass. Ongoing maintenance and revegetation projects would be expected to continue for these purposes. These impacts would be moderate.

Refuge staff would continue to manage invasive plant species to the degree possible. However, due to the large area of the Refuge and lack of resources, many invasive plant communities would persist. Maintenance actions would focus on maintaining specific habitat areas related to the Refuge’s primary mission of providing winter foraging habitat for migratory waterfowl. Eradication of invasive plant communities would not likely be possible. If a new species of invasive plant were found within the Refuge, managers would work aggressively to ensure it does not become established. Localized invasive species control projects would be implemented to maintain vegetation communities’ composition and their benefits to native fish and wildlife species. Impacts of these projects would be low.

3.13.4 Cumulative Impacts

Numerous large federal agencies, watershed groups, and local agencies have made wetland restoration in the Columbia River estuary a priority. Recently completed wetland restoration projects in the vicinity include Sandy River Delta, several projects on Sauvie Island, within the lower Willamette River, Steamboat Slough, and Woodward Creek. A large off-channel fish enhancement project at Oaks Bottom in Portland has been fully designed and permitted, and is scheduled to be constructed in summer of 2018. Other projects are planned at Deer Island and Columbia Stock Ranch. The Proposed Action, when combined with those projects, would be expected to incrementally reverse losses of native wetland and riparian vegetation communities in the Columbia River estuary. Restoration measures implemented under this project and other projects either planned or constructed at Sauvie Island, Ridgefield NWR, Columbia Stock Ranch, and the Sandy River Delta would reduce populations of non-native vegetation and increase populations of native wetland, riparian, and upland vegetation communities. The measures would have an overall beneficial impact by increasing native floodplain habitat communities. By definition, the cumulative impact of restoring numerous native habitats and ecological function would ultimately be high and beneficial to listed fish in the Columbia River.

Cumulative impacts could occur if reconnecting numerous diked floodplains to the rivers and streams in the Columbia River estuary reduced the incidence of perennially-flooded floodplain lakes. Many floodplain lakes are incidentally maintained as perennial water bodies by the presence of dikes that contain the interior lakes, a condition that allows a particular plant and animal community to develop there. Plants that are reliant on perennially-inundated or saturated floodplain lakes may include sago pondweed *(Stuckenia pectinata)*, wapato *(Sagittaria latifolia)*, spikerush *(Eleocharis palustris)*, and water smartweed *(Polygonum amphibium)*. These plants and the communities that form around them might not be able to survive seasonal dry periods if water surface levels of contributing water bodies such as the Columbia River were lower than the level needed to maintain inundation or saturation. This impact is considered to be low.

3.14 Water Resources

This section describes water resources and water quality in the project area and nearby areas where the Proposed Action could affect hydrology or water quality. It also discusses the potential impacts the Proposed Action could have on water resources. The area of analysis includes the Proposed Action footprint, the Gibbons Creek watershed, the Columbia River in the vicinity of the project, and the balance of the Refuge outside of the project footprint.

3.14.1 Affected Environment

3.14.1.1 Hydrologic Characteristics

Surface water in the Steigerwald Lake complex typically flows from east to west. Across the project area are three north-south dikes, which each have a culvert that allows water to pass to the west. A tidegate is located west of the project area on Port land. Water from Steigerwald Lake is conveyed to the Columbia River via pumps located in a channel west of the project area. These pumps are operated by the Port. Surface water sources include overflow from Gibbons Creek, a small perennial stream with headwaters north of the project site; direct precipitation; seasonal groundwater; and diverted flow from Lawton Creek, at the east end of the floodplain. Gibbons Creek flow estimates range from a base flow of less than 10 cfs to an estimated flow up to 1,140 cfs under the 100-year discharge (USGS 2015 cited in ESA 2015). Gibbons Creek was diverted from its original course in 1992 and now conveys water over Steigerwald Lake in an elevated and engineered channel. Once water is conveyed over Steigerwald Lake via the elevated channel, it enters a more natural channel, which meanders through a riparian area and then out into the Columbia River via the Steigerwald fish ladder. During moderate and high flow conditions, Gibbons Creek may overflow its banks near the diversion structure found immediately downstream of SR14, flow overland into the floodplain area located west of the elevated canal, then flow west to the Port facilities, where it is pumped into the Columbia River. The remnant Gibbons Creek channel now serves as the receiving waterbody for industrial facilities and stormwater runoff to the west of the project area.

Other important water bodies on the Refuge or which influence hydrologic conditions in the Refuge include the following:

- Lawton Creek, a perennial tributary to the Columbia River, is found east of the levee that encompasses the Refuge, outside of the Refuge. Lawton Creek typically flows south into the Columbia River but part of the flow is diverted by the adjacent landowner into a stock pond that drains into the Steigerwald Lake wetland complex.
- Steigerwald Lake is a complex of interconnected perennial wetlands that collectively cover approximately 312 acres. Sources of hydrology for Steigerwald Lake include precipitation, subsurface drainage from the nearby hillslopes, occasional overflow from Gibbons Creek, and stormwater runoff (LCEP 2016).
- Straub Lake is a depressional, emergent, palustrine wetland that covers approximately 219 acres in the eastern portion of the study area. To foster waterfowl habitat, the USFWS manages the water level of Straub Lake by placing flashboards across the channel from late summer to early spring (LCEP 2016). Hydrologic input to Straub Lake comes from precipitation, seasonal groundwater, and diverted flow from Lawton Creek.
- Scaup Pond is a depressional, emergent, palustrine wetland that covers approximately 19 acres south of Steigerwald Lake (LCEP 2016). A ditch connects Scaup Pond to Gibbons Creek and allows overflow to drain to the creek.

No public drinking water sources or surface water intakes are known to occur within the project area.

3.14.1.2 Floodplains

In 1965-1966, the Corps constructed the 5.5 mile long levee as part of the Washougal FDR Project. This levee disconnected approximately 1,800 acres of floodplain from the Columbia River, and allowed for development of commercial, residential, and industrial facilities within the former floodplain. In 1992, the Corps constructed the Gibbons Creek diversion structure, elevated channel, and fish ladder, which effectively disconnected Gibbons Creek from the site.

Levees that are maintained or certified by the Corps provide flood protection to at least the 100-year flow elevation, with at least 3 ft. of freeboard above that elevation. A 95-percent level of certainty that this flood protection would be provided is necessary to meet standards of FEMA's National Flood Insurance Program. This standard is exceeded by the WCRL. The Washougal levee system was inspected by the Corps in 2010, and found to be intact, functional, and well maintained. No levee safety issues were identified that threaten the levee's ability to function as authorized (Tetra Tech 2010).

Flooding along the lower Columbia River occurs both in the winter and spring. Storm runoff is the primary cause of winter flooding. Spring flooding occurs from snow melt and is often referred to as the "spring freshet". Spring floods are of very long duration, typically 30 to 60 days, with the peak occurring in late May to the first week in July. Spring floods historically had the highest peak flows; however, winter floods now produce higher peak flows because of highly effective reservoir control of spring floods higher in the system. Flows in the Columbia River at the project site are largely driven by discharge from Bonneville Dam. Water surface elevations in the river fluctuate by up to 2 ft. during low water periods at this location in response to tidal influence (Tetra Tech 2010). The floodplain at the Refuge has been cut off from Columbia River flows since the levees were installed in the 1960s.

Prior to flood protection levee installation in the mid-1960s, Steigerwald Lake and the surrounding lands were characterized by extensive floodplain habitat connected by meandering channels. Presently, water from Gibbons Creek only interacts with the surrounding floodplain habitat if it overflows its banks during high flow conditions. The historic floodplain is protected from greater than 500-year (0.2 percent annual exceedance) Columbia River floods by the levees on the south and east sides of the site. The approximate levee elevation of 45.3-ft. NAVD88 is 9.9 ft. higher than the 100-year (1-percent annual exceedance) flood elevation of 35.4-ft. NAVD88 (FEMA 1980, as cited in Tetra Tech 2010). Table 3-14 summarizes WSEs that correspond to various flood flows at this location.

Table 3-14: Water-Surface Elevations (WSEs) Reported in the Flood Insurance Study for the Columbia River 1-Percent Annual Exceedance Probability Flood.

Feature	Data
RM	123.42
Approximate Levee Elevation (ft. NAVD88)	45.3*
50-Percent Annual Exceedance Probability WSE (ft. NAVD88)	23.7*
1-Percent Annual Exceedance Probability WSE (ft. NAVD88)	35.4**
0.2-Percent Annual Exceedance Probability WSE (ft. NAVD88)	38.0*
Freeboard above 1-Percent Annual Exceedance Probability WSE (ft.)	9.9**

* Source: ESA 2015 **Source: FEMA 1980, as cited in Tetra Tech 2010

3.14.1.3 Groundwater

Piezometers have been installed at the proposed locations for the setback levees to gather groundwater level data for ongoing geotechnical investigations in support of the project designs (CCI 2016). Groundwater levels at the west setback levee location were found to be between 4.1 ft. and 9.7 ft. below ground surface. Groundwater levels along the east setback levee location were found to be between 11.6 ft. and 20.0 ft. below ground surface.

There are no sole source aquifers in the project area under the Protection Program authorized by Section 1424(e) of the Safe Drinking Water Act of 1974 (Public Law 93-523, 42 USC 300 et. seq) (Ecology 2016c). There are three well types in the project area: a water well is located south of SR14 and the railroad track, north of Steigerwald Lake; a resource protection well is located on the west side of the project area; and a decommissioned well is located on the east side of the project area (Ecology 2016c). These wells include temporary wells installed by LCEP to monitor surface water conditions.

Groundwater contamination has not been found within the project area, and the site’s historic uses are not of the type that would lead to contamination. As part of an Ecology water quality study of the Gibbons Creek remnant channel located west of the project area, sediment samples were collected from the remnant channel below Steigerwald Lake. Results from the site farthest downstream, approximately 1.5-miles downstream of the project area, indicated elevated metal concentrations, specifically arsenic, chromium, copper, zinc, cadmium, and lead. Surface water samples from the ditch indicated exceedances of state water quality criteria for pH, temperature, FC, turbidity and dissolved oxygen (DO) (Ecology 1996). Although sources of emissions no longer exist, and despite substantial soil excavations in this area, groundwater monitoring from 2005 indicated continued contamination from two facilities. From this site, groundwater travels east toward the project area, and some of it is intercepted by a utility trench where contaminated waters are treated (USFWS 2005). A portion of the water bypasses the trench and moves into the Refuge west of the project area. Contamination was found in one monitoring sample, taken outside of the project area, but within the Refuge (USFWS 2005).

3.14.1.4 Water Quality

3.14.1.4.1 Designated Beneficial Uses

Designated beneficial uses refers to the benefits that may be derived from a water body and provide for the protection of public water supplies, fish, shellfish, wildlife and well as recreational, agricultural, navigation and aesthetic purposes. Table 3-15 identifies the designated beneficial uses of the Columbia River identified by the state of Washington in the vicinity of the project area, specifically from the mouth of the Columbia River to the Washington-Oregon border (Ecology 2012a).

Table 3-15: Columbia River Beneficial Uses

Specific Uses	Miscellaneous Uses
Aquatic Life (Spawning/Rearing)	Wildlife Habitat
Recreation (Primary Contact)	Fish Harvest
Water Supply (Domestic, Industrial, Agricultural, Stock)	Commerce/Navigation
	Boating
	Aesthetics

3.14.1.4.2 Aquatic Life Criteria

The State of Washington developed aquatic life criteria to protect designated beneficial uses. Criteria for temperature, DO, and pH are provided for salmonid rearing and migration for the entire length of the Columbia River stretching from its mouth to Grand Coulee Dam (RM 596.6) (Table 3-16).

Table 3-16: State of Washington Aquatic Life Criteria for Salmonid Rearing and Migration

Parameter	Description	Criteria
Temperature	Measured as the 7-day average of the daily maximum temperatures (7-DADMax)	63.5°F (17.5 degrees Celsius [°C])[1]
DO	Measured as the 1-day minimum DO	6.5 milligrams per liter (mg/L)[2]
pH	Within the range of 6.5 to 8.5	Human caused variation shall be less than 0.5 units, and maintain pH values within the range of 6.5 to 8.5

Notes:
[1]If the natural conditions of a water body cause water temperatures to exceed these criteria, then cumulative human actions may not cause the 7-DADMax to increase more than 0.54°F (0.3°C).
[2]If the natural conditions of a water body cause DO to be lower than a value of 6.5 mg/L for salmonid rearing and migration, then cumulative human actions may not cause the DO to decrease by more than 0.2 mg/L.

3.14.1.4.3 Clean Water Act

Under the CWA, Ecology and Oregon Department of Environmental Quality (ODEQ) are regularly required to assess the quality of the state's waters and report conditions to the EPA. As required in Section 303(d) of the CWA, Ecology and ODEQ identify those waters that do not meet water quality standards. Where data are available, Ecology and ODEQ also identify specific water quality limitations and impairments for the state's waters. From this determination, a 303(d) list is developed and submitted to the EPA for approval. Waterbodies listed as Category 5 impaired on the 303(d) list require that a total maximum daily load (TMDL) be developed, and Category 4A impaired waters have an approved TMDL in place. A TMDL is a numerical value that represents the highest amount of pollutant a designated surface water can receive while meeting state and national water quality standards.

The Columbia River is on Oregon and Washington's 303(d) lists for a number of Category 5 and Category 4A pollutants. In Oregon, the Columbia River in the vicinity of the project area (RM 123.0 to 128.0) is listed for DDE, a breakdown product of DDT, dioxin, PCBs, pH, polynuclear aromatic hydrocarbons (PAHs), temperature, and total dissolved gas (TDG) (ODEQ 2012). In Washington, the Columbia River is also listed as impaired for dioxin, DO, pH, temperature, and TDG (Ecology 2012b, 2015). An EPA-approved TMDL is available for TDG for that reach of the Columbia River from its confluence with the Snake River to the mouth at the Pacific Ocean (ODEQ and Ecology 2002). A TMDL has also been approved for dioxin for the entire length of the Columbia River (EPA 1991).

Gibbons Creek is listed as Category 4A impaired for fecal coliform bacteria where it enters the project area (Ecology 2002). Land uses in the upper watershed of Gibbons Creek, particularly failing septic systems and livestock, have contributed to elevated fecal coliform bacteria counts (Ecology 2005). Concentrations of fecal coliform bacteria found in Gibbons Creek between October 1991 and September 1992 averaged 230 colonies per 100 milliliters (Ehinger 1993). A subsequent study in 1994 and 1995 of Gibbons Creek, tributary Campen Creek, and two other unnamed tributaries found fecal coliform bacteria criteria exceedances and led to the inclusion of Gibbons Creek on the state's 1996 303(d) list. A TMDL for fecal coliform bacteria was issued by Ecology, resulting in pollution control measures and reduction targets that were developed in an effort to improve water quality in Gibbons Creek (Ecology 2002, 2005). Water quality conditions are improving as a result of adaptive management of the contamination (Ecology 2011); however, recent studies (2011-2012) indicate water quality criteria for fecal coliform bacteria were exceeded (not met) at monitoring sites (Ecology 2013).

3.14.1.4.4 Other Water Quality Parameters

Running water temperature varies seasonally and, in smaller systems, on daily time scales. In addition to ambient air conditions, factors such as elevation, streamside vegetation, impoundments, and groundwater inputs can result in temperature variations. Water temperature strongly affects chemical and biological reactions, and most organisms have a very limited range in which they are able to sustain all aspects of their life cycle. Coldwater fish species, such as Coho and Steelhead rely on water temperatures between 41°F (5 degrees Celsius [°C]) and 55.4°F (13°C), with high water temperatures resulting in "severe impairment" to migration, alevin development, fry emergence, metabolism, behavior, and susceptibility to parasites, disease and mortality for salmonid species (PNWSHIWG 1998).

Ecology lists the seven-day average daily maximum water temperature aquatic life criteria as 63.5° F (17.5°C). Year-round water temperature is a concern in the Columbia River for the designated uses of salmon and steelhead migration. Water temperature data taken from the Columbia River at Ridgefield NWR, downstream of the Refuge, between August 2015 and January 2016 exceeded the daily maximum during late summer 2015 (CREST 2016) (Figure 3-12).

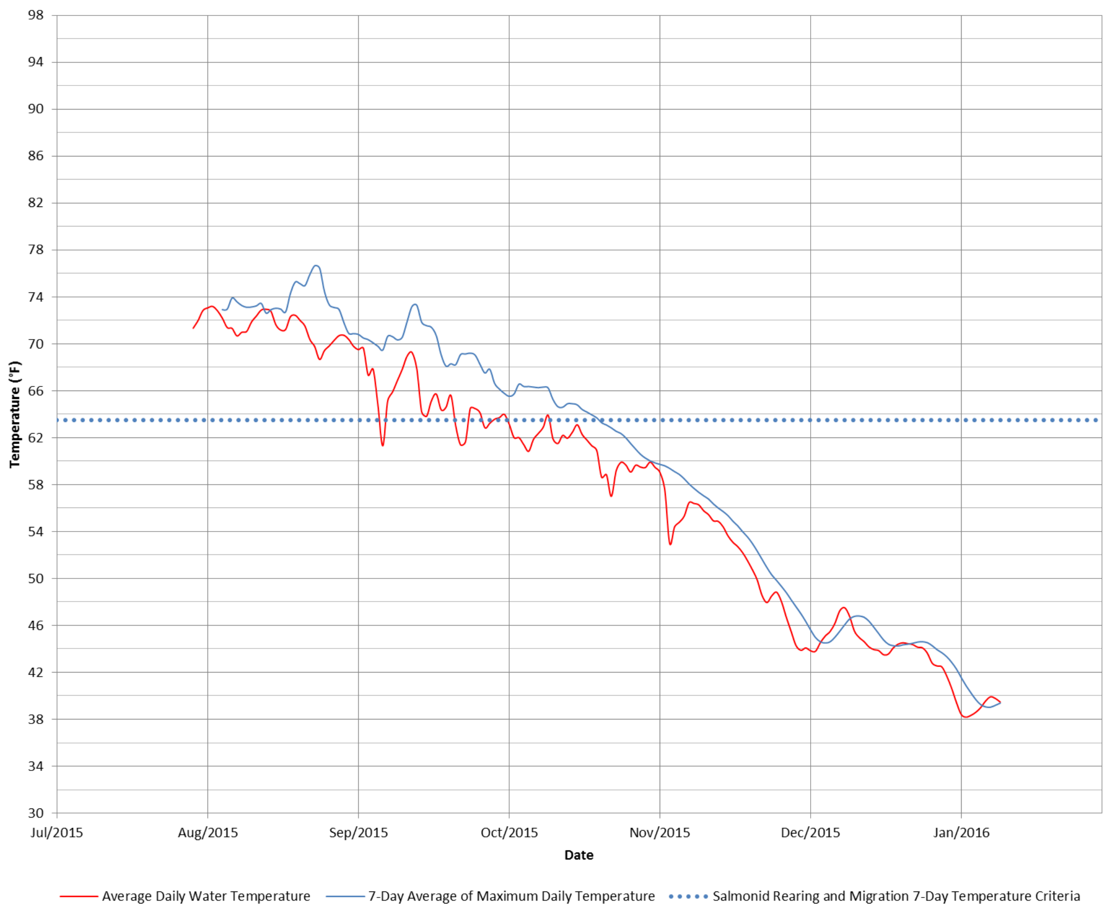

Figure 3-12: Average daily and seven-day average maximum water temperature (°F) in the Columbia River downstream of Steigerwald NWR (CREST 2016).

In general, increased temperature increases the rate of chemical reactions (for example dissolving more minerals). Conversely, warmer water holds less DO than colder water, which is critical to cold-blooded fish and macroinvertebrates. Reduced levels of DO can have deleterious impacts on fish growth and development of many life stages, which ultimately affect fitness and survival. Below 5.0 milligrams per liter (mg/L), most fish species are stressed, (e.g., embryo survival, avoidance) (Carter 2005) with fish kills occurring when concentrations are less than 3.0 mg/L for longer than 3.5 days (EPA 1986).

Gibbons Creek is subject to increased water temperatures due to important temperature problems in lower Campen Creek, a tributary to Gibbons Creek (Brandt et al. 2003). Over time, Campen Creek has undergone reduced shading and reduced summer flows that have contributed to elevated water temperatures (Ecology 2005). Also, ponds in the watershed may be contributing to elevated water temperatures; however, it has not been determined how much, if any, discharge contributes to the creek (Ecology 2005). Similarly, elevated summer water temperature is the main water quality issue for Steigerwald Lake. This is largely due to its shallowness, with depths typically less than 5 ft. Another contributing factor is lack of seasonal water exchange with the Columbia River or other sources (e.g., Gibbons Creek).

A waterbody's pH indicates the hydrogen ion concentration in the water and ranges from 0 to 14 (less than 7 being considered acidic). pH determines the solubility of chemicals and nutrients (e.g., phosphorus, ammonia, nitrogen) in the water. Lower pH values result in increased solubility of pollutants and nutrients. The solubility of these parameters determines their bioavailability for plants and animals. Although pH values in water naturally fluctuate with photosynthesis, values and are also driven by local geology and human activities. In the spring, summer, and fall, pH levels are a concern to the designated uses of residential fish and aquatic life in the Columbia River.

Turbidity is a visual property of water due to suspended solids (clay, silt, sand, and very small organic materials) in the water column. Turbidity results in reduced water clarity. Turbidity is measured in Nephelometric Turbidity Units (NTU). In the Columbia River, turbidity levels commonly follow the hydrograph of the river, increasing during the spring freshets and winter flooding and decreasing during low summer flows. Increased turbidity reduces plant growth and interferes with the ability of fish to catch prey (Bisson and Bilby 1982; Henley et al. 2000). While turbidity levels can exceed 20 NTU during flood events, levels are typically less than 10 NTU in the Columbia River for most of the year (Corps 2011).

As previously mentioned, numerous pollutants are known to occur in the Columbia River in the vicinity of the project area. Specifically, elevated concentrations of DDE, dioxin, PCBs, and PAHs as well as temperature, DO, and pH levels are outside criteria ranges. Toxic substances impact designated beneficial uses, specifically dioxin, DDE, and PCBs impact drinking water, resident fish and aquatic life, and anadromous fish passage. PAHs impact resident fish and drinking water (ODEQ 2010). Elevated fecal coliform bacteria levels, as observed in Gibbons Creek, are detrimental to human health and degrade water quality as cells are broken down and DO is consumed.

3.14.2 Environmental Consequences – Proposed Action

3.14.2.1 Construction Impacts

Potential impacts to water resources resulting from construction activities could include:

- Short-term alterations to hydrology and the floodplain,
- Short-term impacts to turbidity, DO, and pH,
- Accidental spills from construction equipment, and
- Short-term impacts to some designated beneficial uses

Channel excavation and fill, levee setbacks and removal, and habitat expansion in existing wetlands could result in short-term impacts to hydrology and the surrounding floodplain. In particular, 2.2 miles of the WCRL would be fully removed and four floodplain channels would be excavated through the natural fluvial levee and into the interior of the Refuge. The removal of the Gibbons Creek diversion structure and aqueduct would accommodate Gibbons Creek flows into Steigerwald and Straub Lakes year-round. Channels 1 and 4 would require some channel grading to accommodate intended high flow connections.

Stormwater runoff from temporarily disturbed construction and staging areas could contribute sediment laden water to the river and increase turbidity. Most excavation would occur in the dry. In water work on the Columbia River side of the WCRL would be limited to excavation of the mouths of the floodplain channels. These areas would be isolated from the river to the degree possible by sediment curtains, and because of the extensive flow in the river, turbidity levels would be expected to return to background levels within 300 ft. downstream of the excavation areas due to dilution. In water work in the floodplain wetlands would create high rates of turbidity in the immediate work area, but since the work would occur when there was no flow through these wetlands, turbidity would be unlikely to move out of the construction area, and downstream turbidity impacts would not be likely to occur. Furthermore, there are no sensitive fish or wildlife resources found in the floodplain wetlands that would be affected by turbidity. As a result, these impacts would likely be low, and would be reduced further by implementation of mitigation measures identified below.

Construction activities that would result in short-term impacts to hydrology would also be expected to result in short-term impacts to water quality parameters, specifically turbidity, DO, and pH. Channel re-alignment inherently involves disturbing inundated or saturated sediments. Turbidity increases would be expected to be short-term and measures to control erosion and limit the duration of in-water work would keep turbidity to moderate levels. Turbidity-related impacts would be low. Changes to DO and pH would be expected to occur as new areas were inundated and vegetation decomposed. Plant decomposition requires oxygen for microbes and, in turn, respiratory processes result in increased CO_2 in the water which lowers pH. These impacts to DO and pH would be expected to be short-term (within a season) and low and would not result in long-term impacts to water quality. Although decomposition of organic matter could result in the release of nutrients such as phosphorus and nitrogen, concentrations would be diluted by upstream waters and downstream impacts would be low.

During construction, petroleum products and hazardous materials such as fuels, oils, and lubricants would be present onsite, primarily in vehicles and construction equipment. Use of these materials as well as uncured concrete increases the risk of accidental discharge into riparian areas or directly into water bodies, resulting in impaired water quality as well as injury or mortality of aquatic species. Leakage of hydraulic fluids, fuels, and solvents could occur during construction in or near aquatic areas. These impacts would be reduced to low by implementation of a SPCC plan as well as use of standard construction BMPs designed to best contain hazardous materials and reduce the chances of spills or leaks.

Construction activities would be expected to result in short-term impacts to some designated beneficial uses, specifically aquatic life. Aquatic life such as invertebrates would likely be impacted in the short-term; however, no sensitive populations of invertebrate would be likely to be affected, and the impact would be low.

Restored or newly created riparian areas would provide shading of surface water and retention of groundwater, allowing it to be released from soils over a longer period of time. Both of these impacts would benefit water quality.

3.14.2.2 Operational Impacts

Impacts to water resources resulting from operations could include:

- Improved hydrologic connectivity,
- Improved floodplain wetland habitat,
- Improvement to designated beneficial uses, and
- Improved water quality

As previously described, the hydrologic connectivity between features would be increased across the project area to allow for natural water exchange with the Columbia River. Floodplain habitat would be increased by allowing for backwatering (inflow/outflow) of Columbia River water into the floodplain during the spring freshet and winter flow events. Additionally, by diverting flow from Gibbons Creek, there would be improved wetland habitat in Steigerwald and Straub Lakes during dry seasons. These restoration activities would be expected to result in improvement to designated beneficial uses, specifically rearing of aquatic life, wildlife habitat, and aesthetics, and would likely result in greater groundwater recharge and retention than occurs under current conditions. Since the groundwater table is likely already high in this area due to its proximity to the Columbia River, this impact would be low.

Despite evidence of groundwater contamination measured in the remnant Gibbons Creek channel, this site is outside the project area and would not be anticipated to be affected by construction actions. The Columbia River in the vicinity of the project area is included on Oregon and Washington’s 303(d) list for a number of previously described pollutants that could be introduced to the project area through backwatering; however, dilution and flushing from Gibbons Creek would be expected to ameliorate impacts. Conversely, water leaving the project area would not be expected to further impact the previously described parameters for which there are 303(d) listings for the Columbia River, including pH, temperature, and TDG.

In comparison to flowing water in the Columbia River, there would be a potential for a slight increase in water temperature and decrease in DO in shallow wetlands during the summer. However, these changes would be expected to occur outside the timeframe for salmonid rearing. In fact, it is expected that there would be an overall improvement to water quality due to restored riparian areas, improved instream flows, floodplain reconnectivity, the removal of water control structures, and invasive species management. The impact to water quality would be low.

A hydrologic engineering center FDR model (HEC-FDA) was created by the design team for the Columbia River from RM 122.5 to RM 128.3 (ESA 2015). This model indicates that if the WCRL was breached as proposed, there would be no increase in the base flood elevation for the restoration area or the surrounding area (ESA 2015). Under the Proposed Action, up to 570 acres of the floodplain would be inundated during the normal spring freshet. These models also predict that up to 274 acres would be inundated under normal winter flows, and 67 acres under normal summer flows.

The proposed changes to the WCRL and the associated boundaries of the Special Flood Hazard Areas, including the 1-Percent Annual Chance Exceedance (commonly referred to as the 100-year) floodplain area, identified in the current effective FEMA Flood Insurance Rate Map

(FIRM), necessitate compliance with the FEMA Conditional Letter of Map Revision (CLOMR) and Letter of Map Revision (LOMR) process. The FEMA CLOMR and LOMR process requires that hydraulic evaluation of project impacts be performed and post-construction documentation be provided by the applicant. If FEMA approves the LOMR, then flood mapping for the site would be updated to reflect the revisions. The hydraulic analysis performed for the CLOMR submittal indicates that the project would have no effect on the FEMA flood elevations, but would result in an expansion of the floodplain area within the restoration area. The analysis indicates that the changes to the WCRL would continue to provide flood protection to levee protected areas.

Under a 500-year event, the entire floodplain between the east and west setback levees would be inundated, as well as part of the Refuge lands north of SR14. Gibbons Creek would be backwatered to just above SR14, but the proposed Gibbons Creek floodwall and berm would prevent flooding of areas west of Gibbons Creek. This increased flood protection west of Gibbons Creek would constitute a moderate impact. Evergreen Highway is already above the levee’s design elevation of 45 ft. NAVD88 (approximately 7 ft. above the 500-year floodplain elevation) and would not be flooded. The setback levees have been designed with sufficient height and freeboard to contain river stages several feet in excess of the 500-year flood event, meaning floodwaters reaching the Steigerwald floodplain would not reach areas outside of the restoration area. Therefore, impacts from flooding up to the 500-year event (which is approximately 5 ft. above the peak stage of the 1996 flood) would be low.

Because stormwater runoff from Gibbons Creek and SR14 would flow into the restored floodplain and then into the Columbia River, the Proposed Action would affect stormwater management at the Port. Much less pumping would be needed compared to current conditions, lessening the flood risk on Port lands and reducing costs associated with pumping. This impact would be moderate. Additionally, Port and City infrastructure would be removed from the FEMA-mapped interior flood zone. This impact would be moderate, beneficial and long-term. No other stormwater management structures would be affected by the Proposed Action.

Upon completion of the proposed project, USFWS would benefit by no longer needing to dredge sediments from Gibbons Creek at the SR14 Bridge. This would be a moderate impact.

Inputs from Lawton Creek would no longer be diverted into the Refuge, and all flow would go directly into the Columbia River. This would not affect hydrology in the Refuge, as the current amount of diversion is minimal, particularly in comparison to the amount of water that would enter the refuge after the project was completed. Therefore, this impact would be low.

3.14.3 Environmental Consequences – No Action

Under the no action alternative, no construction would occur, and current water quality management practices would remain in effect. Water would continue to collect in the floodplain wetlands and run off to Port properties, where it would be pumped to the Columbia River. This impact would be low. Moderate warming of surface waters likely occurs due to shallow areas and minimal inflow during dry periods, and would likely continue under this alternative. This impact would be low.

Impacts associated with the Gibbons Creek diversion structure would likely worsen over time if USFWS were to lose the ability to dredge at this location, due to possible impacts to fish. In this scenario, sediment would continue to deposit in this location, increasing the incidence of overflow into the floodplain with resulting fish stranding, and increasing the potential for flooding at the SR14 Bridge. This impact would be moderate.

3.14.4 Cumulative Impacts

Previously described past, present, and reasonably foreseeable future actions have resulted in detrimental impacts to water resources along the Columbia River, including 303(d) listings for numerous pollutants. Considerable effort has been invested by the states of Washington and Oregon as well as numerous federal, state, tribal, non-profit, and volunteer organizations to improve water quality in the Columbia River. Results of these efforts indicate improvement in some pollutant concentrations (e.g., fecal coliform bacteria in Gibbons Creek has been reduced [Ecology 2013]).

When combined with the past, present, and reasonably foreseeable actions, the Proposed Action would result in long-term, low, beneficial cumulative impacts on water resources by restoring hydrologic connectivity between the Columbia River and the affected area. Expanded wetland area would improve water quality by ameliorating nutrients and other pollutants. Removal of the water control structure would impact water levels in Steigerwald Lake, and could cause the lake to dry up earlier in the year than it typically has. However, when designers set the invert elevation of channel 3, the goal was to maintain the lowest observed level in Steigerwald Lake, and as a result, the lake level should not change drastically, and this impact would be low. In addition, future colonization of the area by beavers could eventually raise lake levels again. Nonetheless, following completion of the Proposed Action, lake levels would be lower during dry periods than they were previously, potentially reducing habitat for species adapted to longer inundation periods, such as native submergents, aquatic macro invertebrates, diving ducks (particularly early migrants), aquatic mammals such as muskrat and otter; and some species of amphibians. This impact would be low.

3.15 Wildlife

3.15.1 Affected Environment

3.15.1.1 General Wildlife

The project area, which is almost entirely within the Refuge, has been actively managed for wildlife since its establishment in 1987. This management has resulted in a productive and important site for native wildlife species in a region that has been highly altered by humans. The relatively high-quality habitat present is reflected in wildlife abundance, with more than 200 of the 300 bird species seen in Clark County being observed in this relatively small refuge (USFWS 2010). In addition, more than 20 species of mammals, 15 species of reptiles and amphibians, and a wide variety of insects, fish, and plants have all been identified on the refuge (USFWS 2010). Waterfowl have been of primary management focus on the Refuge, especially providing year-round support for breeders, migrant, and wintering species such as cackling goose (*Branta hutchinsii*), a species formally managed under a Pacific Flyway Management Plan (USFWS 2005). The Plan identifies the importance of habitat provided by the Refuge (Pacific Flyway Council 1999). Ongoing management actions at the Refuge include maintaining large expanses of short and/or disturbed grassland by annual mowing and haying from June to July and grazing from May to October (Chmielewski 2016, personal communication). USFWS also manages specifically for purple martin (*Progne subis*), a species identified as a "Conservation Target" of the Refuge (USFWS 2005). Management of this species entails ensuring access to large wetland complexes and appropriate nesting cavities that are typically human-made nesting structures.

Wildlife habitat in the action area is diverse and has generally been shaped by hydrology and disturbance, which work together to determine the distribution of vegetation (see Section 3.13 Vegetation and Wetlands, for a full discussion on the topic). Vegetation, in turn, largely determines wildlife site usage, particularly within this Refuge where human disturbance is low and follows predictable patterns. Seasonal changes drive wildlife habitat usage and result in some habitats hosting higher wildlife densities at certain times of the year. Wildlife are discussed in the context of the habitat they most frequently occupy. Habitats available in the action area are open water, emergent wetland, forested-shrub wetland, cottonwood riparian forest (gallery forest), and maintained grassland. Fish are discussed separately in Section 3.5, Fish.

3.15.1.1.1 Open water habitat

Open water habitat, which includes riverine and ponded sites that are either perennial or seasonal, is very important for a myriad of wildlife species in the Refuge. Waterfowl assemblage changes throughout the year with migratory species visiting the Refuge for wintering, as a stopover during migration, or for breeding. During non-breeding months, open water sites provide important stopover or wintering habitat for various waterfowl including cackling goose, Canada goose (*Branta canadensis*), wood duck (*Aix sponsa*), gadwall (*Anas strepera*), American wigeon (*Anas americana*), mallard (*Anas platyrhynchos*), cinnamon teal (*Anas cyanoptera*), and bufflehead (*Bucephala albeola*). Other wildlife found in ponded sites include western painted turtle (*Chrysemys picta*), American coot (*Fulica americana*), pied-billed grebe (*Podilymbus podiceps*), purple martin, common yellowthroat (*Geothlypis trichas*), various swallow species, and occasionally beaver (*Castor canadensis*) and the invasive nutria (*Myocastor coypus*). Both mammal species are actively managed on the Refuge. Many species frequent open water habitat for foraging but principally reside in neighboring habitats such as wetland and/or riparian zones. Examples include piscivorous species such as belted kingfisher (*Megaceryle alcyon*), bald eagle (*Haliaeetus leucocephalus*), and osprey (*Pandion haliaetus*), as well as the common garter snake (*Thamnophis sirtalis*) and most amphibians.

3.15.1.1.2 Emergent wetland

Emergent wetland, which may or may not fringe open water, provides a moderate quality habitat for wildlife but is somewhat degraded on the Refuge by an extensive infestation of reed canarygrass. The same wildlife species associated with open water habitat are often also found in emergent wetlands. Amphibians and waterfowl use the dense herbaceous vegetation for egg laying, and numerous other species use this habitat for foraging and for cover. Typical species include great blue heron (*Ardea herodias*), dabbling ducks, and Pacific chorus frog (*Pseudacris regilla*).

3.15.1.1.3 Forest-shrub wetland

Forest-shrub wetland is comprised of a mix of woody shrubs and trees associated with an herbaceous understory of hydrophytic species. The woody structure provides important habitat for wildlife associated with shorter trees. Trees in this habitat are typically smaller than those found in riparian gallery forest but the thick woody shrub/tree layer it forms produces important foraging and nesting habitat and cover for birds and small mammals. Many bird species spend the majority of their time in the understory of this habitat, including bushtit (*Psaltriparus minimus*), dark-eyed junco (*Junco hyemalis*), lesser goldfinch (*Spinus psaltria*), black-capped chickadee (*Poecile atricapillus*), spotted towhee (*Pipilo maculatus*), song sparrow (*Melospiza melodia*), western scrub jay (*Aphelocoma californica*), and golden crowned kinglet (*Regulus calendula*).

3.15.1.1.4 Cottonwood riparian (gallery) forest

Cottonwood riparian (gallery) forest forms long, mostly contiguous patches of large mature trees (greater than 30 years-old) that create a mostly intact canopy. This habitat provides a corridor for wildlife to move along riparian system and into adjoining habitats. The mature cottonwoods that dominate this habitat vary in physical condition and compose a mix of standing mature trees, dead or dying individuals (i.e., snags), those with detached crowns and/or limbs, and large downed woody debris. Each provides important structural features for this relatively high-quality habitat. Standing mature trees provide habitat for large tree-nesting birds such as great blue heron, red-tailed hawk (*Buteo jamaicensis*), pileated woodpecker (*Hylatomus pileatus*), and forest hawks (*Accipiter* sp.).

A moderately sized, active great blue heron rookery (approximately 30 nests) is present in the southwestern corner of the study area. This rookery site was likely established because of its large trees, good access to foraging areas, and relatively low disturbance from humans or other predators (summarized in Vennesland and Butler 2011).

Dead or dying trees, including snags and those with detached crowns and/or limbs, are used by cavity-nesting birds such as woodpeckers (Picadae), swifts (Apodidae), swallows (Hirundinidae), wood duck (*Aix sponsa*), and great-horned owl (*Bubo virginianus*), as well as several bat species (Chiroptera), raccoons (*Procyon lotor*), and opossum (*Didelphis virginianus*). All seek cover in the structure it provides. Large downed woody debris provides a diversity of microhabitats used by small terrestrial wildlife throughout the year. Amphibians such as salamanders, garter snakes, small mammals, and bird species that frequent subcanopy areas can all be found in this habitat. These species, in turn, provide a prey-base for most predators in the study area. Coyote (*Canis latrans*), accipiters, raccoon, and Virginia opossum would all forage extensively in and around this habitat type.

3.15.1.1.5 Maintained grassland

Maintained grassland is a managed landscape that is mowed, hayed, and/or grazed as part of the land management of the Refuge for waterfowl intended to support cackling geese and other wintering species. Grassland nesting birds and open-land mammals are the most common species in this habitat type. Grassland birds include western meadowlark (*Sturnella neglecta*), savannah sparrow (*Passerculus sandwichensis*), and American goldfinch (*Spinus tristis*). A prominent mammal of this habitat is the Columbian black-tailed deer (*Odocoileus hemionus columbianus*). Fossorial mammals would also be typical, including; voles, gophers, moles, and mice. Predators of these species would also be common, such as northern harrier (*Circus cyaneus*), barn owl (*Tyto alba*), American kestrel (*Falco sparverius*), long-tailed weasel (*Mustela frenata*), red fox (*Vulpes vulpes*), and coyote. As with other habitats, use varies with season, and maintained grassland is key to sustaining migratory birds, primarily waterfowl, as they fly north to their breeding grounds, or south to their wintering grounds.

3.15.1.2 ESA/State-Listed Wildlife

Information on special status wildlife species was accessed from the USFWS ESA Program (USFWS 2016b), and the WDFW Priority Habitat and Species Program (WDFW 2008). The National Oceanic and Atmospheric Administration (NOAA) was also consulted but no ESA-listed marine mammals have the potential to occur in the study area (NMFS 2016). Lists of protected species identified by both programs were acquired during consultation and collectively indicated that four protected wildlife species may occur in the action area (Table 3-17). One species is listed under the ESA as endangered, while the other three are listed as threatened (USFWS 2016b). Three of these species are unlikely to occur in the action area, primarily due to their extirpation from the region but also because of only limited supporting habitat features present. The only listed species that is likely to occur in the action area is the streaked horned lark (*Eremophila alpestris strigata*), which is a federally threatened species with designated critical habitat. This species and its potential for occurrence is discussed in detail below.

The streaked horned lark was listed under the ESA as threatened in November 2013 (78 FR 61451), and critical habitat was designated in October 2013 (78 FR 61505). Suitable habitat for the streaked horned lark exists within the study area but is generally limited, and there are no reported occurrences of this species on the Refuge. In the lower Columbia River region, this sub-species of the horned lark occurs sporadically throughout open farm fields, lowlands, sand islands, and shorelines of the Columbia River and the lower reaches of the main tributaries (Stinson 2005). This resident species inhabits large tracts of open, sparsely vegetated fields, and areas of exposed sand and dirt, next to large bodies of water (Stinson 2005). The large areas of maintained grassland may provide nesting habitat but vegetation in these areas is generally denser than is preferred by this species. Grasslands are mowed and hayed during the nesting season, further precluding this species' occupation. Many birders informally survey the Refuge, and although their observations are only anecdotal, this species has not been observed (Chmielewski 2016, personal communication).

Table 3-17: Federal ESA listed wildlife species possibly occurring in the project area

Common Name	Scientific Name	ESA Status/1	Critical Habitat[1]	State Status[2]	Likelihood of Occurrence
Northern Spotted Owl	Strix occidentalis caurina	Threatened	Designated	Endangered	Not Likely
Streaked Horned Lark	Eremophila alpestris strigata	Threatened	Designated	Endangered	Not Likely
Yellow-billed Cuckoo	Coccyzus americanus	Threatened	Proposed	Candidate	Not Likely
Gray Wolf	Canis lupus	Endangered	None	Endangered	Not Likely

[1]USFWS 2016b, [2]WDFW 2008, 2016

The project area falls outside of the units that were designated as critical habitat for the streaked horned lark (USFWS 2013c). The primary constituent elements (PCEs) identified in the critical habitat listing include the following:

- Areas having a minimum of 16 percent bare ground that have sparse, low stature vegetation composed primarily of grasses and forbs less than 13 inches high found in:
  a. Large (300-acre), flat (0 to 5 percent slope) areas within a landscape context that provides visual access to open areas such as open water or fields, or;
  b. Areas smaller than described in (a), but that provide visual access to open areas such as open water or fields.

Both of these PCEs are present but limited in the action area.

There are no recorded occurrences of this species in the study area. However, because supporting habitat features (i.e., PCEs) are present in the action area, albeit limited, and extant populations are found within the region, the streaked horned lark can potentially occur in the action area. The likelihood of occurrence is considered low to moderate due to the presence of local populations of streaked horned larks elsewhere near the project area, but those populations are small and unpredictable. Because the PCEs pertain to preferred breeding habitat, if streaked horned larks are present in the action area, the period of highest potential would be during the breeding season, occurring roughly from March through August (Stinson 2005). Wintering habitat does occur in the action area as well (see Pearson and Altman 2005), indicating some potential for this species to be present during the remainder of the year.

Similarly to the streaked horned lark, suitable habitat for the yellow-billed cuckoo occurs on site, but this species is unlikely to occur at the Refuge other than on an occasional transient basis. Therefore, impacts to the yellow-billed cuckoo would be less than significant.

3.15.1.3 Marine Mammal Protection Act

Three species of marine mammals have been known to use the Columbia River in the vicinity of the action area: Steller sea lion (*Eumetopias jubatus*), California sea lion (*Zalophus californianus*), and harbor seal (*Phoca vitulin*) (NMFS 2006). The federal Marine Mammal Protection Act (MMPA) protects all marine mammals including these species. During the spring migration of smelt (Osmeridae), Pacific lamprey (*Entosphenus tridentatus*), salmon and steelhead (*Oncorhynchus* sp.), it is common for seals and sea lions to follow these prey species into the fresh water of the Columbia River up to Bonneville Dam (NMFS 2006), 18 miles upstream of the study area. Tens of seals and sea lions are known to feed in these upriver areas during the spring season (NMFS 2006), largely the result of Bonneville Dam constraining upstream fish movement. This pattern makes them susceptible to marine mammal predation. Some individual marine mammals stay and feed for only a few days, while others remain for much longer.

3.15.2 Environmental Consequences – Proposed Action

The following sections describe any anticipated direct or indirect impacts to wildlife, their habitat, or special status species due to the implementation of the Proposed Action.

3.15.2.1 Construction Impacts

3.15.2.1.1 General Wildlife

Temporary disturbance from construction activities, as well as slightly longer-term temporal impacts from revegetation, would be the primary construction impacts to wildlife species from the Proposed Action. To allow most of the project construction to occur in dry conditions, the primary construction period in the first two construction seasons would be June 1 to October 31. However, some specific work components such as raising SR14 and constructing the parking area would start as early as April.

Construction activities would include widespread grading and use of other heavy equipment. Construction would occur over two primary seasons, with settlement surveys and minor fill activities (if necessary as a result of settlement) to be completed in a third limited season. Construction would result in a large area of temporary disturbance to native wildlife found in the Refuge. In addition, the Refuge's relatively high-quality habitat attracts high densities of a diversity of wildlife species to the Refuge – species that would be subjected to construction disturbances. Disturbance, however, would be mostly restricted to the displacement of individuals from the active work zone, and in most instances would only cause low, short-term impacts. Displaced wildlife could move to undisturbed sites within the Refuge or potentially out of the action area if suitable conditions were not available. Loss of fitness (i.e. from reduced foraging) to displaced wildlife could result from the construction disturbance. Construction impacts would primarily affect various bird species that use the Refuge. It is anticipated that harm to most wildlife would be low and largely prevented by implementing mitigation measures described in Section 2.4.1. Primary construction would generally occur outside of peak waterfowl migrations (spring and fall) and the spring bird breeding season, thus causing low impacts to wildlife. To avoid impacting wintering waterfowl such as the cackling goose, construction activities would avoid their habitat to the degree possible while they are present during the winter season, which is generally October and November.

The great blue heron rookery described in Section 3.15.1 has an active breeding season for several months (rookery initiation begins mid-January, and the last fledglings would depart by mid-August [summarized in Vennesland and Butler 2011]). Construction activities adjacent to the rookery before July could cause moderate impacts to this highly sensitive species, likely leading to nest failures. Current construction plans show that the proposed west setback levee would take up 1.2 acres of the 10-acre rookery, which would be a permanent loss. The remaining 8.8 acres would not be suitable for nesting during the second construction season due to a high level of noise and disturbance from construction machinery and human presence, which would be a temporary but moderate loss, particularly if the great blue heron population permanently abandoned the rookery. Construction in this area should start either prior to the arrival of individuals or after the chicks have fledged in late July and early August to minimize "harassment" under the Migratory Bird Treaty Act (MBTA). The construction specifications would require removal of trees within the rookery (1.2 of 10 acres) during September through December, i.e., outside of the great blue heron breeding season, and recommend avoiding other work in the immediate vicinity of the rookery during the great blue heron breeding season. If construction near the rookery during the breeding season is unavoidable, preventing the establishment of the rookery through hazing could be the best option to minimize impacts to this population. However, if this were not possible, hazing should occur starting in January to prevent nesting pairs from establishing broods. If this were to occur, it is unknown where the displaced individuals would recolonize. Although it is thought that the rookery originated on Reed Island, located in the Columbia River just south of the Refuge, its move to the current location was likely triggered by the old site becoming inhospitable to the rookery. The expansion of the local bald eagle population (bald eagles are antagonistic towards herons and often prey on chicks and adults) may have triggered the move to the mainland (Chmielewski 2016, personal communication), and may prevent the return of the rookery to the island. Because other nesting birds use the cottonwood riparian forest of the rookery, they would be similarly impacted by construction activities. Assuming measures are taken to avoid harassment of migratory birds during the nesting season, this impact would be moderate.

Reduced quality habitat for wildlife would occur after construction until maturation of restored vegetation, relative to existing conditions. However, because the affected portions of the Refuge would be expected to fully recover after several years and would be enhanced above existing conditions (including approximately 200 acres of native riparian reforestation), the impacts would be considered temporary and low.

3.15.2.1.2 ESA/State-Listed Wildlife

The Proposed Action would be expected to have no impact on northern spotted owl, yellow-billed cuckoo, or gray wolf because they do not occur in the area, and there is little to no habitat present that would support viable populations. Critical habitat for these species is not found in the project area and would not be impacted by the Proposed Action.

Although the streaked horned lark is unlikely to be present in the project area, supporting habitat features are present in the project area, and they occur within the region. If streaked horned larks are present in the action area, the period of highest potential for construction impacts would be during the breeding season, occurring roughly from March through August (WDFW 2008). It would be during this time that adults, nests, and chicks would be most susceptible to disturbance or harm from construction activities. Wintering habitat does occur in the project area as well (see Pearson and Altman 2005), indicating some potential for this species to be present during the remainder of the year. Wintering individuals would have reduced site fidelity and be more mobile, readily dispersing away from active construction. Construction is not anticipated to affect streaked horned larks, and would have no impact on critical habitat, which is not found in the Refuge.

3.15.2.1.3 Marine Mammal Protection Act

Although there is some potential for marine mammals to use the Columbia River channel adjacent to the Refuge, the likelihood of occurrence of these species in this area during construction is low. As part of the Proposed Action, part of the levee would be removed. However, because in-water work on the Columbia River side of the WCRL would be limited and in-water noise would be low, construction impacts on marine mammals would be limited to temporary disturbance and would be low.

3.15.2.2 Operational Impacts

3.15.2.2.1 General Wildlife

The Proposed Action would result in several beneficial changes for wildlife. The expansion of available open water would directly increase available habitat for wintering waterfowl, and the increase in emergent wetland would expand nesting capacity for ground nesting waterfowl during spring. Once the planted woody vegetation matures, which ranges between three to five years for shrub and wetland communities and 20 to 30 years for larger trees such as cottonwoods, the increase in forest-shrub wetland and cottonwood riparian forest would substantially increase the capacity for shrub- and/or tree-nesting birds such as passerines, woodpeckers, accipiters, herons, and owls. At that stage, the enhanced habitat would also likely provide diverse structure and would include important features such as standing snags at higher frequencies than current conditions. These impacts would be low.

Impacts to terrestrial avian and wildlife species that could occur during operations include mortality or displacement of species during flood events. Smaller species of wildlife or ground-burrowing animals might not be able to avoid rising waters or might be drowned if burrows were inundated. The Refuge supports a herd of approximately 12 black-tailed deer, which would be unlikely to be directly affected by inundation but which could be injured if they try to cross SR14 to escape rising waters. At least 200 acres of the project area is above the 100-year flood elevation and would be available as refugia for deer during high flows. Ground-nesting birds would be displaced and nests abandoned if they were located in the inundation area when flood events occur. The foraging and cover habitat within the inundated area would be lost to terrestrial species for the duration of the inundation period, but there would still be sufficient upland habitat to support them, so this impact would be low.

The increase in extent and diversity of water resources would also diversify associated aquatic wildlife species. It is anticipated that the Refuge would see increases in fish use, invertebrate populations, and plant species, most of which would enhance conditions for native wildlife. LCEP would monitor fish use, macroinvertebrates, and plant communities as part of its post-construction monitoring program. Part of this increase in species diversity would be due to reestablishing direct connectivity to the Columbia River, which would allow species not currently present in the Refuge, such as western pond turtles, to more easily disperse into this area. The impact associated with this increase in the extent and diversity of aquatic habitat impact would be moderate. The enhanced connectivity would likely facilitate the introduction of invasive species to the Refuge or the spread of existing species. Invasive species that would be likely to proliferate include nutria, purple loosestrife, shiny geranium, false indigo, and yellow flag iris. It is generally viewed that any increases in invasive species, both in diversity and population size, would degrade wildlife habitat in the Refuge and require additional management. This impact would be low due to implementation of an invasive species management plan as described in Section 2.4.1.

Additional long-term impacts would result from habitat enhancements that would alter productive, existing habitats. The removal of vegetation, including 2.2 acres of mature cottonwoods associated with the great blue heron rookery, would cause long-term negative impacts to wildlife that rely on those discrete habitat patches. The proposed location of the west setback levee, through the patch of cottonwood riparian forest that supports the heron rookery, could reduce the number of birds using the site or cause them to relocate the rookery. Nonetheless, a portion of the rookery would be permanently lost, and the functionality of the full rookery would be lost during construction, resulting in a moderate impact. An additional impact may occur if gourd arrays for purple martin nesting sites are affected by construction. It is likely that the Proposed Action would affect two gourd arrays near the fish ladder and one near the trailhead parking lot. USFWS will relocate the array near the parking lot to a location either west of Gibbons Creek or north of SR14, but within 1,000 feet of the current location. This relocation would occur in the winter of 2018/19 after the purple martins have migrated south. The gourd arrays near the fish ladder would likewise be relocated during the winter of 2019/20, and although the exact location has not been determined, it would likely be within 1,500 feet of the current location. Although the Proposed Action would affect purple martins, implementing these measures would keep the impact level to a low level.

Changes to wetlands in areas that are currently managed for wintering waterfowl could degrade the utility of those areas for species such as cackling geese, although it is assumed that conversion from managed grassland habitat would not reduce its extent below the goals set by the CCP. Goals including maintaining 168 acres of short perennial grasses for winter forage for geese, and 71 acres of unmowed grassland habitat for nesting and foraging habitat, would remain in place, and USFWS would monitor to ensure that these habitat goals continue to be met. However, because the Proposed Action would result in extensive new riparian vegetation, restored wetlands, and a plant community comprised of more native species than under current conditions, this impact would be low.

3.15.2.2.2 ESA/State-Listed Wildlife

Long-term impacts to ESA/state-listed wildlife would only be to streaked horned larks in the event that they colonized the area. Enhancement of wetland areas resulting in additional unvegetated surface area would be likely to occur, and could substantially increase breeding habitat for this species.

3.15.2.2.3 Marine Mammal Protection Act

The occurrence of marine mammals in the lower Columbia River is primarily due to prey species such as migrating salmonids moving up the river system. Because the objective of the Proposed Action is to reconnect Gibbons Creek and the Steigerwald floodplain to the Columbia River, with the ultimate goal of enhancing salmonid habitat, salmonid populations could increase to some extent, as would their densities in the action area. If this occurs and salmonids begin to move into and out of the action area at higher frequencies, they could attract predators such as marine mammals to this area, resulting in enhanced conditions for marine mammals.

3.15.3 Environmental Consequences – No Action

Under the no action alternative, the project area would continue to provide a productive and important site for native wildlife species in the region. It would offer seasonally important habitat features for a diversity of native migratory birds, mammals, reptiles, and amphibians that are identified in the current species list for the Refuge (USFWS 2010). Assuming that current vegetation and other land management practices would continue, important habitat features for target species, including the cackling goose and purple martin, would be perpetuated over the foreseeable future, allowing USFWS to continue to meet goals described in the CCP (USFWS

2005). These management activities likely result in some negative impacts to non-target wildlife species that may be inadvertently affected during grazing or mowing. These species are likely not to be ESA- or state-protected species. The no action alternative would also perpetuate partial isolation of the Refuge from the greater Lower Columbia Region. This would continue to help keep down populations of invasive species, further aiding in maintaining habitat quality. It would also perpetuate isolating the Refuge from native aquatic species, including species such as the western pond turtles, which occur upstream (Chmielewski 2016, personal communication). The no action alternative would result in no construction impacts to various species of migrating and nesting birds, resident mammals, and other wildlife species. No changes are anticipated that would impact ESA- or state-listed wildlife species, including the streaked horned lark.

3.15.4 Cumulative Impacts

By increasing the quality of wetland habitat over 550 acres, the Proposed Action would contribute substantially to the cumulative amount of wetland habitat that has been and is being restored in the estuary. Such habitats are highly valuable to migratory waterfowl, and the cumulative impacts of these multiple restoration projects is moderate in terms of supporting populations of migratory birds.

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CHAPTER 4 ENVIRONMENTAL COMPLIANCE AND PERMITTING

This section describes statutes, regulations, and Executive Orders that are relevant to the Proposed Action and the resources that could be affected by the Proposed Action.

4.1 National Environmental Policy Act

NEPA requires federal agencies to assess the impacts that their actions may have on the environment. Major federal actions significantly affecting the quality of the human environment require the preparation of an EIS. This EA has been prepared to determine if the project would create any significant environmental impacts that would warrant preparing an EIS, or whether it is appropriate to prepare a FONSI.

4.2 Cultural Resources

Cultural resources are protected through the following:

- Antiquities Act of 1906 (16 USC 431–433)
- Historic Sites Act of 1935 (16 USC 461–467)
- NHPA (54 USC 300101 *et seq.*)
- Archaeological Data Preservation Act of 1974 (16 USC 469 a–c)
- Archaeological Resources Protection Act of 1979 (16 USC 470 aa–mm), as amended
- Native American Graves Protection and Repatriation Act (25 USC 3001 et seq.)
- Executive Order 13007 Indian Sacred Sites
- American Indian Religious Freedom Act of 1978 (42 USC 1996, 1996a)

Cultural resources include objects, structures, buildings, sites, or districts that provide irreplaceable evidence of natural or human history of national, state, or local significance. These may include National Landmarks, archeological sites, and properties listed or eligible for listing in the NRHP.

Section 106 of NHPA requires federal agencies to consider the impacts of their actions on historic properties. The NHPA provides a process (known as the Section 106 process) that enables agencies to assess impacts on historic properties along with participation from interested and affected parties such as tribes, and then avoid, minimize, or mitigate for these impacts. Historic properties may be pre-contact or historic sites, including objects and structures that are included in or eligible for inclusion in the NRHP. Historic properties also include artifacts or remains within historic sites and properties of traditional and cultural importance to tribes.

If a federal agency plans to undertake a type of activity that could affect historic properties, it must consult with the appropriate State Historic Preservation Officer and/or tribes to assess the property and to assess impacts on identified historic properties. The NHPA specifies that a traditional cultural property may be determined to be eligible for inclusion on the NRHP. In carrying out its responsibilities under Section 106, a federal agency is required to consult with any Indian tribe that attaches religious or cultural significance to any such properties, along with other potential consulting parties. On Oct. 6, 2015, BPA sent letters to the Confederated Tribes and Bands of the Yakama Nation, Nez Perce Tribe, Cowlitz Indian Tribe, Confederated Tribes of the Umatilla Indian Reservation, and Confederated Tribes of Warm Springs Reservation of Oregon to initiate consultation. The letters described the Proposed Action, described the planning process, provided a map of the Area of Potential Effect (APE), and provided avenues for commenting and additional coordination. As described in Section 1.5, initial coordination with the Grand Ronde Tribe occurred during the scoping period. On October 6, 2015 and June 5, 2017, BPA submitted determination letters to the consulting parties to support necessary geotechnical work associated with project design; both letters assumed no effect to historic properties as a result of the proposed geotechnical work. On January 18, 2018, BPA sent a letter to the consulting parties that determined that the implementation of the full project would have an adverse impact to the WCRL, while having no effect on other historic properties. On January 18, 2018, DAHP concurred with BPA's determination, requesting further consultation and development of an MOA associated with the WCRL. The final MOA was negotiated between BPA and DAHP and signed on September 21, 2018. BPA did not receive follow-up communications from any of the other consulting parties associated with this determination.

4.3 Wetlands, Floodplains, and Water Resources

Floodplains, streams, and wetlands are regulated under several federal and state statutes including the CWA (33 USC 1251 et seq.), Executive Orders 11988 (Floodplain Management) and 11900 (Protection of Wetlands), and Washington's Hydraulic Project Approval (HPA) process.

The CWA establishes the structure for (1) regulating discharges of pollutants into the waters of the U.S. and (2) regulating quality standards for surface waters. It is unlawful under the CWA to discharge any pollutant into navigable waters, unless a permit is obtained. The project sponsors would submit a Joint Aquatic Resources Permit Application to the Corps and WDFW prior to construction. The relevant sections of the CWA are described below.

4.3.1 Clean Water Act Section 401 (Water Quality Certification)

A federal permit to conduct an activity that causes discharge into navigable waters is issued only after the state certifies that existing water quality standards would not be violated if the permit were issued. Ecology would review the project's Section 402 and Section 404 permit applications for compliance with state water quality standards and grant certification if the permits comply with these standards. This project may be pre-certified for Section 401 compliance if it is permitted under a Section 404 Nationwide Permit (NWP) for restoration projects (see Section 4.3.3).

4.3.2 Clean Water Act Section 402 (NPDES)

This section authorizes the EPA and applicable state departments to permit the discharge of pollutants under the National Pollutant Discharge Elimination System (NPDES) for all land disturbances over one acre in size. The EPA, Region 10, has a general permit for discharges from construction activities. BPA would issue a Notice of Intent to attain coverage under this general permit, and would prepare a SWPPP describing methods to minimize construction discharges.

4.3.3 Clean Water Act Section 404

Authorization from the Corps is required in accordance with the provisions of Section 404 of the CWA when dredged or fill material is discharged into waters of the U.S., including wetlands. Federal regulations at 33 C.F.R. § 336.1 (a), provide that a Section 404 permit is not issued by the Corps to itself; however, the Corps shall apply all applicable substantive legal requirements, including public notice, opportunity for public hearing, and application of the Section 404 (b) (1) guidelines. Project management would work with the Corps' regulatory process to comply with the CWA Section 404(b)(1) guidelines established by the EPA. The Corps NWP Program provides approval for a standard set of activities in wetlands and waters that have routine and known impacts.

Wetland restoration projects generally fall under a category of actions that has been pre-approved under the NWP program. To qualify for NWP authorization and to use the applicable states' pre-approved 401 water quality certification, the project must comply with the NWP general conditions, any regional or specific conditions and the applicable states' 401 water quality certification general or specific conditions. A "pre-certified" water quality permit means the 401 certification has been approved for all actions authorized by that particular NWP, provided all applicable national and regional NWP conditions and all applicable 401 certification conditions are adhered to. The permittee is not required to contact the certifying agency for further authorization or approval unless the 401 certification for a particular NWP requires it. Each NWP has an individual 404(b)(1) analysis associated with it that was made available for public comment during the FR notice announcing the renewed NWPs (77 FR 10184).

4.3.4 Hydraulic Project Approval

WDFW administers the HPA program under the state Hydraulic Code, which was specifically designed to protect fish. This legislation states that important opportunities exist to modify programs that provide for management and protection of the state's natural resources, including the state's forests, fish, and wildlife (Chapter 77.55 RCW). WDFW Habitat Biologists are available to help people and groups apply for an HPA and ensure their projects meet state conservation standards for finfish, shellfish and their aquatic environment.

4.3.5 Rivers and Harbors Act

Section 10 of the Rivers and Harbors Act of 1899, as amended, regulates structures in or over any navigable water of the U.S., the excavating from or depositing of material in such waters, or the accomplishment of any other work affecting the course, location, condition, or capacity of such waters. Section 408 of the act authorizes the Secretary of the Army, on the recommendation of the Chief of Engineers of the Corps, to grant permission for the alteration or occupation or use of a Corps' civil works project if the Secretary determines that the activity would not be injurious to the public interest and would not impair the usefulness of the project. The Rivers and Harbors Act is administered by the Corps and addresses structures or actions which may affect the course, location, condition, or capacity of navigable waterways.

In-water work would be required for implementation of the estuary restoration program. Under the implementing regulations for Section 10, the Corps issues permits for work in navigable waters of the U.S. BPA would obtain a Section 10 permit prior to implementing restoration actions in a "water of the U.S." as defined in the Rivers and Harbors Act and in a navigable water as defined by the Corps.

Under the Section 408 review process, the Corps would make a determination on the requested alteration to the in-place performance of the federally authorized Washougal FDR Project. BPA is following the Section 408 guidance (EC-1165-2-2-16) and submitting the required documentation necessary for the Corps to make a decision. Approval through Section 408 is necessary to ensure that alteration of the authorized federal project would not be injurious to the public interest and would not impair the usefulness of the flood control project.

4.3.6 Executive Order 11988 Floodplain Management

Executive Order 11988 directs federal agencies to avoid to the extent possible the long and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. By removing a portion of the WCRL, this project enhances floodplain functions including flood storage and off-channel habitat. The project does not increase floodplain development and is consistent with Executive Order 11988.

4.4 Fish and Wildlife

Fish and wildlife are regulated under numerous state and federal laws. The most relevant regulations are described below.

4.4.1 Endangered Species Act

The ESA (16 USC § 1531 *et seq.*) established a national program for the conservation of threatened and endangered species of fish, wildlife, and plants, and the preservation of the ecosystems on which they depend. The ESA is administered by the USFWS for terrestrial species and some freshwater species, and by NMFS for anadromous fish and marine species. Requirements of the ESA ensure activities authorized, funded, and carried out by federal agencies are not likely to jeopardize the continued existence of any listed species or result in adverse impacts to designated critical habitat of a listed species. Section 7(a) of the ESA requires federal agencies to ensure that the actions they authorize, fund, and carry out do not jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat. Section 7(c) of the ESA requires that federal agencies initiate consultation and prepare biological assessments addressing the potential impacts of their actions on listed or proposed endangered species and critical habitats.

Impacts to federally-listed anadromous fish, including Pacific lamprey, and critical habitat are covered by a programmatic BiOp issued by NMFS for BPA HIP projects (NMFS 2013a), and impacts to listed species terrestrial, marine, and non-anadromous fish species are covered by a BiOp issued by USFWS (USFWS 2013a). These BiOps are for habitat restoration projects on the Columbia River and Oregon coast that are funded by BPA under its HIP III, which is intended to mitigate for the impacts of the FCRPS on fish, wildlife, and their habitat.

The NMFS BiOp indicates that actions under this program are likely to have short-term adverse impacts to listed anadromous fish runs that may pass through the action area or access the restored habitat. These species are listed in Table 3-2 (Section 3.5.1). NMFS found that the program would not affect southern green sturgeon, eulachon, or Steller sea lion. The BiOp contains an incidental take statement that specifies the amount or extent of take that is allowed, the effect of the take, and the RPA measures and terms and conditions.

These BiOps identify a range of categories of actions that BPA may implement in its habitat restoration projects. For each category of action, subcategories specific to each project are identified, specific mitigation measures are described. The action categories and mitigation measures that pertain to the Proposed Action are listed in Table 4.1.

Table 4-1: Action Categories and Subcategories Relevant to the Proposed Action

Action Category	Action Subcategories Relevant to the Proposed Action
Fish Passage Restoration	1a. Dams, water control, or legacy structures removal
	1c. Headcut and grade stabilization
	1f. Bridge and culvert removal or replacement
	1g. Bridge and culvert maintenance
River, Stream, Floodplain, and Wetland Restoration	2a. Improve secondary channel and wetland habitats
	2b. Setback or removal of existing berms, dikes, and levees
	2c. Protect streambanks using bioengineering methods
	2d. Install habitat-forming natural material instream structures
	2e. Riparian vegetation planting
	2f. Channel reconstruction
Invasive and Non-Native Plant Control	3a. Manage vegetation using physical controls
	3b. Manage vegetation using herbicides
Road and Trail Erosion Control, Maintenance, and Decommissioning	5b. Road decommissioning
Irrigation and Water Delivery/Management Actions	7g. Install new or upgrade/maintain existing fish screens
Special Actions (for terrestrial species)	9a. Install/develop wildlife structures
	9c: Implement erosion control practices
	9d. Plant vegetation
	9e. Tree removal for large wood projects

For each of the subcategories listed in Table 4.1, USFWS and NMFS have developed mitigation measures that must be applied to reduce potential impacts to listed species or their habitat during construction or operations. In addition to the mitigation measures that correspond to the specific action categories, the BiOps specify general aquatic mitigation measures applicable to all actions. These measures are applicable to project design and site preparation, work area isolation and fish salvage, conservation of aquatic species during construction and post-construction, and conservation of terrestrial plants, wildlife, and aquatic invertebrates. Some of these measures have been incorporated as mitigation measures in this EA. All others are applicable and are described in their entirety in BPA's HIP III handbook (BPA 2016b) and in the programmatic BiOps. This project was reviewed by the Restoration Review Team (RRT), which is comprised of BPA staff who help to ensure that such projects meet the BiOp requirements, promote interagency collaboration, advise in ways to maximize ecological benefits of BPA-funded restoration projects, facilitate site visits, and ensure that HIP III is used consistently across all projects. As required for projects identified as high risk under the HIP III, BPA submitted project designs and received final approval and sign-off on the project from the NMFS Columbia Basin Office, dated November 8th, 2018.

BPA has consulted with USFWS regarding potential impacts to Nelson's checkermallow, golden paintbrush, and bull trout, all of which are listed as threatened under the ESA. USFWS issued a BiOp that indicated that the Proposed Action could affect, but would not be likely to adversely affect, bull trout and golden paintbrush (USFWS 2016c). The BiOp also found that the Proposed Action could affect, and would be likely to adversely affect, Nelson's checkermallow. Adverse impacts to Nelson's checkermallow would occur during operations, when changes in hydrology could inundate the area in which it is found. It is assumed that all specimens of Nelson's checkermallow found south of SR14 would be adversely affected by inundation. The BiOp specifies non-discretionary terms and conditions that the Refuge must comply with, as follows:

1. Continue to conduct annual monitoring in plots where Nelson's checkermallow occurs;
2. Continue to conduct annual vegetation management (invasive plant control and mowing); and,
3. Outplant additional checkermallow plants in suitable protected habitat and monitor the new populations to ensure the population does not decline because of the Proposed Action.

In addition to these terms and conditions, BPA would apply specific mitigation measures identified in the BiOp (USFWS 2016c).

4.4.2 Fish and Wildlife Conservation Act/Fish and Wildlife Coordination Act

The Fish and Wildlife Conservation Act (FWCA) encourages federal agencies to conserve and promote conservation of game and non-game species and their habitats. The FWCA requires federal agencies with projects affecting water resources to consult with USFWS and the state agency responsible for fish and wildlife resources, which in this case is WDFW. Analysis of impacts to fish and fish habitat in Section 3.5 of this document indicates that the adverse impacts would be low and temporary. Impacts to avian species and other wildlife would range from low (reduced wildlife habitat quality until maturation of restored vegetation, and noise impacts on marine mammals) to moderate (loss or disruption of great blue heron breeding habitat). BPA has consulted with USFWS regarding potential impacts to species that they regulate, and would implement the terms and conditions specified in Section 4.4.1, as well as relevant mitigation measures described in BPA's HIP III handbook (BPA 2016b).

4.4.3 Migratory Bird Treaty Act

The MBTA, as amended, implements various treaties and conventions between the U.S. and other countries, including Canada, Japan, Mexico, and Russia, for the protection of migratory birds (16 USC §§ 703-712). Under the MBTA, taking, killing, or possessing migratory birds, or their eggs or nests, is unlawful. The act classifies most species of birds as migratory, except for upland and nonnative birds.

The Department of Energy and USFWS have a memorandum of understanding to address migratory bird conservation in accordance with EO 13186 (Responsibilities to Federal Agencies to Protect Migratory Birds). This order directs each federal agency taking actions that may affect migratory birds to work with the USFWS to develop an agreement to conserve those birds. The memorandum of understanding addresses how both agencies can work cooperatively to address migratory bird conservation, and includes specific measures to consider implementing during project planning and implementation.

Specifically, this MOU describes the responsibilities of both parties as follows:

1. Protect, enhance, and manage habitats of migratory birds, to the extent practicable. This includes implementing management practices that avoid or minimize adverse impacts on migratory bird populations and their nesting, foraging, migration, staging or wintering habitats.

2. Promote monitoring, research, and information exchange related to migratory bird conservation and program actions that may affect migratory birds, and provide access to information on environmental contaminants and other avian stressors that are relevant to the conservation of migratory birds. This includes:

    a. As practicable and compatible with other study needs and program mandates, collaborating on warranted studies: (1) on migratory bird species that may be affected by agency actions, infrastructure, or facilities; and (2) to identify habitat conditions essential to sustain migratory bird populations.

    b. Sharing inventory, monitoring, and research results with other Federal and State agencies and Tribal Nations, as appropriate, and among DOE elements, as practicable, and with national repositories such as the Avian Knowledge Network.

    c. Developing partnerships with other agencies and non-Federal entities to further bird conservation, as practicable.

3. Identify and pursue training opportunities for appropriate DOE and DOE contractor employees in appropriate methods and techniques to:

    a. Inventory and monitor migratory birds;

    b. Assess population status of migratory birds;

    c. Assess temporal and spatial bird use within project areas;

    d. Evaluate impacts of projects on migratory birds;

    e. Develop management practices that avoid or minimize adverse impacts and promote beneficial proactive approaches to migratory bird conservation.

4. Participate annually, or as appropriate, in the interagency Council for the Conservation of Migratory Birds.

5. As identified in its charter, the duties of this Council include the following:
    a. Sharing the latest resource information to assist in the conservation and management of migratory birds.
    b. Developing an annual report of accomplishments and recommendations related to E.O. 13186.
    c. Fostering partnerships to further the goals of E.O. 13186.
    d. Selecting an annual recipient of a Presidential Migratory Bird Federal Stewardship Award for contributions to the protection of migratory birds.
6. Periodically evaluate the measures taken under this MOU, to protect, restore and enhance migratory birds, including avoiding or minimizing the take of migratory birds, to determine whether the most effective conservation measures are employed. These efforts will be coordinated through the FWS's Division of Migratory Birds.
7. Support efforts to promote the ecological, economic, and recreational values of migratory birds by supporting outreach and educational activities and materials, as appropriate.

4.4.4 Bald and Golden Eagle Protection Act

This act provides for the protection of bald and golden eagles by prohibiting the taking, possession and commerce of such birds, except under certain specified conditions. The act covers intentional acts of take or disturbance and acts in "wanton disregard" of the safety of bald or golden eagles. Take is defined as "to pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb." "Disturbance" relates to activities that affect the viability of eagle populations (e.g., from nest or chick abandonment), which would result from otherwise normal, lawful business practices. The USFWS's National Bald Eagle Management Guidelines (USFWS 2007) identify measures to avoid impacts to eagles during the nesting season. These measures differ depending on the type of activity (i.e. road construction, timber operations, off road use, etc.). Specific measures include developing buffers of vegetation or of distance where there is an active eagle nest between January 1 and August 15. No eagle nests have been identified in or near the construction area.

4.4.5 Marine Mammal Protection Act

The MMPA established a federal responsibility to conserve marine mammals within waters of the U.S. With certain specified exceptions, the MMPA establishes a moratorium on the taking and importation of marine mammals. All marine mammals are covered under the MMPA. Marine mammals that could be found in the Columbia River at the project area include harbor seals, Steller sea lion, and the California sea lion. Such occurrences are likely to be relatively rare, and these species would be likely to move elsewhere in the case of in-water construction.

4.4.6 Magnuson-Stevens Act

The Magnuson-Stevens Fishery Conservation and Management Act of 1976 (now called the Magnuson-Stevens Act) was passed to prevent overfishing, rebuild fish populations, and conserve EFH. EFH is defined as "those waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity" (16 USC § 1802(10)).). Under the Magnuson-Stevens

Act, NMFS promotes the protection of these habitats through review, assessment, and mitigation of activities that may adversely affect these habitats. The EFH mandate applies to all species managed under a Federal Fishery Management Plan (FMP). In Washington, Oregon, and California, there are four FMPs that cover groundfish, highly migratory species, coastal pelagic species, and Pacific salmon. Federal agencies must consider the impact of a proposed action on all four types of EFH. This project is located in the freshwater Columbia River and a tributary of the Columbia River, and is located below the Bonneville Dam. Therefore, both the Pacific salmon EFH and groundfish EFH are applicable in this area. The Pacific Salmon EFH designates EFH for Puget Sound pink salmon, Chinook salmon, and coho salmon. The full project area is within a 12-digit USGS hydrologic unit (170800010804) that is designated EFH for both Chinook and coho salmon. The Columbia River immediately adjacent to the project is designated EFH for groundfish (NMFS 2017).

4.5 Air Quality and Climate Change

4.5.1 Executive Orders 13653 and 13693

Executive Orders 13653 (Preparing the U.S. for the Impacts of Climate Change) and 13693 (Federal Leadership in Environment, Energy and Economic Performance) provide guidance to federal agencies on planning for climate change. These EOs require federal agencies to evaluate their climate change risks and vulnerabilities to manage the impacts of climate change on the agency's mission and operations in both the short and long-term as part of their formal planning processes, and to set sustainability goals for their operations.

Two recent CEQ guidance documents (Principles and Requirements for Federal Investments in Water Resources and Interagency Guidelines for Federal Investments in Water Resources) recommend that climate change adaptation processes be incorporated into NEPA processes to avoid instituting parallel planning (CEQ 2013a, 2013b). According to this guidance, climate change can be accounted by: 1) forecasting the key assumptions of future conditions; 2) characterizing the degree of uncertainty; 3) using multiple baselines; 4) accounting for changes resulting from a changing climate, including hydrologic and other conditions, increases in temporal and spatial variability of precipitation and water availability, and inundation in coastal areas; 5) using historical records and best available models to forecast projected future condition; and 6) giving particular consideration of climate change to long-lived projects (CEQ 2013b). The draft guidance encourages using the best available science to forecast the impacts of climate change "to enable evaluation of each alternative's impacts on ecosystem resilience, the sustainability of critical ecosystem services, and the vulnerability of human and natural systems to climate change" (CEQ 2013b).

The Proposed Action has been designed with flexibility to respond to changing hydrologic conditions that may occur under various climate change scenarios. It would also offer benefits by attenuating higher flood flows that are predicted, and offering refugia to juvenile fish during high flows.

4.5.2 Clean Air Act

The CAA, as amended, requires the EPA and delegated states to carry out a wide range of regulatory programs intended to assure attainment of the NAAQS. The NAAQS are health standards set for criteria pollutants: CO; lead; NO_2; 8-hour ozone; PM_{10} and PM 2.5 micrometers or less in diameter ($PM_{2.5}$); and SO_2. The EPA sets these standards and Ecology and ODEQ maintain a list of areas/counties that have exceeded these health standards and are considered "non-attainment" areas. The project area is in an attainment area and the construction emissions would be well below threshold levels. Furthermore, there would be no stationary sources of emissions during operations, therefore there would be no new sources of GHGs associated with the project. Therefore, air quality impacts and contributions to climate change would be low.

4.6 Other Relevant Regulations

4.6.1 Farmland Protection Policy Act

The Farmland Protection Policy Act directs federal agencies to identify and quantify adverse impacts of federal programs on farmlands. The purpose of this act is to minimize the number of federal programs that contribute to the unnecessary and irreversible conversion of agricultural land to non-agricultural uses. The Proposed Action could affect up to 115 acres of Prime Farmland by lowering its elevation and exposing it to seasonal inundation. This action, however, would not be likely to result in the loss of such farmland, as it would still be accessible to farming practices such as grazing and mowing during most times of the year when such uses would be desired.

4.6.2 Environmental Justice, Executive Order 12898

Executive Order 12898 (Federal Actions to Address Environmental Justice in Minority and Low-income Populations) was released to federal agencies in February 1994. This order states that federal agencies shall identify and address, as appropriate, disproportionately high and adverse human health or environmental impacts of its programs, policies, and activities on minority and low income populations. Although part of the Proposed Action would occur in an environmental justice community, the environmental impacts of the components of the project that would occur there would be relatively minor. Impacts would include temporarily increased noise and traffic during construction, and long-term impacts to visual resources due to the presence of the floodwall. The floodwall would be constructed to provide continued flood protection to residents of this area, and it could not be placed elsewhere. Impacts related to environmental justice would be moderate.

4.6.3 Federal Noxious Weed Act

This federal act, as amended in 2009, directs federal agencies to manage undesirable plant species on federal lands when management programs for those species are in place on state or private land in the same area. Undesirable plant species are defined as those that are classified as undesirable, noxious, harmful, exotic, injurious, or poisonous, pursuant to state or federal law. A noxious weed list (7 CFR 360.200) is developed by the Secretary of Agriculture, which lists noxious weeds (as defined by the Plant Protection Act) that are subject to restrictions on interstate movement (7 USC § 7712).

Mitigation measures that are incorporated into the planning and design of this project directly address the import, spread, or establishment of invasive species, and are sufficient to control the spread or introduction of these species. During operations, ongoing invasive weed control would target populations of the most noxious species.

4.6.4 Executive Order 13112 Invasive Species

EO 13112 calls upon federal agencies to take steps to prevent the introduction and spread of invasive species and to support efforts to eradicate and control established populations of invasive species. USFWS will update the Refuge's invasive species management plan in response to the increased potential for the spread of invasive species due to disturbance of soils during construction and because of the heightened potential for introduction of water-borne propagules due to direct inflow of waters from the Columbia River.

4.6.5 Comprehensive Environmental Response Compensation Liability Act, as Amended

The Comprehensive Environmental Response Compensation Liability Act (42 USC 9601 *et seq.*), as amended, provides funding for hazardous materials training in emergency planning, preparedness, mitigation implementation, response, and recovery. Eligible individuals include public officials, emergency service responders, medical personnel, and other tribal response and planning personnel. No sites listed under this act are located within the project area.

4.6.6 Shoreline Substantial Development Permit

Substantial Development Permits (SDPs) are required by the State of Washington for all developments (unless exempt) that meet the legal definition of substantial development, which includes any development of which the total cost or fair market value exceeds five thousand dollars, or any development which materially interferes with the normal public use of the water or shorelines of the state. SDPs are reviewed and processed by local governments and subsequently sent to Ecology for filing. Under WAC 173-27-150, substantial development permits cannot be approved unless they are consistent with policies and procedures of the Shoreline Management Act, Ecology rules, and the local master program. In addition, state rules under WAC 173-27-140 prohibit issuance of permits for any new or expanded building or structure of more than 35 ft. above average grade level on shorelines of the state that would obstruct the view of a substantial number of residences on areas adjoining such shorelines, except where a master program does not prohibit the same and then only when overriding considerations of the public interest would be served.

4.7 Permitting and Environmental Clearances

A summary of the compliance status of several of the key permits and environmental processes is given in Table 4-2.

Table 4-2: Permits and Environmental Clearances

RELEVANT LAW / REGULATION	AGENCY	COMPLIANCE STATUS
NEPA 42 USC 4321 et seq.	Council on Environmental Quality	Draft EA was circulated for public review in January 2018.

RELEVANT LAW / REGULATION	AGENCY	COMPLIANCE STATUS
CWA 33 USC 1251 et seq.; Section 404	Corps	Section 404 permit application will be submitted during later stages of design.
CWA Section 401	Ecology	LCEP would apply for Section 401 Water Quality Certification unless project is preauthorized.
FWCA 16 USC 661 et seq.	USFWS	Coordination with USFWS as part of Section 7 consultation is complete. The Corps will coordinate with USFWS and ODFW, as necessary, during the permitting phase regarding any measures needed to reduce impacts to non-listed species.
ESA 16 USC 1531 et seq.	USFWS and NMFS	Coordination with USFWS for impacts to terrestrial species and bull trout complete in May 2016. Project was reviewed by the RRT. NMFS approval for compliance with HIP III BiOp provided on November 8th, 2018.
CAA USC 7401	EPA	Project would be in compliance with the CAA.
Columbia Gorge Scenic Area Compliance	USFS	LCEP is coordinating with USFS and will submit an application for a permit to construct the components of the project that would occur within the scenic area later in the design process.
Rivers and Harbors Acts 33 USC 403	Corps	Review for Section 10 will occur concurrently with Section 404 application. Coordination under Section 408 is ongoing.
Coastal Zone Management Act/Shoreline SDP	Ecology	Coordination for approval to occur during permitting phase.
NHPA 54 USC 300101	Washington State Department of Archaeology and Historic Preservation	The Section 106 MOA was signed by SHPO on September 21, 2018.
Executive Order 11988, Floodplain Management	FEMA	In compliance.
HPA	WDFW	Coordination for approval to occur during permitting phase.
MBTA 16 USC §§ 703-712	USFWS	LCEP and BPA to coordinate measures to avoid impacts to MBTA species and

RELEVANT LAW / REGULATION	AGENCY	COMPLIANCE STATUS
		mitigate for impacts.

CHAPTER 5 TRIBES, AGENCIES, AND PERSONS RECEIVING THE EA

Those consulted or receiving notice of document availability include local, state, and federal agencies, public officials, and tribes in the project vicinity. Specific individuals were contacted to gather information and data about the project area and applicable requirements.

5.1 Federal

National Marine Fisheries Service (NMFS)

Senator Patty Murray

Senator Maria Cantwell

Representative Jaime Herrera Beutler

U.S. Environmental Protection Agency (EPA)

U.S. Army Corps of Engineers (Corps)

U.S. Fish and Wildlife Service (USFWS), Washington Fish and Wildlife Office, Lacey

5.2 State Agencies

U.S. Forest Service (USFS), Portland, Oregon

Washington Department of Ecology (Ecology)

Washington Department of Fish and Wildlife (WDFW)

Washington Department of Transportation (WSDOT)

Washington State Governor's Office

State of Washington House and Senate, Districts 14 and 18

Washington State Department of Archaeology and Historic Preservation (DAHP)

Southwest Clean Air Agency (SWCAA)

5.3 Tribes

Chinook Indian Nation

Confederated Tribes of the Grand Ronde Community of Oregon

Confederated Tribes of the Umatilla Indian Reservation

Confederated Tribes of Warm Springs Reservation of Oregon

Confederated Tribes and Bands of the Yakama Nation

Cowlitz Indian Tribe

Clatsop-Nehalem Tribe

Nez Perce Tribe

Confederated Tribes of Siletz Indians of Oregon

Cowlitz Indian Tribe

Shoalwater Bay Tribe

5.4 Local Governments

Clark County, Washington

City of Washougal

City of Camas

Skamania County Public Utility District

Port of Camas-Washougal (Port)

5.5 Other

Burlington Northern Santa Fe (BNSF) Railroad

Lower Columbia Fish Recovery Board (LCFRB)

CHAPTER 6 LIST OF PREPARERS AND REVIEWERS

Name	Education	Years of Experience	Project Role
Tetra Tech			
David Munro, PWS	MA, Natural Resources Management	22	Project Manager, Wetlands
Tricia Gross	BS, Marine Biology	17	Fisheries
Jeff Barna, CWB	MS, Ecology and Evolutionary Biology	16	Wildlife
Sara Townsend	MS, Wildlife Ecology and Conservation	20	Deputy Project Manager, Vegetation, Wetlands, Soils and Geology
Toni Pennington, Ph.D.	Ph.D., Aquatic Biology	13	Water Quality / Hydrology
Patti Sexton, PE, CFM	MS, Water Resource Engineering	20	Section 408 Editor/Writer
Chuck Kirchner	MA, Urban Affairs	38	Land Use/ Recreation
Emmy Andrews	MS, Environmental Management	11	Air Quality, Noise, Public Health and Safety, Transportation
Erin King, RPA	MA, Cultural Anthropology	15	Cultural Resources
James Carney	BA, Environmental Economics	7	Socioeconomics
Robert Evans	MS, Landscape Architecture	9	Aesthetics / Visual Resources
Greg Woloveke	BS, Ecological Engineering	4	GIS
Merri Martz, PWS	MMA, Marine Affairs, Wetland Ecology	24	QA/QC for Biological Resources
Peter Stroud, CEG	BA, Geology	31	QA/QC for Physical Resources
Historical Research Associates			
Natalie Perrin	MS, Historic Preservation	8	Cultural Resources

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CHAPTER 8 APPENDICES

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Appendix A: Scoping Summary Report

Steigerwald Floodplain Restoration Project
Scoping Summary Report

Formal public scoping for the Steigerwald Floodplain Restoration Project EA was initiated on December 28, 2015 and closed on January 27, 2016. BPA initiated the scoping period for the EA by mailing public letters and maps to interested parties and creating a project webpage at: https://www.bpa.gov/efw/Analysis/NEPADocuments/Pages/Steigerwald_Floodplain_Restoration.aspx. A public meeting was conducted for the project in Washougal, WA on January 14, 2016, with attendance from a total of 32 members of the public. Attending the public meeting were representatives from BPA, the U.S. Army Corps of Engineers, the U.S. Fish and Wildlife Service, the Lower Columbia Estuary Partnership, and the Friends of the Columbia Gorge Land Trust. BPA also met with natural resources and tribal staff members of the Confederated Tribes of the Grand Ronde in Grand Ronde, OR on January 26, 2016. During the scoping period, BPA received 21 comments, either at the scoping meeting, electronically, or by mail. Comments are posted in their entirety at the project webpage linked above.

During the scoping period, BPA received written comments from the following individuals/organizations:

Name	**Organization**
Gridley	Gibbons Forever
Pinkernell	Individual
Starr	Individual
Devlin	Individual
Danielson	Gibbons Creek Mobile Estates LLC
Sixberry	Individual
Pace	Individual
Clapp	Individual
Kelly	Individual
Burhenn	Individual
Campbell	Individual
Rhodig	Individual
Helmeste	Individual
Hickey	Individual
Breckel	Lower Columbia Fish Recovery Board
Williams	Washington State Department of Transportation
Wall/Evers	Cities of Camas and Washougal
Hutchison	Individual
Tetz	Clark Public Utilities
Karnosh	Confederated Tribes of the Grand Ronde Community of Oregon
James	Individual

Issues raised during the scoping process can generally be divided into the following issue categories:

Fish

BPA received several comments on the anticipated effects of the project on fish species using Gibbons Creek and the Steigerwald lake system. Certain comments requested information on types of fish currently using the area, while others requested information on types of fish anticipated to use the area for refugia or spawning after project completion. Representative comments on fish included the following:

- What species is the project intended to protect and enhance?
- What species have historically used the area for refugia? What species spawn in Gibbons Creek?
- Will there be monitoring associated with the project to determine how the project impacts fish, particularly after project completion?
- What efforts will be taken if the project improves habitat for fish other than salmonids such as pike-minnows, chub, suckers, carp, bass, etc?
- It is important to more fully evaluate potential benefits and impacts in the context of broader goals, strategies and actions outlined in the Lower Columbia Salmon Recovery and Fish & Wildlife Subbasin Plan.
- It is not clear how the proposed timing, extent and duration of anticipated connection to the Columbia River would relate to the various life history stages of salmonid species expected to use the site.
- The EA should provide detailed information on the anticipated duration, frequency and extent of fish access, in relation to the key life history stages of each population expected to use the site.
- Following construction and deconstruction work, routine monitoring of project objectives will be necessary. In addition to channel maintenance, probable need for other activities such as periodic checks for fish stranding and resultant salvage operations, should be recognized and provided for in the EA.
- Prior to construction activity, installation of water temperature logs in Steigerwald Lake and seining there to gather baseline fish population information is recommended.
- Consider releasing PIT tagged groups of coho and/or steelhead smolts into Gibbons Creek, then at the creek's mouth record their success in passing through the refuge.

Wildlife

Many commenters requested that BPA consider the impacts of the proposal on wildlife either currently within the project area or anticipated to return to the project area post-completion. Certain comments requested that surveys be conducted to determine population trends of various wildlife species both before and after the project. Comments on wildlife included:

- How will the project affect wildlife?
- Is there a plan for wildlife surveys for species before and after the project to determine impacts and trends?
- What impacts, either positive or negative, will the project have on turtles in and around the Refuge?
- Does the project area support cormorants? If so, will they be affected?
- Please ensure that beavers are able to be a part of the ecosystem within the refuge.

Cultural/Tribal Resources

BPA had the opportunity to meet with and received comments from the Confederated Tribes of the Grand Ronde. Interests of the tribe included ensuring that notification and consultation be completed for any cultural resources found in the area, and raising the possibility that the project may create new opportunities for partnerships. Comments regarding cultural and tribal resources included:

- Will the project allow opportunities for planting new populations of plants important to tribes, such as wapato?
- Will the project allow opportunities for partnerships with tribes to allow access for gathering culturally significant plants?
- Will the project allow opportunities for tribal interpretation?
- How will BPA ensure that cultural resources within the project area are protected?

Vegetation

Certain comments requested impacts of the project on existing vegetation and potential new vegetation within the Refuge, including:

- What impacts will the project have on invasive plants within the Refuge?
- What impacts will the project have on trees bordering Gibbons creek west of the Refuge?

Flood Risk/Flood Potential/Erosion

Many neighboring residents and landowners in the City of Washougal requested information on whether the project would lead to increased flood risk and/or erosion associated with the project. Such comments included:

- Will there be any increased flood risk associated with lowering the levee?
- The existing levee along the river eroded and had to be fortified during the 1996 Columbia River flood. How would the setback levees be built to high standards to ensure that this does not occur again?
- What impacts will the project have on flood risk during winter months and heavy rains?
- Will the project lead to increased erosion to private land along the Columbia River? If erosion is anticipated, what measures can be incorporated to minimize this loss?

Water Resources

Some comments requested that the EA consider the impact of the project, both positive and negative, on water quality both in Gibbons Creek and in the Refuge. Additionally, comments raised issues regarding the project and the relationship to municipal water supplies. These comments included:

- What impacts will increased development upstream on Gibbons Creek have on sediment transport, and water quality?
- Will the project enhance wetlands?

Project Design

Many comments requested specific inclusions in the project design, both in terms of recreation and access and in terms of the floodplain and stream channel reconstruction. One comment requested consideration of a new alternative that would maintain the existence of the Gibbons Creek elevated channel and the fish ladder. Such comments included:

- Instead of proceeding with the project as proposed, and in order to reduce costs and increase salmonid survival in the area, could the diversion structure be removed and the elevated channel be widened to accommodate high Gibbons Creek flows?
- Please maintain the width of the trail on top of the levee to ensure that there is sufficient room for vehicles and pedestrians to pass.
- Suggest that the levee be left at its current height in certain locations to facilitate better views of the river and surrounding landscape.
- Why is replacement of the Highway 14 bridge an aspect of the proposal? How is this an obligation of the FCRPS?
- Is there any plan to add gravel or structure to Gibbons Creek?
- The project proposes construction of a flood wall on private property north of Highway 14. The private property landowner is against any modification to his property and to Gibbons Creek.
- The project as proposed will require an adequate channel through the alluvial fan in order to allow fish passage. Otherwise, fish blockage, delays, and mortality are expected.
- Will the proposal consider alternative locations for the setback levees, particularly around the property owned by the cities of Camas/Washougal?
- Who will own and manage the restoration project systems?

<u>Proposed Camas/Washougal Water Well Field</u>
The cities of Camas and Washougal have purchased property that is proposed to be bisected by the western setback levee for the project. This property is the site of the future Steigerwald Well Field, which is a groundwater supply project intended to provide future water supply needs. Comments received from the two cities and from the Lower Columbia Fish Recovery Board raised issues regarding project design included:

- How will the project impact and/or affect the feasibility of developing a regional water supply well field at property in the project area owned by the Cities of Camas and Washougal?
- For the project to be completed, there need to be assurances that the restoration will not be a basis for any challenge to the development and operation of the well field.
- The EA should thoroughly evaluate the impacts of the project on the development of the Steigerwald Lake regional municipal water supply.
- The elevation of the well field property should be raised to 38 feet for access roads and well buildings and 35 feet for the wellhead sanitary control zone to eliminate any issues with access or maintenance of future water wells during a large flood event.
- The proposed setback levee as described in the 30% design will divide the well field property. Access provisions to the east half of property will be required, designed to accommodate construction and maintenance equipment vehicle loadings, limited clearance and turning movements.
- Proposed site utilities at the Camas and Washougal well field include raw water transmission, water treatment plant backwash discharge, power / communication conduits and pipeline air release / siphon breaker installations at the levee crest. Increased construction costs and future permitting requirements resulting from levee routing through the property would dictate that the installation of these pipeline crossings occur with the proposed levee construction.

- Levee construction will result in a loss of developable property. Levee easement, setback and use restrictions must be identified and compatible with well field development including potential overlap of wellhead sanitary control zones.
- New and modified levees are proposed to include pedestrian trails. What security measures will the project include to protect the well development project?
- How will BPA ensure that all commitments to the cities of Camas and Washougal are followed? Will BPA ensure that all uses associated with the proposed well development project be permitted and guaranteed into the future?

Other Comments

Members of the public also raised issues not falling into any of the categories described above. Comments on these other issues included the following:

- What impacts will increased development upstream on Gibbons Creek have on air quality?
- What costs will this project have on the local population?
- Will there be any noise associated with project construction?
- Will the project have impacts on traffic on Highway 14?
- What is the commitment to maintain Gibbons Creek north of Highway 14?
- The City of Washougal has proposed a bus barn north of Highway 14 adjacent to the project area. What effects will this proposal have on the project and the area?
- What is the estimated cost savings to the Port?
- Will the project have any land use or regulatory consequences to neighboring or affected properties?
- The project is within the Columbia River Gorge National Scenic Area. How will this be considered?
- How can public access to the present recreation trails be maintained?
- What is the relationship of the project to the Northwest Power and Conservation Council and Independent Scientific Review Panel?
- Will BPA be looking at other restoration projects to learn lessons about similar types of projects?
- Will the project have any impacts on operations or access to overhead or buried power lines at or surrounding the Refuge?

Appendix B: Draft EA Public Comments and Responses

Comment Number	*Date* Name (Organization)	Item Number	EA Section	Comment	Response	Location(s) of Edit in Final EA
STEIG18 0001	*N/A* Sadar/Sad	1		Beryllium is a lightweight but strong metal used principally in the aerospace and defense industries. The most common use is in beryllium-copper alloy because of its electrical and thermal conductivity, high strength and hardness, good corrosion and fatigue resistance, and nonmagnetic properties. Another form is beryllium oxide which is an excellent heat conductor, with high strength and hardness, and acts as an electrical insulator in some applications. Beryllium is also found as a trace element in metal slags that are sometimes used in abrasive blasting. http://steelsbuilding.com	No change made to Environmental Assessment (EA).	N/A

Comment Number	*Date* Name (Organization)	Item Number	EA Section	Comment	Response	Location(s) of Edit in Final EA
STEIG18 0002	*N/A* Elder	1		It is assumed that this project could have an effect on the Purple Martin Swallows colonized at Steigerwald for the last 20 + years. It is possible that these colonies will have to be relocated? Disruption of these birds is of concerned. Bruce Cousens, PhD Purple Martin expert offers the following on the Purple Martin colonies at Steigerwald, in reply to the question of "How do you relocate a Purple Martin colony"?: "Relocation of a colony to a new site nearby should ideally be done over 3 years (it can often be done over 2 years in an emergency, but that's pushing it and some pairs may abandon the site), as follows:" "Year 1: Place new nest boxes at the new colony location, or move up to a third of the existing boxes/gourds - depends in part on the age and condition of the old boxes or gourds and whether some will be replaced, which can be incorporated into the move. Try to avoid removing old nest boxes/gourds after the birds arrive to minimize disturbance, and have them relocated in time for the subadults to arrive - it they are taken down for the winter, that's ideal and they are simply relocated appropriately when replaced." "Result: The adult birds will return to their previous nest site as usual, but new subadult recruits will occupy the new site as cavities at the original site become fully occupied, and the adults will become accustomed to the new active colony site over the nesting season." "Initial subadult occupancy at the new site will be partly a function of subadult recruitment strength, which depends on production and post fledging survival the previous season - 2-3 pairs is sufficient to start the transition, more is a bonus. This situation is somewhat dynamic - if the adult return and occupancy rate at the old site is low, some of the vacant gourds can also be removed and relocated to encourage subadult use of the new site; if subadult recruitment is strong, additional housing can be added at the new site. The objective is retaining adult birds at the original colony site and having 2-yr old adults returning to the new colony location the following spring." "Year 2: Move (and/or replace) up to half of the remaining nest boxes or gourds to the new colony location at the start of the nesting season (again, remove old cavities before the birds arrive, etc.)." "Result: The earliest returning (3+ yr old) adults will continue to return to the older cavities at their original colony nest site, while later-returning 2 yr old adults will return to their previous nest sites at the new colony location and subadults will join them wherever vacancies are available." "(This is where the process can be accelerated to 2 years if necessary - all the remaining nest boxes/gourds can be moved to the new site, and with luck most/all of the older adults will relocate successfully, but since all first-arriving 3+ yr old adults will be returning to the original colony site, now gone, some may not accept the disturbance, abandon and move on.)" "Year 3: Move (and/or replace) all the remaining nest boxes or gourds to the new colony location before the first adults return." "Result: Some earlier-returning 3 yr old adults will return to this location, any remaining older adults from the old colony location will usually join them, the later-returning 2 yr old adults will return to this site as well and new subadult recruits will simply join the colony where vacancies are available." "Your usual practice of delaying spring gourd rack set-up until May to avoid starling interest should still work with this procedure, as long as housing is provided at both sites at the usual time during the transition. Setting up the poles and racks when they arrive and adding the gourds later may help to hold them at the sites during the confusion of the transition phase." The procedure obviously depends on how much lead time you have before dike breaching and flooding (which won't bother the martins but will limit access for monitoring and banding during the nesting season). This should NOT be attempted in a single season by simply relocating the entire colony unless this is unavoidable - in this case, it's possible some adult pairs that 'anchor' the colony (like an anchor tenant at a mall) and re-establish it annually will adapt and accommodate the change (particularly since your birds are used to having housing provided some time after they arrive to limit starling use), but other older pairs likely will not, so the colony may have to be rebuilt over at least several years, and in a worst case scenario (unlikely) all adult pairs will abandon the site and go elsewhere and the colony will be rebuilt over 4-5 years from new subadult recruits." "(Much of our understanding of this situation comes from failures and horror stories with careless eastern martin colony relocation attempts, so we're learning as we go along in the west, with little relocation experience so far.)" Mr. Cousens may be contacted at pmartins@island.net	Steigerwald Lake National Wildlife Refuge (Refuge) has three sets of gourd arrays for Purple Martins. One is located at the trailhead parking lot and consists of a single pole supporting 8 gourds. The second array is located just west of the existing fish ladder and consists of two poles with 8 gourds each. The third array is located outside the likely project area near the old barn west of Redtail Lake and also consists of two poles with 8 gourds each. The proposed project will impact the array at the Trailhead Parking Lot and it is likely to impact the array at the existing fish ladder. The Refuge proposes to relocate the array at the trailhead parking Lot to a location west of Gibbons Creek or north of State Route 14 (SR14) during the winter of 2018/2019 if the Proposed Action is implemented, after the purple martins have migrated south. An exact location has not yet been selected, and would be identified once the construction, equipment staging area, and infrastructure plans are completed in order to avoid having to move the array twice and to reduce disturbance to the birds during the breeding season. It is anticipated that the location of the new array would be less than 1000 feet from the existing array. The array near the existing fish ladder would likely also have to be relocated, based on current construction plans. As stated above, an exact location has not been determined (pending final plans), but a suitable site on the south side of Redtail Lake about 1,500 feet west of the current location appears to be available based on the current plans. The two poles in the array near the existing fish ladder would be relocated during the winter of 2019/2020, after the purple martins have migrated from the area. The array located near the old barn is outside the project area and is not likely to be directly impacted. There may be additional construction traffic in the vicinity during the spring and summer of 2020, but the disturbance should not be sufficient to cause significant impacts to adults or chicks. For reference, the gourds located 400 feet from SR14 and the trailhead are subject to heavier disturbance than is expected at the old barn site, and Purple Martins have successfully fledged chicks from this site each year. The Refuge does not anticipate that the proposed project would have a significant impact on Purple Martins that use the Refuge during construction or following project completion. The poles will be relocated in the vicinity of the existing poles and in suitable habitat. In the past, the Refuge has installed new poles in suitable habitat located miles away from existing colonies and has seen successful occupation of those colonies in the first year, so long as the gourds were placed early in the spring and starlings were prevented from using the gourds. Any impacts that do occur should be limited to a single breeding season.	Section 3.15.2.2.1

Comment Number	*Date* Name (Organization)	Item Number	EA Section	Comment	Response	Location(s) of Edit in Final EA
STEIG18 0003	*N/A* Dave Pinkernell (Columbia Gorge Refuge Stewards)	1		I and the Columbia Gorge Refuge Stewards strongly support the Steigerwald Habitat Restoration and Flood Control Project.	Thank you for your comment.	N/A
		2		It re-establishes nearly 1000 acres of floodplain critically important for salmon recovery.	Comment noted.	N/A
		3		In addition, it improves the refuge's trail system for the public to better enjoy and learn about nature.	Comment noted.	N/A
		4		The project solves the problem of Gibbons creek overflowing into the Port, and reduces flood risk to our community. As a volunteer who has seen Gibbons creek overflowing it's banks and nearly damaging HWY 14's bridge over the creek, it is important action be taken soon before a major flood takes out the bridge.	Comment noted.	N/A
		5		I encourage the BPA to move forward with their plan to make this project happen	Comment noted.	N/A
STEIG18 0004	*N/A* N/A	1		Creating wetland can result in greater amounts of methane gas being released. This is a clean air concern. How will the methane gas production that would result if this project is constructed be measured?	Although it is true that wetlands are a net producer of methane (Chapellaz et al. 1993)[1], the amount of methane produced on a local level is well below levels that would constitute a public health concern. In this instance, methane would be a concern if there were a landfill or extensive peat bogs at the site, but neither is present. On a global scale, although wetlands produce methane, they are very efficient at sequestering carbon, and as sinks for greenhouse gases, they attenuate warming of the atmosphere due to greenhouse gases (Whiting and Chanton 2001)[2].	N/A
		2		In addition, removing grasslands will reduce the carbon sequestration benefits that the site currently provides.	Please see response to previous comment.	N/A
STEIG18 0005	*2/19/2018* Grace Bailey	1		How about the effects on ground water supply since the EA mentioned in 1.5.8 about future water well field.	It is anticipated that greater inundation of the floodplain would improve groundwater supplies by increasing the area of infiltration into the groundwater aquifer. See Section 3.14.2.2 for discussion.	N/A
		2		Would you plant Rhody flower plants (WA's state flower) along the south side of Hwy 14 to beautify this segment of roadway? I know this is a wildlife project (wild plants too). But being at the entrance of scenic gorge, a blazing spring color flower welcoming visitors will certainly highlight the approach from the west side.	Comment noted. Washington State Department of Transportation (WSDOT) makes decisions on the type of vegetation installed along their roadways, therefore the decision as to the ornamental planting palette is beyond the scope of this assessment.	N/A
		3		I think the plants should not be too tall to screen out the view but must provide color to get people's attention. I consider this an important cultural/economic development resources!! Pocket change from 2 million.	Comment noted. Please refer to the response to the previous comment.	N/A
STEIG18 0006	*2/20/2018* John L. Devney (Delta Waterfowl Foundation)	1		We are writing today to offer our perspective related to the Draft Environmental Assessment currently underway in consideration of the Steigerwald Floodplain Restoration Project. We have submitted comments directly to the United States Fish and Wildlife Service on October 27, 2017 and we appreciate the opportunity to offer our comments again on this important issue.	Comment noted.	N/A
		2		As an organization with a mission to ensure the future of waterfowl and waterfowl hunting, we have followed with great interest a variety of efforts in the Pacific Northwest to restore salmon habitat that have frequently come at cross purposes with the habitat needs of waterfowl. We would like to be on the record that we support a diversity of efforts to restore habitat to assist beleaguered salmon and trout stocks. Those efforts are certainly an important and noble task.	Comment noted.	N/A
		3		We are however concerned as we have witnessed a number of occasions where such restoration efforts have negatively impacted wetland and waterfowl habitat with an unknown benefit for salmon. Oftentimes, these restoration efforts have occurred on National Wildlife Refuge lands or other public trust lands, lands that were clearly established, chartered and managed for waterfowl and other migratory birds. We have consistently opposed this change in management focus and resultant habitat changes resulting from restoration activities. This is the case with Steigerwald National Wildlife Refuge which has become important waterfowl habitat since it was developed.	The Proposed Action does not change the management focus in that the habitat acreage objectives of the Refuge's Comprehensive Conservation Plan (CCP) and other cooperative agreements will still be met. The Proposed Action would not reduce any waterfowl habitat areas to the point where waterfowl habitat would be limited and in fact would create 115 acres of new wetland habitat in areas that are currently upland habitat dominated by reed canarygrass, which is of lower value than a diverse wetland plant community. See Sections 3.13.2.2 and 3.14.2.2, which discuss beneficial wetland impacts.	N/A
		4		The draft of the restoration plan clearly shows that efforts to reconnect flows within the floodplain which will no doubt have negative consequences for preferred wetland habitat for waterfowl and as a result likely significantly decrease waterfowl use of the area.	See previous response.	N/A

Comment Number	*Date* Name (Organization)	Item Number	EA Section	Comment	Response	Location(s) of Edit in Final EA
STEIG18 0006	*2/20/2018* John L. Devney (Delta Waterfowl Foundation)	5		Additionally, the infrastructure investment that has been made to the Refuge explicitly for the purposes of wetland and waterfowl management will either be removed and or rendered ineffective, and as such the significant public investment will be lost.	The affected infrastructure was installed either for flood control (levees) or to provide fish access to Gibbons Creek (fish ladder and elevated canal). Both of these functions would be either maintained or improved by the Proposed Action, and would not diminish the ability of the United States Fish and Wildlife Service (USFWS) to manage specific habitats according to their goals and objectives. Additionally, wetland habitat would be increased by 115 acres, therefore the Proposed Action would result in an increase in both the quality and quantity of waterfowl habitat. See Section 3.13.2.2 of the EA.	N/A
		6		Based on our review, we strongly suggest the No Action alternative be chosen as prescribed in the Environmental Assessment. We appreciate the interest, passion commitment and resources focused on enhancing salmon habitat, yet we strongly believe that those efforts should not be on sites where other high value natural resources are already being provided and could be lost as a result of the restoration.	Steigerwald Lake National Wildlife Refuge was selected for this project as it offers the opportunity to restore salmonid habitat while maintaining the current uses of the site. USFWS only agreed to allow the project designs to move forward after completing a review of the proposal in order to ensure that the Refuge's waterfowl habitat goals would continue to be met.	N/A
		7		We urge BPA and the partners to evaluate other sites where restoration activities can be conducted without the potential for other deleterious impacts to waterfowl and wetland habitat.	See previous response.	N/A
		8		If BPA and the partners proceed with the restoration at Steigerwald, we expect that full mitigation for lost waterfowl habitat be conducted in close proximity at the full expense of the project.	Thank you for your comment. Although some waterfowl habitat would be converted to another habitat type, the Proposed Action is designed to continue to meet the goals of the Refuges' Comprehensive Conservation Plan and provide an overall increase in wetland habitat quantity (+115 acres) and quality for both fish and migratory waterfowl. Furthermore, the area of waterfowl habitat types that USFWS specifically manages for would still be above the goals specified in USFWS's CCP.	N/A
STEIG18 0007	*2/19/2018* James R. Clapp (Former Refuge Manager)	1		Before I begin, I would like to ask that you include in the final EA the following: Location of your responses/information to the Comments made in the Scoping Summary Report and if you did not address them, a description as to why not.	Section 1.5 of the EA includes a discussion of the public scoping process and issues raised during that process. The Draft EA does contain information and responses relevant to all scoping comments received that were within the EA's scope of analysis. Since many of the scoping comments were addressed in multiple locations throughout the EA, directing the readers to the specific locations of this information is not feasible.	N/A
		2		Shouldn't the determining criteria to designate an impact as low or moderate be described somewhere near the beginning of the EA?	Revised text as follows: Impacts that were determined to be minimal or barely noticeable were characterized as "low", those that were more than negligible were characterized as "moderate", and those characterized as "High" impacts were those considered to be noticeable, significant impacts, whereas moderate and low impacts are not.	Section 3.1
		3	1.4.4	States that the 430-acre industrial park was inundated during the 1996 flood. This is not so. It was threatened, but to my knowledge was not inundated.	Sentence wording changed to clarify that site was threatened, not inundated, during 1996 flood.	Section 1.4.4
		4	2.1	Should reflect location of description of flood damage reduction system after "FDR".	Added parenthetical reference to section 3.14.1.2 after 'FDR' in text of section 2.1.	Section 2.1
		5	2.1.1	Last sentence. Change to read"…be acquired in fee title or a flood easement."	Sentence wording revised as suggested.	Section 2.1.1
		6	Figure 2-2	Identification of private pedestrian bridges at north end of Gibbons Creek. Change to read "Replace private pedestrian bridges".	Label changed on Figure 2-2.	Figure 2-2
		7	Figure 2-2	Add "SR14" to "Closure Structure".	Label changed on Figure 2-2.	Figure 2-2
		8	Figure 2-2	Change "Gibbons Creek Canal" to "Gibbons Creek Channel".	Label changed on Figure 2-2.	Figure 2-2
		9	2.1.2.1.1.1	Channel Geometry, Para 1, Sentence 1. What about sedimentation from the Columbia River into the Channel 3 outlet?	A geomorphological and sediment transport evaluation has been performed as part of the project planning, and the channels have been designed to move sediment through the system. It is expected that the Columbia River would deposit sediment (primarily sand) at the outlet/confluence area of Channel 3. Although these sediment deposits may persist for extended periods, Gibbons Creek's perennial flow and velocities have the capacity to erode through them, quickly establishing channels and providing fish passage. This is analogous to other confluence areas in the Columbia River Gorge, such as Lawton and Bridal Veil Creeks.	N/A

Comment Number	*Date* Name (Organization)	Item Number	EA Section	Comment	Response	Location(s) of Edit in Final EA
STEIG18 0007	*2/19/2018* James R. Clapp (Former Refuge Manager)	10	2.1.2.1.4	Para 1, Sentence 1. What about expansion of wood habitat structures by beaver, which could block the Gibbons Creek water flow? It has occurred times before.	The Refuge currently supports multiple beaver colonies in Straub Lake and Gibbons Creek. The Refuge expects that the Proposed Action would create additional habitat for beaver and considers this a desirable condition. Beaver are an important part of floodplain ecosystems and increase the diversity of vegetation and habitats. Lodges provide nesting and loafing areas for waterfowl. Beaver impoundments can suppress areas of invasive reed canarygrass and promote submergent and emergent wetland plants that require a longer period of flooding than reed canarygrass can withstand. Studies have shown that beaver dams are not an impassable barrier to juvenile or adult salmonids. Beaver have dammed Gibbons Creek periodically and this can cause problems with overtopping of the elevated channel and water backing up into the channels leading to the Port of Camas/Washougal. This has required significant maintenance by staff and volunteers. The Proposed Action separates Gibbons Creek, Steigerwald Lake, and Straub Lake from the Port and will remove the elevated channel, so no beaver impacts to infrastructure are expected following construction. The Refuge has no current plans to encourage beavers to impound Refuge waterbodies at specific sites. As the site matures in the years following the project, the Refuge may reconsider and may install devices to attract beavers in specific areas.	N/A
		11	2.1.2.2	Paragraph (Para from now on) 5, Sentence 1. Add "south of SR 14" between "Restoring the southern portion of Gibbons Creek" and "would involve removing…".	Phrase added to sentence in requested location.	Section 2.1.2.2
		12	2.1.2.3	Para 1, Sentence 3. Change "high velocity" to "higher velocity".	Changed 'high' to 'higher'.	Section 2.1.2.3
		13	2.1.2.4.1	Para 3, Sentence 2. Change to "The parking lot, bike parking, trailhead and restroom would be relocated to Refuge property on the west side of the west setback levee".	Sentence restructured as requested.	Section 2.1.2.4.1
		14	2.1.2.5.2	Para 2, 4th line. Reads "…concrete wall has been designed to with landowner input…" Should the word "to" be deleted?	Yes. The word 'to' has been deleted.	Section 2.1.2.5.2
		15	2.1.2.5.2	Para 2, Sentence 6. Where do the north/south ends of the gravel road along the Gibbons Creek floodwall tie into?	The south end ties into SR 14, the north end is a dead end.	Section 2.1.2.5.2
		16	2.1.2.5.3.1	Would signage be needed ahead of the road closure structures? Where, when, and by who?	By the Port of Washougal (Port) or WSDOT, prior to placement. Sentence added in text.	Section 2.1.2.5.3.1
		17	2.1.2.5.3.1	Where would all these be stored when not in use? How would empty sleeves be kept free of debris, and by whom?	As stated in the text, the panels would be stored nearby on Refuge property in a fenced gravel area located close to SR14. Maintenance of the panels would be performed by the Port. See Section 2.1.2.5.3.1.	N/A
		18	2.1.2.6	Para 1. Remind the reader who the project sponsors are in this paragraph.	The project sponsors are previously described in sections 1.1 to 1.3 of the EA.	N/A
		19	2.1.2.6	What work to be done to promote survival without invasives? By who? How long?	Additional information has been added to the EA and this work would be performed by Refuge staff.	Section 2.1.2.6.3
		20	2.1.3.1.1	Where/how will vegetation/organic material removed be disposed of?	Organic materials (topsoil and vegetation) removed during construction would be disposed of in one of two areas: (1) in the levee overbuild, which is located on the levees' waterward side and serves as the wind/wave protection berm or (2) in the upland habitat enhancement areas. The exception is medium to large trees, which would be removed intact and used as wood structures in the newly constructed floodplain channels.	Section 2.1.3.1.1
		21	2.1.3.1.4	Para 1. What is the "wave break embankment", and where is it located?	Text corrected to refer to vegetated levee overbuild sections, which are shown on Figure 2-2.	Section 2.1.3.1.4
		22	2.1.3.1.4	Last sentence -Where you refer to the earthen berm along Gibbons Creek, add "north of SR 14".	Phrase added to sentence.	Section 2.1.3.1.4
		23	2.1.3.1.6	Sentence 1. Which levee? If several, identify which ones, or if all, start sentence with "All…".	All levees. Sentence revised to start with 'All…'.	Section 2.1.3.1.6
		24	2.1.3.1.6	Gravel access roads – Identify which one(s) will be graveled	All gravel access roads. Sentence unchanged because this was clarified by insertion of 'All' at the beginning of the sentence in response to the previous comment.	N/A
		25	2.1.3.1.7/ Figure 2-2	Has the site been determined? If so, put in Fig. 2.2 and identify here. If not, say when and how it will be determined.	The site of the interior drainage structure (to be constructed within the eastern setback levee) will be identified in 100% design plans, and would be based on topography and drainage.	N/A

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STEIG18 0007	*2/19/2018* James R. Clapp (Former Refuge Manager)	26	2.1.3.1.8	How will new plantings at the trailhead be irrigated for survival? Or won't there be any, since the new parking area will be outside the Scenic Area? You might say so, since the existing one was heavily planted (and irrigated).	The new trailhead parking area is located outside the Scenic Area, but the Refuge considers it an important component of visitors' experience. A planting plan is currently being developed that will include perennial native vegetation appropriate to the site conditions. It is not expected that an irrigation system would be needed. The contractors hired to plant the vegetation would be required to have a minimum survival rate of 70% after two growing seasons. Perennial plants that survive two growing seasons should have well developed root systems and should not require additional watering. Mention of native vegetation installation has been added to Section 2.1.3.1.8.	2.1.3.1.8
		27	2.1.3.1.12	What about leaking water between SR 14 closure structures and the SR 14 roadbed when water is flowing between the closure structures?	The closure structure has been designed to prevent substantial leaking of water to areas beyond the structure.	N/A
		28	2.1.3.2	last sentence. Change to …construction of the new "Columbia River" levee, and only down to the same FEMA elevation…	Thank you for your comment. However, the word "setback" before "levee" has been inserted instead.	Section 2.1.3.2
		29	2.1.3.2	Line 2. Change to …removal of existing "Columbia River" levee to maintain flood risk..	We did not make this change as doing so would have been counter to the naming convention used in this EA.	N/A
		30	Table 2-6	Second Construction Season. 1. Regarding "Remove old Refuge Parking Lot and stockpile art elements for relocation". Where will they be stockpiled? When do existing parking lot amenities get moved to the new parking area? Part of the construction process? If so, describe so. Will the old parking lot be open and provide access to the existing trail along the Gibbons Creek dike? Have you discussed with Ridgefield Complex staff?	Added "at Refuge headquarters" after "elements". Exact timing of moving parking lot amenities has not been determined and this would likely be left to construction contractor. The old parking lot would be closed for the duration of the construction period, and has been discussed with Refuge staff. Removed sentence in Table 2-6 that said "This allows use of the lot during the winter between seasons if desired."	Table 2-6
		31	Table 2-6	Second Construction Season. 10. Do access roads get built at this time? Access road from new trailhead parking lot up to top of west setback levee? Add which roads are built at this time?	All access roads get built during the second construction season. Added wording about "access roads" to Item 10 under "Second Construction Season".	Table 2-6
		32	Table 2-6	Second Construction Season. 11. Where is the "central access road" located? The one into the existing parking lot?	Along the elevated canal. Clarification added.	Table 2-6
		33	Table 2-7	Item 4. Proposed Action Column. Bullet 1. Replace "building a levee" with "building a West Setback Levee that removes 124 acres."..	Bullet reworded as requested.	Table 2-7
		34	Table 2-7	Item 4. Proposed Action Column. Bullet 2. Add "after "…dredge Gibbons Creek…"	Thank you for your comment, however, "after" is not necessary to include.	N/A
		35	Table 2-7	Item 4. Proposed Action Column. Bullet 6. What is the "Steigerwald levee". It is not identified in Figure 2-2.	Refers to Washougal-Columbia River Levee (WCRL). Sentence corrected. 'Steigerwald levee' replaced with 'WCRL'.	Table 2-7
		36	Table 2-7	Item 4. Proposed Action Column. Bullet 9. Eliminate the bullet.	Bullet has been deleted.	Table 2-7
		37	Table 2-8	Aesthetics/Visual Resources. Proposed Action. Bullet - "Obscured views of Gibbons Creek due to the floodwall." This can be deleted. Because of the low elevation of Gibbons Creek at this site, it is not currently visible.	Some residents that live north of SR14 may see it from their back yard, so this has not been deleted.	N/A
		38	Table 2-8	Land Use and Recreation. Proposed Action. Bullet 1. The Refuge and CRDT is permanently closed to all types of hunting, including waterfowl.	Comment accepted. The phrase "including waterfowl hunting" removed from sentence, so sentence reads "…the CRDT would be closed to recreational uses from June to ….".	Table 2-8
		39	Table 2-8	Land Use and Recreation. Proposed Action. Bullet 1. If both the existing and new parking lots will be closed during the winter season, access to the CRDT will be accessible from the Port Plaza parking lot along the Columbia River.	Comment noted. Details added to bullet in Table 2-8.	Table 2-8
		40	Table 2-8	Transportation and Infrastructure. Bullet 5. Add "during periods of high water levels" after "wind wave action".	Phrase added to sentence.	Table 2-8
		41	Table 2-8	Transportation and Infrastructure. Bullet 7. Is this the case only in Construction Season 2, while amenities are being moved from the existing to the new parking lot? If so, say so.	No, the parking area will be closed for the entire construction period.	N/A
		42	Table 2-9	Land and Recreation. Add Bullet 3. Provide local news media personal with plans for the project close to the initiation of the first and second construction seasons, and upon completion.	Did not add suggested text. BPA will continue to coordinate with stakeholders, landowners, governmental entities, and interested parties throughout the extent of the National Environmental Policy Act (NEPA) process, and if the project is approved for construction.	N/A
		43	Table 2-9	Vegetation and Wetlands. Bullet 4. Add "and from" after "mobilized to …"	Phrase added to sentence.	Table 2-9
		44	Table 2-9	Vegetation and Wetlands. Bulleted 5. Add need for mulch after plantings are completed.	A second sentence was added to the bullet.	Table 2-9
		45	Table 2-9	Water Resources. Bullet 1. Add "…and post construction,…" after "environmental baseline".	Text added.	Table 2-9

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STEIG18 0007	*2/19/2018* James R. Clapp (Former Refuge Manager)	46	Table 2-9	Water Resources. Bullet 15. Add at end "Erosion control measures will be removed at appropriate times."	Phrase added at end.	Table 2-9
		47	Table 2-9	Water Resources. Bullet 19. Add at end "Remaining soils will be incorporated into Refuge lands or disposed of as deemed appropriate by planners and Refuge staff".	Phrase added at end.	Table 2-9
		48	Table 2-9	Wildlife. Bullet 1. Add "and Canada" after "cackling".	Text added.	Table 2-9
		49	3.2.1	Para 1, last line. Change "gorge" to "Columbia River Gorge".	Change made.	Section 3.2.1
		50	3.2.1	No. 2. Delete "," after "that".	Comma deleted.	Section 3.2.1
		51	3.2.1	No. 4. Add a space after "4."	Text aligned with previous indented text.	Section 3.2.1
		52	3.2.1	Page 3-5, Para 3, Line 3. Change "two" to "three"	Two' changed to 'three'.	Section 3.2.1
		53	3.2.1	Last sentence. Change to "One is west of Redtail Lake, a second is on both sides of Gibbons Creek north and east of Redtail Lake, and the third one is between the WCRL and Columbia River west of the mouth of the realigned Gibbons Creek channel".	Sentence revised as requested.	Section 3.2.1
		54	3.2.2.1	Para. 1, Line 1. What does the "built levee" refer to? The WCRL? If so, use it.	Yes. Changed to WCRL.	Section 3.2.2.1
		55	3.2.2.2	Para 1, sentence 1, Line 2. Add "Gibbons Creek" between "elevated" and "channel (changed from canal)".	Phrase added to sentence.	Section 3.2.2.2
		56	3.2.2.2	Lines 2 and 3. Delete "a" between "creating" and "new wetland areas".	The word 'a' has been deleted.	Section 3.2.2.2
		57	3.4.1.2	Page 3-19, Para 1, Line 3. Change "…did not identify and additional artifacts" to "did not find any additional artifacts".	Change made.	Section 3.4.1.2
		58	3.5.1	Para 1, Line 1. "…between 1974 and 1983…" Not sure what this time period refers to. Confirm with Alex Chmielewski, Complex Biologist.	It refers to construction of a second powerhouse at Bonneville Lock & Dam. Comma removed to clarify sentence.	Section 3.5.1
		59	3.5.1	Page 3-20, Para 3, sentence 3. Change "has been altered by past efforts to drain the land…" to "has been altered by previous landowners to drain the land…"	Change made.	Section 3.5.1
		60	3.5.1	Page 3-22, Para 1. River Lamprey. (May be Western Brook Lamprey). Surveys were done above the fish screens and south of SR 14, I think between 2009 and 2014 by USFWS or WDFW biologists. Check with Alex C for accurate information.	Comment noted.	N/A
		61	3.5.1	Page 3-23, Para 3, last sentence. Change "Pikeminnow" to "pikeminnow".	Change made.	Section 3.5.1
		62	3.5.1	Page 3-24, Para 2, Line 3. Insert "from the Refuge" between "across the Columbia River" and "at the Sandy River Delta".	Phrase inserted.	Section 3.5.1
		63	3.6.1.1	Page 3-34, Para 1, Sentence 3. Change "aqueduct" to "channel".	Change made.	Section 3.6.1.1
		64	3.6.1.1	Page 3-34, Para 1, Sentence 3. Change to "The easternmost dike crests about 25 ft and has a gravel road on top of it". This is not a multi-use trail, as it does not allow public use.	Sentence revised as requested.	Section 3.6.1.1
		65	3.7.1.1.3	Check with Ridgefield Refuge staff – Do any of the objectives need to be changed to coincide with the objective acreages for the Proposed Project?	Changes in the habitat acreage objectives are not expected to be drastically different that those outlined in the CCP. Some changes to wetland types are expected as reed canarygrass wetlands are converted to robust emergent marshes (through wetland scraping) or semi-permanently-flooded wetlands (through beaver activity). Some areas of pasture are likely to become wetter for portions of the year (i.e. spring freshet), but will largely remain pasture.	N/A
		66	3.7.1.1.5	What government agency is responsible for The Farmland Protection Policy Act? Might want to mention it here.	Text refers to the Natural Resources Conservation Service, who is responsible for the Farmland Protection Policy Act.	N/A
		67	3.7.2	Para 2. If the site access, parking and trail network are to be moved from their current site, wouldn't the impacts be moderate as stated in 3.7.2.2.1?	Construction impacts would be moderate, as stated here and in Section 3.7.2.2.1. Long term impacts would be low, as stated here.	N/A
		68	3.7.2.1 2	Same impact as in 3.7.2?	Yes.	N/A

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STEIG18 0007	*2/19/2018* James R. Clapp (Former Refuge Manager)	69	3.7.2.2.1	Sentence 3. Add “from the CRDT” after “the seasonal Redtail Lake loop trail, …”.	Phrase added.	Section 3.7.2.2.1
		70	3.7.2.2.1	Sentence 4. After this sentence (which ends …access to the Refuge along the CRDT.), add “The CRDT can be accessed at the Port Plaza parking lot, reached from SR 14 onto 32d Street”.	Phrase added.	Section 3.7.2.2.1
		71	3.7.2.2.2	Para 1, Sentence 2. When would the parking lot (and amenities) be completed? Season 2?	Yes, Season 2.	N/A
		72	3.9.1/ Figure 2-1	Para 3. Where is this utility trench? Put on Figure 2-1? On whose property? Who constructed it?	It is not clear where the utility trench is located. Mention of it has been removed from the EA.	Section 3.9.1
		73	3.9.2.1	Para 2. Who would verify the plans/training?	The contractor would need to guarantee a particular survival percentage, likely 70%. This would be covered in the contract specifications.	N/A
		74	3.10.1	Para 2, Sentence 2. Replace with “USFWS stationed a law enforcement officer at the Refuge beginning June 2016 (double check with Ridgefield Refuge staff). He is responsible for law enforcement on all four of the Ridgefield Refuge (Ridgefield, Steigerwald Lake, Franz Lake, and Pierce).	Text added as requested.	Section 3.10.1
		75	3.10.2.1	Para 1. Again, who would develop, and subsequently ensure the health and safety plan meets what standards?	This would be covered in the contract specifications.	N/A
		76	3.10.2.1	Para 2/3. Same as in Para 1, for the traffic control/management plans? Also, who would be responsible for compliance with developed plans?	This would be covered in the contract specifications.	N/A
		77	3.11.1	Para 2. Use “WA” or “Washington” rather than “Wash”.	Changed to Washington.	Section 3.11.1
		78	3.11.2.2.2	Page 3-69, Last Sentence. Add “at Bonneville Dam,” prior to “…, which begins a short distance upstream of the Refuge …”.	Phrase added.	Section 3.11.2.2.2
		79	3.12.1	Page 3-70. Para 3. Change “Highline Canal” to “..elevated Gibbons Creek channel and dike”.	Wording changed as requested.	Section 3.12.1
		80	3.12.1	Page 3-72, Para 1. Bullet 1. Sentence 2. Add “parking lot” between “existing” and “driveway”.	Phrase added.	Section 3.12.1
		81	3.12.1	Page 3-72, Para 1. Bullet 2. Light Pole and Conduit. Lines 1 and 3. Again, add “parking lot” between “proposed” and “ driveway”, lines.	Phrase added	Section 3.12.1
		82	3.12.1	Page 3-72, Para 1. Bullet 3. Storm Manhole and Storm Line. Line 2. Add “…parking lot” between “proposed” and “driveway”.	Phrase added	Section 3.12.1
		83	3.13.2.2	Para 2. Monitoring (pre and post), planting, and maintenance plans to be developed by Refuge biologist? Say so. Any funds for maintenance for Years 2-3? Who to do what?	Monitoring and maintenance would be a shared responsibility between the Refuge and the Project sponsors. Much of the initial monitoring will be required by permitting agencies. Once the initial work is completed, the Refuge, in cooperation with its partners, would assume management of the site, which would include all project monitoring and maintenance. BPA funds Level 3 action effectiveness monitoring (AEMR) under Lower Columbia Estuary Partnership’s (LCEP’s) habitat contract and Level 2 AEMR under LCEP's monitoring contract.	Section 3.13.2.2
		84	3.14.1.1	Line 3. Delete “s” from “Port lands”.	Done.	Section 3.14.1.1
		85	3.14.1.1	Page 3-91, Para 1. Line 1. Add “overflow from” between “include” and “Gibbons Creek…”.	Phrase added.	Section 3.14.1.1
		86	3.14.1.1	Page 3-91, Para 1. Line 7. The elevated channel is referred to as “Gibbons Creek channel: by Refuge staff. The “Highline Canal” reference was from the Executive Director prior to the current one. I I have never heard it referred to as an Aqueduct”.	Removed reference to "highline canal" and "aqueduct".	Section 3.14.1.1
		87	3.14.1.1	Page 3-91, Para 1. During high water conditions, Gibbons Creek does overflow its banks (above the diversion structure) as described.	Comment noted. Thank you.	N/A
		88	3.14.1.1	Page 3-91, Para 1. Straub Lake – Double check the management of water levels with the Refuge biologist. When I was Refuge Manager for 10 years, we never actively manage water flowing from Straub Lake.	Straub Lake water levels are currently managed by a water control structure at the west end of Steigerwald Lake. The water control structures would be removed as part of the project and water levels in the Refuge wetlands and waterbodies would be largely controlled by levels in the Columbia River, Gibbons Creek, and seep flows from the north.	N/A
		89	3.14.1.2	Para 1, Last line. Change “canal” to “channel”.	Change made.	Section 3.14.1.2

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STEIG18 0007	*2/19/2018* James R. Clapp (Former Refuge Manager)	90	3.14.1.4.3	Does "Ecology" refer to "Washington Department of Ecology"? Although you have it listed in your list of acronyms, you might say so here, as you have done with the Oregon Department of Environmental Quality.	The acronym is defined earlier in the text.	N/A
		91	3.15.1.1.3	The title is wrong – change to "Forest-shrub Wetland".	Fixed.	Section 3.15.1.1.3
		92	3.15.1.2	Page 3-104, Para 2, Sentence 1. Add that the first sentence refers specifically to the streaked horned lark.	Sentence amended.	Section 3.15.1.2
		93	3.15.1.2	Para 3 (last paragraph), Sentence 3. Check last part of sentence after "…presence of local populations…" It does not make sense.	The sentence has been edited for clarity.	Section 3.15.1.2
		94	3.15.13	Just checking – Only "Tens of seals and sea lions are known to feed…"?	Exact numbers are not known.	N/A
		95	3.15.13	Page 3-106. If the proposal for the reduced impact to the heron colony was discussed and approved by the Refuge staff, it would be appropriate to indicate this here.	Comment noted.	N/A
		96	3.15.2.2.1	Para 2, Line 1. Start with "Negative" …Impacts…	The word 'negative' was not added because the impacts are discussed sufficiently in the existing language.	N/A
		97	3.15.2.2.1	Page 3-108, Para 2. Sentence 4. Change "…the rookery would be permanently loss…" to "…permanently lost"…	Typo fixed.	Section 3.15.2.2.1
STEIG18 0008	*2/21/2018* Wilson Cady (Vancouver Audubon Society)	1		Thank you for the opportunity to comment on the Steigerwald Lake Restoration Project. The Vancouver Audubon Society has been working to preserve these valuable wetlands at the mouth of the Columbia River since September 1975, when it was taken on as the first environmental project of our newly formed chapter. At that time the entire area within the dike was zoned heavy industrial and slated to become part of the Port of Camas-Washougal Industrial Park and the fish runs in Gibbons Creek were being severely impacted by the failed tidal gate through the dike. We spent the next twelve years gathering data, running surveys, getting public support and lobbying, first for a zone change, then for public ownership. We were pleased when Steigerwald Lake became a National Wildlife Refuge even though their agreements with adjoining property owners reduced the size and seasonal fluctuations of the lake. Unfortunately, the attempt to accommodate fish passage to Gibbons Creek included bypassing the lake, turning the lake into a rain fed pond. Despite the lack of connectivity of the creek to the lake and the lake's much reduced surface area it continues to be one of the premier wildlife sites in Clark County and has become very popular with visitors. When we took this project on forty years ago it was in hope to save a remnant of the wetlands and creek, we never envisioned the removal of the dike and the reconnecting of Gibbons Creek and Steigerwald Lake to the Columbia River. We look forward with anticipation to seeing Steigerwald Lake's return as a fully functioning wetland and the return of fish to a barrier free Gibbons Creek.	Thank you for your comment.	N/A
		2		The addition of logs and other woody debris will be a boon to all of the wildlife using the lake, we would suggest installing a few of the logs vertically to provide some perching areas for birds.	Most of the large woody debris (LWD) structures include vertical logs. They are designed to ballast the horizontal (habitat) logs, but also would provide snag habitat for birds. This wording has been added to Section 2.1.2.1.4.	2.1.2.1.4
		3		It is unfortunate that there will be disturbance to the Great Blue Heron colony during the restoration project and we hope that most of the more extensive work can be done outside of the nesting season.	EA has been updated to indicate that construction specifications would recommend avoiding the rookery during breeding season and to quantify the amount of acreage that would be lost.	Table 2-9 Section 3.15.2.1.1 Section 3.15.2.2.1
		4		Once the creek is rerouted from the canal north of Red-tail Lake the lake may return to its former seasonal nature and once again provide shorebird habitat in the late summer without the seepage from the creek that keeps it full now.	Comment noted.	N/A

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STEIG18 0009	*N/A* Pace	1		Although I was initially skeptical, after some additional study I believe this will be a very good project. Connecting habitat and removing migration barriers is ALWAYS beneficial. This will occur downstream from Bonneville, i.e., below the last impediment before entering the Pacific Ocean. This is especially beneficial because it is on the upper end of the "estuary" that includes all mainstream habitat downstream from Bonneville. Too often, the focus has been on the area that is most subject to tidal influence. This project will address and mitigate for impacts of power operations as the impact of tides as far up as Steigerwald is de minimis ... of concern primarily to walleye fisherman.	Thank you for your comment.	N/A
		2		There is one lingering problem with this proposal but it's common concern since 2008. This is the fact that funds to mitigate impacts in the estuary were essentially an act of extortion on the part of the Hon. James A. Redden, then-presiding judge in NWF v. NMFS, which is still with us. The problem with the approach—aside from being illegal—is that find projects such as this one are "soiled" by the fact that, no matter how good it is, it is still the fruit of the poisoned tree.	Comment noted.	N/A
STEIG18 0010	*2/15/2018* Albert O'Connor (Vancouver Wildlife League)	1		VWL recommends the No-Action Alternative.	Comment noted.	N/A
		2		The Steigerwald Lake National Wildlife Refuge Comprehensive Conservation Plan (CCP) proposes a small hunting area on the Refuge if it is expanded. There is no hunting area included in the Restoration Project to date. Omitting inclusion of hunting on this project requires mitigation.	The Proposed Action would not expand the Refuge. Consideration of a hunting area could be viable in the future, pending the completion of future NEPA process.	N/A
		3		"Refuge's primary mission of providing winter foraging habitat for migratory waterfowl." "Refuge, has been actively managed for wildlife since its establishment in 1987. This management has resulted in a productive and important site for native wildlife species in a region that has been highly altered by humans". The Refuge should be maintained as a waterfowl area as scoped in 1987 for mitigation for construction of North Bonneville Dam.	PL 98-396, Section 303a, authorized the acquisition of the Refuge lands "for the fish and wildlife mitigation purposes associated with (the Bonneville Second Powerhouse Project)". Therefore, use of the Refuge as mitigation for loss of fish habitat is an authorized purpose. The Proposed Action would create 115 acres of new wetland habitat in areas that are currently upland habitat dominated by reed canarygrass, which is of lower value than a diverse wetland plant community. See Sections 3.13.2.2 and 3.14.2.2, which discuss beneficial wetland impacts.	N/A
		4		Our resource management sources have informed WVL the most effective means of controlling reed canary grass is by farming (spraying every three or four years, disking after spraying and planting a cover crop). This method allows re-establishment of smart weed and beggar tick for several years. The method is only applicable with controlled water levels. These sources indicated that flooding is only effective with extended (long) periods of flooding. The mouth of Salmon Creek (Clark County) is flooded with spring freshets and winter flows in the Columbia River and has a thriving canary grass habitat. Washington Department of Ecology says it is very difficult to eliminate canary grass once it is established.	The Refuge acknowledges that reed canarygrass is extremely difficult to eradicate. Given the Refuge's limited resources, it is not practical to attempt to eradicate it entirely from the Refuge. Currently, over 90% of the emergent marsh at the Refuge is reed canarygrass. The species' dominance can be largely attributed to the historically constant water regime. Upon completion of the proposed project, it is expected that periodic prolonged flooding (> six weeks in duration) of the historic lakebed will reduce the coverage of reed canarygrass and increase coverage by robust emergent plants like cattail, tule bulrush, water pepper (a smartweed), and wapato. Repeated flooding or drying can damage the structure of reed canarygrass, increasing the amount of habitat available for native plants and animals. In Campbell Slough within the Ridgefield Nation Wildlife Refuge, and Franz Lake within the Franz Lake National Wildlife Refuge, where prolonged flooding and periodic drying occur every few years in floodplain lakes connected to the Columbia River, native plant species have successfully become established. From a direct management standpoint, it is recognized that an integrated approach that employs spraying, mechanical methods, and flooding can be effective at controlling reed canarygrass. Refuge managers would monitor the site over time, and will incorporate adaptive management techniques. It is expected that as the site matures, the plant community will vary from year to year depending on the hydrology of the site. One factor that could influence the spread of reed canarygrass is beaver, which could impound some of the waterbodies and thereby make some areas less suitable for reed canarygrass. The current management plan includes planting shrubs along the constructed channels, which will help shade out reed canarygrass. As stated above, management of the site would change over time as managers adapt to the new hydrology of the site and to potential future threats to species diversity, such as the migration of other invasive plants (e.g., purple loosestrife and false indigobush, which are present in the Columbia River Gorge) into the Refuge. Invasive plant management would remain a priority management activity at the Refuge. Impacts associated with reed canarygrass are addressed in Section 3.13.2.2.	N/A

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STEIG18 0010	*2/15/2018* Albert O'Connor (Vancouver Wildlife League)	5		Waterfowl surveys have been conducted on Shillapoo Wildlife Area for at least fifteen years. Low water levels projected for the Shillapoo Floodplain Restoration (SFR) were used by the area manager in evaluating waterfowl uses during this time frame and results indicated at least 60 % drop in duck and geese usage. This same drop in waterfowl usage is expected during raised water levels because waterfowl are unable to access the food. These same numbers would be valid for the Steigerwald Lake Floodplain Restoration (SLFR). If the project is implemented, then appropriate levels of mitigation are required. If water level in SLFR reach 2015 levels, there would not have been water in project area. Columbia River flows have been reduced over time (BPA).	The channel bottom elevations have been designed to ensure that a) the wetlands at Steigerwald do not drain completely, and b) during low water periods on the Columbia River, water surface elevations in the interior marshes would be similar to those occurring under current circumstances. The 115 acres of newly created wetland habitat would contain plenty of shallow water with a fringe of emergent vegetation, as favored by migratory waterfowl. Since the wetland area would increase and the plant community would be more diverse than under current circumstances, it is expected that the Proposed Action would result in a net benefit to waterfowl. See Section 3.14.2.2.	N/A
		6		**This project is trading waterfowl habitat for fish habitat.**[3]	The Proposed Action would not change the management focus in that the habitat acreage objectives of the Refuge's Comprehensive Conservation Plan (CCP) and other cooperative agreements would still be met. The Proposed Action would not reduce any waterfowl habitat areas to the point where this would be a limiting factor and in fact would create 115 acres of new wetland habitat in areas that are currently upland habitat dominated by reed canarygrass, which is of lower value than a diverse wetland plant community. See Sections 3.13.2.2 and 3.14.2.2, which discuss beneficial wetland impacts.	N/A
		7		There was a significant acreage of mudflats predicted on the SFR project. Chris Lapp had indicated mudflats were going to be created on SLFR project. At February 12 public meeting it was indicated there would be maybe 200 ac or more of mudflats. We have been informed that mudflats are habitat for shore birds. These mudflats are dead zones for fish and waterfowl (no food). Seems like a waste of valuable habitat and offsets much of acres added to the project.	The presenters at the public meeting do not recall indicating that there would be 200 acres of mudflats, and the hydrologic and vegetative studies do not indicate that this would happen. Straub Lake dries out in the summer and includes a reasonably expansive mudflat, but far less than 200 acres.	N/A
		8		Thirty thousand acres of wildlife habitat are converted to other uses each year in Western Washington. Ninety percent of wetlands in Western Washington have been altered and fifty percent are no longer accessible to wildlife. (Habitat Trends, Biological Facts and Management Activities, Hunter Education Program, Master Hunter Training Materials, WDFW, 2008.) Providing rearing habitat on lands from willing sellers is an opportunity to create new (replacement) wetlands and provide wildlife habitat for other species.	Comment noted.	N/A
		9		Bonneville Power Administration (BPA) needs to implement a pilot project (small scale) on a site not committed for other purposes to demonstrate that the concepts of establishing shallow water habitat for endangered salmon species are valid. This concept is supported by Ducks Unlimited (Gregory Green) and others.	BPA's estuary restoration program was developed to assist BPA in meeting commitments under the National Marine Fisheries Service (NMFS) Biological Opinion (BiOp) for the operation and maintenance of the Federal Columbia River Power System (FCRPS). In this BiOp, Reasonable and Prudent Alternative (RPA) Actions 36 and 37 set targets for improvements in juvenile and adult fish survival in estuary habitat through ecosystem restoration of floodplain habitats in the Columbia River estuary. Since 2007, BPA and the US Army Corps of Engineers have completed over 60 projects restoring over 7,000 acres of estuary habitat (See BPA Final Estuary Programmatic EA, available at https://www.bpa.gov/efw/Analysis/NEPADocuments/Pages/EstuaryRestorationProgram.aspx).	N/A
		10		Returning the project to natural conditions is mythical. "Hydropower dams on the Columbia River have changed the timing, duration, magnitude, and frequency of seasonal flow, thereby altering the natural processes of sedimentation, accretion necessary to maintain wetlands and floodplain habitat (BPA 2016a)".	The Proposed Action is intended to restore functionality of the habitat.	N/A
		11		Gibbons Creek is on 303(d) Washington Department of Ecology list due to the presences of fecal coliform, hence the viability of creek for fish habitat is questionable. Gibbons Creek is listed as Category 4A impaired due to fecal coliform (SLFR EA 2018).	Comment noted. Although fecal coliform is of concern to humans and wildlife, studies have shown that fish are not affected by exposure to this pathogen.	N/A
		12		Results of a new negotiated Canadian Treaty on the Columbia River between Canada and United States could have impacts on the SLFR project (WDFW). This is not discussed in the EA.	Impacts associated with the treaty renegotiation are speculative and are therefore not addressed in this EA.	N/A

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		13		To our knowledge there is no conservation plan in place by commercial fishing below Bonneville Dam. Commercial fishermen's objective is putting fish in the box. Are commercial fisherman salmon's best friend, we think not? A viable conservation plan is an alternative that should be considered before implementing projects like SFR and SLRR. Coastal Conservation Association (CCA) recommended shutting down the commercial fishing in their article, "The Road Once Taken" in Tide, May/June 2014 as method of conserving salmon. The Columbia River has been over fished for decades for salmon.	Thank you for your comment. Management of commercial fisheries is beyond the scope of the EA.	N/A
STEIG18 0010	*2/15/2018* Albert O'Connor (Vancouver Wildlife League)	14		Recommend BPA consider improving in-river salmon rearing habitat in connected sloughs, river deltas and others. These could be significant considering the variable water levels in the Columbia River.	BPA's estuary restoration program was developed to assist BPA in meeting commitments under the NMFS BiOp for the operation and maintenance of the Federal Columbia River Power System (FCRPS). In this BiOp, Reasonable and Prudent Alternative (RPA) Actions 36 and 37 set targets for improvements in juvenile and adult fish survival in estuary habitat through ecosystem restoration of floodplain habitats in the Columbia River estuary. Since 2007, BPA and the US Army Corps of Engineers have completed over 60 projects restoring over 7,000 acres of estuary habitat (See BPA Final Estuary Programmatic EA, available at https://www.bpa.gov/efw/Analysis/NEPADocuments/Pages/EstuaryRestorationProgram.aspx).	N/A
		15		Mitigation is required on this project due the adverse impacts to waterfowl and other wildlife.	Mitigation measures to minimize effects to waterfowl, wildlife, and other sensitive resources are described in Table 2-9. BPA's Habitat Improvement Program (HIP) III conservation measures, shown in Appendix C, are also designed to minimize impacts to listed species during construction and operations.	N/A
		16		M. Ghandi: There is sufficient land on earth for man's need but insufficient land on earth for man's greed.	Comment noted.	
STEIG18 0013	*N/A* Hamby	1		As a long time Washougal area resident, refuge neighbor and supporter, and Port of Camas-Washougal watcher, I look forward to this project becoming a reality. I would like to see every possible accommodation made for a future Gorge Trail location. There are so many winners in this deal. A great investment for the future.	Comment noted. Project design does not preclude the potential for a future gorge trail.	N/A
		2	Figure 2-1 /2-2	I was surprised to note that the mapping for your proposal incorrectly locates Lawton Creek.	Location of Lawton Creek has been corrected on Figures 2-1, 2-2, and 3-6.	Figures 2-1, 2-2, and 3-6
STEIG18 0014	*N/A* Tom Gordon	1		Gentlemen: I support your Steigerwald Floodplain Restoration Project. This will provide more area for juvenile salmon and help all other species that will call this home.	Thank you for your comment.	N/A
		2		I wonder about the area of Cottonwood Beach. Will the currents be changed and affect the beach? After the 1996 flood, currents changed and erosion picked up pace. Cottonwood trees' root systems have been eroded, causing them to fall down. Is it possible to stop the erosion and save the remaining part of the beach by the way the restoration project is constructed?	Hydraulic and geomorphic models indicate that erosion will not be exacerbated by this project. Stopping current erosion outside of the project area is not within the scope of this project.	N/A
STEIG18 0015	*N/A* Wood	1		I strongly support the Steigerwald Habitat Restoration and Flood Control Project, due to its benefits to fish and wildlife. As someone who visits the refuge and serves on the friends board, Columbia Gorge Refuge Stewards (CGRS), I look forward to the improvements to habitat that will result from opening the refuge to the Columbia River and returning Gibbons Creek to a more natural alignment.	Thank you for your comment.	N/A
		2		I attended the open house on February 12th and appreciated all of the information shared about the project. I have also skimmed through the Draft Environmental Assessment. I have two concerns about the project. One concern is access to the refuge during construction, and the impact on volunteer retention and numerous public activities at the refuge. The CGRS has made much progress in the past couple of years increasing the number of volunteers and events at Steigerwald refuge. At the open house it was stated that there would be no access to the refuge for a year, so I'm concerned that we will lose much of the progress we have made getting people involved with the refuge. Table 2-6 indicates access could be maintained during the winter between the first and second construction season. But Table 2-8 seems to indicate there will be no parking access during the winter between the first and second construction season, so access to the refuge would require walking along the dike trail from the port area. I hope the final construction plan allows for as much ongoing access to the refuge as possible, especially for volunteers.	The existing parking area would be closed to the public during the entirety of construction; however, limited access may be provided during that time for volunteer efforts. Also, the public likely would be able to access the refuge from the west (along the levee) during the first construction season, but not the second. See discussion of construction impacts in Section 3.7.2.	N/A

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		3		Another concern is the US Fish and Wildlife Service's responsibility for maintaining the remaining natural levee and the trails along the Columbia River. I'm concerned that during a major flood event, the remaining levee and trails along the river could be damaged and USFWS would have difficulty coming up with the necessary funds for repair. The continued erosion of Lower River Road at the south end of Ridgefield refuge comes to mind as an area where access to the refuge has not been maintained. I'm excited to see this project progressing and hope to see it come to fruition soon.	The Refuge is committed to maintaining all infrastructure related to resource management and public access as part of its maintenance operations. The Refuge recognizes that periodic routine maintenance and repairs of the trails and bridges will be required. In the event of a significant flood event that incurred major repair costs, the Refuge would seek supplemental funding for flood damage repairs.	N/A
STEIG18 0016	*N/A* Steven D. McCoy (Friends of the Columbia Gorge)	1		*Does the draft EA analyze the resources important to you?* Yes. The EA considers the effects to natural, cultural, scenic, and recreation resources	Thank you for your comment.	N/A
		2		Friends of the Columbia Gorge supports habitat enhancement plans as long as they conform to to all all of the provisions for protection of scenic, cultural, natural, and recreation resources that are outlined in the Management Plan for the Columbia River Gorge National Scenic Area. Friends appreciates BPA's consideration of financing this project.	Thank you for your comment.	N/A
STEIG18 0017	*N/A* Tom Gordon	1		Gentlemen: I appreciate that the Restoration Project is going to return the Steigerwald floodplain to better health and make it a better home for many fish, including salmon, animals and insects. The DEIS reflects a great deal of work for a very worthy project. Obviously, a lot thought went into it. Not only people will appreciate it, but so will the Columbia River, and the creatures that dwell in, on and above it in this "roadside rest." Thank You, Tom Gordon	Thank you for your comment.	N/A
STEIG18 0018	*N/A* Tom Gordon	1		Gentlemen: I think this project is a great idea. I hope that the proximity to the railroad does not turn out to be a problem in the future. Unfortunately, rail engines and cars leak oil, etc., and I hope it does not find its way into the area around Straub Lake, especially. In addition, some cargo like coal is transported in cars with weep holes in the bottom. When it rains, coal dust and its pollutants can be carried out the bottom of the car into the surrounding area. However, this is a wonderful and exciting project and I look forward to seeing it in the future. Thanks for all your hard work in bringing it about.	Comment noted.	N/A
STEIG18 0019	*N/A* Tom Gordon	1		Gentlemen: I like the Steigerwald Floodplain Restoration Project as described in the DEIS. When the Project is finished, the salmon and other creatures will have a greatly improved home As described on page 3-93, the Gibbons Creek remnant channel has serious pollution that proceeds with the ground water to a utility trench where the water is treated. Some of the ground water escapes toward the Columbia River. Is it possible to extend the utility trench to include the rest of the contaminated ground water that comes in? That could be treated with the other water in the utility trench. Thank You, Thomas Gordon	Comment noted. However, the location, management, and function of the utility trench are beyond the scope of this project. Furthermore, mention of this utility trench has been removed from the EA, since its location and existence cannot be verified.	N/A
STEIG18 0021	*2/20/2018* Jim Hutchison	1		Your recently developed EA draft is both well written and comprehensive. In fact, it's detail resembles a miniature EIS report. As a retired fish biologist and Steigerwald Refuge volunteer who offered comments during the scoping process, I still have two dominant fish-related concerns discussed below. And to avoid a cluttered, lengthy letter, I've listed some other draft EA thoughts and suggestions in an attachment.	Thank you for your comment.	N/A

Comment Number	*Date* Name (Organization)	Item Number	EA Section	Comment	Response	Location(s) of Edit in Final EA
		2	Page 2-12 and elsewhere	The draft says little about post-project fish passage and stranding problems potentially resulting from this project. A good Gibbons Creek migration route for adult and juvenile coho salmon, winter steelhead and cutthroat trout -the prevalent salmonids present -should be provided across the entire refuge. This will require construction, and probably periodic maintenance, of a natural appearing manmade channel of proper gradient and water depth available during these species' migration seasons. Such a channel can't be expected to develop naturally. Without an adequate migration route, unacceptable fish passage and delay issues can foreseeably occur, especially across the alluvial fan area likely to form between Highway 14 and the Columbia River. But slight mention of plans to construct a necessary migration channel is offered in the draft EA. The only relevant references I noted are these on page 2-12: "Downstream of the SR 14 crossing, the channel would meander towards Steigerwald Lake and would be constructed as a shallow inset channel with a low floodplain to mimic historic alluvial fan conditions." Below that statement is: "The new Gibbons Creek channel would be ...... designed to provide fish passage for all salmonid life stages at the full range of hydrologic conditions." Additional emphasis and detail within the EA regarding this planned work would strengthen support for improved anadromous fish access to and from the Gibbons Creek watershed, a primary goal of the project.	The channel on the alluvial fan would be allowed to function naturally – that is to say, it would meander across the fan and would not be confined to an artificial channel. Many alluvial fans in the Columbia River Gorge (whose streams have self-sustaining salmonid and lamprey populations) function this way, including Hamilton and Duncan Creeks. There are many benefits of this unique habitat, including the potential for chum salmon spawning, reduced stream temperatures as hyporheic exchange increases, and a disturbance regime that promotes native plant species (alluvial fans in the gorge tend to have the healthiest riparian communities). Although passage would be limited at times and mortality may occur, local populations are adapted to these conditions, which help limit straying from out-of-basin stocks.	N/A
STEIG18 0021	*2/20/2018* Jim Hutchison	3		Probable post-project fish stranding is my second major concern. To minimize stranding, additional channel improvement and/or creation appear advisable. A system of gently sloping side channels connecting ponded depressions to the main Gibbons Creek channel or to breached Columbia dike areas would lessen stranding threats. Otherwise, resultant salmonid mortality could become substantial as the refuge's surface water level drops each spring through fall. If deemed appropriate, low weirs installed in the connecting channels at outlets of certain depressions might reduce stranding and help retain some late season ponded water. Similar structures presently exist at Steigerwald and Straub lakes.	Under the Proposed Action, the floodplain would have positive drainage; however, small shallow depressions would remain in some wetland areas. Although these have the potential to strand salmonids, research shows that salmonids migrate out of floodplain areas before the freshet recedes to the point that stranding would be unlikely to occur. These depressional areas are anticipated to promote native vegetation and to benefit other species, such as waterfowl and amphibians.	N/A
		4	Page 1-1 and elsewhere	1. The two primary concerns which led to this proposed project were severe year after year anadromous smolt loss at the inadequate Gibbons Creek screen facility and the Port's cost of pumping water spilled at that facility. However, the welcome fact that the project will eliminate this annual fish loss is given little ink in the draft EA. This major fisheries benefit should beincluded and clearly emphasized among other expected benefits quoted, both as part of the background discussion on page 1-1 and elsewhere throughout the EA.	Thank you for your comment. Benefits to anadromous fish are addressed in Section 3.5.2.2.	N/A
		5		2. To measure project success and/or shortcomings, goals listed in the EA will need periodic monitoring after project completion. Who will be expected to do this, plus fund and conduct any correction or maintenance work found necessary by the monitoring? The USFWS alone should not be saddled with these needs, as previously occurred with the faulty Gibbons Creek fish screen installed by the Corps. Even if not identified in the EA, these post project issues should be clearly resolved prior to project work.	LCEP would conduct Levels 2 and 3 action effectiveness monitoring (AEMR) under the Columbia Estuary Ecosystem Restoration Program for Years 1-5 and again at Year 10. Level 2 AEMR receives Year 1, 3 and 5 vegetation, channel cross section, and macroinvertebrates monitoring, while Level 3 receives Years 1-5 water surface and temperature, sediment accretion, and photo points monitoring and a fish status check at Year 5. BPA funds Level 3 AEMR under its habitat contract and Level 2 AEMR under LCEP's monitoring contract.	Section 3.6.2.2, Section 3.13.2.2, Section 3.15.2.2.1
		6	Appendix B and elsewhere	3. Throughout the draft, particularly in Appendix B, there is a mix of actual project plans and of routine BPA construction guideline standards. In reading the draft, it can be difficult to determine which is which. Ways to help resolve this situation could include adding more specificity and subtracting unnecessary general guideline text.	The Appendix C mitigation measures are those general conservation measures associated with the HIP III guidance document. The best management practices in Table 2-9 were developed based on the specific impacts that were identified for the Proposed Action.	N/A
		7		4. Gibbons Creek adjacent to the planned 600 foot long floodwall and access road above Highway 14 should be provided with a wide, healthy riparian vegetation strip. To achieve this, it may be necessary to move the creek channel somewhat farther east than presently proposed.	Comment noted. The proposed design takes into account multiple land uses, management priorities, and ownership considerations, and strives to balance optimization of habitat components with other constraints.	N/A
		8		Too, fish habitat could be improved between Highway 14 and Evergreen Road if the creek were provided with some meanders, large woody debris, and notched sill logs that form pools.	Comment noted. Habitat features have been designed in this reach to the extent feasible considering all constraints.	N/A

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		9		5. The relocated parking area is proposed to contain 30 parking spaces, rather than the current 20. Twenty spaces are already not enough to accommodate cars on busy weekends and holidays. Even 30 spaces may in the future be insufficient to prevent parking extended to and along Highway 14. This would create both safety issues and undesired heavy use of the refuge's trail system. How to address these concerns merits more attention in the final EA.	Comment noted. As the commenter mentioned, the Proposed Action would result in a substantial increase in parking spaces relative to current conditions. If, over time, additional parking is needed, this issue may be addressed as a separate project and under separate NEPA analysis.	N/A
		10	Page 3-99	6. Installation of the planned West Setback levee may cause habitat isolation issues within a sizeable portion of the refuge located west of that levee. That western portion contains mostly wetlands, plus a long, rather wide former Gibbons Creek channel utilized by waterfowl and other wildlife. Once the setback levee is installed, that channel will no longer receive flood water previously spilled at the Gibbons Creek screen. Yet, following project completion some water from rainfall and other origins is expected to enter and remain in this isolated channel all or much of each year; occasional removal by pumping may therefore become necessary. In the past, studies have revealed the channel to have impaired water quality associated with nearby development. In case introduction of additional fresh water is eventually wanted to maintain wetland values in this refuge section, incorporation of a screened and gated culvert under the West Setback levee merits consideration. (Thus, the first paragraph on page 3-99 of the draft EA might need restructuring.)	Installing a culvert would not meet the Purpose and Need or the Corps flood protection measures. While Gibbons Creek would no longer flow into this area under the Proposed Action, groundwater and sheet flow would continue to enter the area, and therefore the wetlands are not expected to be substantially impacted by construction of the West Setback Levee.	N/A
STEIG18 0021	*2/20/2018* Jim Hutchison	11	Figure 2-2 Figure 3-6	7. Depicted location of Lawton Creek appears incorrect in Figures 2-2 and 3-6.	Location fixed on Figures 2-1, 2-2, and 3-6.	Figures 2-1, 2-2, and 3-6
		12	Page 3-22	8. The topmost paragraph on page 3-22 states that in the Columbia River basin "there are two species of resident fish." There are actually many more.	The paragraph states that there are two species of resident fish *that are listed as threatened or endangered under the ESA*.	N/A
		13	Table 3-2	9. Table 3-2. Among some prominent species missing from this list are carp and brown bullheads.	Comment noted. These species have been added to Table 3.2	Table 3.2
		14		10. Leaching from newly poured or uncured concrete can kill aquatic life in nearby water, and sometimes far downstream. Impermeable barriers and other safeguards are typically required to prevent such occurrence. The EA draft recognizes this threat well, which ideally will lead to special precautions when the planned floodwall and water regulation structure above Highway 14 are being installed.	Thank you for your comment.	N/A
		15	Page 3-32	11. Near the bottom of page 3-32, the words "the few" are incorrect and should be deleted.	Agreed. Change made.	Section 3.5.3
		16	Page 3-45	12. The Reed Island picnic and primitive campsites mentioned on page 3-45 have been scoured away by the river, so no longer exist.	Comment confirmed on Washington State Parks website. Text amended.	Section 3.7.1.2
		17	Page 3-81	13. Water shield (Brasenia) is another prevalent aquatic plant in Redtail Lake (bottom of page 3-81).	Information noted. Thank you for your comment.	N/A
		18	Page 3-91	14. Scaup Pond on page 3-91: The mentioned ditch actually drains north into Steigerwald Lake most of the year, a fact documented when we were doing recent invasive plant surveys.	Comment noted, but text was taken from hydrologic evaluation section of the wetland delineation report, so needs to stand unless wetland report is amended.	N/A
		19	Page 3-100	15. Page 3-100, paragraph 4: " ... due to possible impacts to fish." is unnecessarily confusing and should be deleted from the end of its sentence. That reference apparently refers only to possible difficulty in acquiring a material removal permit.	The suggested edit has not been made. The difficulty in getting this permit is because of the potential to impact fish during excavation.	N/A
		20	Appendix A	16. Appendix A pages should be numbered.	Page numbers have been added to Appendix A.	Appendix A
		21	Page 1-10 and page 33 of Appendix B	17. On page 1-10, my suggested use of PITtags is deemed "beyond the scope of this EA." On page 33 of Appendix B, however, the draft proposes that the project undertake various worthwhile actions, including installation of PIT tag arrays (item 6). I would appreciate the opportunity to discuss this subject and other fishery aspects of the project with BPA biologists.	BPA is proposing to implement the Proposed Action as proposed by the Estuary Partnership. Additional monitoring features such as PIT tag readers may be implemented in the future as part of a regional effort to track salmonid use of off channel habitat, and would be subject to project-specific NEPA documentation.	N/A

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STEIG18 0023	*N/A* Dave Miller	1		I have been volunteering at Steigerwald since 2006. My main tasks have been GPS mapping of invasive and native plants, leading volunteers in restoration projects, and leading bat walks on summer evenings. So I have spent a lot of time on the refuge and have surveyed nearly every square foot of it. I fully support the proposed action and congratulate the authors and everyone involved for reaching this design milestone.	Thank you for your comment.	N/A
		2		I do have a few comments: - Since the refuge waters will be reconnected to the Columbia River, people will be tempted to bring their watercraft onto the refuge. All watercraft should be disallowed on refuge lands, especially jet skis. This is a refuge for wildlife, not a watercraft recreation area. Those uses would be extremely disruptive to the refuge wildlife and to visitors on the trails.	Comment noted. Watercraft would continue to be disallowed on Refuge lands.	N/A
		3		When checking trees to be removed, check for bat roosts as well as bird nests. If you don't know what to look for, I can help you. On several of the bat walks we have seen bats exit roosts on several trees so I have a pretty good idea of the types of trees that bats are using.	The Refuge staff would work with local experts to map bat roosts and avoid these roost trees to the extent practicable. The proposed project is designed to avoid direct impacts to most of the mature cottonwoods within the Refuge.	N/A
		4		Cultural resources - I have led hundreds of volunteers in planting native plants, digging thousands of holes in the process. Only once have we encountered any man made object, and that was a mostly decomposed spool of barbed wire.	Comment noted.	N/A
STEIG18 0023	*N/A* Dave Miller	5		One of the concerns raised was an increase in mosquitoes due to the increased wetland acreage. The DEA says that the "USFWS would monitor mosquito populations and work with the local vector control district in the event of increased F184 In other words, spray some kind of chemical in the event of an "outbreak", whatever an "outbreak" is. It would be far better to include in the plan habitat for mosquito predators, including swallows, purple martins, bats, dragon/damsel flies, etc. Thanks again for all of your great work on this project. Dave Miller Camas	The Proposed Action has been designed to increase the overall habitat value of the floodplain, including habitat for the species mentioned by the commenter. All options for vector control would be explored as part of the maintenance plan.	N/A
STEIG18 0024	*2/20/2018* Casey Gatz (USFS, CR Gorge NSA)	1		Thank you for the opportunity to comment on the Steigerwald Habitat Restoration and Flood Control Project (DOE/EA-2027). The Columbia River Gorge National Scenic Area (CRGNSA) staff have reviewed the draft Environmental Assessment and appreciate the continued coordination between our agencies	Thank you for your comment.	N/A
		2		Thank you for your awareness of the visual impacts that the Gibbons Creek floodwall will have, and proposed design criteria to better meet the Management Plan for the CRGNSA. Because this area represents the gateway to the CRGNSA from SR-14, extra care with such a visible structure is warranted. We recommend a dark brown color, Federal Standard color 595C/color 14064, added to concrete mix or that the concrete be a colored a dark gray and then treated with Natina. Natina is a natural agent, safe for the environment, which naturally darkens and has the ability to give concrete, stone and metal a weathered appearance. We would also recommend that the metal portion of the wall treated with Natina to provide the weathered appearance.	LCEP will consider these recommendations and will discuss the issue in greater detail with United States Forest Service (USFS) staff.	N/A
		3		Additionally, we would like to continue to work with the BPA on the form liner selection for the Gibbons Creek floodwall. Although the proposed form was taken from within the CRGNSA, there are other forms that would better serve the scenery resources while maintaining structural requirements to meet the projects purpose and need.	BPA will consider these recommendations and will discuss the issue in greater detail with USFS staff.	N/A
STEIG18 0025	*2/23/2018* Jim Cortines (Washington Waterfowl Association)	1		It has come to the attention of Washington Waterfowl Association (WWA) the Bonneville Power Administration (BPA), in conjunction with the U.S. Fish & Wildlife Service (USFWS) has undertaken a plan known as the Steigerwald Floodplain Restoration Project. Without doubt, BPA ,as well as USFWS, is fully aware **that the purchase and maintenance of the Steigerwald area in 1987 was for <u>the express purpose of providing winter foraging and resting habitat for migrating waterfowl in the Pacific Flyway.</u>**[3]	According to the CCP, the Refuge was acquired under the authorization of PL 98-396 "for the fish and wildlife mitigation purposes associated with this project", referring to the Bonneville Lock & Dam Second Powerhouse Project.	N/A
		2		**Further, the aforementioned purchase and maintenance of the Steigerwald area has been funded through Pittman-Robertson (PR), North American Waterfowl Conservation Act (NAWCA), and Duck Stamp funds. BPA, as well as the USFWS, is or should be fully aware of the contractual obligations (strings) attached to those funds.**[3]	Comment noted. BPA and USFWS have conducted a legal and real estate review of the Proposed Action and have determined that it would be in compliance with existing commitments.	N/A

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		3		**To the best of our knowledge, no reference to Salmon or Salmon habitat appears in the Steigerwald originating documents. Efforts to achieve salmon restoration in this region have all failed.**[3]	According to the CCP, the Refuge was acquired under the authorization of PL 98-396 "for the fish and wildlife mitigation purposes associated with this project", referring to the Bonneville Dam Second Powerhouse Project.	N/A
		4		**It is WWA's position that BPA's pursuit of this project will <u>only harm waterfowl</u>[3].** As the restoration project stands, it will flood significant existing feeding areas while at the same time creating mudflats of others. This in it and of itself will have catastrophic impact on waterfowl numbers in that area. May I remind you, as well as the USFWS, that projects in both the Willapa and Nisqually National Wildlife Refuges in recent years have produced as much as a 90% decline in the presence/usage of those areas by waterfowl.	Although the primary goal of this project is to restore off-channel fish habitat, it is intended to benefit other species as well. Waterfowl foraging habitat that would be converted would only be inundated during brief periods during the spring freshet and winter high flows, but would otherwise be available for waterfowl use. An additional 115 acres of wetland would be created, much of it offering high-quality foraging habitat for migratory ducks and geese. The emphasis on restoring the area with native plant species would result in more diversified habitat for these species.	N/A
		5		**It is for these reasons, that Washington Waterfowl Association, in alliance with the Vacouver Wildlife League, seeks your complete and immediate dissolution of this project.**[3]	Thank you for your comment.	N/A
STEIG18 0026	*2/20/2018* Mark Pidgeon (Washingtonians for Wildlife Conservation)	1		Washingtonians for Wildlife Conservation is an alliance of individuals and organizations concerned with the health and well-being of Washington's wildlife, and wildlife management methods. We represent over 30 different sportsmen's groups and we are very concerned about the Steigerwald Floodplain Restoration Project. We appreciate the opportunity to submit comments directly to you.	Thank you for your comment.	N/A
		2		We are an organization of organizations, most of which are hunting organizations. Preserving waterfowl habitat and protecting hunting is of a great concern to us. This project is trading waterfowl habitat for fish habitat and is not an acceptable alternative to us.	Although the primary goal of this project is to restore off-channel fish habitat, it is intended to benefit other species as well. Waterfowl foraging habitat that would be converted would only be inundated during brief periods during the spring freshet and winter high flows, but would otherwise be available for waterfowl use. An additional 115 acres of wetland would be created, much of it offering high-quality foraging habitat for migratory ducks and geese. The emphasis on restoring the area with native plant species would result in more diversified habitat for these species.	N/A
		3		We have seen time after time where such restoration efforts have negatively impacted wetland and waterfowl habitat with no benefit for salmon.	Thank you for your comment. The project sponsors have worked closely with USFWS Refuge managers for several years to ensure that the primary management goals of the Refuge would continue to be met if the Proposed Action is implemented.	N/A
		4		Oftentimes, these restoration efforts have occurred on National Wildlife Refuge lands or other public trust lands, lands that were clearly established, chartered and managed for waterfowl and other migratory birds.	According to the CCP, the Refuge was acquired under the authorization of PL 98-396 "for the fish and wildlife mitigation purposes associated with this project", referring to the Bonneville Dam Second Powerhouse Project.	N/A
		5		We are going to make our comments short and to the point. Washingtonians for Wildlife Conservation strongly suggest that the No Action alternative be chosen as prescribed in the Environmental Assessment. Thank you for allowing us to submit these comments.	Comment noted.	N/A

[1] Chapellaz, J., I. Fung, and A. Thompson. 1993. The atmospheric CH4 increase since the Last Glacial Minimum: (1) Source Estimates. Tellus, 45B, 228-241.

[2] Whiting, G., and J. Chanton. 2001. Greenhouse carbon balance of wetlands: methane emission versus carbon sequestration. Tellus B: Chemical and Physical Meteorology, 53:5, 521-528.

[3] Bold and underlined text retained from comment form (emphasis not added by reviewer).

Appendix C: BPA's HIP III Mitigation Measures

Steigerwald

BPA project #2003-011-00

Contract #70379

3/30/16

HIP III CONSERVATION MEASURES

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General Aquatic Conservation Measures Applicable to all Actions

The activities covered under the HIPIII are intended to protect and restore fish and wildlife habitat with long-term benefits to ESA-listed species. However, project construction may have short-term adverse effects on ESA-listed species and associated critical habitat. To minimize these short-term adverse effects and make them predictable for the purposes of programmatic analysis, the BPA will include in all projects implemented under this HIP III proposed action the following general conservation measures (developed in coordination with USFWS and NMFS) applicable to.

Variance Requests

Because of the wide range of proposed activities and the natural variability within and between stream systems, some projects may require minor variations from criteria specified herein. The Services will consider granting variances, especially when there is a clear conservation benefit or there are no additional adverse effects (especially incidental take) beyond that covered by the opinion. Minor variances can be authorized by the Services at the NMFS Branch Chief or FWS Field Office Supervisor level. Variances can be sought on minor alterations to the proposed action (conservation measures) and reasonable and prudent measures.

Minor variance requests may be submitted and approved by email correspondence and will include:

1) Name and brief description of project, location of project and 6th field HUC number.
2) Define the requested variance and the relevant criterion by page number.
3) Current environmental conditions (current flow and weather conditions).
4) Biological justification as to why a variance is necessary and a brief rationale why the variance will either provide a conservation benefit or, at a minimum, not cause additional adverse effects beyond the scope of the Opinion
5) Include as attachments any necessary approvals by state agencies.

Documentation (to be posted onsite)

1) Name(s), phone number(s), and address(es) of the person(s) responsible for oversight.
2) A description of hazardous materials that will be used, including inventory, storage, and handling procedures.
3) Procedures to contain and control a spill of any hazardous material generated, used or stored on-site, including notification of proper authorities.
4) A standing order to cease work in the event of high flows (above those addressed in the design and implementation plans) or exceedance of take or water quality limitations.

Project Design and Site Preparation

1) **Climate change.** Best available science regarding the future effects within the project area of climate change, such as changes in stream flows and water temperatures, will be considered during project design.
2) **State and Federal Permits.** All applicable regulatory permits and official project authorizations will be obtained before project implementation. These permits and authorizations include, but are not limited to, National Environmental Policy Act, National Historic Preservation Act, and the appropriate state agency removal and fill permit, USACE Clean Water Act (CWA) 404 permits, and CWA section 401 water quality certifications.
3) **Timing of in-water work.** Appropriate state (Oregon Department of Fish and Wildlife (ODFW), Washington Department of Fish and Wildlife (WDFW), Idaho Department of Fish

and Game (IDFG), and Montana Fish Wildlife and Parks (MFWP)) guidelines for timing of in-water work windows (IWW) will be followed.

a) Bull trout - While utilizing the appropriate State designated in-water work period will lessen the risk to bull trout, this alone may not be sufficient to adequately protect local bull trout populations. This is especially true if work is occurring in spawning and rearing areas because eggs, alevin, and fry are in the substrate or closely associated habitats nearly year round. Some areas may not have designated in-water work windows for bull trout or if they do, they may conflict with work windows for salmon and steelhead. If this is the case, or if proposed work is to occur within bull trout spawning and rearing habitats, project proponents will contact the appropriate USFWS Field Office (see Appendix B in this BO) to insure that all reasonable implementation measures are considered and an appropriate in-water work window is being used to minimize project effects.

b) Lamprey – the project sponsor and/or their contractors will avoid working in stream or river channels that contain Pacific Lamprey from March 1 to July 1 in low to mid elevation reaches (<5,000 feet). In high elevation reaches (>5,000 feet), the project sponsor will avoid working in stream or river channels from March 1 to August 1. If either timeframe is incompatible with other objectives, the area will be surveyed for nests and lamprey presence, and avoided if possible. If lampreys are known to exist, the project sponsor will utilize dewatering and salvage procedures outlined in US Fish and Wildlife Service (2010)[1].

c) Exceptions to ODFW, WDFW, MFWP, or IDFG in-water work windows will be requested from NMFS and the FWS. An IWW variance request (pre-coordinated with staff biologists) will be e-mailed from an appropriate representative of the action agency to the NMFS Habitat Branch Chief and the FWS Field Office Supervisor for the project area. Work will not proceed outside of the IWW until the exception is approved by e-mails from NMFS and/or the FWS.

4) **Contaminants.** The project sponsor will complete a site assessment with the following elements to identify the type, quantity, and extent of any potential contamination for any action that involves excavation of more than 20 cubic yards of material:

a) A review of available records, such as former site use, building plans, and records of any prior contamination events;

b) A site visit to inspect the areas used for various industrial processes and the condition of the property;

c) Interviews with knowledgeable people, such as site owners, operators, and occupants, neighbors, or local government officials; and

d) A summary, stored with the project file that includes an assessment of the likelihood that contaminants are present at the site, based on items 5(a) through 5(c).

5) **Site layout and flagging.** Prior to construction, the action area will be clearly flagged to identify the following:

[1] U.S. Fish and Wildlife Service. 2010. Best management practices to minimize adverse effects to Pacific lamprey. Available online at: http://www.fws.gov/pacific/Fisheries/sphabcon/lamprey/pdf/Best%20Management%20Practices%20for%20Pacific%20Lamprey%20April%202010%20Version.pdf

a) Sensitive resource areas, such as areas below ordinary high water, spawning areas, springs, and wetlands;
b) Equipment entry and exit points;
c) Road and stream crossing alignments;
d) Staging, storage, and stockpile areas; and
e) No-spray areas and buffers.

6) **Temporary access roads and paths.**
a) Existing access roads and paths will be preferentially used whenever reasonable, and the number and length of temporary access roads and paths through riparian areas and floodplains will be minimized to lessen soil disturbance and compaction, and impacts to vegetation.
b) Temporary access roads and paths will not be built on slopes where grade, soil, or other features suggest a likelihood of excessive erosion or failure. If slopes are steeper than 30%, then the road will be designed by a civil engineer with experience in steep road design.
c) The removal of riparian vegetation during construction of temporary access roads will be minimized. When temporary vegetation removal is required, vegetation will be cut at ground level (not grubbed).
d) At project completion, all temporary access roads and paths will be obliterated, and the soil will be stabilized and revegetated. Road and path obliteration refers to the most comprehensive degree of decommissioning and involves decompacting the surface and ditch, pulling the fill material onto the running surface, and reshaping to match the original contour.
e) Temporary roads and paths in wet areas or areas prone to flooding will be obliterated by the end of the in-water work window.

7) **Temporary stream crossings.**
a) Existing stream crossings will be preferentially used whenever reasonable, and the number of temporary stream crossings will be minimized.
b) Vehicle fords will only be allowed in intermittent streams with no anadromous fish spawning.
a) Temporary bridges and culverts will be installed to allow for equipment and vehicle crossing over perennial streams during construction.
b) Equipment and vehicles will cross the stream in the wet only where:
   i. The streambed is bedrock; or
   ii. Mats or off-site logs are placed in the stream and used as a crossing.
c) Vehicles and machinery will cross streams at right angles to the main channel wherever possible.
d) The location of the temporary crossing will avoid areas that may increase the risk of channel re-routing or avulsion.
e) Potential spawning habitat (i.e., pool tailouts) and pools will be avoided to the maximum extent possible.
f) No stream crossings will occur at active spawning sites, when holding adult listed fish are present, or when eggs or alevins are in the gravel. The appropriate state fish and wildlife agency will be contacted for specific timing information.
g) After project completion, temporary stream crossings will be obliterated and the stream channel and banks restored.

2) **Staging, storage, and stockpile areas.**
   a) Staging areas (used for construction equipment storage, vehicle storage, fueling, servicing, and hazardous material storage) will be 150 feet or more from any natural water body or wetland, or on an adjacent, established road area in a location and manner that will preclude erosion into or contamination of the stream or floodplain.
   b) Natural materials used for implementation of aquatic restoration, such as large wood, gravel, and boulders, may be staged within the 100-year floodplain.
   c) Any large wood, topsoil, and native channel material displaced by construction will be stockpiled for use during site restoration at a specifically identified and flagged area.
   d) Any material not used in restoration, and not native to the floodplain, will be removed to a location outside of the 100-year floodplain for disposal.
3) **Equipment.** Mechanized equipment and vehicles will be selected, operated, and maintained in a manner that minimizes adverse effects on the environment (e.g., minimally-sized, low pressure tires; minimal hard-turn paths for tracked vehicles; temporary mats or plates within wet areas or on sensitive soils). All vehicles and other mechanized equipment will be:
   a) Stored, fueled, and maintained in a vehicle staging area placed 150 feet or more from any natural water body or wetland or on an adjacent, established road area;
   b) Refueled in a vehicle staging area placed 150 feet or more from a natural waterbody or wetland, or in an isolated hard zone, such as a paved parking lot or adjacent, established road (this measure applies only to gas-powered equipment with tanks larger than 5 gallons);
   c) Biodegradable lubricants and fluids should be used, if possible, on equipment operating in and adjacent to the stream channel and live water.
   d) Inspected daily for fluid leaks before leaving the vehicle staging area for operation within 150 feet of any natural water body or wetland; and
   e) Thoroughly cleaned before operation below ordinary high water, and as often as necessary during operation, to remain grease free.
4) **Erosion control.** Erosion control measures will be prepared and carried out, commensurate in scope with the action, that may include the following:
   a) Temporary erosion controls.
      i. Temporary erosion controls will be in place before any significant alteration of the action site and appropriately installed downslope of project activity within the riparian buffer area until site rehabilitation is complete.
      ii. If there is a potential for eroded sediment to enter the stream, sediment barriers will be installed and maintained for the duration of project implementation.
      iii. Temporary erosion control measures may include fiber wattles, silt fences, jute matting, wood fiber mulch and soil binder, or geotextiles and geosynthetic fabric.
      iv. Soil stabilization utilizing wood fiber mulch and tackifier (hydro-applied) may be used to reduce erosion of bare soil if the materials are noxious weed free and nontoxic to aquatic and terrestrial animals, soil microorganisms, and vegetation.
      v. Sediment will be removed from erosion controls once it has reached 1/3 of the exposed height of the control.
      vi. Once the site is stabilized after construction, temporary erosion control measures will be removed.
   b) Emergency erosion controls. The following materials for emergency erosion control will be available at the work site:

i. A supply of sediment control materials; and
ii. An oil-absorbing floating boom whenever surface water is present.

5) **Dust abatement.** The project sponsor will determine the appropriate dust control measures (if necessary) by considering soil type, equipment usage, prevailing wind direction, and the effects caused by other erosion and sediment control measures. In addition, the following criteria will be followed:
   a) Work will be sequenced and scheduled to reduce exposed bare soil subject to wind erosion.
   b) Dust-abatement additives and stabilization chemicals (typically magnesium chloride, calcium chloride salts, or ligninsulfonate) will not be applied within 25 feet of water or a stream channel and will be applied so as to minimize the likelihood that they will enter streams. Applications of ligninsulfonate will be limited to a maximum rate of 0.5 gallons per square yard of road surface, assuming a 50:50 (ligninsulfonate to water) solution.
   c) Application of dust abatement chemicals will be avoided during or just before wet weather, and at stream crossings or other areas that could result in unfiltered delivery of the dust abatement materials to a waterbody (typically these would be areas within 25 feet of a waterbody or stream channel; distances may be greater where vegetation is sparse or slopes are steep).
   d) Spill containment equipment will be available during application of dust abatement chemicals.
   e) Petroleum-based products will not be used for dust abatement. Water drafting/pumping (for dust suppression or other needs) will be done in accordance with the following criteria:
      i) Non-stream sources will be used prior to the use of stream sources whenever feasible;
      ii) when non-stream sources are unavailable, streams with the greatest flow will be used whenever feasible;
      iii) water withdrawal will not reduce stream flow by more than 1/10th (stream flow may be estimated visually). For pumps with adjustable pump rates, pumping rates will be adjusted to avoid drafting more than 1/10th of the current stream flow;
      iv) streams with less than 5 cfs are used for drafting, no more than 18,000 gallons will be removed in one day;
      v) if streams with less than 5 cfs are used for drafting, no more than one pump will operate at one time at any one drafting site;
      vi) no water will be drafted from sites where adult salmonids are visibly present, to prevent interference with spawning activities;
      vii) no dams or channel alterations will be made for pumping in streams occupied by listed fish species.
6) **Spill prevention, control, and counter measures.** The use of mechanized machinery increases the risk for accidental spills of fuel, lubricants, hydraulic fluid, or other contaminants into the riparian zone or directly into the water. Additionally, uncured concrete and form materials adjacent to the active stream channel may result in accidental discharge into the water. These contaminants can degrade habitat, and injure or kill aquatic food organisms and ESA-listed species. The project sponsor will adhere to the following measures:
   a) A description of hazardous materials that will be used, including inventory, storage, and handling procedures will be available on-site.

b) Written procedures for notifying environmental response agencies will be posted at the work site.
c) Spill containment kits (including instructions for cleanup and disposal) adequate for the types and quantity of hazardous materials used at the site will be available at the work site.
d) Workers will be trained in spill containment procedures and will be informed of the location of spill containment kits.
e) Any waste liquids generated at the staging areas will be temporarily stored under an impervious cover, such as a tarpaulin, until they can be properly transported to and disposed of at a facility that is approved for receipt of hazardous materials.
f) Vegetable based hydraulic fluids (biodegradable oil) will be used in any vehicle that will be operated near the water.

7) **Invasive species control.** The following measures will be followed to avoid introduction of invasive plants and noxious weeds into project areas:
   a) Prior to entering the site, all vehicles and equipment will be power washed, allowed to fully dry, and inspected to make sure no plants, soil, or other organic material adheres to the surface.
   b) Watercraft, waders, boots, and any other gear to be used in or near water will be inspected for aquatic invasive species.
   c) Wading boots with felt soles are not to be used due to their propensity for aiding in the transfer of invasive species.

Work Area Isolation & Fish Salvage.

Any work area within the wetted channel will be isolated from the active stream whenever ESA-listed fish are reasonably certain to be present, or if the work area is less than 300-feet upstream from known spawning habitats. When work area isolation is required, design plans will include all isolation elements, fish release areas, and, when a pump is used to dewater the isolation area and fish are present, a fish screen that meets NMFS's fish screen criteria (NMFS 2011[2], or most current). Work area isolation and fish capture activities will occur during periods of the coolest air and water temperatures possible, normally early in the morning versus late in the day, and during conditions appropriate to minimize stress and death of species present.

For salvage operations in known bull trout spawning and rearing habitat, electrofishing shall only occur from May 1 to July 31. No electrofishing will occur in any bull trout occupied habitat after August 15. Bull trout are very temperature sensitive and generally should not be electroshocked or otherwise handled when temperatures exceed 15 degrees celsius. Salvage activities should take place during periods of the coolest air and water temperatures possible, normally early in the morning versus late in the day, and during conditions appropriate to minimize stress to fish species present.

Salvage operations will follow the ordering, methodologies, and conservation measures specified below in Steps 1 through 6. Steps 1 and 2 will be implemented for all projects where work area isolation is necessary according to conditions above. Electrofishing (Step 3) can be implemented to ensure all fish have been removed following Steps 1 and 2, or when other means of fish capture may not be feasible or effective. Dewatering and rewatering (Steps 4 and 5) will be

[2] National Marine Fisheries Service. 2011. Anadromous salmonid passage facility design. Northwest Region. Available online at: http://www.nwr.noaa.gov/Salmon-Hydropower/FERC/upload/Fish-Passage-Design.pdf

implemented unless wetted in-stream work is deemed to be minimally harmful to fish, and is beneficial to other aquatic species. Dewatering will not be conducted in areas known to be occupied by lamprey, unless lampreys are salvaged using guidance set forth in US Fish and Wildlife Service (2010)[3].

1) **Isolate.**
   a) Block nets will be installed at upstream and downstream locations and maintained in a secured position to exclude fish from entering the project area.
   b) Block nets will be secured to the stream channel bed and banks until fish capture and transport activities are complete. Block nets may be left in place for the duration of the project to exclude fish.
   c) If block nets remain in place more than one day, the nets will be monitored at least daily to ensure they are secured to the banks and free of organic accumulation. If the project is within bull trout spawning and rearing habitat, the block nets must be checked every four hours for fish impingement on the net. Less frequent intervals must be approved through a variance request.
   d) Nets will be monitored hourly anytime there is instream disturbance.
2) **Salvage.** – As described below, fish trapped within the isolated work area will be captured to minimize the risk of injury, then released at a safe site:
   a) Remove as many fish as possible prior to dewatering.
   b) During dewatering, any remaining fish will be collected by hand or dip nets.
   c) Seines with a mesh size to ensure capture of the residing ESA-listed fish will be used.
   d) Minnow traps will be left in place overnight and used in conjunction with seining.
   e) If buckets are used to transport fish:
      i. The time fish are in a transport bucket will be limited, and will be released as quickly as possible;
      ii. The number of fish within a bucket will be limited based on size, and fish will be of relatively comparable size to minimize predation;
      iii. Aerators for buckets will be used or the bucket water will be frequently changed with cold clear water at 15 minute or more frequent intervals.
      iv. Buckets will be kept in shaded areas or will be covered by a canopy in exposed areas.
      v. Dead fish will not be stored in transport buckets, but will be left on the stream bank to avoid mortality counting errors.
   f) As rapidly as possible (especially for temperature-sensitive bull trout), fish will be released in an area that provides adequate cover and flow refuge. Upstream release is generally preferred, but fish released downstream will be sufficiently outside of the influence of construction.
   g) Salvage will be supervised by a qualified fisheries biologist experienced with work area isolation and competent to ensure the safe handling of all fish.
3) **Electrofishing.** Electrofishing will be used only after other salvage methods have been employed or when other means of fish capture are determined to not be feasible or effective. If electrofishing will be used to capture fish for salvage, the salvage operation will be led by an experienced fisheries biologist and the following guidelines will be followed:

[3] U.S. Fish and Wildlife Service. 2010. Best management practices to minimize adverse effects to Pacific lamprey. Available online at: http://www.fws.gov/pacific/Fisheries/sphabcon/lamprey/pdf/Best%20Management%20Practices%20for%20Pacific%20Lamprey%20April%202010%20Version.pdf

a) The NMFS's electrofishing guidelines (NMFS 2000).
b) Only direct current (DC) or pulsed direct current (PDC) will be used and conductivity must be tested.
   i. If conductivity is less than 100 µs, voltage ranges from 900 to 1100 will be used.
   ii. For conductivity ranges between 100 to 300 µs, voltage ranges will be 500 to 800.
   iii. For conductivity greater than 300 µs, voltage will be less than 400.
c) Electrofishing will begin with a minimum pulse width and recommended voltage and then gradually increase to the point where fish are immobilized.
d) The anode will not intentionally contact fish.
e) Electrofishing shall not be conducted when the water conditions are turbid and visibility is poor. This condition may be experienced when the sampler cannot see the stream bottom in one foot of water.
f) If mortality or obvious injury (defined as dark bands on the body, spinal deformations, de-scaling of 25% or more of body, and torpidity or inability to maintain upright attitude after sufficient recovery time) occurs during electrofishing, operations will be immediately discontinued, machine settings, water temperature and conductivity checked, and procedures adjusted or electrofishing postponed to reduce mortality.

4) **Dewater.** Dewatering, when necessary, will be conducted over a sufficient period of time to allow species to naturally migrate out of the work area and will be limited to the shortest linear extent practicable.
   a) Diversion around the construction site may be accomplished with a coffer dam and a by-pass culvert or pipe, or a lined, non-erodible diversion ditch. Where gravity feed is not possible, a pump may be used, but must be operated in such a way as to avoid repetitive dewatering and rewatering of the site. Impoundment behind the cofferdam must occur slowly through the transition, while constant flow is delivered to the downstream reaches.
   b) All pumps will have fish screens to avoid juvenile fish impingement or entrainment, and will be operated in accordance with NMFS's current fish screen criteria (NMFS 2011[4], or most recent version). If the pumping rate exceeds 3 cubic feet second (cfs), a NMFS Hydro fish passage review will be necessary.
   c) Dissipation of flow energy at the bypass outflow will be provided to prevent damage to riparian vegetation or stream channel.
   d) Safe reentry of fish into the stream channel will be provided, preferably into pool habitat with cover, if the diversion allows for downstream fish passage.
   e) Seepage water will be pumped to a temporary storage and treatment site or into upland areas to allow water to percolate through soil or to filter through vegetation prior to reentering the stream channel.
5) **Re-watering.** Upon project completion, the construction site will be slowly re-watered to prevent loss of surface flow downstream and to prevent a sudden increase in stream turbidity. During re-watering, the site will be monitored to prevent stranding of aquatic organisms below the construction site.
6) **Salvage Notice.** Monitoring and recording of fish presence, handling, and mortality must occur during the duration of the isolation, salvage, electrofishing, dewatering, and rewatering operations. Once operations are completed, a salvage report will document procedures used, any fish injuries or deaths (including numbers of fish affected), and causes of any deaths.

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[4] National Marine Fisheries Service. 2011. Anadromous salmonid passage facility design. Northwest Region. Available online at: http://www.nwr.noaa.gov/Salmon-Hydropower/FERC/upload/Fish-Passage-Design.pdf

Construction and Post-Construction Conservation Measures for Aquatic Species

1) **Fish passage.** Fish passage will be provided for any adult or juvenile fish likely to be present in the action area during construction, unless passage did not exist before construction or the stream is naturally impassable at the time of construction. If the provision of temporary fish passage during construction will increase negative effects on aquatic species of interest or their habitat, a variance can be requested from the NMFS Branch Chief and the FWS Field Office Supervisor (Appendix B of this BO). Pertinent information, such as the species affected, length of stream reach affected, proposed time for the passage barrier, and alternatives considered, will be included in the variance request.
2) **Construction and discharge water.**
   a) Surface water may be diverted to meet construction needs, but only if developed sources are unavailable or inadequate.
   b) Diversions will not exceed 10% of the available flow.
   c) All construction discharge water will be collected and treated using the best available technology applicable to site conditions.
   d) Treatments to remove debris, nutrients, sediment, petroleum hydrocarbons, metals and other pollutants likely to be present will be provided.
3) **Minimize time and extent of disturbance.** Earthwork (including drilling, excavation, dredging, filling and compacting) in which mechanized equipment is in stream channels, riparian areas, and wetlands will be completed as quickly as possible. Mechanized equipment will be used in streams only when project specialists believe that such actions are the only reasonable alternative for implementation, or would result in less sediment in the stream channel or damage (short- or long-term) to the overall aquatic and riparian ecosystem relative to other alternatives. To the extent feasible, mechanized equipment will work from the top of the bank, unless work from another location would result in less habitat disturbance.
4) **Cessation of work.** Project operations will cease under the following conditions:
   a) High flow conditions that may result in inundation of the project area, except for efforts to avoid or minimize resource damage;
   b) When allowable water quality impacts, as defined by the state CWA section 401 water quality certification, have been exceeded; or
   c) When "incidental take" limitations have been reached or exceeded.
5) **Site restoration.** When construction is complete:
   a) All streambanks, soils, and vegetation will be cleaned up and restored as necessary using stockpiled large wood, topsoil, and native channel material.
   b) All project related waste will be removed.
   c) All temporary access roads, crossings, and staging areas will be obliterated. When necessary for revegetation and infiltration of water, compacted areas of soil will be loosened.
   d) All disturbed areas will be rehabilitated in a manner that results in similar or improved conditions relative to pre-project conditions. This will be achieved through redistribution of stockpiled materials, seeding, and/or planting with local native seed mixes or plants.
6) **Revegetation.** Long-term soil stabilization of disturbed sites will be accomplished with reestablishment of native vegetation using the following criteria:
   a) Planting and seeding will occur prior to or at the beginning of the first growing season after construction.

b) An appropriate mix of species that will achieve establishment, shade, and erosion control objectives, preferably forb, grass, shrub, or tree species native to the project area or region and appropriate to the site will be used.
c) Vegetation, such as willow, sedge and rush mats, will be salvaged from disturbed or abandoned floodplains, stream channels, or wetlands.
d) Invasive species will not be used.
e) Short-term stabilization measures may include the use of non-native sterile seed mix (when native seeds are not available), weed-free certified straw, jute matting, and other similar techniques.
f) Surface fertilizer will not be applied within 50 feet of any stream channel, waterbody, or wetland.
g) Fencing will be installed as necessary to prevent access to revegetated sites by livestock or unauthorized persons.
h) Re-establishment of vegetation in disturbed areas will achieve at least 70% of pre-project conditions within 3 years.
i) Invasive plants will be removed or controlled until native plant species are well-established (typically 3 years post-construction).

7) **Site access.** The project sponsor will retain the right of reasonable access to the site in order to monitor the success of the project over its life.
8) **Implementation monitoring.** Project sponsor staff or their designated representative will provide implementation monitoring to ensure compliance with the applicable biological opinion, including:
   a) General conservation measures are adequately followed; and
   b) Effects to listed species are not greater than predicted and incidental take limitations are not exceeded
9) **CWA section 401 water quality certification.** The project sponsor or designated representative will complete and record water quality observations to ensure that in-water work is not degrading water quality. During construction, CWA section 401 water quality certification provisions provided by the Oregon Department of Environmental Quality, Washington Department of Ecology, or Idaho Department of Environmental Quality will be followed.

Turbidity Monitoring Protocol

The Project Sponsor shall complete and record the following water quality observations to ensure that any increase in suspended sediment is not exceeding the limit for HIPIII compliance. Records shall be reported in the HIPIII Project Notification Completion (PNC) Form.
If the geomorphology of the project area (silty or claylike materials) or the nature of the action (large amounts of bare earth exposed below the waterline) shall preclude the successful compliance with these triggers, please inform the EC lead who will notify the services.

1) Take a background turbidity sample using an appropriately and frequently calibrated turbidimeter in accord with manufacturer’s instructions, or a visual turbidity observation, every 2 hours while work is being implemented, or more often if turbidity disturbances vary greatly, to ensure that the in-water work area is not contributing visible sediment to the water column. The background samples or observations should be taken at a relatively undisturbed area approximately 100 feet upstream from the project area. Record the observation, location, and time before monitoring at the downstream point.

2) Take a second sample or observation, immediately after each upstream sample or observation, approximately 50 feet downstream from the project area in streams that are 30 feet wide or less; 100 feet downstream from the project area for streams between 30 and 100 feet wide; 200 feet downstream from the project area for streams greater than 100 feet wide; and 300 feet from the discharge point or nonpoint source for areas subject to tidal or coastal scour. Record the downstream observation, location, and time.
3) Compare the upstream and downstream observations/samples. If observed or measured turbidity downstream is more than upstream observation or measurement (> 10%), the activity must be modified to reduce turbidity. If visual estimates are used, an obvious difference between upstream and downstream observations shall bear the assumption of a (> 10%) difference. Continue to monitor every 2 hours as long as instream activity continues.
4) If exceedances occur twice in a row (after 4 hours), the activity must stop until the turbidity level returns to background, and the EC lead must be notified within 48 hours. The EC lead shall document the reasons for the exceedance, corrective measures taken, notify the local NMFS branch chief and/or USFWS field supervisor and seek recommendations.
5) If at any time, monitoring, inspections, or observations/samples show that the turbidity controls are ineffective, immediately mobilize work crews to repair, replace, or reinforce controls as necessary.

Stormwater Management Guidance

The project proponent must provide stormwater management for any project that will: increase the contributing impervious area within the project area; construct new pavement that increases capacity or widens the road prism; construct pavement down to subgrade; rehabilitate or restore a bridge to repair structural or functional deficiencies that are too complicated to be corrected through normal maintenance, except for seismic retrofits that make a bridge more resistant to earthquake damage (e.g., external post-tensioning, supplementary dampening) but do not affect the bridge deck or drainage; replace a stream crossing; change stormwater conveyance Stormwater management is not required for the following pavement actions: minor repairs, patching, chip seal, grind/inlay, overlay or resurfacing (i.e., non-structural pavement preservation, a single lift or inlay).

Stormwater management consists of:

1) Water quality (pollution reduction) treatment for post-construction stormwater runoff from all contributing impervious area.
2) Water quantity treatment
    a) Water quantity (flow) management for runoff from all contributing impervious area that will discharge into an intermittent or perennial water body in a watershed that is smaller than 100 mi^2, unless the outfall discharges directly into a lake, reservoir, or estuary.

        OR

    b) Water quantity (flow) management for runoff from all contributing impervious area that will discharge more than 0.5 cfs during the 2-year, 24-hour storm into an intermittent or perennial water body in a watershed smaller than 100 mi^2, unless the outfall discharges directly into a lake, reservoir, or estuary.

Stormwater management plans must:

1) Explain how highway runoff from all contributing impervious area that is within or contiguous with the project area will be managed using site sketches, drawings, specifications, calculations, or other information commensurate with the scope of the action.
2) Identify the pollutants of concern.
3) Identify all contributing and non-contributing impervious areas that are within and contiguous with the project area.
4) Describe the BMPs that will be used to treat the identified pollutants of concern, and the proposed maintenance activities and schedule for the treatment facilities.
5) Provide a justification for the capacity of the facilities provided based on the expected runoff volume, including, e.g., the design storm, BMP geometry, analyses of residence time, as appropriate.
6) Include the name, email address, telephone number of a person responsible for designing the stormwater management facilities so that NMFS may contact that person if additional information is necessary.

All stormwater quality treatment practices and facilities must be designed to accept 50% of the cumulative rainfall from the 2-year, 24-hour storm for that site, except as follows: climate zone 4 – 67%; climate zone 5 – 75%; and climate zone 9 – 67%. A continuous rainfall/runoff model may be used instead of the above runoff depths to calculate water quality treatment depth.

Use low impact development practices to infiltrate or evaporate runoff to the maximum extent feasible. For runoff that cannot be infiltrated or evaporated and therefore will discharge into surface or subsurface waters, apply one or more of the following specific primary treatment practices, supplemented with appropriate soil amendments:

1) Bioretention cell
2) Bioslope, also known as an “ecology embankment”
3) Bioswale
4) Constructed wetlands
5) Infiltration pond
6) Media filter devices with demonstrated effectiveness
7) Porous pavement, with no soil amendments and appropriate maintenance

All stormwater flow control treatment practices and facilities must be designed to maintain the frequency and duration of flows generated by storms within the following end-points:

1) Lower discharge endpoint, by USGS flood frequency zone:
    a. Western Region = 42% of 2-year event
2) Eastern Region
    a. Southeast, Northeast, North Central = 48% of 2-year event
    b. Eastern Cascade = 56% of 2-year event
3) Upper discharge endpoint

a. Entrenchment ratio <2.2 = 10-year event, 24-hour storm
b. Entrenchment ratio >2.2 = bank overtopping event

When conveyance is necessary to discharge treated stormwater directly into surface water or a wetland, the following requirements apply:

1) Maintain natural drainage patterns.
2) To the maximum extent feasible, ensure that water quality treatment for highway runoff from all contributing impervious area is completed before commingling with offsite runoff for conveyance.

General Conservation Measures for Terrestrial Plants, Wildlife and Aquatic Invertebrates

This section describes general conservation measures (CMs) and practices included in the proposed action to minimize or avoid the exposure of certain endangered, threatened, and proposed species managed by USFWS to any effects of the underlying restoration activities. These standards include practices that would minimize or avoid any such effects on designated critical habitat for those species. Restoration projects are unlikely to occur within the range of some of the listed species included herein, but due to the programmatic approach to this consultation, and the fact that specific project locations are unknown at this time, we are providing the benefit of the doubt to the species and have included project design measures for all species that occur within the proposed action area.

An FWS biologist will review the Project Notification/Completion form for each project to confirm the project design meets the conditions for *no effect* or *not likely to adversely affect* to listed species or critical habitat. Projects than cannot meet these conditions will need to be modified or will require a separate section 7 consultation.

Identifying Species Locations. When proposed project locations have been identified, the action agency or project proponent will obtain the current species list for the county in which the proposed project is located. The species lists can be accessed at the following websites:

- **Washington, Western**: http://www.fws.gov/wafwo/speciesmap.html

If species are located within the county where the proposed project is located, refer to the habitat descriptions for each species below for each species or critical habitat to determine whether that listed species may occur in the vicinity of the proposed project. Maps for some species have also been provided at the end of this Appendix to assist in identifying suitable habitat that may be occupied by listed species. For additional assistance, contact the appropriate state FWS office for more information:

- **Washington Fish and Wildlife Office**, (360) 753-9440

Site-specific information of listed species occurrences in Washington State may be obtained from the Washington Department of Fish and Wildlife Priority Habitat and Species Program http://www.wdfw.wa.gov/hab/phspage.htm and from the Washington Department of Natural Resources Natural Heritage Program at http://wdfw.wa.gov/mapping/phs/.

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1) If it is determined that listed species, critical habitat, or unsurveyed suitable habitat for listed species are located within the vicinity (generally within 1 mile) of the proposed project, the action agency will implement the following project design standards for each species. Additional species-specific conservation measures may apply (Your EC lead shall provide you with those).
2) **Project Access.** Existing roads or travel paths will be used to access project sites whenever possible; vehicular access ways to project sites will be planned ahead of time and will provide for minimizing impacts on riparian corridors and areas where listed species or their critical habitats may occur.
3) **Vehicle use and human activities.** Including walking in areas occupied by listed species, will be minimized to reduce damage or mortality to listed species.
4) **Flight patterns.** Helicopter flight patterns will be established in advance and located to avoid seasonally important wildlife habitat
5) **Herbicide Use.** On sites where ESA-listed **terrestrial wildlife** may occur, herbicide applications will be avoided or minimized to the extent practicable while still achieving project goals. Staff will avoid any potential for direct spraying of wildlife or immediate habitat in use by wildlife for breeding, feeding, or sheltering. Herbicide use in or within 1 mile of habitat where listed terrestrial wildlife occur will be limited to the chemicals and application rates as shown in **Table 1**. Additional species-specific herbicide limitations are also defined below in each species CMs section.

TABLE 1: Maximum Herbicide Application Rates in or Within 1 Mile of Habitat Where ESA-listed Terrestrial Species Occur[5]

	2,4-D	Aminopyralid	Chlorsulfuron	Clethodim	Clopyralid	Dicamba	Glyphosate 1	Glyphosate 2	Imazapic	Imazapyr	Metsulfuron	Picloram	Sethoxydim	Sulfometuron	Triclopyr (TEA)
Listed Species	Maximum Rate of Herbicide Appliction (lb/ac)														
Mammals	NA	0.22	0.083	NA	0.375	NA	2.0	2.0	0.189	1.0	0.125	NA	0.3	NA	NA
Birds*	NA	0.11	0.083	NA	0.375	NA	2.0	2.0	0.189	1.0	0.125	NA	0.3	NA	NA
Invertebrates*	NA	NA	NA	NA	0.375	NA	2.0	2.0	NA	1.0	NA	NA	0.3	NA	NA

NA = Not Authorized for use
** See required buffers and methods restrictions within each species-specific PDS*

[5] This list of chemicals is based on the analyses in the Syracuse Environmental Research Associates (SERA) risk assessments maintained by the U.S. Forest Service and available at http://www.fs.fed.us/foresthealth/pesticide/risk.shtml. The herbicides and application rates listed in this table include only those that were found in the SERA assessments to be below both the acute and chronic NOAELs for terrestrial wildlife.

Fish Passage Restoration (Profile Discontinuities)

1a: Dams, Water Control Structures, or Legacy Structures Removal

Description. BPA proposes to fund and review fish passage projects, and restore more natural channel and flow conditions by removing small dams, channel-spanning weirs, earthen embankments, subsurface drainage features, spillway systems, tide gates, outfalls, pipes, instream flow redirection structures (*e.g.*, drop structure, gabion, groin), or similar devices used to control, discharge, or maintain water levels.

Small dams include instream structures that are 10 feet in height or less for streams with an active channel width of less than 50-feet and a slope less than 4%, or up to 16.4 feet in height and a slope greater than 4%.

If the structure being removed contains material (i.e. large wood, boulders, etc) that is typically found within the stream or floodplain at that site, the material can be reused to implement habitat improvements. Any such project must follow the design criteria outlined in the **Install Habitat-Forming Natural Material Instream Structures (Large Wood, Boulders, and Spawning Gravel)** activity category.

Conservation Measures:

1) Restore all structure banklines and fill in holes with native materials to restore contours of stream bank and floodplain. Compact the fill material adequately to prevent washing out of the soil during over bank flooding. Do not mine material from the stream channel to fill in "key" holes. When removal of buried (keyed) structures may result in significant disruption to riparian vegetation and/or the floodplain, consider leaving the buried structure sections within the streambank.
2) If the legacy structures (log, rock, or gabion weirs) were placed to provide grade control, evaluate the site for potential headcutting and incision due to structure removal by using the appropriate guidance.[6] If headcutting and channel incision are likely to occur due to structure removal, additional measures must be taken to reduce these impacts (see grade control options described under **Headcut and Grade Stabilization** activity category).
3) If the structure is being removed because it has caused an over-widening of the channel, consider implementing other HIP III restoration categories to decrease the width to depth ratio of the stream at that location to a level commensurate with representative upstream and downstream sections (within the same channel type).
4) Tide gates can only be removed not modified or replaced. Modification or replacement of tidegates will require a separate individual consultation with the Services.

Fish Passage Restoration (Transportation)

[6] Castro, J. 2003. Geomorphologic Impacts of Culvert Replacement and Removal: Avoiding Channel Incision. Oregon Fish and Wildlife Office, Portland, OR. Available at: http://library.fws.gov/pubs1/culvert-guidelines03.pdf

1f: Bridge and Culvert Removal or Replacement

Description. For unimpaired fish passage it is desirable to have a crossing that is a larger than the channel bankfull width, allows for a functional floodplain, allows for a natural variation in bed elevation, and provides bed and bank roughness similar to the upstream and downstream channel. In general, bridges will be implemented over culverts because they typically do not constrict a stream channel to as great a degree as culverts and usually allow for vertical movement of the streambed (see #3 below). Bottomless culverts may provide a good alternative for fish passage where foundation conditions allow their construction and width criteria can be met.

Conservation measures:

1) Stream crossings shall be designed to the design benchmarks set in (NMFS 2011 or more recent version)[7] and restore floodplain function.
2) A crossing shall: (a) maintain the general scour prism, as a clear, unobstructed opening (i.e., free of any fill, embankment, scour countermeasure, or structural material); (b) be a single span structure that maintains a clear, unobstructed opening above the general scour elevation that is at least as wide as 1.5 times the active channel width; (c) be a multiple span structure that maintains a clear, unobstructed opening above the general scour elevation, except for piers or interior bents, that is at least as wide as 2.2 times the active channel width.[8] This criteria will restore any physical or biological processes associated with a fully functional floodplain that was degraded by the previous crossing.
3) Bridge scour and stream stability countermeasures may be applied below the general scour elevation, however, except as described above in (2), no scour countermeasure may be applied above the general scour elevation.
4) Remove all other artificial constrictions within the functional floodplain of the project area as follows: (a) remove existing roadway fill, embankment fill, approach fill, or other fills; (b) install relief conduits through existing fill; (c) remove vacant bridge supports below total scour depth, unless the vacant support is part of the rehabilitated or replacement stream crossing; and (d) reshape exposed floodplains and streambanks to match upstream and downstream conditions.
5) If the crossing will occur within 300 feet of active spawning area, only full span bridges or streambed simulation will be used.

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[7] NMFS (National Marine Fisheries Service). 2011. Anadromous Salmonid Passage Facility Design. NMFS, Northwest Region, Portland, Oregon. Available at: http://www.nwr.noaa.gov/Publications/Reference-Documents/Passage-Refs.cfm

[8] For guidance on how to complete bridge scour and stream stability analysis, see Lagasse *et al*. 2001a (HEC-20), Lagasse *et al*. 2001b (HEC-23), Richardson and Davis 2001 (HEC-18), ODOT 2005, and AASHTO 2007.

Active channel width means the stream width measured perpendicular to stream flow between the ordinary high water lines, or at the channel bankfull elevation if the ordinary high water lines are indeterminate. This width includes the cumulative active channel width of all individual side- and off-channel components of channels with braided and meandering forms, and measure outside the area influence of any existing stream crossing, e.g., five to seven channel widths upstream and downstream.

6) Projects in stream channels with gradients above six percent will utilize a bridge or if a bridge is determined to not be feasible, the crossing will be designed using the stream simulation option.
7) Culverts shall not be longer than: 150 feet for stream simulation, 75 feet for no-slope and 500 feet for any other option. Maximum culvert width shall be 20 feet, for widths greater than 20 feet a bridge will be used.
8) Designs must demonstrate that the vertical and lateral stability of the stream channel are taken into consideration when designing a crossing.
9) Designs must demonstrate that culverts and bridges shall mimic the natural stream processes and allow for fish passage, sediment transport, and flood and debris conveyance.
10) Designs must demonstrate that the crossings: (a) avoid causing local scour of streambanks and reasonably likely spawning areas; (b) allow the fluvial transport of large wood, up to a site potential tree height in size, through the project area without becoming stranded on the bridge structure; (c) allow for likely channel migration patterns within the functional floodplain for the design life of the bridge; and otherwise align with well-defined, stable channels; and (d) allow for the passage of all aquatic organisms.
11) The proponent shall include suitable grade controls to prevent culvert failure caused by changes in stream elevation. Grade control structures to prevent headcutting above or below the culvert or bridge may be built using rock or wood as outlined in the **Headcut and Grade Stabilization** criteria under the **Profile Discontinuity** activity subcategory.

River, Stream, and Floodplain Restoration

2a: Improve Secondary Channel and Wetland Habitats

Description. BPA proposes to review and fund projects that reconnect historical stream channels within floodplains, restore or modify hydrologic and other essential habitat features of historical river floodplain swales, abandoned side channels, spring-flow channels, wetlands, historical floodplain channels and create new self-sustaining side channel habitats which are maintained through natural processes.

Actions include the improvement and creation of secondary channels, off channel habitats and wetlands to increase the available area and access to rearing habitat; increase hydrologic capacity, provide resting areas for fish and wildlife species at various levels of inundation; reduce flow velocities; and provide protective cover for fish and other aquatic species.

Reconnection of historical off- and side channels habitats that have been blocked includes the removal of plugs, which impede water movement through off- and side-channels. Excavating pools and ponds in the historic floodplain/channel migration zone to create connected wetlands; Reconnecting existing side channels with a focus on restoring fish access and habitat forming processes (hydrology, riparian vegetation); Wetland habits will be created to reestablish a hydrologic regime that has been disrupted by human activities, including functions such as water depth, seasonal fluctuations, flooding periodicity, and connectivity.

All activities intended for improving secondary channel habitats will provide the greatest degree of natural stream and floodplain function achievable and shall be implemented to address basin specified limiting factors. The long-term development of a restored side channel will depend on natural processes like floods and mainstem migration.

If more than 20% of the amount of water from the main channel shall be diverted into the secondary channel then the action shall be considered Channel Reconstruction (pg. 46).

Conservation measures:

1) Off- and side-channel improvements can include minor excavation ($\leq$ 10%) of naturally accumulated sediment within historical channels. Evidence of historical channel location, such as land use surveys, historical photographs, topographic maps, remote sensing information, or personal observation. There is no limit as to the amount of excavation of anthropogenic fill within historic side channels as long as such channels can be clearly identified through field and/or aerial photographs.
2) Designs must demonstrate sufficient hydrology and that the project will be self-sustaining over time. Self-sustaining means the restored or created habitat would not require major or periodic maintenance, but function naturally within the processes of the floodplain.
3) Proposed new side channel construction must be within the functional floodplain (5-year recurrence interval), current channel meander migration zone, and require limited excavation for construction. Reconnection of historical fragmented habitats are preferred.
4) Side channel habitat will be constructed to prevent fish stranding by providing a continual positive **overall** grade to the intersecting river or stream, or by providing a year-round water connection.
5) Excavated material removed from off- or side-channels shall be hauled to an upland site or spread across the adjacent floodplain in a manner that does not restrict floodplain capacity. Hydric soils may be salvaged to provide appropriate substrate and/or seed source for hydrophytic plant community development. Hydric soils will only be obtained from wetland salvage sites.
6) Excavation depth will never exceed the maximum thalweg depth in the main channel.
7) Restoration of existing side channels including one-time dredging and an up to two times project adjustment including adjusting the elevation of the created side channel habitat.
8) All side channel and pool habitat work will occur in isolation from waters occupied by ESA-listed salmonid species until project completion, at which time a final opening may be made by excavation to waters occupied by ESA-listed salmonid or water will be allowed to return into the area.
9) Adequate precautions will be taken to prevent the creation of fish passage issues or stranding of juvenile or adult fish by demonstrating sufficient hydrologic conditions.
10) **Rewatering stream channels**. For stream channels which have been isolated and dewatered during project construction:
    a) Reconstructed stream channels will be “pre-washed” into a reach equipped with sediment capture devices, prior to reintroduction of flow to the stream.
    b) Stream channels will be re-watered slowly to minimize a sudden increase in turbidity (see Staged Rewatering Plan).

2b: Set-back or Removal of Existing Berms, Dikes, and Levees

Description: The BPA proposes to review and fund projects that reconnect estuary, stream and river channels with floodplains, increase habitat diversity and complexity, moderate flow disturbances, and provide refuge for fish during high flows by either removing existing berms, dikes or levees or increasing the distance that they are set back from active streams or wetlands. This action includes the removal of fill, such as dredge spoils from past channelization projects, road, trail, and railroad beds, dikes, berms, and levees to restore natural estuary and fresh-water floodplain functions. Such functions include overland flow during high flows, dissipation of flood energy, increased water storage to augment low flows, sediment and debris deposition, growth of riparian vegetation, nutrient cycling, and development of side channels and alcoves.

Techniques that are covered by this programmatic need to have the sole purpose of restoring floodplain and estuary functions or to enhance fish habitat. Covered actions in freshwater, estuarine, and marine areas include: 1) full and partial removal of levees, dikes, berms, and jetties; 2) breaching of levees, dikes, and berms; 3) lowering of levees, dikes, and berms; and, 4) setback of levees, dikes, and berms.

Conservation Measures:

1) To the greatest degree possible, nonnative fill material, originating from outside the floodplain of the action area will be removed from the floodplain to an upland site.
2) Where it is not possible to remove or set-back all portions of dikes and berms, or in areas where existing berms, dikes, and levees support abundant riparian vegetation, openings will be created with breaches.
3) Breaches shall be equal to or greater than the active channel width (as defined above) to reduce the potential for channel avulsion during flood events.
4) In addition to other breaches, the berm, dike, or levee shall always be breached at the downstream end of the project and/or at the lowest elevation of the floodplain to ensure the flows will naturally recede back into the main channel thus minimizing fish entrapment.
5) When necessary, loosen compacted soils once overburden material is removed.
6) Overburden or fill comprised of native materials, which originated from the project area, may be used within the floodplain to create set-back dikes and fill anthropogenic holes provided that does not impede floodplain function.
7) When full removal is not possible and a setback is required, the new structure locations should be prioritized to the outside of the meander belt width or to the outside or the channel meander zone margins.

2c: Protect Streambanks Using Bioengineering Methods

Description. The BPA proposes to review and fund projects that restore eroding streambanks by bank shaping and installation of coir logs or other soil reinforcements – bioengineering techniques as necessary to support development of riparian vegetation and/or planting or installing large wood, trees, shrubs, and herbaceous cover as necessary to restore ecological function in riparian and floodplain habitats.

Streambank erosion often occurs within meandering alluvial rivers on the outside of meander bends. The rate of erosion and meander migration is often accelerated due to degradation of the stream side riparian vegetation and land use practices that have removed riparian woody species. Historically, as the river migrates into the adjacent riparian areas, LW would be recruited from the banks resulting in reduced near bank velocities and increased boundary roughness. Where a functional riparian area is lacking, the lateral bank erosion may occur at an unnaturally accelerated rate. The goal of streambank restoration is to reestablish long term riparian processes through re-vegetation and riparian buffer strips. Structural bank protection may be used to provide short term stability to banklines allowing for vegetation establishment.

The primary proposed structural streambank stabilization action is the use of large wood and vegetation to increase bank strength and resistance to erosion in an ecological approach to engineering streambank stabilization.

The following bioengineering techniques[9] are proposed for use either individually or in combination: (a) Woody plantings and variations (e.g., live stakes, brush layering, facines, brush mattresses); (b) herbaceous cover, for use on small streams or adjacent wetlands; (c) deformable soil reinforcement, consisting of soil layers or lifts strengthened with biodegradable coir fabric and plantings that are penetrable by plant roots; (d) coir logs (long bundles of coconut fiber), straw bales and straw logs used individually or in stacks to trap sediment and provide a growth medium for riparian plants; (e) bank reshaping and slope grading, when used to reduce a bank slope angle without changing the location of its toe, to increase roughness and cross section, and to provide more favorable planting surfaces; (f) tree and LW rows, live siltation fences, brush traverses, brush rows and live brush sills in floodplains, used to reduce the likelihood of avulsion in areas where natural floodplain roughness is poorly developed or has been removed and (g) floodplain flow spreaders, consisting of one or more rows of trees and accumulated debris used to spread flow across the floodplain; and (h) use of LW as a primary structural component.

Conservation Measures:

1) Without changing the location of the bank toe, damaged streambanks will be restored to a natural slope, pattern, and profile suitable for establishment of permanent woody vegetation. This may include sloping of unconsolidated bank material to a stable angle of repose, or the use of benches in consolidated, cohesive soils. The purpose of bank shaping is to provide a more stable platform for the establishment of riparian vegetation, while also reducing the depth to the water table, thus promoting better plant survival.
2) Streambank restoration projects shall include the placement of a riparian buffer strip consisting of a diverse assemblage of species native to the action area or region, including trees, shrubs, and herbaceous species. Do not use invasive species.
3) Large wood will be used as an integral component of all streambank protection treatments unless restoration can be achieved with soil bioengineering techniques alone.
4) LW will be placed to maximize near bank hydraulic complexity and interstitial habitats through use of various LW sizes and configurations of the placements.
5) Structural placement of LW should focus on providing bankline roughness for energy dissipation vs. flow re-direction that may affect the stability of the opposite bankline.
6) Large wood will be intact, hard, and undecayed to partly decaying with untrimmed root wads to provide functional refugia habitat for fish. Use of decayed or fragmented wood found

[9] For detailed descriptions of each technique refer to the WDFW Integrated Streambank Protection Guidelines: http://wdfw.wa.gov/publications/00046/,the USACE's EMRRP Technical Notes, Stream Restoration: http://el.erdc.usace.army.mil/publications.cfm?Topic=technote&Code=emrrp, or the NRCS National Engineering Handbook Part 654, Stream Restoration: http://policy.nrcs.usda.gov/viewerFS.aspx?id=3491

lying on the ground may be used for additional roughness and to add complexity to LW placements but will not constitute the primary structural components.

7) Wood that is already within the stream or suspended over the stream may be repositioned to allow for greater interaction with the stream.
8) LW anchoring will not utilize cable or chain. Manila, sisal or other biodegradable ropes may be used for lashing connections. If hydraulic conditions warrant use of structural connections then rebar pinning or bolting may be used. The utilization of structural connections should be used minimally and only to ensure structural longevity in high energetic systems such as (high gradient systems with lateral confinement and limited floodplain). Need for structural anchorage shall be demonstrated in the design documentation.
9) Rock will not be used for streambank restoration, except as ballast to stabilize large wood unless it is necessary to prevent scouring or downcutting of an existing flow control structure (*e.g.*, a culvert or bridge support, headwall, utility lines, or building). In this case rock may be used as the primary structural component for construction of vegetated riprap with large woody debris. Scour holes may be filled with rock to prevent damage to structure foundations but will not extend above the adjacent bed of the river. This does not include scour protection for bridge approach fills.
10) The rock may not impair natural stream flows into or out of secondary channels or riparian wetlands.
11) Any action that requires additional excavation or structural changes to a road, culvert, bridge foundation or that may affect fish passage is covered under the **Fish Passage Restoration** activity category.
12) Fencing will be installed as necessary to prevent access and grazing damage to revegetated sites and project buffer strips.
13) Riparian buffer strips associated with streambank protection shall extend from the project bankline towards the floodplain a minimum distance of 35 feet.

2d: Install Habitat-Forming Natural Material Instream Structures (LW, Boulders, and Spawn Gravel)

Description. The BPA proposes to review and fund projects that include placement of natural habitat forming structures to provide instream spawning, rearing and resting habitat for salmonids and other aquatic species. Projects will provide high flow refugia; increase interstitial spaces for benthic organisms; increase instream structural complexity and diversity including rearing habitat and pool formation; promote natural vegetation composition and diversity; reduce embeddedness in spawning gravels and promote spawning gravel deposition; reduce siltation in pools; reduce the width/depth ratio of the stream; mimic natural input of LW (e.g., whole conifer and hardwood trees, logs, root wads); decrease flow velocities; and deflect flows into adjoining floodplain areas to increase channel and floodplain function. In areas where natural gravel supplies are low (immediately below reservoirs, for instance), gravel placement can be used to improve spawning habitat.

Anthropogenic activities that have altered riparian habitats, such as splash damming and the removal of large wood and logjams, have reduced instream habitat complexity in many rivers and have eliminated or reduced features like pools, hiding cover, and bed complexity. Salmonids need habitat complexity for rearing, feeding, and migrating. To offset these impacts large wood, boulders and spawning gravel will be placed in stream channels either individually or in combination.

Large wood will be placed to increase coarse sediment storage, increase habitat diversity and complexity, retain gravel for spawning habitat, improve flow heterogeneity, provide long-term nutrient storage and substrate for aquatic macroinvertebrates, moderate flow disturbances, increase retention of leaf litter, and provide refugia for fish during high flows. Engineered log jams create a hydraulic shadow, a low-velocity zone downstream that allows sediment to settle out. Scour holes develop adjacent to the log jam which can provide valuable fish and wildlife habitat by redirecting flow and providing stability to a streambank or downstream gravelbar. Boulder placements increase habitat diversity and complexity, improve flow heterogeneity, provide substrate for aquatic vertebrates, moderate flow disturbances, and provide refuge for fish during high flows. The placement of individual large boulders and boulder clusters to increase structural diversity is important to provide holding and rearing habitat for ESA-listed salmonids where similar natural rock has been removed. This treatment will be used in streams that have been identified as lacking structural diversity and that are naturally and/or historically have had boulders.

The quality and quantity of available spawning gravel has been impacted by many anthropogenic features and activities. For example, dams and culverts can block the downstream movement of gravel and result in gravel starved reaches. Channelization, hard streambank stabilization, and diking restrict a stream from meandering and recruiting gravel. Elimination of riparian buffers and grazing up to the stream's edge introduces fines that often cause embedded or silted-in spawning gravel. Spawning gravel will be placed to improve spawning substrate by compensating for an identified loss of a natural gravel supply and may be placed in conjunction with other projects, such as simulated log jams and boulders.

All activities intended for installing habitat-forming instream structures will provide the greatest degree of natural stream and floodplain function achievable through application of an integrated, ecological approach and linkage to basin defined limiting factors. Instream structures capable of enhancing habitat forming processes and migratory corridors will be installed only within previously degraded stream reaches, where past disturbances have removed habitat elements such as LW, boulders, or spawning gravel.

Conservation Measures (Large Wood):

1) LW placements for other purposes than habitat restoration or enhancement are excluded from this consultation.
2) LW will be placed in channels that have an intact, well-vegetated riparian buffer area that is not mature enough to provide large wood, or in conjunction with riparian rehabilitation or management.
3) LW may partially or completely span the channel in first order streams if the active channel top width is less than 20 feet.
4) When available and if the project is located within the appropriate morphology and sized stream, trees with rootwads attached should be a minimum length of 1.5 times the bankfull channel width, while logs without rootwads should be a minimum of 2.0 times the bankfull width.
5) Stabilizing or key pieces of large wood that will be relied on to provide streambank stability or redirect flows must be intact, hard, and undecayed to partly decaying, and should have untrimmed root wads to provide functional refugia habitat for fish. Use of decayed or

fragmented wood found lying on the ground or partially sunken in the ground is not acceptable for key pieces but may be incorporated to add habitat complexity.

6) The partial burial of LW and boulders may constitute the dominant means of placement and key boulders (footings) or LW can be buried into the stream bank or channel.
7) If LW anchoring is required, a variety of methods may be used. These include buttressing the wood between riparian trees, the use of manila, sisal or other biodegradable ropes for lashing connections or if hydraulic conditions warrant use of structural connections then rebar pinning or bolting may be used. The utilization of structural connections should be used minimally and only to ensure structural longevity in high energetic systems such as (high gradient systems with lateral confinement and limited floodplain). Need for structural anchorage shall be demonstrated in the design documentation.
8) Rock may be used for ballast but is limited to that needed to anchor the LW.

Conservation Measures (Boulder Placement):

1) Boulder placements for other purposes than habitat restoration or enhancement are excluded from this consultation.
2) The cross-sectional area of boulder placements may not exceed 25% of the cross-sectional area of the low flow channel, or be installed to shift the stream flow to a single flow pattern in the middle or to the side of the stream.
3) Boulders will be machine-placed (no end dumping allowed) and will rely on the size of boulder for stability.
4) Boulders will be installed low in relation to channel dimensions so that they are completely overtopped during channel-forming flow events (approximately a 1.5-year flow event).
5) Permanent anchoring, including rebar or cabling, may not be used.

Conservation Measures (Spawning Gravel):

1) Spawning gravel to be placed in streams must be obtained from an upland source outside of the channel and riparian area and properly sized gradation for that stream, clean, and non-angular. When possible use gravel of the same lithology as found in the watershed. After spawning gravel placement, allow the stream to naturally sort and distribute the material.
2) A maximum of 100 cubic yards of spawning sized gravel can be imported or relocated and placed upstream of each structure when in combination with other restoration activities that address the underlying systematic problem. For example a combined project consisting of: planting streambank vegetation, placing instream LW and supplementing spawning gravel.
3) Imported gravel must be free of invasive species and non-native seeds.

2e: Riparian Vegetation Planting

Description. The BPA proposes to fund vegetation planting to recover watershed processes and functions associated with native plant communities and that will help restore natural plant species composition and structure. Under this activity category, project proponents would plant trees, shrubs, herbaceous plants, and aquatic macrophytes to help stabilize soils. Large trees such as cottonwoods and conifers will be planted in areas where they historically occurred but are currently either scarce or absent. Native plant species and seeds will be obtained from local sources to ensure plants are adapted to local climate and soil chemistry.

Vegetation management strategies will be utilized that are consistent with local native succession and disturbance regimes and specify seed/plant source, seed/plant mixes, and soil preparation. Planting will address the abiotic factors contributing to the sites' succession, *i.e.*, weather and disturbance patterns, nutrient cycling, and hydrologic condition. Only certified noxious weed-free seed (99.9%), hay, straw, mulch, or other vegetation material for site stability and revegetation projects will be utilized.

Conservation Measures:

1) An experienced silviculturist, botanist, ecologist, or associated technician shall be involved in designing vegetation treatments.
2) Species to be planted must be of the same species that naturally occurs in the project area.
3) Tree and shrub species as well as sedge and rush mats to be used as transplant material shall come from outside the bankfull width, typically in abandoned flood plains, and where such plants are abundant.
4) Sedge and rush mats should be sized as to prevent their movement during high flow events.
5) Concentrate plantings above the bankfull elevation.
6) Species distribution shall mimic natural distribution in the riparian and floodplain areas.

2f: Channel Reconstruction

Description. The BPA proposes to review and fund channel reconstruction projects to improve aquatic and riparian habitat diversity and complexity, reconnect stream channels to floodplains, reduce bed and bank erosion, increase hyporheic exchange, provide long-term nutrient storage, provide substrate for macroinvertebrates, moderate flow disturbance, increase retention of organic material, and provide refuge for fish and other aquatic species by reconstructing stream channels and floodplains that are compatible within the appropriate watershed context and geomorphic setting.

The reconstructed stream system shall be composed of a naturally sustainable and dynamic planform, cross-section, and longitudinal profile that incorporates unimpeded passage and temporary storage of water, sediment, organic material, and species. Stream channel adjustment over time is to be expected in naturally dynamic systems and is a necessary component to restore a wide array of stream functions. It is expected that for most projects that there will be a primary channel with secondary channels that are activated at various flow levels to increase floodplain connectivity and to improve aquatic habitat through a range of flows. This proposed action is not intended to artificially stabilize streams into a single location or into a single channel for the purposes of protecting infrastructure or property.

Channel reconstruction consists of re-meandering or movement of the primary active channel, and may include structural elements such as streambed simulation materials, streambank restoration, and hydraulic roughness elements. For bed stabilization and hydraulic control structures, constructed riffles shall be preferentially used in pool-riffle stream types, while roughened channels and boulder weirs shall be preferentially used in step-pool and cascade stream types. Material selection (large wood, rock, gravel) shall also mimic natural stream system materials.

Due to the complexity of channel reconstruction projects, there shall be separate procedural guidelines, data and information requirements, that will be refined, amended, and updated through an iterative collaborative process with BPA, NMFS, and USFWS.

The channel reconstruction activity is considered ***high risk*** and will require RRT and NMFS Hydro review.

High Risk projects in the Channel Reconstruction activity shall address the **General Project and Data Summary Requirements (Appendix C),** the following **Conservation Measures**, and include a **Monitoring and Adaptive Management Plan.**

Conservation Measures:

Because of the complexity of channel reconstruction projects, there shall be an interdisciplinary design team minimally consisting of a biologist, engineer, and hydrologist.
Data requirements for RRT & NMFS review and analysis include:

1) Designs must demonstrate a clear linkage to limiting factors identified within the appropriate sub-basin plan, recovery plan or recommendations by a technical oversight and steering committee within a localized region.
2) Detailed construction drawings
3) Designs must demonstrate that channel reconstruction will identify, correct to the extent possible, and then account for in the project development process, the conditions that lead to the degraded condition.
4) Designs must demonstrate that the proposed action will mimic natural conditions for gradient, width, sinuosity and other hydraulic parameters.
5) Designs must demonstrate that structural elements shall fit within the geomorphic context of the stream system.
6) Designs must demonstrate sufficient hydrology and that the project will be self-sustaining over time. Self-sustaining means the restored or created habitat would not require major or periodic maintenance, but function naturally within the processes of the floodplain.
7) Designs must demonstrate that the proposed action will not result in the creation of fish passage issues or post construction stranding of juvenile or adult fish.

Invasive Plant Control

3a: Manage Vegetation Using Physical Control

Description. BPA proposes to use two mechanisms for vegetation management by physical control: (a) Manual control includes hand pulling and grubbing with hand tools; bagging plant residue for burning or other proper disposal; mulching with organic materials; shading or covering unwanted vegetation; controlling brush and pruning using hand and power tools such as chain saws and machetes; using grazing goats. When possible, manual control (e.g., hand pulling, grubbing, cutting) will be used in sensitive areas to avoid adverse effects to listed species or water quality. (b) Mechanical control includes techniques such as mowing, tilling, disking, or plowing. Mechanical control may be carried out over large areas or be confined to smaller areas (known as scalping). Ground-disturbing mechanical activity will be restricted in established buffer zones adjacent to streams, lakes, ponds, wetlands and other identified sensitive habitats based on percent slope. For slopes less than 20%, a buffer width of 35 feet will be used. For slopes over 20%, no ground-disturbing mechanical equipment will be used.

Conservation Measures:

1) For mechanical control that will disturb the soil, an untreated area will be maintained within the immediate riparian buffer area to prevent any potential adverse effects to stream channel or water quality conditions. The width of the untreated riparian buffer area will vary depending on site-specific conditions and type of treatment.
2) Ground-disturbing mechanical activity will be restricted in established buffer zones adjacent to streams, lakes, ponds, wetlands and other identified sensitive habitats based on percent slope. For slopes less than 20%, a buffer width of 35 feet will be used. For slopes over 20%, no ground-disturbing mechanical equipment will be used.
3) When possible, manual control (*e.g*., hand pulling, grubbing, cutting) will be used in sensitive areas to avoid adverse effects to listed species or water quality.
4) All noxious weed material will be disposed of in a manner that will prevent its spread. Noxious weeds that have developed seeds will be bagged and burned.

3b: Manage Vegetation Using Herbicides

Description. The BPA proposes to fund management of vegetation using chemical herbicides to recover watershed processes and functions associated with native plant communities. Herbicides will be applied in liquid or granular form using wand or boom sprayers mounted on or towed by trucks, backpack equipment containing a pressurized container with an agitation device, injection, hand wicking cut surfaces, and ground application of granular formulas. Herbicides will be mixed with water as a carrier (no petroleum-based carriers will be used) and may also contain a variety of additives (see adjuvant paragraph below) to promote saturation and adherence, to stabilize, or to enhance chemical reactions. Aerial treatment is not proposed to be covered under this consultation, nor is treatment of aquatic weeds except for knotweed (*Polygonum cuspidatum*).

Conservation Measures:

1) **Maximum herbicide treatment area.** The area treated with herbicides above bankfull elevation, within riparian areas, will not exceed 10 acres above bankfull elevation and 2 acres below bankfull elevation, per 1.6-mile reach of a stream, per year.
2) **Herbicide applicator qualifications.** Herbicides will be applied only by an appropriately licensed applicator using an herbicide specifically targeted for a particular plant species that will cause the least impact to non-target species. The applicator will be responsible for preparing and carrying out the herbicide transportation and safety plan, as follows.
3) **Herbicide transportation and safety plan.** The applicator will prepare and carry out an herbicide safety/spill response plan to reduce the likelihood of spills or misapplication, to take remedial actions in the event of spills, and to fully report the event. At a minimum, the plan will:
   a) Address spill prevention and containment.
   b) Estimate and limit the daily quantity of herbicides to be transported to treatment sites.

c) Require that impervious material be placed beneath mixing areas in such a manner as to contain small spills associated with mixing/refilling.
d) Require a spill cleanup kit be readily available for herbicide transportation, storage and application.
e) Outline reporting procedures, including reporting spills to the appropriate regulatory agency.
f) Ensure applicators are trained in safe handling and transportation procedures and spill cleanup.
g) Require that equipment used in herbicide storage, transportation and handling are maintained in a leak proof condition.
h) Address transportation routes so that hazardous conditions are avoided to the extent possible.
i) Specify mixing and loading locations away from waterbodies so that accidental spills do not contaminate surface waters
j) Require that spray tanks be mixed or washed further than 150 feet of surface water.
k) Ensure safe disposal of herbicide containers.
l) Identify sites that may only be reached by water travel and limit the amount of herbicide that may be transported by watercraft.
m) All individuals involved, including any contracted applicators, will be instructed on the plan.

4) **Herbicides.** BPA proposes the use of the following herbicides in the typical application rates (see Tables 1 and 2) for invasive plant control. These products were previously evaluated in risk assessments by the US Forest Service http://www.fs.fed.us/foresthealth/pesticide/risk).

Table 1. Herbicides Proposed for Use by BPA.

Common Name	Trade Name	Typical Application Rates (ai/ac)	Maximum Label Application Rate (ai/ac)	General Geographic Application Areas
2,4-D (amine)	Many	0.5 - 1.5 lbs.	4.0 lbs	Upland & Riparian
Aminopyralid	Milestone®	0.11 - 0.22 lbs	0.375 lb	Upland & Riparian
Chlorsulfuron	Telar®	0.25 - 1.33 oz	3.0 oz	Upland
Clethodim	Select®	0.125 – 0.5 lbs	0.50 lb	Upland
Clopyralid	Transline®	0.1 - 0.375 lbs	0.5 lb	Upland & Riparian
Dicamba	Banvel® only	0.25 - 7.0 lbs	8.0 lbs	Upland & Riparian
Glyphosate 1 Glyphosate 2	Many Many	0.5 - 2.0 lbs 0.5 - 2.0 lbs	3.75 lbs 3.75 lbs	Upland & Riparian Upland
Imazapic	Plateau®	0.063 – 0.189 lbs	0.189 lb	Upland & Riparian
Imazapyr	Arsenal® Habitat®	0.5 – 1.5 lbs.	1.5 lbs	Upland & Riparian

Metsulfuron methyl	Escort®	0.33 - 2.0 oz	4.0 oz	Upland
Picloram	Tordon®	0.125 - 0.50 lb	1 lb	Upland
Sethoxydim	Poast®	0.1875 – 0.375 lb	0.375 lb	Upland
Sulfometuron methyl	Oust®	0.023 - 0.38 oz	2.25 oz	Upland
Triclopyr (TEA)	Garlon 3A®	1.0 - 2.5 lbs	9.0 lbs	Upland & Riparian

5) **2,4-D.** As a result of the National Consultation[10], this herbicide shall comply with all relevant reasonable and prudent alternatives from the 2011 Biological Opinion (NMFS 2011a):
   a) Do not apply when wind speeds are below 2 mph or exceed 10 mph, except when winds in excess of 10 mph will carry drift away from salmonid-bearing waters.
   b) Do not apply when a precipitation event, likely to produce direct runoff to salmonid bearing waters from the treated area, is forecasted by NOAA/NWS (National Weather Service) or other similar forecasting service within 48 h following application.
6) Control of invasive plants within the riparian habitat shall be by individual plant treatments for woody species, and spot treatment of less than 1/10 acre for herbaceous species per project per year.
7) **Adjuvants.** The following adjuvants are proposed for use (Table 2). Polyethoxylated tallow amine (POEA) surfactant and herbicides that contain POEA (e.g., Roundup) have been removed from the proposed action.
8) **Herbicide carriers.** Herbicide carriers (solvents) are limited to water or specifically labeled vegetable oil.
9) **Herbicide mixing.** Herbicides will be mixed more than 150 feet from any natural waterbody to minimize the risk of an accidental discharge and no more than three different herbicides may be mixed for any one application.
10) **Herbicide application rates.** Herbicides will be applied at the lowest effective label rates, including the typical and maximum rates given (Table 1). For broadcast spraying, application of herbicide or surfactant will not exceed the typical label rates.

Table 2. Adjuvants Proposed for Use by BPA.

Adjuvant Type	Trade Name	Labeled Mixing Rates per Gallon of Application Mix	General Geographic Application Areas
Colorants	Dynamark™ U.V. (red)	0.1 fl oz	Riparian
	Aquamark™ Blue	0.1 fl oz	Riparian

[10] On June 30, 2011, NMFS issued a final biological opinion addressing the effects of this herbicide on ESA-listed Pacfic salmonids. The opinion has concluded that EPA's proposed registration of certain uses of 2,4-D, including aquatic uses of 2,4-D BEE are likely to jeopardize the continued existence of the 28 endangered and threatened Pacific salmonids. http://www.nmfs.noaa.gov/pr/consultation/pesticides.htm

	Dynamark™ U.V. (blu)	0.5 fl oz	Upland
	Hi-Light® (blu)	0.5 fl oz	Upland
Surfactants	Activator 90®	0.16 – 0.64 fl oz	Upland
	Agri-Dex®	0.16 – 0.48 fl oz	Riparian
	Entry II®	0.16 – 0.64 fl oz	Upland
	Hasten®	0.16 – 0.48 fl oz	Riparian
	LI 700®	0.16 – 0.48 fl oz	Riparian
	R-11®	0.16 – 1.28 fl oz	Riparian
	Super Spread MSO®	0.16 – 0.32 fl oz	Riparian
	Syl-Tac®	0.16 – 0.48 fl oz	Upland
Drift Retardants	41-A®	0.03 – 0.06 fl oz	Riparian
	Valid®	0.16 fl oz	Upland

11) **Herbicide application methods.** Liquid or granular forms of herbicides to be applied by a licensed applicator as follows:
   a) Broadcast spraying – hand held nozzles attached to back pack tanks or vehicles, or by using vehicle mounted booms;
   b) Spot spraying – hand held nozzles attached to back pack tanks or vehicles, hand-pumped spray, or squirt bottles to spray herbicide directly onto small patches or individual plants using;
   c) Hand/selective – wicking and wiping, basal bark, fill ("hack and squirt"), stem injection, cut-stump;
   d) Triclopyr – will not be applied by broadcast spraying.
12) **Emergent Knotweed Application.**_ No aquatic application of chemicals is covered by this consultation except for treating emergent knotweed. Only aquatic labeled glyphosate formulations will be used. The only application methods for emergent knotweed are stem injection (formulation up to 100% for emergent stems greater than 0.75 inches in diameter), wicking or wiping (diluted to 50% formulation), and hand-held spray bottle application of glyphosate (up to the percentage allowed by label instructions when applied to foliage using low pressure hand-held spot spray applicators).
13) **Water Transportation.** Most knotweed patches are expected to have overland access. However, some sites may be reached only by water travel, either by wading or inflatable raft (or kayak). The following measures will be used to reduce the risk of a spill during water transport:
   a) No more than 2.5 gallons of glyphosate will be transported per person or raft, and typically it will be one gallon or less.
   b) Glyphosate will be carried in 1 gallon or smaller plastic containers. The containers will be wrapped in plastic bags and then sealed in a dry-bag. If transported by raft, the dry-bag will be secured to the watercraft.
14) **Minimization of herbicide drift and leaching.** Herbicide drift and leaching will be minimized as follows:
   a) Do not spray when wind speeds exceed 10 miles per hour, or are less than 2 miles per hour;

b) Be aware of wind directions and potential for herbicides to affect aquatic habitat area downwind;
c) Keep boom or spray as low as possible to reduce wind effects;
d) Increase spray droplet size whenever possible by decreasing spray pressure, using high flow rate nozzles, using water diluents instead of oil, and adding thickening agents;
e) Do not apply herbicides during temperature inversions, or when ground temperatures exceed 80 degrees Fahrenheit;
f) Do not spray when rain, fog, or other precipitation is falling or is imminent. Wind and other weather data will be monitored and reported for all broadcast applications. Tables 5 and 6 identify BPA's proposed minimum weather and wind speed restrictions (to be used in the absence of more stringent label instructions and restrictions). During application, applicators will monitor weather conditions hourly at sites where spray methods are being used.

Table 3. Herbicide Buffer Widths (from High Water Mark)

Herbicide	Broadcast Application[11]		Backpack Sprayer/Bottle[12] Spot Spray Foliar/Basal		Hand Application[13] Wicking/Wiping/Injection
	Min buffer from high water mark (ft)	Max/ Min wind speed (mph)	Min buffer from high water mark (ft)	Max/ Min wind speed (mph)	Min buffer from high water mark (wind speed not a factor)
2,4-D (amine)	100	10/2	50	5/2	15 feet for aquatic labeled formulations.
Aminopyralid	100	10/2	15	5/2	Up to high water mark.
Chlorsulfuron	100	10/2	15	5/2	Up to high water mark.
Clethodim	NA	NA	50	5/2	Do not use within 50 feet of any surface water.
Clopyralid	100	10/2	15	5/2	Up to high water mark.
Dicamba (Banvel only)	100	10/2	15	5/2	Up to high water mark.
Glyphosate 1	100	10/2	15	5/2	Up to water's edge for aquatic labeled formulations.
Glyphosate 2	100	10/2	100	5/2	100 feet
Imazapic	100	10/2	15	5/2	Up to water's edge for aquatic labeled formulations.
Imazapyr	100	10/2	15	5/2	Up to water's edge for aquatic labeled formulations; otherwise, up to the high water mark.

[11] Ground-based only broadcast application methods via truck/ATV with motorized low-pressure, high-volume sprayers using spray guns, broadcast nozzles, or booms.
[12] Spot and localized foliar and basal/stump applications using a hand-pump backpack sprayer or field-mixed or pre-mixed hand-operated spray bottle.
[13] Hand applications to a specific portion of the target plant using wicking, wiping or injection techniques. This technique implies that herbicides do not touch the soil during the application process.

Metsulfuron	100	10/2	15	5/2	Up to high water mark.
Picloram	100	8/2	100	5/2	Do not use within 100 feet of any surface water.
Sethoxydim	100	10/2	50	5/2	Do not use within 50 feet of any surface water.
Sulfometuron	100	10/2	15	5/2	Up to high water mark.
Triclopyr (TEA)	100	10/2	50	5/2	Up to high water mark for cut-stump application of aquatic labeled formulations; 15 feet for other applications.
Herbicide Mixtures	100	Most conservative of listed herbicides	15	Most conservative of listed herbicides	Most conservative of listed herbicides.

Table 4. Adjuvant Buffer Widths to Minimize Impacts on Non-Target Resources.

Adjuvant	Broadcast Application[14]	Backpack Sprayer/Bottle[15] Spot Spray Foliar/Basal	Hand Application[16] Wicking/Wiping/Injection
	Minimum buffer (ft)	Minimum buffer (ft)	Minimum buffer (ft) (wind speed not a factor)
Dynamark (red)	100	15	Up to water's edge when using herbicides labeled for aquatic uses.
Dynamark (yel)	100	15	Up to water's edge when using herbicides labeled for aquatic uses.
Dynamark (blu)	100	>50 <50 Do not use	>50 Herbicide dependent from Table 2-3. <50 Do not use.
Hi-Light (blu)	100	>50 <50 Do not use	>50 Herbicide dependent from Table 2-3. <50 Do not use.
Activator 90®	100	15	Up to water's edge for aquatic labeled formulations.
Agri-Dex	100	15	Up to water's edge for aquatic labeled formulations.
Entry II	100	<100 Do not use	<100 Do not use.
Hasten	100	15	Up to water's edge for aquatic labeled formulations.

[14] Ground-based only broadcast application methods via truck/ATV with motorized low-pressure, high-volume sprayers using spray guns, broadcast nozzles, or booms.
[15] Spot and localized foliar and basal/stump applications using a hand-pump backpack sprayer or field-mixed or pre-mixed hand-operated spray bottle.
[16] Hand applications to a specific portion of the target plant using wicking, wiping or injection techniques. This technique implies that herbicides do not touch the soil during the application process.

LI 700	100	15	Up to water's edge for aquatic labeled formulations.
R-11	100	>50 <50 Do not use	>50 Herbicide dependent from Table 2-3. <50 Do not use.
Super Spread MSO	100	15	Up to water's edge for aquatic labeled formulations.
Syl-Tac	100	<50	<50 Do not use.
41-A	100	15	Up to water's edge when using herbicides labeled for aquatic uses.
Valid	100	50	<50 Do not use.

Road and Trail Erosion Control, Maintenance, and Decomissioning

5b: Road Decommissioning

Description. BPA proposes to decommission and obliterate roads that are no longer needed, e.g., logging roads. Water bars will be installed, road surfaces will be insloped or outsloped, asphalt and gravel will be removed from road surfaces, culverts and bridges will be altered or removed, streambanks will be recontoured at stream crossings, cross drains will be installed, fill or sidecast materials will be removed, road prism will be reshaped, and sediment catch basins will be created.

1) All surfaces will be revegetated to reduce surface erosion of bare soils.
2) Recontour the affected area to mimic natural floodplain contours and gradient to the extent possible.
3) Surface drainage patterns will be recreated, and dissipaters, chutes or rock will be placed at remaining culvert outlets.
4) Conduct activities during dry-field conditions (generally May 15 – October 15) when the soil is more resistant to compaction and soil moisture is low.
5) Slide and waste material will be disposed in stable, non-floodplain sites unless materials are to restore natural or near-natural contours, and approved by a geotechnical engineer or other qualified personnel.

Irrigation and Water Delivery/Management Actions

7g: Install New or Upgrade/Maintain Existing Fish Screens

Description. Irrigation diversion intake and return points will be designed or replaced to prevent fish and other aquatic organisms of all life stages from swimming or being entrained into the irrigation system. Fish screens for surface water that is diverted by gravity or by pumping at a rate that exceeds 3 cfs will be submitted to NMFS for review and approval. All other diversions will have a fish screen that utilizes an automated cleaning device with a minimum effective surface area of 2.5 square feet per cfs, and a nominal maximum approach velocity of 0.4 feet per second (fps), <u>or</u> no automated cleaning device, a minimum effective surface area of 1 square foot per cfs, and a nominal maximum approach rate of 0.2 fps; <u>and</u> a round or square screen mesh that is no larger than 2.38 mm (0.094") in the narrow dimension, <u>or</u> any other shape that is no larger than 1.75 mm (0.069") in the narrow dimension. Each fish screen will be installed, operated, and maintained according to NMFS' fish screen criteria (NMFS 2011). Periodic maintenance, which may include temporary removal, of fish screens will be conducted to ensure their proper functioning, e.g., cleaning debris buildup, and replacement of parts.

State resource agencies may submit one PNC form for all anticipated fish screen installation, repairs, and maintenance for each field season. The PNC shall contain proposed locations (GIS map) and specific activities. PNCs shall contain actual locations, specific activities undertaken, and a statement of compliance with NMFS fish screen criteria (NMFS 2011).

Fisheries, Hydrologic, and Geomorphologic Surveys

Description. BPA proposes to fund the collection of information in uplands, floodplains, and streambeds regarding existing on-ground conditions relative to habitat type, condition, and impairment; species presence, abundance, and habitat use; and conservation, protection, and rehabilitation opportunities or effects. Electro-shocking and fish handling for research purposes is not included, as this work must have an ESA Section 10 research permit.

Work may entail use of trucks, survey equipment, and crews using hand tools, and includes the following activities:

1) Measuring/assessing and recording physical measurements by visual estimates or with survey instruments.
2) Installing rebar or other markers along transects or at reference points.
3) Installing piezometers and staff gauges to assess hydrologic conditions and installing recording devices for stream flow and temperature.
4) Conducting snorkel surveys to determine species of fish in streams and observing interactions of fish with their habitats
5) Excavating cultural resource test pits.
6) Installing PIT detector arrays.

Special Actions (for Terrestrial Species)

9d: Tree Removal for LW Projects

Description. Live conifers and other trees can be felled or pulled/pushed over in a Northwest Forest Plan (USDA and USDI 1994b) Riparian Reserve or PACFISH/INFISH (USDA-Forest Service 1995; USDA and USDI 1994a) riparian habitat conservation areas (RHCA), and upland areas (e.g., late successional reserves or adaptive management areas for northern spotted owl and marbled murrelet critical habitat) for in-channel LW placement only when conifers and trees are fully stocked. Tree felling shall not create excessive stream bank erosion or increase the likelihood of channel avulsion during high flows. Trees may be removed by cable, ground-based equipment, or helicopter. Danger trees and trees killed through fire, insects, disease, blow-down and other means can be felled and used for in-channel placement regardless of live-tree stocking levels. Trees may be felled or pushed/pulled directly into a stream or floodplain. Trees may be stock piled for future instream restoration projects. The project manager for an aquatic restoration action will coordinate with an action-agency wildlife biologist in tree-removal planning efforts.

The purpose of these criteria is to ensure that there would be no removal or adverse modification of suitable habitat for marbled murrelet or spotted owl.

1) The following Conservation Measures apply to tree removal within the range of marbled murrelets and the spotted owl in Douglas-fir dominated stands less than 80 years old that are not functioning as foraging habitat within a spotted owl home range and do not contain murrelet nesting structure. It does not apply to tree selection in older stands or hardwood-dominated stands unless stated otherwise.
   a) A wildlife biologist must be fully involved in all tree-removal planning efforts, and be involved in making decisions on whether individual trees are suitable for nesting or have other important listed bird habitat value.
   b) Outside of one site potential tree height of streams, trees can be removed to a level not less than a Relative Density (RD) of approximately 35 (stand scale), which is considered as fully occupying a site. This equates to approximately 60 trees per acre in the overstory and a tree spacing averaging 26 feet. Additionally 40% canopy cover would be maintained when in spotted owl or marbled murrelet CH, when within 300 feet of occupied or unsurveyed murrelet nesting structure, and when dispersal habitat is limited in the area.
   c) Tree species removed should be relatively common in the stand (i.e., not "minor" tree species).
   d) Snags and trees with broad, deep crowns ("wolf" trees), damaged tops or other abnormalities that may provide a valuable wildlife habitat component can not be removed.
   e) No gaps (openings) greater than 0.5 acre will be created in spotted owl CH. No gaps greater than ¼ acre will be created in murrelet CH. No gaps shall be created in Riparian Reserves that contain ESA-listed fish habitat.
2) The following conservation measures applies to tree removal within the range of marbled murrelet and the spotted owl in Douglas-fir dominated stands greater than 80 years old or that are functioning as foraging habitat within a spotted owl home range, and/or do contain marbled murrelet nesting structure.
   a) Individual trees or small groups of trees should come from the periphery of permanent openings (roads etc.) or from the periphery of non-permanent openings (e.g., plantations, along recent clear-cuts etc.). Groups of trees greater than 4 trees shall 1) not be removed from within marbled murrelet suitable stands or stands buffering (300 ft.) MM suitable stands, 2) not be buffering (300 ft.) individual trees with marbled murrelet nesting structure. A minimum distance of one potential tree height feet should be maintained between individual or group removals.
   b) Trees up to 36" dbh may be felled in any stands with agreement from an FWSwildlife biologist that the trees are not providing marbled murrelet nesting structures or providing cover for nest sites. No known spotted owl nest trees or alternate nest trees are to be removed. Potential spotted owl nest trees may only be removed in limited instances when it is confirmed with the FWS wildlife biologist that nest trees will not be limited in the stand post removal.
   c) In order to minimize the creation of canopy gaps or edges, groups of adjacent trees selected should not create openings greater than ¼ acre within 0.5 miles of marbled murrelet occupied habitat or when within murrelet CH. Within spotted owl critical habitat, stands greater than 80 years old or within stands providing foraging habitat to spotted owl home ranges, gaps will be restricted to 0.5 acre openings or less. Gaps shall not be created in Riparian Reserves where ESA-listed fish occur.

Species Specific Conservation Measures for Birds

Within the Columbia River Basin, BPA funded activities may occur in areas that are near or occupied by the following avian ESA-listed species; (a) Streaked horned lark (*Eremophila alpestris strigata*), (b) Marbled murrelet (*Brachyramphus marmoratus*) and critical habitat, (c) Northern spotted owl (*Strix occidentalis caurina*) and critical habitat and (d) Western snowy plover (*Charadrius alexandrinus nivosus*) and their critical habitat (Pacific coast DPS).

Streaked horned lark (Eremophila alpestris strigata)

Description. Streaked horned lark and its critical habitat were proposed to be listed as threatened on October 11, 2012. The current range of the streaked horned lark can be divided into three regions: (1) Puget lowlands in Washington, (2) Washington coast and lower Columbia River islands (including dredge spoil deposition sites near the Columbia River in Portland, Oregon), and (3) Willamette Valley in Oregon.

Streaked horned larks prefer wide open spaces with no trees and few or no shrubs. They nest on the ground in sparsely vegetated sites dominated by grasses and forbs. Data indicate that sites used by larks are generally found in open (i.e., flat, treeless) landscapes of 120 hectares (ha)(300 acres) or more. Some patches with the appropriate characteristics (i.e., bare ground, low stature vegetation) may be smaller in size if the adjacent fields provide the required open landscape context. This situation is common in agricultural habitats and on sites next to water. For example, many of the sites used by larks on the islands in the Columbia River are small, but are adjacent to open water, which provides the landscape context needed.

Conservation Measures:

1) Restoration projects proposed at locations with suitable habitat will be surveyed for streaked horned larks (using a survey protocol approved by the USFWS) prior to project design. If streaked horned larks are identified, contact the appropriate USFWS field office to confirm the project is *not likely to adversely affect* streaked horned lark.
2) Restoration activities generating noise above ambient levels within 200 feet (1.0 mile for blasting and pile driving) of likely occupied nesting habitat will not occur from March 15 to August 15.
3) If an area is identified as likely to be occupied by larks, riparian plantings will not occur within 300 feet to maintain the open habitat suitable required by streaked horned larks unless individual project approval has been received from the appropriate FWS field office.

Species Specific Conservation Measures for Plants

Within the Columbia River Basin, BPA funded activities may occur in areas that are near or occupied by the following ESA-listed plant species; Bradshaw's lomatium (*Lomatium bradshawii*), Cook's lomatium (*Lomatium cookie*) and their critical habitat, Gentner's fritillary (*Fritillaria gentneri*), Golden paintbrush (*Castilleja levisecta*), Howell's spectacular thelypody (*Thelypodium howellii spectabilis*), Kincaid's lupine (*Lupinus sulphureus ssp.* Kincaidii) and their critical habitat, Large-flowered wooly meadowfoam (*Limnanthes floccosa*) and their critical habitat, Malheur wire-lettuce (*Stephanomeria malheurensis*) and their critical habitat, McFarlane's four o'clock (*Mirabilis macfarlanei*), Nelson's checkermallow (*Sidalcea nelsoniana*), Rough popcorn flower (*Plagiobothrys hirtus*), Showy stickseed (*Hackelia hispida*), Slickspot peppergrass (*Lepidium papilliferum*) and their proposed critical habitat, Spalding's catchfly (*Silene spaldingii*), Umtanum Desert buckwheat (*Eriogonum codium*) and their critical habitat, Ute ladies' tresses (*Spiranthes diluvialis*), Water howellia (*Howellia aquatilis*), Wenatchee Mountain checkermallow (*Sidalcea oregana var. calva*) and their critical habitat, Western lily (*Lilium* occidentale), Willamette daisy (*Erigeron decumbens*) and their critical habitat, and White Bluffs bladderpod (*Physaria douglasii*) and their critical habitat.

Surveys.

If an ESA- listed plant is located within the county where a project is proposed (based on a review of the most recent USFWS county species list), contact the appropriate USFWS field office to determine whether there are known ESA-listed plants or suitable unsurveyed habitat for ESA-listed plants in the project area. If a known site of an ESA-listed plant is within 0.4 km (0.25 mi) of the project action area, or suitable or potential habitat may be affected by project activities, then a BPA contract botanist will conduct a site visit/vegetation survey to determine whether ESA-listed plants are within the project area. This visit and survey will be conducted at the appropriate time of year to identify the species and determine whether individual listed plants or potential habitat are present and may be adversely affected by project activities (**Table 5**). If listed plants are present and likely to be adversely affected by the project, then an individual consultation with the USFWS under Section 7 of the ESA must be initiated.

Table 5 – Optimal Survey Times for Flowering Periods of Listed Plants in Oregon and Washington

Species	**Optimal Survey Time Period***
Bradshaw's Lomatium (*Lomatium bradshawii*)	April to mid-May
Cook's Lomatium (*Lomatium cookii*)	Mid-March through May (varies with spring moisture)
Gentner's Fritillary (*Fritillaria gentneri*)	April to June
Golden Paintbrush (*Castilleja levisecta*)	April to September
Howell's Spectacular Thelypody (*Thelypodium howellii* ssp. *spectabilis*)	June through July
Kincaid's Lupine (*Lupinus sulphureus* ssp. *kincaidii*)	May through July
Large-flowered Wooly Meadowfoam (*Limnanthes floccose*)	Mid-March to May (varies with spring moisture)
Malheur Wire-Lettuce (*Stephanomeria malheurensis*)	July through August
MacFarlane's four o'clock (*Mirabilis macfarlanei*)	May through June
Nelson's Checkermallow (*Sidalcea nelsoniana*)	Late May to Mid-July
Rough Popcornflower (*Plagiobothrys hirtus*)	Mid-June to early July

Showy Stickseed (*Hackelia venusta*)	May to July
Slickspot peppergrass (*Lepidium papilliferum*)	Mid-May to Mid-July
Spalding's Catchfly (*Silene spaldingii*)	June to September
Umtanum Desert Buckwheat (*Eriogonum codium*)	June through July
Ute Ladies'-Tresses (*Spiranthes diluvialis*)	July to late August
Water Howellia (*Howellia aquatilis*)	May through August
Wenatchee Mountains Checker-Mallow (*Sidalcea oregano* var. *calva*)	June to Mid-August
Western Lily (*Lilium occidentale*)	May to July
Willamette Daisy (*Erigeron decumbens* var. *decumbens*)	Mid-June to early July
White Bluffs Bladderpod (*Physaria douglasii* ssp. *tuplashensis*)	Mid-May to Mid-June

Conservation Measures:

For all of the above mentioned ESA-listed plant species that may occur in project areas within the scope of this proposed action, the following criteria will be applied:

1) Prior to restoration activities at areas with listed plants, all project staff will be familiarized with identification of any ESA-listed plants in the area and will be aware of ESA-listed plant locations within the project area.
2) Access points and tracks within occupied or suitable habitats for ESA-listed plant species must be limited and clearly marked to avoid soil compaction and damage to ESA-listed plant species from vehicles and/or foot traffic.
3) Revegetation activities in habitats where ESA-listed plants may occur or within their critical habitat must be approved by the USFWS field office prior to implementation.
4) Dust-abatement additives and stabilization chemicals will not be applied within 10 m (33 ft) of listed plants or critical habitat for listed plants.
5) Restoration activities will avoid actions that cause soil compaction, erosion, or deposition, or change the hydrology or drainage of a site with listed plants or critical habitat for listed plants.
6) Vehicle and equipment staging areas will be located at least 15 m (50 ft) from listed plants or critical habitat for listed plants.

Steigerwald Floodplain Restoration Project

BPA Project # 2003-011-00
Contract # 70379

11/16/2015

Sponsor Signature

As a condition of funding, I acknowledge my responsibility to ensure that the project as described will meet all of the applicable general and specific conservation measures, in addition to all the applicable terms and conditions of the HIP III Biological Opinion, unless NMFS and/or USFWS has approved a variance request.

______________________________ ______________________

Project Sponsor's Signature Date

Appendix D: Air Quality Model Results

	B	C	D	E	F	H	I	J	K	L	O
2	**Road Construction Emissions Model, Version 7.1.5.1**										
3											
4	**Emission Estimates for ->** Steigerwald Lake				**Total**	**Exhaust**	**Fugitive Dust**	**Total**	**Exhaust**	**Fugitive Dust**	
5	**Project Phases (English Units)**	**ROG (lbs/day)**	**CO (lbs/day)**	**NOx (lbs/day)**	**PM10 (lbs/day)**	**PM10 (lbs/day)**	**PM10 (lbs/day)**	**PM2.5 (lbs/day)**	**PM2.5 (lbs/day)**	**PM2.5 (lbs/day)**	**CO2 (lbs/day)**
6	**Grubbing/Land Clearing**	-	-	-	5.0	-	5.0	1.0	-	1.0	-
7	**Grading/Excavation**	8.4	40.5	80.4	8.6	3.6	5.0	4.3	3.2	1.0	10,562.5
8	**Drainage/Utilities/Sub-Grade**	4.2	21.5	32.6	6.7	1.7	5.0	2.6	1.5	1.0	4,043.8
9	**Paving**	-	-	-	-	-	-	-	-	-	-
10	**Maximum (pounds/day)**	8.4	40.5	80.4	8.6	3.6	5.0	4.3	3.2	1.0	10,562.5
11	**Total (tons/construction project)**	0.6	2.9	5.5	0.6	0.3	0.4	0.3	0.2	0.1	714.4
12	Notes: Project Start Year ->	2017									
13	Project Length (months) ->	8									
14	Total Project Area (acres) ->	42									
15	Maximum Area Disturbed/Day (acres) ->	1									
16	Total Soil Imported/Exported (yd^3/day)->	800									
17	PM10 and PM2.5 estimates assume 50% control of fugitive dust from watering and associated dust control measures if a minimum number of water trucks are specified.										
18	Total PM10 emissions shown in column F are the sum of exhaust and fugitive dust emissions shown in columns H and I. Total PM2.5 emissions shown in Column J are the sum of exhaust and fugitive dust emissions shown in columns K and L.										

Road Construction Emissions Model

Version 7.1.5.1

Data Entry Worksheet

Note: Required data input sections have a yellow background.
Optional data input sections have a blue background. Only areas with a yellow or blue background can be modified. Program defaults have a white background.
The user is required to enter information in cells C10 through C25.

SACRAMENTO METROPOLITAN AIR QUALITY MANAGEMENT DISTRICT

To begin a new project, click this button to clear data previously entered. This button will only work if you opted not to disable macros when loading this spreadsheet.

Input Type		
Project Name	Steigerwald Lake	
Construction Start Year	2017	Enter a Year between 2009 and 2025 (inclusive)
Project Type	1	1 New Road Construction 2 Road Widening 3 Bridge/Overpass Construction
Project Construction Time	8.00	months
Predominant Soil/Site Type: Enter 1, 2, or 3	1	1. Sand Gravel 2. Weathered Rock-Earth 3. Blasted Rock
Project Length	3.00	miles
Total Project Area	41.50	acres
Maximum Area Disturbed/Day	0.50	acres
Water Trucks Used?	1	1. Yes 2. No
Soil Imported	800.00	yd^3/day
Soil Exported	0.00	yd^3/day
Average Truck Capacity	17	yd^3 (assume 20 if unknown)

The remaining sections of this sheet contain areas that can be modified by the user, although those modifications are optional.

Note: The program's estimates of construction period phase length can be overridden in cells C34 through C37.

Construction Periods	User Override of Construction Months	Program Calculated Months	2005	%	2006	%	2007	%
Grubbing/Land Clearing		0.80	0.00	0.00	0.00	0.00	0.00	0.00
Grading/Excavation	5.00	3.20	0.00	0.00	0.00	0.00	0.00	0.00
Drainage/Utilities/Sub-Grade	3.00	2.80	0.00	0.00	0.00	0.00	0.00	0.00
Paving		1.20	0.00	0.00	0.00	0.00	0.00	0.00
Totals	8.00	8.00						

NOTE: soil hauling emissions are included in the Grading/Excavation Construction Period Phase, therefore the Construction Period for Grading/Excavation cannot be zero if hauling is part of the project.

Hauling emission default values can be overridden in cells C45 through C46.

Soil Hauling Emissions

User Input	User Override of Soil Hauling Defaults	Default Values
Miles/round trip	6.00	30
Round trips/day		47
Vehicle miles traveled/day (calculated)		282.3529412

Hauling Emissions	ROG	NOx	CO	PM10	PM2.5	CO2
Emission rate (grams/mile)	0.15	7.43	0.65	0.16	0.09	1652.56
Emission rate (grams/trip)	0.00	0.00	0.00	0.00	0.00	0.00
Pounds per day	0.09	4.62	0.41	0.10	0.06	1027.76
Tons per contruction period	0.00	0.25	0.02	0.01	0.00	56.53

Worker commute default values can be overridden in cells C60 through C65.

Worker Commute Emissions

	User Override of Worker Commute Default Values	Default Values
Miles/ one-way trip	25.00	20
One-way trips/day		2
No. of employees: Grubbing/Land Clearing		10
No. of employees: Grading/Excavation	7.00	23
No. of employees: Drainage/Utilities/Sub-Grade	7.00	20
No. of employees: Paving		16

	ROG	NOx	CO	PM10	PM2.5	CO2
Emission rate - Grubbing/Land Clearing (grams/mile)	0.000	0.000	0.000	0.000	0.000	0.000
Emission rate - Grading/Excavation (grams/mile)	0.133	0.172	1.555	0.047	0.020	443.765
Emission rate - Draining/Utilities/Sub-Grade (gr/mile)	0.133	0.172	1.555	0.047	0.020	443.765
Emission rate - Paving (grams/mile)	0.000	0.000	0.000	0.000	0.000	0.000
Emission rate - Grubbing/Land Clearing (grams/trip)	0.000	0.000	0.000	0.000	0.000	0.000
Emission rate - Grading/Excavation (grams/trip)	0.457	0.287	3.779	0.004	0.003	95.644
Emission rate - Draining/Utilities/Sub-Grade (gr/trip)	0.457	0.287	3.779	0.004	0.003	95.644
Emission rate - Paving (grams/trip)	0.000	0.000	0.000	0.000	0.000	0.000
Pounds per day - Grubbing/Land Clearing	0.000	0.000	0.000	0.000	0.000	0.000
Tons per const. Period - Grub/Land Clear	0.000	0.000	0.000	0.000	0.000	0.000
Pounds per day - Grading/Excavation	0.116	0.142	1.315	0.036	0.015	345.059
Tons per const. Period - Grading/Excavation	0.006	0.008	0.072	0.002	0.001	18.978
Pounds per day - Drainage/Utilities/Sub-Grade	0.116	0.142	1.315	0.036	0.015	345.059
Tons per const. Period - Drain/Util/Sub-Grade	0.004	0.005	0.043	0.001	0.001	11.387
Pounds per day - Paving	0.000	0.000	0.000	0.000	0.000	0.000
Tons per const. Period - Paving	0.000	0.000	0.000	0.000	0.000	0.000
tons per construction period	0.010	0.012	0.116	0.003	0.001	30.365

Water truck default values can be overriden in cells C91 through C93 and E91 through E93.

Water Truck Emissions	User Override of Default # Water Trucks	Program Estimate of Number of Water Trucks	User Override of Truck Miles Traveled/Day	Default Values Miles Traveled/Day		
Grubbing/Land Clearing - Exhaust	2.00	1		40		
Grading/Excavation - Exhaust	2.00	1		40		
Drainage/Utilities/Subgrade		1		40		
	ROG	**NOx**	**CO**	**PM10**	**PM2.5**	**CO2**
Emission rate - Grubbing/Land Clearing (grams/mile)	0.00	0.00	0.00	0.00	0.00	0.00
Emission rate - Grading/Excavation (grams/mile)	0.15	7.43	0.65	0.16	0.09	1652.56
Emission rate - Draining/Utilities/Sub-Grade (gr/mile)	0.15	7.43	0.65	0.16	0.09	1652.56
Pounds per day - Grubbing/Land Clearing	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Grub/Land Clear	0.00	0.00	0.00	0.00	0.00	0.00
Pound per day - Grading/Excavation	0.03	1.31	0.12	0.03	0.02	291.20
Tons per const. Period - Grading/Excavation	0.00	0.07	0.01	0.00	0.00	16.02
Pound per day - Drainage/Utilities/Subgrade	0.01	0.65	0.06	0.01	0.01	145.60
Tons per const. Period - Drainage/Utilities/Subgrade	0.00	0.02	0.00	0.00	0.00	4.80

Fugitive dust default values can be overridden in cells C110 through C112.

Fugitive Dust	User Override of Max Acreage Disturbed/Day	Default Maximum Acreage/Day	PM10 pounds/day	PM10 tons/per period	PM2.5 pounds/day	PM2.5 tons/per period
Fugitive Dust - Grubbing/Land Clearing		0.5	5.0	0.0	1.0	0.0
Fugitive Dust - Grading/Excavation		0.5	5.0	0.2	1.0	0.0
Fugitive Dust - Drainage/Utilities/Subgrade		0.5	5.0	0.2	1.0	0.0

Off-Road Equipment Emissions

Grubbing/Land Clearing Override of Default Number of Vehicles	Default Number of Vehicles *Program-estimate*	Type	ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	CO2 pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00
		Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00
		Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00	0.00
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00
		Cranes	0.00	0.00	0.00	0.00	0.00	0.00
	1	Crawler Tractors	0.00	0.00	0.00	0.00	0.00	0.00
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00
	1	Excavators	0.00	0.00	0.00	0.00	0.00	0.00
		Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
		Generator Sets	0.00	0.00	0.00	0.00	0.00	0.00
		Graders	0.00	0.00	0.00	0.00	0.00	0.00
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00
		Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00	0.00
		Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other Material Handling Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Pavers	0.00	0.00	0.00	0.00	0.00	0.00
		Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00
		Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00
		Pumps	0.00	0.00	0.00	0.00	0.00	0.00
		Rollers	0.00	0.00	0.00	0.00	0.00	0.00
		Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00	0.00
		Scrapers	0.00	0.00	0.00	0.00	0.00	0.00
	6	Signal Boards	0.00	0.00	0.00	0.00	0.00	0.00
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00
		Tractors/Loaders/Backhoes	0.00	0.00	0.00	0.00	0.00	0.00
		Trenchers	0.00	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00	0.00
	Grubbing/Land Clearing	pounds per day	0.0	0.0	0.0	0.0	0.0	0.0
	Grubbing/Land Clearing	tons per phase	0.0	0.0	0.0	0.0	0.0	0.0

Grading/Excavation Override of Default Number of Vehicles	Default Number of Vehicles *Program-estimate*	Type	ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	CO2 pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00
		Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00
		Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00	0.00
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00
	0	Cranes	0.00	0.00	0.00	0.00	0.00	0.00
0.00	1	Crawler Tractors	0.00	0.00	0.00	0.00	0.00	0.00
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00
2.00	3	Excavators	0.76	5.58	8.10	0.40	0.37	1145.50
		Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
		Generator Sets	0.00	0.00	0.00	0.00	0.00	0.00
1.00	1	Graders	1.00	3.47	9.64	0.54	0.50	669.23
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00
3.00		Off-Highway Trucks	2.75	12.87	29.64	1.10	1.01	4251.78
		Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other Material Handling Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Pavers	0.00	0.00	0.00	0.00	0.00	0.00
		Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00
		Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00
		Pumps	0.00	0.00	0.00	0.00	0.00	0.00
1.00	2	Rollers	0.32	1.51	2.88	0.21	0.19	279.45
		Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00
0.00	1	Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00	0.00
1.00	2	Scrapers	1.37	7.25	16.41	0.66	0.61	1607.95
	6	Signal Boards	1.93	7.96	7.63	0.51	0.47	944.60
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00
0.00	2	Tractors/Loaders/Backhoes	0.00	0.00	0.00	0.00	0.00	0.00
		Trenchers	0.00	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00	0.00
	Grading/Excavation	pounds per day	8.1	38.6	74.3	3.4	3.1	8898.5
	Grading	tons per phase	0.4	2.1	4.1	0.2	0.2	489.4

Drainage/Utilities/Subgrade Override of Default Number of Vehicles	Default Number of Vehicles *Program-estimate*		ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	CO2 pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00
0.00	1	Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00
		Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Cement and Mortar Mixers	0.07	0.35	0.42	0.02	0.02	57.88
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00
		Cranes	0.00	0.00	0.00	0.00	0.00	0.00
		Crawler Tractors	0.00	0.00	0.00	0.00	0.00	0.00
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Excavators	0.38	2.79	4.05	0.20	0.18	572.75
		Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
0.00	1	Generator Sets	0.00	0.00	0.00	0.00	0.00	0.00
0.00	1	Graders	0.00	0.00	0.00	0.00	0.00	0.00
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00
		Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00	0.00
		Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other Material Handling Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Pavers	0.00	0.00	0.00	0.00	0.00	0.00
		Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00
1.00	1	Plate Compactors	0.04	0.21	0.25	0.01	0.01	34.45
		Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00
0.00	1	Pumps	0.00	0.00	0.00	0.00	0.00	0.00
		Rollers	0.00	0.00	0.00	0.00	0.00	0.00
0.00	1	Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00	0.00
1.00	2	Scrapers	1.37	7.25	16.41	0.66	0.61	1607.95
	6	Signal Boards	1.93	7.96	7.63	0.51	0.47	944.60
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00
1.00	2	Tractors/Loaders/Backhoes	0.33	1.57	3.06	0.23	0.21	335.52
		Trenchers	0.00	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00	0.00
	Drainage	pounds per day	4.1	20.1	31.8	1.6	1.5	3553.2
	Drainage	tons per phase	0.1	0.7	1.1	0.1	0.0	117.3

Paving Override of Default Number of Vehicles	Default Number of Vehicles *Program-estimate*	Type	ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	CO2 pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00
		Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00
		Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00	0.00
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00
		Cranes	0.00	0.00	0.00	0.00	0.00	0.00
		Crawler Tractors	0.00	0.00	0.00	0.00	0.00	0.00
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Excavators	0.00	0.00	0.00	0.00	0.00	0.00
		Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
		Generator Sets	0.00	0.00	0.00	0.00	0.00	0.00
		Graders	0.00	0.00	0.00	0.00	0.00	0.00
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00
		Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00	0.00
		Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other Material Handling Equipment	0.00	0.00	0.00	0.00	0.00	0.00
	1	Pavers	0.00	0.00	0.00	0.00	0.00	0.00
	1	Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00
		Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00
		Pumps	0.00	0.00	0.00	0.00	0.00	0.00
	3	Rollers	0.00	0.00	0.00	0.00	0.00	0.00
		Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00	0.00
		Scrapers	0.00	0.00	0.00	0.00	0.00	0.00
	6	Signal Boards	0.00	0.00	0.00	0.00	0.00	0.00
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00
	2	Tractors/Loaders/Backhoes	0.00	0.00	0.00	0.00	0.00	0.00
		Trenchers	0.00	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00	0.00
	Paving	pounds per day	0.0	0.0	0.0	0.0	0.0	0.0
	Paving	tons per phase	0.0	0.0	0.0	0.0	0.0	0.0
Total Emissions all Phases (tons per construction period) =>			0.6	2.8	5.1	0.2	0.2	606.7

Equipment default values for horsepower and hours/day can be overridden in cells C289 through C322 and E289 through E322.

Equipment		Default Values Horsepower		Default Values Hours/day
Aerial Lifts		63		8
Air Compressors		106		8
Bore/Drill Rigs		206		8
Cement and Mortar Mixers		10		8
Concrete/Industrial Saws		64		8
Cranes		226		8
Crawler Tractors		208		8
Crushing/Proc. Equipment		142		8
Excavators		163		8
Forklifts		89		8
Generator Sets		66		8
Graders		175		8
Off-Highway Tractors		123		8
Off-Highway Trucks		400		8
Other Construction Equipment		172		8
Other General Industrial Equipment		88		8
Other Material Handling Equipment		167		8
Pavers		126		8
Paving Equipment		131		8
Plate Compactors		8		8
Pressure Washers		26		8
Pumps		53		8
Rollers		81		8
Rough Terrain Forklifts		100		8
Rubber Tired Dozers		255		8
Rubber Tired Loaders		200		8
Scrapers		362		8
Signal Boards		20		8
Skid Steer Loaders		65		8
Surfacing Equipment		254		8
Sweepers/Scrubbers		64		8
Tractors/Loaders/Backhoes		98		8
Trenchers		81		8
Welders		45		8

0

END OF DATA ENTRY SHEET

Light Duty Truck

Worker Commute Truck Emissions (Emfac2011-LDV V2.50.57.246, LDT1 and LDT2)

	Running Exhaust (g/mi)											
Year	ROG	Weighted - Grubbing	Weighted - Grading	Weighted - Drainage	Weighted Paving	NOx	Weighted - Grubbing	Weighted - Grading	Weighted - Drainage	Weighted Paving	CO	Weighted - Grubbing
2009	0.1332	-	-	-	-	0.4682	-	-	-	-	3.9529	-
2010	0.1140	-	-	-	-	0.4124	-	-	-	-	3.5174	-
2011	0.0982	-	-	-	-	0.3637	-	-	-	-	3.1372	-
2012	0.0843	-	-	-	-	0.3206	-	-	-	-	2.7952	-
2013	0.0722	-	-	-	-	0.2827	-	-	-	-	2.4899	-
2014	0.0609	-	-	-	-	0.2488	-	-	-	-	2.2077	-
2015	0.0507	-	-	-	-	0.2192	-	-	-	-	1.9561	-
2016	0.0424	-	-	-	-	0.1942	-	-	-	-	1.7439	-
2017	0.0348	-	0.0348	0.0348	-	0.1724	-	0.1724	0.1724	-	1.5551	-
2018	0.0288	-	-	-	-	0.1543	-	-	-	-	1.3987	-
2019	0.0250	-	-	-	-	0.1402	-	-	-	-	1.2910	-
2020	0.0223	-	-	-	-	0.1288	-	-	-	-	1.1956	-
2021	0.0207	-	-	-	-	0.1196	-	-	-	-	1.1218	-
2022	0.0193	-	-	-	-	0.1117	-	-	-	-	1.0563	-
2023	0.0181	-	-	-	-	0.1050	-	-	-	-	0.9989	-
2024	0.0171	-	-	-	-	0.0994	-	-	-	-	0.9531	-
2025	0.0162	-	-	-	-	0.0946	-	-	-	-	0.9138	-
		-	0.0348	0.0348	-		-	0.1724	0.1724	-		-

Light Duty T

									Tire Wear (g/mi)		
Year	Weighted - Grading	Weighted - Drainage	Weighted Paving	PM10	Weighted - Grubbing	Weighted - Grading	Weighted - Drainage	Weighted Paving	PM10	Weighted - Grubbing	Weighted - Grading
2009	-	-	-	0.0045	-	-	-	-	0.0080	-	-
2010	-	-	-	0.0039	-	-	-	-	0.0080	-	-
2011	-	-	-	0.0034	-	-	-	-	0.0080	-	-
2012	-	-	-	0.0030	-	-	-	-	0.0080	-	-
2013	-	-	-	0.0027	-	-	-	-	0.0080	-	-
2014	-	-	-	0.0025	-	-	-	-	0.0080	-	-
2015	-	-	-	0.0023	-	-	-	-	0.0080	-	-
2016	-	-	-	0.0022	-	-	-	-	0.0080	-	-
2017	1.5551	1.5551	-	0.0021	-	0.0021	0.0021	-	0.0080	-	0.0080
2018	-	-	-	0.0021	-	-	-	-	0.0080	-	-
2019	-	-	-	0.0020	-	-	-	-	0.0080	-	-
2020	-	-	-	0.0020	-	-	-	-	0.0080	-	-
2021	-	-	-	0.0020	-	-	-	-	0.0080	-	-
2022	-	-	-	0.0020	-	-	-	-	0.0080	-	-
2023	-	-	-	0.0020	-	-	-	-	0.0080	-	-
2024	-	-	-	0.0020	-	-	-	-	0.0080	-	-
2025	-	-	-	0.0020	-	-	-	-	0.0080	-	-
	1.5551	1.5551	-		-	0.0021	0.0021	-		-	0.0080

Light Duty T

Year	Weighted - Drainage	Weighted Paving	Break Wear (g/mi) PM10	Weighted - Grubbing	Weighted - Grading	Weighted - Drainage	Weighted Paving	Running Exhaust (grams/mile) PM2.5	Weighted - Grubbing	Weighted - Grading	Weighted - Drainage
2009	-	-	0.0368	-	-	-	-	0.0040	-	-	-
2010	-	-	0.0368	-	-	-	-	0.0035	-	-	-
2011	-	-	0.0368	-	-	-	-	0.0031	-	-	-
2012	-	-	0.0368	-	-	-	-	0.0028	-	-	-
2013	-	-	0.0368	-	-	-	-	0.0025	-	-	-
2014	-	-	0.0368	-	-	-	-	0.0023	-	-	-
2015	-	-	0.0368	-	-	-	-	0.0021	-	-	-
2016	-	-	0.0368	-	-	-	-	0.0020	-	-	-
2017	0.0080	-	0.0368	-	0.0368	0.0368	-	0.0019	-	0.0019	0.0019
2018	-	-	0.0368	-	-	-	-	0.0019	-	-	-
2019	-	-	0.0368	-	-	-	-	0.0019	-	-	-
2020	-	-	0.0368	-	-	-	-	0.0018	-	-	-
2021	-	-	0.0368	-	-	-	-	0.0018	-	-	-
2022	-	-	0.0368	-	-	-	-	0.0018	-	-	-
2023	-	-	0.0368	-	-	-	-	0.0018	-	-	-
2024	-	-	0.0368	-	-	-	-	0.0018	-	-	-
2025	-	-	0.0368	-	-	-	-	0.0018	-	-	-
	0.0080	-		-	0.0368	0.0368	-		-	0.0019	0.0019

Light Duty Tr

		Tire Wear (g/mi)					Break Wear (grams/mile)					Running Ex
Year	Weighted Paving	PM2.5	Weighted - Grubbing	Weighted - Grading	Weighted - Drainage	Weighted Paving	PM2.5	Weighted - Grubbing	Weighted - Grading	Weighted - Drainage	Weighted Paving	CO2
2009	-	0.0020	-	-	-	-	0.0158	-	-	-	-	443.6768
2010	-	0.0020	-	-	-	-	0.0158	-	-	-	-	443.3164
2011	-	0.0020	-	-	-	-	0.0157	-	-	-	-	443.2099
2012	-	0.0020	-	-	-	-	0.0157	-	-	-	-	443.1990
2013	-	0.0020	-	-	-	-	0.0158	-	-	-	-	443.2620
2014	-	0.0020	-	-	-	-	0.0158	-	-	-	-	443.3700
2015	-	0.0020	-	-	-	-	0.0157	-	-	-	-	443.5179
2016	-	0.0020	-	-	-	-	0.0158	-	-	-	-	443.6501
2017	-	0.0020	-	0.0020	0.0020	-	0.0158	-	0.0158	0.0158	-	443.7653
2018	-	0.0020	-	-	-	-	0.0158	-	-	-	-	443.8800
2019	-	0.0020	-	-	-	-	0.0158	-	-	-	-	441.7394
2020	-	0.0020	-	-	-	-	0.0158	-	-	-	-	441.8557
2021	-	0.0020	-	-	-	-	0.0158	-	-	-	-	441.8142
2022	-	0.0020	-	-	-	-	0.0158	-	-	-	-	441.7716
2023	-	0.0020	-	-	-	-	0.0158	-	-	-	-	441.7165
2024	-	0.0020	-	-	-	-	0.0158	-	-	-	-	441.6478
2025	-	0.0020	-	-	-	-	0.0158	-	-	-	-	441.5839
	-		-	0.0020	0.0020	-		-	0.0158	0.0158	-	

Light Duty Tr

	haust (grams/mile)									Start Emission Rate @ 480 r	
Year	Weighted - Grubbing	Weighted - Grading	Weighted - Drainage	Weighted Paving	CH4	Weighted - Grubbing	Weighted - Grading	Weighted - Drainage	Weighted Paving	ROG	Weighted - Grubbing
2009	-	-	-	-	0.0359	-	-	-	-	0.6971	-
2010	-	-	-	-	0.0325	-	-	-	-	0.6284	-
2011	-	-	-	-	0.0294	-	-	-	-	0.5648	-
2012	-	-	-	-	0.0266	-	-	-	-	0.5050	-
2013	-	-	-	-	0.0241	-	-	-	-	0.4500	-
2014	-	-	-	-	0.0218	-	-	-	-	0.3985	-
2015	-	-	-	-	0.0198	-	-	-	-	0.3514	-
2016	-	-	-	-	0.0181	-	-	-	-	0.3102	-
2017	-	443.7653	443.7653	-	0.0166	-	0.0166	0.0166	-	0.2732	-
2018	-	-	-	-	0.0153	-	-	-	-	0.2415	-
2019	-	-	-	-	0.0143	-	-	-	-	0.2164	-
2020	-	-	-	-	0.0135	-	-	-	-	0.1945	-
2021	-	-	-	-	0.0128	-	-	-	-	0.1770	-
2022	-	-	-	-	0.0123	-	-	-	-	0.1620	-
2023	-	-	-	-	0.0118	-	-	-	-	0.1490	-
2024	-	-	-	-	0.0115	-	-	-	-	0.1380	-
2025	-	-	-	-	0.0111	-	-	-	-	0.1287	-
	-	443.7653	443.7653	-		-	0.0166	0.0166	-		-

Light Duty T

Year	min (g/trip) Weighted - Grading	Weighted - Drainage	Weighted Paving	NOx	Weighted - Grubbing	Weighted - Grading	Weighted - Drainage	Weighted Paving	CO	Weighted - Grubbing	Weighted - Grading	Weighted - Drainage
2009	-	-	-	0.6670	-	-	-	-	8.3195	-	-	-
2010	-	-	-	0.6127	-	-	-	-	7.6413	-	-	-
2011	-	-	-	0.5587	-	-	-	-	6.9829	-	-	-
2012	-	-	-	0.5058	-	-	-	-	6.3515	-	-	-
2013	-	-	-	0.4552	-	-	-	-	5.7532	-	-	-
2014	-	-	-	0.4073	-	-	-	-	5.1874	-	-	-
2015	-	-	-	0.3630	-	-	-	-	4.6660	-	-	-
2016	-	-	-	0.3229	-	-	-	-	4.2002	-	-	-
2017	0.2732	0.2732	-	0.2867	-	0.2867	0.2867	-	3.7791	-	3.7791	3.7791
2018	-	-	-	0.2549	-	-	-	-	3.4098	-	-	-
2019	-	-	-	0.2280	-	-	-	-	3.1009	-	-	-
2020	-	-	-	0.2049	-	-	-	-	2.8241	-	-	-
2021	-	-	-	0.1853	-	-	-	-	2.5917	-	-	-
2022	-	-	-	0.1684	-	-	-	-	2.3864	-	-	-
2023	-	-	-	0.1540	-	-	-	-	2.2068	-	-	-
2024	-	-	-	0.1418	-	-	-	-	2.0584	-	-	-
2025	-	-	-	0.1315	-	-	-	-	1.9312	-	-	-
	0.2732	0.2732	-		-	0.2867	0.2867	-		-	3.7791	3.7791

Light Duty T

Year	Weighted Paving	PM10	Weighted - Grubbing	Weighted - Grading	Weighted - Drainage	Weighted Paving	PM2.5	Weighted - Grubbing	Weighted - Grading	Weighted - Drainage	Weighted Paving	CO2
2009	-	0.0061	-	-	-	-	0.0055	-	-	-	-	95.5391
2010	-	0.0055	-	-	-	-	0.0050	-	-	-	-	95.4160
2011	-	0.0049	-	-	-	-	0.0045	-	-	-	-	95.3882
2012	-	0.0045	-	-	-	-	0.0040	-	-	-	-	95.3992
2013	-	0.0041	-	-	-	-	0.0037	-	-	-	-	95.4418
2014	-	0.0038	-	-	-	-	0.0035	-	-	-	-	95.4806
2015	-	0.0037	-	-	-	-	0.0034	-	-	-	-	95.5280
2016	-	0.0036	-	-	-	-	0.0033	-	-	-	-	95.5917
2017	-	0.0036	-	0.0036	0.0036	-	0.0033	-	0.0033	0.0033	-	95.6440
2018	-	0.0036	-	-	-	-	0.0034	-	-	-	-	95.7114
2019	-	0.0037	-	-	-	-	0.0034	-	-	-	-	95.8217
2020	-	0.0038	-	-	-	-	0.0035	-	-	-	-	95.9429
2021	-	0.0039	-	-	-	-	0.0036	-	-	-	-	96.0432
2022	-	0.0040	-	-	-	-	0.0038	-	-	-	-	96.1274
2023	-	0.0042	-	-	-	-	0.0039	-	-	-	-	96.1963
2024	-	0.0043	-	-	-	-	0.0040	-	-	-	-	96.2519
2025	-	0.0044	-	-	-	-	0.0041	-	-	-	-	96.2981
	-		-	0.0036	0.0036	-		-	0.0033	0.0033	-	

Light Duty Tr										20 minutes Hot Soak (g/trip)	
Year	Weighted - Grubbing	Weighted - Grading	Weighted - Drainage	Weighted Paving	CH4	Weighted - Grubbing	Weighted - Grading	Weighted - Drainage	Weighted Paving	ROG	Weighted - Grubbing
2009	-	-	-	-	0.0406	-	-	-	-	0.2665	-
2010	-	-	-	-	0.0365	-	-	-	-	0.2560	-
2011	-	-	-	-	0.0327	-	-	-	-	0.2471	-
2012	-	-	-	-	0.0292	-	-	-	-	0.2375	-
2013	-	-	-	-	0.0259	-	-	-	-	0.2283	-
2014	-	-	-	-	0.0229	-	-	-	-	0.2175	-
2015	-	-	-	-	0.0201	-	-	-	-	0.2063	-
2016	-	-	-	-	0.0177	-	-	-	-	0.1953	-
2017	-	95.6440	95.6440	-	0.0155	-	0.0155	0.0155	-	0.1839	-
2018	-	-	-	-	0.0137	-	-	-	-	0.1735	-
2019	-	-	-	-	0.0122	-	-	-	-	0.1655	-
2020	-	-	-	-	0.0110	-	-	-	-	0.1587	-
2021	-	-	-	-	0.0100	-	-	-	-	0.1529	-
2022	-	-	-	-	0.0091	-	-	-	-	0.1476	-
2023	-	-	-	-	0.0084	-	-	-	-	0.1427	-
2024	-	-	-	-	0.0078	-	-	-	-	0.1383	-
2025	-	-	-	-	0.0073	-	-	-	-	0.1344	-
	-	95.6440	95.6440	-		-	0.0155	0.0155	-		-

Light Duty T								
				20 minutes Evaporative Running Loss (g/mi)				
Year	Weighted - Grading	Weighted - Drainage	Weighted Paving	ROG	Weighted - Grubbing	Weighted - Grading	Weighted - Drainage	Weighted Paving
2009	-	-	-	0.1747	-	-	-	-
2010	-	-	-	0.1628	-	-	-	-
2011	-	-	-	0.1521	-	-	-	-
2012	-	-	-	0.1417	-	-	-	-
2013	-	-	-	0.1316	-	-	-	-
2014	-	-	-	0.1211	-	-	-	-
2015	-	-	-	0.1128	-	-	-	-
2016	-	-	-	0.1050	-	-	-	-
2017	0.1839	0.1839	-	0.0977	-	0.0977	0.0977	-
2018	-	-	-	0.0914	-	-	-	-
2019	-	-	-	0.0869	-	-	-	-
2020	-	-	-	0.0831	-	-	-	-
2021	-	-	-	0.0800	-	-	-	-
2022	-	-	-	0.0773	-	-	-	-
2023	-	-	-	0.0749	-	-	-	-
2024	-	-	-	0.0730	-	-	-	-
2025	-	-	-	0.0712	-	-	-	-
	0.1839	0.1839	-		-	0.0977	0.0977	-

Heavy-Heavy Duty Diesel Truck

Water Truck Commute Emissions (EMFAC2011-HD web, T7 Single Unit Construction Truck)

	Running Exhaust (g/mi)											
Model Year	ROG	Weighted-Grubbing	Weighted - Grading	Weighted - Drainage	Weighted Paving	NOx	Weighted-Grubbing	Weighted - Grading	Weighted - Drainage	Weighted Paving	CO	Weighted-Grubbing
2009	0.5461	-	-	-	-	14.1399	-	-	-	-	2.4577	-
2010	0.5341	-	-	-	-	13.5704	-	-	-	-	2.3852	-
2011	0.5194	-	-	-	-	12.9096	-	-	-	-	2.3044	-
2012	0.4608	-	-	-	-	12.1601	-	-	-	-	2.0332	-
2013	0.4024	-	-	-	-	11.3235	-	-	-	-	1.7799	-
2014	0.2846	-	-	-	-	10.4258	-	-	-	-	1.2629	-
2015	0.2456	-	-	-	-	9.4052	-	-	-	-	1.0869	-
2016	0.1569	-	-	-	-	8.2519	-	-	-	-	0.7011	-
2017	0.1451	-	0.1451	0.1451	-	7.4301	-	7.4301	7.4301	-	0.6528	-
2018	0.1491	-	-	-	-	6.6629	-	-	-	-	0.6732	-
2019	0.1527	-	-	-	-	5.8768	-	-	-	-	0.6921	-
2020	0.1568	-	-	-	-	4.6723	-	-	-	-	0.7143	-
2021	0.1673	-	-	-	-	2.8722	-	-	-	-	0.7688	-
2022	0.1808	-	-	-	-	1.7730	-	-	-	-	0.8311	-
2023	0.1670	-	-	-	-	1.3478	-	-	-	-	0.7682	-
2024	0.1683	-	-	-	-	1.3659	-	-	-	-	0.7743	-
2025	0.1694	-	-	-	-	1.3805	-	-	-	-	0.7793	-
		-	0.1451	0.1451	-		-	7.4301	7.4301	-		-

Heavy-Heavy

									Tire Wear (g/mi)		
Model Year	Weighted - Grading	Weighted - Drainage	Weighted Paving	PM10	Weighted-Grubbing	Weighted - Grading	Weighted - Drainage	Weighted Paving	PM10	Weighted-Grubbing	Weighted - Grading
2009	-	-	-	0.4056	-	-	-	-	0.0360	-	-
2010	-	-	-	0.3778	-	-	-	-	0.0360	-	-
2011	-	-	-	0.3511	-	-	-	-	0.0360	-	-
2012	-	-	-	0.3007	-	-	-	-	0.0360	-	-
2013	-	-	-	0.2490	-	-	-	-	0.0360	-	-
2014	-	-	-	0.1544	-	-	-	-	0.0360	-	-
2015	-	-	-	0.1266	-	-	-	-	0.0360	-	-
2016	-	-	-	0.0693	-	-	-	-	0.0360	-	-
2017	0.6528	0.6528	-	0.0583	-	0.0583	0.0583	-	0.0360	-	0.0360
2018	-	-	-	0.0582	-	-	-	-	0.0360	-	-
2019	-	-	-	0.0581	-	-	-	-	0.0360	-	-
2020	-	-	-	0.0576	-	-	-	-	0.0360	-	-
2021	-	-	-	0.0555	-	-	-	-	0.0360	-	-
2022	-	-	-	0.0529	-	-	-	-	0.0360	-	-
2023	-	-	-	0.0515	-	-	-	-	0.0360	-	-
2024	-	-	-	0.0520	-	-	-	-	0.0360	-	-
2025	-	-	-	0.0525	-	-	-	-	0.0360	-	-
	0.6528	0.6528	-		-	0.0583	0.0583	-		-	0.0360

Heavy-Heavy

			Break Wear (g/mi)					Running Exhaust (grams/mile)			
Model Year	Weighted - Drainage	Weighted Paving	PM10	Weighted-Grubbing	Weighted - Grading	Weighted - Drainage	Weighted Paving	PM2.5	Weighted - Grubbing	Weighted - Grading	Weighted - Drainage
2009	-	-	0.0617	-	-	-	-	0.3732	-	-	-
2010	-	-	0.0617	-	-	-	-	0.3476	-	-	-
2011	-	-	0.0617	-	-	-	-	0.3230	-	-	-
2012	-	-	0.0617	-	-	-	-	0.2766	-	-	-
2013	-	-	0.0617	-	-	-	-	0.2291	-	-	-
2014	-	-	0.0617	-	-	-	-	0.1420	-	-	-
2015	-	-	0.0617	-	-	-	-	0.1165	-	-	-
2016	-	-	0.0617	-	-	-	-	0.0637	-	-	-
2017	0.0360	-	0.0617	-	0.0617	0.0617	-	0.0537	-	0.0537	0.0537
2018	-	-	0.0617	-	-	-	-	0.0536	-	-	-
2019	-	-	0.0617	-	-	-	-	0.0535	-	-	-
2020	-	-	0.0617	-	-	-	-	0.0530	-	-	-
2021	-	-	0.0617	-	-	-	-	0.0510	-	-	-
2022	-	-	0.0617	-	-	-	-	0.0486	-	-	-
2023	-	-	0.0617	-	-	-	-	0.0474	-	-	-
2024	-	-	0.0617	-	-	-	-	0.0479	-	-	-
2025	-	-	0.0617	-	-	-	-	0.0483	-	-	-
	0.0360	-		-	0.0617	0.0617	-		-	0.0537	0.0537

Heavy-Heavy

		Tire Wear (g/mi)					Break Wear (grams/mile)					Running Ex
Model Year	Weighted Paving	PM2.5	Weighted - Grubbing	Weighted - Grading	Weighted - Drainage	Weighted Paving	PM2.5	Weighted - Grubbing	Weighted - Grading	Weighted - Drainage	Weighted Paving	CO2
2009	-	0.0090	-	-	-	-	0.0265	-	-	-	-	1,741.6354
2010	-	0.0090	-	-	-	-	0.0265	-	-	-	-	1,737.2406
2011	-	0.0090	-	-	-	-	0.0265	-	-	-	-	1,729.2678
2012	-	0.0090	-	-	-	-	0.0265	-	-	-	-	1,724.8967
2013	-	0.0090	-	-	-	-	0.0265	-	-	-	-	1,716.8426
2014	-	0.0090	-	-	-	-	0.0265	-	-	-	-	1,713.3514
2015	-	0.0090	-	-	-	-	0.0265	-	-	-	-	1,694.6737
2016	-	0.0090	-	-	-	-	0.0265	-	-	-	-	1,679.8566
2017	-	0.0090	-	0.0090	0.0090	-	0.0265	-	0.0265	0.0265	-	1,652.5585
2018	-	0.0090	-	-	-	-	0.0265	-	-	-	-	1,624.6148
2019	-	0.0090	-	-	-	-	0.0265	-	-	-	-	1,596.4935
2020	-	0.0090	-	-	-	-	0.0265	-	-	-	-	1,558.5933
2021	-	0.0090	-	-	-	-	0.0265	-	-	-	-	1,551.9813
2022	-	0.0090	-	-	-	-	0.0265	-	-	-	-	1,546.6929
2023	-	0.0090	-	-	-	-	0.0265	-	-	-	-	1,541.8979
2024	-	0.0090	-	-	-	-	0.0265	-	-	-	-	1,541.8955
2025	-	0.0090	-	-	-	-	0.0265	-	-	-	-	1,541.8907
	-		-	0.0090	0.0090	-		-	0.0265	0.0265	-	

Heavy-Heavy | There are no start emissions
ARB didn't make assumption

Model Year	haust (grams/mile) Weighted - Grubbing	Weighted - Grading	Weighted - Drainage	Weighted Paving	CH4	Weighted - Grubbing	Weighted - Grading	Weighted - Drainage	Weighted Paving	Start Emission Rate @ 480 ROG	Weighted- Grubbing
2009	-	-	-	-	0.0254	-	-	-	-	-	-
2010	-	-	-	-	0.0248	-	-	-	-	-	-
2011	-	-	-	-	0.0241	-	-	-	-	-	-
2012	-	-	-	-	0.0214	-	-	-	-	-	-
2013	-	-	-	-	0.0187	-	-	-	-	-	-
2014	-	-	-	-	0.0132	-	-	-	-	-	-
2015	-	-	-	-	0.0114	-	-	-	-	-	-
2016	-	-	-	-	0.0073	-	-	-	-	-	-
2017	-	1,652.5585	1,652.5585	-	0.0067	-	0.0067	0.0067	-	-	-
2018	-	-	-	-	0.0069	-	-	-	-	-	-
2019	-	-	-	-	0.0071	-	-	-	-	-	-
2020	-	-	-	-	0.0073	-	-	-	-	-	-
2021	-	-	-	-	0.0078	-	-	-	-	-	-
2022	-	-	-	-	0.0084	-	-	-	-	-	-
2023	-	-	-	-	0.0078	-	-	-	-	-	-
2024	-	-	-	-	0.0078	-	-	-	-	-	-
2025	-	-	-	-	0.0079	-	-	-	-	-	-
	-	1,652.5585	1,652.5585	-		-	0.0067	0.0067	-		-

Heavy-Heavy for heavy-duty diesel trucks, so trips are not necessary for the emissions calculation.
ns on the numbers of trips for the vehicle categories in EMFAC2011-HD.
nin (g/trip)

Model Year	Weighted - Grading	Weighted - Drainage	Weighted Paving	NOx	Wieghted - Grubbing	Weighted - Grading	Weighted - Drainage	Weighted Paving	CO	Wieghted - Grubbing	Weighted - Grading	Weighted - Drainage
2009	-	-	-	-	-	-	-	-	-	-	-	-
2010	-	-	-	-	-	-	-	-	-	-	-	-
2011	-	-	-	-	-	-	-	-	-	-	-	-
2012	-	-	-	-	-	-	-	-	-	-	-	-
2013	-	-	-	-	-	-	-	-	-	-	-	-
2014	-	-	-	-	-	-	-	-	-	-	-	-
2015	-	-	-	-	-	-	-	-	-	-	-	-
2016	-	-	-	-	-	-	-	-	-	-	-	-
2017	-	-	-	-	-	-	-	-	-	-	-	-
2018	-	-	-	-	-	-	-	-	-	-	-	-
2019	-	-	-	-	-	-	-	-	-	-	-	-
2020	-	-	-	-	-	-	-	-	-	-	-	-
2021	-	-	-	-	-	-	-	-	-	-	-	-
2022	-	-	-	-	-	-	-	-	-	-	-	-
2023	-	-	-	-	-	-	-	-	-	-	-	-
2024	-	-	-	-	-	-	-	-	-	-	-	-
2025	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-		-	-	-	-		-	-	-

Heavy-Heavy

Model Year	Weighted Paving	PM10	Wieghted - Grubbing	Weighted - Grading	Weighted - Drainage	Weighted Paving	PM2.5	Weighted - Grubbing	Weighted - Grading	Weighted - Drainage	Weighted Paving	CO2
2009	-	-	-	-	-	-	-	-	-	-	-	-
2010	-	-	-	-	-	-	-	-	-	-	-	-
2011	-	-	-	-	-	-	-	-	-	-	-	-
2012	-	-	-	-	-	-	-	-	-	-	-	-
2013	-	-	-	-	-	-	-	-	-	-	-	-
2014	-	-	-	-	-	-	-	-	-	-	-	-
2015	-	-	-	-	-	-	-	-	-	-	-	-
2016	-	-	-	-	-	-	-	-	-	-	-	-
2017	-	-	-	-	-	-	-	-	-	-	-	-
2018	-	-	-	-	-	-	-	-	-	-	-	-
2019	-	-	-	-	-	-	-	-	-	-	-	-
2020	-	-	-	-	-	-	-	-	-	-	-	-
2021	-	-	-	-	-	-	-	-	-	-	-	-
2022	-	-	-	-	-	-	-	-	-	-	-	-
2023	-	-	-	-	-	-	-	-	-	-	-	-
2024	-	-	-	-	-	-	-	-	-	-	-	-
2025	-	-	-	-	-	-	-	-	-	-	-	-
	-		-	-	-	-		-	-	-	-	

Heavy-Heavy

										20 minutes Hot Soak (g/trip)	
Model Year	Weighted - Grubbing	Weighted - Grading	Weighted - Drainage	Weighted Paving	CH4	Weighted - Grubbing	Weighted - Grading	Weighted - Drainage	Weighted Paving	ROG	Weighted - Grubbing
2009	-	-	-	-	-	-	-	-	-	-	-
2010	-	-	-	-	-	-	-	-	-	-	-
2011	-	-	-	-	-	-	-	-	-	-	-
2012	-	-	-	-	-	-	-	-	-	-	-
2013	-	-	-	-	-	-	-	-	-	-	-
2014	-	-	-	-	-	-	-	-	-	-	-
2015	-	-	-	-	-	-	-	-	-	-	-
2016	-	-	-	-	-	-	-	-	-	-	-
2017	-	-	-	-	-	-	-	-	-	-	-
2018	-	-	-	-	-	-	-	-	-	-	-
2019	-	-	-	-	-	-	-	-	-	-	-
2020	-	-	-	-	-	-	-	-	-	-	-
2021	-	-	-	-	-	-	-	-	-	-	-
2022	-	-	-	-	-	-	-	-	-	-	-
2023	-	-	-	-	-	-	-	-	-	-	-
2024	-	-	-	-	-	-	-	-	-	-	-
2025	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-		-	-	-	-		-

Heavy-Heavy								
				20 minutes Evaporative Running Loss (g/mi)				
Model Year	Weighted - Grading	Weighted - Drainage	Weighted Paving	ROG	Weighted-Grubbing	Weighted - Grading	Weighted - Drainage	Weighted Paving
2009	-	-	-	-	-	-	-	-
2010	-	-	-	-	-	-	-	-
2011	-	-	-	-	-	-	-	-
2012	-	-	-	-	-	-	-	-
2013	-	-	-	-	-	-	-	-
2014	-	-	-	-	-	-	-	-
2015	-	-	-	-	-	-	-	-
2016	-	-	-	-	-	-	-	-
2017	-	-	-	-	-	-	-	-
2018	-	-	-	-	-	-	-	-
2019	-	-	-	-	-	-	-	-
2020	-	-	-	-	-	-	-	-
2021	-	-	-	-	-	-	-	-
2022	-	-	-	-	-	-	-	-
2023	-	-	-	-	-	-	-	-
2024	-	-	-	-	-	-	-	-
2025	-	-	-	-	-	-	-	-
	-	-	-		-	-	-	-

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1																		
2		The following emission rates by equipment type and year cannot be directly edited. The rates shown below,																
3		however, will change when changes are made to the default values for horsepower and/or hours per day.																
4		Note: Years 2005 through 2008 were not updated and are not used in the current model																
5		Emissions (g/bhp-hr)		ROG	ROG	ROG	ROG		CO	CO	CO	CO		NOx	NOx	NOx	NOx	
6		Aerial Lifts		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted	
7			ROG	Grubbing/Land	Grading	Drainage	Paving	CO	Grubbing/La	Grading	Drainage	Paving	NOx	Grubbing/L	Grading	Drainage	Paving	PM10
12		2009	0.1542	-	-	-	-	0.7783	-	-	-	-	1.7197	-	-	-	-	0.1137
13		2010	0.1296	-	-	-	-	0.7783	-	-	-	-	1.5814	-	-	-	-	0.1015
14		2011	0.1101	-	-	-	-	0.7783	-	-	-	-	1.4547	-	-	-	-	0.0886
15		2012	0.0944	-	-	-	-	0.7783	-	-	-	-	1.3522	-	-	-	-	0.0774
16		2013	0.0782	-	-	-	-	0.7783	-	-	-	-	1.2109	-	-	-	-	0.0622
17		2014	0.0653	-	-	-	-	0.7783	-	-	-	-	1.0395	-	-	-	-	0.0496
18		2015	0.0615	-	-	-	-	0.7783	-	-	-	-	0.9596	-	-	-	-	0.0441
19		2016	0.0534	-	-	-	-	0.7783	-	-	-	-	0.8390	-	-	-	-	0.0345
20		2017	0.0460	-	0.0460	0.0460	-	0.7783	-	0.7783	0.7783	-	0.7285	-	0.7285	0.7285	-	0.0257
21		2018	0.0393	-	-	-	-	0.7783	-	-	-	-	0.6360	-	-	-	-	0.0176
22		2019	0.0381	-	-	-	-	0.7783	-	-	-	-	0.6092	-	-	-	-	0.0150
23		2020	0.0371	-	-	-	-	0.7783	-	-	-	-	0.5759	-	-	-	-	0.0128
24		2021	0.0351	-	-	-	-	0.7783	-	-	-	-	0.5374	-	-	-	-	0.0103
25		2022	0.0338	-	-	-	-	0.7783	-	-	-	-	0.5013	-	-	-	-	0.0093
26		2023	0.0324	-	-	-	-	0.7783	-	-	-	-	0.4771	-	-	-	-	0.0082
27		2024	0.0324	-	-	-	-	0.7783	-	-	-	-	0.4709	-	-	-	-	0.0082
28		2025	0.0319	-	-	-	-	0.7783	-	-	-	-	0.4656	-	-	-	-	0.0080
29				-	0.0460	0.0460	-		-	0.7783	0.7783	-		-	0.7285	0.7285	-	
30																		
31		Air Compressors		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted	
32			ROG	Grubbing/Land	Grading	Drainage	Paving	CO	Grubbing/La	Grading	Drainage	Paving	NOx	Grubbing/L	Grading	Drainage	Paving	PM10
37		2009	0.6074	-	-	-	-	1.9501	-	-	-	-	3.5865	-	-	-	-	0.3218
38		2010	0.5767	-	-	-	-	1.9358	-	-	-	-	3.4241	-	-	-	-	0.3110
39		2011	0.5434	-	-	-	-	1.9194	-	-	-	-	3.2512	-	-	-	-	0.2987
40		2012	0.5064	-	-	-	-	1.9000	-	-	-	-	3.0548	-	-	-	-	0.2806
41		2013	0.4686	-	-	-	-	1.8805	-	-	-	-	2.8606	-	-	-	-	0.2595
42		2014	0.4312	-	-	-	-	1.8614	-	-	-	-	2.6861	-	-	-	-	0.2370
43		2015	0.3936	-	-	-	-	1.8432	-	-	-	-	2.4880	-	-	-	-	0.2139
44		2016	0.3674	-	-	-	-	1.8374	-	-	-	-	2.3534	-	-	-	-	0.1971
45		2017	0.3403	-	0.3403	0.3403	-	1.8312	-	1.8312	1.8312	-	2.2153	-	2.2153	2.2153	-	0.1792
46		2018	0.3125	-	-	-	-	1.8246	-	-	-	-	2.0735	-	-	-	-	0.1605
47		2019	0.2847	-	-	-	-	1.8175	-	-	-	-	1.9300	-	-	-	-	0.1413
48		2020	0.2633	-	-	-	-	1.8123	-	-	-	-	1.7971	-	-	-	-	0.1253
49		2021	0.2177	-	-	-	-	1.7627	-	-	-	-	1.5224	-	-	-	-	0.0961
50		2022	0.2040	-	-	-	-	1.7598	-	-	-	-	1.4087	-	-	-	-	0.0842
51		2023	0.1920	-	-	-	-	1.7584	-	-	-	-	1.3068	-	-	-	-	0.0734
52		2024	0.1816	-	-	-	-	1.7578	-	-	-	-	1.2250	-	-	-	-	0.0638
53		2025	0.1720	-	-	-	-	1.7573	-	-	-	-	1.1528	-	-	-	-	0.0547
54				-	0.3403	0.3403	-		-	1.8312	1.8312	-		-	2.2153	2.2153	-	
55																		
56		Bore/Drill Rigs		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted	
57			ROG	Grubbing/Lan(	Grading	Drainage	Paving	CO	Grubbing/L	Grading	Drainage	Paving	NOx	Grubbing/l	Grading	Drainage	Paving	PM10
62		2009	0.1339	-	-	-	-	1.0596	-	-	-	-	2.4004	-	-	-	-	0.0712
63		2010	0.1332	-	-	-	-	1.0571	-	-	-	-	2.3124	-	-	-	-	0.0696
64		2011	0.1281	-	-	-	-	1.0541	-	-	-	-	2.1846	-	-	-	-	0.0665
65		2012	0.1322	-	-	-	-	1.0539	-	-	-	-	2.1687	-	-	-	-	0.0671
66		2013	0.1265	-	-	-	-	1.0528	-	-	-	-	2.0192	-	-	-	-	0.0621
67		2014	0.1143	-	-	-	-	1.0470	-	-	-	-	1.7711	-	-	-	-	0.0527
68		2015	0.1122	-	-	-	-	1.0457	-	-	-	-	1.6706	-	-	-	-	0.0500
69		2016	0.1013	-	-	-	-	1.0474	-	-	-	-	1.4583	-	-	-	-	0.0428
70		2017	0.0912	-	0.0912	0.0912	-	1.0470	-	1.0470	1.0470	-	1.2671	-	1.2671	1.2671	-	0.0364
71		2018	0.0813	-	-	-	-	1.0432	-	-	-	-	1.0819	-	-	-	-	0.0306
72		2019	0.0754	-	-	-	-	1.0410	-	-	-	-	0.9519	-	-	-	-	0.0270
73		2020	0.0749	-	-	-	-	1.0441	-	-	-	-	0.9082	-	-	-	-	0.0262
74		2021	0.0697	-	-	-	-	1.0467	-	-	-	-	0.7794	-	-	-	-	0.0236
75		2022	0.0605	-	-	-	-	1.0484	-	-	-	-	0.5844	-	-	-	-	0.0188
76		2023	0.0581	-	-	-	-	1.0505	-	-	-	-	0.5259	-	-	-	-	0.0170
77		2024	0.0568	-	-	-	-	1.0528	-	-	-	-	0.4902	-	-	-	-	0.0162
78		2025	0.0565	-	-	-	-	1.0526	-	-	-	-	0.4810	-	-	-	-	0.0158
79				-	0.0912	0.0912	-		-	1.0470	1.0470	-		-	1.2671	1.2671	-	
80																		

	A	B	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF
1																
2		The following emission rates by														
3		however, will change when cha							92 % of PM2.5 in PM10 (from CEIDARS)							
4		Note: Years 2005 through 2008 were nc														
5		Emissions (g/bhp-hr)	PM10	PM10	PM10	PM10		PM2.5	PM2.5	PM2.5	PM2.5		CO2	CO2	CO2	CO2
6		Aerial Lifts	Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted
7			Grubbing/Land Cle	Grading	Drainage	Paving	PM2.5	Grubbing/Land Clearing	Grading	Drainage	Paving	CO2	Grubbing/Land Clearin	Grading	Drainage	Paving
12		2009	-	-	-	-	0.1046	-	-	-	-	161.1988	-	-	-	-
13		2010	-	-	-	-	0.0934	-	-	-	-	161.1993	-	-	-	-
14		2011	-	-	-	-	0.0815	-	-	-	-	161.1993	-	-	-	-
15		2012	-	-	-	-	0.0712	-	-	-	-	161.1993	-	-	-	-
16		2013	-	-	-	-	0.0572	-	-	-	-	161.1993	-	-	-	-
17		2014	-	-	-	-	0.0456	-	-	-	-	161.1993	-	-	-	-
18		2015	-	-	-	-	0.0406	-	-	-	-	161.1993	-	-	-	-
19		2016	-	-	-	-	0.0317	-	-	-	-	161.1993	-	-	-	-
20		2017	-	0.0257	0.0257	-	0.0237	-	0.0237	0.0237	-	161.1993	-	161.1993	161.1993	-
21		2018	-	-	-	-	0.0162	-	-	-	-	161.1993	-	-	-	-
22		2019	-	-	-	-	0.0138	-	-	-	-	161.1993	-	-	-	-
23		2020	-	-	-	-	0.0118	-	-	-	-	161.1993	-	-	-	-
24		2021	-	-	-	-	0.0094	-	-	-	-	161.1993	-	-	-	-
25		2022	-	-	-	-	0.0086	-	-	-	-	161.1993	-	-	-	-
26		2023	-	-	-	-	0.0076	-	-	-	-	161.1993	-	-	-	-
27		2024	-	-	-	-	0.0075	-	-	-	-	161.1993	-	-	-	-
28		2025	-	-	-	-	0.0073	-	-	-	-	161.1993	-	-	-	-
29			-	0.0257	0.0257	-		-	0.0237	0.0237	-		-	161.1993	161.1993	-
30																
31		Air Compressors	Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted
32			Grubbing/Land Cle	Grading	Drainage	Paving	PM2.5	Grubbing/Land Clearing	Grading	Drainage	Paving	CO2	Grubbing/Land Clearin	Grading	Drainage	Paving
37		2009	-	-	-	-	0.2961	-	-	-	-	272.7839	-	-	-	-
38		2010	-	-	-	-	0.2861	-	-	-	-	272.7839	-	-	-	-
39		2011	-	-	-	-	0.2748	-	-	-	-	272.7840	-	-	-	-
40		2012	-	-	-	-	0.2581	-	-	-	-	272.7838	-	-	-	-
41		2013	-	-	-	-	0.2387	-	-	-	-	272.7839	-	-	-	-
42		2014	-	-	-	-	0.2180	-	-	-	-	272.7838	-	-	-	-
43		2015	-	-	-	-	0.1968	-	-	-	-	272.7840	-	-	-	-
44		2016	-	-	-	-	0.1813	-	-	-	-	272.7839	-	-	-	-
45		2017	-	0.1792	0.1792	-	0.1649	-	0.1649	0.1649	-	272.7839	-	272.7839	272.7839	-
46		2018	-	-	-	-	0.1476	-	-	-	-	272.7839	-	-	-	-
47		2019	-	-	-	-	0.1300	-	-	-	-	272.7839	-	-	-	-
48		2020	-	-	-	-	0.1153	-	-	-	-	272.7839	-	-	-	-
49		2021	-	-	-	-	0.0884	-	-	-	-	272.7839	-	-	-	-
50		2022	-	-	-	-	0.0775	-	-	-	-	272.7840	-	-	-	-
51		2023	-	-	-	-	0.0675	-	-	-	-	272.7839	-	-	-	-
52		2024	-	-	-	-	0.0587	-	-	-	-	272.7839	-	-	-	-
53		2025	-	-	-	-	0.0504	-	-	-	-	272.7839	-	-	-	-
54			-	0.1792	0.1792	-		-	0.1649	0.1649	-		-	272.7839	272.7839	-
55																
56		Bore/Drill Rigs	Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted
57			Grubbing/Land Cl	Grading	Drainage	Paving	PM2.5	Grubbing/Land Clearing	Grading	Drainage	Paving	CO2	Grubbing/Land Clearin	Grading	Drainage	Paving
62		2009	-	-	-	-	0.0655	-	-	-	-	263.7549	-	-	-	-
63		2010	-	-	-	-	0.0641	-	-	-	-	263.1223	-	-	-	-
64		2011	-	-	-	-	0.0612	-	-	-	-	262.3750	-	-	-	-
65		2012	-	-	-	-	0.0617	-	-	-	-	262.3282	-	-	-	-
66		2013	-	-	-	-	0.0571	-	-	-	-	262.0642	-	-	-	-
67		2014	-	-	-	-	0.0485	-	-	-	-	260.6038	-	-	-	-
68		2015	-	-	-	-	0.0460	-	-	-	-	260.2800	-	-	-	-
69		2016	-	-	-	-	0.0394	-	-	-	-	260.7048	-	-	-	-
70		2017	-	0.0364	0.0364	-	0.0335	-	0.0335	0.0335	-	260.6074	-	260.6074	260.6074	-
71		2018	-	-	-	-	0.0281	-	-	-	-	259.6560	-	-	-	-
72		2019	-	-	-	-	0.0248	-	-	-	-	259.1129	-	-	-	-
73		2020	-	-	-	-	0.0241	-	-	-	-	259.8855	-	-	-	-
74		2021	-	-	-	-	0.0217	-	-	-	-	260.5298	-	-	-	-
75		2022	-	-	-	-	0.0173	-	-	-	-	260.9579	-	-	-	-
76		2023	-	-	-	-	0.0157	-	-	-	-	261.4841	-	-	-	-
77		2024	-	-	-	-	0.0149	-	-	-	-	262.0440	-	-	-	-
78		2025	-	-	-	-	0.0145	-	-	-	-	262.0117	-	-	-	-
79			-	0.0364	0.0364	-		-	0.0335	0.0335	-		-	260.6074	260.6074	-
80																

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
5		Emissions (g/bhp-hr)		ROG	ROG	ROG	ROG		CO	CO	CO	CO		NOx	NOx	NOx	NOx	
81																		
82																		
83		Cement and Mortar Mixers		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted	
84			ROG	Grubbing/Lan(	Grading	Drainage	Paving	CO	Grubbing/L	Grading	Drainage	Paving	NOx	Grubbing/l	Grading	Drainage	Paving	PM10
89		2009	0.4151	-	-	-	-	1.9680	-	-	-	-	2.6767	-	-	-	-	0.1653
90		2010	0.3974	-	-	-	-	1.9559	-	-	-	-	2.5451	-	-	-	-	0.1457
91		2011	0.3838	-	-	-	-	1.9483	-	-	-	-	2.4371	-	-	-	-	0.1295
92		2012	0.3779	-	-	-	-	1.9444	-	-	-	-	2.3926	-	-	-	-	0.1174
93		2013	0.3748	-	-	-	-	1.9432	-	-	-	-	2.3649	-	-	-	-	0.1074
94		2014	0.3731	-	-	-	-	1.9432	-	-	-	-	2.3472	-	-	-	-	0.0991
95		2015	0.3718	-	-	-	-	1.9432	-	-	-	-	2.3341	-	-	-	-	0.0959
96		2016	0.3710	-	-	-	-	1.9432	-	-	-	-	2.3257	-	-	-	-	0.0938
97		2017	0.3706	-	0.3706	0.3706	-	1.9432	-	1.9432	1.9432	-	2.3213	-	2.3213	2.3213	-	0.0926
98		2018	0.3705	-	-	-	-	1.9432	-	-	-	-	2.3199	-	-	-	-	0.0915
99		2019	0.3705	-	-	-	-	1.9432	-	-	-	-	2.3199	-	-	-	-	0.0909
100		2020	0.3705	-	-	-	-	1.9432	-	-	-	-	2.3199	-	-	-	-	0.0906
101		2021	0.3705	-	-	-	-	1.9432	-	-	-	-	2.3199	-	-	-	-	0.0906
102		2022	0.3705	-	-	-	-	1.9432	-	-	-	-	2.3199	-	-	-	-	0.0906
103		2023	0.3705	-	-	-	-	1.9432	-	-	-	-	2.3199	-	-	-	-	0.0906
104		2024	0.3705	-	-	-	-	1.9432	-	-	-	-	2.3199	-	-	-	-	0.0907
105		2025	0.3705	-	-	-	-	1.9432	-	-	-	-	2.3199	-	-	-	-	0.0907
106				-	0.3706	0.3706	-		-	1.9432	1.9432	-		-	2.3213	2.3213	-	
107																		
108																		
109																		
110		Concrete/Industrial Saws		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted	
111			ROG	Grubbing/Lan(	Grading	Drainage	Paving	CO	Grubbing/L	Grading	Drainage	Paving	NOx	Grubbing/l	Grading	Drainage	Paving	PM10
116		2009	0.8069	-	-	-	-	2.8140	-	-	-	-	5.0944	-	-	-	-	0.4229
117		2010	0.7517	-	-	-	-	2.7842	-	-	-	-	4.8134	-	-	-	-	0.4027
118		2011	0.6988	-	-	-	-	2.7566	-	-	-	-	4.5439	-	-	-	-	0.3833
119		2012	0.6470	-	-	-	-	2.7307	-	-	-	-	4.2685	-	-	-	-	0.3582
120		2013	0.5969	-	-	-	-	2.7066	-	-	-	-	4.0057	-	-	-	-	0.3303
121		2014	0.5483	-	-	-	-	2.6840	-	-	-	-	3.7709	-	-	-	-	0.3016
122		2015	0.5004	-	-	-	-	2.6634	-	-	-	-	3.4998	-	-	-	-	0.2729
123		2016	0.4538	-	-	-	-	2.6439	-	-	-	-	3.2393	-	-	-	-	0.2443
124		2017	0.4076	-	0.4076	0.4076	-	2.6248	-	2.6248	2.6248	-	2.9835	-	2.9835	2.9835	-	0.2155
125		2018	0.3641	-	-	-	-	2.6075	-	-	-	-	2.7402	-	-	-	-	0.1876
126		2019	0.3241	-	-	-	-	2.5922	-	-	-	-	2.5121	-	-	-	-	0.1612
127		2020	0.2936	-	-	-	-	2.5809	-	-	-	-	2.3094	-	-	-	-	0.1395
128		2021	0.2703	-	-	-	-	2.5725	-	-	-	-	2.1272	-	-	-	-	0.1214
129		2022	0.2511	-	-	-	-	2.5659	-	-	-	-	1.9610	-	-	-	-	0.1054
130		2023	0.2341	-	-	-	-	2.5603	-	-	-	-	1.8098	-	-	-	-	0.0906
131		2024	0.2196	-	-	-	-	2.5558	-	-	-	-	1.6903	-	-	-	-	0.0775
132		2025	0.2069	-	-	-	-	2.5521	-	-	-	-	1.5891	-	-	-	-	0.0656
133				-	0.4076	0.4076	-		-	2.6248	2.6248	-		-	2.9835	2.9835	-	
134																		
135																		
136																		
137																		
138		Cranes		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted	
139			ROG	Grubbing/Lan(	Grading	Drainage	Paving	CO	Grubbing/L	Grading	Drainage	Paving	NOx	Grubbing/l	Grading	Drainage	Paving	PM10
144		2009	0.2088	-	-	-	-	0.7540	-	-	-	-	2.4288	-	-	-	-	0.1104
145		2010	0.2093	-	-	-	-	0.7540	-	-	-	-	2.4200	-	-	-	-	0.1104
146		2011	0.2075	-	-	-	-	0.7540	-	-	-	-	2.3911	-	-	-	-	0.1092
147		2012	0.2087	-	-	-	-	0.7540	-	-	-	-	2.3917	-	-	-	-	0.1096
148		2013	0.2060	-	-	-	-	0.7540	-	-	-	-	2.3496	-	-	-	-	0.1079
149		2014	0.1992	-	-	-	-	0.7539	-	-	-	-	2.2645	-	-	-	-	0.1038
150		2015	0.1936	-	-	-	-	0.7539	-	-	-	-	2.1958	-	-	-	-	0.1002
151		2016	0.1878	-	-	-	-	0.7539	-	-	-	-	2.1264	-	-	-	-	0.0965
152		2017	0.1690	-	0.1690	0.1690	-	0.7540	-	0.7540	0.7540	-	1.9174	-	1.9174	1.9174	-	0.0855
153		2018	0.1457	-	-	-	-	0.7539	-	-	-	-	1.6632	-	-	-	-	0.0720
154		2019	0.1286	-	-	-	-	0.7538	-	-	-	-	1.4648	-	-	-	-	0.0621
155		2020	0.1157	-	-	-	-	0.7538	-	-	-	-	1.3147	-	-	-	-	0.0542
156		2021	0.1054	-	-	-	-	0.7537	-	-	-	-	1.1825	-	-	-	-	0.0480
157		2022	0.0952	-	-	-	-	0.7539	-	-	-	-	1.0203	-	-	-	-	0.0424
158		2023	0.0897	-	-	-	-	0.7538	-	-	-	-	0.9304	-	-	-	-	0.0389
159		2024	0.0847	-	-	-	-	0.7538	-	-	-	-	0.8545	-	-	-	-	0.0356
160		2025	0.0798	-	-	-	-	0.7539	-	-	-	-	0.7725	-	-	-	-	0.0328
161				-	0.1690	0.1690	-		-	0.7540	0.7540	-		-	1.9174	1.9174	-	
162																		
163																		

	A	B	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF
5		Emissions (g/bhp-hr)	PM10	PM10	PM10	PM10		PM2.5	PM2.5	PM2.5	PM2.5		CO2	CO2	CO2	CO2
81																
82																
83		Cement and Mortar Mixers	Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted
84			Grubbing/Land Cl	Grading	Drainage	Paving	PM2.5	Grubbing/Land Clearing	Grading	Drainage	Paving	CO2	Grubbing/Land Clearin	Grading	Drainage	Paving
89		2009	-	-	-	-	0.1520	-	-	-	-	318.2478	-	-	-	-
90		2010	-	-	-	-	0.1340	-	-	-	-	318.2480	-	-	-	-
91		2011	-	-	-	-	0.1191	-	-	-	-	318.2477	-	-	-	-
92		2012	-	-	-	-	0.1080	-	-	-	-	318.2478	-	-	-	-
93		2013	-	-	-	-	0.0988	-	-	-	-	318.2480	-	-	-	-
94		2014	-	-	-	-	0.0912	-	-	-	-	318.2480	-	-	-	-
95		2015	-	-	-	-	0.0883	-	-	-	-	318.2478	-	-	-	-
96		2016	-	-	-	-	0.0863	-	-	-	-	318.2479	-	-	-	-
97		2017	-	0.0926	0.0926	-	0.0852	-	0.0852	0.0852	-	318.2479	-	318.2479	318.2479	-
98		2018	-	-	-	-	0.0842	-	-	-	-	318.2480	-	-	-	-
99		2019	-	-	-	-	0.0836	-	-	-	-	318.2479	-	-	-	-
100		2020	-	-	-	-	0.0834	-	-	-	-	318.2479	-	-	-	-
101		2021	-	-	-	-	0.0833	-	-	-	-	318.2477	-	-	-	-
102		2022	-	-	-	-	0.0834	-	-	-	-	318.2478	-	-	-	-
103		2023	-	-	-	-	0.0834	-	-	-	-	318.2480	-	-	-	-
104		2024	-	-	-	-	0.0834	-	-	-	-	318.2479	-	-	-	-
105		2025	-	-	-	-	0.0834	-	-	-	-	318.2478	-	-	-	-
106			-	0.0926	0.0926	-		-	0.0852	0.0852	-		-	318.2479	318.2479	-
107																
108																
109																
110		Concrete/Industrial Saws	Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted
111			Grubbing/Land Cl	Grading	Drainage	Paving	PM2.5	Grubbing/Land Clearing	Grading	Drainage	Paving	CO2	Grubbing/Land Clearin	Grading	Drainage	Paving
116		2009	-	-	-	-	0.3891	-	-	-	-	414.8589	-	-	-	-
117		2010	-	-	-	-	0.3705	-	-	-	-	414.8588	-	-	-	-
118		2011	-	-	-	-	0.3527	-	-	-	-	414.8589	-	-	-	-
119		2012	-	-	-	-	0.3295	-	-	-	-	414.8589	-	-	-	-
120		2013	-	-	-	-	0.3038	-	-	-	-	414.8588	-	-	-	-
121		2014	-	-	-	-	0.2774	-	-	-	-	414.8587	-	-	-	-
122		2015	-	-	-	-	0.2510	-	-	-	-	414.8589	-	-	-	-
123		2016	-	-	-	-	0.2248	-	-	-	-	414.8590	-	-	-	-
124		2017	-	0.2155	0.2155	-	0.1982	-	0.1982	0.1982	-	414.8588	-	414.8588	414.8588	-
125		2018	-	-	-	-	0.1726	-	-	-	-	414.8588	-	-	-	-
126		2019	-	-	-	-	0.1483	-	-	-	-	414.8588	-	-	-	-
127		2020	-	-	-	-	0.1284	-	-	-	-	414.8589	-	-	-	-
128		2021	-	-	-	-	0.1117	-	-	-	-	414.8589	-	-	-	-
129		2022	-	-	-	-	0.0969	-	-	-	-	414.8590	-	-	-	-
130		2023	-	-	-	-	0.0833	-	-	-	-	414.8590	-	-	-	-
131		2024	-	-	-	-	0.0713	-	-	-	-	414.8589	-	-	-	-
132		2025	-	-	-	-	0.0604	-	-	-	-	414.8588	-	-	-	-
133			-	0.2155	0.2155	-		-	0.1982	0.1982	-		-	414.8588	414.8588	-
134																
135																
136																
137																
138		Cranes	Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted
139			Grubbing/Land Cl	Grading	Drainage	Paving	PM2.5	Grubbing/Land Clearing	Grading	Drainage	Paving	CO2	Grubbing/Land Clearin	Grading	Drainage	Paving
144		2009	-	-	-	-	0.1016	-	-	-	-	150.9938	-	-	-	-
145		2010	-	-	-	-	0.1016	-	-	-	-	150.9955	-	-	-	-
146		2011	-	-	-	-	0.1005	-	-	-	-	150.9977	-	-	-	-
147		2012	-	-	-	-	0.1009	-	-	-	-	150.9841	-	-	-	-
148		2013	-	-	-	-	0.0993	-	-	-	-	150.9819	-	-	-	-
149		2014	-	-	-	-	0.0955	-	-	-	-	150.9722	-	-	-	-
150		2015	-	-	-	-	0.0922	-	-	-	-	150.9784	-	-	-	-
151		2016	-	-	-	-	0.0888	-	-	-	-	150.9672	-	-	-	-
152		2017	-	0.0855	0.0855	-	0.0786	-	0.0786	0.0786	-	150.9975	-	150.9975	150.9975	-
153		2018	-	-	-	-	0.0662	-	-	-	-	150.9728	-	-	-	-
154		2019	-	-	-	-	0.0571	-	-	-	-	150.9535	-	-	-	-
155		2020	-	-	-	-	0.0499	-	-	-	-	150.9526	-	-	-	-
156		2021	-	-	-	-	0.0442	-	-	-	-	150.9389	-	-	-	-
157		2022	-	-	-	-	0.0390	-	-	-	-	150.9636	-	-	-	-
158		2023	-	-	-	-	0.0357	-	-	-	-	150.9606	-	-	-	-
159		2024	-	-	-	-	0.0327	-	-	-	-	150.9574	-	-	-	-
160		2025	-	-	-	-	0.0302	-	-	-	-	150.9625	-	-	-	-
161			-	0.0855	0.0855	-		-	0.0786	0.0786	-		-	150.9975	150.9975	-
162																
163																

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
5		Emissions (g/bhp-hr)		ROG	ROG	ROG	ROG		CO	CO	CO	CO		NOx	NOx	NOx	NOx	
164																		
165																		
166		Crawler Tractors		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted	
167			ROG	Grubbing/Lan	Grading	Drainage	Paving	CO	Grubbing/L	Grading	Drainage	Paving	NOx	Grubbing/l	Grading	Drainage	Paving	PM10
172		2009	0.2009	-	-	-	-	1.2190	-	-	-	-	2.7729	-	-	-	-	0.1063
173		2010	0.2039	-	-	-	-	1.2189	-	-	-	-	2.7733	-	-	-	-	0.1069
174		2011	0.2042	-	-	-	-	1.2190	-	-	-	-	2.7542	-	-	-	-	0.1063
175		2012	0.2074	-	-	-	-	1.2189	-	-	-	-	2.7611	-	-	-	-	0.1072
176		2013	0.2067	-	-	-	-	1.2185	-	-	-	-	2.7305	-	-	-	-	0.1058
177		2014	0.2038	-	-	-	-	1.2184	-	-	-	-	2.6746	-	-	-	-	0.1034
178		2015	0.2024	-	-	-	-	1.2187	-	-	-	-	2.6342	-	-	-	-	0.1016
179		2016	0.2014	-	-	-	-	1.2180	-	-	-	-	2.5931	-	-	-	-	0.1000
180		2017	0.1928	-	0.1928	0.1928	-	1.2189	-	1.2189	1.2189	-	2.4698	-	2.4698	2.4698	-	0.0943
181		2018	0.1787	-	-	-	-	1.2181	-	-	-	-	2.2682	-	-	-	-	0.0858
182		2019	0.1704	-	-	-	-	1.2174	-	-	-	-	2.1320	-	-	-	-	0.0804
183		2020	0.1616	-	-	-	-	1.2174	-	-	-	-	1.9863	-	-	-	-	0.0748
184		2021	0.1538	-	-	-	-	1.2173	-	-	-	-	1.8584	-	-	-	-	0.0699
185		2022	0.1373	-	-	-	-	1.2152	-	-	-	-	1.6023	-	-	-	-	0.0605
186		2023	0.1240	-	-	-	-	1.2140	-	-	-	-	1.3667	-	-	-	-	0.0530
187		2024	0.1184	-	-	-	-	1.2146	-	-	-	-	1.2663	-	-	-	-	0.0492
188		2025	0.1043	-	-	-	-	1.2140	-	-	-	-	1.0555	-	-	-	-	0.0412
189				-	0.1928	0.1928	-		-	1.2189	1.2189	-		-	2.4698	2.4698	-	
190																		
191																		
192																		
193		Crushing/Proc. Equipment		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted	
194			ROG	Grubbing/Lan	Grading	Drainage	Paving	CO	Grubbing/L	Grading	Drainage	Paving	NOx	Grubbing/l	Grading	Drainage	Paving	PM10
199		2009	0.6594	-	-	-	-	2.5879	-	-	-	-	5.1983	-	-	-	-	0.2936
200		2010	0.6281	-	-	-	-	2.5803	-	-	-	-	4.9338	-	-	-	-	0.2833
201		2011	0.5929	-	-	-	-	2.5702	-	-	-	-	4.6469	-	-	-	-	0.2714
202		2012	0.5542	-	-	-	-	2.5589	-	-	-	-	4.3356	-	-	-	-	0.2511
203		2013	0.5156	-	-	-	-	2.5487	-	-	-	-	4.0432	-	-	-	-	0.2295
204		2014	0.4784	-	-	-	-	2.5402	-	-	-	-	3.7675	-	-	-	-	0.2076
205		2015	0.4395	-	-	-	-	2.5336	-	-	-	-	3.3934	-	-	-	-	0.1860
206		2016	0.4018	-	-	-	-	2.5284	-	-	-	-	3.0339	-	-	-	-	0.1648
207		2017	0.3660	-	0.3660	0.3660	-	2.5247	-	2.5247	2.5247	-	2.6927	-	2.6927	2.6927	-	0.1446
208		2018	0.3334	-	-	-	-	2.5228	-	-	-	-	2.3785	-	-	-	-	0.1259
209		2019	0.3077	-	-	-	-	2.5222	-	-	-	-	2.1063	-	-	-	-	0.1105
210		2020	0.2870	-	-	-	-	2.5225	-	-	-	-	1.8663	-	-	-	-	0.0975
211		2021	0.2690	-	-	-	-	2.5235	-	-	-	-	1.6494	-	-	-	-	0.0858
212		2022	0.2525	-	-	-	-	2.5251	-	-	-	-	1.4523	-	-	-	-	0.0749
213		2023	0.2377	-	-	-	-	2.5276	-	-	-	-	1.2907	-	-	-	-	0.0650
214		2024	0.2240	-	-	-	-	2.5303	-	-	-	-	1.1488	-	-	-	-	0.0557
215		2025	0.2107	-	-	-	-	2.5325	-	-	-	-	1.0152	-	-	-	-	0.0470
216				-	0.3660	0.3660	-		-	2.5247	2.5247	-		-	2.6927	2.6927	-	
217																		
218																		
219																		
220		Excavators		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted	
221			ROG	Grubbing/Lan	Grading	Drainage	Paving	CO	Grubbing/L	Grading	Drainage	Paving	NOx	Grubbing/l	Grading	Drainage	Paving	PM10
226		2009	0.1968	-	-	-	-	0.9735	-	-	-	-	2.2883	-	-	-	-	0.1158
227		2010	0.1924	-	-	-	-	0.9734	-	-	-	-	2.2263	-	-	-	-	0.1142
228		2011	0.1791	-	-	-	-	0.9730	-	-	-	-	2.0811	-	-	-	-	0.1060
229		2012	0.1796	-	-	-	-	0.9727	-	-	-	-	2.0580	-	-	-	-	0.1050
230		2013	0.1692	-	-	-	-	0.9728	-	-	-	-	1.9438	-	-	-	-	0.0968
231		2014	0.1559	-	-	-	-	0.9729	-	-	-	-	1.7785	-	-	-	-	0.0874
232		2015	0.1534	-	-	-	-	0.9729	-	-	-	-	1.7112	-	-	-	-	0.0845
233		2016	0.1429	-	-	-	-	0.9730	-	-	-	-	1.5585	-	-	-	-	0.0767
234		2017	0.1333	-	0.1333	0.1333	-	0.9728	-	0.9728	0.9728	-	1.4129	-	1.4129	1.4129	-	0.0695
235		2018	0.1091	-	-	-	-	0.9729	-	-	-	-	1.1165	-	-	-	-	0.0541
236		2019	0.0984	-	-	-	-	0.9726	-	-	-	-	0.9672	-	-	-	-	0.0466
237		2020	0.0925	-	-	-	-	0.9728	-	-	-	-	0.8701	-	-	-	-	0.0421
238		2021	0.0865	-	-	-	-	0.9730	-	-	-	-	0.7766	-	-	-	-	0.0377
239		2022	0.0764	-	-	-	-	0.9726	-	-	-	-	0.6409	-	-	-	-	0.0310
240		2023	0.0712	-	-	-	-	0.9728	-	-	-	-	0.5585	-	-	-	-	0.0273
241		2024	0.0680	-	-	-	-	0.9731	-	-	-	-	0.5059	-	-	-	-	0.0249
242		2025	0.0631	-	-	-	-	0.9733	-	-	-	-	0.4406	-	-	-	-	0.0216
243				-	0.1333	0.1333	-		-	0.9728	0.9728	-		-	1.4129	1.4129	-	
244																		
245																		

	A	B	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF
5		Emissions (g/bhp-hr)	PM10	PM10	PM10	PM10		PM2.5	PM2.5	PM2.5	PM2.5		CO2	CO2	CO2	CO2
164																
165																
166		Crawler Tractors	Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted
167			Grubbing/Land Cl	Grading	Drainage	Paving	PM2.5	Grubbing/Land Clearing	Grading	Drainage	Paving	CO2	Grubbing/Land Clearin	Grading	Drainage	Paving
172		2009	-	-	-	-	0.0978	-	-	-	-	224.9692	-	-	-	-
173		2010	-	-	-	-	0.0984	-	-	-	-	224.9492	-	-	-	-
174		2011	-	-	-	-	0.0978	-	-	-	-	224.9773	-	-	-	-
175		2012	-	-	-	-	0.0986	-	-	-	-	224.9562	-	-	-	-
176		2013	-	-	-	-	0.0974	-	-	-	-	224.8810	-	-	-	-
177		2014	-	-	-	-	0.0951	-	-	-	-	224.8561	-	-	-	-
178		2015	-	-	-	-	0.0934	-	-	-	-	224.9088	-	-	-	-
179		2016	-	-	-	-	0.0920	-	-	-	-	224.7840	-	-	-	-
180		2017	-	0.0943	0.0943	-	0.0867	-	0.0867	0.0867	-	224.9475	-	224.9475	224.9475	-
181		2018	-	-	-	-	0.0789	-	-	-	-	224.7948	-	-	-	-
182		2019	-	-	-	-	0.0740	-	-	-	-	224.6691	-	-	-	-
183		2020	-	-	-	-	0.0689	-	-	-	-	224.6700	-	-	-	-
184		2021	-	-	-	-	0.0643	-	-	-	-	224.6622	-	-	-	-
185		2022	-	-	-	-	0.0556	-	-	-	-	224.2693	-	-	-	-
186		2023	-	-	-	-	0.0488	-	-	-	-	224.0446	-	-	-	-
187		2024	-	-	-	-	0.0452	-	-	-	-	224.1566	-	-	-	-
188		2025	-	-	-	-	0.0379	-	-	-	-	224.0436	-	-	-	-
189			-	0.0943	0.0943	-		-	0.0867	0.0867	-		-	224.9475	224.9475	-
190																
191																
192																
193		Crushing/Proc. Equipment	Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted
194			Grubbing/Land Cl	Grading	Drainage	Paving	PM2.5	Grubbing/Land Clearing	Grading	Drainage	Paving	CO2	Grubbing/Land Clearin	Grading	Drainage	Paving
199		2009	-	-	-	-	0.2702	-	-	-	-	443.2739	-	-	-	-
200		2010	-	-	-	-	0.2606	-	-	-	-	443.2739	-	-	-	-
201		2011	-	-	-	-	0.2497	-	-	-	-	443.2739	-	-	-	-
202		2012	-	-	-	-	0.2310	-	-	-	-	443.2738	-	-	-	-
203		2013	-	-	-	-	0.2111	-	-	-	-	443.2739	-	-	-	-
204		2014	-	-	-	-	0.1910	-	-	-	-	443.2739	-	-	-	-
205		2015	-	-	-	-	0.1711	-	-	-	-	443.2739	-	-	-	-
206		2016	-	-	-	-	0.1516	-	-	-	-	443.2739	-	-	-	-
207		2017	-	0.1446	0.1446	-	0.1330	-	0.1330	0.1330	-	443.2739	-	443.2739	443.2739	-
208		2018	-	-	-	-	0.1159	-	-	-	-	443.2739	-	-	-	-
209		2019	-	-	-	-	0.1017	-	-	-	-	443.2738	-	-	-	-
210		2020	-	-	-	-	0.0897	-	-	-	-	443.2738	-	-	-	-
211		2021	-	-	-	-	0.0789	-	-	-	-	443.2739	-	-	-	-
212		2022	-	-	-	-	0.0689	-	-	-	-	443.2738	-	-	-	-
213		2023	-	-	-	-	0.0598	-	-	-	-	443.2741	-	-	-	-
214		2024	-	-	-	-	0.0512	-	-	-	-	443.2738	-	-	-	-
215		2025	-	-	-	-	0.0432	-	-	-	-	443.2738	-	-	-	-
216			-	0.1446	0.1446	-		-	0.1330	0.1330	-		-	443.2739	443.2739	-
217																
218																
219																
220		Excavators	Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted
221			Grubbing/Land Cl	Grading	Drainage	Paving	PM2.5	Grubbing/Land Clearing	Grading	Drainage	Paving	CO2	Grubbing/Land Clearin	Grading	Drainage	Paving
226		2009	-	-	-	-	0.1065	-	-	-	-	199.9666	-	-	-	-
227		2010	-	-	-	-	0.1051	-	-	-	-	199.9286	-	-	-	-
228		2011	-	-	-	-	0.0975	-	-	-	-	199.8454	-	-	-	-
229		2012	-	-	-	-	0.0966	-	-	-	-	199.8033	-	-	-	-
230		2013	-	-	-	-	0.0890	-	-	-	-	199.8124	-	-	-	-
231		2014	-	-	-	-	0.0804	-	-	-	-	199.8257	-	-	-	-
232		2015	-	-	-	-	0.0777	-	-	-	-	199.8367	-	-	-	-
233		2016	-	-	-	-	0.0706	-	-	-	-	199.8588	-	-	-	-
234		2017	-	0.0695	0.0695	-	0.0640	-	0.0640	0.0640	-	199.8188	-	199.8188	199.8188	-
235		2018	-	-	-	-	0.0498	-	-	-	-	199.8277	-	-	-	-
236		2019	-	-	-	-	0.0429	-	-	-	-	199.7793	-	-	-	-
237		2020	-	-	-	-	0.0388	-	-	-	-	199.8209	-	-	-	-
238		2021	-	-	-	-	0.0347	-	-	-	-	199.8503	-	-	-	-
239		2022	-	-	-	-	0.0285	-	-	-	-	199.7797	-	-	-	-
240		2023	-	-	-	-	0.0252	-	-	-	-	199.8158	-	-	-	-
241		2024	-	-	-	-	0.0229	-	-	-	-	199.8796	-	-	-	-
242		2025	-	-	-	-	0.0199	-	-	-	-	199.9086	-	-	-	-
243			-	0.0695	0.0695	-		-	0.0640	0.0640	-		-	199.8188	199.8188	-
244																
245																

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
5		Emissions (g/bhp-hr)		ROG	ROG	ROG	ROG		CO	CO	CO	CO		NOx	NOx	NOx	NOx	
246																		
247		Forklifts		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted	
248			ROG	Grubbing/Lan(	Grading	Drainage	Paving	CO	Grubbing/L	Grading	Drainage	Paving	NOx	Grubbing/I	Grading	Drainage	Paving	PM10
253		2009	0.1862	-	-	-	-	0.5722	-	-	-	-	1.5517	-	-	-	-	0.1255
254		2010	0.1848	-	-	-	-	0.5722	-	-	-	-	1.5346	-	-	-	-	0.1255
255		2011	0.1809	-	-	-	-	0.5722	-	-	-	-	1.4994	-	-	-	-	0.1240
256		2012	0.1815	-	-	-	-	0.5722	-	-	-	-	1.4936	-	-	-	-	0.1246
257		2013	0.1762	-	-	-	-	0.5722	-	-	-	-	1.4503	-	-	-	-	0.1213
258		2014	0.1671	-	-	-	-	0.5722	-	-	-	-	1.3765	-	-	-	-	0.1153
259		2015	0.1617	-	-	-	-	0.5722	-	-	-	-	1.3268	-	-	-	-	0.1115
260		2016	0.1521	-	-	-	-	0.5722	-	-	-	-	1.2506	-	-	-	-	0.1046
261		2017	0.1413	-	0.1413	0.1413	-	0.5722	-	0.5722	0.5722	-	1.1694	-	1.1694	1.1694	-	0.0965
262		2018	0.1194	-	-	-	-	0.5722	-	-	-	-	1.0081	-	-	-	-	0.0804
263		2019	0.1072	-	-	-	-	0.5722	-	-	-	-	0.9145	-	-	-	-	0.0708
264		2020	0.0965	-	-	-	-	0.5722	-	-	-	-	0.8307	-	-	-	-	0.0619
265		2021	0.0867	-	-	-	-	0.5722	-	-	-	-	0.7549	-	-	-	-	0.0536
266		2022	0.0761	-	-	-	-	0.5722	-	-	-	-	0.6754	-	-	-	-	0.0447
267		2023	0.0687	-	-	-	-	0.5722	-	-	-	-	0.6144	-	-	-	-	0.0380
268		2024	0.0631	-	-	-	-	0.5722	-	-	-	-	0.5657	-	-	-	-	0.0327
269		2025	0.0582	-	-	-	-	0.5722	-	-	-	-	0.5241	-	-	-	-	0.0281
270				-	0.1413	0.1413	-		-	0.5722	0.5722	-		-	1.1694	1.1694	-	
271																		
272																		
273																		
274		Generator Sets		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted	
275			ROG	Grubbing/Lan(	Grading	Drainage	Paving	CO	Grubbing/L	Grading	Drainage	Paving	NOx	Grubbing/I	Grading	Drainage	Paving	PM10
280		2009	0.7833	-	-	-	-	2.7396	-	-	-	-	5.0707	-	-	-	-	0.3945
281		2010	0.7369	-	-	-	-	2.7154	-	-	-	-	4.8338	-	-	-	-	0.3790
282		2011	0.6885	-	-	-	-	2.6903	-	-	-	-	4.5876	-	-	-	-	0.3628
283		2012	0.6359	-	-	-	-	2.6634	-	-	-	-	4.3120	-	-	-	-	0.3393
284		2013	0.5833	-	-	-	-	2.6371	-	-	-	-	4.0419	-	-	-	-	0.3124
285		2014	0.5317	-	-	-	-	2.6120	-	-	-	-	3.8009	-	-	-	-	0.2845
286		2015	0.4804	-	-	-	-	2.5884	-	-	-	-	3.5242	-	-	-	-	0.2565
287		2016	0.4433	-	-	-	-	2.5763	-	-	-	-	3.3371	-	-	-	-	0.2365
288		2017	0.4056	-	0.4056	0.4056	-	2.5642	-	2.5642	2.5642	-	3.1472	-	3.1472	3.1472	-	0.2158
289		2018	0.3675	-	-	-	-	2.5524	-	-	-	-	2.9540	-	-	-	-	0.1943
290		2019	0.3299	-	-	-	-	2.5408	-	-	-	-	2.7589	-	-	-	-	0.1725
291		2020	0.3012	-	-	-	-	2.5325	-	-	-	-	2.5767	-	-	-	-	0.1543
292		2021	0.2483	-	-	-	-	2.4901	-	-	-	-	2.1974	-	-	-	-	0.1195
293		2022	0.2303	-	-	-	-	2.4851	-	-	-	-	2.0388	-	-	-	-	0.1056
294		2023	0.2146	-	-	-	-	2.4814	-	-	-	-	1.8956	-	-	-	-	0.0929
295		2024	0.2007	-	-	-	-	2.4786	-	-	-	-	1.7800	-	-	-	-	0.0812
296		2025	0.1882	-	-	-	-	2.4760	-	-	-	-	1.6777	-	-	-	-	0.0701
297				-	0.4056	0.4056	-		-	2.5642	2.5642	-		-	3.1472	3.1472	-	
298																		
299																		
300																		
301		Graders		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted	
302			ROG	Grubbing/Lan(	Grading	Drainage	Paving	CO	Grubbing/L	Grading	Drainage	Paving	NOx	Grubbing/I	Grading	Drainage	Paving	PM10
307		2009	0.3650	-	-	-	-	1.1350	-	-	-	-	3.6633	-	-	-	-	0.2005
308		2010	0.3686	-	-	-	-	1.1349	-	-	-	-	3.6742	-	-	-	-	0.2028
309		2011	0.3665	-	-	-	-	1.1347	-	-	-	-	3.6425	-	-	-	-	0.2021
310		2012	0.3677	-	-	-	-	1.1346	-	-	-	-	3.6362	-	-	-	-	0.2027
311		2013	0.3666	-	-	-	-	1.1341	-	-	-	-	3.6104	-	-	-	-	0.2024
312		2014	0.3623	-	-	-	-	1.1331	-	-	-	-	3.5565	-	-	-	-	0.1996
313		2015	0.3610	-	-	-	-	1.1326	-	-	-	-	3.5301	-	-	-	-	0.1985
314		2016	0.3463	-	-	-	-	1.1310	-	-	-	-	3.3716	-	-	-	-	0.1894
315		2017	0.3238	-	0.3238	0.3238	-	1.1279	-	1.1279	1.1279	-	3.1317	-	3.1317	3.1317	-	0.1759
316		2018	0.2829	-	-	-	-	1.1248	-	-	-	-	2.6993	-	-	-	-	0.1517
317		2019	0.2604	-	-	-	-	1.1240	-	-	-	-	2.4577	-	-	-	-	0.1375
318		2020	0.2424	-	-	-	-	1.1231	-	-	-	-	2.2603	-	-	-	-	0.1261
319		2021	0.2161	-	-	-	-	1.1243	-	-	-	-	1.9779	-	-	-	-	0.1103
320		2022	0.1883	-	-	-	-	1.1244	-	-	-	-	1.6858	-	-	-	-	0.0937
321		2023	0.1668	-	-	-	-	1.1241	-	-	-	-	1.4500	-	-	-	-	0.0798
322		2024	0.1556	-	-	-	-	1.1242	-	-	-	-	1.3087	-	-	-	-	0.0722
323		2025	0.1406	-	-	-	-	1.1242	-	-	-	-	1.1337	-	-	-	-	0.0622
324				-	0.3238	0.3238	-		-	1.1279	1.1279	-		-	3.1317	3.1317	-	
325																		

	A	B	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF
5		Emissions (g/bhp-hr)	PM10	PM10	PM10	PM10		PM2.5	PM2.5	PM2.5	PM2.5		CO2	CO2	CO2	CO2
246																
247		Forklifts	Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted
248			Grubbing/Land Cl	Grading	Drainage	Paving	PM2.5	Grubbing/Land Clearing	Grading	Drainage	Paving	CO2	Grubbing/Land Clearin	Grading	Drainage	Paving
253		2009	-	-	-	-	0.1154	-	-	-	-	104.9995	-	-	-	-
254		2010	-	-	-	-	0.1155	-	-	-	-	104.9995	-	-	-	-
255		2011	-	-	-	-	0.1141	-	-	-	-	104.9995	-	-	-	-
256		2012	-	-	-	-	0.1147	-	-	-	-	104.9995	-	-	-	-
257		2013	-	-	-	-	0.1116	-	-	-	-	104.9995	-	-	-	-
258		2014	-	-	-	-	0.1061	-	-	-	-	104.9995	-	-	-	-
259		2015	-	-	-	-	0.1025	-	-	-	-	104.9995	-	-	-	-
260		2016	-	-	-	-	0.0962	-	-	-	-	104.9995	-	-	-	-
261		2017	-	0.0965	0.0965	-	0.0888	-	0.0888	0.0888	-	104.9995	-	104.9995	104.9995	-
262		2018	-	-	-	-	0.0740	-	-	-	-	104.9995	-	-	-	-
263		2019	-	-	-	-	0.0652	-	-	-	-	104.9995	-	-	-	-
264		2020	-	-	-	-	0.0569	-	-	-	-	104.9995	-	-	-	-
265		2021	-	-	-	-	0.0493	-	-	-	-	104.9995	-	-	-	-
266		2022	-	-	-	-	0.0412	-	-	-	-	104.9995	-	-	-	-
267		2023	-	-	-	-	0.0349	-	-	-	-	104.9995	-	-	-	-
268		2024	-	-	-	-	0.0301	-	-	-	-	104.9995	-	-	-	-
269		2025	-	-	-	-	0.0258	-	-	-	-	104.9995	-	-	-	-
270			-	0.0965	0.0965	-		-	0.0888	0.0888	-		-	104.9995	104.9995	-
271																
272																
273																
274		Generator Sets	Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted
275			Grubbing/Land Cl	Grading	Drainage	Paving	PM2.5	Grubbing/Land Clearing	Grading	Drainage	Paving	CO2	Grubbing/Land Clearin	Grading	Drainage	Paving
280		2009	-	-	-	-	0.3629	-	-	-	-	420.5418	-	-	-	-
281		2010	-	-	-	-	0.3487	-	-	-	-	420.5420	-	-	-	-
282		2011	-	-	-	-	0.3338	-	-	-	-	420.5418	-	-	-	-
283		2012	-	-	-	-	0.3122	-	-	-	-	420.5419	-	-	-	-
284		2013	-	-	-	-	0.2874	-	-	-	-	420.5421	-	-	-	-
285		2014	-	-	-	-	0.2617	-	-	-	-	420.5421	-	-	-	-
286		2015	-	-	-	-	0.2360	-	-	-	-	420.5419	-	-	-	-
287		2016	-	-	-	-	0.2176	-	-	-	-	420.5418	-	-	-	-
288		2017	-	0.2158	0.2158	-	0.1985	-	0.1985	0.1985	-	420.5418	-	420.5418	420.5418	-
289		2018	-	-	-	-	0.1788	-	-	-	-	420.5420	-	-	-	-
290		2019	-	-	-	-	0.1587	-	-	-	-	420.5419	-	-	-	-
291		2020	-	-	-	-	0.1419	-	-	-	-	420.5420	-	-	-	-
292		2021	-	-	-	-	0.1099	-	-	-	-	420.5420	-	-	-	-
293		2022	-	-	-	-	0.0972	-	-	-	-	420.5419	-	-	-	-
294		2023	-	-	-	-	0.0854	-	-	-	-	420.5417	-	-	-	-
295		2024	-	-	-	-	0.0747	-	-	-	-	420.5420	-	-	-	-
296		2025	-	-	-	-	0.0645	-	-	-	-	420.5420	-	-	-	-
297			-	0.2158	0.2158	-		-	0.1985	0.1985	-		-	420.5418	420.5418	-
298																
299																
300																
301		Graders	Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted
302			Grubbing/Land Cl	Grading	Drainage	Paving	PM2.5	Grubbing/Land Clearing	Grading	Drainage	Paving	CO2	Grubbing/Land Clearin	Grading	Drainage	Paving
307		2009	-	-	-	-	0.1845	-	-	-	-	218.7264	-	-	-	-
308		2010	-	-	-	-	0.1866	-	-	-	-	218.7080	-	-	-	-
309		2011	-	-	-	-	0.1859	-	-	-	-	218.6773	-	-	-	-
310		2012	-	-	-	-	0.1865	-	-	-	-	218.6500	-	-	-	-
311		2013	-	-	-	-	0.1862	-	-	-	-	218.5595	-	-	-	-
312		2014	-	-	-	-	0.1836	-	-	-	-	218.3692	-	-	-	-
313		2015	-	-	-	-	0.1826	-	-	-	-	218.2619	-	-	-	-
314		2016	-	-	-	-	0.1743	-	-	-	-	217.9530	-	-	-	-
315		2017	-	0.1759	0.1759	-	0.1618	-	0.1618	0.1618	-	217.3696	-	217.3696	217.3696	-
316		2018	-	-	-	-	0.1396	-	-	-	-	216.7726	-	-	-	-
317		2019	-	-	-	-	0.1265	-	-	-	-	216.6151	-	-	-	-
318		2020	-	-	-	-	0.1160	-	-	-	-	216.4475	-	-	-	-
319		2021	-	-	-	-	0.1015	-	-	-	-	216.6687	-	-	-	-
320		2022	-	-	-	-	0.0862	-	-	-	-	216.6857	-	-	-	-
321		2023	-	-	-	-	0.0734	-	-	-	-	216.6388	-	-	-	-
322		2024	-	-	-	-	0.0665	-	-	-	-	216.6541	-	-	-	-
323		2025	-	-	-	-	0.0572	-	-	-	-	216.6594	-	-	-	-
324			-	0.1759	0.1759	-		-	0.1618	0.1618	-		-	217.3696	217.3696	-
325																

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
5		Emissions (g/bhp-hr)		ROG	ROG	ROG	ROG		CO	CO	CO	CO		NOx	NOx	NOx	NOx	
326																		
327																		
328		Off-Highway Tractors		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted	
329			ROG	Grubbing/Lan(	Grading	Drainage	Paving	CO	Grubbing/L	Grading	Drainage	Paving	NOx	Grubbing/l	Grading	Drainage	Paving	PM10
334		2009	0.2402	-	-	-	-	1.1749	-	-	-	-	2.7415	-	-	-	-	0.1408
335		2010	0.2388	-	-	-	-	1.1751	-	-	-	-	2.6977	-	-	-	-	0.1404
336		2011	0.2255	-	-	-	-	1.1747	-	-	-	-	2.5612	-	-	-	-	0.1337
337		2012	0.2197	-	-	-	-	1.1746	-	-	-	-	2.4863	-	-	-	-	0.1304
338		2013	0.2085	-	-	-	-	1.1747	-	-	-	-	2.3609	-	-	-	-	0.1223
339		2014	0.1933	-	-	-	-	1.1751	-	-	-	-	2.1885	-	-	-	-	0.1122
340		2015	0.1831	-	-	-	-	1.1744	-	-	-	-	2.0572	-	-	-	-	0.1042
341		2016	0.1782	-	-	-	-	1.1750	-	-	-	-	1.9645	-	-	-	-	0.0997
342		2017	0.1622	-	0.1622	0.1622	-	1.1739	-	1.1739	1.1739	-	1.7533	-	1.7533	1.7533	-	0.0892
343		2018	0.1435	-	-	-	-	1.1738	-	-	-	-	1.5232	-	-	-	-	0.0765
344		2019	0.1341	-	-	-	-	1.1738	-	-	-	-	1.3969	-	-	-	-	0.0691
345		2020	0.1235	-	-	-	-	1.1737	-	-	-	-	1.2587	-	-	-	-	0.0611
346		2021	0.1179	-	-	-	-	1.1738	-	-	-	-	1.1583	-	-	-	-	0.0560
347		2022	0.1054	-	-	-	-	1.1735	-	-	-	-	0.9750	-	-	-	-	0.0467
348		2023	0.0916	-	-	-	-	1.1739	-	-	-	-	0.7773	-	-	-	-	0.0372
349		2024	0.0832	-	-	-	-	1.1742	-	-	-	-	0.6514	-	-	-	-	0.0311
350		2025	0.0799	-	-	-	-	1.1747	-	-	-	-	0.5873	-	-	-	-	0.0282
351				-	0.1622	0.1622	-		-	1.1739	1.1739	-		-	1.7533	1.7533	-	
352																		
353																		
354																		
355		Off-Highway Trucks		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted	
356			ROG	Grubbing/Lan(	Grading	Drainage	Paving	CO	Grubbing/L	Grading	Drainage	Paving	NOx	Grubbing/l	Grading	Drainage	Paving	PM10
361		2009	0.1650	-	-	-	-	0.6097	-	-	-	-	2.1007	-	-	-	-	0.0802
362		2010	0.1719	-	-	-	-	0.6096	-	-	-	-	2.1083	-	-	-	-	0.0814
363		2011	0.1731	-	-	-	-	0.6094	-	-	-	-	2.0615	-	-	-	-	0.0801
364		2012	0.1766	-	-	-	-	0.6094	-	-	-	-	2.0534	-	-	-	-	0.0803
365		2013	0.1688	-	-	-	-	0.6097	-	-	-	-	1.9333	-	-	-	-	0.0751
366		2014	0.1573	-	-	-	-	0.6099	-	-	-	-	1.7895	-	-	-	-	0.0686
367		2015	0.1537	-	-	-	-	0.6099	-	-	-	-	1.7292	-	-	-	-	0.0661
368		2016	0.1404	-	-	-	-	0.6091	-	-	-	-	1.5459	-	-	-	-	0.0583
369		2017	0.1300	-	0.1300	0.1300	-	0.6085	-	0.6085	0.6085	-	1.4010	-	1.4010	1.4010	-	0.0520
370		2018	0.1147	-	-	-	-	0.6085	-	-	-	-	1.1801	-	-	-	-	0.0431
371		2019	0.1053	-	-	-	-	0.6082	-	-	-	-	1.0191	-	-	-	-	0.0371
372		2020	0.0984	-	-	-	-	0.6079	-	-	-	-	0.8962	-	-	-	-	0.0327
373		2021	0.0899	-	-	-	-	0.6079	-	-	-	-	0.7461	-	-	-	-	0.0274
374		2022	0.0784	-	-	-	-	0.6081	-	-	-	-	0.5689	-	-	-	-	0.0207
375		2023	0.0748	-	-	-	-	0.6085	-	-	-	-	0.5057	-	-	-	-	0.0183
376		2024	0.0737	-	-	-	-	0.6087	-	-	-	-	0.4717	-	-	-	-	0.0170
377		2025	0.0709	-	-	-	-	0.6084	-	-	-	-	0.4063	-	-	-	-	0.0145
378				-	0.1300	0.1300	-		-	0.6085	0.6085	-		-	1.4010	1.4010	-	
379																		
380																		
381																		
382		Other Construction Equipment		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted	
383			ROG	Grubbing/Lan(	Grading	Drainage	Paving	CO	Grubbing/L	Grading	Drainage	Paving	NOx	Grubbing/l	Grading	Drainage	Paving	PM10
388		2009	0.2776	-	-	-	-	1.1888	-	-	-	-	3.0247	-	-	-	-	0.1554
389		2010	0.2811	-	-	-	-	1.1889	-	-	-	-	3.0364	-	-	-	-	0.1577
390		2011	0.2651	-	-	-	-	1.1885	-	-	-	-	2.8750	-	-	-	-	0.1498
391		2012	0.2670	-	-	-	-	1.1885	-	-	-	-	2.8730	-	-	-	-	0.1507
392		2013	0.2587	-	-	-	-	1.1891	-	-	-	-	2.7794	-	-	-	-	0.1458
393		2014	0.2463	-	-	-	-	1.1895	-	-	-	-	2.6469	-	-	-	-	0.1384
394		2015	0.2422	-	-	-	-	1.1894	-	-	-	-	2.5882	-	-	-	-	0.1356
395		2016	0.2280	-	-	-	-	1.1891	-	-	-	-	2.4166	-	-	-	-	0.1271
396		2017	0.2176	-	0.2176	0.2176	-	1.1887	-	1.1887	1.1887	-	2.2823	-	2.2823	2.2823	-	0.1206
397		2018	0.1897	-	-	-	-	1.1884	-	-	-	-	1.9752	-	-	-	-	0.1039
398		2019	0.1791	-	-	-	-	1.1891	-	-	-	-	1.8415	-	-	-	-	0.0970
399		2020	0.1686	-	-	-	-	1.1890	-	-	-	-	1.7081	-	-	-	-	0.0901
400		2021	0.1433	-	-	-	-	1.1885	-	-	-	-	1.4283	-	-	-	-	0.0747
401		2022	0.1283	-	-	-	-	1.1881	-	-	-	-	1.2439	-	-	-	-	0.0649
402		2023	0.1189	-	-	-	-	1.1880	-	-	-	-	1.1208	-	-	-	-	0.0583
403		2024	0.1133	-	-	-	-	1.1879	-	-	-	-	1.0469	-	-	-	-	0.0540
404		2025	0.1021	-	-	-	-	1.1887	-	-	-	-	0.9003	-	-	-	-	0.0466
405				-	0.2176	0.2176	-		-	1.1887	1.1887	-		-	2.2823	2.2823	-	
406																		
407																		

	A	B	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF
5		Emissions (g/bhp-hr)	PM10	PM10	PM10	PM10		PM2.5	PM2.5	PM2.5	PM2.5		CO2	CO2	CO2	CO2
326																
327																
328		Off-Highway Tractors	Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted
329			Grubbing/Land Cl	Grading	Drainage	Paving	PM2.5	Grubbing/Land Clearing	Grading	Drainage	Paving	CO2	Grubbing/Land Clearin	Grading	Drainage	Paving
334		2009	-	-	-	-	0.1295	-	-	-	-	228.3910	-	-	-	-
335		2010	-	-	-	-	0.1292	-	-	-	-	228.4230	-	-	-	-
336		2011	-	-	-	-	0.1230	-	-	-	-	228.3444	-	-	-	-
337		2012	-	-	-	-	0.1200	-	-	-	-	228.3271	-	-	-	-
338		2013	-	-	-	-	0.1126	-	-	-	-	228.3471	-	-	-	-
339		2014	-	-	-	-	0.1033	-	-	-	-	228.4257	-	-	-	-
340		2015	-	-	-	-	0.0959	-	-	-	-	228.2941	-	-	-	-
341		2016	-	-	-	-	0.0917	-	-	-	-	228.4197	-	-	-	-
342		2017	-	0.0892	0.0892	-	0.0821	-	0.0821	0.0821	-	228.1938	-	228.1938	228.1938	-
343		2018	-	-	-	-	0.0704	-	-	-	-	228.1710	-	-	-	-
344		2019	-	-	-	-	0.0635	-	-	-	-	228.1709	-	-	-	-
345		2020	-	-	-	-	0.0562	-	-	-	-	228.1689	-	-	-	-
346		2021	-	-	-	-	0.0515	-	-	-	-	228.1721	-	-	-	-
347		2022	-	-	-	-	0.0430	-	-	-	-	228.1178	-	-	-	-
348		2023	-	-	-	-	0.0342	-	-	-	-	228.2071	-	-	-	-
349		2024	-	-	-	-	0.0286	-	-	-	-	228.2557	-	-	-	-
350		2025	-	-	-	-	0.0259	-	-	-	-	228.3547	-	-	-	-
351			-	0.0892	0.0892	-		-	0.0821	0.0821	-		-	228.1938	228.1938	-
352																
353																
354																
355		Off-Highway Trucks	Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted
356			Grubbing/Land Cl	Grading	Drainage	Paving	PM2.5	Grubbing/Land Clearing	Grading	Drainage	Paving	CO2	Grubbing/Land Clearin	Grading	Drainage	Paving
361		2009	-	-	-	-	0.0738	-	-	-	-	201.3723	-	-	-	-
362		2010	-	-	-	-	0.0749	-	-	-	-	201.3601	-	-	-	-
363		2011	-	-	-	-	0.0737	-	-	-	-	201.2740	-	-	-	-
364		2012	-	-	-	-	0.0739	-	-	-	-	201.2744	-	-	-	-
365		2013	-	-	-	-	0.0690	-	-	-	-	201.3702	-	-	-	-
366		2014	-	-	-	-	0.0631	-	-	-	-	201.4303	-	-	-	-
367		2015	-	-	-	-	0.0608	-	-	-	-	201.4594	-	-	-	-
368		2016	-	-	-	-	0.0537	-	-	-	-	201.1868	-	-	-	-
369		2017	-	0.0520	0.0520	-	0.0478	-	0.0478	0.0478	-	200.9871	-	200.9871	200.9871	-
370		2018	-	-	-	-	0.0396	-	-	-	-	200.9816	-	-	-	-
371		2019	-	-	-	-	0.0341	-	-	-	-	200.8965	-	-	-	-
372		2020	-	-	-	-	0.0300	-	-	-	-	200.7896	-	-	-	-
373		2021	-	-	-	-	0.0252	-	-	-	-	200.7741	-	-	-	-
374		2022	-	-	-	-	0.0190	-	-	-	-	200.8467	-	-	-	-
375		2023	-	-	-	-	0.0168	-	-	-	-	200.9885	-	-	-	-
376		2024	-	-	-	-	0.0156	-	-	-	-	201.0611	-	-	-	-
377		2025	-	-	-	-	0.0134	-	-	-	-	200.9551	-	-	-	-
378			-	0.0520	0.0520	-		-	0.0478	0.0478	-		-	200.9871	200.9871	-
379																
380																
381																
382		Other Construction Equipment	Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted
383			Grubbing/Land Cl	Grading	Drainage	Paving	PM2.5	Grubbing/Land Clearing	Grading	Drainage	Paving	CO2	Grubbing/Land Clearin	Grading	Drainage	Paving
388		2009	-	-	-	-	0.1430	-	-	-	-	216.2355	-	-	-	-
389		2010	-	-	-	-	0.1451	-	-	-	-	216.2551	-	-	-	-
390		2011	-	-	-	-	0.1378	-	-	-	-	216.1907	-	-	-	-
391		2012	-	-	-	-	0.1386	-	-	-	-	216.1860	-	-	-	-
392		2013	-	-	-	-	0.1341	-	-	-	-	216.2896	-	-	-	-
393		2014	-	-	-	-	0.1273	-	-	-	-	216.3641	-	-	-	-
394		2015	-	-	-	-	0.1247	-	-	-	-	216.3552	-	-	-	-
395		2016	-	-	-	-	0.1169	-	-	-	-	216.3040	-	-	-	-
396		2017	-	0.1206	0.1206	-	0.1109	-	0.1109	0.1109	-	216.2171	-	216.2171	216.2171	-
397		2018	-	-	-	-	0.0956	-	-	-	-	216.1663	-	-	-	-
398		2019	-	-	-	-	0.0892	-	-	-	-	216.2989	-	-	-	-
399		2020	-	-	-	-	0.0829	-	-	-	-	216.2881	-	-	-	-
400		2021	-	-	-	-	0.0687	-	-	-	-	216.1871	-	-	-	-
401		2022	-	-	-	-	0.0597	-	-	-	-	216.1173	-	-	-	-
402		2023	-	-	-	-	0.0537	-	-	-	-	216.0922	-	-	-	-
403		2024	-	-	-	-	0.0497	-	-	-	-	216.0860	-	-	-	-
404		2025	-	-	-	-	0.0428	-	-	-	-	216.2234	-	-	-	-
405			-	0.1206	0.1206	-		-	0.1109	0.1109	-		-	216.2171	216.2171	-
406																
407																

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
5		Emissions (g/bhp-hr)		ROG	ROG	ROG	ROG		CO	CO	CO	CO		NOx	NOx	NOx	NOx	
408																		
409		Other General Industrial Equipment		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted	
410			ROG	Grubbing/Lan(	Grading	Drainage	Paving	CO	Grubbing/L	Grading	Drainage	Paving	NOx	Grubbing/l	Grading	Drainage	Paving	PM10
415		2009	0.3056	-	-	-	-	0.8686	-	-	-	-	2.5284	-	-	-	-	0.2074
416		2010	0.3057	-	-	-	-	0.8686	-	-	-	-	2.5164	-	-	-	-	0.2088
417		2011	0.3024	-	-	-	-	0.8686	-	-	-	-	2.4769	-	-	-	-	0.2080
418		2012	0.3031	-	-	-	-	0.8686	-	-	-	-	2.4653	-	-	-	-	0.2091
419		2013	0.2952	-	-	-	-	0.8686	-	-	-	-	2.4032	-	-	-	-	0.2039
420		2014	0.2820	-	-	-	-	0.8686	-	-	-	-	2.2972	-	-	-	-	0.1961
421		2015	0.2720	-	-	-	-	0.8686	-	-	-	-	2.2216	-	-	-	-	0.1889
422		2016	0.2559	-	-	-	-	0.8686	-	-	-	-	2.0994	-	-	-	-	0.1769
423		2017	0.2360	-	0.2360	0.2360	-	0.8686	-	0.8686	0.8686	-	1.9550	-	1.9550	1.9550	-	0.1608
424		2018	0.1993	-	-	-	-	0.8686	-	-	-	-	1.6930	-	-	-	-	0.1338
425		2019	0.1787	-	-	-	-	0.8686	-	-	-	-	1.5365	-	-	-	-	0.1172
426		2020	0.1595	-	-	-	-	0.8686	-	-	-	-	1.3876	-	-	-	-	0.1011
427		2021	0.1444	-	-	-	-	0.8686	-	-	-	-	1.2703	-	-	-	-	0.0874
428		2022	0.1211	-	-	-	-	0.8686	-	-	-	-	1.0933	-	-	-	-	0.0680
429		2023	0.1100	-	-	-	-	0.8686	-	-	-	-	0.9991	-	-	-	-	0.0576
430		2024	0.1027	-	-	-	-	0.8686	-	-	-	-	0.9252	-	-	-	-	0.0499
431		2025	0.0921	-	-	-	-	0.8686	-	-	-	-	0.8334	-	-	-	-	0.0403
432				-	0.2360	0.2360	-		-	0.8686	0.8686	-		-	1.9550	1.9550	-	
433																		
434																		
435																		
436		Other Material Handling Equipment		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted	
437			ROG	Grubbing/Lan(	Grading	Drainage	Paving	CO	Grubbing/L	Grading	Drainage	Paving	NOx	Grubbing/l	Grading	Drainage	Paving	PM10
442		2009	0.2426	-	-	-	-	1.0781	-	-	-	-	2.6300	-	-	-	-	0.1428
443		2010	0.2447	-	-	-	-	1.0781	-	-	-	-	2.6206	-	-	-	-	0.1441
444		2011	0.2417	-	-	-	-	1.0781	-	-	-	-	2.5639	-	-	-	-	0.1423
445		2012	0.2408	-	-	-	-	1.0781	-	-	-	-	2.5335	-	-	-	-	0.1409
446		2013	0.2315	-	-	-	-	1.0781	-	-	-	-	2.4325	-	-	-	-	0.1316
447		2014	0.2186	-	-	-	-	1.0781	-	-	-	-	2.2918	-	-	-	-	0.1236
448		2015	0.2172	-	-	-	-	1.0781	-	-	-	-	2.2313	-	-	-	-	0.1210
449		2016	0.2022	-	-	-	-	1.0781	-	-	-	-	2.0601	-	-	-	-	0.1105
450		2017	0.1766	-	0.1766	0.1766	-	1.0781	-	1.0781	1.0781	-	1.7741	-	1.7741	1.7741	-	0.0940
451		2018	0.1351	-	-	-	-	1.0781	-	-	-	-	1.3173	-	-	-	-	0.0682
452		2019	0.1157	-	-	-	-	1.0781	-	-	-	-	1.0964	-	-	-	-	0.0549
453		2020	0.1043	-	-	-	-	1.0781	-	-	-	-	0.9355	-	-	-	-	0.0467
454		2021	0.1029	-	-	-	-	1.0781	-	-	-	-	0.8880	-	-	-	-	0.0450
455		2022	0.0933	-	-	-	-	1.0781	-	-	-	-	0.7486	-	-	-	-	0.0406
456		2023	0.0897	-	-	-	-	1.0781	-	-	-	-	0.6993	-	-	-	-	0.0379
457		2024	0.0862	-	-	-	-	1.0781	-	-	-	-	0.6478	-	-	-	-	0.0348
458		2025	0.0783	-	-	-	-	1.0781	-	-	-	-	0.5518	-	-	-	-	0.0286
459				-	0.1766	0.1766	-		-	1.0781	1.0781	-		-	1.7741	1.7741	-	
460																		
461																		
462																		
463		Pavers	ROG	Grubbing/Lan(	Grading	Drainage	Paving	CO	Grubbing/L	Grading	Drainage	Paving	NOx	Grubbing/l	Grading	Drainage	Paving	PM10
468		2009	0.2507	-	-	-	-	1.2817	-	-	-	-	2.7677	-	-	-	-	0.1379
469		2010	0.2534	-	-	-	-	1.2818	-	-	-	-	2.7702	-	-	-	-	0.1400
470		2011	0.2465	-	-	-	-	1.2820	-	-	-	-	2.6800	-	-	-	-	0.1360
471		2012	0.2476	-	-	-	-	1.2822	-	-	-	-	2.6759	-	-	-	-	0.1368
472		2013	0.2302	-	-	-	-	1.2809	-	-	-	-	2.5170	-	-	-	-	0.1262
473		2014	0.2184	-	-	-	-	1.2801	-	-	-	-	2.3829	-	-	-	-	0.1192
474		2015	0.2128	-	-	-	-	1.2805	-	-	-	-	2.2999	-	-	-	-	0.1152
475		2016	0.1884	-	-	-	-	1.2808	-	-	-	-	2.0246	-	-	-	-	0.1006
476		2017	0.1691	-	0.1691	0.1691	-	1.2816	-	1.2816	1.2816	-	1.8083	-	1.8083	1.8083	-	0.0890
477		2018	0.1473	-	-	-	-	1.2822	-	-	-	-	1.5566	-	-	-	-	0.0761
478		2019	0.1299	-	-	-	-	1.2821	-	-	-	-	1.3479	-	-	-	-	0.0660
479		2020	0.1186	-	-	-	-	1.2818	-	-	-	-	1.2123	-	-	-	-	0.0589
480		2021	0.1112	-	-	-	-	1.2812	-	-	-	-	1.1194	-	-	-	-	0.0541
481		2022	0.0934	-	-	-	-	1.2817	-	-	-	-	0.9054	-	-	-	-	0.0430
482		2023	0.0867	-	-	-	-	1.2816	-	-	-	-	0.8122	-	-	-	-	0.0382
483		2024	0.0829	-	-	-	-	1.2815	-	-	-	-	0.7514	-	-	-	-	0.0351
484		2025	0.0785	-	-	-	-	1.2810	-	-	-	-	0.6829	-	-	-	-	0.0320
485				-	0.1691	0.1691	-		-	1.2816	1.2816	-		-	1.8083	1.8083	-	
486																		
487																		

	A	B	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF
5		Emissions (g/bhp-hr)	PM10	PM10	PM10	PM10		PM2.5	PM2.5	PM2.5	PM2.5		CO2	CO2	CO2	CO2
408																
409		Other General Industrial Equipment	Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted
410			Grubbing/Land Cl	Grading	Drainage	Paving	PM2.5	Grubbing/Land Clearing	Grading	Drainage	Paving	CO2	Grubbing/Land Clearin	Grading	Drainage	Paving
415		2009	-	-	-	-	0.1908	-	-	-	-	177.9205	-	-	-	-
416		2010	-	-	-	-	0.1921	-	-	-	-	177.9205	-	-	-	-
417		2011	-	-	-	-	0.1914	-	-	-	-	177.9205	-	-	-	-
418		2012	-	-	-	-	0.1924	-	-	-	-	177.9205	-	-	-	-
419		2013	-	-	-	-	0.1876	-	-	-	-	177.9205	-	-	-	-
420		2014	-	-	-	-	0.1804	-	-	-	-	177.9205	-	-	-	-
421		2015	-	-	-	-	0.1738	-	-	-	-	177.9205	-	-	-	-
422		2016	-	-	-	-	0.1628	-	-	-	-	177.9205	-	-	-	-
423		2017	-	0.1608	0.1608	-	0.1479	-	0.1479	0.1479	-	177.9205	-	177.9205	177.9205	-
424		2018	-	-	-	-	0.1231	-	-	-	-	177.9205	-	-	-	-
425		2019	-	-	-	-	0.1078	-	-	-	-	177.9205	-	-	-	-
426		2020	-	-	-	-	0.0930	-	-	-	-	177.9205	-	-	-	-
427		2021	-	-	-	-	0.0804	-	-	-	-	177.9205	-	-	-	-
428		2022	-	-	-	-	0.0626	-	-	-	-	177.9205	-	-	-	-
429		2023	-	-	-	-	0.0530	-	-	-	-	177.9205	-	-	-	-
430		2024	-	-	-	-	0.0459	-	-	-	-	177.9205	-	-	-	-
431		2025	-	-	-	-	0.0371	-	-	-	-	177.9205	-	-	-	-
432			-	0.1608	0.1608	-		-	0.1479	0.1479	-		-	177.9205	177.9205	-
433																
434																
435																
436		Other Material Handling Equipment	Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted
437			Grubbing/Land Cl	Grading	Drainage	Paving	PM2.5	Grubbing/Land Clearing	Grading	Drainage	Paving	CO2	Grubbing/Land Clearin	Grading	Drainage	Paving
442		2009	-	-	-	-	0.1314	-	-	-	-	206.8016	-	-	-	-
443		2010	-	-	-	-	0.1325	-	-	-	-	206.8016	-	-	-	-
444		2011	-	-	-	-	0.1309	-	-	-	-	206.8016	-	-	-	-
445		2012	-	-	-	-	0.1297	-	-	-	-	206.8016	-	-	-	-
446		2013	-	-	-	-	0.1210	-	-	-	-	206.8016	-	-	-	-
447		2014	-	-	-	-	0.1137	-	-	-	-	206.8016	-	-	-	-
448		2015	-	-	-	-	0.1113	-	-	-	-	206.8016	-	-	-	-
449		2016	-	-	-	-	0.1016	-	-	-	-	206.8016	-	-	-	-
450		2017	-	0.0940	0.0940	-	0.0865	-	0.0865	0.0865	-	206.8016	-	206.8016	206.8016	-
451		2018	-	-	-	-	0.0627	-	-	-	-	206.8016	-	-	-	-
452		2019	-	-	-	-	0.0505	-	-	-	-	206.8016	-	-	-	-
453		2020	-	-	-	-	0.0429	-	-	-	-	206.8016	-	-	-	-
454		2021	-	-	-	-	0.0414	-	-	-	-	206.8016	-	-	-	-
455		2022	-	-	-	-	0.0374	-	-	-	-	206.8016	-	-	-	-
456		2023	-	-	-	-	0.0349	-	-	-	-	206.8016	-	-	-	-
457		2024	-	-	-	-	0.0320	-	-	-	-	206.8016	-	-	-	-
458		2025	-	-	-	-	0.0263	-	-	-	-	206.8016	-	-	-	-
459			-	0.0940	0.0940	-		-	0.0865	0.0865	-		-	206.8016	206.8016	-
460																
461																
462								Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted
463		Pavers	Grubbing/Land Cl	Grading	Drainage	Paving	PM2.5	Grubbing/Land Clearing	Grading	Drainage	Paving	CO2	Grubbing/Land Clearin	Grading	Drainage	Paving
468		2009	-	-	-	-	0.1269	-	-	-	-	217.5575	-	-	-	-
469		2010	-	-	-	-	0.1288	-	-	-	-	217.5800	-	-	-	-
470		2011	-	-	-	-	0.1251	-	-	-	-	217.6118	-	-	-	-
471		2012	-	-	-	-	0.1259	-	-	-	-	217.6366	-	-	-	-
472		2013	-	-	-	-	0.1161	-	-	-	-	217.4178	-	-	-	-
473		2014	-	-	-	-	0.1096	-	-	-	-	217.2863	-	-	-	-
474		2015	-	-	-	-	0.1060	-	-	-	-	217.3487	-	-	-	-
475		2016	-	-	-	-	0.0926	-	-	-	-	217.4097	-	-	-	-
476		2017	-	0.0890	0.0890	-	0.0819	-	0.0819	0.0819	-	217.5407	-	217.5407	217.5407	-
477		2018	-	-	-	-	0.0700	-	-	-	-	217.6441	-	-	-	-
478		2019	-	-	-	-	0.0607	-	-	-	-	217.6234	-	-	-	-
479		2020	-	-	-	-	0.0542	-	-	-	-	217.5725	-	-	-	-
480		2021	-	-	-	-	0.0498	-	-	-	-	217.4715	-	-	-	-
481		2022	-	-	-	-	0.0396	-	-	-	-	217.5657	-	-	-	-
482		2023	-	-	-	-	0.0351	-	-	-	-	217.5463	-	-	-	-
483		2024	-	-	-	-	0.0323	-	-	-	-	217.5200	-	-	-	-
484		2025	-	-	-	-	0.0294	-	-	-	-	217.4392	-	-	-	-
485			-	0.0890	0.0890	-		-	0.0819	0.0819	-		-	217.5407	217.5407	-
486																
487																

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
5		Emissions (g/bhp-hr)		ROG	ROG	ROG	ROG		CO	CO	CO	CO		NOx	NOx	NOx	NOx	
488																		
489		Paving Equipment		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted	
490			ROG	Grubbing/Lan(	Grading	Drainage	Paving	CO	Grubbing/L	Grading	Drainage	Paving	NOx	Grubbing/l	Grading	Drainage	Paving	PM10
495		2009	0.1752	-	-	-	-	1.1710	-	-	-	-	2.1495	-	-	-	-	0.1025
496		2010	0.1791	-	-	-	-	1.1710	-	-	-	-	2.1644	-	-	-	-	0.1046
497		2011	0.1765	-	-	-	-	1.1711	-	-	-	-	2.1218	-	-	-	-	0.1030
498		2012	0.1766	-	-	-	-	1.1708	-	-	-	-	2.1067	-	-	-	-	0.1031
499		2013	0.1661	-	-	-	-	1.1698	-	-	-	-	1.9898	-	-	-	-	0.0962
500		2014	0.1543	-	-	-	-	1.1698	-	-	-	-	1.8521	-	-	-	-	0.0884
501		2015	0.1527	-	-	-	-	1.1700	-	-	-	-	1.7633	-	-	-	-	0.0860
502		2016	0.1382	-	-	-	-	1.1703	-	-	-	-	1.5346	-	-	-	-	0.0762
503		2017	0.1273	-	0.1273	0.1273	-	1.1707	-	1.1707	1.1707	-	1.3836	-	1.3836	1.3836	-	0.0691
504		2018	0.1054	-	-	-	-	1.1705	-	-	-	-	1.1264	-	-	-	-	0.0551
505		2019	0.0944	-	-	-	-	1.1702	-	-	-	-	0.9561	-	-	-	-	0.0474
506		2020	0.0920	-	-	-	-	1.1701	-	-	-	-	0.9073	-	-	-	-	0.0454
507		2021	0.0852	-	-	-	-	1.1699	-	-	-	-	0.8221	-	-	-	-	0.0406
508		2022	0.0790	-	-	-	-	1.1699	-	-	-	-	0.7362	-	-	-	-	0.0359
509		2023	0.0757	-	-	-	-	1.1699	-	-	-	-	0.6791	-	-	-	-	0.0330
510		2024	0.0731	-	-	-	-	1.1699	-	-	-	-	0.6339	-	-	-	-	0.0306
511		2025	0.0651	-	-	-	-	1.1695	-	-	-	-	0.5358	-	-	-	-	0.0265
512				-	0.1273	0.1273	-		-	1.1707	1.1707	-		-	1.3836	1.3836	-	
513																		
514																		
515																		
516		Plate Compactors		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted	
517			ROG	Grubbing/Lan(	Grading	Drainage	Paving	CO	Grubbing/L	Grading	Drainage	Paving	NOx	Grubbing/l	Grading	Drainage	Paving	PM10
522		2009	0.2882	-	-	-	-	1.4921	-	-	-	-	1.8206	-	-	-	-	0.1005
523		2010	0.2859	-	-	-	-	1.4921	-	-	-	-	1.7967	-	-	-	-	0.0855
524		2011	0.2848	-	-	-	-	1.4921	-	-	-	-	1.7846	-	-	-	-	0.0740
525		2012	0.2845	-	-	-	-	1.4921	-	-	-	-	1.7814	-	-	-	-	0.0711
526		2013	0.2845	-	-	-	-	1.4921	-	-	-	-	1.7814	-	-	-	-	0.0698
527		2014	0.2845	-	-	-	-	1.4921	-	-	-	-	1.7814	-	-	-	-	0.0694
528		2015	0.2845	-	-	-	-	1.4921	-	-	-	-	1.7814	-	-	-	-	0.0694
529		2016	0.2845	-	-	-	-	1.4921	-	-	-	-	1.7814	-	-	-	-	0.0695
530		2017	0.2845	-	0.2845	0.2845	-	1.4921	-	1.4921	1.4921	-	1.7814	-	1.7814	1.7814	-	0.0696
531		2018	0.2845	-	-	-	-	1.4921	-	-	-	-	1.7814	-	-	-	-	0.0696
532		2019	0.2845	-	-	-	-	1.4921	-	-	-	-	1.7814	-	-	-	-	0.0696
533		2020	0.2845	-	-	-	-	1.4921	-	-	-	-	1.7814	-	-	-	-	0.0696
534		2021	0.2845	-	-	-	-	1.4921	-	-	-	-	1.7814	-	-	-	-	0.0696
535		2022	0.2845	-	-	-	-	1.4921	-	-	-	-	1.7814	-	-	-	-	0.0696
536		2023	0.2845	-	-	-	-	1.4921	-	-	-	-	1.7814	-	-	-	-	0.0696
537		2024	0.2845	-	-	-	-	1.4921	-	-	-	-	1.7814	-	-	-	-	0.0696
538		2025	0.2845	-	-	-	-	1.4921	-	-	-	-	1.7814	-	-	-	-	0.0696
539				-	0.2845	0.2845	-		-	1.4921	1.4921	-		-	1.7814	1.7814	-	
540																		
541																		
542																		
543		Pressure Washers		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted	
544			ROG	Grubbing/Lan(	Grading	Drainage	Paving	CO	Grubbing/L	Grading	Drainage	Paving	NOx	Grubbing/l	Grading	Drainage	Paving	PM10
549		2009	0.5144	-	-	-	-	1.3823	-	-	-	-	1.6710	-	-	-	-	0.1418
550		2010	0.4808	-	-	-	-	1.3475	-	-	-	-	1.6455	-	-	-	-	0.1350
551		2011	0.4447	-	-	-	-	1.3092	-	-	-	-	1.6181	-	-	-	-	0.1279
552		2012	0.4053	-	-	-	-	1.2667	-	-	-	-	1.5888	-	-	-	-	0.1201
553		2013	0.3656	-	-	-	-	1.2238	-	-	-	-	1.5235	-	-	-	-	0.1097
554		2014	0.3267	-	-	-	-	1.1826	-	-	-	-	1.4604	-	-	-	-	0.0995
555		2015	0.2914	-	-	-	-	1.1479	-	-	-	-	1.4047	-	-	-	-	0.0899
556		2016	0.2658	-	-	-	-	1.1268	-	-	-	-	1.3715	-	-	-	-	0.0833
557		2017	0.2398	-	0.2398	0.2398	-	1.1054	-	1.1054	1.1054	-	1.3379	-	1.3379	1.3379	-	0.0766
558		2018	0.2134	-	-	-	-	1.0838	-	-	-	-	1.3034	-	-	-	-	0.0697
559		2019	0.1873	-	-	-	-	1.0619	-	-	-	-	1.2676	-	-	-	-	0.0626
560		2020	0.1673	-	-	-	-	1.0452	-	-	-	-	1.2330	-	-	-	-	0.0561
561		2021	0.1356	-	-	-	-	1.0023	-	-	-	-	1.1446	-	-	-	-	0.0431
562		2022	0.1236	-	-	-	-	0.9916	-	-	-	-	1.1107	-	-	-	-	0.0375
563		2023	0.1131	-	-	-	-	0.9826	-	-	-	-	1.0788	-	-	-	-	0.0324
564		2024	0.1040	-	-	-	-	0.9751	-	-	-	-	1.0487	-	-	-	-	0.0283
565		2025	0.0961	-	-	-	-	0.9683	-	-	-	-	1.0190	-	-	-	-	0.0246
566				-	0.2398	0.2398	-		-	1.1054	1.1054	-		-	1.3379	1.3379	-	
567																		
568																		

	A	B	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF
5		Emissions (g/bhp-hr)	PM10	PM10	PM10	PM10		PM2.5	PM2.5	PM2.5	PM2.5		CO2	CO2	CO2	CO2
488																
489		Paving Equipment	Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted
490			Grubbing/Land Cl	Grading	Drainage	Paving	PM2.5	Grubbing/Land Clearing	Grading	Drainage	Paving	CO2	Grubbing/Land Clearin	Grading	Drainage	Paving
495		2009	-	-	-	-	0.0943	-	-	-	-	185.3197	-	-	-	-
496		2010	-	-	-	-	0.0963	-	-	-	-	185.3194	-	-	-	-
497		2011	-	-	-	-	0.0948	-	-	-	-	185.3374	-	-	-	-
498		2012	-	-	-	-	0.0948	-	-	-	-	185.2955	-	-	-	-
499		2013	-	-	-	-	0.0885	-	-	-	-	185.1341	-	-	-	-
500		2014	-	-	-	-	0.0813	-	-	-	-	185.1299	-	-	-	-
501		2015	-	-	-	-	0.0792	-	-	-	-	185.1621	-	-	-	-
502		2016	-	-	-	-	0.0701	-	-	-	-	185.2191	-	-	-	-
503		2017	-	0.0691	0.0691	-	0.0636	-	0.0636	0.0636	-	185.2843	-	185.2843	185.2843	-
504		2018	-	-	-	-	0.0507	-	-	-	-	185.2480	-	-	-	-
505		2019	-	-	-	-	0.0436	-	-	-	-	185.1983	-	-	-	-
506		2020	-	-	-	-	0.0417	-	-	-	-	185.1874	-	-	-	-
507		2021	-	-	-	-	0.0373	-	-	-	-	185.1534	-	-	-	-
508		2022	-	-	-	-	0.0330	-	-	-	-	185.1593	-	-	-	-
509		2023	-	-	-	-	0.0304	-	-	-	-	185.1587	-	-	-	-
510		2024	-	-	-	-	0.0282	-	-	-	-	185.1581	-	-	-	-
511		2025	-	-	-	-	0.0244	-	-	-	-	185.0884	-	-	-	-
512			-	0.0691	0.0691	-		-	0.0636	0.0636	-		-	185.2843	185.2843	-
513																
514																
515																
516		Plate Compactors	Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted
517			Grubbing/Land Cl	Grading	Drainage	Paving	PM2.5	Grubbing/Land Clearing	Grading	Drainage	Paving	CO2	Grubbing/Land Clearin	Grading	Drainage	Paving
522		2009	-	-	-	-	0.0925	-	-	-	-	244.3689	-	-	-	-
523		2010	-	-	-	-	0.0787	-	-	-	-	244.3689	-	-	-	-
524		2011	-	-	-	-	0.0681	-	-	-	-	244.3689	-	-	-	-
525		2012	-	-	-	-	0.0654	-	-	-	-	244.3690	-	-	-	-
526		2013	-	-	-	-	0.0642	-	-	-	-	244.3689	-	-	-	-
527		2014	-	-	-	-	0.0639	-	-	-	-	244.3690	-	-	-	-
528		2015	-	-	-	-	0.0638	-	-	-	-	244.3689	-	-	-	-
529		2016	-	-	-	-	0.0640	-	-	-	-	244.3688	-	-	-	-
530		2017	-	0.0696	0.0696	-	0.0640	-	0.0640	0.0640	-	244.3690	-	244.3690	244.3690	-
531		2018	-	-	-	-	0.0640	-	-	-	-	244.3689	-	-	-	-
532		2019	-	-	-	-	0.0640	-	-	-	-	244.3690	-	-	-	-
533		2020	-	-	-	-	0.0640	-	-	-	-	244.3690	-	-	-	-
534		2021	-	-	-	-	0.0640	-	-	-	-	244.3690	-	-	-	-
535		2022	-	-	-	-	0.0640	-	-	-	-	244.3691	-	-	-	-
536		2023	-	-	-	-	0.0640	-	-	-	-	244.3689	-	-	-	-
537		2024	-	-	-	-	0.0640	-	-	-	-	244.3689	-	-	-	-
538		2025	-	-	-	-	0.0640	-	-	-	-	244.3688	-	-	-	-
539			-	0.0696	0.0696	-		-	0.0640	0.0640	-		-	244.3690	244.3690	-
540																
541																
542																
543		Pressure Washers	Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted
544			Grubbing/Land Cl	Grading	Drainage	Paving	PM2.5	Grubbing/Land Clearing	Grading	Drainage	Paving	CO2	Grubbing/Land Clearin	Grading	Drainage	Paving
549		2009	-	-	-	-	0.1304	-	-	-	-	170.4900	-	-	-	-
550		2010	-	-	-	-	0.1242	-	-	-	-	170.4900	-	-	-	-
551		2011	-	-	-	-	0.1176	-	-	-	-	170.4899	-	-	-	-
552		2012	-	-	-	-	0.1105	-	-	-	-	170.4900	-	-	-	-
553		2013	-	-	-	-	0.1010	-	-	-	-	170.4900	-	-	-	-
554		2014	-	-	-	-	0.0916	-	-	-	-	170.4900	-	-	-	-
555		2015	-	-	-	-	0.0827	-	-	-	-	170.4899	-	-	-	-
556		2016	-	-	-	-	0.0767	-	-	-	-	170.4899	-	-	-	-
557		2017	-	0.0766	0.0766	-	0.0705	-	0.0705	0.0705	-	170.4900	-	170.4900	170.4900	-
558		2018	-	-	-	-	0.0641	-	-	-	-	170.4900	-	-	-	-
559		2019	-	-	-	-	0.0576	-	-	-	-	170.4900	-	-	-	-
560		2020	-	-	-	-	0.0516	-	-	-	-	170.4900	-	-	-	-
561		2021	-	-	-	-	0.0396	-	-	-	-	170.4901	-	-	-	-
562		2022	-	-	-	-	0.0345	-	-	-	-	170.4900	-	-	-	-
563		2023	-	-	-	-	0.0298	-	-	-	-	170.4900	-	-	-	-
564		2024	-	-	-	-	0.0260	-	-	-	-	170.4900	-	-	-	-
565		2025	-	-	-	-	0.0226	-	-	-	-	170.4899	-	-	-	-
566			-	0.0766	0.0766	-		-	0.0705	0.0705	-		-	170.4900	170.4900	-
567																
568																

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
5		Emissions (g/bhp-hr)		ROG	ROG	ROG	ROG		CO	CO	CO	CO		NOx	NOx	NOx	NOx	
569																		
570		Pumps		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted	
571			ROG	Grubbing/Lan	Grading	Drainage	Paving	CO	Grubbing/L	Grading	Drainage	Paving	NOx	Grubbing/l	Grading	Drainage	Paving	PM10
576		2009	0.8081	-	-	-	-	2.7822	-	-	-	-	5.1466	-	-	-	-	0.4106
577		2010	0.7614	-	-	-	-	2.7582	-	-	-	-	4.9074	-	-	-	-	0.3949
578		2011	0.7125	-	-	-	-	2.7329	-	-	-	-	4.6580	-	-	-	-	0.3784
579		2012	0.6592	-	-	-	-	2.7055	-	-	-	-	4.3784	-	-	-	-	0.3542
580		2013	0.6058	-	-	-	-	2.6786	-	-	-	-	4.1039	-	-	-	-	0.3266
581		2014	0.5533	-	-	-	-	2.6529	-	-	-	-	3.8588	-	-	-	-	0.2978
582		2015	0.5011	-	-	-	-	2.6287	-	-	-	-	3.5780	-	-	-	-	0.2688
583		2016	0.4637	-	-	-	-	2.6173	-	-	-	-	3.3884	-	-	-	-	0.2481
584		2017	0.4256	-	0.4256	0.4256	-	2.6059	-	2.6059	2.6059	-	3.1957	-	3.1957	3.1957	-	0.2266
585		2018	0.3871	-	-	-	-	2.5947	-	-	-	-	2.9995	-	-	-	-	0.2043
586		2019	0.3490	-	-	-	-	2.5835	-	-	-	-	2.8011	-	-	-	-	0.1816
587		2020	0.3198	-	-	-	-	2.5756	-	-	-	-	2.6159	-	-	-	-	0.1625
588		2021	0.2640	-	-	-	-	2.5278	-	-	-	-	2.2288	-	-	-	-	0.1259
589		2022	0.2456	-	-	-	-	2.5229	-	-	-	-	2.0675	-	-	-	-	0.1114
590		2023	0.2294	-	-	-	-	2.5195	-	-	-	-	1.9220	-	-	-	-	0.0980
591		2024	0.2151	-	-	-	-	2.5169	-	-	-	-	1.8043	-	-	-	-	0.0858
592		2025	0.2021	-	-	-	-	2.5146	-	-	-	-	1.7001	-	-	-	-	0.0741
593				-	0.4256	0.4256	-		-	2.6059	2.6059	-		-	3.1957	3.1957	-	
594																		
595																		
596																		
597		Rollers		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted	
598			ROG	Grubbing/Lan	Grading	Drainage	Paving	CO	Grubbing/L	Grading	Drainage	Paving	NOx	Grubbing/l	Grading	Drainage	Paving	PM10
603		2009	0.3258	-	-	-	-	1.0656	-	-	-	-	2.8286	-	-	-	-	0.2097
604		2010	0.3246	-	-	-	-	1.0657	-	-	-	-	2.8145	-	-	-	-	0.2102
605		2011	0.3050	-	-	-	-	1.0649	-	-	-	-	2.6766	-	-	-	-	0.2001
606		2012	0.3049	-	-	-	-	1.0647	-	-	-	-	2.6587	-	-	-	-	0.2003
607		2013	0.2883	-	-	-	-	1.0646	-	-	-	-	2.5325	-	-	-	-	0.1891
608		2014	0.2729	-	-	-	-	1.0638	-	-	-	-	2.3977	-	-	-	-	0.1785
609		2015	0.2683	-	-	-	-	1.0637	-	-	-	-	2.3531	-	-	-	-	0.1754
610		2016	0.2467	-	-	-	-	1.0637	-	-	-	-	2.1783	-	-	-	-	0.1604
611		2017	0.2277	-	0.2277	0.2277	-	1.0634	-	1.0634	1.0634	-	2.0304	-	2.0304	2.0304	-	0.1471
612		2018	0.1889	-	-	-	-	1.0633	-	-	-	-	1.7449	-	-	-	-	0.1201
613		2019	0.1659	-	-	-	-	1.0633	-	-	-	-	1.5681	-	-	-	-	0.1031
614		2020	0.1524	-	-	-	-	1.0634	-	-	-	-	1.4563	-	-	-	-	0.0928
615		2021	0.1388	-	-	-	-	1.0635	-	-	-	-	1.3466	-	-	-	-	0.0823
616		2022	0.1218	-	-	-	-	1.0636	-	-	-	-	1.2078	-	-	-	-	0.0696
617		2023	0.1126	-	-	-	-	1.0636	-	-	-	-	1.1267	-	-	-	-	0.0620
618		2024	0.1067	-	-	-	-	1.0638	-	-	-	-	1.0667	-	-	-	-	0.0565
619		2025	0.1003	-	-	-	-	1.0634	-	-	-	-	1.0098	-	-	-	-	0.0508
620				-	0.2277	0.2277	-		-	1.0634	1.0634	-		-	2.0304	2.0304	-	
621																		
622																		
623																		
624																		
625		Rough Terrain Forklifts		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted	
626			ROG	Grubbing/Lan	Grading	Drainage	Paving	CO	Grubbing/L	Grading	Drainage	Paving	NOx	Grubbing/l	Grading	Drainage	Paving	PM10
631		2009	0.2263	-	-	-	-	1.1458	-	-	-	-	2.4140	-	-	-	-	0.1600
632		2010	0.2149	-	-	-	-	1.1456	-	-	-	-	2.3359	-	-	-	-	0.1550
633		2011	0.1941	-	-	-	-	1.1452	-	-	-	-	2.1857	-	-	-	-	0.1415
634		2012	0.1875	-	-	-	-	1.1450	-	-	-	-	2.1270	-	-	-	-	0.1365
635		2013	0.1661	-	-	-	-	1.1447	-	-	-	-	1.9792	-	-	-	-	0.1201
636		2014	0.1476	-	-	-	-	1.1447	-	-	-	-	1.7958	-	-	-	-	0.1049
637		2015	0.1421	-	-	-	-	1.1449	-	-	-	-	1.7206	-	-	-	-	0.0995
638		2016	0.1269	-	-	-	-	1.1454	-	-	-	-	1.5437	-	-	-	-	0.0857
639		2017	0.1140	-	0.1140	0.1140	-	1.1454	-	1.1454	1.1454	-	1.3739	-	1.3739	1.3739	-	0.0730
640		2018	0.0935	-	-	-	-	1.1452	-	-	-	-	1.1437	-	-	-	-	0.0547
641		2019	0.0849	-	-	-	-	1.1451	-	-	-	-	1.0541	-	-	-	-	0.0470
642		2020	0.0796	-	-	-	-	1.1456	-	-	-	-	0.9858	-	-	-	-	0.0412
643		2021	0.0735	-	-	-	-	1.1459	-	-	-	-	0.9187	-	-	-	-	0.0356
644		2022	0.0667	-	-	-	-	1.1458	-	-	-	-	0.8435	-	-	-	-	0.0294
645		2023	0.0631	-	-	-	-	1.1460	-	-	-	-	0.7974	-	-	-	-	0.0256
646		2024	0.0611	-	-	-	-	1.1458	-	-	-	-	0.7694	-	-	-	-	0.0234
647		2025	0.0578	-	-	-	-	1.1457	-	-	-	-	0.7319	-	-	-	-	0.0206
648				-	0.1140	0.1140	-		-	1.1454	1.1454	-		-	1.3739	1.3739	-	
649																		
650																		

	A	B	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF
5		Emissions (g/bhp-hr)	PM10	PM10	PM10	PM10		PM2.5	PM2.5	PM2.5	PM2.5		CO2	CO2	CO2	CO2
569																
570		Pumps	Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted
571			Grubbing/Land Cl	Grading	Drainage	Paving	PM2.5	Grubbing/Land Clearing	Grading	Drainage	Paving	CO2	Grubbing/Land Clearin	Grading	Drainage	Paving
576		2009	-	-	-	-	0.3778	-	-	-	-	420.5418	-	-	-	-
577		2010	-	-	-	-	0.3633	-	-	-	-	420.5419	-	-	-	-
578		2011	-	-	-	-	0.3481	-	-	-	-	420.5419	-	-	-	-
579		2012	-	-	-	-	0.3259	-	-	-	-	420.5419	-	-	-	-
580		2013	-	-	-	-	0.3005	-	-	-	-	420.5421	-	-	-	-
581		2014	-	-	-	-	0.2740	-	-	-	-	420.5420	-	-	-	-
582		2015	-	-	-	-	0.2473	-	-	-	-	420.5422	-	-	-	-
583		2016	-	-	-	-	0.2283	-	-	-	-	420.5419	-	-	-	-
584		2017	-	0.2266	0.2266	-	0.2085	-	0.2085	0.2085	-	420.5418	-	420.5418	420.5418	-
585		2018	-	-	-	-	0.1880	-	-	-	-	420.5418	-	-	-	-
586		2019	-	-	-	-	0.1670	-	-	-	-	420.5420	-	-	-	-
587		2020	-	-	-	-	0.1495	-	-	-	-	420.5418	-	-	-	-
588		2021	-	-	-	-	0.1159	-	-	-	-	420.5420	-	-	-	-
589		2022	-	-	-	-	0.1025	-	-	-	-	420.5419	-	-	-	-
590		2023	-	-	-	-	0.0902	-	-	-	-	420.5418	-	-	-	-
591		2024	-	-	-	-	0.0789	-	-	-	-	420.5421	-	-	-	-
592		2025	-	-	-	-	0.0682	-	-	-	-	420.5418	-	-	-	-
593			-	0.2266	0.2266	-		-	0.2085	0.2085	-		-	420.5418	420.5418	-
594																
595																
596																
597		Rollers	Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted
598			Grubbing/Land Cl	Grading	Drainage	Paving	PM2.5	Grubbing/Land Clearing	Grading	Drainage	Paving	CO2	Grubbing/Land Clearin	Grading	Drainage	Paving
603		2009	-	-	-	-	0.1929	-	-	-	-	197.3765	-	-	-	-
604		2010	-	-	-	-	0.1934	-	-	-	-	197.3860	-	-	-	-
605		2011	-	-	-	-	0.1841	-	-	-	-	197.2474	-	-	-	-
606		2012	-	-	-	-	0.1842	-	-	-	-	197.2120	-	-	-	-
607		2013	-	-	-	-	0.1739	-	-	-	-	197.1838	-	-	-	-
608		2014	-	-	-	-	0.1643	-	-	-	-	197.0340	-	-	-	-
609		2015	-	-	-	-	0.1613	-	-	-	-	197.0284	-	-	-	-
610		2016	-	-	-	-	0.1476	-	-	-	-	197.0130	-	-	-	-
611		2017	-	0.1471	0.1471	-	0.1353	-	0.1353	0.1353	-	196.9552	-	196.9552	196.9552	-
612		2018	-	-	-	-	0.1105	-	-	-	-	196.9378	-	-	-	-
613		2019	-	-	-	-	0.0948	-	-	-	-	196.9463	-	-	-	-
614		2020	-	-	-	-	0.0854	-	-	-	-	196.9680	-	-	-	-
615		2021	-	-	-	-	0.0757	-	-	-	-	196.9854	-	-	-	-
616		2022	-	-	-	-	0.0640	-	-	-	-	196.9970	-	-	-	-
617		2023	-	-	-	-	0.0570	-	-	-	-	197.0000	-	-	-	-
618		2024	-	-	-	-	0.0519	-	-	-	-	197.0295	-	-	-	-
619		2025	-	-	-	-	0.0467	-	-	-	-	196.9645	-	-	-	-
620			-	0.1471	0.1471	-		-	0.1353	0.1353	-		-	196.9552	196.9552	-
621																
622																
623																
624																
625		Rough Terrain Forklifts	Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted
626			Grubbing/Land Cl	Grading	Drainage	Paving	PM2.5	Grubbing/Land Clearing	Grading	Drainage	Paving	CO2	Grubbing/Land Clearin	Grading	Drainage	Paving
631		2009	-	-	-	-	0.1472	-	-	-	-	210.6925	-	-	-	-
632		2010	-	-	-	-	0.1426	-	-	-	-	210.6449	-	-	-	-
633		2011	-	-	-	-	0.1302	-	-	-	-	210.5776	-	-	-	-
634		2012	-	-	-	-	0.1256	-	-	-	-	210.5344	-	-	-	-
635		2013	-	-	-	-	0.1105	-	-	-	-	210.4949	-	-	-	-
636		2014	-	-	-	-	0.0965	-	-	-	-	210.4867	-	-	-	-
637		2015	-	-	-	-	0.0915	-	-	-	-	210.5184	-	-	-	-
638		2016	-	-	-	-	0.0788	-	-	-	-	210.6149	-	-	-	-
639		2017	-	0.0730	0.0730	-	0.0672	-	0.0672	0.0672	-	210.6082	-	210.6082	210.6082	-
640		2018	-	-	-	-	0.0503	-	-	-	-	210.5757	-	-	-	-
641		2019	-	-	-	-	0.0432	-	-	-	-	210.5670	-	-	-	-
642		2020	-	-	-	-	0.0379	-	-	-	-	210.6474	-	-	-	-
643		2021	-	-	-	-	0.0327	-	-	-	-	210.7034	-	-	-	-
644		2022	-	-	-	-	0.0271	-	-	-	-	210.6941	-	-	-	-
645		2023	-	-	-	-	0.0236	-	-	-	-	210.7250	-	-	-	-
646		2024	-	-	-	-	0.0216	-	-	-	-	210.6825	-	-	-	-
647		2025	-	-	-	-	0.0189	-	-	-	-	210.6707	-	-	-	-
648			-	0.0730	0.0730	-		-	0.0672	0.0672	-		-	210.6082	210.6082	-
649																
650																

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
5		Emissions (g/bhp-hr)		ROG	ROG	ROG	ROG		CO	CO	CO	CO		NOx	NOx	NOx	NOx	
651																		
652																		
653		Rubber Tired Dozers		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted	
654			ROG	Grubbing/Lan(	Grading	Drainage	Paving	CO	Grubbing/L	Grading	Drainage	Paving	NOx	Grubbing/l	Grading	Drainage	Paving	PM10
659		2009	0.3098	-	-	-	-	0.9839	-	-	-	-	3.4941	-	-	-	-	0.1632
660		2010	0.3072	-	-	-	-	0.9829	-	-	-	-	3.4419	-	-	-	-	0.1606
661		2011	0.3054	-	-	-	-	0.9835	-	-	-	-	3.4012	-	-	-	-	0.1588
662		2012	0.3070	-	-	-	-	0.9833	-	-	-	-	3.3934	-	-	-	-	0.1587
663		2013	0.3004	-	-	-	-	0.9831	-	-	-	-	3.2954	-	-	-	-	0.1541
664		2014	0.2926	-	-	-	-	0.9821	-	-	-	-	3.1854	-	-	-	-	0.1485
665		2015	0.2928	-	-	-	-	0.9817	-	-	-	-	3.1614	-	-	-	-	0.1475
666		2016	0.2848	-	-	-	-	0.9807	-	-	-	-	3.0479	-	-	-	-	0.1418
667		2017	0.2738	-	0.2738	0.2738	-	0.9817	-	0.9817	0.9817	-	2.8989	-	2.8989	2.8989	-	0.1347
668		2018	0.2474	-	-	-	-	0.9823	-	-	-	-	2.5702	-	-	-	-	0.1187
669		2019	0.2367	-	-	-	-	0.9827	-	-	-	-	2.4285	-	-	-	-	0.1118
670		2020	0.2213	-	-	-	-	0.9828	-	-	-	-	2.2298	-	-	-	-	0.1024
671		2021	0.2037	-	-	-	-	0.9812	-	-	-	-	2.0085	-	-	-	-	0.0917
672		2022	0.1964	-	-	-	-	0.9819	-	-	-	-	1.9005	-	-	-	-	0.0869
673		2023	0.1848	-	-	-	-	0.9822	-	-	-	-	1.7426	-	-	-	-	0.0797
674		2024	0.1723	-	-	-	-	0.9820	-	-	-	-	1.5932	-	-	-	-	0.0721
675		2025	0.1518	-	-	-	-	0.9814	-	-	-	-	1.3320	-	-	-	-	0.0595
676				-	0.2738	0.2738	-		-	0.9817	0.9817	-		-	2.8989	2.8989	-	
677																		
678																		
679																		
680																		
681		Rubber Tired Loaders		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted	
682			ROG	Grubbing/Lan(	Grading	Drainage	Paving	CO	Grubbing/L	Grading	Drainage	Paving	NOx	Grubbing/l	Grading	Drainage	Paving	PM10
687		2009	0.1464	-	-	-	-	0.8859	-	-	-	-	2.1401	-	-	-	-	0.0708
688		2010	0.1514	-	-	-	-	0.8858	-	-	-	-	2.1514	-	-	-	-	0.0719
689		2011	0.1531	-	-	-	-	0.8857	-	-	-	-	2.1263	-	-	-	-	0.0713
690		2012	0.1566	-	-	-	-	0.8857	-	-	-	-	2.1194	-	-	-	-	0.0716
691		2013	0.1580	-	-	-	-	0.8856	-	-	-	-	2.0814	-	-	-	-	0.0710
692		2014	0.1540	-	-	-	-	0.8853	-	-	-	-	1.9882	-	-	-	-	0.0676
693		2015	0.1536	-	-	-	-	0.8852	-	-	-	-	1.9426	-	-	-	-	0.0663
694		2016	0.1489	-	-	-	-	0.8851	-	-	-	-	1.8506	-	-	-	-	0.0631
695		2017	0.1411	-	0.1411	0.1411	-	0.8853	-	0.8853	0.8853	-	1.7203	-	1.7203	1.7203	-	0.0586
696		2018	0.1263	-	-	-	-	0.8849	-	-	-	-	1.4947	-	-	-	-	0.0507
697		2019	0.1172	-	-	-	-	0.8850	-	-	-	-	1.3548	-	-	-	-	0.0454
698		2020	0.1099	-	-	-	-	0.8847	-	-	-	-	1.2378	-	-	-	-	0.0411
699		2021	0.1008	-	-	-	-	0.8848	-	-	-	-	1.0846	-	-	-	-	0.0362
700		2022	0.0856	-	-	-	-	0.8854	-	-	-	-	0.8491	-	-	-	-	0.0285
701		2023	0.0795	-	-	-	-	0.8853	-	-	-	-	0.7452	-	-	-	-	0.0250
702		2024	0.0746	-	-	-	-	0.8852	-	-	-	-	0.6534	-	-	-	-	0.0219
703		2025	0.0672	-	-	-	-	0.8854	-	-	-	-	0.5217	-	-	-	-	0.0175
704				-	0.1411	0.1411	-		-	0.8853	0.8853	-		-	1.7203	1.7203	-	
705																		
706																		
707																		
708																		
709		Scrapers		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted	
710			ROG	Grubbing/Lan(	Grading	Drainage	Paving	CO	Grubbing/L	Grading	Drainage	Paving	NOx	Grubbing/l	Grading	Drainage	Paving	PM10
715		2009	0.2490	-	-	-	-	1.1397	-	-	-	-	3.2550	-	-	-	-	0.1303
716		2010	0.2524	-	-	-	-	1.1396	-	-	-	-	3.2588	-	-	-	-	0.1312
717		2011	0.2505	-	-	-	-	1.1398	-	-	-	-	3.2064	-	-	-	-	0.1292
718		2012	0.2531	-	-	-	-	1.1399	-	-	-	-	3.2046	-	-	-	-	0.1296
719		2013	0.2506	-	-	-	-	1.1400	-	-	-	-	3.1439	-	-	-	-	0.1271
720		2014	0.2417	-	-	-	-	1.1398	-	-	-	-	3.0068	-	-	-	-	0.1213
721		2015	0.2384	-	-	-	-	1.1394	-	-	-	-	2.9358	-	-	-	-	0.1186
722		2016	0.2284	-	-	-	-	1.1387	-	-	-	-	2.7774	-	-	-	-	0.1119
723		2017	0.2146	-	0.2146	0.2146	-	1.1386	-	1.1386	1.1386	-	2.5758	-	2.5758	2.5758	-	0.1034
724		2018	0.1864	-	-	-	-	1.1390	-	-	-	-	2.2035	-	-	-	-	0.0868
725		2019	0.1731	-	-	-	-	1.1386	-	-	-	-	2.0051	-	-	-	-	0.0786
726		2020	0.1613	-	-	-	-	1.1385	-	-	-	-	1.8247	-	-	-	-	0.0712
727		2021	0.1510	-	-	-	-	1.1392	-	-	-	-	1.6618	-	-	-	-	0.0646
728		2022	0.1331	-	-	-	-	1.1410	-	-	-	-	1.3886	-	-	-	-	0.0542
729		2023	0.1279	-	-	-	-	1.1409	-	-	-	-	1.2861	-	-	-	-	0.0504
730		2024	0.1235	-	-	-	-	1.1401	-	-	-	-	1.1949	-	-	-	-	0.0472
731		2025	0.1092	-	-	-	-	1.1394	-	-	-	-	0.9892	-	-	-	-	0.0389
732				-	0.2146	0.2146	-		-	1.1386	1.1386	-		-	2.5758	2.5758	-	
733																		
734																		

	A	B	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF
5		Emissions (g/bhp-hr)	PM10	PM10	PM10	PM10		PM2.5	PM2.5	PM2.5	PM2.5		CO2	CO2	CO2	CO2
651																
652																
653		Rubber Tired Dozers	Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted
654			Grubbing/Land Cl	Grading	Drainage	Paving	PM2.5	Grubbing/Land Clearing	Grading	Drainage	Paving	CO2	Grubbing/Land Clearin	Grading	Drainage	Paving
659		2009	-	-	-	-	0.1501	-	-	-	-	210.3423	-	-	-	-
660		2010	-	-	-	-	0.1478	-	-	-	-	210.1359	-	-	-	-
661		2011	-	-	-	-	0.1461	-	-	-	-	210.2435	-	-	-	-
662		2012	-	-	-	-	0.1460	-	-	-	-	210.2060	-	-	-	-
663		2013	-	-	-	-	0.1418	-	-	-	-	210.1729	-	-	-	-
664		2014	-	-	-	-	0.1366	-	-	-	-	209.9459	-	-	-	-
665		2015	-	-	-	-	0.1357	-	-	-	-	209.8643	-	-	-	-
666		2016	-	-	-	-	0.1305	-	-	-	-	209.6553	-	-	-	-
667		2017	-	0.1347	0.1347	-	0.1239	-	0.1239	0.1239	-	209.8699	-	209.8699	209.8699	-
668		2018	-	-	-	-	0.1092	-	-	-	-	210.0065	-	-	-	-
669		2019	-	-	-	-	0.1029	-	-	-	-	210.0875	-	-	-	-
670		2020	-	-	-	-	0.0942	-	-	-	-	210.1026	-	-	-	-
671		2021	-	-	-	-	0.0844	-	-	-	-	209.7653	-	-	-	-
672		2022	-	-	-	-	0.0800	-	-	-	-	209.9072	-	-	-	-
673		2023	-	-	-	-	0.0733	-	-	-	-	209.9760	-	-	-	-
674		2024	-	-	-	-	0.0663	-	-	-	-	209.9436	-	-	-	-
675		2025	-	-	-	-	0.0548	-	-	-	-	209.8112	-	-	-	-
676			-	0.1347	0.1347	-		-	0.1239	0.1239	-		-	209.8699	209.8699	-
677																
678																
679																
680																
681		Rubber Tired Loaders	Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted
682			Grubbing/Land Cl	Grading	Drainage	Paving	PM2.5	Grubbing/Land Clearing	Grading	Drainage	Paving	CO2	Grubbing/Land Clearin	Grading	Drainage	Paving
687		2009	-	-	-	-	0.0651	-	-	-	-	188.4395	-	-	-	-
688		2010	-	-	-	-	0.0661	-	-	-	-	188.4326	-	-	-	-
689		2011	-	-	-	-	0.0656	-	-	-	-	188.4069	-	-	-	-
690		2012	-	-	-	-	0.0659	-	-	-	-	188.3991	-	-	-	-
691		2013	-	-	-	-	0.0653	-	-	-	-	188.3769	-	-	-	-
692		2014	-	-	-	-	0.0622	-	-	-	-	188.3234	-	-	-	-
693		2015	-	-	-	-	0.0610	-	-	-	-	188.2926	-	-	-	-
694		2016	-	-	-	-	0.0581	-	-	-	-	188.2780	-	-	-	-
695		2017	-	0.0586	0.0586	-	0.0539	-	0.0539	0.0539	-	188.3253	-	188.3253	188.3253	-
696		2018	-	-	-	-	0.0466	-	-	-	-	188.2416	-	-	-	-
697		2019	-	-	-	-	0.0418	-	-	-	-	188.2513	-	-	-	-
698		2020	-	-	-	-	0.0378	-	-	-	-	188.1912	-	-	-	-
699		2021	-	-	-	-	0.0333	-	-	-	-	188.2118	-	-	-	-
700		2022	-	-	-	-	0.0262	-	-	-	-	188.3480	-	-	-	-
701		2023	-	-	-	-	0.0230	-	-	-	-	188.3160	-	-	-	-
702		2024	-	-	-	-	0.0201	-	-	-	-	188.3013	-	-	-	-
703		2025	-	-	-	-	0.0161	-	-	-	-	188.3348	-	-	-	-
704			-	0.0586	0.0586	-		-	0.0539	0.0539	-		-	188.3253	188.3253	-
705																
706																
707																
708																
709		Scrapers	Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted
710			Grubbing/Land Cl	Grading	Drainage	Paving	PM2.5	Grubbing/Land Clearing	Grading	Drainage	Paving	CO2	Grubbing/Land Clearin	Grading	Drainage	Paving
715		2009	-	-	-	-	0.1198	-	-	-	-	252.6090	-	-	-	-
716		2010	-	-	-	-	0.1207	-	-	-	-	252.5928	-	-	-	-
717		2011	-	-	-	-	0.1189	-	-	-	-	252.6245	-	-	-	-
718		2012	-	-	-	-	0.1192	-	-	-	-	252.6648	-	-	-	-
719		2013	-	-	-	-	0.1170	-	-	-	-	252.6825	-	-	-	-
720		2014	-	-	-	-	0.1116	-	-	-	-	252.6332	-	-	-	-
721		2015	-	-	-	-	0.1091	-	-	-	-	252.5537	-	-	-	-
722		2016	-	-	-	-	0.1030	-	-	-	-	252.3812	-	-	-	-
723		2017	-	0.1034	0.1034	-	0.0951	-	0.0951	0.0951	-	252.3698	-	252.3698	252.3698	-
724		2018	-	-	-	-	0.0799	-	-	-	-	252.4658	-	-	-	-
725		2019	-	-	-	-	0.0723	-	-	-	-	252.3779	-	-	-	-
726		2020	-	-	-	-	0.0655	-	-	-	-	252.3444	-	-	-	-
727		2021	-	-	-	-	0.0595	-	-	-	-	252.4986	-	-	-	-
728		2022	-	-	-	-	0.0499	-	-	-	-	252.9084	-	-	-	-
729		2023	-	-	-	-	0.0464	-	-	-	-	252.8800	-	-	-	-
730		2024	-	-	-	-	0.0434	-	-	-	-	252.7027	-	-	-	-
731		2025	-	-	-	-	0.0358	-	-	-	-	252.5391	-	-	-	-
732			-	0.1034	0.1034	-		-	0.0951	0.0951	-		-	252.3698	252.3698	-
733																
734																

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
5		Emissions (g/bhp-hr)		ROG	ROG	ROG	ROG		CO	CO	CO	CO		NOx	NOx	NOx	NOx	
735																		
736																		
737		Signal Boards		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted	
738			ROG	Grubbing/Lan	Grading	Drainage	Paving	CO	Grubbing/L	Grading	Drainage	Paving	NOx	Grubbing/I	Grading	Drainage	Paving	PM10
743		2009	1.9377	-	-	-	-	4.7943	-	-	-	-	4.5821	-	-	-	-	0.4661
744		2010	1.8287	-	-	-	-	4.6872	-	-	-	-	4.5175	-	-	-	-	0.4457
745		2011	1.7007	-	-	-	-	4.5519	-	-	-	-	4.4445	-	-	-	-	0.4225
746		2012	1.5578	-	-	-	-	4.3950	-	-	-	-	4.3658	-	-	-	-	0.3969
747		2013	1.4124	-	-	-	-	4.2356	-	-	-	-	4.1837	-	-	-	-	0.3631
748		2014	1.2707	-	-	-	-	4.0833	-	-	-	-	4.0101	-	-	-	-	0.3300
749		2015	1.1427	-	-	-	-	3.9563	-	-	-	-	3.8569	-	-	-	-	0.2987
750		2016	1.0219	-	-	-	-	3.8421	-	-	-	-	3.7151	-	-	-	-	0.2686
751		2017	0.9050	-	0.9050	0.9050	-	3.7333	-	3.7333	3.7333	-	3.5801	-	3.5801	3.5801	-	0.2393
752		2018	0.7949	-	-	-	-	3.6330	-	-	-	-	3.4529	-	-	-	-	0.2111
753		2019	0.6926	-	-	-	-	3.5401	-	-	-	-	3.3321	-	-	-	-	0.1843
754		2020	0.6158	-	-	-	-	3.4698	-	-	-	-	3.2226	-	-	-	-	0.1607
755		2021	0.5583	-	-	-	-	3.4169	-	-	-	-	3.1215	-	-	-	-	0.1398
756		2022	0.5117	-	-	-	-	3.3747	-	-	-	-	3.0265	-	-	-	-	0.1206
757		2023	0.4713	-	-	-	-	3.3405	-	-	-	-	2.9382	-	-	-	-	0.1033
758		2024	0.4373	-	-	-	-	3.3133	-	-	-	-	2.8565	-	-	-	-	0.0893
759		2025	0.4077	-	-	-	-	3.2901	-	-	-	-	2.7778	-	-	-	-	0.0769
760				-	0.9050	0.9050	-		-	3.7333	3.7333	-		-	3.5801	3.5801	-	
761																		
762																		
763																		
764																		
765		Skid Steer Loaders		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted	
766			ROG	Grubbing/Lan	Grading	Drainage	Paving	CO	Grubbing/L	Grading	Drainage	Paving	NOx	Grubbing/I	Grading	Drainage	Paving	PM10
771		2009	0.1753	-	-	-	-	1.2361	-	-	-	-	1.9956	-	-	-	-	0.1323
772		2010	0.1636	-	-	-	-	1.2358	-	-	-	-	1.9140	-	-	-	-	0.1268
773		2011	0.1491	-	-	-	-	1.2351	-	-	-	-	1.7995	-	-	-	-	0.1166
774		2012	0.1437	-	-	-	-	1.2346	-	-	-	-	1.7448	-	-	-	-	0.1117
775		2013	0.1312	-	-	-	-	1.2339	-	-	-	-	1.6370	-	-	-	-	0.0999
776		2014	0.1173	-	-	-	-	1.2340	-	-	-	-	1.4789	-	-	-	-	0.0864
777		2015	0.1133	-	-	-	-	1.2335	-	-	-	-	1.4042	-	-	-	-	0.0811
778		2016	0.1053	-	-	-	-	1.2334	-	-	-	-	1.3024	-	-	-	-	0.0727
779		2017	0.0984	-	0.0984	0.0984	-	1.2331	-	1.2331	1.2331	-	1.2110	-	1.2110	1.2110	-	0.0651
780		2018	0.0832	-	-	-	-	1.2322	-	-	-	-	1.0539	-	-	-	-	0.0515
781		2019	0.0769	-	-	-	-	1.2326	-	-	-	-	0.9787	-	-	-	-	0.0448
782		2020	0.0727	-	-	-	-	1.2326	-	-	-	-	0.9229	-	-	-	-	0.0400
783		2021	0.0686	-	-	-	-	1.2328	-	-	-	-	0.8718	-	-	-	-	0.0355
784		2022	0.0633	-	-	-	-	1.2340	-	-	-	-	0.8067	-	-	-	-	0.0300
785		2023	0.0592	-	-	-	-	1.2346	-	-	-	-	0.7512	-	-	-	-	0.0254
786		2024	0.0567	-	-	-	-	1.2351	-	-	-	-	0.7180	-	-	-	-	0.0231
787		2025	0.0539	-	-	-	-	1.2345	-	-	-	-	0.6881	-	-	-	-	0.0209
788				-	0.0984	0.0984	-		-	1.2331	1.2331	-		-	1.2110	1.2110	-	
789																		
790																		
791																		
792																		
793		Surfacing Equipment		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted	
794			ROG	Grubbing/Lan	Grading	Drainage	Paving	CO	Grubbing/L	Grading	Drainage	Paving	NOx	Grubbing/I	Grading	Drainage	Paving	PM10
799		2009	0.0798	-	-	-	-	0.7479	-	-	-	-	1.3623	-	-	-	-	0.0446
800		2010	0.0791	-	-	-	-	0.7470	-	-	-	-	1.3365	-	-	-	-	0.0435
801		2011	0.0768	-	-	-	-	0.7452	-	-	-	-	1.2865	-	-	-	-	0.0410
802		2012	0.0769	-	-	-	-	0.7451	-	-	-	-	1.2672	-	-	-	-	0.0405
803		2013	0.0766	-	-	-	-	0.7447	-	-	-	-	1.2339	-	-	-	-	0.0396
804		2014	0.0748	-	-	-	-	0.7448	-	-	-	-	1.1744	-	-	-	-	0.0378
805		2015	0.0760	-	-	-	-	0.7448	-	-	-	-	1.1760	-	-	-	-	0.0381
806		2016	0.0685	-	-	-	-	0.7437	-	-	-	-	1.0456	-	-	-	-	0.0335
807		2017	0.0643	-	0.0643	0.0643	-	0.7471	-	0.7471	0.7471	-	0.9366	-	0.9366	0.9366	-	0.0309
808		2018	0.0497	-	-	-	-	0.7453	-	-	-	-	0.6645	-	-	-	-	0.0229
809		2019	0.0459	-	-	-	-	0.7482	-	-	-	-	0.5727	-	-	-	-	0.0205
810		2020	0.0459	-	-	-	-	0.7485	-	-	-	-	0.5540	-	-	-	-	0.0202
811		2021	0.0444	-	-	-	-	0.7487	-	-	-	-	0.5285	-	-	-	-	0.0191
812		2022	0.0417	-	-	-	-	0.7467	-	-	-	-	0.4695	-	-	-	-	0.0173
813		2023	0.0415	-	-	-	-	0.7465	-	-	-	-	0.4449	-	-	-	-	0.0168
814		2024	0.0422	-	-	-	-	0.7463	-	-	-	-	0.4455	-	-	-	-	0.0169
815		2025	0.0403	-	-	-	-	0.7464	-	-	-	-	0.4000	-	-	-	-	0.0154
816				-	0.0643	0.0643	-		-	0.7471	0.7471	-		-	0.9366	0.9366	-	
817																		
818																		

	A	B	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF
5		Emissions (g/bhp-hr)	PM10	PM10	PM10	PM10		PM2.5	PM2.5	PM2.5	PM2.5		CO2	CO2	CO2	CO2
735																
736																
737		Signal Boards	Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted
738			Grubbing/Land Cl	Grading	Drainage	Paving	PM2.5	Grubbing/Land Clearing	Grading	Drainage	Paving	CO2	Grubbing/Land Clearin	Grading	Drainage	Paving
743		2009	-	-	-	-	0.4288	-	-	-	-	443.2739	-	-	-	-
744		2010	-	-	-	-	0.4101	-	-	-	-	443.2738	-	-	-	-
745		2011	-	-	-	-	0.3887	-	-	-	-	443.2737	-	-	-	-
746		2012	-	-	-	-	0.3651	-	-	-	-	443.2739	-	-	-	-
747		2013	-	-	-	-	0.3341	-	-	-	-	443.2739	-	-	-	-
748		2014	-	-	-	-	0.3036	-	-	-	-	443.2739	-	-	-	-
749		2015	-	-	-	-	0.2748	-	-	-	-	443.2737	-	-	-	-
750		2016	-	-	-	-	0.2471	-	-	-	-	443.2738	-	-	-	-
751		2017	-	0.2393	0.2393	-	0.2201	-	0.2201	0.2201	-	443.2739	-	443.2739	443.2739	-
752		2018	-	-	-	-	0.1942	-	-	-	-	443.2739	-	-	-	-
753		2019	-	-	-	-	0.1695	-	-	-	-	443.2738	-	-	-	-
754		2020	-	-	-	-	0.1479	-	-	-	-	443.2737	-	-	-	-
755		2021	-	-	-	-	0.1286	-	-	-	-	443.2740	-	-	-	-
756		2022	-	-	-	-	0.1110	-	-	-	-	443.2738	-	-	-	-
757		2023	-	-	-	-	0.0950	-	-	-	-	443.2738	-	-	-	-
758		2024	-	-	-	-	0.0821	-	-	-	-	443.2740	-	-	-	-
759		2025	-	-	-	-	0.0707	-	-	-	-	443.2740	-	-	-	-
760			-	0.2393	0.2393	-		-	0.2201	0.2201	-		-	443.2739	443.2739	-
761																
762																
763																
764																
765		Skid Steer Loaders	Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted
766			Grubbing/Land Cl	Grading	Drainage	Paving	PM2.5	Grubbing/Land Clearing	Grading	Drainage	Paving	CO2	Grubbing/Land Clearin	Grading	Drainage	Paving
771		2009	-	-	-	-	0.1218	-	-	-	-	193.1900	-	-	-	-
772		2010	-	-	-	-	0.1167	-	-	-	-	193.1498	-	-	-	-
773		2011	-	-	-	-	0.1072	-	-	-	-	193.0446	-	-	-	-
774		2012	-	-	-	-	0.1028	-	-	-	-	192.9551	-	-	-	-
775		2013	-	-	-	-	0.0919	-	-	-	-	192.8545	-	-	-	-
776		2014	-	-	-	-	0.0795	-	-	-	-	192.8723	-	-	-	-
777		2015	-	-	-	-	0.0747	-	-	-	-	192.7902	-	-	-	-
778		2016	-	-	-	-	0.0669	-	-	-	-	192.7709	-	-	-	-
779		2017	-	0.0651	0.0651	-	0.0599	-	0.0599	0.0599	-	192.7316	-	192.7316	192.7316	-
780		2018	-	-	-	-	0.0474	-	-	-	-	192.5886	-	-	-	-
781		2019	-	-	-	-	0.0413	-	-	-	-	192.6499	-	-	-	-
782		2020	-	-	-	-	0.0368	-	-	-	-	192.6539	-	-	-	-
783		2021	-	-	-	-	0.0326	-	-	-	-	192.6824	-	-	-	-
784		2022	-	-	-	-	0.0276	-	-	-	-	192.8681	-	-	-	-
785		2023	-	-	-	-	0.0234	-	-	-	-	192.9595	-	-	-	-
786		2024	-	-	-	-	0.0212	-	-	-	-	193.0374	-	-	-	-
787		2025	-	-	-	-	0.0192	-	-	-	-	192.9486	-	-	-	-
788			-	0.0651	0.0651	-		-	0.0599	0.0599	-		-	192.7316	192.7316	-
789																
790																
791																
792																
793		Surfacing Equipment	Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted
794			Grubbing/Land Cl	Grading	Drainage	Paving	PM2.5	Grubbing/Land Clearing	Grading	Drainage	Paving	CO2	Grubbing/Land Clearin	Grading	Drainage	Paving
799		2009	-	-	-	-	0.0410	-	-	-	-	157.3969	-	-	-	-
800		2010	-	-	-	-	0.0400	-	-	-	-	157.2123	-	-	-	-
801		2011	-	-	-	-	0.0377	-	-	-	-	156.8394	-	-	-	-
802		2012	-	-	-	-	0.0373	-	-	-	-	156.8188	-	-	-	-
803		2013	-	-	-	-	0.0364	-	-	-	-	156.7303	-	-	-	-
804		2014	-	-	-	-	0.0348	-	-	-	-	156.7528	-	-	-	-
805		2015	-	-	-	-	0.0351	-	-	-	-	156.7519	-	-	-	-
806		2016	-	-	-	-	0.0308	-	-	-	-	156.5297	-	-	-	-
807		2017	-	0.0309	0.0309	-	0.0285	-	0.0285	0.0285	-	157.2336	-	157.2336	157.2336	-
808		2018	-	-	-	-	0.0211	-	-	-	-	156.8584	-	-	-	-
809		2019	-	-	-	-	0.0189	-	-	-	-	157.4632	-	-	-	-
810		2020	-	-	-	-	0.0185	-	-	-	-	157.5342	-	-	-	-
811		2021	-	-	-	-	0.0176	-	-	-	-	157.5728	-	-	-	-
812		2022	-	-	-	-	0.0159	-	-	-	-	157.1641	-	-	-	-
813		2023	-	-	-	-	0.0154	-	-	-	-	157.1139	-	-	-	-
814		2024	-	-	-	-	0.0155	-	-	-	-	157.0730	-	-	-	-
815		2025	-	-	-	-	0.0141	-	-	-	-	157.0832	-	-	-	-
816			-	0.0309	0.0309	-		-	0.0285	0.0285	-		-	157.2336	157.2336	-
817																
818																

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
5		Emissions (g/bhp-hr)		ROG	ROG	ROG	ROG		CO	CO	CO	CO		NOx	NOx	NOx	NOx	
819																		
820																		
821		Sweepers/Scrubbers		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted	
822			ROG	Grubbing/Lan(	Grading	Drainage	Paving	CO	Grubbing/L	Grading	Drainage	Paving	NOx	Grubbing/l	Grading	Drainage	Paving	PM10
827		2009	0.4311	-	-	-	-	1.3931	-	-	-	-	3.4829	-	-	-	-	0.2929
828		2010	0.4382	-	-	-	-	1.3931	-	-	-	-	3.5034	-	-	-	-	0.2993
829		2011	0.4287	-	-	-	-	1.3931	-	-	-	-	3.4168	-	-	-	-	0.2967
830		2012	0.4323	-	-	-	-	1.3931	-	-	-	-	3.4182	-	-	-	-	0.3000
831		2013	0.4085	-	-	-	-	1.3931	-	-	-	-	3.2565	-	-	-	-	0.2851
832		2014	0.3970	-	-	-	-	1.3931	-	-	-	-	3.1591	-	-	-	-	0.2781
833		2015	0.3974	-	-	-	-	1.3931	-	-	-	-	3.1374	-	-	-	-	0.2780
834		2016	0.3732	-	-	-	-	1.3931	-	-	-	-	2.9405	-	-	-	-	0.2600
835		2017	0.3436	-	0.3436	0.3436	-	1.3931	-	1.3931	1.3931	-	2.7428	-	2.7428	2.7428	-	0.2370
836		2018	0.2858	-	-	-	-	1.3931	-	-	-	-	2.3399	-	-	-	-	0.1951
837		2019	0.2621	-	-	-	-	1.3931	-	-	-	-	2.1744	-	-	-	-	0.1764
838		2020	0.2479	-	-	-	-	1.3931	-	-	-	-	2.0420	-	-	-	-	0.1640
839		2021	0.2099	-	-	-	-	1.3931	-	-	-	-	1.8051	-	-	-	-	0.1328
840		2022	0.1776	-	-	-	-	1.3931	-	-	-	-	1.5819	-	-	-	-	0.1057
841		2023	0.1672	-	-	-	-	1.3931	-	-	-	-	1.4968	-	-	-	-	0.0955
842		2024	0.1583	-	-	-	-	1.3931	-	-	-	-	1.4117	-	-	-	-	0.0859
843		2025	0.1445	-	-	-	-	1.3931	-	-	-	-	1.2836	-	-	-	-	0.0728
844				-	0.3436	0.3436	-		-	1.3931	1.3931	-		-	2.7428	2.7428	-	
845																		
846																		
847																		
848																		
849		Tractors/Loaders/Backhoes		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted	
850			ROG	Grubbing/Lan(	Grading	Drainage	Paving	CO	Grubbing/L	Grading	Drainage	Paving	NOx	Grubbing/l	Grading	Drainage	Paving	PM10
855		2009	0.1276	-	-	-	-	0.9084	-	-	-	-	1.2255	-	-	-	-	0.0775
856		2010	0.1141	-	-	-	-	0.9088	-	-	-	-	1.1037	-	-	-	-	0.0651
857		2011	0.1004	-	-	-	-	0.9099	-	-	-	-	0.9755	-	-	-	-	0.0525
858		2012	0.0922	-	-	-	-	0.9109	-	-	-	-	0.8940	-	-	-	-	0.0441
859		2013	0.2388	-	-	-	-	0.9155	-	-	-	-	2.1674	-	-	-	-	0.1726
860		2014	0.2245	-	-	-	-	0.9137	-	-	-	-	2.0565	-	-	-	-	0.1616
861		2015	0.2196	-	-	-	-	0.9130	-	-	-	-	1.9980	-	-	-	-	0.1564
862		2016	0.2075	-	-	-	-	0.9118	-	-	-	-	1.8950	-	-	-	-	0.1459
863		2017	0.1930	-	0.1930	0.1930	-	0.9107	-	0.9107	0.9107	-	1.7720	-	1.7720	1.7720	-	0.1333
864		2018	0.1621	-	-	-	-	0.9093	-	-	-	-	1.5309	-	-	-	-	0.1085
865		2019	0.1418	-	-	-	-	0.9087	-	-	-	-	1.3607	-	-	-	-	0.0908
866		2020	0.1276	-	-	-	-	0.9084	-	-	-	-	1.2255	-	-	-	-	0.0775
867		2021	0.1141	-	-	-	-	0.9088	-	-	-	-	1.1037	-	-	-	-	0.0651
868		2022	0.1004	-	-	-	-	0.9099	-	-	-	-	0.9755	-	-	-	-	0.0525
869		2023	0.0922	-	-	-	-	0.9109	-	-	-	-	0.8940	-	-	-	-	0.0441
870		2024	0.0877	-	-	-	-	0.9114	-	-	-	-	0.8431	-	-	-	-	0.0387
871		2025	0.0805	-	-	-	-	0.9123	-	-	-	-	0.7772	-	-	-	-	0.0315
872				-	0.1930	0.1930	-		-	0.9107	0.9107	-		-	1.7720	1.7720	-	
873																		
874																		
875																		
876																		
877		Trenchers		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted	
878			ROG	Grubbing/Lan(	Grading	Drainage	Paving	CO	Grubbing/L	Grading	Drainage	Paving	NOx	Grubbing/l	Grading	Drainage	Paving	PM10
883		2009	0.4913	-	-	-	-	1.4755	-	-	-	-	4.0635	-	-	-	-	0.3128
884		2010	0.4858	-	-	-	-	1.4755	-	-	-	-	4.0196	-	-	-	-	0.3117
885		2011	0.4619	-	-	-	-	1.4748	-	-	-	-	3.8566	-	-	-	-	0.3004
886		2012	0.4652	-	-	-	-	1.4747	-	-	-	-	3.8665	-	-	-	-	0.3034
887		2013	0.4468	-	-	-	-	1.4739	-	-	-	-	3.7438	-	-	-	-	0.2926
888		2014	0.4303	-	-	-	-	1.4738	-	-	-	-	3.6266	-	-	-	-	0.2829
889		2015	0.4297	-	-	-	-	1.4736	-	-	-	-	3.6072	-	-	-	-	0.2822
890		2016	0.4144	-	-	-	-	1.4730	-	-	-	-	3.4684	-	-	-	-	0.2720
891		2017	0.4005	-	0.4005	0.4005	-	1.4730	-	1.4730	1.4730	-	3.3561	-	3.3561	3.3561	-	0.2629
892		2018	0.3461	-	-	-	-	1.4720	-	-	-	-	2.9724	-	-	-	-	0.2261
893		2019	0.3321	-	-	-	-	1.4707	-	-	-	-	2.8618	-	-	-	-	0.2164
894		2020	0.3209	-	-	-	-	1.4717	-	-	-	-	2.7736	-	-	-	-	0.2077
895		2021	0.2924	-	-	-	-	1.4721	-	-	-	-	2.5657	-	-	-	-	0.1863
896		2022	0.2782	-	-	-	-	1.4723	-	-	-	-	2.4690	-	-	-	-	0.1749
897		2023	0.2651	-	-	-	-	1.4734	-	-	-	-	2.3620	-	-	-	-	0.1639
898		2024	0.2600	-	-	-	-	1.4732	-	-	-	-	2.3081	-	-	-	-	0.1597
899		2025	0.2401	-	-	-	-	1.4741	-	-	-	-	2.1502	-	-	-	-	0.1432
900				-	0.4005	0.4005	-		-	1.4730	1.4730	-		-	3.3561	3.3561	-	
901																		
902																		

	A	B	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF
5		Emissions (g/bhp-hr)	PM10	PM10	PM10	PM10		PM2.5	PM2.5	PM2.5	PM2.5		CO2	CO2	CO2	CO2
819																
820																
821		Sweepers/Scrubbers	Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted
822			Grubbing/Land Cl	Grading	Drainage	Paving	PM2.5	Grubbing/Land Clearing	Grading	Drainage	Paving	CO2	Grubbing/Land Clearin	Grading	Drainage	Paving
827		2009	-	-	-	-	0.2695	-	-	-	-	239.3048	-	-	-	-
828		2010	-	-	-	-	0.2754	-	-	-	-	239.3048	-	-	-	-
829		2011	-	-	-	-	0.2730	-	-	-	-	239.3048	-	-	-	-
830		2012	-	-	-	-	0.2760	-	-	-	-	239.3048	-	-	-	-
831		2013	-	-	-	-	0.2623	-	-	-	-	239.3048	-	-	-	-
832		2014	-	-	-	-	0.2558	-	-	-	-	239.3048	-	-	-	-
833		2015	-	-	-	-	0.2558	-	-	-	-	239.3048	-	-	-	-
834		2016	-	-	-	-	0.2392	-	-	-	-	239.3048	-	-	-	-
835		2017	-	0.2370	0.2370	-	0.2181	-	0.2181	0.2181	-	239.3048	-	239.3048	239.3048	-
836		2018	-	-	-	-	0.1795	-	-	-	-	239.3048	-	-	-	-
837		2019	-	-	-	-	0.1623	-	-	-	-	239.3048	-	-	-	-
838		2020	-	-	-	-	0.1509	-	-	-	-	239.3048	-	-	-	-
839		2021	-	-	-	-	0.1221	-	-	-	-	239.3048	-	-	-	-
840		2022	-	-	-	-	0.0973	-	-	-	-	239.3048	-	-	-	-
841		2023	-	-	-	-	0.0878	-	-	-	-	239.3048	-	-	-	-
842		2024	-	-	-	-	0.0790	-	-	-	-	239.3048	-	-	-	-
843		2025	-	-	-	-	0.0669	-	-	-	-	239.3048	-	-	-	-
844			-	0.2370	0.2370	-		-	0.2181	0.2181	-		-	239.3048	239.3048	-
845																
846																
847																
848																
849		Tractors/Loaders/Backhoes	Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted
850			Grubbing/Land Cl	Grading	Drainage	Paving	PM2.5	Grubbing/Land Clearing	Grading	Drainage	Paving	CO2	Grubbing/Land Clearin	Grading	Drainage	Paving
855		2009	-	-	-	-	0.0713	-	-	-	-	193.9794	-	-	-	-
856		2010	-	-	-	-	0.0599	-	-	-	-	194.0642	-	-	-	-
857		2011	-	-	-	-	0.0483	-	-	-	-	194.2828	-	-	-	-
858		2012	-	-	-	-	0.0406	-	-	-	-	194.5005	-	-	-	-
859		2013	-	-	-	-	0.1588	-	-	-	-	195.4806	-	-	-	-
860		2014	-	-	-	-	0.1486	-	-	-	-	195.0935	-	-	-	-
861		2015	-	-	-	-	0.1439	-	-	-	-	194.9647	-	-	-	-
862		2016	-	-	-	-	0.1342	-	-	-	-	194.6931	-	-	-	-
863		2017	-	0.1333	0.1333	-	0.1226	-	0.1226	0.1226	-	194.4603	-	194.4603	194.4603	-
864		2018	-	-	-	-	0.0998	-	-	-	-	194.1724	-	-	-	-
865		2019	-	-	-	-	0.0836	-	-	-	-	194.0359	-	-	-	-
866		2020	-	-	-	-	0.0713	-	-	-	-	193.9794	-	-	-	-
867		2021	-	-	-	-	0.0599	-	-	-	-	194.0642	-	-	-	-
868		2022	-	-	-	-	0.0483	-	-	-	-	194.2828	-	-	-	-
869		2023	-	-	-	-	0.0406	-	-	-	-	194.5005	-	-	-	-
870		2024	-	-	-	-	0.0356	-	-	-	-	194.6232	-	-	-	-
871		2025	-	-	-	-	0.0290	-	-	-	-	194.8096	-	-	-	-
872			-	0.1333	0.1333	-		-	0.1226	0.1226	-		-	194.4603	194.4603	-
873																
874																
875																
876																
877		Trenchers	Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted
878			Grubbing/Land Cl	Grading	Drainage	Paving	PM2.5	Grubbing/Land Clearing	Grading	Drainage	Paving	CO2	Grubbing/Land Clearin	Grading	Drainage	Paving
883		2009	-	-	-	-	0.2877	-	-	-	-	265.1861	-	-	-	-
884		2010	-	-	-	-	0.2868	-	-	-	-	265.1971	-	-	-	-
885		2011	-	-	-	-	0.2763	-	-	-	-	265.0645	-	-	-	-
886		2012	-	-	-	-	0.2792	-	-	-	-	265.0444	-	-	-	-
887		2013	-	-	-	-	0.2692	-	-	-	-	264.8988	-	-	-	-
888		2014	-	-	-	-	0.2602	-	-	-	-	264.8916	-	-	-	-
889		2015	-	-	-	-	0.2596	-	-	-	-	264.8488	-	-	-	-
890		2016	-	-	-	-	0.2503	-	-	-	-	264.7415	-	-	-	-
891		2017	-	0.2629	0.2629	-	0.2419	-	0.2419	0.2419	-	264.7493	-	264.7493	264.7493	-
892		2018	-	-	-	-	0.2080	-	-	-	-	264.5615	-	-	-	-
893		2019	-	-	-	-	0.1991	-	-	-	-	264.3268	-	-	-	-
894		2020	-	-	-	-	0.1910	-	-	-	-	264.5018	-	-	-	-
895		2021	-	-	-	-	0.1714	-	-	-	-	264.5912	-	-	-	-
896		2022	-	-	-	-	0.1609	-	-	-	-	264.6130	-	-	-	-
897		2023	-	-	-	-	0.1508	-	-	-	-	264.8157	-	-	-	-
898		2024	-	-	-	-	0.1469	-	-	-	-	264.7835	-	-	-	-
899		2025	-	-	-	-	0.1318	-	-	-	-	264.9332	-	-	-	-
900			-	0.2629	0.2629	-		-	0.2419	0.2419	-		-	264.7493	264.7493	-
901																
902																

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
5		Emissions (g/bhp-hr)		ROG	ROG	ROG	ROG		CO	CO	CO	CO		NOx	NOx	NOx	NOx	
903																		
904																		
905		Welders		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted	
906			ROG	Grubbing/Lan	Grading	Drainage	Paving	CO	Grubbing/L	Grading	Drainage	Paving	NOx	Grubbing/l	Grading	Drainage	Paving	PM10
911		2009	1.2418	-	-	-	-	2.9918	-	-	-	-	2.7010	-	-	-	-	0.2892
912		2010	1.1798	-	-	-	-	2.9326	-	-	-	-	2.6654	-	-	-	-	0.2780
913		2011	1.1080	-	-	-	-	2.8591	-	-	-	-	2.6259	-	-	-	-	0.2654
914		2012	1.0245	-	-	-	-	2.7688	-	-	-	-	2.5818	-	-	-	-	0.2508
915		2013	0.9370	-	-	-	-	2.6734	-	-	-	-	2.4825	-	-	-	-	0.2316
916		2014	0.8488	-	-	-	-	2.5785	-	-	-	-	2.3858	-	-	-	-	0.2121
917		2015	0.7675	-	-	-	-	2.4972	-	-	-	-	2.2994	-	-	-	-	0.1933
918		2016	0.7108	-	-	-	-	2.4613	-	-	-	-	2.2523	-	-	-	-	0.1808
919		2017	0.6511	-	0.6511	0.6511	-	2.4224	-	2.4224	2.4224	-	2.2039	-	2.2039	2.2039	-	0.1676
920		2018	0.5887	-	-	-	-	2.3800	-	-	-	-	2.1532	-	-	-	-	0.1536
921		2019	0.5248	-	-	-	-	2.3340	-	-	-	-	2.0994	-	-	-	-	0.1387
922		2020	0.4752	-	-	-	-	2.2978	-	-	-	-	2.0467	-	-	-	-	0.1249
923		2021	0.3829	-	-	-	-	2.1276	-	-	-	-	1.8856	-	-	-	-	0.0961
924		2022	0.3517	-	-	-	-	2.1024	-	-	-	-	1.8312	-	-	-	-	0.0839
925		2023	0.3247	-	-	-	-	2.0829	-	-	-	-	1.7800	-	-	-	-	0.0727
926		2024	0.3018	-	-	-	-	2.0678	-	-	-	-	1.7314	-	-	-	-	0.0636
927		2025	0.2818	-	-	-	-	2.0545	-	-	-	-	1.6828	-	-	-	-	0.0553
928				-	0.6511	0.6511	-		-	2.4224	2.4224	-		-	2.2039	2.2039	-	
929																		

	A	B	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF
5		Emissions (g/bhp-hr)	PM10	PM10	PM10	PM10		PM2.5	PM2.5	PM2.5	PM2.5		CO2	CO2	CO2	CO2
903																
904																
905		Welders	Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted		Weighted	Weighted	Weighted	Weighted
906			Grubbing/Land Cl	Grading	Drainage	Paving	PM2.5	Grubbing/Land Clearing	Grading	Drainage	Paving	CO2	Grubbing/Land Clearin	Grading	Drainage	Paving
911		2009	-	-	-	-	0.2661	-	-	-	-	255.7350	-	-	-	-
912		2010	-	-	-	-	0.2557	-	-	-	-	255.7350	-	-	-	-
913		2011	-	-	-	-	0.2442	-	-	-	-	255.7349	-	-	-	-
914		2012	-	-	-	-	0.2308	-	-	-	-	255.7350	-	-	-	-
915		2013	-	-	-	-	0.2130	-	-	-	-	255.7349	-	-	-	-
916		2014	-	-	-	-	0.1951	-	-	-	-	255.7350	-	-	-	-
917		2015	-	-	-	-	0.1778	-	-	-	-	255.7350	-	-	-	-
918		2016	-	-	-	-	0.1664	-	-	-	-	255.7349	-	-	-	-
919		2017	-	0.1676	0.1676	-	0.1542	-	0.1542	0.1542	-	255.7349	-	255.7349	255.7349	-
920		2018	-	-	-	-	0.1413	-	-	-	-	255.7350	-	-	-	-
921		2019	-	-	-	-	0.1276	-	-	-	-	255.7350	-	-	-	-
922		2020	-	-	-	-	0.1149	-	-	-	-	255.7350	-	-	-	-
923		2021	-	-	-	-	0.0885	-	-	-	-	255.7350	-	-	-	-
924		2022	-	-	-	-	0.0772	-	-	-	-	255.7349	-	-	-	-
925		2023	-	-	-	-	0.0669	-	-	-	-	255.7349	-	-	-	-
926		2024	-	-	-	-	0.0585	-	-	-	-	255.7349	-	-	-	-
927		2025	-	-	-	-	0.0509	-	-	-	-	255.7350	-	-	-	-
928			-	0.1676	0.1676	-		-	0.1542	0.1542	-		-	255.7349	255.7349	-
929																

From OFFROAD2008: EQUIP.CSV

Updated with ARB's 2011 Inventory Model for In-Use Off-Road Equipment
Categories not updated in Off-Road2011 remained from Off-Road2007

Equipment	Fuel	HP	Life	Pop	Base	Avg HP	Load	Total HP	Avg HP by Equipment Type
Aerial Lifts	D	50	16	100	2010	46	0.3082	4614.596	
Aerial Lifts	D	120	16	121	2010	74	0.3082	8973.642	
Aerial Lifts	D	175	16	4	2010	130	0.3082	548.411	
Aerial Lifts	D	250	16	0	2010	210	0.3082	19.83574	
Aerial Lifts	D	500	16	0	2010	380	0.3082	35.89325	62.9
Air Compressors	D	15	16	52	2000	12	0.48	624	
Air Compressors	D	25	16	103	2000	24	0.48	2472	
Air Compressors	D	50	16	936	2000	37	0.48	34632	
Air Compressors	D	120	16	6234	2000	78	0.48	486252	
Air Compressors	D	175	16	236	2000	147	0.48	34692	
Air Compressors	D	250	16	332	2000	218	0.48	72376	
Air Compressors	D	500	16	433	2000	385	0.48	166705	
Air Compressors	D	750	16	162	2000	595	0.48	96390	
Air Compressors	D	1000	16	4	2000	808	0.48	3232	105.7
Bore/Drill Rigs	D	50	10	7	2000	39	0.5025	289.4177	
Bore/Drill Rigs	D	120	10	23	2000	82	0.5025	1858.448	
Bore/Drill Rigs	D	175	10	18	2000	149	0.5025	2627.022	
Bore/Drill Rigs	D	250	10	18	2000	208	0.5025	3658.252	
Bore/Drill Rigs	D	500	10	12	2000	349	0.5025	4306.746	
Bore/Drill Rigs	D	750	10	6	2000	612	0.5025	3750.174	
Bore/Drill Rigs	D	1000	10	0	2000	919	0.5025	213.8634	
Bore/Drill Rigs	D	9999	10	0	2000	2667	0.5025	620.5686	205.8
Cement and Mortar Mixers	D	15	7	511	2000	9	0.56	4599	
Cement and Mortar Mixers	D	25	14	46	2000	25	0.56	1150	10.3
Concrete/Industrial Saws	D	25	5	4	2000	18	0.73	72	
Concrete/Industrial Saws	D	50	16	35	2000	33	0.73	1155	
Concrete/Industrial Saws	D	120	16	61	2000	81	0.73	4941	
Concrete/Industrial Saws	D	175	16	2	2000	175	0.73	350	63.9
Cranes	D	50	19	3	2010	41	0.2881	138.6843	
Cranes	D	120	19	41	2010	89	0.2881	3660.701	
Cranes	D	175	19	62	2010	148	0.2881	9129.662	
Cranes	D	250	19	69	2010	217	0.2881	15047.25	
Cranes	D	500	19	67	2010	336	0.2881	22355.78	
Cranes	D	750	19	10	2010	567	0.2881	5531.672	
Cranes	D	1000	19	1	2010	938	0.2881	1371.629	
Cranes	D	9999	19	0	2010	1030	0.2881	100.4535	226.2
Crawler Tractors	D	50	29	9	2010	43	0.4288	367.9703	
Crawler Tractors	D	120	29	149	2010	87	0.4288	12939.21	
Crawler Tractors	D	175	29	97	2010	150	0.4288	14575.55	
Crawler Tractors	D	250	29	71	2010	203	0.4288	14450.64	
Crawler Tractors	D	500	29	115	2010	341	0.4288	39016.1	
Crawler Tractors	D	750	29	23	2010	570	0.4288	13373.74	
Crawler Tractors	D	1000	29	2	2010	828	0.4288	1720.484	
Crawler Tractors	D	9999	29	1	2010	1527	0.4288	792.811	208.3
Crushing/Proc. Equipment	D	50	16	160	2000	45	0.78	7200	
Crushing/Proc. Equipment	D	120	16	451	2000	85	0.78	38335	
Crushing/Proc. Equipment	D	175	16	191	2000	171	0.78	32661	
Crushing/Proc. Equipment	D	250	16	19	2000	250	0.78	4750	
Crushing/Proc. Equipment	D	500	16	107	2000	382	0.78	40874	
Crushing/Proc. Equipment	D	750	16	5	2000	602	0.78	3010	
Crushing/Proc. Equipment	D	9999	16	5	2000	1337	0.78	6685	142.3
Excavators	D	50	17	212	2010	36	0.3819	7576.74	
Excavators	D	120	17	153	2010	82	0.3819	12539.96	
Excavators	D	175	17	195	2010	146	0.3819	28452.26	
Excavators	D	250	17	167	2010	218	0.3819	36591.6	
Excavators	D	500	17	170	2010	329	0.3819	55985.07	
Excavators	D	750	17	9	2010	578	0.3819	5015.463	
Excavators	D	1000	17	1	2010	843	0.3819	585.1692	
Excavators	D	9999	17	1	2010	1569	0.3819	953.2106	162.7
Forklifts	D	50	12	46	2010	42	0.201	1967.167	
Forklifts	D	120	12	310	2010	82	0.201	25509.73	
Forklifts	D	175	12	57	2010	141	0.201	8118.648	
Forklifts	D	250	12	8	2010	208	0.201	1715.579	
Forklifts	D	500	12	1	2010	344	0.201	513.8725	
Forklifts	D	1000	12	0	2010	880	0.201	33.73426	89.4
Generator Sets	D	15	16	5086	2000	11	0.74	55946	
Generator Sets	D	25	16	3720	2000	19	0.74	70680	

Equipment	Fuel	HP	Life	Pop	Base	Avg HP	Load	Total HP	Avg HP by Equipment Type
Generator Sets	D	50	16	4543	2000	33	0.74	149919	
Generator Sets	D	120	16	6903	2000	84	0.74	579852	
Generator Sets	D	175	16	408	2000	153	0.74	62424	
Generator Sets	D	250	16	228	2000	229	0.74	52212	
Generator Sets	D	500	16	507	2000	363	0.74	184041	
Generator Sets	D	750	16	315	2000	586	0.74	184590	
Generator Sets	D	9999	16	82	2000	1130	0.74	92660	65.7
Graders	D	50	23	3	2010	39	0.4087	105.8898	
Graders	D	120	23	29	2010	91	0.4087	2619.246	
Graders	D	175	23	135	2010	148	0.4087	19924.55	
Graders	D	250	23	107	2010	204	0.4087	21852.81	
Graders	D	500	23	20	2010	293	0.4087	5855.863	
Graders	D	1000	23	0	2010	796	0.4087	69.43021	
Graders	D	9999	23	0	2010	1993	0.4087	869.0988	174.7
Off-Highway Tractors	D	50	31	81	2010	38	0.4355	3058.346	
Off-Highway Tractors	D	120	31	59	2010	75	0.4355	4400.544	
Off-Highway Tractors	D	175	31	22	2010	158	0.4355	3544.053	
Off-Highway Tractors	D	250	31	15	2010	214	0.4355	3129.114	
Off-Highway Tractors	D	500	31	25	2010	334	0.4355	8413.79	
Off-Highway Tractors	D	750	31	4	2010	574	0.4355	2110.379	
Off-Highway Tractors	D	1000	31	0	2010	1000	0.4355	85.57209	
Off-Highway Tractors	D	9999	31	0	2010	1726	0.4355	590.8752	122.6
Off-Highway Trucks	D	50	17	5	2010	29	0.3819	140.8353	
Off-Highway Trucks	D	120	17	3	2010	87	0.3819	236.2235	
Off-Highway Trucks	D	175	17	26	2010	159	0.3819	4122.464	
Off-Highway Trucks	D	250	17	44	2010	211	0.3819	9375.342	
Off-Highway Trucks	D	500	17	99	2010	372	0.3819	36755.73	
Off-Highway Trucks	D	750	17	23	2010	656	0.3819	14793.56	
Off-Highway Trucks	D	1000	17	10	2010	897	0.3819	9281.226	
Off-Highway Trucks	D	9999	17	7	2010	1764	0.3819	11817.19	400.2
Other Construction Equipment	D	50	16	63	2010	38	0.4154	2383.482	
Other Construction Equipment	D	120	16	111	2010	82	0.4154	9025.141	
Other Construction Equipment	D	175	16	34	2010	152	0.4154	5251.274	
Other Construction Equipment	D	250	16	31	2010	217	0.4154	6700.573	
Other Construction Equipment	D	500	16	60	2010	357	0.4154	21415.72	
Other Construction Equipment	D	750	16	12	2010	598	0.4154	7415.559	
Other Construction Equipment	D	1000	16	1	2010	830	0.4154	910.887	
Other Construction Equipment	D	9999	16	1	2010	1127	0.4154	570.5704	171.6
Other General Industrial Equipmen	D	50	16	62	2010	35	0.3417	2172.079	
Other General Industrial Equipmen	D	120	16	27	2010	73	0.3417	1987.832	
Other General Industrial Equipmen	D	175	16	6	2010	149	0.3417	890.0775	
Other General Industrial Equipmen	D	250	16	4	2010	209	0.3417	843.524	
Other General Industrial Equipmen	D	500	16	7	2010	355	0.3417	2501.616	
Other General Industrial Equipmen	D	750	16	2	2010	592	0.3417	922.6276	
Other General Industrial Equipmen	D	1000	16	0	2010	885	0.3417	90.02155	
Other General Industrial Equipmen	D	9999	16	0	2010	2000	0.3417	67.81284	87.9
Other Material Handling Equipment	D	50	16	3	2010	36	0.3953	98.19676	
Other Material Handling Equipment	D	120	16	14	2010	93	0.3953	1286.811	
Other Material Handling Equipment	D	175	16	5	2010	145	0.3953	738.3328	
Other Material Handling Equipment	D	250	16	4	2010	218	0.3953	886.7887	
Other Material Handling Equipment	D	500	16	6	2010	331	0.3953	2025.685	
Other Material Handling Equipment	D	750	16	0	2010	565	0.3953	262.1289	
Other Material Handling Equipment	D	1000	16	0	2010	923	0.3953	35.71143	
Other Material Handling Equipment	D	9999	16	0	2010	1050	0.3953	81.25027	167.0
Pavers	D	50	26	10	2010	39	0.4154	392.6077	
Pavers	D	120	26	49	2010	80	0.4154	3930.058	
Pavers	D	175	26	33	2010	158	0.4154	5277.545	
Pavers	D	250	26	14	2010	213	0.4154	3070.218	
Pavers	D	500	26	4	2010	327	0.4154	1164.694	
Pavers	D	750	26	0	2010	750	0.4154	127.0575	125.7
Paving Equipment	D	50	24	13	2010	35	0.3551	435.783	
Paving Equipment	D	120	24	26	2010	89	0.3551	2262.807	
Paving Equipment	D	175	24	14	2010	148	0.3551	2070.836	
Paving Equipment	D	250	24	5	2010	216	0.3551	1094.32	
Paving Equipment	D	500	24	5	2010	339	0.3551	1547.017	
Paving Equipment	D	750	24	1	2010	605	0.3551	665.1335	
Paving Equipment	D	1000	24	0	2010	842	0.3551	142.4138	130.6
Plate Compactors	D	15	4	322	2000	8	0.43	2576	8.0
Pressure Washers	D	15	16	236	2000	13	0.3	3068	

Equipment	Fuel	HP	Life	Pop	Base	Avg HP	Load	Total HP	Avg HP by Equipment Type
Pressure Washers	D	25	16	55	2000	19	0.3	1045	
Pressure Washers	D	50	16	109	2000	38	0.3	4142	
Pressure Washers	D	120	16	45	2000	64	0.3	2880	
Pressure Washers	D	175	16	3	2000	152	0.6	456	
Pressure Washers	D	250	3	1	2000	191	0.6	191	26.2
Pumps	D	15	16	3820	2000	8	0.74	30560	
Pumps	D	25	16	1141	2000	21	0.74	23961	
Pumps	D	50	16	1989	2000	37	0.74	73593	
Pumps	D	120	16	3900	2000	84	0.74	327600	
Pumps	D	175	16	422	2000	151	0.74	63722	
Pumps	D	250	16	304	2000	217	0.74	65968	
Pumps	D	500	16	6	2000	372	0.74	2232	
Pumps	D	750	16	1	2000	615	0.74	615	
Pumps	D	9999	16	22	2000	1460	0.74	32120	53.5
Rollers	D	50	20	257	2010	36	0.3752	9162.281	
Rollers	D	120	20	192	2010	87	0.3752	16635.08	
Rollers	D	175	20	111	2010	144	0.3752	15920.48	
Rollers	D	250	20	14	2010	213	0.3752	2895.922	
Rollers	D	500	20	6	2010	335	0.3752	1865.675	
Rollers	D	750	20	0	2010	521	0.3752	90.61998	80.5
Rough Terrain Forklifts	D	50	16	12	2010	47	0.402	551.5141	
Rough Terrain Forklifts	D	120	16	500	2010	96	0.402	48137.78	
Rough Terrain Forklifts	D	175	16	67	2010	130	0.402	8665.157	
Rough Terrain Forklifts	D	250	16	4	2010	208	0.402	816.8643	
Rough Terrain Forklifts	D	500	16	1	2010	374	0.402	338.3491	
Rough Terrain Forklifts	D	750	16	0	2010	625	0.402	62.84345	100.4
Rubber Tired Dozers	D	50	32	3	2010	42	0.3953	141.3369	
Rubber Tired Dozers	D	120	32	10	2010	82	0.3953	825.1424	
Rubber Tired Dozers	D	175	32	5	2010	150	0.3953	781.7052	
Rubber Tired Dozers	D	250	32	4	2010	211	0.3953	856.9743	
Rubber Tired Dozers	D	500	32	27	2010	354	0.3953	9597.234	
Rubber Tired Dozers	D	750	32	2	2010	584	0.3953	968.386	255.4
Rubber Tired Loaders	D	50	21	13	2010	42	0.3618	533.1886	
Rubber Tired Loaders	D	120	21	159	2010	86	0.3618	13695.71	
Rubber Tired Loaders	D	175	21	208	2010	150	0.3618	31246.78	
Rubber Tired Loaders	D	250	21	185	2010	206	0.3618	38125.44	
Rubber Tired Loaders	D	500	21	172	2010	320	0.3618	54995.23	
Rubber Tired Loaders	D	750	21	15	2010	600	0.3618	9131.34	
Rubber Tired Loaders	D	1000	21	3	2010	837	0.3618	2313.681	
Rubber Tired Loaders	D	9999	21	1	2010	1521	0.3618	919.9252	199.7
Scrapers	D	50	26	1	2010	36	0.4824	21.60502	
Scrapers	D	120	26	9	2010	84	0.4824	727.312	
Scrapers	D	175	26	55	2010	166	0.4824	9209.117	
Scrapers	D	250	26	54	2010	225	0.4824	12103.34	
Scrapers	D	500	26	236	2010	381	0.4824	90173.71	
Scrapers	D	750	26	67	2010	565	0.4824	38064.62	
Scrapers	D	1000	26	1	2010	950	0.4824	1054.632	
Scrapers	D	9999	26	1	2010	1923	0.4824	2135.139	361.6
Signal Boards	D	15	2	2815	2000	6	0.82	16890	
Signal Boards	D	50	16	14	2000	37	0.78	518	
Signal Boards	D	120	16	229	2000	82	0.78	18778	
Signal Boards	D	175	16	142	2000	158	0.78	22436	
Signal Boards	D	250	16	30	2000	216	0.78	6480	20.2
Skid Steer Loaders	D	50	13	178	2010	43	0.3685	7733.408	
Skid Steer Loaders	D	120	13	574	2010	71	0.3685	40495.5	
Skid Steer Loaders	D	175	13	2	2010	153	0.3685	364.1918	
Skid Steer Loaders	D	250	13	1	2010	201	0.3685	265.3158	
Skid Steer Loaders	D	500	13	0	2010	277	0.3685	73.20881	
Skid Steer Loaders	D	750	13	0	2010	530	0.3685	46.74779	
Skid Steer Loaders	D	1000	13	0	2010	1000	0.3685	176.4068	65.0
Surfacing Equipment	D	50	22	3	2010	36	0.3015	111.306	
Surfacing Equipment	D	120	22	10	2010	89	0.3015	887.0073	
Surfacing Equipment	D	175	22	3	2010	151	0.3015	507.3986	
Surfacing Equipment	D	250	22	5	2010	216	0.3015	1089.215	
Surfacing Equipment	D	500	22	8	2010	362	0.3015	3015.505	
Surfacing Equipment	D	750	22	4	2010	615	0.3015	2559.318	
Surfacing Equipment	D	1000	22	1	2010	814	0.3015	456.1066	
Surfacing Equipment	D	9999	22	0	2010	1141	0.3015	182.6027	253.6
Sweepers/Scrubbers	D	50	13	48	2010	36	0.4556	1705.372	

Equipment	Fuel	HP	Life	Pop	Base	Avg HP	Load	Total HP	Avg HP by Equipment Type
Sweepers/Scrubbers	D	120	13	39	2010	78	0.4556	3024.817	
Sweepers/Scrubbers	D	175	13	4	2010	159	0.4556	716.8907	
Sweepers/Scrubbers	D	250	13	2	2010	204	0.4556	381.4313	
Sweepers/Scrubbers	D	500	13	0	2010	303	0.4556	102.6311	
Sweepers/Scrubbers	D	1000	13	0	2010	848	0.4556	71.92656	64.0
Tractors/Loaders/Backhoes	D	50	18	249	2010	38	0.3685	9536.711	
Tractors/Loaders/Backhoes	D	120	18	1690	2010	83	0.3685	139717	
Tractors/Loaders/Backhoes	D	175	18	189	2010	144	0.3685	27219.48	
Tractors/Loaders/Backhoes	D	250	18	76	2010	204	0.3685	15447.88	
Tractors/Loaders/Backhoes	D	500	18	68	2010	320	0.3685	21856.12	
Tractors/Loaders/Backhoes	D	750	18	5	2010	575	0.3685	2741.579	
Tractors/Loaders/Backhoes	D	1000	18	0	2010	871	0.3685	377.9604	
Tractors/Loaders/Backhoes	D	9999	18	3	2010	2006	0.3685	6437.384	97.9
Trenchers	D	50	18	82	2010	40	0.5025	3247.6	
Trenchers	D	120	28	38	2010	82	0.5025	3106.114	
Trenchers	D	175	28	5	2010	144	0.5025	720.7921	
Trenchers	D	250	28	6	2010	218	0.5025	1296.943	
Trenchers	D	500	28	5	2010	359	0.5025	1929.225	
Trenchers	D	750	28	1	2010	619	0.5025	689.4331	
Trenchers	D	1000	28	0	2010	860	0.5025	79.78906	80.8
Welder	D	50	16	21	2000	35	0.6	735	
Welder	D	120	16	58	2000	62	0.6	3596	
Welders	D	15	16	1727	2000	11	0.45	18997	
Welders	D	25	16	1520	2000	20	0.45	30400	
Welders	D	50	16	4678	2000	46	0.45	215188	
Welders	D	120	16	3633	2000	70	0.45	254310	
Welders	D	175	16	18	2000	174	0.45	3132	
Welders	D	250	16	4	2000	211	0.45	844	
Welders	D	500	16	10	2000	297	0.45	2970	45.4

Sacramento Valley Air Basin Fleet Average Emission Factors (Diesel)

Updated with ARB's 2011 Inventory Model for In-Use Off-Road Equipment. Categories ı

2005

2005 data has not been updated and not used in this model
(OFFROAD2007 rows were added or deleted to match OFFROAD2011 HP categories)

		2005		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	Equipment	MaxHP	ROG	CO	NOX	SOX	PM	CO2	ROG	CO	NOX	SOX	PM	CO2
0	46	Aerial Lifts	50	0.135	0.546	0.885	0.012	0.063	85.116	6.24	25.16	40.80	0.57	2.92	3,924.79
50	74		120	0.181	0.444	0.704	0.008	0.055	67.164	13.39	32.84	52.07	0.59	4.10	4,971.40
120	130		175	0.321	0.726	0.733	0.008	0.078	68.185	41.88	94.78	95.58	1.07	10.19	8,896.20
175	210		250	0.192	0.562	1.159	0.009	0.093	82.234	40.30	118.01	243.45	1.89	19.63	17,269.09
250	380		500	0.243	1.010	2.880	0.023	0.095	254.079	92.45	383.91	1,094.58	8.84	36.25	96,549.91
0	12	Air Compressors	15	0.661	2.092	3.722	0.040	0.295	273.029	7.93	25.10	44.66	0.48	3.54	3,276.35
15	24		25	0.767	1.862	2.879	0.032	0.230	273.029	18.42	44.70	69.09	0.78	5.52	6,552.70
25	37		50	1.678	3.643	3.081	0.033	0.377	273.029	62.09	134.80	114.01	1.22	13.94	10,102.08
50	78		120	0.722	2.008	4.121	0.030	0.369	273.029	56.35	156.59	321.46	2.33	28.79	21,296.26
120	147		175	0.472	1.598	3.769	0.029	0.204	273.029	69.40	234.85	554.03	4.21	29.94	40,135.27
175	218		250	0.336	0.942	3.556	0.029	0.133	273.029	73.32	205.25	775.27	6.25	29.02	59,520.34
250	385		500	0.297	1.227	3.264	0.025	0.119	273.029	114.44	472.52	1,256.74	9.63	45.90	105,116.18
500	595		750	0.304	1.227	3.341	0.026	0.121	273.029	180.97	730.26	1,987.76	15.25	71.72	162,452.35
750	808		1000	0.367	1.485	3.835	0.026	0.128	273.029	296.38	1,199.77	3,098.55	20.70	103.74	220,607.55
0	39	Bore/Drill Rigs	50	0.161	0.730	1.099	0.017	0.076	119.487	6.33	28.65	43.18	0.68	2.99	4,692.69
50	82		120	0.142	0.409	0.839	0.010	0.054	88.089	11.73	33.71	69.07	0.86	4.44	7,252.34
120	149		175	0.406	0.984	0.950	0.011	0.104	94.779	60.29	146.15	141.15	1.70	15.52	14,078.06
175	208		250	0.350	1.130	2.044	0.018	0.190	168.382	72.69	234.76	424.58	3.83	39.44	34,981.87
250	349		500	0.234	0.979	2.016	0.019	0.106	183.260	81.87	341.89	703.97	6.72	37.08	63,991.18
500	612		750	0.097	0.269	1.424	0.015	0.036	139.423	59.45	164.35	871.43	8.96	21.84	85,321.58
750	919		1000	0.090	0.289	1.366	0.014	0.036	153.653	82.57	265.41	1,255.01	12.94	33.25	141,207.33
1000	2667		9999	0.065	0.197	0.985	0.010	0.026	104.626	174.37	524.40	2,626.79	26.18	68.14	279,001.55
0	9	Cement and Mortar Mix	15	0.561	2.124	3.530	0.046	0.261	318.534	5.05	19.12	31.77	0.42	2.35	2,866.80
15	25		25	0.866	2.118	3.341	0.038	0.264	318.534	21.65	52.96	83.53	0.94	6.59	7,963.35
0	18	Concrete/Industrial Saw	25	0.621	1.840	3.888	0.049	0.244	415.232	11.17	33.13	69.99	0.89	4.38	7,474.17
25	33		50	2.319	5.104	4.615	0.050	0.535	415.232	76.52	168.43	152.30	1.65	17.65	13,702.64
50	81		120	1.043	2.958	6.133	0.045	0.522	415.232	84.49	239.63	496.80	3.68	42.26	33,633.77
120	175		175	0.682	2.354	5.612	0.044	0.288	415.232	119.27	411.93	982.16	7.63	50.35	72,665.57
0	41	Cranes	50	1.908	4.046	3.066	0.031	0.409	258.865	77.52	164.40	124.59	1.27	16.62	10,517.31
50	89		120	0.758	2.021	4.207	0.028	0.394	255.738	67.46	179.79	374.17	2.49	35.03	22,746.74
120	148		175	0.480	1.560	3.702	0.026	0.211	246.433	71.05	230.75	547.45	3.83	31.28	36,443.68
175	217		250	0.349	0.974	3.365	0.025	0.141	234.444	75.73	211.37	730.20	5.34	30.63	50,874.41
250	336		500	0.320	1.401	3.180	0.022	0.129	243.055	107.60	470.89	1,068.90	7.48	43.46	81,692.58
500	567		750	0.324	1.397	3.239	0.023	0.130	242.350	183.67	792.34	1,837.16	12.90	73.84	137,458.77
750	938		1000	0.000	0.000	0.000	0.000	0.000	0.000						
1000	1030		9999	0.630	2.790	6.391	0.040	0.221	427.436	648.67	2,873.93	6,582.52	41.32	227.31	440,259.39
0	43	Crawler Tractors	50	2.017	4.257	3.178	0.032	0.429	265.472	85.74	180.96	135.12	1.36	18.24	11,285.20
50	87		120	1.063	2.798	5.888	0.038	0.546	343.682	92.35	243.07	511.42	3.27	47.46	29,851.19
120	150		175	0.752	2.423	5.743	0.039	0.332	367.587	112.49	362.32	858.81	5.77	49.69	54,969.90
175	203		250	0.593	1.665	5.565	0.039	0.242	371.494	120.34	337.78	1,128.78	7.91	49.10	75,356.05
250	341		500	0.487	2.384	4.721	0.032	0.198	345.134	165.97	812.23	1,608.34	10.77	67.31	117,584.45
500	570		750	0.528	2.554	5.156	0.035	0.213	369.713	301.01	1,455.97	2,939.45	19.78	121.70	210,778.43
750	828		1000	0.000	0.000	0.000	0.000	0.000	0.000						
1000	1527		9999	0.306	1.495	3.027	0.018	0.110	195.553	466.38	2,282.40	4,620.15	28.01	167.66	298,511.78
0	45	Crushing/Proc. Equipme	50	2.856	6.163	5.054	0.054	0.634	443.672	128.51	277.35	227.43	2.41	28.52	19,965.25
50	85		120	1.202	3.309	6.771	0.049	0.620	443.672	102.16	281.26	575.56	4.13	52.73	37,712.14
120	171		175	0.787	2.631	6.197	0.047	0.342	443.672	134.52	449.96	1,059.61	7.97	58.50	75,867.95
175	250		250	0.555	1.534	5.839	0.047	0.220	443.672	138.79	383.59	1,459.81	11.65	54.94	110,918.06
250	382		500	0.490	1.985	5.338	0.041	0.197	443.672	187.12	758.17	2,039.15	15.53	75.08	169,482.75
500	602		750	0.493	1.895	5.443	0.042	0.195	443.673	296.85	1,140.84	3,276.85	25.06	117.25	267,090.87
750	1337		9999	0.602	2.371	6.284	0.042	0.209	443.672	804.53	3,169.39	8,401.81	55.67	279.99	593,190.07
0	16	Dumpers/Tenders	25	0.494	1.267	2.183	0.026	0.162	216.148	7.90	20.28	34.93	0.41	2.59	3,458.37
0	36	Excavators	50	0.286	0.880	1.916	0.025	0.117	208.660	10.23	31.46	68.47	0.88	4.19	7,457.11
50	82		120	0.970	2.098	1.602	0.017	0.213	138.765	79.34	171.60	130.98	1.37	17.40	11,347.77
120	146		175	0.637	1.752	3.472	0.025	0.344	228.669	93.03	255.89	507.03	3.66	50.21	33,394.86
175	218		250	0.424	1.415	3.241	0.024	0.189	232.995	92.57	309.18	708.09	5.35	41.38	50,902.87
250	329		500	0.273	0.728	2.873	0.023	0.106	219.014	89.82	239.09	944.20	7.56	34.98	71,977.30
500	578		750	0.203	0.706	2.155	0.017	0.080	183.446	117.27	408.18	1,245.70	9.71	46.20	106,020.59
750	843		1000	0.000	0.000	0.000	0.000	0.000	0.000						
1000	1569		9999	0.126	0.431	1.357	0.011	0.050	111.990	197.77	676.56	2,129.80	16.49	77.80	175,728.29
0	42	Forklifts	50	1.117	2.396	1.818	0.019	0.243	156.923	47.39	101.60	77.10	0.80	10.33	6,655.08
50	82		120	0.483	1.311	2.583	0.019	0.263	171.952	39.79	108.00	212.75	1.55	21.64	14,163.38
120	141		175	0.332	1.079	2.493	0.019	0.149	179.962	46.92	152.41	352.25	2.67	21.02	25,425.83
175	208		250	0.194	0.494	2.161	0.018	0.074	168.058	40.43	102.89	449.74	3.67	15.34	34,981.86
250	344		500	0.000	0.000	0.000	0.000	0.000	0.000						
500	880		1000	0.058	0.179	0.658	0.005	0.023	57.204	51.47	157.37	579.17	4.61	20.06	50,339.75
0	11	Generator Sets	15	0.888	3.225	5.593	0.061	0.372	420.920	9.77	35.47	61.52	0.67	4.09	4,630.12
15	19		25	0.917	2.871	4.438	0.050	0.318	420.920	17.43	54.55	84.32	0.95	6.04	7,997.48
25	33		50	1.907	4.345	4.497	0.051	0.470	420.920	62.94	143.39	148.41	1.68	15.52	13,890.35
50	84		120	0.965	2.845	5.875	0.046	0.467	420.920	81.02	239.01	493.51	3.87	39.21	35,357.26
120	153		175	0.626	2.266	5.372	0.044	0.257	420.920	95.82	346.67	821.88	6.76	39.31	64,400.76
175	229		250	0.441	1.316	5.067	0.044	0.168	420.920	101.01	301.38	1,160.24	10.12	38.36	96,390.64
250	363		500	0.397	1.607	4.741	0.039	0.155	420.920	143.93	583.22	1,720.86	14.00	56.09	152,793.82
500	586		750	0.409	1.607	4.854	0.040	0.156	420.920	239.60	941.50	2,844.26	23.15	91.62	246,659.19
750	1130		9999	0.524	1.976	5.582	0.040	0.186	420.920	592.62	2,232.54	6,307.92	44.64	210.60	475,639.23
0	39	Graders	50	2.239	4.798	3.709	0.038	0.487	318.965	87.67	187.89	145.24	1.51	19.07	12,491.08
50	91		120	1.067	2.897	5.925	0.041	0.558	373.677	97.11	263.57	539.18	3.72	50.82	34,003.48
120	148		175	0.711	2.354	5.505	0.040	0.314	379.933	105.12	348.19	814.41	5.90	46.48	56,209.86
175	204		250	0.526	1.454	5.264	0.040	0.211	382.031	107.46	297.10	1,075.74	8.20	43.11	78,069.26
250	293		500	0.431	1.813	4.438	0.033	0.174	355.058	126.48	531.39	1,301.18	9.54	50.99	104,092.33
500	796		1000	0.000	0.000	0.000	0.000	0.000	0.000						
1000	1993		9999	0.137	0.564	1.417	0.010	0.055	110.562	272.39	1,124.78	2,823.12	20.68	109.18	220,328.81
0	38	Off-Highway Tractors	50	3.692	9.530	20.585	0.124	1.852	1128.991	139.05	358.90	775.24	4.66	69.75	42,518.60
50	75		120	1.739	5.502	13.223	0.083	0.763	793.736	129.61	410.04	985.50	6.21	56.90	59,156.32
120	158		175	0.674	1.918	6.023	0.039	0.279	374.226	106.59	303.14	952.09	6.21	44.08	59,156.32
175	214		250	1.933	10.554	18.102	0.113	0.787	1205.093	413.36	2,256.99	3,870.89	24.18	168.33	257,699.65
250	334		500	0.000	0.000	0.000	0.000	0.000	0.000						
500	574		750	0.000	0.000	0.000	0.000	0.000	0.000						
750	1000		1000	0.000	0.000	0.000	0.000	0.000	0.000						
1000	1726		9999	0.367	2.015	3.495	0.020	0.135	213.965	632.80	3,478.70	6,033.23	34.66	233.18	369,357.14
0	29	Off-Highway Trucks	50	3.689	12.100	27.758	0.204	1.652	1947.088	107.49	352.60	808.87	5.96	48.14	56,738.84
50	87		120	1.142	3.013	11.682	0.091	0.444	867.695	99.43	262.33	1,017.07	7.93	38.65	75,543.73
120	159		175	0.915	3.182	9.358	0.071	0.356	777.452	145.40	505.51	1,486.83	11.32	56.50	123,528.56
175	211		250	1.130	3.886	11.783	0.089	0.441	949.548	238.52	819.97	2,486.38	18.80	93.14	200,369.21
250	372		500	0.000	0.000	0.000	0.000	0.000	0.000						
500	656		750	0.000	0.000	0.000	0.000	0.000	0.000						
750	897		1000	0.000	0.000	0.000	0.000	0.000	0.000						
1000	1764		9999	0.218	0.793	2.310	0.015	0.075	160.623	385.23	1,399.26	4,075.38	26.59	132.82	283,369.92
0	38	Other Construction Equ	50	0.163	0.737	1.110	0.018	0.077	120.626	6.18	27.99	42.18	0.67	2.92	4,584.61
50	82		120	0.119	0.342	0.700	0.009	0.045	73.505	9.69	27.86	57.10	0.71	3.67	5,995.27

		2005		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	Equipment	MaxHP	ROG	CO	NOX	SOX	PM	CO2	ROG	CO	NOX	SOX	PM	CO2
120	152		175	0.467	1.039	0.912	0.010	0.108	83.257	71.25	158.51	139.02	1.53	16.50	12,695.85
175	217		250	0.416	1.203	2.399	0.019	0.216	169.092	90.21	260.91	520.29	4.02	46.80	36,676.89
250	357		500	0.215	0.764	1.758	0.014	0.093	135.388	76.87	272.65	627.24	5.07	33.34	48,314.78
500	598		750	0.000	0.000	0.000	0.000	0.000	0.000						
750	830		1000	0.000	0.000	0.000	0.000	0.000	0.000						
1000	1127		9999	0.099	0.368	1.139	0.009	0.040	102.356	111.41	414.97	1,283.74	10.56	44.63	115,320.64
0	35	Other General Industria	50	0.103	0.505	0.724	0.012	0.051	82.643	3.61	17.71	25.43	0.42	1.79	2,900.93
50	73		120	0.126	0.401	0.874	0.011	0.053	95.123	9.25	29.38	63.95	0.82	3.87	6,962.24
120	149		175	0.472	1.006	0.772	0.008	0.102	66.128	70.34	150.10	115.15	1.19	15.24	9,863.18
175	209		250	0.386	1.041	2.121	0.015	0.203	134.599	80.71	217.63	443.44	3.08	42.52	28,139.07
250	355		500	0.231	0.755	1.768	0.013	0.102	122.674	81.85	267.65	627.13	4.57	36.23	43,514.00
500	592		750	0.137	0.371	1.411	0.011	0.054	103.965	81.01	219.57	834.94	6.46	32.00	61,499.80
750	885		1000	0.158	0.628	1.676	0.012	0.063	136.032	140.10	555.75	1,483.29	11.03	56.04	120,388.75
1000	2000		9999	0.117	0.458	1.252	0.009	0.047	99.212	234.97	915.99	2,504.08	18.62	93.45	198,423.85
0	36	Other Material Handling	50	2.703	5.777	4.476	0.046	0.587	384.920	96.63	206.51	160.00	1.66	21.00	13,759.53
50	93		120	0.840	2.272	4.634	0.032	0.441	295.388	78.22	211.62	431.70	3.01	41.06	27,519.05
120	145		175	0.714	2.343	5.494	0.040	0.315	383.028	103.17	338.69	794.32	5.82	45.54	55,373.69
175	218		250	0.394	1.072	4.073	0.032	0.156	301.336	86.03	234.07	888.97	6.91	34.03	65,777.25
250	331		500	0.303	1.209	3.221	0.024	0.121	262.307	100.36	400.49	1,067.44	7.96	40.21	86,919.87
500	565		750	0.000	0.000	0.000	0.000	0.000	0.000						
750	923		1000	0.000	0.000	0.000	0.000	0.000	0.000						
1000	1050		9999	0.446	1.797	4.634	0.029	0.155	320.256	467.78	1,886.58	4,865.80	30.81	162.32	336,269.32
0	39	Pavers	50	0.534	1.346	2.243	0.026	0.171	219.130	20.63	52.00	86.65	1.00	6.61	8,463.90
50	80		120	1.156	2.444	1.892	0.019	0.248	159.529	92.00	194.53	150.59	1.53	19.72	12,695.85
120	158		175	0.605	1.600	3.417	0.022	0.304	198.483	95.65	252.98	540.30	3.44	48.00	31,386.97
175	213		250	0.551	1.790	4.280	0.029	0.240	272.918	117.41	381.71	912.45	6.11	51.23	58,189.31
250	327		500	0.439	1.257	4.066	0.028	0.181	269.306	143.56	411.44	1,331.09	9.26	59.19	88,165.67
500	750		750	0.203	1.058	1.959	0.013	0.083	141.065	151.93	793.83	1,469.39	9.69	62.13	105,798.77
0	35	Paving Equipment	50	0.266	0.765	1.567	0.019	0.101	164.512	9.26	26.62	54.55	0.68	3.50	5,727.92
50	89		120	0.877	1.856	1.450	0.015	0.188	122.494	77.73	164.48	128.43	1.31	16.70	10,852.90
120	148		175	0.504	1.335	2.855	0.018	0.252	166.573	74.75	198.08	423.68	2.71	37.41	24,720.50
175	216		250	0.424	1.384	3.314	0.022	0.185	212.473	91.53	298.51	714.72	4.81	39.84	45,823.37
250	339		500	0.000	0.000	0.000	0.000	0.000	0.000						
500	605		750	0.000	0.000	0.000	0.000	0.000	0.000						
750	842		1000	0.107	0.307	0.990	0.007	0.044	65.879	89.70	258.27	833.30	5.83	37.00	55,470.42
0	8	Plate Compactors	15	0.344	1.508	2.338	0.036	0.162	244.589	2.75	12.06	18.70	0.28	1.30	1,956.71
0	13	Pressure Washers	15	0.360	1.307	2.267	0.025	0.151	170.643	4.68	17.00	29.48	0.32	1.96	2,218.36
15	19		25	0.372	1.164	1.799	0.020	0.129	170.643	7.07	22.12	34.18	0.38	2.45	3,242.22
25	38		50	0.640	1.513	1.774	0.021	0.169	170.643	24.32	57.51	67.42	0.78	6.43	6,484.44
50	64		120	0.361	1.103	2.283	0.019	0.169	170.643	23.09	70.61	146.12	1.20	10.82	10,921.16
0	8	Pumps	15	1.019	3.225	5.738	0.061	0.455	420.920	8.16	25.80	45.90	0.49	3.64	3,367.36
15	21		25	1.183	2.871	4.438	0.050	0.354	420.920	24.85	60.30	93.20	1.05	7.44	8,839.32
25	37		50	2.018	4.551	4.538	0.051	0.488	420.920	74.66	168.38	167.90	1.88	18.06	15,574.03
50	84		120	0.990	2.887	5.957	0.046	0.484	420.920	83.13	242.51	500.38	3.87	40.62	35,357.26
120	151		175	0.643	2.299	5.446	0.044	0.267	420.920	97.13	347.20	822.35	6.67	40.24	63,558.87
175	217		250	0.455	1.341	5.138	0.044	0.174	420.920	98.68	291.04	1,114.90	9.59	37.85	91,339.61
250	372		500	0.407	1.689	4.791	0.039	0.160	420.920	151.48	628.14	1,782.21	14.34	59.44	156,582.14
500	615		750	0.419	1.689	4.905	0.040	0.162	420.920	257.88	1,038.45	3,016.30	24.29	99.40	258,865.51
750	1460		9999	0.532	2.061	5.638	0.040	0.189	420.920	776.90	3,009.65	8,230.93	57.67	276.01	614,542.92
0	36	Rollers	50	0.108	0.491	0.739	0.012	0.051	80.351	3.87	17.50	26.38	0.42	1.83	2,866.80
50	87		120	0.113	0.324	0.664	0.008	0.043	69.676	9.79	28.13	57.64	0.72	3.70	6,052.15
120	144		175	0.525	1.133	0.938	0.010	0.116	81.971	75.53	162.86	134.91	1.42	16.75	11,785.75
175	213		250	0.345	0.946	1.977	0.014	0.174	125.472	73.55	201.83	421.53	2.93	37.19	26,756.85
250	335		500	0.264	0.886	2.107	0.015	0.114	146.485	88.28	296.77	705.57	5.15	38.09	49,054.23
500	521		750	0.185	0.530	1.835	0.014	0.075	133.411	96.16	275.62	954.92	7.29	38.87	69,440.42
0	47	Rough Terrain Forklifts	50	2.192	4.730	3.729	0.039	0.482	324.798	103.65	223.68	176.33	1.85	22.79	15,357.89
50	96		120	0.805	2.219	4.487	0.032	0.425	294.068	77.55	213.73	432.18	3.10	40.90	28,326.77
120	130		175	0.782	2.617	6.107	0.046	0.345	437.172	101.39	339.20	791.40	5.95	44.65	56,653.55
175	208		250	0.476	1.303	4.919	0.039	0.189	371.911	99.18	271.38	1,024.63	8.14	39.32	77,472.00
250	374		500	0.000	0.000	0.000	0.000	0.000	0.000						
500	625		750	0.210	0.786	2.232	0.017	0.084	186.206	131.53	491.22	1,394.74	10.66	52.73	116,378.64
0	42	Rubber Tired Dozers	50	3.197	9.998	23.997	0.148	1.410	1412.268	132.93	415.76	997.93	6.17	58.63	58,729.68
50	82		120	1.896	5.347	16.751	0.107	0.782	1020.078	154.71	436.27	1,366.70	8.74	63.81	83,228.32
120	150		175	1.320	7.252	12.083	0.074	0.536	802.660	197.64	1,085.43	1,808.56	11.01	80.17	120,144.18
175	211		250	1.419	7.746	13.107	0.080	0.576	857.369	299.41	1,634.21	2,765.29	16.98	121.54	180,887.43
250	354		500	0.000	0.000	0.000	0.000	0.000	0.000						
500	584		750	0.806	4.454	7.631	0.043	0.299	459.645	470.87	2,601.73	4,457.47	25.20	174.42	268,478.61
0	42	Rubber Tired Loaders	50	0.275	0.816	1.725	0.022	0.108	184.165	11.48	34.04	71.91	0.91	4.50	7,678.94
50	86		120	1.138	2.442	1.901	0.020	0.248	164.013	98.02	210.36	163.73	1.70	21.38	14,129.25
120	150		175	0.504	1.372	2.804	0.020	0.264	178.155	75.61	205.84	420.64	2.93	39.55	26,722.73
175	206		250	0.434	1.440	3.371	0.025	0.191	234.204	89.28	296.54	694.04	5.06	39.39	48,223.75
250	320		500	0.287	0.795	2.892	0.022	0.115	211.376	91.86	254.11	924.52	7.10	36.80	67,574.71
500	600		750	0.215	0.890	2.222	0.016	0.087	179.033	128.94	534.31	1,334.40	9.85	51.96	107,505.17
750	837		1000	0.321	1.308	3.350	0.025	0.129	263.180	269.01	1,094.57	2,803.13	20.67	107.70	220,232.08
1000	1521		9999	0.246	1.019	2.564	0.017	0.086	177.105	374.44	1,550.43	3,899.12	25.28	130.40	269,377.34
0	36	Scrapers	50	3.654	9.609	20.309	0.129	1.868	1178.450	132.08	347.30	734.02	4.66	67.53	42,592.54
50	84		120	1.634	5.266	12.511	0.084	0.721	796.487	137.81	444.05	1,054.99	7.05	60.77	67,165.12
120	166		175	0.925	2.610	8.623	0.060	0.379	571.806	153.69	433.61	1,432.89	9.98	62.93	95,014.12
175	225		250	0.926	4.620	8.938	0.059	0.377	648.067	208.32	1,039.40	2,010.88	13.36	84.71	145,797.48
250	381		500	0.000	0.000	0.000	0.000	0.000	0.000						
500	565		750	0.000	0.000	0.000	0.000	0.000	0.000						
750	950		1000	0.000	0.000	0.000	0.000	0.000	0.000						
1000	1923		9999	0.189	0.934	1.840	0.012	0.077	130.956	364.14	1,795.59	3,539.19	23.64	147.55	251,869.33
0	6	Signal Boards	15	0.609	2.848	4.088	0.068	0.288	466.425	3.66	17.09	24.53	0.41	1.73	2,798.55
15	37		50	2.341	5.197	4.859	0.054	0.549	443.672	86.63	192.27	179.78	1.98	20.33	16,415.87
50	82		120	1.091	3.122	6.423	0.049	0.543	443.672	89.47	256.02	526.72	3.98	44.49	36,381.11
120	158		175	0.711	2.486	5.875	0.047	0.299	443.672	112.29	392.79	928.22	7.36	47.32	70,100.20
175	216		250	0.607	1.749	6.693	0.056	0.236	536.104	131.01	377.70	1,445.61	12.16	50.99	115,798.41
0	43	Skid Steer Loaders	50	0.380	0.938	1.497	0.017	0.117	143.940	16.54	40.77	65.08	0.74	5.07	6,256.92
50	71		120	0.873	1.981	1.752	0.020	0.207	164.106	61.59	139.76	123.57	1.40	14.58	11,575.30
120	153		175	0.000	0.000	0.000	0.000	0.000	0.000						
175	201		250	0.000	0.000	0.000	0.000	0.000	0.000						
250	277		500	0.000	0.000	0.000	0.000	0.000	0.000						
500	530		750	0.000	0.000	0.000	0.000	0.000	0.000						
750	1000		1000	0.046	0.136	0.261	0.002	0.024	19.396	45.75	136.13	261.14	2.12	24.34	19,396.43
0	36	Surfacing Equipment	50	0.993	2.187	1.993	0.022	0.229	179.415	35.40	77.99	71.09	0.77	8.18	6,399.12
50	89		120	0.837	2.365	4.951	0.036	0.412	326.162	74.21	209.70	439.03	3.17	36.53	28,924.01
120	151		175	0.432	1.503	3.568	0.027	0.183	257.701	65.16	226.86	538.69	4.09	27.55	38,906.65
175	216		250	0.363	1.073	3.747	0.030	0.144	283.137	78.44	231.80	809.68	6.42	31.16	61,175.59
250	362		500	0.316	1.467	3.399	0.025	0.127	276.905	114.51	531.64	1,231.50	9.19	45.86	100,338.15
500	615		750	0.000	0.000	0.000	0.000	0.000	0.000						
750	814		1000	0.000	0.000	0.000	0.000	0.000	0.000						
1000	1141		9999	0.161	0.731	1.731	0.013	0.064	137.965	183.85	834.09	1,974.76	14.77	72.66	157,418.31
0	36	Sweepers/Scrubbers	50	0.189	0.929	1.334	0.022	0.094	152.169	6.74	33.06	47.47	0.79	3.34	5,415.08
50	78		120	0.156	0.509	1.075	0.014	0.065	114.751	12.11	39.45	83.31	1.05	5.06	8,896.19
120	159		175	0.597	1.286	1.023	0.011	0.132	89.742	95.22	205.07	163.21	1.73	21.01	14,311.27

		2005		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	Equipment	MaxHP	ROG	CO	NOX	SOX	PM	CO2	ROG	CO	NOX	SOX	PM	CO2
175	204		250	0.452	1.241	2.481	0.018	0.240	166.517	92.36	253.57	507.09	3.73	49.00	34,037.62
250	303		500	0.370	1.223	2.853	0.022	0.163	208.420	111.81	370.07	863.09	6.62	49.30	63,046.94
500	848		1000	0.100	0.265	1.106	0.009	0.039	86.663	84.97	224.30	937.92	7.72	32.81	73,490.32
0	38	Tractors/Loaders/Backh	50	0.393	1.036	1.867	0.022	0.134	187.845	15.05	39.68	71.50	0.85	5.11	7,195.45
50	83		120	1.074	2.348	1.876	0.020	0.240	166.547	88.77	194.07	155.09	1.66	19.84	13,765.22
120	144		175	0.430	1.210	2.387	0.018	0.230	163.015	61.94	174.21	343.54	2.57	33.16	23,463.45
175	204		250	0.386	1.324	3.023	0.024	0.171	225.193	78.88	270.34	617.31	4.83	35.02	45,988.35
250	320		500	0.282	0.758	3.074	0.026	0.110	243.327	90.28	242.68	984.13	8.18	35.13	77,898.58
500	575		750	0.278	0.952	3.086	0.029	0.110	272.221	159.48	546.91	1,773.39	16.43	63.40	156,422.88
750	871		1000	0.000	0.000	0.000	0.000	0.000	0.000						
1000	2006		9999	0.122	0.409	1.370	0.012	0.048	116.988	245.16	820.37	2,747.98	24.64	96.68	234,634.43
0	40	Trenchers	50	0.126	0.589	0.846	0.014	0.060	96.524	5.02	23.44	33.65	0.56	2.37	3,839.47
50	82		120	0.272	0.807	1.704	0.022	0.107	181.964	22.32	66.18	139.82	1.77	8.76	14,931.28
120	144		175	0.715	1.518	1.218	0.013	0.155	103.783	102.82	218.46	175.19	1.80	22.29	14,931.28
175	218		250	0.402	1.072	2.303	0.015	0.199	134.767	87.88	234.22	502.99	3.22	43.46	29,435.96
250	359		500	0.360	1.183	2.835	0.019	0.156	182.058	129.23	423.99	1,016.53	6.85	55.88	65,271.02
500	619		750	0.263	0.764	2.451	0.017	0.109	163.272	163.16	472.91	1,518.03	10.62	67.19	101,106.09
750	860		1000	0.234	1.264	2.278	0.015	0.096	164.194	201.16	1,086.78	1,959.16	12.94	82.17	141,207.23
0	11	Welders	15	0.620	1.961	3.489	0.037	0.277	255.965	6.82	21.57	38.38	0.41	3.04	2,815.61
15	20		25	0.720	1.746	2.699	0.030	0.216	255.965	14.39	34.92	53.97	0.61	4.31	5,119.30
25	46		50	1.449	3.183	2.842	0.031	0.333	255.965	66.66	146.40	130.73	1.42	15.32	11,774.38
50	70		120	0.651	1.838	3.781	0.028	0.327	255.965	45.56	128.63	264.64	1.96	22.92	17,917.54
120	174		175	0.424	1.463	3.456	0.027	0.181	255.965	73.85	254.59	601.40	4.68	31.46	44,537.86
175	211		250	0.302	0.862	3.262	0.027	0.119	255.965	63.81	181.80	688.27	5.67	25.09	54,008.57
250	297		500	0.268	1.135	3.010	0.023	0.107	255.965	79.63	337.05	893.99	6.96	31.79	76,021.52
0	29	Water Trucks	50	3.689	12.100	27.758	0.204	1.652	1947.088	107.486	352.601	808.870	5.958	48.137	56738.842
50	87		120	1.142	3.013	11.682	0.091	0.444	867.695	99.434	262.331	1017.072	7.933	38.649	75543.734
120	159		175	0.915	3.182	9.358	0.071	0.356	777.452	145.401	505.515	1486.832	11.316	56.505	123528.562
175	211		250	1.130	3.886	11.783	0.089	0.441	949.548	238.524	819.969	2486.377	18.803	93.135	200369.215
250	372		500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
500	656		750	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
750	897		1000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1000	1764		9999	0.218	0.793	2.310	0.015	0.075	160.623	385.226	1399.263	4075.377	26.593	132.816	283369.917

Road2011 were updated from OffRoad2007 (Air Compressors, Cement and Mortar Mixers, Concrete/Industrial Saws, Crushing/Proc. Equipment, Dumpers/Tenders, Generator Sets, Plate Compactors, Pressure Washers, Pumps, Signal Board

2006

2006 data has not been updated and not used in this model
(OFFROAD2007 rows were added or deleted to match OFFROAD2011 HP categories)

		2006		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	Equipment	MaxHP	ROG	CO	NOX	SOX	PM	CO2	ROG	CO	NOX	SOX	PM	CO2
0	46	Aerial Lifts	50	0.125	0.536	0.822	0.012	0.059	85.116	5.77	24.71	37.92	0.57	2.71	3,924.79
50	74		120	0.171	0.427	0.689	0.008	0.054	67.164	12.68	31.62	50.98	0.59	3.98	4,971.41
120	130		175	0.306	0.710	0.721	0.008	0.076	68.185	39.92	92.67	94.05	1.07	9.92	8,896.20
175	210		250	0.182	0.556	1.122	0.009	0.090	82.234	38.22	116.68	235.60	1.89	18.95	17,269.09
250	380		500	0.225	0.928	2.726	0.023	0.089	254.079	85.64	352.47	1,035.89	8.84	33.99	96,549.89
0	12	Air Compressors	15	0.631	2.053	3.582	0.040	0.283	273.029	7.58	24.63	42.99	0.48	3.40	3,276.35
15	24		25	0.728	1.794	2.820	0.032	0.223	273.029	17.47	43.06	67.67	0.78	5.35	6,552.70
25	37		50	1.615	3.579	3.037	0.033	0.369	273.029	59.75	132.43	112.39	1.22	13.64	10,102.07
50	78		120	0.690	1.988	3.994	0.030	0.359	273.029	53.81	155.08	311.54	2.33	27.98	21,296.27
120	147		175	0.452	1.587	3.649	0.029	0.198	273.029	66.48	233.33	536.34	4.21	29.07	40,135.28
175	218		250	0.315	0.881	3.437	0.029	0.124	273.029	68.57	191.95	749.17	6.25	27.10	59,520.34
250	385		500	0.278	1.114	3.095	0.025	0.112	273.029	106.98	429.08	1,191.50	9.63	43.07	105,116.19
500	595		750	0.284	1.114	3.171	0.026	0.113	273.029	169.10	663.12	1,886.67	15.25	67.35	162,452.30
750	808		1000	0.348	1.368	3.732	0.026	0.122	273.029	281.46	1,105.43	3,015.58	20.70	98.69	220,607.43
0	39	Bore/Drill Rigs	50	0.151	0.730	0.998	0.017	0.071	119.487	5.94	28.65	39.19	0.68	2.81	4,692.69
50	82		120	0.131	0.392	0.802	0.010	0.052	88.089	10.76	32.25	66.05	0.86	4.27	7,252.33
120	149		175	0.351	0.930	0.925	0.011	0.097	94.779	52.08	138.16	137.35	1.70	14.43	14,078.06
175	208		250	0.304	1.111	1.933	0.018	0.171	168.382	63.25	230.82	401.49	3.83	35.48	34,981.86
250	349		500	0.208	0.979	1.894	0.019	0.097	183.260	72.46	341.92	661.21	6.72	33.77	63,991.20
500	612		750	0.090	0.265	1.354	0.015	0.034	139.423	55.12	161.92	828.71	8.96	20.77	85,321.61
750	919		1000	0.084	0.284	1.225	0.014	0.035	153.653	77.62	260.60	1,125.68	12.94	31.86	141,207.22
1000	2667		9999	0.061	0.193	0.881	0.010	0.024	104.626	162.02	514.89	2,350.30	26.18	65.09	279,001.60
0	9	Cement and Mor	15	0.496	2.043	3.206	0.046	0.232	318.534	4.47	18.39	28.85	0.42	2.09	2,866.81
15	25		25	0.819	2.038	3.268	0.038	0.256	318.534	20.48	50.96	81.71	0.94	6.39	7,963.35
0	18	Concrete/Industri	25	0.573	1.775	3.698	0.049	0.236	415.232	10.32	31.96	66.56	0.89	4.25	7,474.17
25	33		50	2.199	4.967	4.530	0.050	0.518	415.232	72.56	163.90	149.50	1.65	17.09	13,702.65
50	81		120	0.984	2.920	5.913	0.045	0.501	415.232	79.68	236.54	478.98	3.68	40.60	33,633.76
120	175		175	0.645	2.334	5.404	0.044	0.276	415.232	112.85	408.43	945.66	7.63	48.39	72,665.55
0	41	Cranes	50	1.824	3.954	3.020	0.031	0.398	258.865	74.11	160.63	122.70	1.27	16.18	10,517.31
50	89		120	0.720	1.992	4.052	0.028	0.380	255.738	64.00	177.16	360.40	2.49	33.81	22,746.73
120	148		175	0.458	1.541	3.565	0.026	0.204	246.433	67.77	227.88	527.20	3.83	30.10	36,443.69
175	217		250	0.328	0.914	3.238	0.025	0.132	234.444	71.21	198.27	702.68	5.34	28.64	50,874.41
250	336		500	0.302	1.260	3.004	0.022	0.121	243.055	101.53	423.34	1,009.71	7.48	40.84	81,692.54
500	567		750	0.305	1.256	3.062	0.023	0.122	242.351	173.00	712.33	1,736.88	12.90	69.43	137,458.80
750	938		1000	0.000	0.000	0.000	0.000	0.000	0.000						
1000	1030		9999	0.596	2.528	6.188	0.040	0.209	427.436	614.23	2,603.77	6,373.92	41.32	215.02	440,259.30
0	43	Crawler Tractors	50	1.932	4.163	3.134	0.032	0.418	265.471	82.12	176.98	133.21	1.36	17.77	11,285.19
50	87		120	1.013	2.761	5.691	0.038	0.528	343.682	87.98	239.79	494.28	3.27	45.88	29,851.20
120	150		175	0.720	2.395	5.545	0.039	0.320	367.587	107.60	358.16	829.15	5.77	47.92	54,969.88
175	203		250	0.562	1.577	5.371	0.039	0.228	371.494	114.01	319.94	1,089.55	7.91	46.35	75,356.01
250	341		500	0.463	2.197	4.481	0.032	0.187	345.134	157.83	748.46	1,526.58	10.77	63.79	117,584.50
500	570		750	0.501	2.353	4.897	0.035	0.202	369.713	285.71	1,341.66	2,791.61	19.78	115.40	210,778.44
750	828		1000	0.000	0.000	0.000	0.000	0.000	0.000						
1000	1527		9999	0.291	1.382	2.936	0.018	0.105	195.553	443.73	2,109.10	4,482.45	28.01	159.82	298,511.82
0	45	Crushing/Proc. E	50	2.740	6.046	4.977	0.054	0.619	443.672	123.30	272.06	223.96	2.41	27.83	19,965.26
50	85		120	1.144	3.275	6.549	0.049	0.601	443.672	97.22	278.39	556.65	4.13	51.12	37,712.14
120	171		175	0.751	2.614	5.985	0.047	0.331	443.672	128.49	447.06	1,023.48	7.97	56.69	75,867.94
175	250		250	0.518	1.431	5.631	0.047	0.204	443.672	129.39	357.71	1,407.72	11.65	51.09	110,918.08
250	382		500	0.457	1.795	5.041	0.041	0.184	443.672	174.51	685.87	1,925.70	15.53	70.22	169,482.83
500	602		750	0.462	1.724	5.166	0.042	0.183	443.672	278.11	1,037.65	3,110.19	25.06	110.40	267,090.80
750	1337		9999	0.572	2.189	6.119	0.042	0.199	443.672	764.82	2,926.45	8,180.59	55.67	266.72	593,189.83
0	16	Dumpers/Tender	25	0.439	1.173	2.094	0.026	0.151	216.148	7.02	18.77	33.50	0.41	2.42	3,458.37
0	36	Excavators	50	0.270	0.864	1.809	0.025	0.115	208.660	9.65	30.86	64.66	0.88	4.12	7,457.11
50	82		120	0.905	2.028	1.570	0.017	0.204	138.765	74.04	165.82	128.42	1.37	16.71	11,347.77
120	146		175	0.596	1.731	3.333	0.025	0.327	228.669	86.97	252.73	486.79	3.66	47.75	33,394.87
175	218		250	0.399	1.409	3.101	0.024	0.180	232.995	87.19	307.76	677.52	5.35	39.41	50,902.87
250	329		500	0.255	0.681	2.751	0.023	0.099	219.014	83.79	223.83	904.16	7.56	32.41	71,977.28
500	578		750	0.191	0.649	2.007	0.017	0.074	183.446	110.18	374.88	1,159.90	9.71	43.03	106,020.62
750	843		1000	0.000	0.000	0.000	0.000	0.000	0.000						
1000	1569		9999	0.118	0.396	1.265	0.011	0.046	111.990	185.09	621.35	1,984.87	16.49	72.55	175,728.27
0	42	Forklifts	50	1.054	2.326	1.784	0.019	0.235	156.923	44.70	98.63	75.66	0.80	9.98	6,655.08
50	82		120	0.457	1.298	2.485	0.019	0.253	171.952	37.61	106.89	204.66	1.55	20.82	14,163.38
120	141		175	0.315	1.075	2.392	0.019	0.143	179.962	44.57	151.85	338.01	2.67	20.21	25,425.82
175	208		250	0.179	0.454	2.071	0.018	0.067	168.058	37.30	94.41	431.00	3.67	13.96	34,981.85
250	344		500	0.000	0.000	0.000	0.000	0.000	0.000						
500	880		1000	0.054	0.159	0.614	0.005	0.021	57.204	47.77	139.86	540.58	4.61	18.41	50,339.72
0	11	Generator Sets	15	0.843	3.164	5.383	0.061	0.356	420.920	9.27	34.81	59.21	0.67	3.92	4,630.12
15	19		25	0.865	2.766	4.347	0.050	0.308	420.920	16.43	52.56	82.59	0.95	5.86	7,997.47
25	33		50	1.817	4.248	4.426	0.051	0.458	420.920	59.97	140.19	146.04	1.68	15.10	13,890.35
50	84		120	0.915	2.814	5.688	0.046	0.451	420.920	76.83	236.37	477.78	3.87	37.84	35,357.26
120	153		175	0.595	2.249	5.195	0.044	0.248	420.920	91.08	344.11	794.78	6.76	37.96	64,400.73
175	229		250	0.410	1.232	4.893	0.044	0.157	420.920	93.93	282.06	1,120.47	10.12	35.92	96,390.62
250	363		500	0.367	1.479	4.489	0.039	0.145	420.920	133.33	536.97	1,629.46	14.00	52.64	152,793.90
500	586		750	0.379	1.479	4.600	0.040	0.147	420.920	222.15	866.84	2,695.71	23.15	86.04	246,659.08
750	1130		9999	0.496	1.840	5.426	0.040	0.177	420.920	560.98	2,079.03	6,131.17	44.64	199.95	475,639.29
0	39	Graders	50	2.125	4.675	3.648	0.038	0.472	318.965	83.21	183.08	142.85	1.51	18.49	12,491.08
50	91		120	1.007	2.857	5.703	0.041	0.536	373.677	91.61	259.95	518.91	3.72	48.80	34,003.49
120	148		175	0.674	2.331	5.292	0.040	0.301	379.933	99.76	344.83	782.98	5.90	44.58	56,209.86
175	204		250	0.493	1.366	5.062	0.040	0.197	382.031	100.79	279.05	1,034.35	8.20	40.26	78,069.24
250	293		500	0.406	1.641	4.175	0.033	0.163	355.058	119.10	481.21	1,223.97	9.54	47.87	104,092.32
500	796		1000	0.000	0.000	0.000	0.000	0.000	0.000						
1000	1993		9999	0.128	0.511	1.333	0.010	0.051	110.562	255.91	1,018.56	2,657.16	20.68	102.57	220,328.73
0	38	Off-Highway Trac	50	3.549	9.413	19.997	0.124	1.803	1128.991	133.67	354.50	753.09	4.66	67.90	42,518.60
50	75		120	1.675	5.438	12.828	0.083	0.740	793.735	124.84	405.26	956.04	6.21	55.19	59,156.29
120	158		175	0.644	1.833	5.841	0.039	0.266	374.226	101.82	289.70	923.26	6.21	42.01	59,156.27
175	214		250	1.849	9.889	17.338	0.113	0.753	1205.092	395.37	2,114.60	3,707.65	24.18	160.98	257,699.48
250	334		500	0.000	0.000	0.000	0.000	0.000	0.000						
500	574		750	0.000	0.000	0.000	0.000	0.000	0.000						
750	1000		1000	0.000	0.000	0.000	0.000	0.000	0.000						
1000	1726		9999	0.351	1.892	3.403	0.020	0.130	213.965	606.47	3,265.59	5,875.26	34.66	223.58	369,357.03
0	29	Off-Highway Truc	50	3.482	12.035	26.541	0.204	1.569	1947.088	101.48	350.69	773.41	5.96	45.73	56,738.84
50	87		120	1.071	2.822	11.177	0.091	0.412	867.695	93.28	245.70	973.11	7.93	35.84	75,543.74
120	159		175	0.864	2.918	8.729	0.071	0.332	777.452	137.29	463.62	1,387.00	11.32	52.69	123,528.55
175	211		250	1.065	3.564	10.997	0.089	0.412	949.548	224.81	752.02	2,320.54	18.80	86.89	200,369.21
250	372		500	0.000	0.000	0.000	0.000	0.000	0.000						
500	656		750	0.000	0.000	0.000	0.000	0.000	0.000						
750	897		1000	0.000	0.000	0.000	0.000	0.000	0.000						
1000	1764		9999	0.206	0.728	2.230	0.015	0.072	160.623	363.13	1,284.07	3,933.37	26.59	126.53	283,370.03
0	38	Other Constructio	50	0.153	0.737	1.007	0.018	0.072	120.626	5.81	27.99	38.29	0.67	2.74	4,584.61
50	82		120	0.109	0.327	0.669	0.009	0.043	73.505	8.89	26.66	54.60	0.71	3.53	5,995.26
120	152		175	0.435	1.004	0.892	0.010	0.104	83.257	66.33	153.11	136.09	1.53	15.83	12,695.85
175	217		250	0.386	1.187	2.302	0.019	0.205	169.093	83.74	257.50	499.36	4.02	44.37	36,676.92
250	357		500	0.201	0.760	1.682	0.014	0.089	135.388	71.81	271.27	600.28	5.07	31.73	48,314.78

		2006		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	Equipment	MaxHP	ROG	CO	NOX	SOX	PM	CO2	ROG	CO	NOX	SOX	PM	CO2
500	598		750	0.000	0.000	0.000	0.000	0.000	0.000						
750	830		1000	0.000	0.000	0.000	0.000	0.000	0.000						
1000	1127		9999	0.091	0.337	1.059	0.009	0.037	102.356	102.63	379.60	1,193.13	10.56	41.49	115,320.65
0	35	Other General In	50	0.090	0.505	0.630	0.012	0.047	82.643	3.14	17.71	22.10	0.42	1.64	2,900.93
50	73		120	0.122	0.394	0.826	0.011	0.052	95.123	8.95	28.82	60.44	0.82	3.84	6,962.24
120	149		175	0.454	0.988	0.762	0.008	0.100	66.128	67.68	147.43	113.61	1.19	14.91	9,863.17
175	209		250	0.370	1.032	2.055	0.015	0.198	134.599	77.33	215.74	429.67	3.08	41.43	28,139.05
250	355		500	0.222	0.750	1.711	0.013	0.099	122.674	78.70	266.19	606.92	4.57	35.23	43,514.01
500	592		750	0.129	0.347	1.364	0.011	0.050	103.965	76.06	205.18	806.61	6.46	29.82	61,499.79
750	885		1000	0.149	0.570	1.588	0.012	0.059	136.032	131.96	504.38	1,405.78	11.03	52.52	120,388.74
1000	2000		9999	0.110	0.416	1.188	0.009	0.044	99.212	220.90	831.31	2,376.65	18.62	87.69	198,423.93
0	36	Other Material Ha	50	2.604	5.679	4.416	0.046	0.575	384.920	93.09	203.01	157.86	1.66	20.56	13,759.53
50	93		120	0.804	2.252	4.491	0.032	0.430	295.388	74.94	209.80	418.35	3.01	40.03	27,519.05
120	145		175	0.686	2.330	5.318	0.040	0.307	383.028	99.19	336.86	768.88	5.82	44.31	55,373.70
175	218		250	0.370	1.002	3.935	0.032	0.145	301.336	80.71	218.69	858.97	6.91	31.70	65,777.26
250	331		500	0.285	1.097	3.053	0.024	0.114	262.307	94.40	363.40	1,011.82	7.96	37.68	86,919.96
500	565		750	0.000	0.000	0.000	0.000	0.000	0.000						
750	923		1000	0.000	0.000	0.000	0.000	0.000	0.000						
1000	1050		9999	0.424	1.654	4.512	0.029	0.148	320.256	445.38	1,737.08	4,737.19	30.81	155.20	336,269.26
0	39	Pavers	50	0.481	1.255	2.159	0.026	0.161	219.130	18.58	48.47	83.38	1.00	6.21	8,463.90
50	80		120	1.114	2.399	1.867	0.019	0.242	159.529	88.67	190.91	148.56	1.53	19.28	12,695.85
120	158		175	0.577	1.578	3.307	0.022	0.294	198.483	91.31	249.49	522.95	3.44	46.53	31,386.97
175	213		250	0.527	1.767	4.139	0.029	0.232	272.918	112.42	376.83	882.49	6.11	49.51	58,189.31
250	327		500	0.415	1.192	3.930	0.028	0.171	269.306	136.01	390.27	1,286.67	9.26	56.02	88,165.61
500	750		750	0.192	0.977	1.865	0.013	0.079	141.065	144.19	732.49	1,398.78	9.69	59.02	105,798.77
0	35	Paving Equipmen	50	0.244	0.732	1.498	0.019	0.097	164.512	8.50	25.47	52.17	0.68	3.37	5,727.92
50	89		120	0.847	1.823	1.430	0.015	0.184	122.494	75.00	161.53	126.72	1.31	16.34	10,852.90
120	148		175	0.481	1.316	2.762	0.018	0.244	166.573	71.35	195.25	409.88	2.71	36.28	24,720.50
175	216		250	0.406	1.365	3.205	0.022	0.178	212.473	87.63	294.43	691.19	4.81	38.49	45,823.36
250	339		500	0.000	0.000	0.000	0.000	0.000	0.000						
500	605		750	0.000	0.000	0.000	0.000	0.000	0.000						
750	842		1000	0.101	0.291	0.956	0.007	0.042	65.879	84.92	244.65	805.31	5.83	35.00	55,470.39
0	8	Plate Compactors	15	0.321	1.496	2.147	0.036	0.152	244.589	2.57	11.97	17.17	0.28	1.21	1,956.71
0	13	Pressure Washer	15	0.342	1.283	2.182	0.025	0.144	170.643	4.44	16.68	28.37	0.32	1.88	2,218.36
15	19		25	0.351	1.121	1.762	0.020	0.125	170.643	6.66	21.31	33.48	0.38	2.37	3,242.22
25	38		50	0.605	1.476	1.745	0.021	0.164	170.643	23.01	56.08	66.30	0.78	6.24	6,484.44
50	64		120	0.341	1.091	2.210	0.019	0.163	170.643	21.82	69.81	141.41	1.20	10.40	10,921.16
0	8	Pumps	15	0.973	3.164	5.523	0.061	0.436	420.920	7.79	25.31	44.18	0.49	3.49	3,367.36
15	21		25	1.122	2.766	4.347	0.050	0.344	420.920	23.57	58.09	91.29	1.05	7.22	8,839.31
25	37		50	1.926	4.453	4.467	0.051	0.475	420.920	71.27	164.75	165.26	1.88	17.59	15,574.03
50	84		120	0.940	2.855	5.768	0.046	0.467	420.920	78.92	239.86	484.48	3.87	39.24	35,357.25
120	151		175	0.612	2.282	5.267	0.044	0.258	420.920	92.43	344.64	795.33	6.67	38.89	63,558.88
175	217		250	0.423	1.255	4.962	0.044	0.163	420.920	91.86	272.37	1,076.72	9.59	35.44	91,339.57
250	372		500	0.378	1.551	4.537	0.039	0.150	420.920	140.53	576.95	1,687.86	14.34	55.78	156,582.10
500	615		750	0.389	1.551	4.649	0.040	0.152	420.920	239.42	953.83	2,859.37	24.29	93.36	258,865.67
750	1460		9999	0.504	1.916	5.480	0.040	0.179	420.920	735.71	2,796.88	8,001.41	57.67	262.06	614,542.97
0	36	Rollers	50	0.102	0.491	0.671	0.012	0.048	80.351	3.63	17.50	23.94	0.42	1.71	2,866.80
50	87		120	0.103	0.310	0.635	0.008	0.041	69.676	8.98	26.91	55.12	0.72	3.56	6,052.14
120	144		175	0.503	1.108	0.924	0.010	0.113	81.971	72.27	159.36	132.80	1.42	16.31	11,785.75
175	213		250	0.326	0.933	1.905	0.014	0.168	125.472	69.57	198.86	406.30	2.93	35.84	26,756.85
250	335		500	0.251	0.875	2.030	0.015	0.109	146.485	83.91	293.13	679.89	5.15	36.62	49,054.21
500	521		750	0.173	0.498	1.767	0.014	0.070	133.411	90.25	259.12	919.73	7.29	36.48	69,440.38
0	47	Rough Terrain Fo	50	2.065	4.588	3.658	0.039	0.465	324.798	97.66	216.93	172.98	1.85	22.00	15,357.89
50	96		120	0.757	2.191	4.315	0.032	0.407	294.068	72.91	211.06	415.69	3.10	39.17	28,326.77
120	130		175	0.740	2.601	5.861	0.046	0.330	437.172	95.83	337.02	759.47	5.95	42.80	56,653.52
175	208		250	0.441	1.213	4.718	0.039	0.174	371.911	91.96	252.65	982.75	8.14	36.32	77,471.99
250	374		500	0.000	0.000	0.000	0.000	0.000	0.000						
500	625		750	0.196	0.715	2.088	0.017	0.078	186.206	122.29	446.94	1,304.91	10.66	49.01	116,378.64
0	42	Rubber Tired Doz	50	3.081	9.882	23.272	0.148	1.365	1412.268	128.13	410.96	967.79	6.17	56.77	58,729.69
50	82		120	1.817	5.118	16.240	0.107	0.746	1020.078	148.23	417.59	1,325.04	8.74	60.88	83,228.35
120	150		175	1.270	6.813	11.573	0.074	0.512	802.660	190.10	1,019.73	1,732.28	11.01	76.69	120,144.17
175	211		250	1.363	7.277	12.560	0.080	0.551	857.369	287.57	1,535.29	2,649.91	16.98	116.32	180,887.36
250	354		500	0.000	0.000	0.000	0.000	0.000	0.000						
500	584		750	0.774	4.190	7.434	0.043	0.287	459.645	452.06	2,447.28	4,341.93	25.20	167.62	268,478.57
0	42	Rubber Tired Loa	50	0.254	0.787	1.640	0.022	0.105	184.165	10.60	32.83	68.39	0.91	4.36	7,678.94
50	86		120	1.080	2.380	1.869	0.020	0.241	164.013	93.05	205.00	161.02	1.70	20.73	14,129.25
120	150		175	0.475	1.353	2.699	0.020	0.253	178.155	71.30	203.02	404.83	2.93	37.98	26,722.73
175	206		250	0.411	1.427	3.240	0.025	0.184	234.204	84.71	293.73	667.21	5.06	37.79	48,223.75
250	320		500	0.269	0.746	2.780	0.022	0.107	211.376	86.08	238.49	888.83	7.10	34.33	67,574.68
500	600		750	0.202	0.804	2.090	0.016	0.081	179.033	121.28	483.00	1,254.77	9.85	48.74	107,505.17
750	837		1000	0.302	1.182	3.152	0.025	0.121	263.180	252.46	989.46	2,637.42	20.67	101.09	220,232.12
1000	1521		9999	0.232	0.927	2.479	0.017	0.081	177.105	353.23	1,409.23	3,770.59	25.28	123.30	269,377.32
0	36	Scrapers	50	3.484	9.477	19.630	0.129	1.808	1178.450	125.92	342.53	709.50	4.66	65.35	42,592.55
50	84		120	1.564	5.202	12.083	0.084	0.695	796.487	131.87	438.66	1,018.89	7.05	58.62	67,165.14
120	166		175	0.876	2.471	8.325	0.060	0.357	571.806	145.58	410.64	1,383.38	9.98	59.40	95,014.09
175	225		250	0.880	4.253	8.490	0.059	0.357	648.067	197.99	956.77	1,910.09	13.36	80.29	145,797.48
250	381		500	0.000	0.000	0.000	0.000	0.000	0.000						
500	565		750	0.000	0.000	0.000	0.000	0.000	0.000						
750	950		1000	0.000	0.000	0.000	0.000	0.000	0.000						
1000	1923		9999	0.180	0.859	1.749	0.012	0.073	130.956	345.48	1,652.84	3,363.66	23.64	139.91	251,869.36
0	6	Signal Boards	15	0.558	2.848	3.552	0.068	0.263	466.425	3.35	17.09	21.31	0.41	1.58	2,798.55
15	37		50	2.227	5.072	4.777	0.054	0.534	443.672	82.41	187.65	176.73	1.98	19.74	16,415.87
50	82		120	1.032	3.084	6.203	0.049	0.523	443.672	84.59	252.91	508.63	3.98	42.85	36,381.11
120	158		175	0.674	2.466	5.666	0.047	0.288	443.672	106.49	389.58	895.23	7.36	45.58	70,100.20
175	216		250	0.563	1.631	6.446	0.056	0.220	536.104	121.50	352.25	1,392.44	12.16	47.48	115,798.43
0	43	Skid Steer Loade	50	0.353	0.891	1.456	0.017	0.112	143.940	15.37	38.75	63.29	0.74	4.87	6,256.91
50	71		120	0.798	1.903	1.711	0.020	0.197	164.106	56.27	134.20	120.72	1.40	13.88	11,575.30
120	153		175	0.000	0.000	0.000	0.000	0.000	0.000						
175	201		250	0.000	0.000	0.000	0.000	0.000	0.000						
250	277		500	0.000	0.000	0.000	0.000	0.000	0.000						
500	530		750	0.000	0.000	0.000	0.000	0.000	0.000						
750	1000		1000	0.042	0.134	0.249	0.002	0.023	19.396	41.79	134.27	249.22	2.12	22.79	19,396.44
0	36	Surfacing Equipm	50	0.946	2.138	1.961	0.022	0.223	179.415	33.75	76.24	69.95	0.77	7.95	6,399.12
50	89		120	0.789	2.331	4.774	0.036	0.396	326.162	70.00	206.67	423.37	3.17	35.11	28,924.01
120	151		175	0.409	1.485	3.439	0.027	0.175	257.701	61.73	224.25	519.21	4.09	26.45	38,906.65
175	216		250	0.340	1.012	3.612	0.030	0.136	283.137	73.56	218.60	780.39	6.42	29.35	61,175.57
250	362		500	0.296	1.345	3.210	0.025	0.120	276.905	107.33	487.35	1,163.32	9.19	43.32	100,338.17
500	615		750	0.000	0.000	0.000	0.000	0.000	0.000						
750	814		1000	0.000	0.000	0.000	0.000	0.000	0.000						
1000	1141		9999	0.151	0.670	1.635	0.013	0.060	137.965	172.20	764.59	1,866.00	14.77	68.66	157,418.33
0	36	Sweepers/Scrubb	50	0.165	0.929	1.159	0.022	0.086	152.169	5.87	33.06	41.25	0.79	3.06	5,415.08
50	78		120	0.151	0.491	1.024	0.014	0.064	114.751	11.70	38.06	79.35	1.05	4.97	8,896.19
120	159		175	0.578	1.271	1.011	0.011	0.130	89.742	92.19	202.62	161.26	1.73	20.65	14,311.27
175	204		250	0.434	1.234	2.411	0.018	0.235	166.517	88.71	252.15	492.80	3.73	47.94	34,037.62
250	303		500	0.357	1.222	2.770	0.022	0.159	208.420	107.85	369.61	838.01	6.62	48.20	63,046.95
500	848		1000	0.094	0.248	1.072	0.009	0.036	86.663	79.90	209.97	909.45	7.72	30.61	73,490.34
0	38	Tractors/Loaders	50	0.343	0.950	1.783	0.022	0.124	187.845	13.13	36.39	68.30	0.85	4.74	7,195.46
50	83		120	1.000	2.268	1.838	0.020	0.230	166.547	82.67	187.46	151.94	1.66	19.04	13,765.22
120	144		175	0.400	1.195	2.290	0.018	0.219	163.015	57.64	172.05	329.64	2.57	31.48	23,463.43

		2006		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	**Equipment**	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2	**ROG**	**CO**	**NOX**	**SOX**	**PM**	**CO2**
175	204		250	0.362	1.319	2.891	0.024	0.163	225.193	73.98	269.26	590.46	4.83	33.34	45,988.34
250	320		500	0.262	0.709	2.944	0.026	0.101	243.327	83.74	227.13	942.46	8.18	32.48	77,898.61
500	575		750	0.259	0.874	2.868	0.029	0.103	272.221	148.64	502.05	1,647.90	16.43	59.01	156,422.90
750	871		1000	0.000	0.000	0.000	0.000	0.000	0.000						
1000	2006		9999	0.114	0.375	1.274	0.012	0.045	116.988	227.71	753.07	2,554.85	24.64	90.05	234,634.35
0	40	Trenchers	50	0.115	0.589	0.735	0.014	0.054	96.524	4.59	23.44	29.24	0.56	2.17	3,839.47
50	82		120	0.251	0.778	1.620	0.022	0.103	181.964	20.62	63.84	132.97	1.77	8.48	14,931.28
120	144		175	0.690	1.492	1.201	0.013	0.152	103.783	99.25	214.65	172.86	1.80	21.82	14,931.27
175	218		250	0.384	1.058	2.232	0.015	0.193	134.766	83.95	231.07	487.43	3.22	42.14	29,435.94
250	359		500	0.345	1.168	2.745	0.019	0.151	182.058	123.76	418.71	984.19	6.85	54.04	65,271.00
500	619		750	0.250	0.727	2.373	0.017	0.103	163.272	154.91	450.00	1,469.22	10.62	63.89	101,106.10
750	860		1000	0.222	1.172	2.172	0.015	0.091	164.194	191.12	1,008.06	1,867.91	12.94	78.34	141,207.24
0	11	Welders	15	0.592	1.924	3.359	0.037	0.265	255.965	6.51	21.17	36.94	0.41	2.92	2,815.61
15	20		25	0.683	1.682	2.643	0.030	0.209	255.965	13.65	33.64	52.87	0.61	4.18	5,119.30
25	46		50	1.390	3.120	2.799	0.031	0.325	255.965	63.94	143.54	128.77	1.42	14.95	11,774.38
50	70		120	0.620	1.818	3.661	0.028	0.317	255.965	43.39	127.27	256.29	1.96	22.21	17,917.53
120	174		175	0.405	1.452	3.344	0.027	0.175	255.965	70.53	252.73	581.80	4.68	30.47	44,537.87
175	211		250	0.282	0.806	3.150	0.027	0.111	255.965	59.55	170.00	664.74	5.67	23.43	54,008.58
250	297		500	0.250	1.030	2.852	0.023	0.100	255.965	74.21	305.91	847.07	6.96	29.82	76,021.53
0	29	Water Trucks	50	3.482	12.035	26.541	0.204	1.569	1947.088	101.475	350.693	773.413	5.958	45.734	56738.841
50	87		120	1.071	2.822	11.177	0.091	0.412	867.695	93.279	245.704	973.112	7.933	35.835	75543.737
120	159		175	0.864	2.918	8.729	0.071	0.332	777.452	137.290	463.621	1387.002	11.316	52.692	123528.552
175	211		250	1.065	3.564	10.997	0.089	0.412	949.548	224.813	752.015	2320.541	18.803	86.894	200369.206
250	372		500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
500	656		750	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
750	897		1000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1000	1764		9999	0.206	0.728	2.230	0.015	0.072	160.623	363.134	1284.070	3933.373	26.593	126.530	283370.026

cks, and Welders)

2007

2007 data has not been updated and not used in this model
(OFFROAD2007 rows were added or deleted to match OFFROAD2011 HP categories)

		2007		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	Equipment	MaxHP	ROG	CO	NOX	SOX	PM	CO2	ROG	CO	NOX	SOX	PM	CO2
0	46	Aerial Lifts	50	0.117	0.529	0.769	0.001	0.054	85.116	5.41	24.40	35.45	0.06	2.48	3,924.79
50	74		120	0.160	0.408	0.672	0.001	0.050	67.164	11.87	30.21	49.73	0.06	3.72	4,971.40
120	130		175	0.294	0.698	0.711	0.001	0.072	68.185	38.34	91.13	92.83	0.12	9.38	8,896.20
175	210		250	0.174	0.551	1.090	0.001	0.085	82.234	36.47	115.64	229.00	0.20	17.79	17,269.09
250	380		500	0.211	0.857	2.596	0.002	0.082	254.079	80.21	325.50	986.55	0.95	31.08	96,549.90
0	12	Air Compressors	15	0.605	2.019	3.461	0.004	0.265	273.029	7.27	24.23	41.53	0.05	3.18	3,276.35
15	24		25	0.694	1.736	2.768	0.003	0.211	273.029	16.65	41.65	66.43	0.08	5.06	6,552.70
25	37		50	1.564	3.537	3.003	0.004	0.350	273.029	57.88	130.87	111.11	0.13	12.95	10,102.07
50	78		120	0.663	1.974	3.887	0.003	0.339	273.029	51.69	154.01	303.17	0.25	26.43	21,296.27
120	147		175	0.434	1.581	3.495	0.003	0.186	273.029	63.81	232.43	513.72	0.45	27.40	40,135.27
175	218		250	0.296	0.830	3.286	0.003	0.113	273.029	64.62	180.97	716.34	0.67	24.65	59,520.34
250	385		500	0.263	1.018	2.950	0.003	0.102	273.029	101.08	391.93	1,135.65	1.03	39.37	105,116.18
500	595		750	0.268	1.018	3.025	0.003	0.104	273.029	159.63	605.71	1,799.98	1.63	61.63	162,452.25
750	808		1000	0.331	1.267	3.634	0.003	0.113	273.029	267.83	1,023.73	2,936.38	2.22	91.28	220,607.45
0	39	Bore/Drill Rigs	50	0.143	0.730	0.911	0.002	0.066	119.487	5.61	28.65	35.76	0.07	2.58	4,692.69
50	82		120	0.122	0.380	0.769	0.001	0.049	88.089	10.05	31.26	63.34	0.09	4.04	7,252.34
120	149		175	0.300	0.882	0.904	0.001	0.088	94.779	44.56	131.05	134.27	0.18	13.08	14,078.06
175	208		250	0.264	1.094	1.838	0.002	0.149	168.382	54.92	227.38	381.85	0.41	30.92	34,981.86
250	349		500	0.180	0.979	1.680	0.002	0.085	183.260	62.92	342.01	586.74	0.72	29.54	63,991.20
500	612		750	0.084	0.262	1.211	0.002	0.032	139.423	51.12	160.20	741.01	0.96	19.32	85,321.59
750	919		1000	0.080	0.280	1.103	0.002	0.033	153.653	73.91	257.56	1,013.86	1.39	29.91	141,207.18
1000	2667		9999	0.057	0.191	0.791	0.001	0.023	104.626	152.65	508.89	2,109.80	2.81	60.86	279,001.63
0	9	Cement and Mortar Mixers	15	0.463	2.010	3.005	0.005	0.212	318.534	4.17	18.09	27.04	0.04	1.91	2,866.81
15	25		25	0.775	1.963	3.198	0.004	0.241	318.534	19.38	49.07	79.96	0.10	6.02	7,963.35
0	18	Concrete/Industrial Saws	25	0.541	1.737	3.531	0.005	0.225	415.232	9.74	31.26	63.57	0.09	4.05	7,474.17
25	33		50	2.078	4.830	4.449	0.005	0.484	415.232	68.57	159.39	146.82	0.18	15.97	13,702.65
50	81		120	0.926	2.884	5.702	0.005	0.465	415.232	75.04	233.64	461.86	0.39	37.65	33,633.77
120	175		175	0.606	2.316	5.102	0.005	0.256	415.232	106.02	405.34	892.81	0.82	44.80	72,665.51
0	41	Cranes	50	1.735	3.856	2.975	0.003	0.373	258.865	70.51	156.66	120.87	0.14	15.17	10,517.31
50	89		120	0.683	1.966	3.908	0.003	0.354	255.738	60.71	174.84	347.62	0.27	31.48	22,746.74
120	148		175	0.435	1.526	3.377	0.003	0.189	246.433	64.34	225.60	499.35	0.41	27.91	36,443.70
175	217		250	0.308	0.859	3.065	0.003	0.119	234.444	66.94	186.39	665.01	0.57	25.85	50,874.44
250	336		500	0.286	1.141	2.838	0.002	0.110	243.055	96.06	383.61	953.74	0.80	37.05	81,692.56
500	567		750	0.288	1.138	2.895	0.002	0.111	242.350	163.37	645.48	1,641.91	1.38	63.05	137,458.74
750	938		1000	0.000	0.000	0.000	0.000	0.000	0.000						
1000	1030		9999	0.563	2.305	5.976	0.004	0.191	427.436	580.34	2,374.31	6,155.42	4.43	197.18	440,259.42
0	43	Crawler Tractors	50	1.843	4.067	3.090	0.003	0.393	265.472	78.36	172.91	131.37	0.15	16.69	11,285.20
50	87		120	0.964	2.725	5.500	0.004	0.492	343.682	83.71	236.64	477.70	0.35	42.74	29,851.18
120	150		175	0.685	2.369	5.267	0.004	0.297	367.587	102.42	354.30	787.69	0.62	44.45	54,969.87
175	203		250	0.532	1.495	5.102	0.004	0.208	371.494	108.00	303.23	1,034.83	0.85	42.17	75,356.01
250	341		500	0.442	2.023	4.251	0.003	0.171	345.134	150.44	689.29	1,448.14	1.15	58.29	117,584.50
500	570		750	0.477	2.167	4.647	0.004	0.185	369.712	271.83	1,235.59	2,649.60	2.12	105.52	210,778.36
750	828		1000	0.000	0.000	0.000	0.000	0.000	0.000						
1000	1527		9999	0.276	1.275	2.840	0.002	0.096	195.553	420.99	1,946.71	4,334.62	3.00	147.04	298,511.81
0	45	Crushing/Proc. Equipment	50	2.643	5.961	4.916	0.006	0.586	443.672	118.93	268.23	221.21	0.26	26.37	19,965.25
50	85		120	1.095	3.250	6.360	0.005	0.567	443.672	93.05	276.29	540.58	0.44	48.16	37,712.15
120	171		175	0.719	2.604	5.710	0.005	0.312	443.672	122.93	445.28	976.43	0.85	53.29	75,867.93
175	250		250	0.486	1.345	5.363	0.005	0.185	443.672	121.54	336.34	1,340.82	1.25	46.26	110,918.01
250	382		500	0.431	1.635	4.787	0.004	0.167	443.672	164.55	624.51	1,828.50	1.66	63.98	169,482.84
500	602		750	0.437	1.577	4.925	0.004	0.168	443.672	262.98	949.58	2,964.92	2.69	101.17	267,090.73
750	1337		9999	0.544	2.031	5.956	0.004	0.185	443.672	727.94	2,715.69	7,962.88	5.96	247.04	593,189.60
0	16	Dumpers/Tenders	25	0.388	1.086	2.010	0.003	0.137	216.148	6.20	17.37	32.15	0.04	2.20	3,458.37
0	36	Excavators	50	0.261	0.859	1.717	0.003	0.112	208.660	9.32	30.70	61.36	0.09	3.99	7,457.11
50	82		120	0.839	1.957	1.541	0.002	0.189	138.765	68.60	160.02	126.03	0.15	15.50	11,347.77
120	146		175	0.556	1.710	3.201	0.003	0.300	228.669	81.15	249.76	467.52	0.39	43.77	33,394.85
175	218		250	0.373	1.403	2.888	0.003	0.165	232.995	81.45	306.58	630.86	0.57	36.09	50,902.87
250	329		500	0.238	0.640	2.563	0.002	0.088	219.014	78.25	210.23	842.30	0.81	29.06	71,977.29
500	578		750	0.180	0.599	1.868	0.002	0.067	183.446	104.01	346.35	1,079.52	1.04	38.84	106,020.56
750	843		1000	0.000	0.000	0.000	0.000	0.000	0.000						
1000	1569		9999	0.111	0.366	1.178	0.001	0.042	111.990	174.24	574.07	1,848.18	1.77	65.52	175,728.29
0	42	Forklifts	50	0.978	2.239	1.747	0.002	0.218	156.923	41.47	94.95	74.08	0.09	9.25	6,655.08
50	82		120	0.427	1.282	2.379	0.002	0.233	171.952	35.20	105.63	195.96	0.17	19.22	14,163.39
120	141		175	0.295	1.070	2.230	0.002	0.132	179.962	41.70	151.23	315.05	0.29	18.61	25,425.83
175	208		250	0.164	0.413	1.926	0.002	0.058	168.058	34.04	86.04	400.92	0.39	12.18	34,981.85
250	344		500	0.000	0.000	0.000	0.000	0.000	0.000						
500	880		1000	0.050	0.141	0.568	0.001	0.018	57.204	44.08	124.23	500.19	0.49	16.20	50,339.74
0	11	Generator Sets	15	0.804	3.112	5.200	0.007	0.332	420.920	8.84	34.23	57.20	0.07	3.65	4,630.12
15	19		25	0.820	2.676	4.267	0.005	0.291	420.920	15.59	50.84	81.08	0.10	5.53	7,997.48
25	33		50	1.741	4.172	4.366	0.005	0.432	420.920	57.45	137.67	144.06	0.18	14.25	13,890.36
50	84		120	0.871	2.788	5.526	0.005	0.422	420.920	73.20	234.21	464.17	0.41	35.48	35,357.28
120	153		175	0.566	2.236	4.962	0.005	0.232	420.920	86.56	342.11	759.16	0.72	35.53	64,400.75
175	229		250	0.383	1.161	4.667	0.005	0.143	420.920	87.81	265.93	1,068.80	1.08	32.73	96,390.64
250	363		500	0.343	1.368	4.271	0.004	0.132	420.920	124.55	496.76	1,550.49	1.50	48.09	152,793.88
500	586		750	0.354	1.368	4.381	0.004	0.134	420.920	207.65	801.93	2,567.09	2.48	78.65	246,659.05
750	1130		9999	0.470	1.720	5.273	0.004	0.163	420.920	531.08	1,943.41	5,958.62	4.78	184.33	475,639.51
0	39	Graders	50	2.008	4.550	3.591	0.004	0.442	318.965	78.62	178.17	140.61	0.16	17.30	12,491.08
50	91		120	0.949	2.820	5.493	0.004	0.497	373.677	86.38	256.62	499.88	0.40	45.23	34,003.50
120	148		175	0.636	2.311	4.986	0.004	0.278	379.933	94.15	341.96	737.66	0.63	41.19	56,209.87
175	204		250	0.463	1.286	4.768	0.004	0.178	382.031	94.60	262.76	974.41	0.88	36.33	78,069.24
250	293		500	0.384	1.491	3.928	0.003	0.148	355.057	112.61	437.21	1,151.56	1.02	43.45	104,092.31
500	796		1000	0.000	0.000	0.000	0.000	0.000	0.000						
1000	1993		9999	0.121	0.464	1.255	0.001	0.047	110.562	241.41	925.42	2,501.22	2.22	93.17	220,328.78
0	38	Off-Highway Tractors	50	3.408	9.299	19.420	0.013	1.690	1128.991	128.36	350.19	731.37	0.50	63.64	42,518.60
50	75		120	1.607	5.376	12.292	0.009	0.691	793.735	119.80	400.69	916.12	0.67	51.48	59,156.29
120	158		175	0.615	1.751	5.595	0.004	0.244	374.226	97.22	276.86	884.38	0.67	38.54	59,156.28
175	214		250	1.771	9.255	16.597	0.012	0.693	1205.093	378.71	1,979.01	3,549.24	2.59	148.26	257,699.59
250	334		500	0.000	0.000	0.000	0.000	0.000	0.000						
500	574		750	0.000	0.000	0.000	0.000	0.000	0.000						
750	1000		1000	0.000	0.000	0.000	0.000	0.000	0.000						
1000	1726		9999	0.336	1.773	3.305	0.002	0.120	213.965	579.87	3,061.08	5,706.12	3.71	206.64	369,357.05
0	29	Off-Highway Trucks	50	3.264	11.982	24.736	0.022	1.434	1947.089	95.10	349.17	720.80	0.64	41.79	56,738.86
50	87		120	1.006	2.651	10.421	0.010	0.369	867.695	87.63	230.78	907.26	0.85	32.14	75,543.73
120	159		175	0.818	2.692	8.140	0.008	0.300	777.453	130.05	427.67	1,293.39	1.21	47.60	123,528.58
175	211		250	1.008	3.287	10.257	0.010	0.372	949.548	212.73	693.70	2,164.31	2.01	78.52	200,369.19
250	372		500	0.000	0.000	0.000	0.000	0.000	0.000						
500	656		750	0.000	0.000	0.000	0.000	0.000	0.000						
750	897		1000	0.000	0.000	0.000	0.000	0.000	0.000						
1000	1764		9999	0.194	0.671	2.142	0.002	0.066	160.623	341.61	1,183.31	3,778.28	2.85	116.57	283,369.94
0	38	Other Construction Equipment	50	0.144	0.737	0.919	0.002	0.066	120.626	5.48	27.99	34.94	0.07	2.52	4,584.61
50	82		120	0.102	0.317	0.642	0.001	0.041	73.505	8.31	25.84	52.36	0.08	3.34	5,995.26
120	152		175	0.403	0.970	0.875	0.001	0.096	83.257	61.52	147.92	133.42	0.16	14.69	12,695.85
175	217		250	0.358	1.173	2.212	0.002	0.188	169.093	77.68	254.36	479.82	0.43	40.68	36,676.90
250	357		500	0.186	0.757	1.565	0.002	0.082	135.388	66.51	270.09	558.63	0.54	29.09	48,314.78
500	598		750	0.000	0.000	0.000	0.000	0.000	0.000						
750	830		1000	0.000	0.000	0.000	0.000	0.000	0.000						
1000	1127		9999	0.084	0.309	0.985	0.001	0.033	102.356	94.90	348.14	1,109.49	1.13	37.37	115,320.66
0	35	Other General Industrial Equipm	50	0.086	0.505	0.607	0.001	0.044	82.643	3.03	17.71	21.32	0.05	1.56	2,900.93
50	73		120	0.119	0.392	0.784	0.001	0.051	95.123	8.71	28.67	57.36	0.09	3.72	6,962.24

		2007		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	Equipment	MaxHP	ROG	CO	NOX	SOX	PM	CO2	ROG	CO	NOX	SOX	PM	CO2
120	149		175	0.438	0.975	0.754	0.001	0.095	66.128	65.36	145.38	112.42	0.13	14.15	9,863.18
175	209		250	0.356	1.025	1.999	0.002	0.187	134.599	74.46	214.35	417.96	0.33	39.17	28,139.06
250	355		500	0.214	0.748	1.639	0.001	0.094	122.674	75.81	265.28	581.40	0.49	33.20	43,514.01
500	592		750	0.122	0.327	1.304	0.001	0.046	103.965	72.12	193.62	771.53	0.69	27.12	61,499.79
750	885		1000	0.142	0.521	1.514	0.001	0.054	136.032	125.96	461.05	1,339.94	1.18	48.02	120,388.75
1000	2000		9999	0.105	0.380	1.134	0.001	0.040	99.212	210.37	759.89	2,268.28	2.00	80.29	198,423.94
0	36	Other Material Handling Equipme	50	2.517	5.603	4.370	0.005	0.546	384.920	89.98	200.30	156.21	0.18	19.52	13,759.52
50	93		120	0.775	2.238	4.369	0.003	0.406	295.388	72.18	208.47	407.04	0.32	37.87	27,519.05
120	145		175	0.661	2.322	5.096	0.004	0.289	383.028	95.56	335.73	736.77	0.62	41.80	55,373.68
175	218		250	0.350	0.945	3.765	0.003	0.132	301.336	76.47	206.34	821.82	0.74	28.83	65,777.27
250	331		500	0.272	1.002	2.911	0.003	0.104	262.307	89.98	332.13	964.71	0.85	34.46	86,919.90
500	565		750	0.000	0.000	0.000	0.000	0.000	0.000						
750	923		1000	0.000	0.000	0.000	0.000	0.000	0.000						
1000	1050		9999	0.405	1.531	4.395	0.003	0.138	320.257	425.48	1,607.54	4,614.30	3.30	144.49	336,269.46
0	39	Pavers	50	0.431	1.170	2.079	0.003	0.147	219.130	16.66	45.17	80.29	0.11	5.68	8,463.90
50	80		120	1.071	2.352	1.842	0.002	0.228	159.529	85.24	187.20	146.62	0.16	18.16	12,695.85
120	158		175	0.551	1.557	3.201	0.002	0.275	198.483	87.12	246.17	506.23	0.37	43.48	31,386.96
175	213		250	0.503	1.746	3.946	0.003	0.216	272.918	107.20	372.31	841.38	0.65	46.05	58,189.32
250	327		500	0.393	1.131	3.745	0.003	0.156	269.306	128.69	370.14	1,225.98	0.99	51.01	88,165.63
500	750		750	0.183	0.900	1.775	0.001	0.072	141.065	136.97	674.97	1,331.18	1.04	53.99	105,798.74
0	35	Paving Equipment	50	0.228	0.709	1.437	0.002	0.092	164.512	7.94	24.69	50.02	0.07	3.19	5,727.92
50	89		120	0.815	1.789	1.412	0.002	0.174	122.494	72.20	158.51	125.08	0.14	15.41	10,852.90
120	148		175	0.459	1.298	2.673	0.002	0.229	166.573	68.09	192.58	396.62	0.29	33.92	24,720.50
175	216		250	0.388	1.348	3.057	0.002	0.166	212.473	83.57	290.68	659.28	0.52	35.80	45,823.38
250	339		500	0.000	0.000	0.000	0.000	0.000	0.000						
500	605		750	0.000	0.000	0.000	0.000	0.000	0.000						
750	842		1000	0.095	0.275	0.912	0.001	0.038	65.879	80.29	231.72	767.55	0.62	31.86	55,470.41
0	8	Plate Compactors	15	0.305	1.493	1.990	0.004	0.140	244.589	2.44	11.95	15.92	0.03	1.12	1,956.71
0	13	Pressure Washers	15	0.326	1.262	2.108	0.003	0.135	170.643	4.24	16.40	27.41	0.03	1.75	2,218.36
15	19		25	0.333	1.085	1.730	0.002	0.118	170.643	6.32	20.61	32.87	0.04	2.24	3,242.22
25	38		50	0.576	1.444	1.720	0.002	0.154	170.643	21.87	54.88	65.34	0.08	5.87	6,484.44
50	64		120	0.323	1.080	2.146	0.002	0.152	170.643	20.70	69.12	137.32	0.13	9.72	10,921.16
0	8	Pumps	15	0.933	3.112	5.336	0.007	0.408	420.920	7.47	24.90	42.69	0.05	3.26	3,367.36
15	21		25	1.070	2.676	4.267	0.005	0.325	420.920	22.47	56.19	89.61	0.11	6.82	8,839.31
25	37		50	1.849	4.377	4.407	0.005	0.449	420.920	68.41	161.94	163.07	0.20	16.62	15,574.04
50	84		120	0.896	2.830	5.604	0.005	0.438	420.920	75.28	237.71	470.76	0.41	36.83	35,357.27
120	151		175	0.583	2.269	5.033	0.005	0.241	420.920	87.98	342.69	759.96	0.72	36.43	63,558.91
175	217		250	0.396	1.183	4.735	0.005	0.149	420.920	85.99	256.79	1,027.40	1.03	32.28	91,339.60
250	372		500	0.354	1.431	4.318	0.004	0.137	420.920	131.52	532.28	1,606.42	1.54	50.96	156,582.13
500	615		750	0.364	1.431	4.429	0.004	0.139	420.920	224.15	879.98	2,723.62	2.60	85.35	258,865.67
750	1460		9999	0.477	1.787	5.327	0.004	0.165	420.920	696.92	2,608.50	7,777.98	6.18	241.61	614,543.09
0	36	Rollers	50	0.096	0.491	0.612	0.001	0.044	80.351	3.43	17.50	21.85	0.04	1.58	2,866.81
50	87		120	0.097	0.300	0.608	0.001	0.039	69.676	8.39	26.08	52.85	0.08	3.37	6,052.14
120	144		175	0.479	1.083	0.910	0.001	0.106	81.971	68.91	155.73	130.78	0.15	15.31	11,785.75
175	213		250	0.309	0.920	1.839	0.001	0.156	125.472	65.80	196.19	392.08	0.31	33.32	26,756.86
250	335		500	0.237	0.866	1.922	0.002	0.101	146.485	79.34	290.11	643.74	0.55	33.92	49,054.22
500	521		750	0.162	0.469	1.672	0.002	0.063	133.411	84.55	243.90	870.24	0.78	33.01	69,440.37
0	47	Rough Terrain Forklifts	50	1.937	4.445	3.592	0.004	0.433	324.798	91.58	210.19	169.87	0.20	20.49	15,357.89
50	96		120	0.711	2.165	4.152	0.003	0.376	294.068	68.48	208.59	399.93	0.33	36.23	28,326.77
120	130		175	0.694	2.586	5.497	0.005	0.305	437.172	89.97	335.16	712.35	0.64	39.53	56,653.54
175	208		250	0.409	1.131	4.422	0.004	0.156	371.911	85.20	235.57	921.04	0.87	32.41	77,471.99
250	374		500	0.000	0.000	0.000	0.000	0.000	0.000						
500	625		750	0.183	0.651	1.952	0.002	0.070	186.206	114.09	407.04	1,220.21	1.14	44.05	116,378.63
0	42	Rubber Tired Dozers	50	2.959	9.771	22.295	0.016	1.270	1412.268	123.04	406.34	927.14	0.66	52.81	58,729.66
50	82		120	1.741	4.899	15.555	0.011	0.685	1020.079	142.03	399.73	1,269.15	0.94	55.91	83,228.37
120	150		175	1.223	6.394	11.080	0.008	0.472	802.660	182.99	957.06	1,658.43	1.18	70.66	120,144.13
175	211		250	1.311	6.830	12.027	0.009	0.508	857.369	276.65	1,440.93	2,537.51	1.82	107.20	180,887.41
250	354		500	0.000	0.000	0.000	0.000	0.000	0.000						
500	584		750	0.742	3.937	7.222	0.005	0.266	459.645	433.29	2,299.84	4,218.63	2.70	155.13	268,478.45
0	42	Rubber Tired Loaders	50	0.240	0.770	1.566	0.002	0.100	184.165	10.01	32.12	65.31	0.10	4.16	7,678.94
50	86		120	1.020	2.316	1.839	0.002	0.225	164.013	87.91	199.50	158.47	0.18	19.39	14,129.25
120	150		175	0.448	1.336	2.600	0.002	0.235	178.155	67.20	200.45	389.99	0.31	35.20	26,722.73
175	206		250	0.388	1.415	3.052	0.003	0.170	234.204	79.90	291.39	628.35	0.54	34.91	48,223.76
250	320		500	0.252	0.702	2.618	0.002	0.097	211.376	80.68	224.42	836.96	0.76	30.95	67,574.71
500	600		750	0.191	0.731	1.965	0.002	0.074	179.033	114.48	438.81	1,179.95	1.06	44.21	107,505.14
750	837		1000	0.284	1.074	2.965	0.003	0.110	263.180	237.78	898.93	2,481.43	2.21	91.76	220,232.03
1000	1521		9999	0.218	0.845	2.389	0.002	0.074	177.105	332.11	1,285.26	3,633.06	2.71	112.89	269,377.16
0	36	Scrapers	50	3.318	9.352	18.977	0.014	1.686	1178.450	119.93	337.99	685.89	0.50	60.94	42,592.53
50	84		120	1.490	5.143	11.492	0.009	0.645	796.487	125.63	433.69	969.06	0.76	54.42	67,165.16
120	166		175	0.830	2.342	7.915	0.006	0.325	571.806	137.89	389.18	1,315.25	1.07	54.04	95,014.12
175	225		250	0.838	3.912	8.062	0.006	0.326	648.067	188.62	880.16	1,813.71	1.43	73.37	145,797.59
250	381		500	0.000	0.000	0.000	0.000	0.000	0.000						
500	565		750	0.000	0.000	0.000	0.000	0.000	0.000						
750	950		1000	0.000	0.000	0.000	0.000	0.000	0.000						
1000	1923		9999	0.171	0.791	1.662	0.001	0.067	130.956	328.57	1,520.50	3,195.63	2.53	127.93	251,869.30
0	6	Signal Boards	15	0.546	2.848	3.428	0.007	0.251	466.425	3.27	17.09	20.57	0.04	1.50	2,798.55
15	37		50	2.132	4.977	4.709	0.006	0.503	443.672	78.89	184.14	174.25	0.21	18.62	16,415.87
50	82		120	0.981	3.054	6.014	0.005	0.489	443.672	80.42	250.47	493.19	0.43	40.11	36,381.13
120	158		175	0.640	2.451	5.393	0.005	0.270	443.672	101.06	387.23	852.16	0.79	42.59	70,100.19
175	216		250	0.525	1.534	6.128	0.006	0.199	536.104	113.44	331.27	1,323.73	1.30	43.07	115,798.40
0	43	Skid Steer Loaders	50	0.328	0.848	1.417	0.002	0.104	143.940	14.27	36.86	61.58	0.08	4.54	6,256.92
50	71		120	0.725	1.828	1.676	0.002	0.181	164.106	51.16	128.96	118.20	0.15	12.80	11,575.30
120	153		175	0.000	0.000	0.000	0.000	0.000	0.000						
175	201		250	0.000	0.000	0.000	0.000	0.000	0.000						
250	277		500	0.000	0.000	0.000	0.000	0.000	0.000						
500	530		750	0.000	0.000	0.000	0.000	0.000	0.000						
750	1000		1000	0.038	0.133	0.238	0.000	0.021	19.396	38.16	132.62	238.47	0.23	20.67	19,396.44
0	36	Surfacing Equipment	50	0.900	2.089	1.931	0.002	0.209	179.415	32.10	74.50	68.87	0.08	7.46	6,399.12
50	89		120	0.744	2.299	4.609	0.004	0.367	326.162	66.01	203.89	408.71	0.34	32.58	28,924.02
120	151		175	0.385	1.470	3.254	0.003	0.162	257.701	58.15	221.96	491.25	0.44	24.46	38,906.64
175	216		250	0.319	0.955	3.417	0.003	0.123	283.137	68.86	206.41	738.21	0.69	26.66	61,175.59
250	362		500	0.278	1.233	3.034	0.003	0.109	276.905	100.73	446.93	1,099.22	0.98	39.50	100,338.18
500	615		750	0.000	0.000	0.000	0.000	0.000	0.000						
750	814		1000	0.000	0.000	0.000	0.000	0.000	0.000						
1000	1141		9999	0.142	0.615	1.546	0.001	0.055	137.965	161.48	701.18	1,763.64	1.58	62.62	157,418.28
0	36	Sweepers/Scrubbers	50	0.159	0.929	1.119	0.002	0.082	152.169	5.66	33.06	39.81	0.08	2.91	5,415.07
50	78		120	0.147	0.480	0.978	0.001	0.062	114.751	11.37	37.22	75.81	0.11	4.79	8,896.20
120	159		175	0.548	1.238	0.994	0.001	0.121	89.742	87.34	197.42	158.54	0.19	19.37	14,311.27
175	204		250	0.411	1.222	2.326	0.002	0.219	166.517	84.07	249.87	475.42	0.40	44.83	34,037.62
250	303		500	0.338	1.218	2.615	0.002	0.149	208.420	102.11	368.43	790.92	0.71	44.98	63,046.94
500	848		1000	0.087	0.228	1.010	0.001	0.032	86.663	73.66	193.69	856.51	0.83	27.11	73,490.31
0	38	Tractors/Loaders/Backhoes	50	0.300	0.878	1.709	0.002	0.112	187.845	11.50	33.61	65.45	0.09	4.30	7,195.46
50	83		120	0.925	2.188	1.803	0.002	0.213	166.547	76.46	180.80	149.03	0.18	17.64	13,765.21
120	144		175	0.372	1.181	2.200	0.002	0.200	163.015	53.56	170.05	316.62	0.28	28.84	23,463.43
175	204		250	0.337	1.315	2.687	0.003	0.150	225.193	68.76	268.45	548.64	0.52	30.55	45,988.35
250	320		500	0.243	0.667	2.738	0.003	0.091	243.327	77.70	213.54	876.40	0.88	29.12	77,898.62
500	575		750	0.242	0.810	2.665	0.003	0.093	272.221	139.30	465.18	1,531.25	1.76	53.29	156,422.89
750	871		1000	0.000	0.000	0.000	0.000	0.000	0.000						
1000	2006		9999	0.106	0.348	1.184	0.001	0.041	116.988	212.70	697.77	2,374.73	2.64	81.37	234,634.29
0	40	Trenchers	50	0.113	0.589	0.709	0.002	0.052	96.524	4.49	23.44	28.22	0.06	2.06	3,839.47
50	82		120	0.237	0.761	1.548	0.002	0.099	181.964	19.47	62.45	126.99	0.19	8.10	14,931.28
120	144		175	0.664	1.465	1.186	0.001	0.143	103.783	95.58	210.72	170.62	0.19	20.57	14,931.27
175	218		250	0.367	1.044	2.163	0.002	0.180	134.766	80.14	228.05	472.39	0.35	39.39	29,435.94
250	359		500	0.329	1.154	2.621	0.002	0.140	182.058	118.02	413.75	939.50	0.73	50.28	65,271.01

				g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
		2007													
	AvgHP	**Equipment**	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2	**ROG**	**CO**	**NOX**	**SOX**	**PM**	**CO2**
500	619		750	0.237	0.691	2.264	0.002	0.094	163.272	146.84	428.14	1,401.95	1.14	58.45	101,106.09
750	860		1000	0.211	1.086	2.070	0.002	0.084	164.194	181.69	933.82	1,780.40	1.39	71.91	141,207.20
0	11	Welders	15	0.568	1.893	3.245	0.004	0.248	255.965	6.24	20.82	35.69	0.04	2.73	2,815.61
15	20		25	0.651	1.627	2.595	0.003	0.197	255.965	13.01	32.54	51.90	0.06	3.95	5,119.30
25	46		50	1.341	3.076	2.765	0.003	0.308	255.965	61.71	141.48	127.19	0.15	14.16	11,774.38
50	70		120	0.594	1.803	3.560	0.003	0.299	255.965	41.55	126.24	249.17	0.21	20.92	17,917.53
120	174		175	0.388	1.445	3.199	0.003	0.165	255.965	67.46	251.45	556.60	0.50	28.63	44,537.86
175	211		250	0.265	0.759	3.009	0.003	0.101	255.965	55.95	160.20	634.92	0.61	21.31	54,008.58
250	297		500	0.235	0.940	2.716	0.003	0.092	255.965	69.84	279.22	806.74	0.75	27.23	76,021.53
0	29	Water Trucks	50	3.264	11.982	24.736	0.022	1.434	1947.089	95.101	349.171	720.804	0.638	41.793	56738.855
50	87		120	1.006	2.651	10.421	0.010	0.369	867.695	87.625	230.776	907.255	0.850	32.143	75543.727
120	159		175	0.818	2.692	8.140	0.008	0.300	777.453	130.047	427.667	1293.393	1.212	47.599	123528.582
175	211		250	1.008	3.287	10.257	0.010	0.372	949.548	212.726	693.696	2164.308	2.015	78.519	200369.187
250	372		500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
500	656		750	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
750	897		1000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1000	1764		9999	0.194	0.671	2.142	0.002	0.066	160.623	341.606	1183.315	3778.284	2.849	116.574	283369.941

2008

2008 data has not been updated and not used in this model
(OFFROAD2007 rows were added or deleted to match OFFROAD2011 HP categories)

		2008		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	Equipment	MaxHP	ROG	CO	NOX	SOX	PM	CO2	ROG	CO	NOX	SOX	PM	CO2
0	46	Aerial Lifts	50	0.111	0.525	0.722	0.001	0.047	85.116	5.11	24.19	33.31	0.06	2.17	3,924.79
50	74		120	0.149	0.388	0.654	0.001	0.047	67.164	11.00	28.72	48.39	0.06	3.46	4,971.40
120	130		175	0.282	0.687	0.703	0.001	0.069	68.185	36.76	89.69	91.68	0.12	9.07	8,896.20
175	210		250	0.165	0.546	1.046	0.001	0.082	82.234	34.70	114.68	219.72	0.20	17.25	########
250	380		500	0.198	0.792	2.478	0.002	0.078	254.079	75.42	300.87	941.64	0.95	29.52	########
0	12	Air Compressors	15	0.582	1.988	3.349	0.004	0.251	273.029	6.98	23.85	40.18	0.05	3.02	3,276.35
15	24		25	0.663	1.682	2.720	0.003	0.201	273.029	15.90	40.36	65.27	0.08	4.83	6,552.70
25	37		50	1.512	3.498	2.971	0.004	0.341	273.029	55.96	129.43	109.92	0.13	12.60	########
50	78		120	0.635	1.962	3.735	0.003	0.331	273.029	49.53	153.06	291.34	0.25	25.79	########
120	147		175	0.418	1.577	3.352	0.003	0.182	273.029	61.41	231.84	492.77	0.45	26.74	########
175	218		250	0.280	0.785	3.146	0.003	0.107	273.029	61.12	171.06	685.93	0.67	23.27	########
250	385		500	0.249	0.931	2.816	0.003	0.097	273.029	95.93	358.47	1,084.27	1.03	37.37	########
500	595		750	0.254	0.931	2.891	0.003	0.098	273.029	151.34	553.99	1,720.07	1.63	58.54	########
750	808		1000	0.316	1.175	3.539	0.003	0.108	273.029	255.24	949.72	2,859.40	2.22	87.48	########
0	39	Bore/Drill Rigs	50	0.141	0.730	0.886	0.002	0.054	119.487	5.52	28.65	34.80	0.07	2.12	4,692.69
50	82		120	0.116	0.371	0.740	0.001	0.044	88.089	9.52	30.57	60.92	0.09	3.62	7,252.34
120	149		175	0.249	0.836	0.885	0.001	0.077	94.779	36.99	124.17	131.50	0.18	11.50	########
175	208		250	0.223	1.078	1.653	0.002	0.131	168.382	46.42	223.90	343.33	0.41	27.14	########
250	349		500	0.157	0.980	1.492	0.002	0.076	183.260	54.76	342.09	521.05	0.72	26.59	########
500	612		750	0.078	0.260	1.084	0.002	0.030	139.423	47.92	158.85	663.35	0.96	18.58	########
750	919		1000	0.077	0.278	0.999	0.002	0.032	153.653	71.09	255.43	918.30	1.39	29.03	########
1000	2667		9999	0.055	0.189	0.713	0.001	0.022	104.626	145.39	504.68	1,901.25	2.81	58.80	########
0	9	Cement and Mortar Mixers	15	0.437	1.987	2.830	0.005	0.187	318.534	3.93	17.88	25.47	0.04	1.68	2,866.81
15	25		25	0.728	1.881	3.124	0.004	0.226	318.534	18.20	47.03	78.10	0.10	5.66	7,963.35
0	18	Concrete/Industrial Saws	25	0.520	1.716	3.387	0.005	0.200	415.232	9.36	30.88	60.96	0.09	3.60	7,474.17
25	33		50	1.948	4.688	4.368	0.005	0.460	415.232	64.30	154.70	144.14	0.18	15.18	########
50	81		120	0.866	2.849	5.393	0.005	0.444	415.232	70.12	230.76	436.81	0.39	35.96	########
120	175		175	0.569	2.301	4.811	0.005	0.245	415.232	99.51	402.59	841.96	0.82	42.86	########
0	41	Cranes	50	1.638	3.751	2.929	0.003	0.357	258.865	66.54	152.39	119.01	0.14	14.50	########
50	89		120	0.644	1.942	3.709	0.003	0.339	255.738	57.26	172.69	329.94	0.27	30.15	########
120	148		175	0.413	1.514	3.196	0.003	0.181	246.433	61.09	223.87	472.68	0.41	26.75	########
175	217		250	0.291	0.810	2.899	0.003	0.112	234.444	63.08	175.67	629.09	0.57	24.22	########
250	336		500	0.271	1.045	2.680	0.002	0.104	243.055	91.14	351.11	900.93	0.80	34.90	########
500	567		750	0.273	1.042	2.737	0.002	0.105	242.350	154.69	590.79	1,552.20	1.38	59.43	########
750	938		1000	0.000	0.000	0.000	0.000	0.000	0.000						
1000	1030		9999	0.533	2.120	5.766	0.004	0.183	427.436	548.93	2,183.11	5,938.91	4.43	188.02	########
0	43	Crawler Tractors	50	1.746	3.965	3.047	0.003	0.376	265.472	74.22	168.54	129.52	0.15	15.99	########
50	87		120	0.911	2.688	5.231	0.004	0.472	343.682	79.15	233.49	454.33	0.35	40.96	########
120	150		175	0.652	2.345	4.999	0.004	0.285	367.587	97.46	350.74	747.49	0.62	42.59	########
175	203		250	0.505	1.418	4.841	0.004	0.196	371.494	102.50	287.66	981.93	0.85	39.81	########
250	341		500	0.422	1.863	4.031	0.003	0.162	345.134	143.75	634.71	1,373.25	1.15	55.27	########
500	570		750	0.455	1.996	4.409	0.004	0.176	369.712	259.30	1,137.76	2,513.70	2.12	100.11	########
750	828		1000	0.000	0.000	0.000	0.000	0.000	0.000						
1000	1527		9999	0.262	1.177	2.742	0.002	0.092	195.553	399.55	1,796.35	4,185.68	3.00	140.15	########
0	45	Crushing/Proc. Equipment	50	2.539	5.873	4.858	0.006	0.568	443.672	114.25	264.28	218.61	0.26	25.54	########
50	85		120	1.044	3.227	6.087	0.005	0.550	443.672	88.75	274.32	517.44	0.44	46.79	########
120	171		175	0.689	2.596	5.454	0.005	0.303	443.672	117.86	443.97	932.68	0.85	51.81	########
175	250		250	0.458	1.269	5.115	0.005	0.174	443.672	114.61	317.18	1,278.79	1.25	43.45	########
250	382		500	0.408	1.492	4.553	0.004	0.158	443.672	155.94	569.83	1,739.30	1.66	60.49	########
500	602		750	0.415	1.446	4.701	0.004	0.160	443.672	249.64	870.66	2,829.83	2.69	96.09	########
750	1337		9999	0.519	1.888	5.794	0.004	0.177	443.672	693.68	2,524.38	7,746.73	5.96	237.02	########
0	16	Dumpers/Tenders	25	0.342	1.008	1.932	0.003	0.122	216.148	5.48	16.13	30.91	0.04	1.95	3,458.37
0	36	Excavators	50	0.255	0.859	1.639	0.003	0.097	208.660	9.12	30.70	58.57	0.09	3.48	7,457.11
50	82		120	0.767	1.883	1.513	0.002	0.177	138.765	62.75	154.00	123.69	0.15	14.50	########
120	146		175	0.513	1.689	2.993	0.003	0.281	228.669	74.93	246.72	437.09	0.39	41.02	########
175	218		250	0.348	1.399	2.684	0.003	0.156	232.995	76.07	305.55	586.38	0.57	34.01	########
250	329		500	0.224	0.603	2.384	0.002	0.082	219.014	73.47	198.14	783.58	0.81	27.01	########
500	578		750	0.171	0.556	1.739	0.002	0.063	183.446	98.62	321.08	1,005.18	1.04	36.36	########
750	843		1000	0.000	0.000	0.000	0.000	0.000	0.000						
1000	1569		9999	0.105	0.339	1.097	0.001	0.039	111.990	164.98	532.19	1,720.78	1.77	61.34	########
0	42	Forklifts	50	0.888	2.138	1.706	0.002	0.203	156.923	37.67	90.69	72.36	0.09	8.63	6,655.08
50	82		120	0.394	1.265	2.215	0.002	0.219	171.952	32.43	104.21	182.42	0.17	18.03	########
120	141		175	0.274	1.066	2.062	0.002	0.124	179.962	38.74	150.63	291.38	0.29	17.51	########
175	208		250	0.154	0.393	1.794	0.002	0.055	168.058	32.03	81.82	373.48	0.39	11.37	########
250	344		500	0.000	0.000	0.000	0.000	0.000	0.000						
500	880		1000	0.048	0.131	0.528	0.001	0.017	57.204	41.92	115.41	464.26	0.49	15.19	########
0	11	Generator Sets	15	0.769	3.064	5.031	0.007	0.314	420.920	8.45	33.71	55.34	0.07	3.46	4,630.12
15	19		25	0.780	2.592	4.193	0.005	0.278	420.920	14.83	49.25	79.66	0.10	5.28	7,997.48
25	33		50	1.663	4.098	4.308	0.005	0.417	420.920	54.87	135.23	142.17	0.18	13.75	########
50	84		120	0.827	2.764	5.295	0.005	0.409	420.920	69.48	232.16	444.77	0.41	34.32	########
120	153		175	0.539	2.225	4.746	0.005	0.225	420.920	82.41	340.46	726.16	0.72	34.41	########
175	229		250	0.359	1.097	4.458	0.005	0.135	420.920	82.27	251.32	1,020.94	1.08	30.94	########
250	363		500	0.321	1.267	4.071	0.004	0.126	420.920	116.68	459.79	1,477.78	1.50	45.58	########
500	586		750	0.332	1.267	4.178	0.004	0.127	420.920	194.60	742.25	2,448.40	2.48	74.60	########
750	1130		9999	0.445	1.609	5.124	0.004	0.156	420.920	502.75	1,817.97	5,790.08	4.78	175.90	########
0	39	Graders	50	1.881	4.418	3.534	0.004	0.420	318.965	73.65	173.01	138.38	0.16	16.44	########
50	91		120	0.889	2.784	5.187	0.004	0.473	373.677	80.86	253.38	472.00	0.40	43.06	########
120	148		175	0.601	2.295	4.694	0.004	0.266	379.933	88.88	339.58	694.52	0.63	39.28	########
175	204		250	0.436	1.214	4.490	0.004	0.167	382.031	89.09	248.14	917.59	0.88	34.03	########
250	293		500	0.365	1.362	3.697	0.003	0.140	355.058	106.92	399.24	1,083.76	1.02	40.94	########
500	796		1000	0.000	0.000	0.000	0.000	0.000	0.000						
1000	1993		9999	0.115	0.424	1.182	0.001	0.044	110.562	228.69	845.06	2,354.94	2.22	87.82	########
0	38	Off-Highway Tractors	50	3.257	9.183	18.629	0.013	1.634	1128.991	122.67	345.82	701.60	0.50	61.53	########
50	75		120	1.542	5.318	11.767	0.009	0.667	793.735	114.91	396.32	877.00	0.67	49.69	########
120	158		175	0.588	1.674	5.354	0.004	0.232	374.226	92.92	264.61	846.39	0.67	36.72	########
175	214		250	1.699	8.652	15.880	0.012	0.663	1205.093	363.31	1,850.10	3,395.73	2.59	141.76	########
250	334		500	0.000	0.000	0.000	0.000	0.000	0.000						
500	574		750	0.000	0.000	0.000	0.000	0.000	0.000						
750	1000		1000	0.000	0.000	0.000	0.000	0.000	0.000						
1000	1726		9999	0.321	1.660	3.206	0.002	0.115	213.965	554.37	2,866.00	5,534.44	3.71	198.10	########
0	29	Off-Highway Trucks	50	3.060	11.938	23.026	0.022	1.352	1947.090	89.17	347.89	671.00	0.64	39.40	########
50	87		120	0.949	2.497	9.706	0.010	0.343	867.696	82.63	217.38	845.07	0.85	29.89	########
120	159		175	0.778	2.490	7.592	0.008	0.281	777.453	123.63	395.61	1,206.27	1.21	44.59	########
175	211		250	0.958	3.041	9.565	0.010	0.349	949.549	202.07	641.69	2,018.46	2.01	73.56	########
250	372		500	0.000	0.000	0.000	0.000	0.000	0.000						
500	656		750	0.000	0.000	0.000	0.000	0.000	0.000						
750	897		1000	0.000	0.000	0.000	0.000	0.000	0.000						
1000	1764		9999	0.183	0.619	2.052	0.002	0.063	160.623	322.42	1,092.35	3,620.83	2.85	110.94	########
0	38	Other Construction Equipment	50	0.142	0.737	0.895	0.002	0.055	120.626	5.39	27.99	34.00	0.07	2.07	4,584.61
50	82		120	0.096	0.310	0.617	0.001	0.037	73.505	7.87	25.27	50.36	0.08	2.99	5,995.26
120	152		175	0.370	0.935	0.858	0.001	0.090	83.257	56.46	142.65	130.83	0.16	13.74	########
175	217		250	0.329	1.158	2.068	0.002	0.176	169.093	71.34	251.23	448.47	0.43	38.25	########
250	357		500	0.173	0.754	1.457	0.002	0.077	135.388	61.63	269.09	519.86	0.54	27.53	########
500	598		750	0.000	0.000	0.000	0.000	0.000	0.000						

		2008		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	Equipment	MaxHP	ROG	CO	NOX	SOX	PM	CO2	ROG	CO	NOX	SOX	PM	CO2
750	830		1000	0.000	0.000	0.000	0.000	0.000	0.000						
1000	1127		9999	0.078	0.284	0.917	0.001	0.031	102.356	88.12	319.94	1,032.70	1.13	34.89	########
0	35	Other General Industrial Equipmen	50	0.086	0.505	0.602	0.001	0.034	82.643	3.01	17.71	21.15	0.05	1.18	2,900.93
50	73		120	0.116	0.392	0.748	0.001	0.045	95.123	8.52	28.67	54.73	0.09	3.26	6,962.24
120	149		175	0.421	0.960	0.746	0.001	0.092	66.128	62.85	143.24	111.27	0.13	13.74	9,863.18
175	209		250	0.342	1.019	1.921	0.002	0.182	134.599	71.46	212.97	401.57	0.33	38.14	########
250	355		500	0.206	0.746	1.571	0.001	0.091	122.674	73.13	264.53	557.33	0.49	32.30	########
500	592		750	0.116	0.310	1.249	0.001	0.043	103.965	68.72	183.32	738.56	0.69	25.60	########
750	885		1000	0.137	0.477	1.445	0.001	0.051	136.032	120.96	422.27	1,278.93	1.18	45.57	########
1000	2000		9999	0.101	0.348	1.084	0.001	0.038	99.212	201.52	695.98	2,167.63	2.00	76.28	########
0	36	Other Material Handling Equipment	50	2.423	5.524	4.326	0.005	0.531	384.920	86.63	197.48	154.63	0.18	18.97	########
50	93		120	0.744	2.224	4.199	0.003	0.396	295.388	69.29	207.17	391.18	0.32	36.91	########
120	145		175	0.638	2.316	4.888	0.004	0.282	383.028	92.20	334.84	706.59	0.62	40.71	########
175	218		250	0.334	0.895	3.605	0.003	0.125	301.336	72.80	195.35	787.02	0.74	27.21	########
250	331		500	0.260	0.918	2.780	0.003	0.099	262.307	86.27	304.16	921.15	0.85	32.72	########
500	565		750	0.000	0.000	0.000	0.000	0.000	0.000						
750	923		1000	0.000	0.000	0.000	0.000	0.000	0.000						
1000	1050		9999	0.388	1.418	4.279	0.003	0.133	320.257	407.34	1,489.12	4,492.68	3.30	139.45	########
0	39	Pavers	50	0.386	1.091	2.003	0.003	0.132	219.130	14.89	42.14	77.37	0.11	5.09	8,463.90
50	80		120	1.024	2.302	1.818	0.002	0.220	159.529	81.46	183.21	144.67	0.16	17.51	########
120	158		175	0.523	1.536	3.055	0.002	0.265	198.483	82.71	242.90	483.12	0.37	41.92	########
175	213		250	0.479	1.727	3.760	0.003	0.208	272.918	102.23	368.16	801.76	0.65	44.35	########
250	327		500	0.372	1.073	3.567	0.003	0.147	269.306	121.91	351.27	1,167.73	0.99	48.23	########
500	750		750	0.174	0.829	1.689	0.001	0.068	141.065	130.34	621.52	1,266.78	1.04	51.27	########
0	35	Paving Equipment	50	0.216	0.693	1.382	0.002	0.082	164.512	7.52	24.14	48.11	0.07	2.86	5,727.92
50	89		120	0.780	1.753	1.393	0.002	0.168	122.494	69.13	155.28	123.44	0.14	14.87	########
120	148		175	0.436	1.280	2.551	0.002	0.221	166.573	64.66	189.97	378.58	0.29	32.74	########
175	216		250	0.370	1.332	2.915	0.002	0.160	212.473	79.73	287.27	628.57	0.52	34.49	########
250	339		500	0.000	0.000	0.000	0.000	0.000	0.000						
500	605		750	0.000	0.000	0.000	0.000	0.000	0.000						
750	842		1000	0.090	0.261	0.868	0.001	0.036	65.879	75.95	219.48	731.23	0.62	30.07	########
0	8	Plate Compactors	15	0.292	1.493	1.862	0.004	0.118	244.588	2.34	11.95	14.90	0.03	0.94	1,956.71
0	13	Pressure Washers	15	0.312	1.242	2.040	0.003	0.127	170.643	4.05	16.15	26.52	0.03	1.66	2,218.36
15	19		25	0.316	1.051	1.700	0.002	0.113	170.643	6.01	19.97	32.30	0.04	2.14	3,242.22
25	38		50	0.545	1.413	1.695	0.002	0.148	170.643	20.70	53.70	64.42	0.08	5.63	6,484.44
50	64		120	0.305	1.070	2.053	0.002	0.146	170.643	19.55	68.46	131.42	0.13	9.36	########
0	8	Pumps	15	0.897	3.064	5.162	0.007	0.388	420.920	7.17	24.51	41.30	0.05	3.10	3,367.36
15	21		25	1.021	2.592	4.193	0.005	0.310	420.920	21.45	54.44	88.05	0.11	6.52	8,839.31
25	37		50	1.770	4.304	4.351	0.005	0.434	420.920	65.49	159.24	160.98	0.20	16.05	########
50	84		120	0.852	2.806	5.372	0.005	0.425	420.920	71.56	235.70	451.26	0.41	35.68	########
120	151		175	0.556	2.259	4.816	0.005	0.234	420.920	83.90	341.09	727.20	0.72	35.32	########
175	217		250	0.372	1.118	4.524	0.005	0.141	420.920	80.69	242.68	981.71	1.03	30.50	########
250	372		500	0.332	1.320	4.117	0.004	0.130	420.920	123.47	491.15	1,531.44	1.54	48.32	########
500	615		750	0.342	1.320	4.225	0.004	0.132	420.920	210.45	811.97	2,598.36	2.60	80.97	########
750	1460		9999	0.452	1.667	5.178	0.004	0.158	420.920	660.30	2,434.06	7,559.91	6.18	230.61	########
0	36	Rollers	50	0.095	0.491	0.596	0.001	0.036	80.351	3.37	17.50	21.26	0.04	1.30	2,866.80
50	87		120	0.091	0.294	0.585	0.001	0.035	69.676	7.95	25.51	50.83	0.08	3.02	6,052.14
120	144		175	0.453	1.056	0.895	0.001	0.102	81.971	65.19	151.78	128.72	0.15	14.63	########
175	213		250	0.290	0.908	1.744	0.001	0.150	125.472	61.85	193.70	371.96	0.31	31.92	########
250	335		500	0.224	0.859	1.820	0.002	0.097	146.485	75.04	287.72	609.40	0.55	32.53	########
500	521		750	0.152	0.442	1.582	0.002	0.060	133.411	79.28	230.01	823.33	0.78	30.98	########
0	47	Rough Terrain Forklifts	50	1.799	4.298	3.528	0.004	0.409	324.798	85.05	203.21	166.81	0.20	19.36	########
50	96		120	0.662	2.140	3.905	0.003	0.357	294.068	63.78	206.12	376.19	0.33	34.40	########
120	130		175	0.652	2.574	5.151	0.005	0.291	437.172	84.47	333.56	667.46	0.64	37.65	########
175	208		250	0.380	1.056	4.140	0.004	0.144	371.911	79.13	219.92	862.34	0.87	29.95	########
250	374		500	0.000	0.000	0.000	0.000	0.000	0.000						
500	625		750	0.171	0.593	1.825	0.002	0.066	186.206	106.82	370.72	1,140.58	1.14	41.00	########
0	42	Rubber Tired Dozers	50	2.840	9.666	21.335	0.016	1.223	1412.268	118.12	401.95	887.24	0.66	50.84	########
50	82		120	1.670	4.690	14.885	0.011	0.654	1020.078	136.26	382.67	1,214.43	0.94	53.32	########
120	150		175	1.178	5.995	10.604	0.008	0.452	802.659	176.28	897.35	1,587.25	1.18	67.62	########
175	211		250	1.263	6.404	11.512	0.009	0.486	857.370	266.42	1,351.04	2,428.90	1.82	102.60	########
250	354		500	0.000	0.000	0.000	0.000	0.000	0.000						
500	584		750	0.711	3.697	7.008	0.005	0.255	459.645	415.55	2,159.24	4,093.32	2.70	148.87	########
0	42	Rubber Tired Loaders	50	0.231	0.761	1.502	0.002	0.089	184.165	9.62	31.73	62.63	0.10	3.70	7,678.94
50	86		120	0.955	2.247	1.810	0.002	0.214	164.013	82.27	193.59	155.90	0.18	18.41	########
120	150		175	0.419	1.320	2.455	0.002	0.223	178.155	62.87	197.98	368.17	0.31	33.51	########
175	206		250	0.366	1.406	2.872	0.003	0.162	234.204	75.37	289.53	591.37	0.54	33.31	########
250	320		500	0.237	0.663	2.464	0.002	0.091	211.376	75.85	211.84	787.78	0.76	28.97	########
500	600		750	0.181	0.669	1.848	0.002	0.069	179.033	108.48	401.85	1,109.91	1.06	41.62	########
750	837		1000	0.269	0.984	2.790	0.003	0.103	263.180	224.81	823.23	2,335.12	2.21	86.43	########
1000	1521		9999	0.205	0.775	2.298	0.002	0.071	177.105	312.54	1,178.97	3,495.38	2.71	107.28	########
0	36	Scrapers	50	3.143	9.227	18.071	0.014	1.620	1178.450	113.60	333.49	653.12	0.50	58.53	########
50	84		120	1.419	5.089	10.921	0.009	0.619	796.487	119.68	429.16	920.93	0.76	52.23	########
120	166		175	0.788	2.222	7.521	0.006	0.307	571.806	130.86	369.19	1,249.65	1.07	51.04	########
175	225		250	0.801	3.598	7.654	0.006	0.309	648.067	180.16	809.55	1,721.84	1.43	69.59	########
250	381		500	0.000	0.000	0.000	0.000	0.000	0.000						
500	565		750	0.000	0.000	0.000	0.000	0.000	0.000						
750	950		1000	0.000	0.000	0.000	0.000	0.000	0.000						
1000	1923		9999	0.163	0.727	1.578	0.001	0.063	130.956	313.31	1,398.53	3,035.29	2.53	121.40	########
0	6	Signal Boards	15	0.543	2.848	3.400	0.007	0.189	466.425	3.26	17.09	20.40	0.04	1.14	2,798.55
15	37		50	2.036	4.888	4.646	0.006	0.485	443.672	75.34	180.84	171.91	0.21	17.94	########
50	82		120	0.929	3.027	5.747	0.005	0.473	443.672	76.20	248.22	471.23	0.43	38.77	########
120	158		175	0.609	2.439	5.143	0.005	0.261	443.672	96.16	385.40	812.67	0.79	41.20	########
175	216		250	0.492	1.447	5.837	0.006	0.188	536.104	106.31	312.55	1,260.78	1.30	40.56	########
0	43	Skid Steer Loaders	50	0.304	0.806	1.378	0.002	0.097	143.940	13.21	35.05	59.91	0.08	4.21	6,256.92
50	71		120	0.649	1.753	1.642	0.002	0.167	164.106	45.79	123.64	115.79	0.15	11.78	########
120	153		175	0.000	0.000	0.000	0.000	0.000	0.000						
175	201		250	0.000	0.000	0.000	0.000	0.000	0.000						
250	277		500	0.000	0.000	0.000	0.000	0.000	0.000						
500	530		750	0.000	0.000	0.000	0.000	0.000	0.000						
750	1000		1000	0.034	0.131	0.220	0.000	0.019	19.396	34.36	130.96	220.07	0.23	19.13	########
0	36	Surfacing Equipment	50	0.850	2.037	1.901	0.002	0.200	179.414	30.31	72.64	67.79	0.08	7.12	6,399.12
50	89		120	0.697	2.269	4.368	0.004	0.351	326.162	61.83	201.20	387.39	0.34	31.14	########
120	151		175	0.363	1.457	3.078	0.003	0.155	257.700	54.78	220.00	464.77	0.44	23.41	########
175	216		250	0.299	0.903	3.232	0.003	0.116	283.137	64.52	195.21	698.34	0.69	25.13	########
250	362		500	0.261	1.133	2.868	0.003	0.103	276.905	94.66	410.73	1,039.06	0.98	37.37	########
500	615		750	0.000	0.000	0.000	0.000	0.000	0.000						
750	814		1000	0.000	0.000	0.000	0.000	0.000	0.000						
1000	1141		9999	0.133	0.565	1.461	0.001	0.052	137.965	151.62	644.39	1,667.46	1.58	59.26	########
0	36	Sweepers/Scrubbers	50	0.158	0.929	1.109	0.002	0.062	152.169	5.62	33.06	39.47	0.08	2.20	5,415.07
50	78		120	0.143	0.474	0.938	0.001	0.055	114.751	11.10	36.76	72.69	0.11	4.29	8,896.19
120	159		175	0.508	1.194	0.974	0.001	0.115	89.742	81.04	190.39	155.36	0.19	18.30	########
175	204		250	0.384	1.208	2.185	0.002	0.209	166.517	78.40	246.98	446.69	0.40	42.71	########
250	303		500	0.317	1.213	2.446	0.002	0.142	208.420	95.77	367.00	740.00	0.71	42.92	########
500	848		1000	0.079	0.209	0.943	0.001	0.029	86.663	67.26	177.36	799.78	0.83	24.54	########
0	38	Tractors/Loaders/Backhoes	50	0.280	0.847	1.654	0.002	0.102	187.845	10.74	32.44	63.35	0.09	3.92	7,195.45
50	83		120	0.845	2.104	1.769	0.002	0.199	166.547	69.83	173.91	146.18	0.18	16.46	########
120	144		175	0.342	1.167	2.053	0.002	0.188	163.015	49.23	168.03	295.45	0.28	27.03	########
175	204		250	0.313	1.311	2.494	0.003	0.141	225.193	63.91	267.81	509.22	0.52	28.83	########
250	320		500	0.226	0.630	2.544	0.003	0.085	243.327	72.50	201.76	814.47	0.88	27.10	########
500	575		750	0.229	0.756	2.478	0.003	0.087	272.220	131.39	434.32	1,423.74	1.76	49.93	########

				g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
		2008													
	AvgHP	Equipment	MaxHP	ROG	CO	NOX	SOX	PM	CO2	ROG	CO	NOX	SOX	PM	CO2
750	871		1000	0.000	0.000	0.000	0.000	0.000	0.000						
1000	2006		9999	0.100	0.325	1.101	0.001	0.038	116.988	199.97	651.47	2,208.12	2.64	76.27	########
0	40	Trenchers	50	0.112	0.589	0.704	0.002	0.039	96.524	4.47	23.44	27.99	0.06	1.56	3,839.47
50	82		120	0.228	0.752	1.484	0.002	0.088	181.964	18.70	61.69	121.78	0.19	7.20	########
120	144		175	0.636	1.435	1.170	0.001	0.138	103.783	91.54	206.49	168.36	0.19	19.84	########
175	218		250	0.348	1.030	2.067	0.002	0.174	134.767	76.11	225.04	451.41	0.35	38.00	########
250	359		500	0.314	1.141	2.500	0.002	0.135	182.058	112.54	409.13	896.45	0.73	48.46	########
500	619		750	0.225	0.658	2.159	0.002	0.090	163.272	139.25	407.38	1,337.22	1.14	55.49	########
750	860		1000	0.201	1.005	1.973	0.002	0.080	164.194	172.87	864.17	1,696.80	1.39	68.51	########
0	11	Welders	15	0.545	1.863	3.139	0.004	0.236	255.965	6.00	20.50	34.53	0.04	2.59	2,815.61
15	20		25	0.621	1.576	2.550	0.003	0.189	255.965	12.42	31.53	50.99	0.06	3.78	5,119.30
25	46		50	1.292	3.034	2.733	0.003	0.299	255.965	59.43	139.55	125.71	0.15	13.74	########
50	70		120	0.567	1.790	3.416	0.003	0.291	255.965	39.67	125.31	239.14	0.21	20.35	########
120	174		175	0.372	1.440	3.065	0.003	0.160	255.965	64.67	250.51	533.27	0.50	27.85	########
175	211		250	0.250	0.717	2.878	0.003	0.095	255.965	52.75	151.36	607.33	0.61	20.11	########
250	297		500	0.222	0.859	2.591	0.003	0.087	255.965	65.98	255.18	769.65	0.75	25.82	########
0	29	Water Trucks	50	3.060	11.938	23.026	0.022	1.352	1947.090	89.167	347.888	670.995	0.638	39.396	56738.898
50	87		120	0.949	2.497	9.706	0.010	0.343	867.696	82.633	217.377	845.066	0.850	29.888	75543.783
120	159		175	0.778	2.490	7.592	0.008	0.281	777.453	123.626	395.605	1206.274	1.212	44.595	123528.665
175	211		250	0.958	3.041	9.565	0.010	0.349	949.549	202.067	641.690	2018.460	2.015	73.560	200369.253
250	372		500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
500	656		750	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
750	897		1000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1000	1764		9999	0.183	0.619	2.052	0.002	0.063	160.623	322.418	1092.350	3620.834	2.849	110.941	283370.036

2009

		2009		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	Equipment	MaxHP	ROG	CO	NOX	SOX	PM	CO2	ROG	CO	NOX	SOX	PM	CO2
0	46	Aerial Lifts	50	0.213	0.866	1.541	0.002	0.111	179.277	9.83	39.91	71.05	0.08	5.12	8,267
50	74		120	0.1542	0.778	1.720	0.002	0.114	161.199	11.41	57.61	127.29	0.11	8.41	11,932
120	130		175	0.081	0.778	1.337	0.002	0.056	161.168	10.61	101.52	174.41	0.20	7.31	21,028
175	210		250	0.341	0.778	3.561	0.002	0.181	161.179	71.60	163.42	747.74	0.32	37.97	33,848
250	380		500	0.146	0.778	2.156	0.002	0.067	161.179	55.48	295.70	819.21	0.58	25.45	61,248
0	12	Air Compress	15	0.560	1.958	3.241	0.004	0.239	272.784	6.71	23.50	38.90	0.05	2.87	3,273
15	24		25	0.634	1.632	2.671	0.003	0.193	272.784	15.22	39.17	64.11	0.08	4.62	6,547
25	37		50	1.458	3.456	2.939	0.004	0.331	272.784	53.95	127.88	108.74	0.13	12.24	10,093
50	78		120	0.607	1.950	3.586	0.003	0.322	272.784	47.38	152.11	279.75	0.25	25.10	21,277
120	147		175	0.402	1.574	3.212	0.003	0.177	272.784	59.10	231.35	472.12	0.45	26.08	40,099
175	218		250	0.266	0.743	3.010	0.003	0.101	272.784	57.90	162.04	656.13	0.67	21.97	59,467
250	385		500	0.237	0.857	2.689	0.003	0.092	272.784	91.32	329.76	1,035.28	1.03	35.52	105,022
500	595		750	0.242	0.857	2.761	0.003	0.094	272.784	143.81	509.64	1,642.73	1.63	55.67	162,306
750	808		1000	0.302	1.098	3.446	0.003	0.104	272.784	243.79	886.82	2,784.05	2.22	84.12	220,409
0	39	Bore/Drill Rig	50	0.465	1.216	2.714	0.003	0.204	302.703	18.26	47.76	106.57	0.11	8.01	11,888
50	82		120	0.208	1.019	2.523	0.002	0.162	253.631	17.14	83.89	207.73	0.20	13.30	20,881
120	149		175	0.183	1.073	2.403	0.003	0.115	267.032	27.24	159.35	356.90	0.38	17.08	39,664
175	208		250	0.134	1.060	2.400	0.003	0.071	263.755	27.83	220.14	498.68	0.52	14.79	54,796
250	349		500	0.122	1.044	2.054	0.002	0.068	259.757	42.77	364.39	717.14	0.87	23.71	90,703
500	612		750	0.083	1.074	1.526	0.003	0.054	267.302	50.67	657.17	934.13	1.56	32.83	163,579
750	919		1000	0.078	1.055	2.160	0.003	0.048	262.715	71.98	969.95	1,985.44	2.31	44.34	241,435
1000	2667		9999	0.062	1.056	2.063	0.003	0.046	262.792	166.45	2,815.34	5,500.44	6.69	122.19	700,778
0	9	Cement and I	15	0.415	1.968	2.677	0.005	0.165	318.248	3.74	17.71	24.09	0.04	1.49	2,864
15	25		25	0.678	1.795	3.042	0.004	0.210	318.248	16.95	44.88	76.06	0.10	5.26	7,956
0	18	Concrete/Indu	25	0.508	1.708	3.260	0.005	0.178	414.859	9.14	30.75	58.69	0.09	3.20	7,467
25	33		50	1.818	4.545	4.288	0.005	0.436	414.859	60.01	149.98	141.49	0.18	14.39	13,690
50	81		120	0.807	2.814	5.094	0.005	0.423	414.859	65.36	227.94	412.65	0.39	34.26	33,604
120	175		175	0.533	2.286	4.529	0.005	0.234	414.859	93.24	400.01	792.64	0.82	40.96	72,600
0	41	Cranes	50	0.692	0.826	1.807	0.002	0.189	165.359	28.13	33.55	73.40	0.06	7.66	6,718
50	89		120	0.413	0.749	3.242	0.001	0.240	150.034	36.72	66.64	288.36	0.13	21.34	13,345
120	148		175	0.252	0.757	2.608	0.001	0.138	151.595	37.23	111.95	385.71	0.21	20.44	22,419
175	217		250	0.209	0.754	2.429	0.001	0.110	150.994	45.32	163.62	527.05	0.31	23.96	32,766
250	336		500	0.159	0.752	2.044	0.001	0.084	150.576	53.52	252.73	687.13	0.48	28.30	50,610
500	567		750	0.076	0.751	1.292	0.001	0.043	150.468	43.30	426.18	732.70	0.81	24.11	85,344
750	938		1000	0.311	0.748	3.325	0.001	0.164	149.774	291.15	701.25	3,117.82	1.34	154.13	140,428
1000	1030		9999	0.097	0.752	1.831	0.001	0.043	150.667	99.81	774.95	1,885.88	1.48	43.86	155,187
0	43	Crawler Tract	50	1.188	1.327	2.795	0.002	0.332	244.948	50.48	56.42	118.83	0.10	14.13	10,413
50	87		120	0.399	1.228	3.323	0.002	0.266	226.628	34.65	106.66	288.58	0.19	23.06	19,684
120	150		175	0.281	1.215	3.056	0.002	0.160	224.250	41.99	181.71	457.03	0.32	23.86	33,535
175	203		250	0.201	1.219	2.773	0.002	0.106	224.969	40.75	247.27	562.48	0.44	21.56	45,634
250	341		500	0.182	1.225	2.555	0.002	0.096	226.060	62.09	417.32	870.54	0.74	32.84	77,017
500	570		750	0.156	1.217	2.299	0.002	0.081	224.627	89.11	693.91	1,310.92	1.22	46.29	128,063
750	828		1000	0.203	1.222	3.091	0.002	0.089	225.547	168.43	1,012.12	2,559.66	1.78	73.85	186,790
1000	1527		9999	0.139	1.168	2.506	0.002	0.063	215.490	211.52	1,782.39	3,826.04	3.14	96.20	328,945
0	45	Crushing/Pro	50	2.423	5.767	4.797	0.006	0.547	443.274	109.05	259.51	215.86	0.26	24.63	19,947
50	85		120	0.993	3.202	5.817	0.005	0.533	443.274	84.41	272.17	494.44	0.44	45.27	37,678
120	171		175	0.659	2.588	5.198	0.005	0.294	443.274	112.76	442.53	888.91	0.85	50.21	75,800
175	250		250	0.433	1.198	4.870	0.005	0.163	443.274	108.13	299.38	1,217.41	1.25	40.78	110,818
250	382		500	0.387	1.366	4.326	0.004	0.150	443.274	147.99	521.78	1,652.43	1.66	57.17	169,331
500	602		750	0.394	1.331	4.477	0.004	0.151	443.274	237.14	801.54	2,695.26	2.68	91.19	266,851
750	1337		9999	0.495	1.760	5.631	0.004	0.170	443.274	661.54	2,352.66	7,529.31	5.96	227.74	592,657
0	16	Dumpers/Ter	25	0.322	0.976	1.875	0.003	0.112	215.954	5.15	15.62	30.00	0.04	1.79	3,455
0	36	Excavators	50	0.329	1.083	1.969	0.002	0.156	222.387	11.77	38.69	70.39	0.08	5.58	7,948
50	82		120	0.251	0.962	2.378	0.002	0.181	197.605	20.52	78.67	194.47	0.15	14.80	16,160
120	146		175	0.197	0.974	2.288	0.002	0.116	199.967	28.74	142.18	334.19	0.28	16.91	29,203
175	218		250	0.141	0.974	2.250	0.002	0.070	200.019	30.85	212.75	491.56	0.42	15.33	43,698
250	329		500	0.105	0.968	1.711	0.002	0.056	198.795	34.41	318.07	562.44	0.62	18.27	65,332
500	578		750	0.107	0.965	1.748	0.002	0.057	198.170	61.91	557.59	1,010.04	1.09	32.86	114,530
750	843		1000	0.165	0.968	2.567	0.002	0.081	198.838	139.37	815.94	2,163.99	1.60	68.59	167,595
1000	1569		9999	0.100	0.963	1.952	0.002	0.053	197.811	157.01	1,511.16	3,062.83	2.96	83.62	310,393
0	42	Forklifts	50	0.508	0.638	1.272	0.001	0.148	117.014	21.56	27.04	53.96	0.05	6.27	4,963
50	82		120	0.186	0.572	1.552	0.001	0.125	105.000	15.34	47.13	127.81	0.08	10.33	8,649
120	141		175	0.138	0.573	1.488	0.001	0.079	105.128	19.44	80.94	210.24	0.14	11.17	14,853
175	208		250	0.155	0.574	1.758	0.001	0.083	105.400	32.32	119.55	366.00	0.21	17.22	21,939
250	344		500	0.143	0.575	1.633	0.001	0.076	105.464	49.05	197.53	561.16	0.35	26.22	36,250
500	880		1000	0.327	0.573	3.140	0.001	0.175	105.117	288.17	504.07	2,762.92	0.88	154.30	92,503
0	11	Generator Se	15	0.735	3.019	4.870	0.007	0.297	420.542	8.09	33.21	53.57	0.07	3.27	4,626
15	19		25	0.744	2.516	4.118	0.005	0.265	420.542	14.14	47.81	78.24	0.10	5.04	7,990
25	33		50	1.585	4.024	4.251	0.005	0.401	420.542	52.29	132.81	140.29	0.18	13.23	13,878
50	84		120	0.783	2.740	5.071	0.005	0.394	420.542	65.80	230.12	425.94	0.41	33.14	35,326
120	153		175	0.513	2.215	4.535	0.005	0.218	420.542	78.42	338.97	693.90	0.72	33.33	64,343
175	229		250	0.337	1.040	4.255	0.005	0.128	420.542	77.17	238.15	974.44	1.08	29.29	96,304
250	363		500	0.302	1.177	3.881	0.004	0.119	420.542	109.61	427.33	1,408.77	1.50	43.32	152,657
500	586		750	0.312	1.177	3.983	0.004	0.121	420.542	182.73	689.85	2,334.15	2.48	70.90	246,438
750	1130		9999	0.422	1.512	4.979	0.004	0.149	420.542	476.40	1,708.93	5,626.33	4.78	168.27	475,212
0	39	Graders	50	1.285	1.157	2.648	0.002	0.344	222.989	50.31	45.31	103.69	0.08	13.48	8,733
50	91		120	0.564	1.107	4.282	0.002	0.347	213.430	51.31	100.78	389.68	0.19	31.60	19,421
120	148		175	0.365	1.135	3.663	0.002	0.201	218.726	54.00	167.92	541.97	0.31	29.67	32,360
175	204		250	0.148	1.121	2.327	0.002	0.073	216.072	30.29	229.12	475.52	0.42	14.94	44,155
250	293		500	0.110	1.111	1.553	0.002	0.057	214.203	32.28	325.86	455.17	0.60	16.72	62,798
500	796		1000	0.296	1.109	3.698	0.002	0.131	213.737	235.27	882.83	2,943.41	1.62	104.21	170,135
1000	1993		9999	0.171	1.107	2.635	0.002	0.077	213.348	339.81	2,206.16	5,250.71	4.06	154.36	425,161
0	38	Off-Highway	50	0.812	1.300	2.544	0.002	0.263	252.659	30.59	48.95	95.79	0.09	9.90	9,515
50	75		120	0.387	1.183	3.250	0.002	0.265	230.057	28.82	88.20	242.18	0.16	19.76	17,146
120	158		175	0.240	1.175	2.742	0.002	0.141	228.391	37.97	185.72	433.37	0.34	22.25	36,103
175	214		250	0.208	1.168	2.885	0.002	0.106	227.009	44.38	249.72	616.89	0.46	22.68	48,544
250	334		500	0.153	1.172	2.267	0.002	0.082	227.786	51.11	391.89	758.00	0.73	27.42	76,180
500	574		750	0.143	1.176	2.176	0.002	0.077	228.672	82.23	674.67	1,248.02	1.25	43.89	131,152
750	1000		1000	0.473	1.172	5.345	0.002	0.272	227.753	473.17	1,171.61	5,344.58	2.17	271.92	227,753
1000	1726		9999	0.346	1.139	4.142	0.002	0.157	221.372	597.07	1,965.83	7,150.01	3.65	270.32	382,144
0	29	Off-Highway	50	0.634	0.651	2.135	0.002	0.219	214.862	18.49	18.96	62.22	0.06	6.37	6,261
50	87		120	0.431	0.599	3.215	0.002	0.284	197.770	37.53	52.13	279.89	0.16	24.73	17,218
120	159		175	0.252	0.603	2.536	0.002	0.149	199.046	40.12	95.75	402.98	0.30	23.61	31,626
175	211		250	0.219	0.602	2.666	0.002	0.112	198.786	46.14	127.00	562.64	0.40	23.54	41,947
250	372		500	0.165	0.610	2.101	0.002	0.080	201.372	61.45	227.06	782.35	0.72	29.85	74,995
500	656		750	0.208	0.612	2.505	0.002	0.104	202.001	136.38	401.15	1,643.14	1.27	68.51	132,496
750	897		1000	0.185	0.607	2.758	0.002	0.082	200.550	166.24	544.79	2,474.88	1.72	73.20	179,939
1000	1764		9999	0.176	0.614	2.592	0.002	0.080	202.650	310.30	1,082.42	4,573.51	3.41	140.71	357,513
0	38	Other Constr	50	0.552	1.338	2.298	0.002	0.204	243.312	20.98	50.84	87.32	0.09	7.77	9,247
50	82		120	0.338	1.192	2.967	0.002	0.227	216.757	27.60	97.19	241.97	0.17	18.48	17,679

	AvgHP	2009 Equipment	MaxHP	g/hp/hr ROG	g/hp/hr CO	g/hp/hr NOX	g/hp/hr SOX	g/hp/hr PM	g/hp/hr CO2	(g/hr) ROG	(g/hr) CO	(g/hr) NOX	(g/hr) SOX	(g/hr) PM	(g/hr) CO2
120	152		175	0.278	1.189	3.025	0.002	0.155	216.236	42.32	181.27	461.23	0.31	23.70	32,974
175	217		250	0.214	1.203	2.928	0.002	0.112	218.885	46.50	261.01	635.10	0.45	24.31	47,477
250	357		500	0.174	1.210	2.418	0.002	0.091	220.010	62.02	431.63	862.81	0.75	32.43	78,513
500	598		750	0.121	1.196	1.972	0.002	0.064	217.573	72.33	714.89	1,178.87	1.24	38.19	130,038
750	830		1000	0.173	1.201	2.723	0.002	0.081	218.376	143.85	996.62	2,260.74	1.73	67.60	181,286
1000	1127		9999	0.175	1.163	2.670	0.002	0.086	211.518	197.64	1,310.12	3,008.21	2.28	97.15	238,310
0	35	Other Genera	50	0.558	0.972	1.934	0.002	0.191	199.186	19.59	34.13	67.89	0.07	6.71	6,992
50	73		120	0.306	0.869	2.528	0.002	0.207	177.921	22.36	63.57	185.06	0.12	15.18	13,022
120	149		175	0.221	0.872	2.393	0.002	0.127	178.621	32.94	130.06	356.90	0.25	19.02	26,642
175	209		250	0.234	0.875	2.805	0.002	0.124	179.141	48.82	182.83	586.41	0.36	26.02	37,451
250	355		500	0.143	0.874	1.938	0.002	0.074	179.029	50.89	310.02	687.55	0.61	26.40	63,504
500	592		750	0.112	0.875	1.713	0.002	0.059	179.232	66.00	517.60	1,013.04	1.01	34.85	106,023
750	885		1000	0.108	0.872	2.062	0.002	0.049	178.698	95.24	772.06	1,824.44	1.51	43.44	158,148
1000	2000		9999	0.049	0.872	1.419	0.002	0.032	178.698	97.31	1,744.77	2,837.02	3.41	64.99	357,397
0	36	Other Materia	50	0.848	1.196	2.398	0.002	0.259	229.351	30.31	42.74	85.71	0.08	9.27	8,198
50	93		120	0.312	1.081	2.766	0.002	0.219	207.401	29.05	100.73	257.65	0.18	20.37	19,322
120	145		175	0.243	1.078	2.630	0.002	0.143	206.802	35.07	155.86	380.22	0.29	20.64	29,897
175	218		250	0.218	1.076	2.774	0.002	0.114	206.479	47.69	234.96	605.44	0.43	24.95	45,071
250	331		500	0.163	1.074	2.205	0.002	0.089	205.960	54.06	355.79	730.51	0.65	29.53	68,248
500	565		750	0.072	1.078	1.392	0.002	0.043	206.729	40.61	608.45	786.04	1.11	24.27	116,716
750	923		1000	0.067	1.078	1.740	0.002	0.039	206.729	62.28	994.72	1,606.44	1.82	35.85	190,811
1000	1050		9999	0.061	1.078	1.689	0.002	0.038	206.729	64.46	1,131.59	1,773.96	2.07	40.02	217,066
0	39	Pavers	50	0.800	1.429	2.467	0.002	0.252	242.481	30.91	55.18	95.29	0.09	9.75	9,366
50	80		120	0.339	1.273	2.936	0.002	0.224	216.000	26.96	101.27	233.66	0.16	17.84	17,190
120	158		175	0.251	1.282	2.768	0.002	0.138	217.558	39.64	202.68	437.67	0.33	21.81	34,403
175	213		250	0.086	1.285	1.833	0.002	0.047	218.142	18.30	274.00	390.72	0.44	9.98	46,511
250	327		500	0.085	1.264	1.476	0.002	0.050	214.495	27.70	413.69	483.28	0.67	16.48	70,222
500	750		750	0.054	1.280	0.986	0.002	0.040	217.241	40.56	959.87	739.68	1.56	29.78	162,931
0	35	Paving Equip	50	0.422	1.294	1.894	0.002	0.165	204.868	14.71	45.07	65.93	0.07	5.73	7,133
50	89		120	0.293	1.178	2.584	0.002	0.195	186.437	25.94	104.37	228.98	0.16	17.31	16,518
120	148		175	0.175	1.171	2.150	0.002	0.103	185.320	26.01	173.78	319.00	0.26	15.21	27,503
175	216		250	0.159	1.174	2.221	0.002	0.084	185.825	34.38	253.23	478.99	0.38	18.10	40,076
250	339		500	0.141	1.167	1.992	0.002	0.073	184.623	47.60	395.18	674.70	0.60	24.78	62,543
500	605		750	0.086	1.176	1.568	0.002	0.041	186.113	51.97	711.46	948.75	1.08	24.62	112,598
750	842		1000	0.177	1.175	2.596	0.002	0.074	185.931	148.78	989.20	2,185.65	1.50	62.72	156,554
0	8	Plate Compa	15	0.288	1.492	1.821	0.004	0.101	244.369	2.31	11.94	14.56	0.03	0.80	1,955
0	13	Pressure Wa	15	0.298	1.224	1.974	0.003	0.121	170.490	3.88	15.91	25.67	0.03	1.57	2,216
15	19		25	0.302	1.020	1.669	0.002	0.108	170.490	5.73	19.38	31.72	0.04	2.04	3,239
25	38		50	0.514	1.382	1.671	0.002	0.142	170.490	19.55	52.53	63.50	0.08	5.39	6,479
50	64		120	0.288	1.059	1.964	0.002	0.140	170.490	18.41	67.79	125.70	0.13	8.99	10,911
0	8	Pumps	15	0.863	3.019	4.997	0.007	0.368	420.542	6.90	24.15	39.98	0.05	2.95	3,364
15	21		25	0.977	2.516	4.118	0.005	0.297	420.542	20.52	52.84	86.48	0.11	6.23	8,831
25	37		50	1.691	4.231	4.295	0.005	0.418	420.542	62.56	156.55	158.91	0.20	15.47	15,560
50	84		120	0.808	2.782	5.147	0.005	0.411	420.542	67.88	233.71	432.32	0.41	34.49	35,326
120	151		175	0.530	2.250	4.604	0.005	0.227	420.542	79.99	339.68	695.18	0.71	34.25	63,502
175	217		250	0.349	1.060	4.319	0.005	0.133	420.542	75.82	229.96	937.33	1.03	28.87	91,258
250	372		500	0.313	1.223	3.925	0.004	0.123	420.542	116.26	455.13	1,460.28	1.54	45.92	156,442
500	615		750	0.322	1.223	4.029	0.004	0.125	420.542	198.01	752.44	2,477.80	2.60	76.98	258,633
750	1460		9999	0.429	1.564	5.033	0.004	0.151	420.542	626.34	2,282.79	7,348.09	6.17	220.68	613,991
0	36	Rollers	50	0.536	1.181	2.093	0.002	0.192	218.702	19.11	42.13	74.67	0.07	6.87	7,803
50	87		120	0.326	1.066	2.829	0.002	0.210	197.376	28.30	92.56	245.70	0.16	18.22	17,144
120	144		175	0.169	1.059	2.118	0.002	0.099	196.127	24.29	152.24	304.49	0.27	14.20	28,199
175	213		250	0.209	1.063	2.835	0.002	0.104	196.886	44.59	226.68	604.64	0.40	22.15	41,986
250	335		500	0.233	1.081	2.922	0.002	0.122	200.161	78.00	361.89	978.56	0.64	40.84	67,029
500	521		750	0.233	1.061	3.166	0.002	0.115	196.512	121.45	552.23	1,648.07	0.98	59.69	102,285
0	47	Rough Terrai	50	0.531	1.273	2.237	0.002	0.198	234.012	25.11	60.18	105.76	0.11	9.37	11,065
50	96		120	0.226	1.146	2.414	0.002	0.160	210.692	21.80	110.37	232.54	0.19	15.41	20,295
120	130		175	0.147	1.142	2.051	0.002	0.091	210.039	18.99	148.03	265.81	0.26	11.82	27,219
175	208		250	0.267	1.150	3.195	0.002	0.140	211.552	55.65	239.65	665.50	0.42	29.23	44,068
250	374		500	0.143	1.131	2.476	0.002	0.071	207.950	53.50	422.83	925.76	0.74	26.56	77,750
500	625		750	0.600	1.143	5.980	0.002	0.312	210.233	374.73	714.57	3,737.27	1.25	194.72	131,396
0	42	Rubber Tired	50	1.167	1.060	2.579	0.002	0.328	226.685	48.54	44.10	107.26	0.09	13.64	9,427
50	82		120	0.496	0.975	3.754	0.002	0.327	208.417	40.46	79.54	306.30	0.16	26.64	17,005
120	150		175	0.388	0.970	3.859	0.002	0.218	207.455	58.05	145.25	577.66	0.30	32.65	31,052
175	211		250	0.288	0.973	3.238	0.002	0.155	208.071	60.80	205.34	683.14	0.42	32.62	43,899
250	354		500	0.310	0.984	3.494	0.002	0.163	210.342	109.67	348.36	1,237.09	0.71	57.78	74,472
500	584		750	0.212	0.969	2.915	0.002	0.105	207.205	123.77	566.13	1,702.84	1.16	61.36	121,029
0	42	Rubber Tired	50	0.896	0.987	2.272	0.002	0.265	209.931	37.35	41.15	94.75	0.08	11.06	8,753
50	86		120	0.361	0.881	2.862	0.002	0.246	187.393	31.11	75.89	246.56	0.15	21.20	16,143
120	150		175	0.243	0.888	2.547	0.002	0.139	188.982	36.47	133.26	381.97	0.27	20.85	28,347
175	206		250	0.146	0.886	2.140	0.002	0.071	188.440	30.15	182.41	440.66	0.37	14.58	38,801
250	320		500	0.152	0.885	2.043	0.002	0.075	188.339	48.71	283.05	653.15	0.57	24.06	60,210
500	600		750	0.139	0.861	1.821	0.002	0.070	183.057	83.27	516.75	1,093.38	1.05	42.03	109,922
750	837		1000	0.144	0.887	2.378	0.002	0.066	188.765	120.22	742.59	1,989.89	1.51	55.21	157,961
1000	1521		9999	0.133	0.884	2.204	0.002	0.059	187.956	202.82	1,343.95	3,352.50	2.73	89.91	285,882
0	36	Scrapers	50	1.484	1.260	3.170	0.003	0.405	279.274	53.64	45.54	114.58	0.10	14.63	10,094
50	84		120	0.350	1.167	3.439	0.002	0.242	258.603	29.54	98.39	290.01	0.21	20.43	21,807
120	166		175	0.383	1.156	4.134	0.002	0.213	256.161	63.68	192.04	686.97	0.41	35.34	42,565
175	225		250	0.397	1.130	4.541	0.002	0.209	250.571	89.21	254.33	1,021.68	0.54	46.92	56,372
250	381		500	0.249	1.140	3.255	0.002	0.130	252.609	94.96	434.62	1,241.29	0.92	49.68	96,332
500	565		750	0.189	1.141	2.666	0.002	0.100	252.801	106.59	644.36	1,506.38	1.36	56.54	142,820
750	950		1000	0.593	1.138	6.460	0.002	0.301	252.280	562.94	1,081.30	6,137.29	2.29	286.14	239,666
1000	1923		9999	0.227	1.163	3.362	0.002	0.120	257.796	436.09	2,236.99	6,466.24	4.73	231.31	495,821
0	6	Signal Boards	15	0.542	2.845	3.397	0.007	0.139	466.006	3.25	17.07	20.38	0.04	0.83	2,796
15	37		50	1.938	4.794	4.582	0.006	0.466	443.274	71.70	177.39	169.54	0.21	17.25	16,401
50	82		120	0.879	3.000	5.486	0.005	0.456	443.274	72.05	245.97	449.88	0.43	37.38	36,348
120	158		175	0.578	2.428	4.898	0.005	0.252	443.274	91.39	383.68	773.96	0.79	39.82	70,037
175	216		250	0.461	1.366	5.553	0.006	0.177	535.623	99.59	295.12	1,199.47	1.30	38.16	115,694
0	43	Skid Steer Lo	50	0.410	1.379	1.968	0.002	0.167	215.536	17.84	59.95	85.55	0.09	7.27	9,369
50	71		120	0.175	1.236	1.996	0.002	0.132	193.190	12.36	87.19	140.76	0.13	9.34	13,627
120	153		175	0.185	1.226	2.164	0.002	0.103	191.660	28.26	187.53	330.86	0.28	15.83	29,310
175	201		250	0.143	1.218	2.024	0.002	0.080	190.347	28.58	244.23	405.91	0.36	16.10	38,171
250	277		500	0.111	1.201	1.707	0.002	0.057	187.666	30.62	332.20	472.15	0.50	15.89	51,921
500	530		750	0.041	1.233	0.865	0.002	0.034	192.714	21.53	653.51	458.54	0.98	17.91	102,138
750	1000		1000	0.243	1.233	3.012	0.002	0.110	192.714	242.89	1,233.03	3,012.47	1.84	109.65	192,714
0	36	Surfacing Eq	50	0.439	0.846	1.736	0.002	0.152	178.051	15.64	30.17	61.93	0.06	5.43	6,350
50	89		120	0.194	0.749	1.885	0.002	0.131	157.553	17.17	66.39	167.20	0.13	11.60	13,972
120	151		175	0.174	0.746	1.984	0.001	0.095	157.068	26.26	112.67	299.50	0.23	14.30	23,714
175	216		250	0.129	0.757	1.937	0.002	0.064	159.426	27.82	163.67	418.43	0.33	13.80	34,446
250	362		500	0.080	0.748	1.362	0.002	0.045	157.397	28.91	270.99	493.65	0.54	16.16	57,034
500	615		750	0.054	0.750	1.068	0.002	0.033	157.796	33.08	461.15	656.79	0.93	20.46	97,057
750	814		1000	0.108	0.752	1.880	0.002	0.047	158.224	87.82	612.16	1,531.16	1.23	38.62	128,839
1000	1141		9999	0.110	0.737	1.792	0.001	0.050	155.194	125.18	841.35	2,044.40	1.69	56.99	177,076
0	36	Sweepers/Sc	50	0.854	1.544	2.645	0.003	0.277	265.154	30.37	54.93	94.14	0.09	9.87	9,436
50	78		120	0.431	1.393	3.483	0.002	0.293	239.305	33.42	108.00	270.01	0.18	22.71	18,552
120	159		175	0.473	1.390	4.716	0.002	0.261	238.803	75.45	221.69	752.02	0.36	41.63	38,082

		2009		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	Equipment	MaxHP	ROG	CO	NOX	SOX	PM	CO2	ROG	CO	NOX	SOX	PM	CO2
175	204		250	0.294	1.381	3.570	0.002	0.155	237.291	60.04	282.36	729.72	0.46	31.74	48,504
250	303		500	0.197	1.387	2.687	0.002	0.113	238.264	59.60	419.57	812.69	0.69	34.16	72,075
500	848		1000	0.048	1.387	1.777	0.002	0.041	238.264	41.00	1,176.17	1,507.07	1.93	35.12	202,048
0	38	Tractors/Load	50	0.624	0.980	2.076	0.002	0.209	209.296	23.90	37.55	79.53	0.08	8.01	8,017
50	83		120	0.258	0.918	2.349	0.002	0.186	196.126	21.33	75.91	194.13	0.15	15.33	16,210
120	144		175	0.180	0.898	2.109	0.002	0.104	191.762	25.86	129.26	303.54	0.26	15.03	27,601
175	204		250	0.130	0.900	2.076	0.002	0.065	192.132	26.65	183.75	424.06	0.37	13.37	39,237
250	320		500	0.125	0.906	1.931	0.002	0.064	193.373	39.97	289.92	618.32	0.59	20.39	61,906
500	575		750	0.104	0.890	1.640	0.002	0.056	190.141	59.61	511.68	942.19	1.04	32.31	109,259
750	871		1000	0.094	0.928	1.993	0.002	0.038	198.256	81.93	809.06	1,737.04	1.65	33.51	172,761
1000	2006		9999	0.134	0.904	2.253	0.002	0.067	193.002	268.31	1,812.80	4,518.53	3.70	134.86	387,090
0	40	Trenchers	50	0.666	1.634	2.767	0.003	0.253	293.745	26.51	65.01	110.07	0.11	10.06	11,684
50	82		120	0.491	1.475	4.063	0.003	0.313	265.186	40.31	121.07	333.44	0.21	25.66	21,760
120	144		175	0.411	1.449	4.393	0.002	0.222	260.379	59.12	208.43	632.09	0.36	31.91	37,461
175	218		250	0.309	1.470	3.944	0.003	0.157	264.257	67.48	321.14	861.51	0.55	34.27	57,720
250	359		500	0.174	1.462	2.579	0.003	0.093	262.733	62.54	524.08	924.48	0.90	33.33	94,194
500	619		750	0.082	1.466	1.603	0.003	0.056	263.447	50.61	907.68	992.82	1.56	34.64	163,139
750	860		1000	0.582	1.462	6.510	0.003	0.290	262.792	500.24	1,257.44	5,598.74	2.16	249.31	226,001
0	11	Welders	15	0.525	1.836	3.039	0.004	0.224	255.735	5.77	20.20	33.43	0.04	2.46	2,813
15	20		25	0.594	1.530	2.504	0.003	0.180	255.735	11.89	30.60	50.08	0.06	3.61	5,115
25	46		50	1.242	2.992	2.701	0.003	0.289	255.735	57.12	137.62	124.24	0.15	13.31	11,764
50	70		120	0.540	1.777	3.277	0.003	0.282	255.735	37.82	124.40	229.41	0.21	19.75	17,901
120	174		175	0.356	1.435	2.934	0.003	0.156	255.735	62.01	249.72	510.47	0.50	27.10	44,498
175	211		250	0.236	0.680	2.751	0.003	0.090	255.735	49.82	143.40	580.51	0.61	19.01	53,960
250	297		500	0.211	0.790	2.473	0.003	0.083	255.735	62.56	234.65	734.48	0.75	24.55	75,953
0	29	Water Trucks	50	0.634	0.651	2.135	0.002	0.219	214.862	18.489	18.957	62.215	0.060	6.370	6261.140
50	87		120	0.431	0.599	3.215	0.002	0.284	197.770	37.533	52.131	279.890	0.164	24.726	17218.342
120	159		175	0.252	0.603	2.536	0.002	0.149	199.046	40.118	95.753	402.978	0.302	23.608	31626.188
175	211		250	0.219	0.602	2.666	0.002	0.112	198.786	46.135	127.001	562.642	0.401	23.540	41946.967
250	372		500	0.165	0.610	2.101	0.002	0.080	201.372	61.452	227.057	782.348	0.716	29.854	74994.573
500	656		750	0.208	0.612	2.505	0.002	0.104	202.001	136.379	401.151	1643.143	1.265	68.509	132496.155
750	897		1000	0.185	0.607	2.758	0.002	0.082	200.550	166.242	544.793	2474.875	1.718	73.196	179939.468
1000	1764		9999	0.176	0.614	2.592	0.002	0.080	202.650	310.296	1082.422	4573.513	3.414	140.709	357512.951

2010

		2010		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	Equipment	MaxHP	ROG	CO	NOX	SOX	PM	CO2	ROG	CO	NOX	SOX	PM	CO2
0	46	Aerial Lifts	50	0.175	0.866	1.519	0.002	0.099	179.282	8.08	39.91	70.02	0.08	4.57	8,267
50	74		120	0.130	0.778	1.581	0.002	0.101	161.199	9.59	57.61	117.06	0.11	7.51	11,932
120	130		175	0.078	0.778	1.297	0.002	0.055	161.168	10.20	101.52	169.28	0.20	7.16	21,028
175	210		250	0.344	0.778	3.579	0.002	0.183	161.179	72.21	163.42	751.59	0.32	38.38	33,848
250	380		500	0.147	0.778	2.165	0.002	0.068	161.179	55.92	295.70	822.59	0.58	25.74	61,248
0	12	Air Compressors	15	0.534	1.926	3.123	0.004	0.225	272.784	6.41	23.11	37.48	0.05	2.70	3,273
15	24		25	0.601	1.575	2.620	0.003	0.183	272.784	14.42	37.81	62.89	0.08	4.38	6,547
25	37		50	1.387	3.389	2.902	0.004	0.318	272.784	51.32	125.41	107.36	0.13	11.77	10,093
50	78		120	0.577	1.936	3.424	0.003	0.311	272.784	44.98	150.99	267.08	0.25	24.26	21,277
120	147		175	0.384	1.570	3.058	0.003	0.172	272.784	56.45	230.76	449.58	0.45	25.27	40,099
175	218		250	0.249	0.699	2.862	0.003	0.094	272.784	54.34	152.37	623.98	0.67	20.51	59,467
250	385		500	0.224	0.782	2.551	0.003	0.087	272.784	86.13	301.22	982.03	1.03	33.42	105,022
500	595		750	0.228	0.782	2.622	0.003	0.088	272.784	135.49	465.53	1,559.93	1.63	52.42	162,306
750	808		1000	0.286	1.015	3.338	0.003	0.100	272.784	230.78	820.34	2,697.24	2.22	80.45	220,409
0	39	Bore/Drill Rigs	50	0.465	1.217	2.724	0.003	0.204	302.816	18.27	47.78	106.99	0.11	8.02	11,893
50	82		120	0.199	1.017	2.433	0.002	0.157	253.080	16.41	83.71	200.35	0.20	12.96	20,836
120	149		175	0.186	1.074	2.402	0.003	0.116	267.231	27.63	159.47	356.75	0.38	17.27	39,693
175	208		250	0.133	1.057	2.312	0.003	0.070	263.122	27.67	219.61	480.40	0.52	14.47	54,665
250	349		500	0.120	1.041	1.964	0.002	0.066	259.191	41.79	363.60	685.67	0.86	22.91	90,505
500	612		750	0.088	1.074	1.525	0.003	0.054	267.347	53.83	657.28	933.47	1.56	33.08	163,606
750	919		1000	0.084	1.055	2.176	0.003	0.050	262.709	77.04	969.93	1,999.42	2.31	45.50	241,429
1000	2667		9999	0.069	1.056	2.080	0.003	0.047	262.792	184.57	2,815.34	5,546.83	6.69	126.09	700,778
0	9	Cement and Mortar Mixers	15	0.397	1.956	2.545	0.005	0.146	318.248	3.58	17.60	22.91	0.04	1.31	2,864
15	25		25	0.627	1.707	2.960	0.004	0.194	318.248	15.66	42.67	74.01	0.10	4.85	7,956
0	18	Concrete/Industrial Saws	25	0.505	1.708	3.220	0.005	0.158	414.859	9.08	30.75	57.96	0.09	2.84	7,467
25	33		50	1.692	4.409	4.215	0.005	0.413	414.859	55.82	145.50	139.11	0.18	13.63	13,690
50	81		120	0.752	2.784	4.813	0.005	0.403	414.859	60.89	225.52	389.88	0.39	32.62	33,604
120	175		175	0.500	2.275	4.265	0.005	0.224	414.859	87.44	398.15	746.32	0.82	39.17	72,600
0	41	Cranes	50	0.706	0.826	1.816	0.002	0.192	165.360	28.69	33.55	73.79	0.06	7.78	6,718
50	89		120	0.412	0.749	3.230	0.001	0.240	150.025	36.65	66.64	287.26	0.13	21.37	13,344
120	148		175	0.253	0.757	2.611	0.001	0.139	151.589	37.45	111.95	386.11	0.21	20.60	22,418
175	217		250	0.209	0.754	2.420	0.001	0.110	150.995	45.42	163.62	525.13	0.31	23.96	32,766
250	336		500	0.160	0.752	2.033	0.001	0.084	150.594	53.64	252.76	683.15	0.48	28.24	50,616
500	567		750	0.079	0.751	1.295	0.001	0.043	150.469	44.62	426.18	734.76	0.81	24.35	85,345
750	938		1000	0.311	0.748	3.330	0.001	0.165	149.774	291.86	701.25	3,122.05	1.34	154.43	140,429
1000	1030		9999	0.098	0.752	1.844	0.001	0.043	150.667	101.15	774.95	1,898.87	1.48	44.69	155,187
0	43	Crawler Tractors	50	1.204	1.327	2.808	0.002	0.337	244.971	51.20	56.43	119.35	0.10	14.31	10,414
50	87		120	0.403	1.228	3.330	0.002	0.269	226.605	35.02	106.65	289.26	0.19	23.40	19,682
120	150		175	0.285	1.215	3.069	0.002	0.162	224.247	42.61	181.71	459.01	0.32	24.24	33,534
175	203		250	0.204	1.219	2.773	0.002	0.107	224.949	41.35	247.25	562.56	0.44	21.69	45,630
250	341		500	0.186	1.225	2.559	0.002	0.097	226.034	63.20	417.27	871.77	0.74	33.12	77,008
500	570		750	0.158	1.218	2.281	0.002	0.081	224.862	89.88	694.64	1,300.47	1.22	46.12	128,197
750	828		1000	0.206	1.222	3.111	0.002	0.090	225.573	170.24	1,012.24	2,576.55	1.78	74.64	186,812
1000	1527		9999	0.141	1.168	2.524	0.002	0.064	215.490	215.78	1,782.39	3,852.73	3.14	97.83	328,945
0	45	Crushing/Proc. Equipment	50	2.288	5.633	4.733	0.006	0.524	443.274	102.97	253.48	212.99	0.26	23.58	19,947
50	85		120	0.939	3.176	5.536	0.005	0.512	443.274	79.83	269.94	470.58	0.44	43.54	37,678
120	171		175	0.628	2.580	4.934	0.005	0.283	443.274	107.40	441.23	843.68	0.85	48.44	75,800
175	250		250	0.407	1.128	4.618	0.005	0.152	443.274	101.64	281.89	1,154.55	1.25	38.08	110,818
250	382		500	0.367	1.249	4.094	0.004	0.141	443.274	140.04	477.25	1,563.76	1.66	53.78	169,331
500	602		750	0.373	1.224	4.250	0.004	0.143	443.274	224.58	736.60	2,558.38	2.68	86.12	266,851
750	1337		9999	0.469	1.632	5.450	0.004	0.163	443.274	626.96	2,181.69	7,287.04	5.96	218.28	592,657
0	16	Dumpers/Tenders	25	0.306	0.953	1.826	0.003	0.103	215.954	4.90	15.24	29.21	0.04	1.65	3,455
0	36	Excavators	50	0.334	1.083	1.983	0.002	0.158	222.404	11.93	38.70	70.85	0.08	5.63	7,948
50	82		120	0.246	0.962	2.330	0.002	0.179	197.623	20.13	78.68	190.56	0.15	14.66	16,161
120	146		175	0.192	0.973	2.226	0.002	0.114	199.929	28.10	142.15	325.13	0.28	16.68	29,198
175	218		250	0.142	0.974	2.210	0.002	0.069	200.003	30.96	212.73	482.78	0.42	15.17	43,695
250	329		500	0.106	0.968	1.675	0.002	0.055	198.879	34.88	318.21	550.46	0.62	18.01	65,360
500	578		750	0.110	0.965	1.730	0.002	0.057	198.169	63.66	557.59	999.83	1.09	32.82	114,530
750	843		1000	0.168	0.968	2.582	0.002	0.082	198.875	141.76	816.09	2,176.18	1.60	69.35	167,626
1000	1569		9999	0.100	0.963	1.829	0.002	0.051	197.811	156.78	1,511.16	2,869.55	2.96	80.35	310,393
0	42	Forklifts	50	0.503	0.638	1.269	0.001	0.147	117.014	21.34	27.04	53.80	0.05	6.21	4,963
50	82		120	0.185	0.572	1.535	0.001	0.126	105.000	15.22	47.13	126.40	0.08	10.34	8,649
120	141		175	0.135	0.573	1.456	0.001	0.078	105.128	19.10	80.94	205.69	0.14	11.03	14,853
175	208		250	0.151	0.574	1.708	0.001	0.080	105.400	31.37	119.55	355.44	0.21	16.64	21,939
250	344		500	0.144	0.575	1.636	0.001	0.077	105.464	49.50	197.53	562.24	0.35	26.33	36,250
500	880		1000	0.327	0.573	3.140	0.001	0.175	105.117	288.17	504.07	2,762.92	0.88	154.30	92,503
0	11	Generator Sets	15	0.700	2.969	4.695	0.007	0.280	420.542	7.70	32.66	51.64	0.07	3.08	4,626
15	19		25	0.706	2.429	4.040	0.005	0.252	420.542	13.42	46.15	76.76	0.10	4.79	7,990
25	33		50	1.494	3.933	4.190	0.005	0.383	420.542	49.30	129.80	138.27	0.18	12.65	13,878
50	84		120	0.737	2.715	4.834	0.005	0.379	420.542	61.90	228.09	406.04	0.41	31.84	35,326
120	153		175	0.484	2.207	4.313	0.005	0.210	420.542	74.11	337.68	659.85	0.72	32.12	64,343
175	229		250	0.313	0.979	4.043	0.005	0.120	420.542	71.69	224.30	925.77	1.08	27.50	96,304
250	363		500	0.281	1.086	3.679	0.004	0.112	420.542	101.83	394.34	1,335.44	1.50	40.82	152,657
500	586		750	0.290	1.086	3.779	0.004	0.114	420.542	169.86	636.60	2,214.56	2.48	66.86	246,438
750	1130		9999	0.395	1.408	4.818	0.004	0.141	420.542	446.75	1,591.17	5,444.12	4.78	159.88	475,212
0	39	Graders	50	1.300	1.157	2.659	0.002	0.348	222.997	50.93	45.31	104.11	0.08	13.63	8,733
50	91		120	0.565	1.108	4.283	0.002	0.349	213.437	51.44	100.78	389.78	0.19	31.76	19,422
120	148		175	0.369	1.135	3.674	0.002	0.203	218.708	54.53	167.90	543.59	0.31	30.00	32,357
175	204		250	0.153	1.121	2.342	0.002	0.074	216.113	31.27	229.16	478.68	0.42	15.16	44,163
250	293		500	0.116	1.112	1.556	0.002	0.058	214.208	34.12	325.87	456.25	0.60	16.99	62,799
500	796		1000	0.298	1.109	3.726	0.002	0.131	213.737	237.08	882.83	2,966.20	1.62	104.50	170,135
1000	1993		9999	0.174	1.107	2.644	0.002	0.078	213.348	346.63	2,206.16	5,268.85	4.06	155.75	425,161
0	38	Off-Highway Tractors	50	0.806	1.300	2.543	0.002	0.262	252.645	30.34	48.95	95.77	0.09	9.85	9,515
50	75		120	0.385	1.184	3.221	0.002	0.266	230.091	28.66	88.22	240.05	0.16	19.79	17,148
120	158		175	0.239	1.175	2.698	0.002	0.140	228.423	37.75	185.75	426.44	0.34	22.19	36,108
175	214		250	0.207	1.168	2.860	0.002	0.105	227.022	44.26	249.74	611.69	0.46	22.45	48,547
250	334		500	0.155	1.171	2.253	0.002	0.082	227.697	51.96	391.73	753.52	0.73	27.38	76,150
500	574		750	0.135	1.176	2.068	0.002	0.071	228.680	77.71	674.69	1,186.21	1.25	40.79	131,156
750	1000		1000	0.473	1.172	5.345	0.002	0.272	227.753	473.17	1,171.61	5,344.58	2.17	271.92	227,753
1000	1726		9999	0.346	1.138	4.150	0.002	0.156	221.171	597.87	1,964.04	7,164.02	3.65	269.89	381,796
0	29	Off-Highway Trucks	50	0.659	0.650	2.171	0.002	0.226	214.842	19.20	18.95	63.28	0.06	6.60	6,261
50	87		120	0.425	0.599	3.167	0.002	0.280	197.783	37.02	52.13	275.70	0.16	24.37	17,219
120	159		175	0.255	0.603	2.517	0.002	0.149	199.014	40.49	95.74	399.99	0.30	23.69	31,621
175	211		250	0.221	0.602	2.622	0.002	0.111	198.721	46.59	126.96	553.32	0.40	23.37	41,933
250	372		500	0.172	0.610	2.108	0.002	0.081	201.360	64.02	227.04	785.16	0.72	30.33	74,990
500	656		750	0.213	0.612	2.499	0.002	0.105	201.980	139.66	401.11	1,639.46	1.27	69.07	132,482
750	897		1000	0.185	0.607	2.732	0.002	0.081	200.516	165.70	544.70	2,451.21	1.72	72.43	179,909
1000	1764		9999	0.182	0.614	2.613	0.002	0.081	202.659	321.74	1,082.47	4,610.02	3.41	143.64	357,528
0	38	Other Construction Equipr	50	0.558	1.338	2.307	0.002	0.206	243.353	21.22	50.85	87.69	0.09	7.85	9,249
50	82		120	0.339	1.191	2.957	0.002	0.228	216.687	27.63	97.16	241.15	0.17	18.58	17,673
120	152		175	0.281	1.189	3.036	0.002	0.158	216.255	42.87	181.29	463.02	0.31	24.05	32,977
175	217		250	0.213	1.204	2.890	0.002	0.111	218.937	46.20	261.07	626.85	0.45	24.09	47,488
250	357		500	0.175	1.209	2.404	0.002	0.091	219.870	62.61	431.35	857.74	0.75	32.43	78,463
500	598		750	0.124	1.196	1.966	0.002	0.064	217.530	74.03	714.74	1,175.05	1.24	38.53	130,012
750	830		1000	0.176	1.201	2.738	0.002	0.082	218.413	145.91	996.79	2,272.73	1.73	68.14	181,316

		2010		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	Equipment	MaxHP	ROG	CO	NOX	SOX	PM	CO2	ROG	CO	NOX	SOX	PM	CO2
1000	1127		9999	0.179	1.163	2.693	0.002	0.088	211.581	202.22	1,310.51	3,033.73	2.28	98.68	238,381
0	35	Other General Industrial E	50	0.563	0.972	1.943	0.002	0.193	199.186	19.76	34.13	68.19	0.07	6.76	6,992
50	73		120	0.306	0.869	2.516	0.002	0.209	177.921	22.37	63.57	184.18	0.12	15.28	13,022
120	149		175	0.224	0.872	2.399	0.002	0.129	178.621	33.44	130.06	357.79	0.25	19.31	26,642
175	209		250	0.231	0.875	2.750	0.002	0.123	179.141	48.32	182.83	574.98	0.36	25.63	37,451
250	355		500	0.147	0.874	1.942	0.002	0.075	179.029	52.15	310.02	688.71	0.61	26.60	63,504
500	592		750	0.111	0.875	1.634	0.002	0.057	179.232	65.52	517.60	966.60	1.01	33.90	106,023
750	885		1000	0.111	0.872	2.085	0.002	0.051	178.698	98.11	772.06	1,845.35	1.51	44.83	158,148
1000	2000		9999	0.054	0.872	1.433	0.002	0.034	178.698	108.58	1,744.77	2,865.86	3.41	67.42	357,397
0	36	Other Material Handling E	50	0.874	1.196	2.419	0.002	0.266	229.351	31.23	42.74	86.47	0.08	9.51	8,198
50	93		120	0.306	1.081	2.712	0.002	0.217	207.401	28.51	100.73	252.65	0.18	20.25	19,322
120	145		175	0.245	1.078	2.621	0.002	0.144	206.802	35.38	155.86	378.86	0.29	20.83	29,897
175	218		250	0.222	1.076	2.790	0.002	0.115	206.479	48.50	234.96	608.98	0.43	25.19	45,071
250	331		500	0.165	1.074	2.190	0.002	0.089	205.960	54.67	355.79	725.61	0.65	29.42	68,248
500	565		750	0.073	1.078	1.315	0.002	0.041	206.729	41.35	608.45	742.23	1.11	23.29	116,716
750	923		1000	0.073	1.078	1.757	0.002	0.040	206.729	67.51	994.72	1,621.93	1.82	37.10	190,811
1000	1050		9999	0.067	1.078	1.706	0.002	0.039	206.729	70.60	1,131.59	1,790.87	2.07	41.41	217,066
0	39	Pavers	50	0.820	1.428	2.480	0.002	0.257	242.464	31.67	55.17	95.81	0.09	9.93	9,365
50	80		120	0.337	1.272	2.916	0.002	0.224	215.897	26.82	101.22	232.05	0.16	17.86	17,182
120	158		175	0.253	1.282	2.770	0.002	0.140	217.580	40.07	202.70	438.06	0.33	22.13	34,407
175	213		250	0.086	1.286	1.820	0.002	0.046	218.213	18.43	274.09	387.94	0.44	9.83	46,526
250	327		500	0.088	1.264	1.483	0.002	0.051	214.495	28.76	413.69	485.42	0.67	16.74	70,222
500	750		750	0.058	1.280	0.991	0.002	0.040	217.241	43.44	959.87	743.49	1.56	30.34	162,931
0	35	Paving Equipment	50	0.431	1.294	1.902	0.002	0.167	204.867	14.99	45.07	66.23	0.07	5.82	7,133
50	89		120	0.292	1.178	2.569	0.002	0.196	186.442	25.87	104.37	227.65	0.16	17.38	16,519
120	148		175	0.179	1.171	2.164	0.002	0.105	185.319	26.57	173.78	321.21	0.26	15.53	27,503
175	216		250	0.152	1.173	2.143	0.002	0.079	185.659	32.78	253.00	462.27	0.38	17.12	40,041
250	339		500	0.140	1.167	1.971	0.002	0.073	184.619	47.38	395.17	667.74	0.60	24.62	62,541
500	605		750	0.089	1.176	1.577	0.002	0.041	186.121	53.72	711.49	954.22	1.08	25.07	112,603
750	842		1000	0.178	1.175	2.612	0.002	0.075	185.931	150.01	989.20	2,198.97	1.50	63.23	156,554
0	8	Plate Compactors	15	0.286	1.492	1.797	0.004	0.085	244.369	2.29	11.94	14.37	0.03	0.68	1,955
0	13	Pressure Washers	15	0.284	1.204	1.903	0.003	0.113	170.490	3.69	15.65	24.74	0.03	1.47	2,216
15	19		25	0.286	0.985	1.638	0.002	0.102	170.490	5.44	18.71	31.12	0.04	1.94	3,239
25	38		50	0.481	1.348	1.645	0.002	0.135	170.490	18.27	51.21	62.53	0.08	5.13	6,479
50	64		120	0.269	1.049	1.871	0.002	0.134	170.490	17.23	67.16	119.73	0.13	8.61	10,911
0	8	Pumps	15	0.824	2.969	4.815	0.007	0.347	420.542	6.59	23.75	38.52	0.05	2.77	3,364
15	21		25	0.927	2.429	4.040	0.005	0.282	420.542	19.46	51.01	84.84	0.11	5.91	8,831
25	37		50	1.597	4.138	4.234	0.005	0.400	420.542	59.11	153.12	156.66	0.20	14.81	15,560
50	84		120	0.761	2.758	4.907	0.005	0.395	420.542	63.96	231.69	412.22	0.41	33.18	35,326
120	151		175	0.502	2.241	4.379	0.005	0.219	420.542	75.73	338.41	661.23	0.71	33.04	63,502
175	217		250	0.325	0.998	4.105	0.005	0.125	420.542	70.57	216.53	890.68	1.03	27.09	91,258
250	372		500	0.291	1.125	3.722	0.004	0.116	420.542	108.29	418.60	1,384.46	1.54	43.27	156,442
500	615		750	0.300	1.125	3.823	0.004	0.118	420.542	184.50	692.04	2,351.22	2.60	72.58	258,633
750	1460		9999	0.403	1.452	4.871	0.004	0.144	420.542	588.13	2,120.16	7,111.41	6.17	209.79	613,991
0	36	Rollers	50	0.540	1.181	2.097	0.002	0.194	218.704	19.28	42.13	74.81	0.07	6.91	7,803
50	87		120	0.325	1.066	2.815	0.002	0.210	197.386	28.20	92.57	244.48	0.16	18.26	17,145
120	144		175	0.169	1.059	2.103	0.002	0.099	196.102	24.28	152.23	302.39	0.27	14.26	28,195
175	213		250	0.203	1.063	2.754	0.002	0.101	196.872	43.36	226.66	587.39	0.40	21.46	41,983
250	335		500	0.225	1.078	2.822	0.002	0.117	199.724	75.45	361.10	944.91	0.64	39.32	66,883
500	521		750	0.235	1.061	3.179	0.002	0.116	196.512	122.32	552.23	1,654.57	0.98	60.28	102,285
0	47	Rough Terrain Forklifts	50	0.535	1.273	2.241	0.002	0.199	234.013	25.32	60.18	105.97	0.11	9.40	11,065
50	96		120	0.215	1.146	2.336	0.002	0.155	210.645	20.70	110.35	225.01	0.19	14.93	20,291
120	130		175	0.133	1.142	1.925	0.002	0.085	210.076	17.25	148.05	249.42	0.26	11.07	27,224
175	208		250	0.268	1.150	3.167	0.002	0.141	211.511	55.91	239.61	659.64	0.42	29.38	44,059
250	374		500	0.137	1.131	2.332	0.002	0.068	207.951	51.11	422.83	871.74	0.74	25.29	77,751
500	625		750	0.603	1.143	5.996	0.002	0.314	210.233	376.63	714.57	3,747.54	1.25	196.06	131,396
0	42	Rubber Tired Dozers	50	1.194	1.060	2.598	0.002	0.335	226.646	49.65	44.09	108.04	0.09	13.92	9,425
50	82		120	0.502	0.975	3.774	0.002	0.332	208.423	40.95	79.55	307.93	0.16	27.05	17,005
120	150		175	0.390	0.970	3.867	0.002	0.219	207.442	58.42	145.24	578.88	0.30	32.84	31,050
175	211		250	0.292	0.973	3.251	0.002	0.156	208.073	61.68	205.35	685.84	0.42	32.83	43,899
250	354		500	0.307	0.983	3.442	0.002	0.161	210.136	108.75	348.01	1,218.61	0.71	56.87	74,399
500	584		750	0.216	0.969	2.935	0.002	0.106	207.203	125.89	566.12	1,714.05	1.16	62.17	121,027
0	42	Rubber Tired Loaders	50	0.893	0.987	2.279	0.002	0.266	209.950	37.25	41.15	95.03	0.08	11.07	8,754
50	86		120	0.360	0.881	2.841	0.002	0.246	187.406	31.04	75.90	244.76	0.15	21.20	16,145
120	150		175	0.246	0.888	2.537	0.002	0.140	188.992	36.84	133.27	380.49	0.27	21.01	28,348
175	206		250	0.151	0.886	2.151	0.002	0.072	188.433	31.17	182.40	442.98	0.37	14.80	38,799
250	320		500	0.158	0.885	2.049	0.002	0.076	188.265	50.36	282.94	655.01	0.57	24.37	60,186
500	600		750	0.145	0.860	1.832	0.002	0.071	182.999	86.85	516.59	1,100.09	1.05	42.79	109,886
750	837		1000	0.148	0.887	2.402	0.002	0.068	188.758	123.77	742.56	2,010.21	1.51	56.65	157,955
1000	1521		9999	0.139	0.884	2.228	0.002	0.061	187.956	210.98	1,343.95	3,388.15	2.73	92.53	285,882
0	36	Scrapers	50	1.511	1.260	3.185	0.003	0.411	279.274	54.61	45.54	115.12	0.10	14.84	10,094
50	84		120	0.351	1.167	3.422	0.002	0.244	258.725	29.63	98.43	288.60	0.21	20.61	21,817
120	166		175	0.385	1.156	4.128	0.002	0.214	256.150	63.97	192.03	685.96	0.41	35.57	42,563
175	225		250	0.399	1.130	4.548	0.002	0.209	250.564	89.70	254.32	1,023.23	0.54	47.11	56,370
250	381		500	0.252	1.140	3.259	0.002	0.131	252.593	96.27	434.59	1,242.75	0.92	50.01	96,326
500	565		750	0.193	1.140	2.670	0.002	0.101	252.769	108.93	644.28	1,508.31	1.36	57.01	142,802
750	950		1000	0.593	1.138	6.460	0.002	0.301	252.280	562.94	1,081.30	6,137.29	2.29	286.14	239,666
1000	1923		9999	0.233	1.163	3.395	0.002	0.123	257.796	447.98	2,236.99	6,529.66	4.73	235.91	495,821
0	6	Signal Boards	15	0.542	2.845	3.397	0.007	0.127	466.006	3.25	17.07	20.38	0.04	0.76	2,796
15	37		50	1.829	4.687	4.518	0.006	0.446	443.274	67.66	173.43	167.15	0.21	16.49	16,401
50	82		120	0.827	2.974	5.221	0.005	0.438	443.274	67.81	243.83	428.14	0.43	35.90	36,348
120	158		175	0.548	2.420	4.650	0.005	0.243	443.274	86.51	382.33	734.64	0.79	38.37	70,037
175	216		250	0.430	1.287	5.267	0.006	0.165	535.622	92.86	277.96	1,137.62	1.30	35.73	115,694
0	43	Skid Steer Loaders	50	0.385	1.378	1.952	0.002	0.160	215.432	16.76	59.92	84.86	0.09	6.97	9,365
50	71		120	0.164	1.236	1.914	0.002	0.127	193.150	11.54	87.17	135.00	0.13	8.94	13,624
120	153		175	0.161	1.226	1.938	0.002	0.095	191.669	24.67	187.54	296.31	0.28	14.46	29,311
175	201		250	0.146	1.217	2.038	0.002	0.082	190.280	29.27	244.14	408.71	0.36	16.37	38,158
250	277		500	0.112	1.201	1.702	0.002	0.058	187.666	31.00	332.20	470.76	0.50	16.01	51,921
500	530		750	0.044	1.233	0.869	0.002	0.034	192.714	23.25	653.51	460.81	0.98	18.25	102,138
750	1000		1000	0.244	1.233	3.020	0.002	0.109	192.714	243.60	1,233.03	3,019.83	1.84	109.45	192,714
0	36	Surfacing Equipment	50	0.405	0.847	1.708	0.002	0.144	178.281	14.46	30.21	60.93	0.06	5.15	6,359
50	89		120	0.194	0.748	1.859	0.002	0.132	157.532	17.19	66.38	164.84	0.13	11.67	13,970
120	151		175	0.176	0.746	1.992	0.001	0.096	157.070	26.53	112.67	300.68	0.23	14.47	23,714
175	216		250	0.130	0.758	1.923	0.002	0.064	159.435	28.00	163.68	415.41	0.33	13.81	34,448
250	362		500	0.079	0.747	1.337	0.002	0.043	157.212	28.68	270.67	484.29	0.54	15.76	56,967
500	615		750	0.055	0.750	1.071	0.002	0.034	157.789	34.08	461.13	658.59	0.93	20.69	97,052
750	814		1000	0.109	0.752	1.887	0.002	0.048	158.226	88.54	612.17	1,536.58	1.23	38.93	128,841
1000	1141		9999	0.111	0.737	1.797	0.001	0.050	155.194	126.39	841.35	2,050.69	1.69	57.32	177,076
0	36	Sweepers/Scrubbers	50	0.863	1.544	2.654	0.003	0.280	265.154	30.72	54.93	94.46	0.09	9.97	9,436
50	78		120	0.438	1.393	3.503	0.002	0.299	239.305	33.97	108.00	271.61	0.18	23.21	18,552
120	159		175	0.476	1.390	4.733	0.002	0.263	238.803	75.98	221.69	754.85	0.36	42.00	38,082
175	204		250	0.278	1.381	3.405	0.002	0.146	237.291	56.78	282.36	696.09	0.46	29.75	48,504
250	303		500	0.201	1.387	2.698	0.002	0.114	238.264	60.87	419.57	816.15	0.69	34.50	72,075
500	848		1000	0.048	1.387	1.777	0.002	0.041	238.264	41.00	1,176.17	1,507.07	1.93	35.12	202,048
0	38	Tractors/Loaders/Backhoe	50	0.614	0.981	2.075	0.002	0.207	209.425	23.52	37.57	79.50	0.08	7.92	8,022
50	83		120	0.257	0.918	2.326	0.002	0.186	196.051	21.22	75.88	192.25	0.15	15.35	16,204
120	144		175	0.181	0.898	2.095	0.002	0.105	191.780	26.08	129.27	301.57	0.26	15.14	27,604
175	204		250	0.132	0.900	2.058	0.002	0.065	192.106	27.03	183.73	420.36	0.37	13.36	39,232
250	320		500	0.127	0.906	1.911	0.002	0.063	193.481	40.61	290.08	611.70	0.59	20.32	61,941
500	575		750	0.107	0.890	1.621	0.002	0.056	190.110	61.57	511.59	931.25	1.04	32.41	109,240
750	871		1000	0.078	0.928	1.691	0.002	0.032	198.189	68.33	808.79	1,473.96	1.65	27.96	172,702

		2010		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	**Equipment**	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2	**ROG**	**CO**	**NOX**	**SOX**	**PM**	**CO2**
1000	2006		9999	0.135	0.904	2.196	0.002	0.067	193.002	270.80	1,812.80	4,403.99	3.70	134.66	387,090
0	40	Trenchers	50	0.677	1.634	2.778	0.003	0.256	293.751	26.92	65.01	110.49	0.11	10.17	11,685
50	82		120	0.486	1.476	4.020	0.003	0.312	265.197	39.86	121.08	329.84	0.21	25.58	21,761
120	144		175	0.408	1.449	4.347	0.002	0.222	260.378	58.67	208.43	625.42	0.36	31.89	37,461
175	218		250	0.312	1.470	3.952	0.003	0.158	264.219	68.07	321.10	863.16	0.55	34.41	57,711
250	359		500	0.168	1.460	2.439	0.003	0.089	262.430	60.32	523.48	874.41	0.90	31.76	94,086
500	619		750	0.086	1.466	1.611	0.003	0.057	263.434	53.34	907.64	997.31	1.56	35.22	163,132
750	860		1000	0.584	1.462	6.526	0.003	0.292	262.792	502.41	1,257.44	5,612.11	2.16	250.77	226,001
0	11	Welders	15	0.501	1.805	2.928	0.004	0.211	255.735	5.51	19.86	32.21	0.04	2.32	2,813
15	20		25	0.563	1.477	2.457	0.003	0.171	255.735	11.27	29.54	49.13	0.06	3.43	5,115
25	46		50	1.180	2.933	2.665	0.003	0.278	255.735	54.27	134.90	122.61	0.15	12.79	11,764
50	70		120	0.512	1.763	3.128	0.003	0.272	255.735	35.82	123.43	218.95	0.21	19.06	17,901
120	174		175	0.339	1.431	2.793	0.003	0.151	255.735	59.06	248.97	485.98	0.50	26.22	44,498
175	211		250	0.221	0.640	2.616	0.003	0.084	255.735	46.63	134.94	552.00	0.61	17.79	53,960
250	297		500	0.198	0.722	2.346	0.003	0.078	255.735	58.75	214.34	696.67	0.75	23.11	75,953
0	29	Water Trucks	50	0.659	0.650	2.171	0.002	0.226	214.842	19.196	18.955	63.276	0.060	6.598	6260.565
50	87		120	0.425	0.599	3.167	0.002	0.280	197.783	37.020	52.134	275.700	0.164	24.372	17219.487
120	159		175	0.255	0.603	2.517	0.002	0.149	199.014	40.487	95.737	399.990	0.302	23.694	31621.047
175	211		250	0.221	0.602	2.622	0.002	0.111	198.721	46.593	126.959	553.322	0.400	23.368	41933.244
250	372		500	0.172	0.610	2.108	0.002	0.081	201.360	64.016	227.043	785.161	0.716	30.332	74990.029
500	656		750	0.213	0.612	2.499	0.002	0.105	201.980	139.663	401.110	1639.455	1.265	69.069	132482.368
750	897		1000	0.185	0.607	2.732	0.002	0.081	200.516	165.699	544.701	2451.214	1.718	72.433	179909.011
1000	1764		9999	0.182	0.614	2.613	0.002	0.081	202.659	321.743	1082.469	4610.023	3.414	143.637	357528.463

2011

		2011		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	**Equipment**	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2	**ROG**	**CO**	**NOX**	**SOX**	**PM**	**CO2**
0	46	Aerial Lifts	50	0.134	0.866	1.492	0.002	0.085	179.282	6.16	39.91	68.80	0.08	3.90	8,267
50	74		120	0.110	0.778	1.455	0.002	0.089	161.199	8.15	57.61	107.68	0.11	6.56	11,932
120	130		175	0.074	0.778	1.247	0.002	0.053	161.168	9.70	101.52	162.69	0.20	6.93	21,028
175	210		250	0.347	0.778	3.597	0.002	0.185	161.179	72.82	163.42	755.43	0.32	38.80	33,848
250	380		500	0.148	0.778	2.174	0.002	0.068	161.179	56.37	295.70	825.97	0.58	26.03	61,248
0	12	Air Compress	15	0.508	1.891	2.998	0.004	0.210	272.784	6.10	22.70	35.98	0.05	2.52	3,273
15	24		25	0.566	1.516	2.567	0.003	0.172	272.784	13.59	36.37	61.60	0.08	4.14	6,547
25	37		50	1.302	3.302	2.859	0.004	0.304	272.784	48.17	122.16	105.80	0.13	11.24	10,093
50	78		120	0.543	1.919	3.251	0.003	0.299	272.784	42.39	149.71	253.59	0.25	23.30	21,277
120	147		175	0.364	1.565	2.895	0.003	0.166	272.784	53.56	230.06	425.59	0.45	24.36	40,099
175	218		250	0.231	0.655	2.677	0.003	0.085	272.784	50.44	142.74	583.54	0.67	18.48	59,467
250	385		500	0.209	0.713	2.375	0.003	0.079	272.784	80.36	274.52	914.45	1.03	30.29	105,022
500	595		750	0.212	0.713	2.446	0.003	0.080	272.784	126.28	424.26	1,455.09	1.63	47.60	162,306
750	808		1000	0.268	0.935	3.175	0.003	0.094	272.784	216.41	755.09	2,565.59	2.22	75.80	220,409
0	39	Bore/Drill Rig	50	0.450	1.217	2.722	0.003	0.201	302.846	17.69	47.78	106.90	0.11	7.90	11,894
50	82		120	0.192	1.017	2.375	0.002	0.152	253.260	15.83	83.77	195.57	0.20	12.55	20,851
120	149		175	0.179	1.073	2.308	0.003	0.110	267.119	26.53	159.40	342.79	0.38	16.36	39,677
175	208		250	0.128	1.054	2.185	0.003	0.066	262.375	26.62	218.99	453.86	0.52	13.81	54,509
250	349		500	0.117	1.033	1.872	0.002	0.063	257.197	40.81	360.80	653.51	0.86	21.95	89,809
500	612		750	0.086	1.074	1.454	0.003	0.049	267.452	52.86	657.54	890.01	1.56	30.13	163,670
750	919		1000	0.089	1.055	2.189	0.003	0.051	262.701	81.53	969.90	2,011.75	2.31	46.53	241,422
1000	2667		9999	0.075	1.056	2.096	0.003	0.049	262.792	200.99	2,815.34	5,588.85	6.69	129.62	700,778
0	9	Cement and I	15	0.384	1.948	2.437	0.005	0.129	318.248	3.45	17.53	21.93	0.04	1.17	2,864
15	25		25	0.577	1.622	2.881	0.004	0.179	318.248	14.43	40.54	72.03	0.10	4.46	7,956
0	18	Concrete/Indu	25	0.503	1.708	3.192	0.005	0.141	414.859	9.05	30.75	57.45	0.09	2.54	7,467
25	33		50	1.566	4.275	4.147	0.005	0.391	414.859	51.66	141.08	136.84	0.18	12.89	13,690
50	81		120	0.699	2.757	4.544	0.005	0.383	414.859	56.60	223.28	368.06	0.39	31.05	33,604
120	175		175	0.468	2.266	4.012	0.005	0.214	414.859	81.92	396.60	702.06	0.82	37.50	72,600
0	41	Cranes	50	0.676	0.826	1.794	0.002	0.185	165.361	27.46	33.55	72.89	0.06	7.50	6,718
50	89		120	0.400	0.749	3.145	0.001	0.233	150.037	35.59	66.64	279.75	0.13	20.76	13,345
120	148		175	0.251	0.757	2.583	0.001	0.138	151.575	37.13	111.94	382.01	0.21	20.44	22,416
175	217		250	0.207	0.754	2.391	0.001	0.109	150.998	45.02	163.62	518.88	0.31	23.70	32,766
250	336		500	0.156	0.752	1.974	0.001	0.082	150.612	52.27	252.79	663.32	0.48	27.40	50,622
500	567		750	0.080	0.751	1.291	0.001	0.043	150.467	45.66	426.18	732.04	0.81	24.65	85,343
750	938		1000	0.312	0.748	3.334	0.001	0.165	149.775	292.55	701.26	3,126.21	1.34	154.71	140,429
1000	1030		9999	0.099	0.752	1.856	0.001	0.044	150.667	102.47	774.95	1,911.62	1.48	45.52	155,187
0	43	Crawler Tract	50	1.165	1.327	2.782	0.002	0.327	244.848	49.54	56.40	118.26	0.10	13.89	10,409
50	87		120	0.398	1.228	3.284	0.002	0.268	226.543	34.57	106.62	285.26	0.19	23.26	19,677
120	150		175	0.284	1.215	3.042	0.002	0.162	224.213	42.49	181.68	454.88	0.32	24.21	33,529
175	203		250	0.204	1.219	2.754	0.002	0.106	224.977	41.43	247.28	558.68	0.44	21.57	45,636
250	341		500	0.187	1.225	2.536	0.002	0.097	226.052	63.56	417.30	864.03	0.74	33.00	77,014
500	570		750	0.157	1.219	2.245	0.002	0.080	225.005	89.57	695.08	1,280.03	1.22	45.53	128,279
750	828		1000	0.208	1.222	3.131	0.002	0.091	225.602	171.96	1,012.37	2,592.73	1.78	75.39	186,836
1000	1527		9999	0.144	1.168	2.541	0.002	0.065	215.490	219.85	1,782.39	3,878.16	3.14	99.40	328,945
0	45	Crushing/Pro	50	2.126	5.458	4.659	0.006	0.497	443.274	95.66	245.62	209.65	0.26	22.34	19,947
50	85		120	0.879	3.144	5.232	0.005	0.488	443.274	74.74	267.26	444.69	0.44	41.51	37,678
120	171		175	0.593	2.570	4.647	0.005	0.271	443.274	101.39	439.51	794.62	0.85	46.41	75,800
175	250		250	0.377	1.058	4.292	0.005	0.137	443.274	94.31	264.39	1,072.99	1.25	34.16	110,818
250	382		500	0.343	1.140	3.790	0.004	0.127	443.274	130.86	435.47	1,447.70	1.66	48.50	169,331
500	602		750	0.348	1.120	3.942	0.004	0.129	443.274	209.44	674.10	2,373.08	2.68	77.82	266,851
750	1337		9999	0.441	1.501	5.155	0.004	0.153	443.274	589.21	2,006.99	6,892.66	5.96	205.17	592,657
0	16	Dumpers/Ter	25	0.293	0.933	1.781	0.003	0.095	215.954	4.69	14.93	28.49	0.04	1.53	3,455
0	36	Excavators	50	0.336	1.083	1.993	0.002	0.158	222.498	12.00	38.71	71.22	0.08	5.63	7,952
50	82		120	0.227	0.962	2.177	0.002	0.166	197.515	18.54	78.64	178.02	0.15	13.61	16,152
120	146		175	0.179	0.973	2.081	0.002	0.106	199.845	26.16	142.09	303.93	0.28	15.48	29,185
175	218		250	0.134	0.973	2.069	0.002	0.065	199.911	29.38	212.63	452.07	0.42	14.23	43,675
250	329		500	0.102	0.969	1.571	0.002	0.051	198.998	33.48	318.40	516.23	0.62	16.72	65,399
500	578		750	0.110	0.965	1.688	0.002	0.056	198.167	63.30	557.59	975.84	1.09	32.17	114,529
750	843		1000	0.171	0.968	2.595	0.002	0.083	198.915	144.02	816.26	2,187.41	1.60	70.05	167,661
1000	1569		9999	0.099	0.963	1.716	0.002	0.049	197.811	154.58	1,511.16	2,692.52	2.96	76.97	310,393
0	42	Forklifts	50	0.490	0.638	1.260	0.001	0.144	117.014	20.78	27.04	53.42	0.05	6.09	4,963
50	82		120	0.181	0.572	1.499	0.001	0.124	105.000	14.90	47.13	123.51	0.08	10.21	8,649
120	141		175	0.134	0.573	1.435	0.001	0.077	105.128	18.97	80.94	202.80	0.14	10.94	14,853
175	208		250	0.145	0.574	1.643	0.001	0.077	105.400	30.15	119.55	342.03	0.21	15.94	21,939
250	344		500	0.139	0.575	1.576	0.001	0.074	105.464	47.83	197.53	541.64	0.35	25.40	36,250
500	880		1000	0.327	0.573	3.140	0.001	0.175	105.117	288.17	504.07	2,762.92	0.88	154.30	92,503
0	11	Generator Se	15	0.668	2.916	4.515	0.007	0.264	420.542	7.35	32.07	49.66	0.07	2.91	4,626
15	19		25	0.677	2.337	3.957	0.005	0.239	420.542	12.86	44.40	75.18	0.10	4.55	7,990
25	33		50	1.393	3.828	4.123	0.005	0.365	420.542	45.97	126.31	136.07	0.18	12.03	13,878
50	84		120	0.688	2.690	4.588	0.005	0.363	420.542	57.83	225.99	385.36	0.41	30.48	35,326
120	153		175	0.455	2.199	4.081	0.005	0.202	420.542	69.58	336.45	624.47	0.72	30.88	64,343
175	229		250	0.287	0.919	3.777	0.005	0.108	420.542	65.70	210.52	864.87	1.08	24.82	96,304
250	363		500	0.257	0.999	3.423	0.004	0.102	420.542	93.24	362.74	1,242.61	1.50	36.91	152,657
500	586		750	0.266	0.999	3.522	0.004	0.103	420.542	155.71	585.59	2,063.66	2.48	60.55	246,438
750	1130		9999	0.368	1.304	4.576	0.004	0.132	420.542	416.30	1,473.95	5,170.91	4.78	149.33	475,212
0	39	Graders	50	1.314	1.157	2.668	0.002	0.351	223.006	51.45	45.32	104.49	0.08	13.76	8,733
50	91		120	0.559	1.108	4.230	0.002	0.346	213.457	50.83	100.79	384.90	0.19	31.52	19,424
120	148		175	0.367	1.135	3.643	0.002	0.202	218.677	54.23	167.88	538.90	0.31	29.89	32,353
175	204		250	0.157	1.121	2.349	0.002	0.075	216.129	32.08	229.18	480.01	0.42	15.30	44,167
250	293		500	0.123	1.112	1.561	0.002	0.059	214.209	35.94	325.87	457.50	0.60	17.25	62,800
500	796		1000	0.300	1.109	3.753	0.002	0.132	213.737	238.77	882.83	2,987.59	1.62	104.76	170,135
1000	1993		9999	0.177	1.107	2.651	0.002	0.079	213.348	352.94	2,206.16	5,283.43	4.06	156.99	425,161
0	38	Off-Highway	50	0.796	1.299	2.540	0.002	0.260	252.543	29.98	48.93	95.67	0.09	9.78	9,511
50	75		120	0.367	1.184	3.102	0.002	0.256	230.112	27.35	88.22	231.16	0.16	19.09	17,150
120	158		175	0.225	1.175	2.561	0.002	0.134	228.344	35.64	185.68	404.86	0.34	21.13	36,096
175	214		250	0.200	1.168	2.774	0.002	0.100	227.030	42.83	249.74	593.28	0.46	21.45	48,549
250	334		500	0.150	1.171	2.154	0.002	0.078	227.570	50.05	391.51	720.27	0.73	25.94	76,107
500	574		750	0.140	1.176	2.081	0.002	0.072	228.677	80.44	674.69	1,193.76	1.25	41.49	131,154
750	1000		1000	0.473	1.172	5.345	0.002	0.272	227.753	473.17	1,171.61	5,344.58	2.17	271.92	227,753
1000	1726		9999	0.349	1.138	4.176	0.002	0.157	221.300	601.91	1,965.18	7,208.97	3.65	271.39	382,018
0	29	Off-Highway	50	0.651	0.650	2.185	0.002	0.227	214.818	18.98	18.95	63.67	0.06	6.61	6,260
50	87		120	0.380	0.598	2.914	0.002	0.248	197.461	33.04	52.05	253.74	0.16	21.59	17,191
120	159		175	0.237	0.603	2.344	0.002	0.136	199.007	37.60	95.73	372.50	0.30	21.66	31,620
175	211		250	0.215	0.601	2.497	0.002	0.106	198.561	45.40	126.86	526.81	0.40	22.42	41,899

		2011		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	Equipment	MaxHP	ROG	CO	NOX	SOX	PM	CO2	ROG	CO	NOX	SOX	PM	CO2
250	372		500	0.173	0.609	2.062	0.002	0.080	201.274	64.48	226.95	767.74	0.72	29.83	74,958
500	656		750	0.216	0.611	2.488	0.002	0.105	201.944	141.82	401.04	1,631.66	1.26	69.20	132,458
750	897		1000	0.185	0.606	2.710	0.002	0.081	200.314	165.78	544.15	2,431.49	1.72	72.38	179,728
1000	1764		9999	0.184	0.614	2.563	0.002	0.081	202.675	325.22	1,082.55	4,521.20	3.41	142.87	357,557
0	38	Other Constru	50	0.560	1.338	2.313	0.002	0.207	243.349	21.27	50.85	87.92	0.09	7.88	9,249
50	82		120	0.332	1.190	2.901	0.002	0.225	216.550	27.11	97.10	236.60	0.17	18.36	17,662
120	152		175	0.265	1.189	2.875	0.002	0.150	216.191	40.43	181.24	438.41	0.31	22.85	32,967
175	217		250	0.206	1.203	2.803	0.002	0.107	218.894	44.71	261.02	607.90	0.45	23.28	47,479
250	357		500	0.164	1.210	2.255	0.002	0.085	220.052	58.62	431.71	804.60	0.75	30.24	78,528
500	598		750	0.123	1.196	1.924	0.002	0.063	217.501	73.64	714.65	1,149.95	1.24	37.84	129,994
750	830		1000	0.124	1.193	2.195	0.002	0.061	216.996	103.05	990.33	1,822.34	1.72	50.86	180,140
1000	1127		9999	0.183	1.164	2.715	0.002	0.089	211.650	206.74	1,310.94	3,059.35	2.28	100.23	238,459
0	35	Other Genera	50	0.559	0.972	1.946	0.002	0.192	199.186	19.63	34.13	68.30	0.07	6.74	6,992
50	73		120	0.302	0.869	2.477	0.002	0.208	177.921	22.14	63.57	181.29	0.12	15.23	13,022
120	149		175	0.207	0.872	2.230	0.002	0.120	178.621	30.86	130.06	332.67	0.25	17.94	26,642
175	209		250	0.204	0.875	2.494	0.002	0.107	179.141	42.66	182.83	521.49	0.36	22.39	37,451
250	355		500	0.140	0.874	1.855	0.002	0.071	179.029	49.81	310.02	658.00	0.61	25.06	63,504
500	592		750	0.112	0.875	1.616	0.002	0.056	179.232	66.35	517.60	955.81	1.01	33.02	106,023
750	885		1000	0.114	0.872	2.109	0.002	0.052	178.698	100.98	772.06	1,866.26	1.51	46.23	158,148
1000	2000		9999	0.060	0.872	1.447	0.002	0.035	178.698	119.85	1,744.77	2,894.70	3.41	69.84	357,397
0	36	Other Materia	50	0.820	1.196	2.382	0.002	0.255	229.351	29.30	42.74	85.16	0.08	9.10	8,198
50	93		120	0.290	1.081	2.588	0.002	0.208	207.401	27.06	100.73	241.13	0.18	19.41	19,322
120	145		175	0.242	1.078	2.564	0.002	0.142	206.802	34.94	155.86	370.65	0.29	20.57	29,897
175	218		250	0.221	1.076	2.763	0.002	0.114	206.479	48.31	234.96	603.13	0.43	24.85	45,071
250	331		500	0.165	1.074	2.147	0.002	0.087	205.960	54.66	355.79	711.49	0.65	28.90	68,248
500	565		750	0.078	1.078	1.327	0.002	0.043	206.729	44.29	608.45	749.11	1.11	24.00	116,716
750	923		1000	0.079	1.078	1.774	0.002	0.042	206.729	72.75	994.72	1,637.42	1.82	38.34	190,811
1000	1050		9999	0.073	1.078	1.722	0.002	0.041	206.729	76.74	1,131.59	1,807.78	2.07	42.80	217,066
0	39	Pavers	50	0.824	1.428	2.482	0.002	0.258	242.445	31.83	55.17	95.85	0.09	9.97	9,364
50	80		120	0.322	1.271	2.785	0.002	0.216	215.808	25.65	101.18	221.65	0.16	17.22	17,175
120	158		175	0.246	1.282	2.680	0.002	0.136	217.612	38.98	202.73	423.80	0.33	21.51	34,412
175	213		250	0.089	1.286	1.823	0.002	0.047	218.209	19.06	274.09	388.70	0.44	9.94	46,525
250	327		500	0.091	1.264	1.489	0.002	0.052	214.495	29.82	413.69	487.54	0.67	16.99	70,222
500	750		750	0.062	1.280	0.996	0.002	0.041	217.241	46.26	959.87	747.21	1.56	30.89	162,931
0	35	Paving Equip	50	0.431	1.294	1.907	0.002	0.168	204.851	15.01	45.07	66.39	0.07	5.83	7,132
50	89		120	0.280	1.177	2.484	0.002	0.190	186.321	24.77	104.31	220.09	0.16	16.87	16,508
120	148		175	0.176	1.171	2.122	0.002	0.103	185.337	26.19	173.79	314.89	0.26	15.29	27,505
175	216		250	0.146	1.173	2.052	0.002	0.076	185.649	31.40	252.99	442.63	0.38	16.30	40,038
250	339		500	0.125	1.168	1.798	0.002	0.065	184.815	42.50	395.59	609.01	0.60	22.05	62,608
500	605		750	0.090	1.176	1.555	0.002	0.040	186.129	54.53	711.52	941.08	1.08	24.03	112,608
750	842		1000	0.180	1.175	2.627	0.002	0.076	185.931	151.21	989.20	2,212.04	1.50	63.73	156,554
0	8	Plate Compa	15	0.285	1.492	1.785	0.004	0.074	244.369	2.28	11.94	14.28	0.03	0.59	1,955
0	13	Pressure Wa	15	0.271	1.182	1.830	0.003	0.107	170.490	3.52	15.37	23.80	0.03	1.39	2,216
15	19		25	0.274	0.947	1.604	0.002	0.097	170.490	5.21	18.00	30.48	0.04	1.84	3,239
25	38		50	0.445	1.309	1.618	0.002	0.128	170.490	16.90	49.75	61.49	0.08	4.86	6,479
50	64		120	0.250	1.039	1.775	0.002	0.128	170.490	16.01	66.52	113.59	0.13	8.22	10,911
0	8	Pumps	15	0.783	2.916	4.622	0.007	0.324	420.542	6.27	23.33	36.97	0.05	2.59	3,364
15	21		25	0.873	2.337	3.957	0.005	0.266	420.542	18.33	49.07	83.10	0.11	5.58	8,831
25	37		50	1.493	4.029	4.168	0.005	0.381	420.542	55.23	149.07	154.20	0.20	14.10	15,560
50	84		120	0.712	2.733	4.658	0.005	0.378	420.542	59.85	229.56	391.27	0.41	31.78	35,326
120	151		175	0.472	2.233	4.145	0.005	0.210	420.542	71.24	337.19	625.86	0.71	31.78	63,502
175	217		250	0.299	0.936	3.835	0.005	0.113	420.542	64.82	203.15	832.29	1.03	24.44	91,258
250	372		500	0.267	1.031	3.464	0.004	0.105	420.542	99.47	383.70	1,288.46	1.54	39.15	156,442
500	615		750	0.276	1.031	3.563	0.004	0.107	420.542	169.60	634.35	2,191.49	2.60	65.77	258,633
750	1460		9999	0.376	1.342	4.628	0.004	0.134	420.542	548.91	1,958.91	6,756.32	6.17	196.11	613,991
0	36	Rollers	50	0.528	1.181	2.088	0.002	0.190	218.688	18.84	42.13	74.49	0.07	6.79	7,802
50	87		120	0.305	1.065	2.677	0.002	0.200	197.247	26.50	92.50	232.50	0.16	17.38	17,133
120	144		175	0.165	1.059	2.044	0.002	0.097	196.122	23.66	152.24	293.85	0.27	13.89	28,198
175	213		250	0.184	1.063	2.510	0.002	0.091	196.855	39.15	226.64	535.36	0.40	19.35	41,979
250	335		500	0.197	1.072	2.493	0.002	0.103	198.619	66.00	359.10	834.73	0.64	34.58	66,513
500	521		750	0.237	1.061	3.191	0.002	0.117	196.512	123.18	552.23	1,660.98	0.98	60.85	102,285
0	47	Rough Terrai	50	0.511	1.273	2.220	0.002	0.193	234.014	24.15	60.18	104.98	0.11	9.12	11,065
50	96		120	0.194	1.145	2.186	0.002	0.141	210.578	18.70	110.31	210.54	0.19	13.63	20,284
120	130		175	0.120	1.142	1.791	0.002	0.077	210.049	15.55	148.03	232.10	0.26	10.03	27,220
175	208		250	0.243	1.149	2.878	0.002	0.127	211.298	50.56	239.37	599.48	0.42	26.55	44,015
250	374		500	0.138	1.131	2.338	0.002	0.068	207.953	51.62	422.84	874.30	0.74	25.50	77,751
500	625		750	0.606	1.143	6.013	0.002	0.316	210.233	378.53	714.57	3,757.82	1.25	197.40	131,396
0	42	Rubber Tired	50	1.214	1.060	2.614	0.002	0.340	226.605	50.49	44.08	108.69	0.09	14.14	9,423
50	82		120	0.496	0.975	3.739	0.002	0.329	208.430	40.49	79.55	305.08	0.16	26.81	17,006
120	150		175	0.392	0.970	3.874	0.002	0.220	207.429	58.73	145.23	579.81	0.30	32.98	31,048
175	211		250	0.296	0.973	3.261	0.002	0.157	208.074	62.49	205.35	688.03	0.42	33.02	43,899
250	354		500	0.305	0.983	3.401	0.002	0.159	210.243	108.13	348.19	1,204.20	0.71	56.22	74,437
500	584		750	0.219	0.969	2.950	0.002	0.108	207.200	127.77	566.12	1,722.98	1.16	62.83	121,025
0	42	Rubber Tired	50	0.853	0.988	2.260	0.002	0.257	210.269	35.55	41.22	94.25	0.08	10.72	8,767
50	86		120	0.354	0.881	2.782	0.002	0.243	187.309	30.51	75.86	239.67	0.15	20.93	16,136
120	150		175	0.241	0.888	2.465	0.002	0.137	188.970	36.14	133.25	369.77	0.27	20.52	28,345
175	206		250	0.153	0.886	2.126	0.002	0.071	188.407	31.53	182.37	437.81	0.37	14.69	38,794
250	320		500	0.159	0.884	2.021	0.002	0.076	188.111	50.98	282.71	646.19	0.57	24.17	60,137
500	600		750	0.150	0.860	1.843	0.002	0.072	182.949	90.32	516.45	1,106.68	1.05	43.53	109,857
750	837		1000	0.152	0.887	2.422	0.002	0.069	188.751	126.88	742.53	2,026.66	1.51	57.83	157,949
1000	1521		9999	0.144	0.884	2.250	0.002	0.062	187.956	218.85	1,343.95	3,422.35	2.73	95.05	285,882
0	36	Scrapers	50	1.537	1.260	3.200	0.003	0.416	279.274	55.54	45.54	115.65	0.10	15.04	10,094
50	84		120	0.353	1.167	3.410	0.002	0.246	258.681	29.75	98.42	287.57	0.21	20.72	21,814
120	166		175	0.385	1.156	4.109	0.002	0.214	256.133	63.94	192.02	682.77	0.41	35.60	42,560
175	225		250	0.396	1.131	4.509	0.002	0.208	250.581	89.06	254.34	1,014.46	0.54	46.69	56,374
250	381		500	0.250	1.140	3.206	0.002	0.129	252.625	95.52	434.65	1,222.75	0.92	49.27	96,338
500	565		750	0.195	1.140	2.647	0.002	0.100	252.729	109.92	644.17	1,495.15	1.36	56.58	142,779
750	950		1000	0.593	1.138	6.460	0.002	0.301	252.280	562.94	1,081.30	6,137.29	2.29	286.14	239,666
1000	1923		9999	0.239	1.163	3.428	0.002	0.125	257.796	459.77	2,236.99	6,593.28	4.73	240.52	495,821
0	6	Signal Boards	15	0.542	2.845	3.397	0.007	0.129	466.006	3.25	17.07	20.38	0.04	0.77	2,796
15	37		50	1.701	4.552	4.445	0.006	0.423	443.274	62.93	168.42	164.45	0.21	15.63	16,401
50	82		120	0.771	2.944	4.937	0.005	0.418	443.274	63.19	241.42	404.83	0.43	34.26	36,348
120	158		175	0.514	2.410	4.383	0.005	0.233	443.274	81.19	380.84	692.53	0.79	36.79	70,037
175	216		250	0.395	1.207	4.895	0.006	0.148	535.623	85.27	260.76	1,057.41	1.30	32.03	115,694
0	43	Skid Steer Lo	50	0.342	1.378	1.922	0.002	0.148	215.380	14.87	59.90	83.56	0.09	6.44	9,362
50	71		120	0.149	1.235	1.800	0.002	0.117	193.045	10.52	87.12	126.93	0.13	8.22	13,616
120	153		175	0.148	1.225	1.827	0.002	0.088	191.530	22.60	187.40	279.35	0.28	13.42	29,290
175	201		250	0.149	1.217	2.053	0.002	0.083	190.208	29.95	244.05	411.60	0.36	16.63	38,143
250	277		500	0.113	1.201	1.694	0.002	0.058	187.666	31.34	332.20	468.77	0.50	16.12	51,921
500	530		750	0.047	1.233	0.873	0.002	0.035	192.714	24.87	653.51	462.95	0.98	18.56	102,138

		2011		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	**Equipment**	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2	**ROG**	**CO**	**NOX**	**SOX**	**PM**	**CO2**
750	1000		1000	0.244	1.233	3.026	0.002	0.109	192.714	244.27	1,233.03	3,026.41	1.84	109.20	192,714
0	36	Surfacing Equ	50	0.391	0.845	1.694	0.002	0.141	177.887	13.96	30.15	60.44	0.06	5.02	6,345
50	89		120	0.188	0.749	1.805	0.002	0.129	157.570	16.71	66.39	160.08	0.13	11.43	13,973
120	151		175	0.172	0.746	1.949	0.001	0.094	157.071	25.91	112.67	294.22	0.23	14.20	23,714
175	216		250	0.128	0.758	1.895	0.002	0.063	159.431	27.57	163.67	409.51	0.33	13.52	34,447
250	362		500	0.077	0.745	1.287	0.001	0.041	156.839	27.82	270.03	466.17	0.54	14.84	56,832
500	615		750	0.057	0.750	1.074	0.002	0.034	157.782	35.06	461.11	660.29	0.93	20.92	97,048
750	814		1000	0.110	0.752	1.893	0.002	0.048	158.229	89.24	612.18	1,541.81	1.23	39.22	128,844
1000	1141		9999	0.112	0.737	1.803	0.001	0.051	155.194	127.56	841.35	2,056.73	1.69	57.63	177,076
0	36	Sweepers/Sc	50	0.843	1.544	2.644	0.003	0.276	265.154	30.01	54.93	94.09	0.09	9.82	9,436
50	78		120	0.429	1.393	3.417	0.002	0.297	239.305	33.24	108.00	264.89	0.18	23.00	18,552
120	159		175	0.454	1.390	4.523	0.002	0.252	238.803	72.48	221.69	721.28	0.36	40.21	38,082
175	204		250	0.250	1.381	3.194	0.002	0.129	237.291	51.04	282.36	652.92	0.46	26.41	48,504
250	303		500	0.205	1.387	2.709	0.002	0.115	238.264	62.14	419.57	819.60	0.69	34.84	72,075
500	848		1000	0.055	1.387	1.792	0.002	0.043	238.264	46.78	1,176.17	1,519.80	1.93	36.25	202,048
0	38	Tractors/Load	50	0.580	0.982	2.058	0.002	0.199	209.740	22.21	37.63	78.85	0.08	7.62	8,034
50	83		120	0.248	0.916	2.259	0.002	0.181	195.696	20.52	75.75	186.69	0.15	14.94	16,174
120	144		175	0.176	0.899	2.026	0.002	0.102	191.861	25.39	129.33	291.54	0.26	14.71	27,615
175	204		250	0.130	0.900	1.986	0.002	0.063	192.169	26.49	183.79	405.52	0.37	12.92	39,244
250	320		500	0.124	0.906	1.838	0.002	0.062	193.392	39.77	289.95	588.42	0.59	19.69	61,913
500	575		750	0.109	0.890	1.606	0.002	0.056	190.073	62.79	511.49	923.00	1.04	32.33	109,219
750	871		1000	0.069	0.912	1.583	0.002	0.029	194.759	60.25	794.79	1,379.01	1.62	24.87	169,713
1000	2006		9999	0.134	0.904	2.172	0.002	0.067	193.002	269.41	1,812.80	4,356.47	3.70	134.98	387,090
0	40	Trenchers	50	0.672	1.635	2.775	0.003	0.255	293.853	26.72	65.03	110.40	0.11	10.14	11,689
50	82		120	0.462	1.475	3.857	0.003	0.300	265.064	37.90	121.02	316.46	0.21	24.65	21,750
120	144		175	0.405	1.449	4.303	0.002	0.220	260.384	58.24	208.43	619.10	0.36	31.68	37,462
175	218		250	0.290	1.470	3.725	0.003	0.146	264.178	63.25	321.05	813.54	0.55	31.85	57,702
250	359		500	0.165	1.461	2.344	0.003	0.086	262.615	59.03	523.85	840.38	0.90	30.85	94,152
500	619		750	0.080	1.469	1.344	0.003	0.049	264.046	49.39	909.75	831.98	1.56	30.17	163,510
750	860		1000	0.587	1.462	6.541	0.003	0.293	262.792	504.58	1,257.44	5,625.49	2.16	252.22	226,001
0	11	Welders	15	0.476	1.773	2.811	0.004	0.197	255.735	5.24	19.50	30.92	0.04	2.17	2,813
15	20		25	0.531	1.421	2.406	0.003	0.162	255.735	10.62	28.42	48.13	0.06	3.23	5,115
25	46		50	1.108	2.859	2.626	0.003	0.265	255.735	50.97	131.52	120.79	0.15	12.21	11,764
50	70		120	0.481	1.748	2.971	0.003	0.262	255.735	33.69	122.37	207.95	0.21	18.31	17,901
120	174		175	0.321	1.426	2.645	0.003	0.145	255.735	55.90	248.20	460.22	0.50	25.28	44,498
175	211		250	0.204	0.599	2.447	0.003	0.076	255.735	43.12	126.46	516.24	0.61	16.04	53,960
250	297		500	0.184	0.658	2.184	0.003	0.071	255.735	54.50	195.31	648.77	0.75	20.95	75,953
0	29	Water Trucks	50	0.651	0.650	2.185	0.002	0.227	214.818	18.979	18.953	63.672	0.060	6.613	6259.883
50	87		120	0.380	0.598	2.914	0.002	0.248	197.461	33.045	52.050	253.738	0.164	21.593	17191.451
120	159		175	0.237	0.603	2.344	0.002	0.136	199.007	37.595	95.734	372.500	0.302	21.661	31620.039
175	211		250	0.215	0.601	2.497	0.002	0.106	198.561	45.396	126.857	526.813	0.400	22.423	41899.450
250	372		500	0.173	0.609	2.062	0.002	0.080	201.274	64.476	226.946	767.740	0.716	29.828	74957.954
500	656		750	0.216	0.611	2.488	0.002	0.105	201.944	141.824	401.037	1631.663	1.265	69.198	132458.272
750	897		1000	0.185	0.606	2.710	0.002	0.081	200.314	165.780	544.152	2431.490	1.716	72.378	179727.779
1000	1764		9999	0.184	0.614	2.563	0.002	0.081	202.675	325.225	1082.554	4521.201	3.414	142.868	357556.588

2012

		2012		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	**Equipment**	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2	**ROG**	**CO**	**NOX**	**SOX**	**PM**	**CO2**
0	46	Aerial Lifts	50	0.122	0.866	1.439	0.002	0.076	179.282	5.61	39.91	66.33	0.08	3.51	8,267
50	74		120	0.094	0.778	1.352	0.002	0.077	161.199	6.99	57.61	100.09	0.11	5.73	11,932
120	130		175	0.075	0.778	1.241	0.002	0.053	161.168	9.82	101.52	161.87	0.20	6.94	21,028
175	210		250	0.350	0.778	3.616	0.002	0.187	161.179	73.44	163.42	759.27	0.32	39.21	33,848
250	380		500	0.150	0.778	2.182	0.002	0.069	161.179	56.81	295.70	829.35	0.58	26.32	61,248
0	12	Air Compress	15	0.480	1.854	2.864	0.004	0.194	272.784	5.76	22.25	34.37	0.05	2.33	3,273
15	24		25	0.529	1.451	2.509	0.003	0.161	272.784	12.70	34.83	60.22	0.08	3.87	6,547
25	37		50	1.202	3.191	2.812	0.004	0.287	272.784	44.47	118.07	104.03	0.13	10.61	10,093
50	78		120	0.506	1.900	3.055	0.003	0.281	272.784	39.50	148.20	238.28	0.25	21.89	21,277
120	147		175	0.342	1.559	2.715	0.003	0.155	272.784	50.29	229.20	399.08	0.45	22.75	40,099
175	218		250	0.217	0.627	2.493	0.003	0.077	272.784	47.37	136.67	543.54	0.67	16.84	59,467
250	385		500	0.197	0.663	2.203	0.003	0.072	272.784	75.96	255.43	848.33	1.03	27.66	105,022
500	595		750	0.200	0.663	2.273	0.003	0.073	272.784	119.20	394.76	1,352.18	1.63	43.54	162,306
750	808		1000	0.249	0.854	2.998	0.003	0.087	272.784	201.10	690.07	2,422.09	2.22	70.69	220,409
0	39	Bore/Drill Rig	50	0.461	1.217	2.740	0.003	0.204	303.000	18.11	47.81	107.60	0.11	8.02	11,900
50	82		120	0.194	1.018	2.366	0.002	0.152	253.496	16.00	83.85	194.80	0.20	12.48	20,870
120	149		175	0.177	1.075	2.275	0.003	0.108	267.706	26.35	159.75	337.97	0.38	16.07	39,764
175	208		250	0.132	1.054	2.169	0.003	0.067	262.328	27.46	218.95	450.55	0.52	13.94	54,500
250	349		500	0.120	1.034	1.866	0.002	0.063	257.317	41.89	360.97	651.44	0.86	21.84	89,851
500	612		750	0.087	1.072	1.399	0.003	0.047	266.917	52.97	656.22	856.10	1.56	28.85	163,343
750	919		1000	0.093	1.055	2.201	0.003	0.052	262.691	85.44	969.87	2,022.40	2.31	47.43	241,413
1000	2667		9999	0.081	1.056	2.110	0.003	0.050	262.792	215.70	2,815.34	5,626.50	6.69	132.79	700,778
0	9	Cement and I	15	0.378	1.944	2.393	0.005	0.117	318.248	3.40	17.50	21.53	0.04	1.06	2,864
15	25		25	0.532	1.544	2.807	0.004	0.164	318.248	13.29	38.59	70.18	0.10	4.10	7,956
0	18	Concrete/Indu	25	0.501	1.708	3.174	0.005	0.127	414.859	9.02	30.75	57.14	0.09	2.28	7,467
25	33		50	1.439	4.142	4.081	0.005	0.368	414.859	47.50	136.68	134.68	0.18	12.15	13,690
50	81		120	0.647	2.731	4.268	0.005	0.358	414.859	52.41	221.19	345.75	0.39	29.01	33,604
120	175		175	0.437	2.259	3.761	0.005	0.199	414.859	76.49	395.35	658.11	0.82	34.81	72,600
0	41	Cranes	50	0.652	0.826	1.777	0.002	0.179	165.362	26.51	33.55	72.21	0.06	7.29	6,718
50	89		120	0.393	0.749	3.092	0.001	0.229	149.938	34.92	66.60	275.05	0.13	20.38	13,336
120	148		175	0.251	0.757	2.576	0.001	0.139	151.570	37.17	111.93	380.96	0.21	20.48	22,415
175	217		250	0.209	0.754	2.392	0.001	0.110	150.984	45.30	163.61	518.99	0.31	23.79	32,764
250	336		500	0.155	0.752	1.956	0.001	0.081	150.597	52.16	252.76	657.42	0.48	27.22	50,617
500	567		750	0.082	0.751	1.284	0.001	0.044	150.443	46.63	426.11	728.17	0.81	24.79	85,330
750	938		1000	0.313	0.748	3.339	0.001	0.165	149.776	293.24	701.26	3,130.29	1.34	155.00	140,430
1000	1030		9999	0.101	0.752	1.868	0.001	0.045	150.667	103.77	774.95	1,924.13	1.48	46.33	155,187
0	43	Crawler Tract	50	1.180	1.327	2.793	0.002	0.330	244.877	50.14	56.41	118.72	0.10	14.04	10,410
50	87		120	0.402	1.228	3.293	0.002	0.271	226.544	34.92	106.62	286.01	0.19	23.56	19,677
120	150		175	0.288	1.215	3.050	0.002	0.164	224.201	43.01	181.67	456.12	0.32	24.49	33,528
175	203		250	0.207	1.219	2.761	0.002	0.107	224.956	42.06	247.25	560.07	0.44	21.74	45,631
250	341		500	0.189	1.225	2.535	0.002	0.097	226.028	64.51	417.26	863.49	0.74	33.19	77,006
500	570		750	0.160	1.219	2.254	0.002	0.081	225.034	91.50	695.17	1,284.85	1.23	46.09	128,295
750	828		1000	0.210	1.223	3.149	0.002	0.092	225.634	173.60	1,012.52	2,608.21	1.78	76.12	186,863
1000	1527		9999	0.147	1.168	2.556	0.002	0.066	215.490	223.73	1,782.39	3,902.32	3.14	100.90	328,945
0	45	Crushing/Pro	50	1.943	5.255	4.577	0.006	0.466	443.274	87.46	236.48	205.99	0.26	20.96	19,947
50	85		120	0.814	3.109	4.893	0.005	0.455	443.274	69.20	264.26	415.92	0.44	38.65	37,678
120	171		175	0.554	2.559	4.336	0.005	0.251	443.274	94.76	437.58	741.40	0.85	42.94	75,800
175	250		250	0.354	1.013	3.973	0.005	0.124	443.274	88.56	253.35	993.23	1.25	30.94	110,818
250	382		500	0.324	1.062	3.496	0.004	0.115	443.274	123.90	405.85	1,335.42	1.66	44.03	169,331
500	602		750	0.328	1.047	3.636	0.004	0.117	443.274	197.48	630.13	2,188.84	2.68	70.64	266,851
750	1337		9999	0.411	1.370	4.834	0.004	0.142	443.274	549.06	1,831.14	6,462.48	5.96	190.51	592,657
0	16	Dumpers/Ter	25	0.282	0.918	1.739	0.003	0.088	215.954	4.51	14.69	27.82	0.04	1.42	3,455
0	36	Excavators	50	0.342	1.083	1.984	0.002	0.157	222.523	12.22	38.72	70.90	0.08	5.63	7,953
50	82		120	0.227	0.962	2.151	0.002	0.166	197.502	18.53	78.63	175.87	0.15	13.54	16,151
120	146		175	0.180	0.973	2.058	0.002	0.105	199.803	26.22	142.06	300.56	0.28	15.34	29,179
175	218		250	0.135	0.973	2.034	0.002	0.064	199.956	29.54	212.68	444.35	0.42	14.08	43,685
250	329		500	0.104	0.969	1.549	0.002	0.050	199.014	34.05	318.42	509.21	0.62	16.48	65,405
500	578		750	0.112	0.965	1.676	0.002	0.055	198.166	64.86	557.58	968.90	1.09	32.05	114,528
750	843		1000	0.173	0.969	2.607	0.002	0.084	198.960	146.13	816.45	2,197.64	1.60	70.70	167,699
1000	1569		9999	0.102	0.963	1.727	0.002	0.050	197.811	160.69	1,511.16	2,710.18	2.96	78.07	310,393
0	42	Forklifts	50	0.495	0.638	1.262	0.001	0.145	117.014	21.00	27.04	53.51	0.05	6.14	4,963
50	82		120	0.181	0.572	1.494	0.001	0.125	105.000	14.95	47.13	123.02	0.08	10.27	8,649
120	141		175	0.135	0.573	1.431	0.001	0.078	105.128	19.10	80.94	202.19	0.14	11.00	14,853
175	208		250	0.146	0.574	1.637	0.001	0.077	105.400	30.33	119.55	340.65	0.21	15.93	21,939
250	344		500	0.141	0.575	1.579	0.001	0.074	105.464	48.31	197.53	542.77	0.35	25.52	36,250
500	880		1000	0.327	0.573	3.140	0.001	0.175	105.117	288.17	504.07	2,762.92	0.88	154.30	92,503
0	11	Generator Se	15	0.637	2.859	4.326	0.007	0.249	420.542	7.01	31.45	47.58	0.07	2.74	4,626
15	19		25	0.651	2.238	3.868	0.005	0.226	420.542	12.38	42.52	73.50	0.10	4.30	7,990
25	33		50	1.280	3.705	4.051	0.005	0.344	420.542	42.23	122.25	133.67	0.18	11.34	13,878
50	84		120	0.636	2.663	4.312	0.005	0.339	420.542	53.42	223.73	362.21	0.41	28.50	35,326
120	153		175	0.422	2.191	3.829	0.005	0.187	420.542	64.61	335.23	585.90	0.72	28.66	64,343
175	229		250	0.266	0.881	3.517	0.005	0.099	420.542	60.83	201.82	805.33	1.08	22.58	96,304
250	363		500	0.238	0.937	3.175	0.004	0.093	420.542	86.34	340.25	1,152.54	1.50	33.61	152,657
500	586		750	0.246	0.937	3.271	0.004	0.094	420.542	144.28	549.27	1,916.78	2.48	55.20	246,438
750	1130		9999	0.340	1.200	4.317	0.004	0.122	420.542	384.20	1,355.65	4,878.20	4.78	137.81	475,212
0	39	Graders	50	1.326	1.157	2.677	0.002	0.354	223.016	51.94	45.32	104.84	0.08	13.88	8,734
50	91		120	0.557	1.108	4.205	0.002	0.347	213.456	50.70	100.79	382.62	0.19	31.54	19,424
120	148		175	0.368	1.135	3.636	0.002	0.203	218.650	54.40	167.86	537.96	0.31	29.99	32,349
175	204		250	0.161	1.122	2.361	0.002	0.076	216.170	33.00	229.22	482.49	0.42	15.48	44,175
250	293		500	0.128	1.111	1.558	0.002	0.059	214.135	37.44	325.76	456.79	0.60	17.38	62,778
500	796		1000	0.302	1.109	3.778	0.002	0.132	213.737	240.35	882.83	3,007.57	1.62	105.01	170,135
1000	1993		9999	0.180	1.107	2.657	0.002	0.079	213.348	358.68	2,206.16	5,293.99	4.06	158.07	425,161
0	38	Off-Highway '	50	0.803	1.299	2.538	0.002	0.261	252.603	30.23	48.94	95.59	0.09	9.81	9,513
50	75		120	0.366	1.183	3.080	0.002	0.256	230.042	27.31	88.20	229.53	0.16	19.08	17,145
120	158		175	0.220	1.175	2.486	0.002	0.130	228.327	34.72	185.67	393.02	0.34	20.62	36,093
175	214		250	0.198	1.168	2.730	0.002	0.098	227.046	42.30	249.76	583.76	0.46	20.94	48,552
250	334		500	0.151	1.171	2.126	0.002	0.077	227.639	50.47	391.63	711.10	0.73	25.67	76,131
500	574		750	0.145	1.176	2.094	0.002	0.074	228.674	83.14	674.68	1,201.17	1.25	42.18	131,153
750	1000		1000	0.473	1.172	5.345	0.002	0.272	227.753	473.17	1,171.61	5,344.58	2.17	271.92	227,753
1000	1726		9999	0.351	1.139	4.202	0.002	0.158	221.434	605.98	1,966.38	7,253.93	3.65	272.93	382,251
0	29	Off-Highway '	50	0.665	0.651	2.212	0.002	0.232	214.915	19.37	18.96	64.47	0.06	6.75	6,263
50	87		120	0.370	0.596	2.851	0.002	0.239	196.940	32.18	51.91	248.17	0.16	20.77	17,146
120	159		175	0.237	0.602	2.317	0.002	0.135	198.963	37.58	95.71	368.13	0.30	21.45	31,613
175	211		250	0.217	0.601	2.459	0.002	0.106	198.509	45.79	126.82	518.83	0.40	22.30	41,888

		2012		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	Equipment	MaxHP	ROG	CO	NOX	SOX	PM	CO2	ROG	CO	NOX	SOX	PM	CO2
250	372		500	0.177	0.609	2.053	0.002	0.080	201.274	65.78	226.95	764.72	0.72	29.90	74,958
500	656		750	0.222	0.611	2.504	0.002	0.107	201.915	145.68	400.98	1,642.45	1.26	70.23	132,440
750	897		1000	0.188	0.606	2.713	0.002	0.081	200.276	168.48	544.05	2,434.12	1.72	73.09	179,693
1000	1764		9999	0.184	0.614	2.506	0.002	0.080	202.691	325.16	1,082.64	4,421.51	3.41	141.17	357,585
0	38	Other Constru	50	0.566	1.338	2.319	0.002	0.209	243.375	21.50	50.85	88.12	0.09	7.94	9,250
50	82		120	0.333	1.190	2.890	0.002	0.226	216.419	27.14	97.04	235.69	0.17	18.41	17,652
120	152		175	0.267	1.188	2.873	0.002	0.151	216.186	40.71	181.23	438.10	0.31	22.98	32,966
175	217		250	0.208	1.204	2.787	0.002	0.108	218.994	45.01	261.14	604.53	0.45	23.33	47,501
250	357		500	0.168	1.210	2.253	0.002	0.086	220.048	59.82	431.70	803.96	0.75	30.52	78,527
500	598		750	0.126	1.196	1.921	0.002	0.064	217.515	75.38	714.70	1,147.85	1.24	38.16	130,003
750	830		1000	0.126	1.193	2.199	0.002	0.062	216.921	104.61	989.98	1,825.16	1.72	51.19	180,078
1000	1127		9999	0.187	1.164	2.739	0.002	0.090	211.725	211.24	1,311.40	3,085.38	2.28	101.82	238,544
0	35	Other Genera	50	0.570	0.972	1.952	0.002	0.195	199.186	19.99	34.13	68.52	0.07	6.83	6,992
50	73		120	0.303	0.869	2.465	0.002	0.209	177.921	22.18	63.57	180.44	0.12	15.31	13,022
120	149		175	0.206	0.872	2.202	0.002	0.119	178.621	30.73	130.06	328.47	0.25	17.78	26,642
175	209		250	0.203	0.875	2.441	0.002	0.105	179.141	42.41	182.83	510.31	0.36	22.03	37,451
250	355		500	0.143	0.874	1.845	0.002	0.071	179.029	50.76	310.02	654.29	0.61	25.07	63,504
500	592		750	0.114	0.875	1.605	0.002	0.055	179.232	67.38	517.60	949.72	1.01	32.53	106,023
750	885		1000	0.117	0.872	2.132	0.002	0.054	178.698	103.85	772.06	1,887.17	1.51	47.63	158,148
1000	2000		9999	0.066	0.872	1.462	0.002	0.036	178.698	131.12	1,744.77	2,923.54	3.41	72.27	357,397
0	36	Other Materia	50	0.778	1.196	2.342	0.002	0.245	229.351	27.82	42.74	83.72	0.08	8.76	8,198
50	93		120	0.284	1.081	2.517	0.002	0.204	207.401	26.46	100.73	234.50	0.18	19.00	19,322
120	145		175	0.241	1.078	2.534	0.002	0.141	206.802	34.82	155.86	366.27	0.29	20.38	29,897
175	218		250	0.225	1.076	2.777	0.002	0.115	206.479	49.06	234.96	606.23	0.43	25.04	45,071
250	331		500	0.164	1.074	2.096	0.002	0.085	205.960	54.18	355.79	694.57	0.65	28.10	68,248
500	565		750	0.084	1.078	1.339	0.002	0.044	206.729	47.44	608.45	756.20	1.11	24.71	116,716
750	923		1000	0.084	1.078	1.791	0.002	0.043	206.729	77.98	994.72	1,652.91	1.82	39.59	190,811
1000	1050		9999	0.079	1.078	1.738	0.002	0.042	206.729	82.89	1,131.59	1,824.70	2.07	44.19	217,066
0	39	Pavers	50	0.835	1.429	2.435	0.002	0.253	242.508	32.27	55.18	94.03	0.09	9.77	9,367
50	80		120	0.324	1.271	2.772	0.002	0.217	215.774	25.78	101.16	220.61	0.16	17.30	17,172
120	158		175	0.248	1.282	2.676	0.002	0.137	217.637	39.15	202.75	423.14	0.33	21.63	34,416
175	213		250	0.092	1.286	1.833	0.002	0.047	218.215	19.72	274.10	390.87	0.44	10.10	46,526
250	327		500	0.094	1.264	1.495	0.002	0.053	214.495	30.85	413.69	489.57	0.67	17.24	70,222
500	750		750	0.065	1.280	1.001	0.002	0.042	217.241	49.01	959.87	750.85	1.56	31.43	162,931
0	35	Paving Equip	50	0.433	1.294	1.898	0.002	0.167	204.852	15.06	45.07	66.07	0.07	5.81	7,132
50	89		120	0.284	1.177	2.500	0.002	0.194	186.313	25.19	104.30	221.54	0.16	17.19	16,507
120	148		175	0.177	1.171	2.107	0.002	0.103	185.295	26.21	173.76	312.64	0.26	15.30	27,499
175	216		250	0.148	1.173	2.064	0.002	0.076	185.647	31.98	252.98	445.17	0.38	16.50	40,038
250	339		500	0.128	1.168	1.807	0.002	0.066	184.805	43.42	395.57	612.15	0.60	22.36	62,604
500	605		750	0.093	1.176	1.564	0.002	0.040	186.137	56.04	711.56	946.07	1.08	24.43	112,613
750	842		1000	0.181	1.175	2.642	0.002	0.076	185.931	152.39	989.20	2,224.84	1.50	64.22	156,554
0	8	Plate Compa	15	0.284	1.492	1.781	0.004	0.071	244.369	2.28	11.94	14.25	0.03	0.57	1,955
0	13	Pressure Was	15	0.258	1.159	1.754	0.003	0.101	170.490	3.36	15.07	22.80	0.03	1.31	2,216
15	19		25	0.264	0.907	1.568	0.002	0.092	170.490	5.02	17.24	29.80	0.04	1.74	3,239
25	38		50	0.405	1.267	1.589	0.002	0.120	170.490	15.40	48.13	60.37	0.08	4.57	6,479
50	64		120	0.230	1.029	1.668	0.002	0.120	170.490	14.70	65.86	106.75	0.13	7.65	10,911
0	8	Pumps	15	0.740	2.859	4.415	0.007	0.299	420.542	5.92	22.87	35.32	0.05	2.39	3,364
15	21		25	0.816	2.238	3.868	0.005	0.248	420.542	17.13	46.99	81.24	0.11	5.22	8,831
25	37		50	1.374	3.900	4.095	0.005	0.359	420.542	50.83	144.29	151.51	0.20	13.30	15,560
50	84		120	0.659	2.706	4.378	0.005	0.354	420.542	55.38	227.26	367.78	0.41	29.76	35,326
120	151		175	0.439	2.225	3.889	0.005	0.196	420.542	66.29	335.94	587.21	0.71	29.53	63,502
175	217		250	0.277	0.897	3.572	0.005	0.103	420.542	60.16	194.68	775.11	1.03	22.25	91,258
250	372		500	0.248	0.964	3.213	0.004	0.096	420.542	92.44	358.51	1,195.21	1.54	35.68	156,442
500	615		750	0.256	0.964	3.310	0.004	0.098	420.542	157.65	592.69	2,035.84	2.60	60.01	258,633
750	1460		9999	0.348	1.231	4.366	0.004	0.124	420.542	507.60	1,796.93	6,375.03	6.17	181.19	613,991
0	36	Rollers	50	0.536	1.181	2.089	0.002	0.192	218.696	19.12	42.13	74.54	0.07	6.85	7,803
50	87		120	0.305	1.065	2.659	0.002	0.200	197.212	26.49	92.49	230.94	0.16	17.39	17,130
120	144		175	0.164	1.059	2.020	0.002	0.096	196.093	23.62	152.22	290.40	0.27	13.77	28,194
175	213		250	0.183	1.063	2.492	0.002	0.090	196.849	39.11	226.64	531.45	0.40	19.28	41,978
250	335		500	0.199	1.072	2.501	0.002	0.104	198.569	66.80	359.01	837.64	0.63	34.90	66,496
500	521		750	0.238	1.061	3.203	0.002	0.118	196.512	124.03	552.23	1,667.30	0.98	61.43	102,285
0	47	Rough Terrai	50	0.509	1.273	2.208	0.002	0.191	234.017	24.09	60.18	104.42	0.11	9.05	11,065
50	96		120	0.188	1.145	2.127	0.002	0.137	210.534	18.06	110.29	204.89	0.19	13.15	20,280
120	130		175	0.119	1.142	1.763	0.002	0.076	210.056	15.41	148.04	228.41	0.26	9.83	27,221
175	208		250	0.245	1.149	2.859	0.002	0.128	211.264	51.04	239.33	595.52	0.42	26.68	44,008
250	374		500	0.140	1.131	2.345	0.002	0.069	207.954	52.17	422.84	876.85	0.74	25.72	77,752
500	625		750	0.609	1.143	6.029	0.002	0.318	210.233	380.43	714.57	3,768.10	1.25	198.74	131,396
0	42	Rubber Tired	50	1.230	1.060	2.627	0.002	0.344	226.562	51.17	44.07	109.24	0.09	14.32	9,422
50	82		120	0.501	0.975	3.756	0.002	0.333	208.452	40.90	79.56	306.48	0.16	27.13	17,008
120	150		175	0.394	0.970	3.879	0.002	0.221	207.422	59.00	145.23	580.57	0.30	33.09	31,048
175	211		250	0.300	0.973	3.270	0.002	0.157	208.076	63.27	205.35	689.92	0.42	33.19	43,900
250	354		500	0.307	0.983	3.393	0.002	0.159	210.206	108.70	348.13	1,201.44	0.71	56.19	74,424
500	584		750	0.221	0.969	2.957	0.002	0.108	207.197	129.13	566.11	1,727.21	1.16	63.19	121,024
0	42	Rubber Tired	50	0.869	0.989	2.281	0.002	0.262	210.273	36.23	41.22	95.10	0.08	10.92	8,768
50	86		120	0.354	0.881	2.770	0.002	0.243	187.303	30.53	75.86	238.63	0.15	20.91	16,136
120	150		175	0.244	0.888	2.459	0.002	0.137	188.926	36.53	133.22	368.79	0.27	20.60	28,338
175	206		250	0.157	0.886	2.119	0.002	0.072	188.399	32.25	182.37	436.40	0.37	14.75	38,792
250	320		500	0.164	0.884	2.021	0.002	0.076	188.065	52.42	282.64	646.23	0.57	24.40	60,122
500	600		750	0.155	0.860	1.838	0.002	0.073	182.974	92.81	516.52	1,103.47	1.05	43.74	109,872
750	837		1000	0.155	0.887	2.436	0.002	0.070	188.742	129.44	742.50	2,038.31	1.51	58.70	157,942
1000	1521		9999	0.149	0.884	2.270	0.002	0.064	187.956	226.23	1,343.95	3,453.38	2.73	97.36	285,882
0	36	Scrapers	50	1.562	1.260	3.214	0.003	0.422	279.274	56.45	45.54	116.16	0.10	15.24	10,094
50	84		120	0.359	1.167	3.431	0.002	0.250	258.681	30.30	98.42	289.31	0.21	21.11	21,814
120	166		175	0.388	1.156	4.117	0.002	0.216	256.115	64.51	192.00	684.14	0.41	35.94	42,557
175	225		250	0.397	1.131	4.502	0.002	0.207	250.582	89.25	254.34	1,012.74	0.54	46.67	56,374
250	381		500	0.253	1.140	3.205	0.002	0.130	252.665	96.51	434.72	1,222.06	0.92	49.42	96,354
500	565		750	0.199	1.140	2.653	0.002	0.101	252.705	112.21	644.11	1,498.92	1.36	57.08	142,766
750	950		1000	0.593	1.138	6.460	0.002	0.301	252.280	562.94	1,081.30	6,137.29	2.29	286.14	239,666
1000	1923		9999	0.245	1.163	3.461	0.002	0.127	257.796	471.47	2,236.99	6,657.18	4.73	245.15	495,821
0	6	Signal Boards	15	0.542	2.845	3.397	0.007	0.132	466.006	3.25	17.07	20.38	0.04	0.79	2,796
15	37		50	1.558	4.395	4.366	0.006	0.397	443.274	57.64	162.61	161.53	0.21	14.68	16,401
50	82		120	0.710	2.913	4.622	0.005	0.389	443.274	58.26	238.84	379.04	0.43	31.91	36,348
120	158		175	0.477	2.401	4.096	0.005	0.215	443.274	75.41	379.32	647.15	0.79	34.01	70,037
175	216		250	0.367	1.157	4.535	0.006	0.134	535.623	79.17	249.86	979.66	1.30	28.97	115,694
0	43	Skid Steer Lo	50	0.334	1.378	1.890	0.002	0.143	215.329	14.53	59.89	82.17	0.09	6.21	9,360
50	71		120	0.144	1.235	1.745	0.002	0.112	192.955	10.13	87.08	123.07	0.13	7.88	13,610
120	153		175	0.150	1.225	1.835	0.002	0.089	191.436	22.96	187.31	280.56	0.28	13.59	29,275
175	201		250	0.153	1.216	2.067	0.002	0.084	190.128	30.63	243.95	414.58	0.36	16.90	38,127
250	277		500	0.114	1.201	1.685	0.002	0.059	187.666	31.62	332.20	466.06	0.50	16.22	51,921
500	530		750	0.050	1.233	0.877	0.002	0.036	192.714	26.39	653.51	464.96	0.98	18.86	102,138

		2012		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	Equipment	MaxHP	ROG	CO	NOX	SOX	PM	CO2	ROG	CO	NOX	SOX	PM	CO2
750	1000		1000	0.245	1.233	3.032	0.002	0.109	192.714	244.91	1,233.03	3,032.28	1.84	108.88	192,714
0	36	Surfacing Equ	50	0.398	0.845	1.700	0.002	0.142	177.866	14.19	30.14	60.64	0.06	5.08	6,344
50	89		120	0.188	0.749	1.794	0.002	0.128	157.536	16.69	66.38	159.09	0.13	11.39	13,970
120	151		175	0.173	0.746	1.956	0.001	0.095	157.072	26.16	112.67	295.31	0.23	14.36	23,714
175	216		250	0.128	0.757	1.877	0.002	0.062	159.427	27.60	163.67	405.62	0.33	13.50	34,446
250	362		500	0.077	0.745	1.267	0.001	0.040	156.819	27.87	269.99	459.16	0.54	14.67	56,824
500	615		750	0.056	0.748	1.042	0.002	0.033	157.429	34.29	460.08	641.13	0.92	20.14	96,831
750	814		1000	0.110	0.752	1.900	0.002	0.049	158.233	89.91	612.20	1,546.83	1.23	39.51	128,847
1000	1141		9999	0.113	0.737	1.808	0.001	0.051	155.194	128.69	841.35	2,062.52	1.69	57.94	177,076
0	36	Sweepers/Sc	50	0.873	1.544	2.665	0.003	0.283	265.154	31.05	54.93	94.85	0.09	10.07	9,436
50	78		120	0.432	1.393	3.418	0.002	0.300	239.305	33.51	108.00	265.00	0.18	23.26	18,552
120	159		175	0.457	1.390	4.536	0.002	0.254	238.803	72.93	221.69	723.42	0.36	40.52	38,082
175	204		250	0.254	1.381	3.215	0.002	0.131	237.291	51.86	282.36	657.09	0.46	26.68	48,504
250	303		500	0.210	1.387	2.721	0.002	0.116	238.264	63.41	419.57	823.06	0.69	35.18	72,075
500	848		1000	0.062	1.387	1.807	0.002	0.044	238.264	52.56	1,176.17	1,532.54	1.93	37.37	202,048
0	38	Tractors/Load	50	0.576	0.982	2.053	0.002	0.198	209.787	22.07	37.63	78.65	0.08	7.58	8,036
50	83		120	0.248	0.916	2.240	0.002	0.180	195.638	20.50	75.72	185.16	0.15	14.91	16,170
120	144		175	0.179	0.899	2.022	0.002	0.103	191.864	25.75	129.33	291.09	0.26	14.82	27,616
175	204		250	0.132	0.900	1.982	0.002	0.064	192.212	27.04	183.83	404.82	0.37	13.01	39,253
250	320		500	0.127	0.905	1.827	0.002	0.062	193.351	40.62	289.88	584.96	0.59	19.76	61,899
500	575		750	0.112	0.890	1.587	0.002	0.056	190.031	64.39	511.38	911.77	1.04	32.35	109,195
750	871		1000	0.074	0.912	1.597	0.002	0.029	194.746	64.54	794.74	1,391.74	1.62	25.60	169,702
1000	2006		9999	0.140	0.904	2.196	0.002	0.069	193.002	279.79	1,812.80	4,404.49	3.70	138.78	387,090
0	40	Trenchers	50	0.683	1.635	2.781	0.003	0.257	293.851	27.16	65.03	110.63	0.11	10.24	11,689
50	82		120	0.465	1.475	3.867	0.003	0.303	265.044	38.17	121.01	317.27	0.21	24.90	21,749
120	144		175	0.401	1.449	4.250	0.002	0.219	260.391	57.70	208.44	611.44	0.36	31.52	37,463
175	218		250	0.293	1.470	3.743	0.003	0.147	264.146	63.93	321.01	817.54	0.55	32.18	57,695
250	359		500	0.163	1.461	2.304	0.003	0.084	262.663	58.47	523.94	826.09	0.90	30.29	94,169
500	619		750	0.060	1.470	1.029	0.003	0.035	264.288	37.20	910.58	637.26	1.56	21.59	163,660
750	860		1000	0.589	1.462	6.557	0.003	0.295	262.792	506.75	1,257.44	5,638.87	2.16	253.68	226,001
0	11	Welders	15	0.450	1.739	2.685	0.004	0.182	255.735	4.95	19.12	29.53	0.04	2.00	2,813
15	20		25	0.496	1.361	2.352	0.003	0.151	255.735	9.92	27.21	47.05	0.06	3.02	5,115
25	46		50	1.025	2.769	2.582	0.003	0.251	255.735	47.13	127.36	118.76	0.15	11.54	11,764
50	70		120	0.448	1.731	2.793	0.003	0.246	255.735	31.35	121.17	195.52	0.21	17.20	17,901
120	174		175	0.301	1.421	2.482	0.003	0.136	255.735	52.37	247.33	431.86	0.50	23.59	44,498
175	211		250	0.191	0.574	2.280	0.003	0.069	255.735	40.33	121.08	481.04	0.61	14.61	53,960
250	297		500	0.172	0.612	2.027	0.003	0.064	255.735	51.20	181.65	602.07	0.75	19.12	75,953
0	29	Water Trucks	50	0.665	0.651	2.212	0.002	0.232	214.915	19.368	18.961	64.466	0.060	6.749	6262.690
50	87		120	0.370	0.596	2.851	0.002	0.239	196.940	32.180	51.912	248.172	0.164	20.774	17146.088
120	159		175	0.237	0.602	2.317	0.002	0.135	198.963	37.581	95.713	368.131	0.302	21.452	31613.067
175	211		250	0.217	0.601	2.459	0.002	0.106	198.509	45.794	126.823	518.829	0.400	22.302	41888.392
250	372		500	0.177	0.609	2.053	0.002	0.080	201.274	65.781	226.947	764.719	0.716	29.895	74958.110
500	656		750	0.222	0.611	2.504	0.002	0.107	201.915	145.685	400.980	1642.455	1.265	70.232	132439.629
750	897		1000	0.188	0.606	2.713	0.002	0.081	200.276	168.477	544.048	2434.121	1.716	73.092	179693.374
1000	1764		9999	0.184	0.614	2.506	0.002	0.080	202.691	325.158	1082.641	4421.507	3.415	141.172	357585.199

2013

		2013		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	**Equipment**	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2	**ROG**	**CO**	**NOX**	**SOX**	**PM**	**CO2**
0	46	Aerial Lifts	50	0.099	0.866	1.335	0.002	0.060	179.282	4.56	39.91	61.56	0.08	2.78	8,267
50	74		120	0.078	0.778	1.211	0.002	0.062	161.199	5.79	57.61	89.63	0.11	4.60	11,932
120	130		175	0.071	0.778	1.162	0.002	0.048	161.168	9.28	101.52	151.64	0.20	6.31	21,028
175	210		250	0.353	0.778	3.634	0.002	0.189	161.179	74.05	163.42	763.11	0.32	39.63	33,848
250	380		500	0.075	0.778	1.413	0.002	0.031	161.179	28.56	295.70	536.84	0.58	11.72	61,248
0	12	Air Compress	15	0.452	1.818	2.731	0.004	0.178	272.784	5.42	21.81	32.77	0.05	2.14	3,273
15	24		25	0.492	1.388	2.452	0.003	0.150	272.784	11.81	33.31	58.84	0.08	3.60	6,547
25	37		50	1.096	3.074	2.704	0.004	0.265	272.784	40.56	113.75	100.06	0.13	9.79	10,093
50	78		120	0.469	1.880	2.861	0.003	0.260	272.784	36.55	146.68	223.13	0.25	20.24	21,277
120	147		175	0.319	1.554	2.543	0.003	0.143	272.784	46.96	228.39	373.89	0.45	20.97	40,099
175	218		250	0.206	0.608	2.315	0.003	0.071	272.784	44.81	132.50	504.66	0.67	15.40	59,467
250	385		500	0.188	0.627	2.038	0.003	0.066	272.784	72.39	241.32	784.59	1.03	25.33	105,022
500	595		750	0.191	0.627	2.106	0.003	0.067	272.784	113.42	372.95	1,253.10	1.63	39.92	162,306
750	808		1000	0.230	0.779	2.818	0.003	0.081	272.784	186.09	629.23	2,277.21	2.22	65.62	220,409
0	39	Bore/Drill Rig	50	0.450	1.217	2.735	0.003	0.200	302.960	17.69	47.80	107.43	0.11	7.86	11,898
50	82		120	0.184	1.019	2.274	0.002	0.140	253.743	15.19	83.93	187.22	0.20	11.53	20,891
120	149		175	0.168	1.073	2.162	0.003	0.100	266.966	24.98	159.31	321.15	0.38	14.84	39,654
175	208		250	0.126	1.053	2.019	0.003	0.062	262.064	26.27	218.73	419.49	0.52	12.90	54,445
250	349		500	0.115	1.032	1.756	0.002	0.058	256.977	40.21	360.49	613.23	0.86	20.17	89,732
500	612		750	0.085	1.073	1.295	0.003	0.044	267.078	52.08	656.62	792.26	1.56	26.99	163,441
750	919		1000	0.071	1.057	1.742	0.003	0.041	263.092	65.12	971.35	1,600.86	2.31	37.85	241,781
1000	2667		9999	0.086	1.056	2.122	0.003	0.051	262.792	228.70	2,815.34	5,659.77	6.69	135.59	700,778
0	9	Cement and	15	0.375	1.943	2.365	0.005	0.107	318.248	3.37	17.49	21.28	0.04	0.97	2,864
15	25		25	0.490	1.473	2.737	0.004	0.151	318.248	12.25	36.81	68.44	0.10	3.77	7,956
0	18	Concrete/Indu	25	0.501	1.708	3.165	0.005	0.123	414.859	9.01	30.75	56.97	0.09	2.21	7,467
25	33		50	1.314	4.010	3.926	0.005	0.339	414.859	43.35	132.32	129.56	0.18	11.19	13,690
50	81		120	0.597	2.707	4.006	0.005	0.330	414.859	48.35	219.23	324.46	0.39	26.75	33,604
120	175		175	0.407	2.253	3.529	0.005	0.183	414.859	71.24	394.36	617.63	0.82	32.05	72,600
0	41	Cranes	50	0.645	0.826	1.760	0.002	0.176	165.364	26.21	33.55	71.50	0.06	7.14	6,718
50	89		120	0.382	0.749	3.015	0.001	0.223	149.922	33.94	66.59	268.18	0.13	19.86	13,335
120	148		175	0.249	0.757	2.545	0.001	0.137	151.559	36.82	111.92	376.30	0.21	20.30	22,413
175	217		250	0.206	0.754	2.350	0.001	0.108	150.982	44.70	163.61	509.87	0.31	23.42	32,763
250	336		500	0.150	0.752	1.877	0.001	0.078	150.620	50.49	252.80	630.92	0.48	26.15	50,624
500	567		750	0.083	0.751	1.258	0.001	0.043	150.405	47.08	426.00	713.66	0.81	24.55	85,308
750	938		1000	0.313	0.748	3.343	0.001	0.166	149.776	293.91	701.26	3,134.30	1.34	155.27	140,430
1000	1030		9999	0.102	0.752	1.880	0.001	0.046	150.667	105.04	774.95	1,936.40	1.48	47.12	155,187
0	43	Crawler Tract	50	1.154	1.328	2.757	0.002	0.323	245.019	49.07	56.44	117.19	0.10	13.72	10,416
50	87		120	0.403	1.228	3.279	0.002	0.273	226.552	34.96	106.62	284.81	0.19	23.69	19,678
120	150		175	0.286	1.215	3.012	0.002	0.163	224.167	42.79	181.64	450.38	0.32	24.35	33,523
175	203		250	0.207	1.219	2.730	0.002	0.106	224.881	41.92	247.17	553.86	0.44	21.47	45,616
250	341		500	0.189	1.225	2.499	0.002	0.096	226.106	64.39	417.40	851.32	0.74	32.82	77,032
500	570		750	0.158	1.218	2.186	0.002	0.078	224.814	89.88	694.49	1,246.47	1.22	44.72	128,170
750	828		1000	0.212	1.223	3.167	0.002	0.093	225.670	175.16	1,012.68	2,622.97	1.78	76.82	186,893
1000	1527		9999	0.149	1.168	2.571	0.002	0.067	215.490	227.42	1,782.39	3,925.17	3.14	102.34	328,945
0	45	Crushing/Pro	50	1.757	5.048	4.391	0.006	0.426	443.274	79.06	227.18	197.60	0.26	19.17	19,947
50	85		120	0.749	3.074	4.563	0.005	0.416	443.274	63.68	261.31	387.88	0.44	35.39	37,678
120	171		175	0.516	2.549	4.043	0.005	0.229	443.274	88.16	435.83	691.38	0.85	39.24	75,800
175	250		250	0.335	0.983	3.667	0.005	0.113	443.274	83.81	245.80	916.66	1.25	28.13	110,818
250	382		500	0.310	1.006	3.217	0.004	0.105	443.274	118.27	384.15	1,228.72	1.66	40.05	169,331
500	602		750	0.312	0.994	3.342	0.004	0.107	443.274	187.70	598.21	2,011.88	2.68	64.18	266,851
750	1337		9999	0.382	1.248	4.512	0.004	0.131	443.274	510.69	1,668.18	6,033.16	5.96	175.77	592,657
0	16	Dumpers/Ten	25	0.273	0.906	1.702	0.003	0.082	215.954	4.37	14.50	27.23	0.04	1.31	3,455
0	36	Excavators	50	0.334	1.083	1.930	0.002	0.150	222.405	11.95	38.70	68.96	0.08	5.36	7,948
50	82		120	0.215	0.962	2.051	0.002	0.154	197.595	17.55	78.67	167.72	0.15	12.63	16,159
120	146		175	0.169	0.973	1.944	0.002	0.097	199.812	24.72	142.07	283.88	0.28	14.13	29,181
175	218		250	0.129	0.974	1.886	0.002	0.060	199.958	28.16	212.68	411.96	0.42	13.11	43,685
250	329		500	0.099	0.970	1.426	0.002	0.046	199.153	32.62	318.65	468.79	0.63	15.16	65,450
500	578		750	0.101	0.963	1.500	0.002	0.048	197.771	58.59	556.47	867.17	1.09	27.86	114,299
750	843		1000	0.132	0.969	2.234	0.002	0.061	199.011	110.97	816.65	1,883.13	1.60	51.46	167,741
1000	1569		9999	0.089	0.963	1.535	0.002	0.042	197.811	139.87	1,511.16	2,408.70	2.96	66.55	310,393
0	42	Forklifts	50	0.469	0.638	1.236	0.001	0.138	117.014	19.91	27.04	52.40	0.05	5.87	4,963
50	82		120	0.176	0.572	1.450	0.001	0.121	105.000	14.51	47.13	119.46	0.08	9.99	8,649
120	141		175	0.131	0.573	1.387	0.001	0.075	105.128	18.58	80.94	196.01	0.14	10.64	14,853
175	208		250	0.139	0.574	1.562	0.001	0.072	105.400	28.94	119.55	325.23	0.21	15.08	21,939
250	344		500	0.121	0.575	1.389	0.001	0.063	105.464	41.72	197.53	477.44	0.35	21.68	36,250
500	880		1000	0.327	0.573	3.140	0.001	0.175	105.117	288.17	504.07	2,762.92	0.88	154.30	92,503
0	11	Generator Se	15	0.606	2.803	4.138	0.007	0.235	420.542	6.67	30.83	45.52	0.07	2.58	4,626
15	19		25	0.628	2.140	3.780	0.005	0.214	420.542	11.92	40.65	71.82	0.10	4.06	7,990
25	33		50	1.163	3.578	3.888	0.005	0.315	420.542	38.39	118.08	128.32	0.18	10.41	13,878
50	84		120	0.583	2.637	4.042	0.005	0.312	420.542	49.00	221.52	339.52	0.41	26.24	35,326
120	153		175	0.390	2.184	3.592	0.005	0.172	420.542	59.63	334.18	549.63	0.72	26.30	64,343
175	229		250	0.247	0.855	3.266	0.005	0.090	420.542	56.64	195.86	748.03	1.08	20.62	96,304
250	363		500	0.222	0.891	2.938	0.004	0.085	420.542	80.49	323.48	1,066.32	1.50	30.68	152,657
500	586		750	0.230	0.891	3.031	0.004	0.086	420.542	134.56	522.20	1,776.37	2.48	50.46	246,438
750	1130		9999	0.312	1.101	4.058	0.004	0.112	420.542	352.82	1,243.86	4,585.71	4.78	126.36	475,212
0	39	Graders	50	1.338	1.157	2.686	0.002	0.357	223.027	52.40	45.32	105.18	0.08	14.00	8,734
50	91		120	0.557	1.108	4.186	0.002	0.347	213.447	50.65	100.79	380.92	0.19	31.59	19,423
120	148		175	0.367	1.134	3.610	0.002	0.202	218.559	54.24	167.79	534.14	0.31	29.94	32,335
175	204		250	0.164	1.121	2.348	0.002	0.076	216.117	33.48	229.17	479.88	0.42	15.44	44,164
250	293		500	0.129	1.111	1.517	0.002	0.058	214.063	37.90	325.65	444.80	0.60	16.94	62,757
500	796		1000	0.303	1.109	3.798	0.002	0.132	213.737	241.58	882.83	3,023.02	1.62	105.21	170,135
1000	1993		9999	0.184	1.107	2.669	0.002	0.080	213.348	365.90	2,206.16	5,317.88	4.06	159.61	425,161
0	38	Off-Highway	50	0.774	1.299	2.509	0.002	0.253	252.503	29.13	48.92	94.47	0.09	9.52	9,509
50	75		120	0.350	1.183	2.960	0.002	0.246	229.900	26.12	88.14	220.58	0.16	18.31	17,134
120	158		175	0.208	1.175	2.361	0.002	0.122	228.347	32.96	185.69	373.20	0.34	19.34	36,096
175	214		250	0.195	1.168	2.663	0.002	0.095	227.008	41.67	249.72	569.42	0.46	20.37	48,544
250	334		500	0.139	1.171	1.919	0.002	0.068	227.618	46.38	391.59	641.78	0.73	22.82	76,123
500	574		750	0.131	1.172	1.884	0.002	0.065	227.913	75.23	672.43	1,080.39	1.25	37.25	130,716
750	1000		1000	0.473	1.172	5.345	0.002	0.272	227.753	473.17	1,171.61	5,344.58	2.17	271.92	227,753
1000	1726		9999	0.233	1.178	3.207	0.002	0.104	229.023	401.85	2,033.77	5,536.91	3.78	180.32	395,351
0	29	Off-Highway	50	0.655	0.651	2.205	0.002	0.229	215.017	19.09	18.97	64.25	0.06	6.68	6,266
50	87		120	0.352	0.596	2.758	0.002	0.222	196.910	30.63	51.90	240.15	0.16	19.34	17,143
120	159		175	0.226	0.602	2.209	0.002	0.126	198.857	35.85	95.66	350.91	0.30	20.03	31,596
175	211		250	0.209	0.601	2.314	0.002	0.100	198.401	44.19	126.75	488.21	0.40	21.18	41,866

		2013		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	Equipment	MaxHP	ROG	CO	NOX	SOX	PM	CO2	ROG	CO	NOX	SOX	PM	CO2
250	372		500	0.169	0.610	1.933	0.002	0.075	201.370	62.85	227.05	720.00	0.72	27.95	74,994
500	656		750	0.217	0.611	2.409	0.002	0.102	201.971	142.20	401.09	1,580.28	1.27	67.23	132,476
750	897		1000	0.182	0.606	2.632	0.002	0.078	200.232	163.65	543.93	2,361.82	1.72	70.33	179,654
1000	1764		9999	0.186	0.613	2.470	0.002	0.079	202.618	327.27	1,082.25	4,358.26	3.41	140.23	357,457
0	38	Other Constru	50	0.574	1.338	2.328	0.002	0.211	243.426	21.82	50.86	88.47	0.09	8.04	9,252
50	82		120	0.326	1.190	2.837	0.002	0.221	216.544	26.60	97.10	231.36	0.17	18.01	17,662
120	152		175	0.259	1.189	2.779	0.002	0.146	216.290	39.44	181.32	423.84	0.31	22.23	32,982
175	217		250	0.192	1.204	2.595	0.002	0.098	219.031	41.74	261.18	562.86	0.45	21.32	47,509
250	357		500	0.161	1.208	2.136	0.002	0.081	219.688	57.37	431.00	762.43	0.75	28.79	78,398
500	598		750	0.117	1.196	1.765	0.002	0.059	217.572	70.10	714.88	1,054.62	1.24	34.97	130,037
750	830		1000	0.115	1.192	2.061	0.002	0.056	216.907	95.35	989.92	1,710.82	1.72	46.74	180,066
1000	1127		9999	0.190	1.164	2.749	0.002	0.091	211.725	214.10	1,311.40	3,097.28	2.28	102.51	238,544
0	35	Other Genera	50	0.556	0.972	1.929	0.002	0.190	199.186	19.50	34.13	67.71	0.07	6.67	6,992
50	73		120	0.295	0.869	2.403	0.002	0.204	177.921	21.60	63.57	175.89	0.12	14.93	13,022
120	149		175	0.192	0.872	2.058	0.002	0.111	178.621	28.70	130.06	306.98	0.25	16.53	26,642
175	209		250	0.183	0.875	2.228	0.002	0.093	179.141	38.29	182.83	465.73	0.36	19.50	37,451
250	355		500	0.131	0.874	1.647	0.002	0.062	179.029	46.34	310.02	584.29	0.61	22.14	63,504
500	592		750	0.104	0.875	1.408	0.002	0.048	179.232	61.27	517.60	832.89	1.01	28.14	106,023
750	885		1000	0.121	0.872	2.156	0.002	0.055	178.698	106.73	772.06	1,908.08	1.51	49.03	158,148
1000	2000		9999	0.071	0.872	1.476	0.002	0.037	178.698	142.38	1,744.77	2,952.39	3.41	74.69	357,397
0	36	Other Materia	50	0.732	1.196	2.315	0.002	0.236	229.351	26.17	42.74	82.74	0.08	8.42	8,198
50	93		120	0.252	1.081	2.278	0.002	0.177	207.401	23.45	100.73	212.23	0.18	16.46	19,322
120	145		175	0.232	1.078	2.433	0.002	0.132	206.802	33.47	155.86	351.66	0.29	19.02	29,897
175	218		250	0.221	1.076	2.697	0.002	0.111	206.479	48.15	234.96	588.65	0.43	24.26	45,071
250	331		500	0.152	1.074	1.926	0.002	0.077	205.960	50.46	355.79	638.05	0.65	25.51	68,248
500	565		750	0.090	1.078	1.352	0.002	0.045	206.729	50.58	608.45	763.28	1.11	25.42	116,716
750	923		1000	0.090	1.078	1.808	0.002	0.044	206.729	83.21	994.72	1,668.41	1.82	40.84	190,811
1000	1050		9999	0.085	1.078	1.754	0.002	0.043	206.729	89.03	1,131.59	1,841.61	2.07	45.58	217,066
0	39	Pavers	50	0.831	1.430	2.427	0.002	0.251	242.740	32.11	55.24	93.73	0.09	9.71	9,376
50	80		120	0.309	1.273	2.674	0.002	0.208	216.129	24.59	101.33	212.77	0.16	16.56	17,200
120	158		175	0.230	1.281	2.517	0.002	0.126	217.418	36.40	202.55	398.02	0.33	19.96	34,381
175	213		250	0.090	1.285	1.757	0.002	0.044	218.191	19.14	274.07	374.68	0.44	9.40	46,521
250	327		500	0.089	1.267	1.410	0.002	0.049	215.137	29.05	414.93	461.63	0.67	15.98	70,432
500	750		750	0.069	1.280	1.006	0.002	0.043	217.241	51.69	959.87	754.40	1.56	31.95	162,931
0	35	Paving Equip	50	0.415	1.294	1.882	0.002	0.163	204.734	14.43	45.04	65.51	0.07	5.67	7,128
50	89		120	0.264	1.177	2.364	0.002	0.180	186.211	23.39	104.25	209.46	0.16	15.96	16,498
120	148		175	0.166	1.170	1.990	0.002	0.096	185.134	24.66	173.60	295.30	0.26	14.27	27,475
175	216		250	0.127	1.174	1.865	0.002	0.064	185.800	27.44	253.19	402.22	0.38	13.81	40,071
250	339		500	0.119	1.166	1.697	0.002	0.060	184.495	40.28	394.91	574.82	0.60	20.43	62,499
500	605		750	0.078	1.174	1.392	0.002	0.032	185.768	47.41	710.14	842.05	1.07	19.16	112,389
750	842		1000	0.182	1.175	2.657	0.002	0.077	185.931	153.55	989.20	2,237.39	1.50	64.70	156,554
0	8	Plate Compa	15	0.284	1.492	1.781	0.004	0.070	244.369	2.28	11.94	14.25	0.03	0.56	1,955
0	13	Pressure Wa	15	0.246	1.136	1.678	0.003	0.095	170.490	3.20	14.77	21.81	0.03	1.24	2,216
15	19		25	0.254	0.867	1.532	0.002	0.087	170.490	4.83	16.48	29.12	0.04	1.64	3,239
25	38		50	0.366	1.224	1.523	0.002	0.110	170.490	13.89	46.51	57.89	0.08	4.17	6,479
50	64		120	0.209	1.019	1.564	0.002	0.110	170.490	13.40	65.22	100.08	0.13	7.01	10,911
0	8	Pumps	15	0.697	2.803	4.210	0.007	0.275	420.542	5.57	22.42	33.68	0.05	2.20	3,364
15	21		25	0.759	2.140	3.780	0.005	0.231	420.542	15.94	44.93	79.38	0.11	4.86	8,831
25	37		50	1.251	3.766	3.932	0.005	0.331	420.542	46.30	139.35	145.50	0.20	12.23	15,560
50	84		120	0.606	2.679	4.104	0.005	0.327	420.542	50.89	225.00	344.72	0.41	27.43	35,326
120	151		175	0.406	2.218	3.648	0.005	0.180	420.542	61.32	334.86	550.83	0.71	27.14	63,502
175	217		250	0.259	0.870	3.318	0.005	0.094	420.542	56.17	188.85	720.02	1.03	20.32	91,258
250	372		500	0.233	0.913	2.973	0.004	0.088	420.542	86.50	339.56	1,105.88	1.54	32.59	156,442
500	615		750	0.240	0.913	3.068	0.004	0.089	420.542	147.53	561.37	1,886.92	2.60	54.89	258,633
750	1460		9999	0.320	1.126	4.105	0.004	0.114	420.542	467.29	1,644.48	5,993.54	6.17	166.37	613,991
0	36	Rollers	50	0.527	1.181	2.064	0.002	0.188	218.742	18.81	42.14	73.65	0.07	6.69	7,804
50	87		120	0.288	1.065	2.532	0.002	0.189	197.184	25.04	92.47	219.97	0.16	16.42	17,128
120	144		175	0.155	1.059	1.919	0.002	0.089	196.146	22.22	152.26	275.84	0.27	12.82	28,202
175	213		250	0.163	1.062	2.230	0.002	0.080	196.652	34.85	226.41	475.46	0.40	17.02	41,936
250	335		500	0.155	1.071	2.040	0.002	0.080	198.298	51.96	358.52	683.19	0.63	26.79	66,405
500	521		750	0.240	1.061	3.215	0.002	0.119	196.512	124.87	552.23	1,673.54	0.98	61.99	102,285
0	47	Rough Terrai	50	0.505	1.273	2.147	0.002	0.182	234.119	23.86	60.20	101.51	0.11	8.62	11,070
50	96		120	0.166	1.145	1.979	0.002	0.120	210.495	16.00	110.27	190.65	0.19	11.57	20,276
120	130		175	0.100	1.142	1.571	0.002	0.062	210.008	13.01	148.00	203.53	0.26	7.97	27,215
175	208		250	0.148	1.149	1.929	0.002	0.074	211.197	30.82	239.25	401.92	0.42	15.37	43,994
250	374		500	0.118	1.132	1.857	0.002	0.057	208.218	44.26	423.37	694.43	0.74	21.13	77,850
500	625		750	0.031	1.143	0.524	0.002	0.004	210.233	19.55	714.57	327.42	1.25	2.21	131,396
0	42	Rubber Tired	50	1.214	1.060	2.619	0.002	0.343	226.517	50.50	44.06	108.91	0.09	14.27	9,420
50	82		120	0.506	0.975	3.772	0.002	0.336	208.475	41.28	79.56	307.76	0.16	27.42	17,009
120	150		175	0.396	0.970	3.883	0.002	0.222	207.416	59.25	145.23	581.24	0.30	33.20	31,047
175	211		250	0.299	0.973	3.205	0.002	0.156	208.077	63.08	205.35	676.12	0.42	32.94	43,900
250	354		500	0.300	0.983	3.295	0.002	0.154	210.173	106.35	348.08	1,166.76	0.71	54.56	74,412
500	584		750	0.223	0.969	2.961	0.002	0.109	207.194	130.30	566.10	1,729.70	1.16	63.43	121,022
0	42	Rubber Tired	50	0.829	0.988	2.238	0.002	0.252	210.255	34.58	41.21	93.30	0.08	10.49	8,767
50	86		120	0.346	0.880	2.705	0.002	0.237	187.270	29.81	75.84	233.04	0.15	20.38	16,133
120	150		175	0.239	0.888	2.390	0.002	0.133	188.889	35.83	133.19	358.52	0.27	20.00	28,333
175	206		250	0.158	0.886	2.081	0.002	0.071	188.377	32.53	182.34	428.57	0.37	14.62	38,788
250	320		500	0.165	0.884	1.980	0.002	0.075	188.001	52.63	282.55	633.12	0.57	24.02	60,102
500	600		750	0.156	0.861	1.806	0.002	0.072	183.234	93.71	517.25	1,084.41	1.05	43.14	110,028
750	837		1000	0.154	0.887	2.412	0.002	0.070	188.733	128.93	742.46	2,018.55	1.51	58.42	157,934
1000	1521		9999	0.153	0.884	2.287	0.002	0.065	187.956	232.78	1,343.95	3,477.91	2.73	99.23	285,882
0	36	Scrapers	50	1.586	1.260	3.228	0.003	0.427	279.274	57.33	45.54	116.65	0.10	15.43	10,094
50	84		120	0.361	1.167	3.419	0.002	0.253	258.671	30.44	98.41	288.33	0.21	21.29	21,813
120	166		175	0.380	1.155	4.019	0.002	0.211	256.077	63.13	191.98	667.74	0.41	35.13	42,551
175	225		250	0.392	1.131	4.440	0.002	0.204	250.579	88.11	254.34	998.82	0.54	45.91	56,373
250	381		500	0.251	1.140	3.144	0.002	0.127	252.683	95.56	434.75	1,198.92	0.92	48.48	96,360
500	565		750	0.196	1.140	2.576	0.002	0.098	252.690	110.84	644.07	1,455.27	1.36	55.48	142,757
750	950		1000	0.593	1.138	6.460	0.002	0.301	252.280	562.94	1,081.30	6,137.29	2.29	286.14	239,666
1000	1923		9999	0.251	1.163	3.495	0.002	0.130	257.796	483.08	2,236.99	6,721.44	4.73	249.80	495,821
0	6	Signal Boards	15	0.542	2.845	3.397	0.007	0.133	466.006	3.25	17.07	20.38	0.04	0.80	2,796
15	37		50	1.412	4.236	4.184	0.006	0.363	443.274	52.26	156.72	154.80	0.21	13.44	16,401
50	82		120	0.651	2.882	4.318	0.005	0.357	443.274	53.38	236.35	354.07	0.43	29.25	36,348
120	158		175	0.441	2.392	3.829	0.005	0.197	443.274	69.71	378.01	604.92	0.79	31.11	70,037
175	216		250	0.343	1.122	4.193	0.006	0.122	535.623	74.03	242.38	905.66	1.30	26.31	115,694
0	43	Skid Steer Lo	50	0.294	1.377	1.785	0.002	0.124	215.262	12.80	59.87	77.60	0.09	5.41	9,357
50	71		120	0.131	1.234	1.637	0.002	0.100	192.854	9.26	87.04	115.47	0.13	7.05	13,603
120	153		175	0.122	1.225	1.598	0.002	0.072	191.415	18.70	187.29	244.35	0.28	11.06	29,272
175	201		250	0.121	1.213	1.625	0.002	0.063	189.647	24.23	243.33	325.86	0.36	12.61	38,031
250	277		500	0.085	1.201	1.130	0.002	0.040	187.666	23.61	332.20	312.67	0.50	10.97	51,921
500	530		750	0.052	1.233	0.881	0.002	0.036	192.714	27.81	653.51	466.84	0.98	19.13	102,138

		2013		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	**Equipment**	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2	**ROG**	**CO**	**NOX**	**SOX**	**PM**	**CO2**
750	1000		1000	0.081	1.233	1.385	0.002	0.043	192.714	80.65	1,233.03	1,384.53	1.84	43.01	192,714
0	36	Surfacing Equ	50	0.386	0.845	1.670	0.002	0.138	177.856	13.76	30.14	59.55	0.06	4.92	6,344
50	89		120	0.185	0.748	1.754	0.002	0.125	157.520	16.45	66.37	155.51	0.13	11.09	13,969
120	151		175	0.156	0.748	1.791	0.002	0.086	157.436	23.58	112.94	270.45	0.23	13.03	23,769
175	216		250	0.117	0.757	1.773	0.002	0.056	159.275	25.28	163.51	383.12	0.33	12.18	34,414
250	362		500	0.077	0.745	1.234	0.001	0.040	156.730	27.77	269.84	447.10	0.54	14.35	56,792
500	615		750	0.057	0.748	1.044	0.002	0.033	157.409	35.12	460.02	641.87	0.92	20.31	96,819
750	814		1000	0.093	0.752	1.724	0.002	0.042	158.236	75.75	612.21	1,403.76	1.23	34.11	128,849
1000	1141		9999	0.050	0.737	1.151	0.001	0.026	155.194	57.59	841.35	1,313.79	1.69	29.39	177,076
0	36	Sweepers/Sc	50	0.851	1.544	2.637	0.003	0.277	265.154	30.29	54.93	93.84	0.09	9.86	9,436
50	78		120	0.409	1.393	3.257	0.002	0.285	239.305	31.67	108.00	252.46	0.18	22.10	18,552
120	159		175	0.450	1.390	4.448	0.002	0.249	238.803	71.69	221.69	709.37	0.36	39.72	38,082
175	204		250	0.237	1.381	3.036	0.002	0.120	237.291	48.39	282.36	620.55	0.46	24.49	48,504
250	303		500	0.214	1.387	2.732	0.002	0.117	238.264	64.68	419.57	826.51	0.69	35.52	72,075
500	848		1000	0.069	1.387	1.822	0.002	0.045	238.264	58.34	1,176.17	1,545.27	1.93	38.50	202,048
0	38	Tractors/Load	50	0.554	0.984	2.029	0.002	0.191	210.213	21.23	37.71	77.73	0.08	7.33	8,052
50	83		120	0.239	0.915	2.167	0.002	0.173	195.481	19.74	75.66	179.14	0.15	14.27	16,157
120	144		175	0.175	0.898	1.963	0.002	0.099	191.782	25.14	129.27	282.52	0.26	14.29	27,604
175	204		250	0.131	0.900	1.924	0.002	0.062	192.243	26.75	183.86	392.94	0.37	12.65	39,259
250	320		500	0.125	0.905	1.759	0.002	0.060	193.229	40.07	289.70	563.13	0.59	19.13	61,860
500	575		750	0.116	0.890	1.590	0.002	0.057	189.981	66.52	511.24	913.90	1.04	32.82	109,166
750	871		1000	0.079	0.912	1.611	0.002	0.030	194.732	68.60	794.68	1,403.74	1.62	26.29	169,690
1000	2006		9999	0.135	0.904	2.112	0.002	0.066	193.002	270.42	1,812.80	4,236.87	3.70	132.07	387,090
0	40	Trenchers	50	0.680	1.635	2.769	0.003	0.256	293.921	27.04	65.05	110.14	0.11	10.18	11,691
50	82		120	0.447	1.474	3.744	0.003	0.293	264.899	36.66	120.94	307.20	0.21	24.01	21,737
120	144		175	0.405	1.449	4.268	0.002	0.222	260.398	58.26	208.44	614.10	0.36	31.87	37,464
175	218		250	0.277	1.465	3.537	0.003	0.139	263.386	60.52	320.08	772.64	0.55	30.30	57,529
250	359		500	0.166	1.462	2.313	0.003	0.085	262.682	59.62	523.98	829.12	0.90	30.61	94,176
500	619		750	0.064	1.471	1.033	0.003	0.035	264.319	39.50	910.69	639.65	1.56	21.91	163,680
750	860		1000	0.592	1.462	6.572	0.003	0.297	262.792	508.92	1,257.44	5,652.24	2.16	255.13	226,001
0	11	Welders	15	0.424	1.704	2.560	0.004	0.167	255.735	4.66	18.75	28.16	0.04	1.84	2,813
15	20		25	0.462	1.301	2.299	0.003	0.141	255.735	9.23	26.02	45.97	0.06	2.81	5,115
25	46		50	0.937	2.673	2.482	0.003	0.232	255.735	43.10	122.98	114.19	0.15	10.65	11,764
50	70		120	0.414	1.714	2.618	0.003	0.227	255.735	28.97	119.98	183.24	0.21	15.92	17,901
120	174		175	0.280	1.417	2.328	0.003	0.125	255.735	48.79	246.54	405.02	0.50	21.77	44,498
175	211		250	0.180	0.556	2.118	0.003	0.063	255.735	37.98	117.38	446.96	0.61	13.36	53,960
250	297		500	0.163	0.578	1.876	0.003	0.059	255.735	48.48	171.52	557.18	0.75	17.50	75,953
0	29	Water Trucks	50	0.655	0.651	2.205	0.002	0.229	215.017	19.093	18.970	64.254	0.060	6.676	6265.656
50	87		120	0.352	0.596	2.758	0.002	0.222	196.910	30.628	51.904	240.147	0.164	19.343	17143.478
120	159		175	0.226	0.602	2.209	0.002	0.126	198.857	35.851	95.662	350.909	0.302	20.035	31596.195
175	211		250	0.209	0.601	2.314	0.002	0.100	198.401	44.194	126.755	488.208	0.400	21.182	41865.714
250	372		500	0.169	0.610	1.933	0.002	0.075	201.370	62.849	227.055	720.004	0.716	27.951	74993.773
500	656		750	0.217	0.611	2.409	0.002	0.102	201.971	142.199	401.091	1580.282	1.265	67.231	132476.125
750	897		1000	0.182	0.606	2.632	0.002	0.078	200.232	163.654	543.930	2361.821	1.716	70.325	179654.335
1000	1764		9999	0.186	0.613	2.470	0.002	0.079	202.618	327.267	1082.253	4358.263	3.414	140.232	357457.022

2014

	AvgHP	Equipment	MaxHP	ROG	CO	NOX	SOX	PM	CO2	ROG	CO	NOX	SOX	PM	CO2
		2014		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
0	46	Aerial Lifts	50	0.084	0.866	1.262	0.002	0.049	179.282	3.87	39.91	58.20	0.08	2.24	8,267
50	74		120	0.065	0.778	1.039	0.002	0.050	161.199	4.83	57.61	76.94	0.11	3.67	11,932
120	130		175	0.063	0.778	0.994	0.002	0.041	161.168	8.18	101.52	129.69	0.20	5.33	21,028
175	210		250	0.353	0.778	3.641	0.002	0.189	161.179	74.23	163.42	764.62	0.32	39.73	33,848
250	380		500	0.076	0.778	1.418	0.002	0.031	161.179	28.95	295.70	539.00	0.58	11.85	61,248
0	12	Air Compress	15	0.426	1.784	2.604	0.004	0.163	272.784	5.11	21.40	31.24	0.05	1.95	3,273
15	24		25	0.458	1.328	2.397	0.003	0.139	272.784	10.98	31.88	57.52	0.08	3.34	6,547
25	37		50	0.990	2.959	2.600	0.004	0.242	272.784	36.64	109.49	96.19	0.13	8.95	10,093
50	78		120	0.431	1.861	2.686	0.003	0.237	272.784	33.63	145.19	209.51	0.25	18.49	21,277
120	147		175	0.297	1.549	2.380	0.003	0.130	272.784	43.68	227.67	349.80	0.45	19.14	40,099
175	218		250	0.194	0.592	2.107	0.003	0.064	272.784	42.26	129.00	459.25	0.67	14.04	59,467
250	385		500	0.179	0.597	1.843	0.003	0.060	272.784	68.79	229.73	709.50	1.03	23.08	105,022
500	595		750	0.181	0.597	1.910	0.003	0.061	272.784	107.61	355.04	1,136.28	1.63	36.44	162,306
750	808		1000	0.213	0.711	2.643	0.003	0.075	272.784	172.00	574.24	2,135.63	2.22	60.79	220,410
0	39	Bore/Drill Rig	50	0.439	1.209	2.680	0.003	0.192	300.841	17.23	47.47	105.23	0.11	7.54	11,815
50	82		120	0.168	1.025	2.108	0.002	0.125	255.023	13.81	84.35	173.56	0.20	10.31	20,996
120	149		175	0.162	1.071	2.043	0.003	0.093	266.563	24.05	159.07	303.46	0.38	13.88	39,594
175	208		250	0.114	1.047	1.771	0.002	0.053	260.604	23.74	217.51	367.95	0.52	10.95	54,141
250	349		500	0.106	1.034	1.601	0.002	0.051	257.459	37.06	361.17	559.06	0.86	17.71	89,900
500	612		750	0.083	1.073	1.193	0.003	0.040	267.167	50.50	656.84	729.80	1.56	24.75	163,496
750	919		1000	0.055	1.056	1.500	0.003	0.029	262.773	50.75	970.17	1,378.17	2.31	26.92	241,488
1000	2667		9999	0.090	1.056	2.133	0.003	0.052	262.792	239.99	2,815.34	5,688.68	6.69	138.02	700,778
0	9	Cement and	15	0.373	1.943	2.347	0.005	0.099	318.248	3.36	17.49	21.12	0.04	0.89	2,864
15	25		25	0.469	1.439	2.685	0.004	0.142	318.248	11.73	35.98	67.13	0.10	3.55	7,956
0	18	Concrete/Ind	25	0.500	1.708	3.163	0.005	0.120	414.859	9.01	30.75	56.93	0.09	2.16	7,467
25	33		50	1.190	3.882	3.777	0.005	0.310	414.859	39.26	128.11	124.65	0.18	10.24	13,690
50	81		120	0.548	2.684	3.771	0.005	0.302	414.859	44.41	217.40	305.44	0.39	24.43	33,604
120	175		175	0.378	2.249	3.312	0.005	0.167	414.859	66.20	393.62	579.62	0.82	29.29	72,600
0	41	Cranes	50	0.638	0.826	1.755	0.002	0.175	165.356	25.91	33.55	71.32	0.06	7.11	6,718
50	89		120	0.375	0.749	2.968	0.001	0.220	149.906	33.39	66.58	263.98	0.13	19.60	13,334
120	148		175	0.239	0.757	2.440	0.001	0.132	151.505	35.38	111.88	360.89	0.21	19.47	22,405
175	217		250	0.199	0.754	2.265	0.001	0.104	150.972	43.23	163.60	491.41	0.31	22.52	32,761
250	336		500	0.146	0.752	1.805	0.001	0.075	150.650	48.94	252.85	606.57	0.48	25.14	50,635
500	567		750	0.084	0.751	1.247	0.001	0.043	150.367	47.87	425.89	707.12	0.81	24.63	85,287
750	938		1000	0.314	0.748	3.347	0.001	0.166	149.777	294.57	701.26	3,138.24	1.34	155.54	140,431
1000	1030		9999	0.036	0.752	0.657	0.001	0.016	150.667	37.40	774.95	676.80	1.48	16.14	155,187
0	43	Crawler Trac	50	1.131	1.328	2.743	0.002	0.319	245.052	48.10	56.45	116.58	0.10	13.55	10,417
50	87		120	0.397	1.228	3.226	0.002	0.269	226.628	34.44	106.66	280.24	0.19	23.41	19,684
120	150		175	0.282	1.215	2.948	0.002	0.160	224.148	42.20	181.63	440.88	0.32	24.00	33,520
175	203		250	0.204	1.218	2.675	0.002	0.103	224.856	41.33	247.14	542.54	0.44	20.97	45,611
250	341		500	0.185	1.224	2.408	0.002	0.093	225.932	63.01	417.08	820.44	0.74	31.73	76,973
500	570		750	0.156	1.218	2.099	0.002	0.077	224.780	88.72	694.38	1,196.58	1.22	43.65	128,150
750	828		1000	0.213	1.223	3.184	0.002	0.094	225.711	176.65	1,012.86	2,637.02	1.79	77.48	186,926
1000	1527		9999	0.151	1.168	2.585	0.002	0.068	215.490	230.91	1,782.39	3,946.69	3.14	103.70	328,945
0	45	Crushing/Pro	50	1.573	4.850	4.213	0.006	0.387	443.274	70.80	218.25	189.57	0.26	17.40	19,947
50	85		120	0.686	3.042	4.269	0.005	0.376	443.274	58.31	258.54	362.90	0.44	32.00	37,678
120	171		175	0.478	2.540	3.768	0.005	0.208	443.274	81.81	434.38	644.25	0.85	35.50	75,800
175	250		250	0.316	0.958	3.312	0.005	0.102	443.274	79.09	239.55	827.95	1.25	25.48	110,818
250	382		500	0.294	0.960	2.890	0.004	0.095	443.274	112.46	366.62	1,104.04	1.66	36.30	169,331
500	602		750	0.295	0.951	2.997	0.004	0.096	443.274	177.80	572.42	1,804.38	2.68	58.04	266,851
750	1337		9999	0.356	1.139	4.204	0.004	0.121	443.274	476.18	1,523.38	5,621.32	5.96	161.75	592,657
0	16	Dumpers/Ter	25	0.268	0.898	1.685	0.003	0.076	215.954	4.29	14.37	26.96	0.04	1.22	3,455
0	36	Excavators	50	0.330	1.083	1.896	0.002	0.145	222.387	11.79	38.69	67.76	0.08	5.19	7,948
50	82		120	0.205	0.962	1.960	0.002	0.146	197.661	16.77	78.70	160.26	0.15	11.94	16,164
120	146		175	0.156	0.973	1.779	0.002	0.087	199.826	22.77	142.08	259.73	0.28	12.77	29,183
175	218		250	0.118	0.974	1.670	0.002	0.053	199.987	25.69	212.71	364.93	0.42	11.58	43,692
250	329		500	0.093	0.970	1.280	0.002	0.041	199.172	30.56	318.68	420.81	0.63	13.56	65,456
500	578		750	0.095	0.964	1.352	0.002	0.044	197.908	55.14	556.86	781.53	1.09	25.23	114,379
750	843		1000	0.124	0.969	2.109	0.002	0.056	199.067	104.14	816.89	1,777.95	1.60	47.34	167,789
1000	1569		9999	0.081	0.963	1.373	0.002	0.035	197.811	126.65	1,511.16	2,153.77	2.96	55.59	310,393
0	42	Forklifts	50	0.445	0.638	1.207	0.001	0.132	117.014	18.86	27.04	51.20	0.05	5.59	4,963
50	82		120	0.167	0.572	1.377	0.001	0.115	105.000	13.77	47.13	113.38	0.08	9.50	8,649
120	141		175	0.122	0.573	1.277	0.001	0.069	105.128	17.18	80.94	180.39	0.14	9.80	14,853
175	208		250	0.129	0.574	1.462	0.001	0.066	105.400	26.91	119.55	304.42	0.21	13.81	21,939
250	344		500	0.114	0.575	1.277	0.001	0.058	105.464	39.14	197.53	438.88	0.35	19.97	36,250
500	880		1000	0.327	0.573	3.140	0.001	0.175	105.117	288.17	504.07	2,762.92	0.88	154.30	92,503
0	11	Generator Se	15	0.578	2.750	3.959	0.007	0.221	420.542	6.35	30.25	43.55	0.07	2.43	4,626
15	19		25	0.605	2.048	3.695	0.005	0.201	420.542	11.50	38.91	70.20	0.10	3.82	7,990
25	33		50	1.048	3.455	3.731	0.005	0.288	420.542	34.59	114.01	123.14	0.18	9.49	13,878
50	84		120	0.532	2.612	3.801	0.005	0.285	420.542	44.66	219.41	319.28	0.41	23.90	35,326
120	153		175	0.358	2.178	3.368	0.005	0.156	420.542	54.78	333.31	515.30	0.72	23.93	64,343
175	229		250	0.229	0.833	2.972	0.005	0.082	420.542	52.45	190.83	680.61	1.08	18.75	96,304
250	363		500	0.206	0.852	2.656	0.004	0.077	420.542	74.61	309.44	964.11	1.50	27.89	152,657
500	586		750	0.213	0.852	2.747	0.004	0.078	420.542	124.78	499.54	1,609.91	2.48	45.93	246,438
750	1130		9999	0.286	1.011	3.807	0.004	0.102	420.542	323.37	1,141.99	4,302.01	4.78	115.52	475,212
0	39	Graders	50	1.323	1.157	2.677	0.002	0.354	223.039	51.82	45.32	104.83	0.08	13.88	8,734
50	91		120	0.543	1.106	4.081	0.002	0.340	213.218	49.40	100.68	371.37	0.19	30.94	19,402
120	148		175	0.362	1.133	3.557	0.002	0.200	218.369	53.59	167.64	526.18	0.31	29.53	32,307
175	204		250	0.167	1.121	2.346	0.002	0.076	216.092	34.07	229.14	479.40	0.42	15.48	44,159
250	293		500	0.134	1.111	1.518	0.002	0.058	214.043	39.39	325.61	444.97	0.60	17.10	62,751
500	796		1000	0.303	1.109	3.798	0.002	0.132	213.737	241.58	882.83	3,023.02	1.62	105.21	170,135
1000	1993		9999	0.187	1.107	2.679	0.002	0.081	213.348	372.66	2,206.16	5,338.90	4.06	161.02	425,161
0	38	Off-Highway	50	0.740	1.299	2.454	0.002	0.242	252.522	27.85	48.92	92.43	0.09	9.12	9,510
50	75		120	0.318	1.181	2.735	0.002	0.224	229.599	23.71	88.03	203.86	0.16	16.66	17,112
120	158		175	0.193	1.175	2.188	0.002	0.112	228.426	30.56	185.75	345.95	0.34	17.74	36,109
175	214		250	0.184	1.166	2.465	0.002	0.088	226.753	39.44	249.44	527.19	0.46	18.92	48,489
250	334		500	0.128	1.170	1.716	0.002	0.061	227.491	42.70	391.38	573.98	0.73	20.24	76,081
500	574		750	0.121	1.172	1.745	0.002	0.058	227.870	69.68	672.31	1,000.72	1.25	33.21	130,692
750	1000		1000	0.039	1.172	0.993	0.002	0.024	227.753	38.55	1,171.61	992.67	2.17	23.64	227,753
1000	1726		9999	0.179	1.198	2.531	0.002	0.081	232.835	309.79	2,067.62	4,368.71	3.84	139.88	401,931
0	29	Off-Highway	50	0.662	0.651	2.220	0.002	0.231	215.124	19.28	18.98	64.69	0.06	6.73	6,269
50	87		120	0.268	0.596	2.157	0.002	0.175	196.908	23.33	51.90	187.82	0.16	15.23	17,143
120	159		175	0.205	0.602	1.993	0.002	0.112	198.724	32.56	95.60	316.70	0.30	17.73	31,575
175	211		250	0.193	0.600	2.078	0.002	0.090	198.251	40.73	126.66	438.48	0.40	18.98	41,834
250	372		500	0.157	0.610	1.789	0.002	0.069	201.430	58.56	227.12	666.44	0.72	25.53	75,016
500	656		750	0.194	0.610	2.130	0.002	0.088	201.497	127.11	400.15	1,397.30	1.26	57.80	132,165
750	897		1000	0.166	0.605	2.431	0.002	0.072	199.838	148.65	542.86	2,181.10	1.71	64.16	179,301
1000	1764		9999	0.167	0.608	2.244	0.002	0.070	200.921	294.93	1,073.19	3,957.97	3.38	123.83	354,462
0	38	Other Constr	50	0.565	1.338	2.312	0.002	0.209	243.447	21.49	50.87	87.87	0.09	7.93	9,253
50	82		120	0.317	1.191	2.755	0.002	0.215	216.672	25.83	97.15	224.73	0.17	17.54	17,672
120	152		175	0.246	1.189	2.647	0.002	0.138	216.364	37.56	181.38	403.62	0.32	21.11	32,993
175	217		250	0.176	1.203	2.397	0.002	0.088	218.806	38.24	260.91	520.00	0.45	19.13	47,460
250	357		500	0.143	1.204	1.895	0.002	0.070	219.052	51.13	429.75	676.10	0.75	24.91	78,171

		2014		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	Equipment	MaxHP	ROG	CO	NOX	SOX	PM	CO2	ROG	CO	NOX	SOX	PM	CO2
500	598		750	0.107	1.196	1.607	0.002	0.051	217.638	63.70	715.10	960.37	1.24	30.73	130,076
750	830		1000	0.096	1.192	1.844	0.002	0.048	216.891	79.39	989.84	1,530.69	1.72	40.17	180,053
1000	1127		9999	0.123	1.168	2.041	0.002	0.056	212.401	138.25	1,315.59	2,299.20	2.29	63.10	239,305
0	35	Other Genera	50	0.544	0.972	1.908	0.002	0.186	199.186	19.09	34.13	66.97	0.07	6.52	6,992
50	73		120	0.282	0.869	2.297	0.002	0.196	177.921	20.64	63.57	168.14	0.12	14.35	13,022
120	149		175	0.187	0.872	1.979	0.002	0.107	178.621	27.87	130.06	295.18	0.25	15.89	26,642
175	209		250	0.174	0.875	2.102	0.002	0.087	179.141	36.46	182.83	439.52	0.36	18.18	37,451
250	355		500	0.127	0.874	1.560	0.002	0.059	179.029	45.01	310.02	553.29	0.61	20.90	63,504
500	592		750	0.091	0.875	1.238	0.002	0.039	179.232	54.10	517.60	732.11	1.01	23.32	106,023
750	885		1000	0.124	0.872	2.180	0.002	0.057	178.698	109.60	772.06	1,928.99	1.51	50.43	158,148
1000	2000		9999	0.077	0.872	1.491	0.002	0.039	178.698	153.65	1,744.77	2,981.23	3.41	77.12	357,397
0	36	Other Materia	50	0.701	1.196	2.273	0.002	0.227	229.351	25.07	42.74	81.27	0.08	8.13	8,198
50	93		120	0.231	1.081	2.124	0.002	0.163	207.401	21.50	100.73	197.84	0.18	15.18	19,322
120	145		175	0.219	1.078	2.292	0.002	0.124	206.802	31.60	155.86	331.32	0.29	17.87	29,897
175	218		250	0.197	1.076	2.440	0.002	0.096	206.479	42.91	234.96	532.62	0.43	20.89	45,071
250	331		500	0.137	1.074	1.722	0.002	0.067	205.960	45.43	355.79	570.67	0.65	22.12	68,248
500	565		750	0.095	1.078	1.364	0.002	0.046	206.729	53.73	608.45	770.36	1.11	26.13	116,716
750	923		1000	0.021	1.078	0.892	0.002	0.007	206.729	19.39	994.72	823.65	1.82	6.44	190,811
1000	1050		9999	0.058	1.078	1.358	0.002	0.026	206.729	61.34	1,131.59	1,426.29	2.07	27.60	217,066
0	39	Pavers	50	0.825	1.429	2.375	0.002	0.247	242.630	31.87	55.21	91.73	0.09	9.54	9,372
50	80		120	0.297	1.274	2.575	0.002	0.201	216.291	23.64	101.41	204.92	0.16	15.96	17,213
120	158		175	0.218	1.280	2.383	0.002	0.119	217.286	34.54	202.43	376.81	0.33	18.84	34,360
175	213		250	0.090	1.285	1.720	0.002	0.044	218.118	19.27	273.97	366.70	0.44	9.31	46,505
250	327		500	0.078	1.269	1.266	0.002	0.042	215.371	25.63	415.38	414.42	0.67	13.76	70,508
500	750		750	0.072	1.280	1.010	0.002	0.043	217.241	54.31	959.87	757.86	1.56	32.46	162,931
0	35	Paving Equip	50	0.391	1.293	1.841	0.002	0.155	204.701	13.63	45.03	64.09	0.07	5.40	7,127
50	89		120	0.252	1.177	2.262	0.002	0.173	186.223	22.29	104.25	200.40	0.16	15.28	16,499
120	148		175	0.154	1.170	1.852	0.002	0.088	185.130	22.90	173.60	274.86	0.26	13.11	27,474
175	216		250	0.115	1.174	1.698	0.002	0.056	185.800	24.85	253.19	366.25	0.38	12.13	40,071
250	339		500	0.117	1.166	1.639	0.002	0.058	184.485	39.51	394.89	555.35	0.60	19.78	62,496
500	605		750	0.081	1.174	1.399	0.002	0.032	185.770	49.02	710.15	846.63	1.07	19.48	112,391
750	842		1000	0.081	1.175	1.624	0.002	0.039	185.931	68.35	989.20	1,367.16	1.50	33.07	156,554
0	8	Plate Compa	15	0.284	1.492	1.781	0.004	0.069	244.369	2.28	11.94	14.25	0.03	0.56	1,955
0	13	Pressure Wa	15	0.234	1.115	1.605	0.003	0.089	170.490	3.04	14.49	20.87	0.03	1.16	2,216
15	19		25	0.245	0.830	1.498	0.002	0.082	170.490	4.66	15.77	28.46	0.04	1.55	3,239
25	38		50	0.327	1.183	1.460	0.002	0.100	170.490	12.41	44.94	55.49	0.08	3.78	6,479
50	64		120	0.189	1.010	1.471	0.002	0.099	170.490	12.13	64.61	94.15	0.13	6.36	10,911
0	8	Pumps	15	0.656	2.750	4.014	0.007	0.251	420.542	5.25	22.00	32.11	0.05	2.01	3,364
15	21		25	0.706	2.048	3.695	0.005	0.215	420.542	14.82	43.01	77.59	0.11	4.51	8,831
25	37		50	1.130	3.636	3.775	0.005	0.302	420.542	41.79	134.53	139.67	0.20	11.16	15,560
50	84		120	0.553	2.653	3.859	0.005	0.298	420.542	46.48	222.84	324.14	0.41	25.01	35,326
120	151		175	0.374	2.212	3.420	0.005	0.164	420.542	56.48	333.95	516.35	0.71	24.73	63,502
175	217		250	0.240	0.848	3.020	0.005	0.085	420.542	52.18	183.94	655.29	1.03	18.49	91,258
250	372		500	0.216	0.870	2.688	0.004	0.080	420.542	80.54	323.70	1,000.11	1.54	29.64	156,442
500	615		750	0.223	0.870	2.781	0.004	0.081	420.542	137.35	535.15	1,710.56	2.60	50.00	258,633
750	1460		9999	0.294	1.031	3.851	0.004	0.104	420.542	429.57	1,505.89	5,623.16	6.17	152.35	613,991
0	36	Rollers	50	0.514	1.181	2.023	0.002	0.181	218.686	18.33	42.12	72.20	0.07	6.47	7,802
50	87		120	0.273	1.064	2.398	0.002	0.179	197.034	23.71	92.40	208.27	0.16	15.51	17,115
120	144		175	0.144	1.059	1.772	0.002	0.082	196.200	20.77	152.30	254.83	0.27	11.82	28,209
175	213		250	0.150	1.062	2.027	0.002	0.072	196.664	31.92	226.42	432.34	0.40	15.32	41,938
250	335		500	0.148	1.070	1.945	0.002	0.076	198.274	49.68	358.47	651.25	0.63	25.32	66,397
500	521		750	0.241	1.061	3.227	0.002	0.120	196.512	125.70	552.23	1,679.69	0.98	62.55	102,285
0	47	Rough Terrai	50	0.497	1.273	2.101	0.002	0.175	234.126	23.52	60.21	99.34	0.11	8.29	11,071
50	96		120	0.148	1.145	1.796	0.002	0.105	210.487	14.21	110.27	172.99	0.19	10.11	20,276
120	130		175	0.093	1.142	1.445	0.002	0.056	210.011	12.07	148.01	187.25	0.26	7.27	27,216
175	208		250	0.078	1.146	1.199	0.002	0.035	210.693	16.32	238.68	249.85	0.42	7.29	43,889
250	374		500	0.072	1.132	1.407	0.002	0.031	208.207	26.76	423.35	526.02	0.74	11.44	77,846
500	625		750	0.033	1.143	0.526	0.002	0.004	210.233	20.67	714.57	328.54	1.25	2.23	131,396
0	42	Rubber Tired	50	1.225	1.059	2.630	0.002	0.347	226.500	50.96	44.06	109.36	0.09	14.41	9,419
50	82		120	0.510	0.975	3.785	0.002	0.339	208.499	41.59	79.57	308.78	0.16	27.64	17,011
120	150		175	0.397	0.970	3.887	0.002	0.222	207.409	59.50	145.22	581.87	0.30	33.30	31,045
175	211		250	0.298	0.973	3.151	0.002	0.155	208.079	62.96	205.35	664.88	0.42	32.73	43,900
250	354		500	0.293	0.982	3.185	0.002	0.149	209.946	103.60	347.70	1,127.80	0.71	52.58	74,332
500	584		750	0.212	0.969	2.825	0.002	0.102	207.191	124.00	566.09	1,650.22	1.16	59.49	121,020
0	42	Rubber Tired	50	0.801	0.987	2.208	0.002	0.244	210.043	33.39	41.17	92.07	0.08	10.19	8,758
50	86		120	0.329	0.878	2.579	0.002	0.224	186.783	28.31	75.64	222.21	0.15	19.29	16,091
120	150		175	0.229	0.888	2.269	0.002	0.127	188.892	34.37	133.20	340.37	0.27	19.01	28,333
175	206		250	0.154	0.885	1.988	0.002	0.068	188.323	31.70	182.29	409.39	0.37	13.92	38,777
250	320		500	0.159	0.882	1.879	0.002	0.071	187.698	50.98	282.09	600.80	0.57	22.64	60,005
500	600		750	0.154	0.860	1.740	0.002	0.069	183.005	92.33	516.60	1,045.09	1.05	41.30	109,890
750	837		1000	0.157	0.887	2.421	0.002	0.071	188.723	131.07	742.42	2,026.21	1.51	59.04	157,926
1000	1521		9999	0.157	0.884	2.302	0.002	0.066	187.956	239.07	1,343.95	3,501.37	2.73	101.03	285,882
0	36	Scrapers	50	1.609	1.260	3.241	0.003	0.432	279.274	58.17	45.54	117.13	0.10	15.62	10,094
50	84		120	0.363	1.168	3.408	0.002	0.254	258.778	30.61	98.45	287.41	0.21	21.41	21,822
120	166		175	0.363	1.155	3.814	0.002	0.202	255.959	60.25	191.89	633.82	0.41	33.57	42,531
175	225		250	0.375	1.130	4.252	0.002	0.194	250.432	84.27	254.19	956.66	0.54	43.73	56,340
250	381		500	0.242	1.140	3.007	0.002	0.121	252.633	92.17	434.66	1,146.64	0.92	46.25	96,341
500	565		750	0.186	1.140	2.418	0.002	0.091	252.649	105.21	643.97	1,366.06	1.36	51.65	142,734
750	950		1000	0.593	1.138	6.460	0.002	0.301	252.280	562.94	1,081.30	6,137.29	2.29	286.14	239,666
1000	1923		9999	0.257	1.163	3.528	0.002	0.132	257.796	494.61	2,236.99	6,786.14	4.73	254.47	495,821
0	6	Signal Board	15	0.542	2.845	3.397	0.007	0.133	466.006	3.25	17.07	20.38	0.04	0.80	2,796
15	37		50	1.271	4.083	4.010	0.006	0.330	443.274	47.01	151.08	148.38	0.21	12.21	16,401
50	82		120	0.594	2.854	4.049	0.005	0.324	443.274	48.69	234.03	332.03	0.43	26.54	36,348
120	158		175	0.407	2.386	3.579	0.005	0.179	443.274	64.27	376.97	565.49	0.79	28.22	70,037
175	216		250	0.319	1.093	3.794	0.006	0.110	535.623	68.96	236.19	819.41	1.30	23.82	115,694
0	43	Skid Steer Lo	50	0.256	1.377	1.673	0.002	0.105	215.258	11.14	59.87	72.74	0.09	4.58	9,357
50	71		120	0.117	1.234	1.479	0.002	0.086	192.872	8.27	87.04	104.31	0.13	6.10	13,604
120	153		175	0.117	1.224	1.531	0.002	0.070	191.378	17.88	187.26	234.10	0.28	10.67	29,267
175	201		250	0.097	1.215	1.355	0.002	0.049	189.834	19.55	243.57	271.79	0.36	9.78	38,068
250	277		500	0.087	1.201	1.132	0.002	0.040	187.666	24.16	332.20	313.13	0.50	11.02	51,921
500	530		750	0.055	1.233	0.884	0.002	0.037	192.714	29.13	653.51	468.59	0.98	19.39	102,138
750	1000		1000	0.085	1.233	1.412	0.002	0.044	192.714	84.82	1,233.03	1,411.68	1.84	44.22	192,714
0	36	Surfacing Eq	50	0.360	0.845	1.636	0.002	0.131	177.845	12.84	30.14	58.34	0.06	4.67	6,343
50	89		120	0.176	0.749	1.664	0.002	0.118	157.584	15.64	66.40	147.60	0.13	10.45	13,975
120	151		175	0.149	0.748	1.722	0.002	0.082	157.426	22.49	112.93	259.98	0.23	12.41	23,768
175	216		250	0.097	0.756	1.538	0.002	0.045	159.144	20.87	163.38	332.35	0.33	9.73	34,385
250	362		500	0.075	0.745	1.174	0.001	0.038	156.753	27.10	269.88	425.55	0.54	13.71	56,800
500	615		750	0.055	0.749	0.990	0.002	0.031	157.578	33.72	460.52	609.07	0.93	19.13	96,923
750	814		1000	0.094	0.752	1.729	0.002	0.042	158.240	76.46	612.22	1,408.17	1.23	34.38	128,852
1000	1141		9999	0.051	0.737	1.155	0.001	0.026	155.194	58.49	841.35	1,317.34	1.69	29.66	177,076
0	36	Sweepers/Sc	50	0.843	1.544	2.620	0.003	0.275	265.154	29.99	54.93	93.25	0.09	9.77	9,436
50	78		120	0.397	1.393	3.159	0.002	0.278	239.305	30.78	108.00	244.91	0.18	21.56	18,552
120	159		175	0.417	1.390	4.150	0.002	0.229	238.803	66.57	221.69	661.74	0.36	36.56	38,082
175	204		250	0.241	1.381	3.054	0.002	0.121	237.291	49.19	282.36	624.33	0.46	24.71	48,504
250	303		500	0.218	1.387	2.744	0.002	0.119	238.264	65.95	419.57	829.96	0.69	35.86	72,075
500	848		1000	0.076	1.387	1.837	0.002	0.047	238.264	64.11	1,176.17	1,558.01	1.93	39.63	202,048
0	38	Tractors/Loa	50	0.515	0.985	1.978	0.002	0.180	210.397	19.73	37.74	75.78	0.08	6.89	8,059
50	83		120	0.225	0.914	2.057	0.002	0.162	195.093	18.56	75.51	169.97	0.15	13.35	16,125
120	144		175	0.163	0.898	1.820	0.002	0.092	191.689	23.48	129.21	261.90	0.26	13.17	27,591

		2014		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	**Equipment**	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2	**ROG**	**CO**	**NOX**	**SOX**	**PM**	**CO2**
175	204		250	0.126	0.900	1.814	0.002	0.058	192.168	25.75	183.79	370.38	0.37	11.95	39,244
250	320		500	0.120	0.903	1.654	0.002	0.056	192.895	38.55	289.20	529.48	0.59	17.91	61,753
500	575		750	0.118	0.893	1.564	0.002	0.057	190.737	67.52	513.28	898.53	1.05	32.53	109,601
750	871		1000	0.065	0.912	1.399	0.002	0.031	194.717	56.82	794.62	1,218.73	1.62	27.04	169,676
1000	2006		9999	0.131	0.904	2.033	0.002	0.063	193.002	261.75	1,812.80	4,077.30	3.70	125.55	387,090
0	40	Trenchers	50	0.667	1.635	2.741	0.003	0.252	293.866	26.52	65.04	109.04	0.11	10.00	11,689
50	82		120	0.430	1.474	3.627	0.003	0.283	264.892	35.31	120.94	297.59	0.21	23.21	21,736
120	144		175	0.364	1.449	3.869	0.002	0.199	260.508	52.41	208.53	556.61	0.36	28.57	37,479
175	218		250	0.261	1.465	3.258	0.003	0.130	263.342	57.06	320.03	711.69	0.55	28.30	57,520
250	359		500	0.161	1.454	2.196	0.002	0.081	261.320	57.67	521.27	787.31	0.89	29.02	93,688
500	619		750	0.062	1.471	0.917	0.003	0.031	264.328	38.32	910.72	567.89	1.56	19.07	163,685
750	860		1000	0.594	1.462	6.588	0.003	0.298	262.792	511.09	1,257.44	5,665.62	2.16	256.59	226,001
0	11	Welders	15	0.399	1.672	2.441	0.004	0.153	255.735	4.39	18.39	26.85	0.04	1.68	2,813
15	20		25	0.429	1.245	2.247	0.003	0.131	255.735	8.58	24.91	44.94	0.06	2.61	5,115
25	46		50	0.849	2.579	2.386	0.003	0.212	255.735	39.05	118.61	109.74	0.15	9.75	11,764
50	70		120	0.380	1.697	2.461	0.003	0.208	255.735	26.62	118.82	172.24	0.21	14.56	17,901
120	174		175	0.260	1.413	2.181	0.003	0.114	255.735	45.29	245.86	379.44	0.50	19.90	44,498
175	211		250	0.169	0.541	1.929	0.003	0.058	255.735	35.62	114.26	407.03	0.61	12.16	53,960
250	297		500	0.154	0.549	1.698	0.003	0.054	255.735	45.74	163.19	504.16	0.75	15.94	75,953
0	29	Water Trucks	50	0.662	0.651	2.220	0.002	0.231	215.124	19.282	18.980	64.692	0.060	6.731	6268.796
50	87		120	0.268	0.596	2.157	0.002	0.175	196.908	23.331	51.904	187.822	0.164	15.227	17143.315
120	159		175	0.205	0.602	1.993	0.002	0.112	198.724	32.562	95.598	316.700	0.302	17.726	31575.081
175	211		250	0.193	0.600	2.078	0.002	0.090	198.251	40.732	126.658	438.481	0.399	18.977	41834.003
250	372		500	0.157	0.610	1.789	0.002	0.069	201.430	58.564	227.122	666.437	0.716	25.535	75016.172
500	656		750	0.194	0.610	2.130	0.002	0.088	201.497	127.106	400.149	1397.301	1.262	57.797	132165.272
750	897		1000	0.166	0.605	2.431	0.002	0.072	199.838	148.654	542.859	2181.097	1.712	64.161	179300.608
1000	1764		9999	0.167	0.608	2.244	0.002	0.070	200.921	294.932	1073.186	3957.969	3.385	123.827	354462.314

2015

		2015		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	**Equipment**	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2	**ROG**	**CO**	**NOX**	**SOX**	**PM**	**CO2**
0	46	Aerial Lifts	50	0.080	0.866	1.212	0.002	0.042	179.282	3.69	39.91	55.89	0.08	1.93	8,267
50	74		120	0.061	0.778	0.960	0.002	0.044	161.199	4.55	57.61	71.03	0.11	3.26	11,932
120	130		175	0.058	0.778	0.835	0.002	0.036	161.168	7.58	101.52	109.01	0.20	4.66	21,028
175	210		250	0.354	0.778	3.646	0.002	0.189	161.179	74.34	163.42	765.74	0.32	39.78	33,848
250	380		500	0.077	0.778	1.424	0.002	0.032	161.179	29.34	295.70	541.17	0.58	11.98	61,248
0	12	Air Compress	15	0.402	1.753	2.487	0.004	0.149	272.784	4.82	21.04	29.84	0.05	1.78	3,273
15	24		25	0.427	1.275	2.345	0.003	0.129	272.784	10.24	30.61	56.27	0.08	3.10	6,547
25	37		50	0.893	2.860	2.506	0.004	0.220	272.784	33.03	105.83	92.71	0.13	8.15	10,093
50	78		120	0.394	1.843	2.488	0.003	0.214	272.784	30.70	143.77	194.06	0.25	16.68	21,277
120	147		175	0.273	1.545	2.157	0.003	0.118	272.784	40.19	227.09	317.11	0.45	17.29	40,099
175	218		250	0.183	0.578	1.902	0.003	0.058	272.784	39.83	126.02	414.72	0.67	12.72	59,467
250	385		500	0.170	0.573	1.654	0.003	0.054	272.784	65.39	220.58	636.74	1.03	20.91	105,022
500	595		750	0.172	0.573	1.718	0.003	0.056	272.784	102.14	340.90	1,022.29	1.63	33.08	162,306
750	808		1000	0.196	0.653	2.475	0.003	0.068	272.784	158.40	527.57	2,000.05	2.22	55.35	220,409
0	39	Bore/Drill Rigs	50	0.445	1.208	2.665	0.003	0.191	300.704	17.49	47.45	104.66	0.11	7.48	11,810
50	82		120	0.167	1.026	2.024	0.002	0.120	255.370	13.77	84.47	166.63	0.20	9.90	21,025
120	149		175	0.159	1.068	1.962	0.003	0.088	265.780	23.60	158.60	291.41	0.38	13.11	39,478
175	208		250	0.112	1.046	1.671	0.002	0.050	260.280	23.30	217.24	347.07	0.52	10.39	54,074
250	349		500	0.105	1.032	1.509	0.002	0.048	256.887	36.59	360.37	526.93	0.86	16.82	89,700
500	612		750	0.085	1.075	1.194	0.003	0.041	267.458	52.07	657.55	730.52	1.56	24.83	163,674
750	919		1000	0.057	1.055	1.504	0.003	0.029	262.720	52.81	969.97	1,382.56	2.31	27.03	241,440
1000	2667		9999	0.094	1.056	2.142	0.003	0.053	262.792	249.58	2,815.34	5,713.21	6.69	140.08	700,778
0	9	Cement and M	15	0.372	1.943	2.334	0.005	0.096	318.248	3.35	17.49	21.01	0.04	0.86	2,864
15	25		25	0.454	1.417	2.639	0.004	0.134	318.248	11.36	35.43	65.98	0.10	3.36	7,956
0	18	Concrete/Indu	25	0.500	1.708	3.163	0.005	0.119	414.859	9.01	30.75	56.93	0.09	2.14	7,467
25	33		50	1.076	3.774	3.644	0.005	0.283	414.859	35.52	124.53	120.25	0.18	9.33	13,690
50	81		120	0.500	2.663	3.500	0.005	0.273	414.859	40.53	215.73	283.49	0.39	22.10	33,604
120	175		175	0.348	2.247	3.007	0.005	0.152	414.859	60.89	393.15	526.23	0.82	26.56	72,600
0	41	Cranes	50	0.629	0.826	1.750	0.002	0.173	165.349	25.56	33.55	71.11	0.06	7.03	6,718
50	89		120	0.366	0.749	2.898	0.001	0.215	149.914	32.55	66.59	257.80	0.13	19.13	13,334
120	148		175	0.236	0.757	2.399	0.001	0.130	151.512	34.87	111.89	354.71	0.21	19.18	22,406
175	217		250	0.194	0.754	2.196	0.001	0.100	150.978	42.02	163.60	476.48	0.31	21.75	32,762
250	336		500	0.143	0.752	1.764	0.001	0.073	150.610	48.14	252.78	593.01	0.48	24.53	50,621
500	567		750	0.086	0.751	1.242	0.001	0.044	150.355	48.90	425.86	704.59	0.81	24.81	85,280
750	938		1000	0.315	0.748	3.351	0.001	0.166	149.777	295.22	701.27	3,142.09	1.34	155.81	140,431
1000	1030		9999	0.040	0.752	0.661	0.001	0.016	150.667	40.73	774.95	680.96	1.48	16.45	155,187
0	43	Crawler Tract	50	1.128	1.328	2.735	0.002	0.318	245.076	47.94	56.45	116.25	0.10	13.50	10,418
50	87		120	0.397	1.228	3.213	0.002	0.270	226.639	34.48	106.66	279.10	0.19	23.46	19,685
120	150		175	0.283	1.215	2.937	0.002	0.161	224.211	42.39	181.68	439.21	0.32	24.10	33,529
175	203		250	0.202	1.219	2.634	0.002	0.102	224.909	41.06	247.20	534.33	0.44	20.60	45,622
250	341		500	0.183	1.225	2.351	0.002	0.091	225.994	62.39	417.20	801.04	0.74	31.03	76,994
500	570		750	0.158	1.218	2.094	0.002	0.077	224.752	89.87	694.30	1,193.73	1.22	43.72	128,134
750	828		1000	0.215	1.223	3.200	0.002	0.094	225.756	178.04	1,013.06	2,650.35	1.79	78.12	186,964
1000	1527		9999	0.153	1.168	2.599	0.002	0.069	215.490	234.20	1,782.39	3,966.82	3.14	104.99	328,945
0	45	Crushing/Proc	50	1.405	4.681	4.054	0.006	0.349	443.274	63.23	210.66	182.43	0.26	15.70	19,947
50	85		120	0.624	3.011	3.936	0.005	0.336	443.274	53.01	255.97	334.55	0.44	28.59	37,678
120	171		175	0.439	2.534	3.393	0.005	0.186	443.274	75.15	433.25	580.27	0.85	31.80	75,800
175	250		250	0.299	0.937	2.970	0.005	0.092	443.274	74.67	234.33	742.50	1.25	22.97	110,818
250	382		500	0.280	0.924	2.580	0.004	0.086	443.274	106.92	352.98	985.48	1.66	32.74	169,331
500	602		750	0.280	0.917	2.668	0.004	0.087	443.274	168.45	552.32	1,606.15	2.68	52.20	266,851
750	1337		9999	0.329	1.048	3.915	0.004	0.109	443.274	440.49	1,401.65	5,233.84	5.96	146.02	592,657
0	16	Dumpers/Ten	25	0.265	0.893	1.673	0.003	0.071	215.954	4.23	14.29	26.77	0.04	1.14	3,455
0	36	Excavators	50	0.333	1.083	1.878	0.002	0.143	222.420	11.90	38.70	67.12	0.08	5.11	7,949
50	82		120	0.203	0.962	1.917	0.002	0.143	197.683	16.57	78.70	156.75	0.15	11.66	16,166
120	146		175	0.153	0.973	1.711	0.002	0.084	199.837	22.40	142.08	249.90	0.28	12.33	29,184
175	218		250	0.115	0.974	1.597	0.002	0.051	199.981	25.21	212.71	348.94	0.42	11.10	43,690
250	329		500	0.093	0.969	1.227	0.002	0.040	199.126	30.48	318.60	403.38	0.62	13.08	65,441
500	578		750	0.097	0.963	1.326	0.002	0.043	197.882	55.92	556.78	766.52	1.09	24.93	114,364
750	843		1000	0.125	0.969	2.116	0.002	0.057	199.131	105.53	817.15	1,783.73	1.60	47.73	167,843
1000	1569		9999	0.084	0.963	1.380	0.002	0.036	197.811	132.46	1,511.16	2,165.83	2.96	56.38	310,393
0	42	Forklifts	50	0.436	0.638	1.192	0.001	0.129	117.014	18.49	27.04	50.56	0.05	5.48	4,963
50	82		120	0.162	0.572	1.327	0.001	0.111	105.000	13.32	47.13	109.28	0.08	9.18	8,649
120	141		175	0.119	0.573	1.233	0.001	0.067	105.128	16.81	80.94	174.22	0.14	9.51	14,853
175	208		250	0.119	0.574	1.346	0.001	0.060	105.400	24.73	119.55	280.18	0.21	12.46	21,939
250	344		500	0.095	0.575	1.072	0.001	0.048	105.464	32.80	197.53	368.39	0.35	16.36	36,250
500	880		1000	0.327	0.573	3.140	0.001	0.175	105.117	288.17	504.07	2,762.92	0.88	154.30	92,503
0	11	Generator Se	15	0.551	2.703	3.794	0.007	0.207	420.542	6.06	29.73	41.74	0.07	2.28	4,626
15	19		25	0.585	1.966	3.615	0.005	0.190	420.542	11.12	37.35	68.68	0.10	3.60	7,990
25	33		50	0.943	3.351	3.592	0.005	0.261	420.542	31.12	110.58	118.54	0.18	8.61	13,878
50	84		120	0.480	2.588	3.524	0.005	0.256	420.542	40.36	217.43	296.03	0.41	21.54	35,326
120	153		175	0.325	2.174	3.056	0.005	0.141	420.542	49.68	332.64	467.52	0.72	21.58	64,343
175	229		250	0.212	0.815	2.686	0.005	0.074	420.542	48.48	186.55	615.05	1.08	16.97	96,304
250	363		500	0.190	0.821	2.385	0.004	0.070	420.542	69.11	298.11	865.60	1.50	25.23	152,657
500	586		750	0.197	0.821	2.472	0.004	0.071	420.542	115.56	481.24	1,448.52	2.48	41.60	246,438
750	1130		9999	0.259	0.933	3.568	0.004	0.092	420.542	292.90	1,054.30	4,031.52	4.78	103.63	475,212
0	39	Graders	50	1.334	1.157	2.685	0.002	0.357	223.053	52.24	45.33	105.15	0.08	13.98	8,735
50	91		120	0.530	1.105	3.980	0.002	0.332	212.987	48.23	100.57	362.15	0.19	30.24	19,381
120	148		175	0.361	1.133	3.530	0.002	0.198	218.262	53.41	167.56	522.27	0.31	29.37	32,291
175	204		250	0.169	1.122	2.341	0.002	0.076	216.134	34.62	229.19	478.36	0.42	15.50	44,168
250	293		500	0.139	1.111	1.521	0.002	0.059	214.032	40.89	325.60	445.87	0.60	17.28	62,748
500	796		1000	0.303	1.109	3.798	0.002	0.132	213.737	241.58	882.83	3,023.02	1.62	105.21	170,135
1000	1993		9999	0.190	1.107	2.687	0.002	0.081	213.348	378.82	2,206.16	5,355.26	4.06	162.28	425,161
0	38	Off-Highway T	50	0.710	1.300	2.408	0.002	0.233	252.805	26.72	48.98	90.67	0.09	8.76	9,521
50	75		120	0.307	1.181	2.642	0.002	0.215	229.502	22.91	87.99	196.93	0.16	16.04	17,105
120	158		175	0.183	1.174	2.057	0.002	0.104	228.294	28.94	185.64	325.19	0.34	16.47	36,088
175	214		250	0.183	1.167	2.407	0.002	0.087	226.772	39.03	249.46	514.79	0.46	18.52	48,493
250	334		500	0.125	1.170	1.635	0.002	0.058	227.483	41.82	391.36	546.72	0.73	19.24	76,078
500	574		750	0.120	1.171	1.687	0.002	0.055	227.614	68.56	671.55	967.72	1.25	31.52	130,545
750	1000		1000	0.044	1.172	1.002	0.002	0.024	227.753	43.78	1,171.61	1,001.58	2.17	24.30	227,753
1000	1726		9999	0.184	1.198	2.547	0.002	0.082	232.958	317.89	2,068.71	4,396.35	3.84	140.98	402,143
0	29	Off-Highway T	50	0.666	0.652	2.230	0.002	0.232	215.238	19.41	18.99	64.98	0.06	6.76	6,272
50	87		120	0.272	0.596	2.166	0.002	0.176	196.896	23.72	51.90	188.57	0.16	15.31	17,142
120	159		175	0.203	0.602	1.949	0.002	0.109	198.671	32.27	95.57	309.74	0.30	17.26	31,567
175	211		250	0.189	0.600	2.002	0.002	0.087	198.322	39.93	126.70	422.46	0.40	18.27	41,849
250	372		500	0.154	0.610	1.729	0.002	0.066	201.459	57.23	227.16	643.99	0.72	24.60	75,027
500	656		750	0.181	0.609	1.957	0.002	0.080	200.991	118.42	399.15	1,283.60	1.26	52.22	131,834
750	897		1000	0.164	0.604	2.398	0.002	0.070	199.622	147.41	542.27	2,151.90	1.71	63.25	179,107

		2015		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	Equipment	MaxHP	ROG	CO	NOX	SOX	PM	CO2	ROG	CO	NOX	SOX	PM	CO2
1000	1764		9999	0.167	0.608	2.201	0.002	0.069	200.841	294.22	1,072.76	3,882.43	3.38	121.17	354,321
0	38	Other Constru	50	0.569	1.338	2.311	0.002	0.209	243.421	21.63	50.86	87.84	0.09	7.95	9,252
50	82		120	0.314	1.191	2.715	0.002	0.213	216.722	25.63	97.18	221.46	0.17	17.34	17,676
120	152		175	0.242	1.189	2.588	0.002	0.136	216.355	36.94	181.37	394.67	0.32	20.68	32,992
175	217		250	0.175	1.203	2.359	0.002	0.087	218.814	37.98	260.92	511.68	0.45	18.79	47,462
250	357		500	0.141	1.203	1.834	0.002	0.068	218.857	50.32	429.37	654.51	0.75	24.11	78,102
500	598		750	0.108	1.197	1.593	0.002	0.051	217.679	64.60	715.23	952.29	1.24	30.57	130,101
750	830		1000	0.099	1.192	1.852	0.002	0.049	216.873	81.91	989.77	1,537.09	1.72	40.69	180,038
1000	1127		9999	0.126	1.168	2.057	0.002	0.057	212.371	142.39	1,315.40	2,317.12	2.28	64.07	239,271
0	35	Other Genera	50	0.535	0.972	1.888	0.002	0.182	199.186	18.77	34.13	66.26	0.07	6.39	6,992
50	73		120	0.272	0.869	2.222	0.002	0.189	177.921	19.91	63.57	162.60	0.12	13.83	13,022
120	149		175	0.177	0.872	1.844	0.002	0.100	178.621	26.40	130.06	275.08	0.25	14.98	26,642
175	209		250	0.162	0.875	1.928	0.002	0.078	179.141	33.81	182.83	403.11	0.36	16.40	37,451
250	355		500	0.126	0.874	1.512	0.002	0.057	179.029	44.79	310.02	536.31	0.61	20.25	63,504
500	592		750	0.090	0.875	1.150	0.002	0.037	179.232	53.12	517.60	680.19	1.01	22.06	106,023
750	885		1000	0.127	0.872	2.203	0.002	0.059	178.698	112.47	772.06	1,949.89	1.51	51.82	158,148
1000	2000		9999	0.082	0.872	1.505	0.002	0.040	178.698	164.92	1,744.77	3,010.07	3.41	79.54	357,397
0	36	Other Materia	50	0.717	1.196	2.293	0.002	0.232	229.351	25.64	42.74	81.95	0.08	8.29	8,198
50	93		120	0.218	1.081	1.970	0.002	0.151	207.401	20.34	100.73	183.51	0.18	14.09	19,322
120	145		175	0.217	1.078	2.231	0.002	0.121	206.802	31.41	155.86	322.57	0.29	17.49	29,897
175	218		250	0.175	1.076	2.187	0.002	0.082	206.479	38.24	234.96	477.37	0.43	17.87	45,071
250	331		500	0.138	1.074	1.689	0.002	0.065	205.960	45.66	355.79	559.64	0.65	21.68	68,248
500	565		750	0.101	1.078	1.377	0.002	0.048	206.729	56.88	608.45	777.44	1.11	26.84	116,716
750	923		1000	0.021	1.078	0.892	0.002	0.007	206.729	19.39	994.72	823.65	1.82	6.44	190,811
1000	1050		9999	0.061	1.078	1.367	0.002	0.027	206.729	64.32	1,131.59	1,435.10	2.07	28.31	217,066
0	39	Pavers	50	0.806	1.429	2.342	0.002	0.241	242.599	31.11	55.20	90.45	0.09	9.29	9,370
50	80		120	0.296	1.275	2.551	0.002	0.199	216.385	23.52	101.45	203.01	0.16	15.85	17,221
120	158		175	0.213	1.280	2.300	0.002	0.115	217.349	33.65	202.48	363.70	0.33	18.22	34,370
175	213		250	0.093	1.285	1.728	0.002	0.044	218.123	19.86	273.98	368.49	0.44	9.44	46,506
250	327		500	0.077	1.267	1.212	0.002	0.040	214.992	25.06	414.65	396.75	0.67	13.17	70,384
500	750		750	0.076	1.280	1.015	0.002	0.044	217.241	56.87	959.87	761.24	1.56	32.96	162,931
0	35	Paving Equipr	50	0.364	1.293	1.785	0.002	0.144	204.648	12.69	45.02	62.16	0.07	5.03	7,125
50	89		120	0.246	1.177	2.182	0.002	0.167	186.351	21.76	104.32	193.32	0.16	14.81	16,511
120	148		175	0.153	1.170	1.763	0.002	0.086	185.162	22.66	173.63	261.68	0.26	12.77	27,479
175	216		250	0.117	1.174	1.694	0.002	0.056	185.801	25.25	253.19	365.44	0.38	12.16	40,071
250	339		500	0.119	1.166	1.647	0.002	0.059	184.483	40.39	394.88	558.10	0.60	20.04	62,495
500	605		750	0.084	1.174	1.407	0.002	0.033	185.772	50.61	710.16	851.11	1.07	19.80	112,392
750	842		1000	0.083	1.175	1.633	0.002	0.040	185.931	70.08	989.20	1,375.15	1.50	33.61	156,554
0	8	Plate Compac	15	0.284	1.492	1.781	0.004	0.069	244.369	2.28	11.94	14.25	0.03	0.55	1,955
0	13	Pressure Was	15	0.223	1.096	1.538	0.003	0.084	170.490	2.90	14.24	20.00	0.03	1.09	2,216
15	19		25	0.237	0.797	1.465	0.002	0.077	170.490	4.51	15.14	27.84	0.04	1.46	3,239
25	38		50	0.291	1.148	1.405	0.002	0.090	170.490	11.07	43.62	53.38	0.08	3.41	6,479
50	64		120	0.170	1.001	1.364	0.002	0.089	170.490	10.87	64.05	87.28	0.13	5.71	10,911
0	8	Pumps	15	0.619	2.703	3.834	0.007	0.229	420.542	4.95	21.62	30.67	0.05	1.83	3,364
15	21		25	0.658	1.966	3.615	0.005	0.199	420.542	13.81	41.29	75.91	0.11	4.19	8,831
25	37		50	1.018	3.525	3.635	0.005	0.274	420.542	37.68	130.44	134.50	0.20	10.15	15,560
50	84		120	0.501	2.629	3.578	0.005	0.269	420.542	42.09	220.81	300.55	0.41	22.58	35,326
120	151		175	0.340	2.207	3.103	0.005	0.148	420.542	51.38	333.25	468.55	0.71	22.33	63,502
175	217		250	0.223	0.828	2.729	0.005	0.077	420.542	48.40	179.75	592.29	1.03	16.74	91,258
250	372		500	0.201	0.836	2.414	0.004	0.072	420.542	74.96	310.94	898.09	1.54	26.83	156,442
500	615		750	0.208	0.836	2.503	0.004	0.074	420.542	127.77	514.06	1,539.44	2.60	45.32	258,633
750	1460		9999	0.267	0.950	3.609	0.004	0.094	420.542	390.55	1,386.97	5,269.73	6.17	136.98	613,991
0	36	Rollers	50	0.515	1.181	2.013	0.002	0.181	218.675	18.36	42.12	71.83	0.07	6.44	7,802
50	87		120	0.268	1.064	2.353	0.002	0.175	197.028	23.31	92.40	204.39	0.16	15.23	17,114
120	144		175	0.143	1.059	1.737	0.002	0.081	196.218	20.55	152.32	249.79	0.27	11.62	28,212
175	213		250	0.136	1.062	1.850	0.002	0.064	196.767	29.06	226.54	394.61	0.40	13.67	41,961
250	335		500	0.146	1.072	1.888	0.002	0.073	198.479	48.77	358.84	632.18	0.63	24.50	66,466
500	521		750	0.179	1.061	1.875	0.002	0.090	196.512	93.29	552.23	975.81	0.98	46.70	102,285
0	47	Rough Terrair	50	0.500	1.273	2.086	0.002	0.173	234.116	23.65	60.20	98.65	0.11	8.20	11,070
50	96		120	0.142	1.145	1.721	0.002	0.099	210.518	13.69	110.28	165.74	0.19	9.58	20,279
120	130		175	0.091	1.142	1.375	0.002	0.053	210.012	11.82	148.01	178.19	0.26	6.91	27,216
175	208		250	0.059	1.145	0.990	0.002	0.023	210.550	12.26	238.52	206.22	0.42	4.87	43,859
250	374		500	0.073	1.132	1.415	0.002	0.031	208.195	27.38	423.33	529.17	0.74	11.59	77,842
500	625		750	0.035	1.143	0.527	0.002	0.004	210.233	21.76	714.57	329.62	1.25	2.25	131,396
0	42	Rubber Tired	50	1.231	1.059	2.637	0.002	0.349	226.483	51.19	44.06	109.68	0.09	14.50	9,418
50	82		120	0.504	0.980	3.742	0.002	0.335	209.407	41.13	79.92	305.28	0.16	27.33	17,086
120	150		175	0.399	0.970	3.891	0.002	0.223	207.401	59.73	145.22	582.48	0.30	33.39	31,044
175	211		250	0.301	0.973	3.156	0.002	0.156	208.081	63.58	205.35	665.84	0.42	32.85	43,901
250	354		500	0.293	0.982	3.161	0.002	0.147	209.864	103.66	347.56	1,119.29	0.71	52.22	74,303
500	584		750	0.214	0.969	2.829	0.002	0.102	207.187	125.23	566.08	1,652.69	1.16	59.73	121,018
0	42	Rubber Tired	50	0.798	0.987	2.211	0.002	0.244	210.033	33.28	41.17	92.21	0.08	10.18	8,758
50	86		120	0.324	0.878	2.537	0.002	0.219	186.853	27.91	75.67	218.54	0.15	18.89	16,097
120	150		175	0.225	0.888	2.206	0.002	0.123	188.868	33.80	133.18	330.90	0.27	18.49	28,330
175	206		250	0.154	0.885	1.943	0.002	0.066	188.293	31.62	182.26	399.99	0.37	13.66	38,770
250	320		500	0.157	0.881	1.816	0.002	0.069	187.353	50.27	281.57	580.57	0.57	21.92	59,895
500	600		750	0.149	0.862	1.648	0.002	0.065	183.260	89.76	517.32	989.76	1.05	38.91	110,043
750	837		1000	0.159	0.887	2.429	0.002	0.071	188.711	133.01	742.38	2,032.31	1.51	59.55	157,916
1000	1521		9999	0.161	0.884	2.316	0.002	0.068	187.956	244.97	1,343.95	3,522.49	2.73	102.67	285,882
0	36	Scrapers	50	1.632	1.260	3.253	0.003	0.437	279.274	58.98	45.54	117.58	0.10	15.79	10,094
50	84		120	0.369	1.168	3.427	0.002	0.258	258.776	31.12	98.45	289.03	0.21	21.76	21,822
120	166		175	0.360	1.155	3.746	0.002	0.200	255.949	59.89	191.88	622.40	0.41	33.26	42,530
175	225		250	0.368	1.130	4.179	0.002	0.191	250.394	82.87	254.15	940.19	0.54	42.89	56,332
250	381		500	0.238	1.139	2.936	0.002	0.119	252.554	90.92	434.52	1,119.56	0.92	45.22	96,311
500	565		750	0.182	1.140	2.334	0.002	0.088	252.621	102.58	643.90	1,318.68	1.36	49.55	142,718
750	950		1000	0.593	1.138	6.460	0.002	0.301	252.280	562.94	1,081.30	6,137.29	2.29	286.14	239,666
1000	1923		9999	0.263	1.163	3.562	0.002	0.135	257.796	506.08	2,236.99	6,851.39	4.73	259.18	495,821
0	6	Signal Boards	15	0.542	2.845	3.397	0.007	0.133	466.006	3.25	17.07	20.38	0.04	0.80	2,796
15	37		50	1.143	3.956	3.857	0.006	0.299	443.274	42.28	146.38	142.71	0.21	11.05	16,401
50	82		120	0.538	2.828	3.741	0.005	0.291	443.274	44.09	231.91	306.78	0.43	23.84	36,348
120	158		175	0.371	2.381	3.232	0.005	0.161	443.274	58.59	376.21	510.58	0.79	25.39	70,037
175	216		250	0.297	1.069	3.411	0.006	0.099	535.623	64.24	231.00	736.68	1.30	21.48	115,695
0	43	Skid Steer Lo	50	0.247	1.378	1.635	0.002	0.099	215.335	10.72	59.89	71.06	0.09	4.28	9,360
50	71		120	0.113	1.234	1.404	0.002	0.081	192.790	7.99	87.01	99.05	0.13	5.72	13,599
120	153		175	0.118	1.224	1.500	0.002	0.068	191.337	17.98	187.22	229.36	0.28	10.47	29,260
175	201		250	0.101	1.214	1.376	0.002	0.050	189.731	20.33	243.44	275.98	0.36	10.09	38,047
250	277		500	0.089	1.201	1.133	0.002	0.040	187.666	24.66	332.20	313.48	0.50	11.05	51,921
500	530		750	0.057	1.233	0.887	0.002	0.037	192.714	30.36	653.51	470.21	0.98	19.63	102,138
750	1000		1000	0.089	1.233	1.441	0.002	0.045	192.714	89.03	1,233.03	1,440.57	1.84	45.49	192,714
0	36	Surfacing Equ	50	0.324	0.845	1.584	0.002	0.121	177.833	11.57	30.14	56.51	0.06	4.32	6,343
50	89		120	0.173	0.747	1.620	0.002	0.114	157.289	15.32	66.27	143.69	0.13	10.11	13,948
120	151		175	0.151	0.748	1.729	0.002	0.083	157.415	22.74	112.92	260.97	0.23	12.55	23,766
175	216		250	0.098	0.756	1.541	0.002	0.045	159.114	21.12	163.35	333.01	0.33	9.81	34,379
250	362		500	0.076	0.745	1.176	0.001	0.038	156.752	27.53	269.88	426.12	0.54	13.82	56,800
500	615		750	0.056	0.749	0.991	0.002	0.031	157.590	34.48	460.55	609.52	0.93	19.28	96,930

		2015		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	**Equipment**	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2	**ROG**	**CO**	**NOX**	**SOX**	**PM**	**CO2**
750	814		1000	0.095	0.752	1.735	0.002	0.043	158.243	77.15	612.24	1,412.43	1.23	34.65	128,855
1000	1141		9999	0.053	0.737	1.158	0.001	0.026	155.194	60.22	841.35	1,321.83	1.69	30.00	177,076
0	36	Sweepers/Scr	50	0.862	1.544	2.630	0.003	0.278	265.154	30.67	54.93	93.58	0.09	9.91	9,436
50	78		120	0.397	1.393	3.137	0.002	0.278	239.305	30.81	108.00	243.23	0.18	21.56	18,552
120	159		175	0.400	1.390	3.962	0.002	0.218	238.803	63.79	221.69	631.87	0.36	34.82	38,082
175	204		250	0.245	1.381	3.073	0.002	0.122	237.291	49.98	282.36	628.12	0.46	24.93	48,504
250	303		500	0.222	1.387	2.755	0.002	0.120	238.264	67.22	419.57	833.42	0.69	36.20	72,075
500	848		1000	0.082	1.387	1.852	0.002	0.048	238.264	69.89	1,176.17	1,570.74	1.93	40.75	202,048
0	38	Tractors/Load	50	0.504	0.986	1.960	0.002	0.176	210.545	19.31	37.77	75.10	0.08	6.73	8,065
50	83		120	0.220	0.913	1.998	0.002	0.156	194.965	18.15	75.46	165.14	0.15	12.93	16,114
120	144		175	0.163	0.898	1.782	0.002	0.090	191.692	23.39	129.21	256.50	0.26	12.96	27,591
175	204		250	0.126	0.899	1.763	0.002	0.057	192.049	25.66	183.67	359.95	0.37	11.69	39,220
250	320		500	0.120	0.903	1.602	0.002	0.055	192.893	38.52	289.20	512.98	0.59	17.59	61,753
500	575		750	0.119	0.893	1.542	0.002	0.056	190.737	68.15	513.28	886.12	1.05	32.20	109,601
750	871		1000	0.068	0.912	1.407	0.002	0.032	194.700	59.23	794.55	1,226.21	1.62	27.61	169,661
1000	2006		9999	0.127	0.904	1.969	0.002	0.061	193.002	255.40	1,812.80	3,949.88	3.70	121.76	387,090
0	40	Trenchers	50	0.662	1.634	2.716	0.003	0.248	293.765	26.33	65.01	108.05	0.11	9.86	11,685
50	82		120	0.430	1.474	3.607	0.003	0.282	264.849	35.26	120.92	296.00	0.21	23.16	21,733
120	144		175	0.367	1.449	3.856	0.002	0.199	260.505	52.74	208.53	554.78	0.36	28.62	37,479
175	218		250	0.264	1.465	3.271	0.003	0.131	263.326	57.63	320.01	714.50	0.55	28.54	57,516
250	359		500	0.164	1.453	2.203	0.002	0.082	261.218	58.72	521.06	789.70	0.89	29.30	93,651
500	619		750	0.060	1.471	0.816	0.003	0.027	264.337	37.02	910.75	505.15	1.56	16.53	163,691
750	860		1000	0.597	1.462	6.603	0.003	0.300	262.792	513.26	1,257.44	5,678.99	2.16	258.04	226,001
0	11	Welders	15	0.377	1.643	2.331	0.004	0.139	255.735	4.14	18.08	25.64	0.04	1.53	2,813
15	20		25	0.400	1.196	2.198	0.003	0.121	255.735	8.00	23.91	43.96	0.06	2.43	5,115
25	46		50	0.767	2.497	2.299	0.003	0.193	255.735	35.30	114.87	105.77	0.15	8.89	11,764
50	70		120	0.347	1.682	2.281	0.003	0.188	255.735	24.27	117.72	159.69	0.21	13.17	17,901
120	174		175	0.239	1.410	1.979	0.003	0.104	255.735	41.56	245.32	344.38	0.50	18.02	44,498
175	211		250	0.158	0.529	1.744	0.003	0.052	255.735	33.39	111.59	367.99	0.61	11.02	53,960
250	297		500	0.145	0.527	1.525	0.003	0.049	255.735	43.17	156.62	452.85	0.75	14.45	75,953
0	29	Water Trucks	50	0.666	0.652	2.230	0.002	0.232	215.238	19.408	18.990	64.985	0.060	6.758	6272.125
50	87		120	0.272	0.596	2.166	0.002	0.176	196.896	23.721	51.901	188.569	0.164	15.308	17142.259
120	159		175	0.203	0.602	1.949	0.002	0.109	198.671	32.274	95.572	309.739	0.301	17.256	31566.547
175	211		250	0.189	0.600	2.002	0.002	0.087	198.322	39.927	126.704	422.459	0.400	18.272	41848.985
250	372		500	0.154	0.610	1.729	0.002	0.066	201.459	57.231	227.155	643.993	0.716	24.598	75027.015
500	656		750	0.181	0.609	1.957	0.002	0.080	200.991	118.417	399.146	1283.603	1.259	52.217	131833.730
750	897		1000	0.164	0.604	2.398	0.002	0.070	199.622	147.408	542.271	2151.897	1.710	63.249	179106.645
1000	1764		9999	0.167	0.608	2.201	0.002	0.069	200.841	294.224	1072.759	3882.428	3.384	121.174	354321.133

2016

		2016		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	Equipment	MaxHP	ROG	CO	NOX	SOX	PM	CO2	ROG	CO	NOX	SOX	PM	CO2
0	46	Aerial Lifts	50	0.073	0.866	1.133	0.002	0.032	179.282	3.39	39.91	52.24	0.08	1.49	8,267
50	74		120	0.053	0.778	0.839	0.002	0.034	161.199	3.95	57.61	62.10	0.11	2.55	11,932
120	130		175	0.048	0.778	0.606	0.002	0.026	161.168	6.29	101.52	79.00	0.20	3.44	21,028
175	210		250	0.355	0.778	3.652	0.002	0.190	161.179	74.45	163.42	766.87	0.32	39.84	33,848
250	380		500	0.078	0.778	1.430	0.002	0.032	161.179	29.73	295.70	543.33	0.58	12.11	61,248
0	12	Air Compressors	15	0.389	1.739	2.419	0.004	0.141	272.784	4.67	20.86	29.03	0.05	1.69	3,273
15	24		25	0.411	1.250	2.311	0.003	0.124	272.784	9.87	30.00	55.47	0.08	2.97	6,547
25	37		50	0.824	2.817	2.455	0.004	0.206	272.784	30.48	104.23	90.85	0.13	7.61	10,093
50	78		120	0.367	1.837	2.353	0.003	0.197	272.784	28.66	143.32	183.57	0.25	15.37	21,277
120	147		175	0.258	1.549	2.003	0.003	0.109	272.784	37.88	227.72	294.49	0.45	15.95	40,099
175	218		250	0.177	0.570	1.758	0.003	0.054	272.784	38.58	124.26	383.27	0.67	11.82	59,467
250	385		500	0.166	0.557	1.521	0.003	0.051	272.784	63.85	214.31	585.52	1.03	19.44	105,022
500	595		750	0.167	0.557	1.582	0.003	0.052	272.784	99.63	331.21	941.47	1.63	30.77	162,306
750	808		1000	0.189	0.624	2.373	0.003	0.065	272.784	152.42	503.88	1,917.46	2.22	52.40	220,409
0	39	Bore/Drill Rigs	50	0.457	1.208	2.662	0.003	0.192	300.786	17.96	47.46	104.56	0.11	7.55	11,813
50	82		120	0.161	1.026	1.920	0.002	0.111	255.267	13.29	84.43	158.07	0.20	9.16	21,016
120	149		175	0.150	1.067	1.817	0.003	0.081	265.536	22.31	158.45	269.88	0.38	12.08	39,441
175	208		250	0.101	1.047	1.458	0.002	0.043	260.705	21.04	217.59	302.97	0.52	8.89	54,162
250	349		500	0.090	1.032	1.261	0.002	0.039	256.880	31.42	360.36	440.34	0.86	13.59	89,698
500	612		750	0.080	1.074	1.089	0.003	0.036	267.327	49.22	657.23	666.18	1.56	22.10	163,594
750	919		1000	0.061	1.055	1.512	0.003	0.030	262.715	55.76	969.95	1,389.24	2.31	27.38	241,435
1000	2667		9999	0.097	1.056	2.150	0.003	0.053	262.792	257.46	2,815.34	5,733.38	6.69	141.78	700,778
0	9	Cement and Mortar Mix	15	0.371	1.943	2.326	0.005	0.094	318.248	3.34	17.49	20.93	0.04	0.84	2,864
15	25		25	0.441	1.398	2.596	0.004	0.128	318.248	11.03	34.95	64.91	0.10	3.19	7,956
0	18	Concrete/Industrial Saw	25	0.500	1.708	3.163	0.005	0.118	414.859	9.01	30.75	56.93	0.09	2.12	7,467
25	33		50	0.968	3.674	3.519	0.005	0.256	414.859	31.94	121.25	116.13	0.18	8.45	13,690
50	81		120	0.454	2.644	3.239	0.005	0.244	414.859	36.76	214.16	262.39	0.39	19.79	33,604
120	175		175	0.318	2.245	2.712	0.005	0.136	414.859	55.71	392.85	474.54	0.82	23.86	72,600
0	41	Cranes	50	0.642	0.826	1.760	0.002	0.176	165.341	26.10	33.55	71.52	0.06	7.14	6,718
50	89		120	0.348	0.749	2.768	0.001	0.204	149.909	30.94	66.58	246.20	0.13	18.18	13,334
120	148		175	0.224	0.757	2.272	0.001	0.123	151.502	33.16	111.88	336.04	0.21	18.20	22,405
175	217		250	0.188	0.754	2.126	0.001	0.096	150.967	40.76	163.59	461.42	0.31	20.94	32,760
250	336		500	0.134	0.752	1.627	0.001	0.067	150.650	44.89	252.85	546.97	0.48	22.58	50,634
500	567		750	0.088	0.751	1.243	0.001	0.044	150.346	49.97	425.83	704.92	0.81	24.98	85,275
750	938		1000	0.316	0.748	3.355	0.001	0.166	149.778	295.85	701.27	3,145.89	1.34	156.07	140,432
1000	1030		9999	0.043	0.752	0.665	0.001	0.016	150.667	44.01	774.95	685.05	1.48	16.75	155,187
0	43	Crawler Tractors	50	1.131	1.328	2.709	0.002	0.314	245.102	48.06	56.46	115.15	0.10	13.36	10,419
50	87		120	0.390	1.227	3.150	0.002	0.265	226.518	33.88	106.61	273.59	0.19	23.06	19,675
120	150		175	0.280	1.215	2.882	0.002	0.159	224.198	41.91	181.67	430.94	0.32	23.76	33,527
175	203		250	0.201	1.218	2.593	0.002	0.100	224.784	40.85	247.06	526.01	0.44	20.28	45,596
250	341		500	0.179	1.225	2.264	0.002	0.088	226.106	60.87	417.40	771.21	0.74	29.88	77,033
500	570		750	0.155	1.218	2.026	0.002	0.075	224.739	88.49	694.26	1,154.81	1.22	42.48	128,127
750	828		1000	0.217	1.224	3.215	0.002	0.095	225.808	179.35	1,013.30	2,662.96	1.79	78.73	187,007
1000	1527		9999	0.155	1.168	2.611	0.002	0.070	215.490	237.27	1,782.39	3,985.53	3.14	106.21	328,945
0	45	Crushing/Proc. Equipm	50	1.246	4.529	3.906	0.006	0.312	443.274	56.07	203.80	175.77	0.26	14.05	19,947
50	85		120	0.563	2.983	3.616	0.005	0.297	443.274	47.88	253.57	307.37	0.44	25.21	37,678
120	171		175	0.402	2.528	3.034	0.005	0.165	443.274	68.70	432.36	518.79	0.85	28.19	75,800
175	250		250	0.282	0.919	2.642	0.005	0.082	443.274	70.42	229.80	660.44	1.25	20.57	110,818
250	382		500	0.266	0.895	2.287	0.004	0.077	443.274	101.59	341.70	873.69	1.66	29.37	169,331
500	602		750	0.265	0.890	2.356	0.004	0.077	443.274	159.51	535.64	1,418.28	2.68	46.63	266,851
750	1337		9999	0.310	0.994	3.666	0.004	0.100	443.274	414.51	1,329.60	4,901.23	5.96	133.10	592,657
0	16	Dumpers/Tenders	25	0.262	0.890	1.664	0.003	0.067	215.954	4.20	14.24	26.62	0.04	1.07	3,455
0	36	Excavators	50	0.326	1.083	1.842	0.002	0.137	222.472	11.64	38.71	65.84	0.08	4.89	7,951
50	82		120	0.190	0.962	1.798	0.002	0.131	197.677	15.55	78.70	147.04	0.15	10.75	16,165
120	146		175	0.143	0.973	1.559	0.002	0.077	199.859	20.87	142.10	227.61	0.28	11.20	29,187
175	218		250	0.105	0.973	1.401	0.002	0.044	199.878	22.90	212.60	305.98	0.42	9.66	43,668
250	329		500	0.085	0.969	1.075	0.002	0.035	198.989	28.01	318.38	353.25	0.62	11.37	65,396
500	578		750	0.097	0.964	1.282	0.002	0.042	197.951	55.84	556.98	741.08	1.09	24.33	114,404
750	843		1000	0.127	0.970	2.123	0.002	0.057	199.204	107.17	817.45	1,789.35	1.60	48.09	167,904
1000	1569		9999	0.089	0.963	1.389	0.002	0.036	197.811	139.07	1,511.16	2,180.26	2.96	57.22	310,393
0	42	Forklifts	50	0.392	0.638	1.138	0.001	0.117	117.014	16.63	27.04	48.27	0.05	4.97	4,963
50	82		120	0.152	0.572	1.251	0.001	0.105	105.000	12.53	47.13	103.01	0.08	8.61	8,649
120	141		175	0.111	0.573	1.141	0.001	0.062	105.128	15.75	80.94	161.15	0.14	8.81	14,853
175	208		250	0.113	0.574	1.277	0.001	0.056	105.400	23.62	119.55	265.80	0.21	11.71	21,939
250	344		500	0.074	0.575	0.812	0.001	0.035	105.464	25.49	197.53	279.26	0.35	12.00	36,250
500	880		1000	0.327	0.573	3.140	0.001	0.175	105.117	288.17	504.07	2,762.92	0.88	154.30	92,503
0	11	Generator Sets	15	0.535	2.680	3.696	0.007	0.198	420.542	5.89	29.48	40.66	0.07	2.18	4,626
15	19		25	0.573	1.927	3.563	0.005	0.183	420.542	10.89	36.62	67.70	0.10	3.47	7,990
25	33		50	0.869	3.298	3.512	0.005	0.243	420.542	28.68	108.82	115.91	0.18	8.03	13,878
50	84		120	0.443	2.576	3.337	0.005	0.237	420.542	37.24	216.41	280.31	0.41	19.87	35,326
120	153		175	0.301	2.176	2.842	0.005	0.130	420.542	46.04	332.95	434.85	0.72	19.91	64,343
175	229		250	0.200	0.802	2.486	0.005	0.069	420.542	45.90	183.66	569.26	1.08	15.75	96,304
250	363		500	0.181	0.798	2.194	0.004	0.064	420.542	65.65	289.79	796.37	1.50	23.41	152,657
500	586		750	0.187	0.798	2.278	0.004	0.066	420.542	109.66	467.82	1,334.62	2.48	38.63	246,438
750	1130		9999	0.245	0.893	3.420	0.004	0.086	420.542	277.31	1,008.57	3,864.37	4.78	97.20	475,212
0	39	Graders	50	1.319	1.158	2.665	0.002	0.353	223.068	51.67	45.33	104.35	0.08	13.83	8,736
50	91		120	0.510	1.103	3.848	0.002	0.319	212.476	46.43	100.33	350.14	0.18	29.00	19,335
120	148		175	0.346	1.131	3.372	0.002	0.189	217.953	51.24	167.32	498.82	0.31	28.02	32,245
175	204		250	0.170	1.121	2.314	0.002	0.075	216.080	34.81	229.13	472.95	0.42	15.36	44,157
250	293		500	0.143	1.110	1.506	0.002	0.059	213.889	41.92	325.38	441.63	0.60	17.25	62,706
500	796		1000	0.303	1.109	3.798	0.002	0.132	213.737	241.58	882.83	3,023.02	1.62	105.21	170,135
1000	1993		9999	0.193	1.107	2.690	0.002	0.082	213.348	383.95	2,206.16	5,361.41	4.06	163.30	425,161
0	38	Off-Highway Tractors	50	0.675	1.302	2.348	0.002	0.220	253.086	25.43	49.03	88.44	0.09	8.30	9,531
50	75		120	0.285	1.179	2.459	0.002	0.198	229.238	21.22	87.89	183.27	0.16	14.73	17,085
120	158		175	0.178	1.175	1.965	0.002	0.100	228.420	28.17	185.75	310.54	0.34	15.76	36,108
175	214		250	0.163	1.167	2.147	0.002	0.074	226.842	34.96	249.54	459.12	0.46	15.91	48,508
250	334		500	0.110	1.168	1.395	0.002	0.048	226.996	36.88	390.53	466.68	0.72	16.06	75,915
500	574		750	0.115	1.171	1.556	0.002	0.051	227.579	65.86	671.45	892.36	1.25	29.25	130,525
750	1000		1000	0.049	1.172	1.010	0.002	0.025	227.753	48.90	1,171.61	1,010.30	2.17	24.96	227,753
1000	1726		9999	0.098	1.199	1.635	0.002	0.042	233.086	168.64	2,069.85	2,822.13	3.84	71.89	402,366
0	29	Off-Highway Trucks	50	0.668	0.652	2.235	0.002	0.232	215.360	19.47	19.00	65.12	0.06	6.77	6,276
50	87		120	0.258	0.596	2.039	0.002	0.164	196.937	22.50	51.91	177.51	0.16	14.30	17,146
120	159		175	0.189	0.602	1.775	0.002	0.098	198.697	30.04	95.59	281.98	0.30	15.63	31,571
175	211		250	0.178	0.600	1.843	0.002	0.079	198.272	37.60	126.67	388.95	0.40	16.74	41,838
250	372		500	0.140	0.609	1.546	0.002	0.058	201.187	52.30	226.85	575.73	0.72	21.72	74,925
500	656		750	0.167	0.607	1.773	0.002	0.071	200.607	109.57	398.38	1,162.91	1.26	46.75	131,582
750	897		1000	0.157	0.604	2.305	0.002	0.067	199.554	140.90	542.09	2,067.97	1.71	60.11	179,046
1000	1764		9999	0.163	0.608	2.145	0.002	0.066	200.748	288.37	1,072.26	3,783.95	3.38	116.54	354,157
0	38	Other Construction Equ	50	0.557	1.338	2.284	0.002	0.204	243.350	21.16	50.85	86.82	0.09	7.77	9,249
50	82		120	0.306	1.192	2.628	0.002	0.206	216.898	24.94	97.26	214.31	0.17	16.79	17,691
120	152		175	0.228	1.189	2.417	0.002	0.127	216.304	34.77	181.33	368.51	0.31	19.38	32,984
175	217		250	0.166	1.203	2.194	0.002	0.081	218.792	35.92	260.90	475.80	0.45	17.54	47,457

		2016		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	**Equipment**	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2	**ROG**	**CO**	**NOX**	**SOX**	**PM**	**CO2**
250	357		500	0.134	1.203	1.699	0.002	0.063	218.769	47.72	429.19	606.26	0.75	22.33	78,070
500	598		750	0.109	1.197	1.556	0.002	0.050	217.690	65.00	715.27	930.09	1.24	30.18	130,108
750	830		1000	0.092	1.192	1.764	0.002	0.045	216.833	76.23	989.58	1,464.06	1.72	37.29	180,005
1000	1127		9999	0.130	1.167	2.072	0.002	0.058	212.338	146.37	1,315.20	2,334.98	2.28	65.03	239,235
0	35	Other General Industria	50	0.508	0.972	1.848	0.002	0.173	199.186	17.83	34.13	64.85	0.07	6.07	6,992
50	73		120	0.256	0.869	2.099	0.002	0.177	177.921	18.73	63.57	153.66	0.12	12.95	13,022
120	149		175	0.168	0.872	1.727	0.002	0.094	178.621	25.08	130.06	257.61	0.25	14.05	26,642
175	209		250	0.156	0.875	1.848	0.002	0.074	179.141	32.66	182.83	386.28	0.36	15.52	37,451
250	355		500	0.122	0.874	1.418	0.002	0.054	179.029	43.39	310.02	502.96	0.61	19.26	63,504
500	592		750	0.087	0.875	1.060	0.002	0.034	179.232	51.39	517.60	627.01	1.01	20.30	106,023
750	885		1000	0.087	0.872	1.622	0.002	0.038	178.698	76.68	772.06	1,435.27	1.51	33.86	158,148
1000	2000		9999	0.088	0.872	1.519	0.002	0.041	178.698	176.19	1,744.77	3,038.91	3.41	81.97	357,397
0	36	Other Material Handling	50	0.730	1.196	2.293	0.002	0.235	229.351	26.10	42.74	81.98	0.08	8.38	8,198
50	93		120	0.213	1.081	1.897	0.002	0.145	207.401	19.81	100.73	176.71	0.18	13.52	19,322
120	145		175	0.202	1.078	2.060	0.002	0.110	206.802	29.23	155.86	297.83	0.29	15.97	29,897
175	218		250	0.165	1.076	2.054	0.002	0.075	206.479	35.98	234.96	448.38	0.43	16.30	45,071
250	331		500	0.133	1.074	1.602	0.002	0.062	205.960	44.24	355.79	530.93	0.65	20.40	68,248
500	565		750	0.106	1.078	1.390	0.002	0.049	206.729	60.02	608.45	784.52	1.11	27.56	116,716
750	923		1000	0.024	1.078	0.900	0.002	0.007	206.729	22.15	994.72	831.01	1.82	6.66	190,811
1000	1050		9999	0.066	1.078	1.379	0.002	0.028	206.729	68.86	1,131.59	1,448.10	2.07	29.14	217,066
0	39	Pavers	50	0.794	1.429	2.317	0.002	0.236	242.601	30.69	55.20	89.51	0.09	9.13	9,370
50	80		120	0.283	1.274	2.445	0.002	0.190	216.225	22.48	101.38	194.60	0.16	15.09	17,208
120	158		175	0.188	1.281	2.025	0.002	0.101	217.410	29.79	202.54	320.17	0.33	15.91	34,380
175	213		250	0.093	1.285	1.672	0.002	0.043	218.066	19.79	273.91	356.38	0.44	9.22	46,494
250	327		500	0.078	1.267	1.198	0.002	0.040	215.005	25.66	414.68	392.33	0.67	13.09	70,388
500	750		750	0.079	1.280	1.019	0.002	0.045	217.241	59.36	959.87	764.54	1.56	33.45	162,931
0	35	Paving Equipment	50	0.368	1.293	1.770	0.002	0.143	204.623	12.82	45.02	61.63	0.07	4.99	7,124
50	89		120	0.232	1.177	2.036	0.002	0.156	186.353	20.52	104.32	180.38	0.16	13.79	16,511
120	148		175	0.138	1.170	1.535	0.002	0.076	185.219	20.51	173.68	227.75	0.26	11.30	27,488
175	216		250	0.110	1.174	1.572	0.002	0.052	185.724	23.81	253.09	339.13	0.38	11.31	40,055
250	339		500	0.113	1.166	1.550	0.002	0.055	184.481	38.42	394.88	525.24	0.60	18.76	62,495
500	605		750	0.085	1.174	1.383	0.002	0.033	185.774	51.25	710.17	836.95	1.07	20.10	112,393
750	842		1000	0.085	1.175	1.643	0.002	0.041	185.931	71.79	989.20	1,383.00	1.50	34.13	156,554
0	8	Plate Compactors	15	0.284	1.492	1.781	0.004	0.070	244.369	2.28	11.94	14.25	0.03	0.56	1,955
0	13	Pressure Washers	15	0.217	1.087	1.498	0.003	0.080	170.490	2.82	14.13	19.48	0.03	1.05	2,216
15	19		25	0.232	0.781	1.445	0.002	0.074	170.490	4.41	14.85	27.45	0.04	1.41	3,239
25	38		50	0.266	1.127	1.371	0.002	0.083	170.490	10.10	42.82	52.12	0.08	3.17	6,479
50	64		120	0.155	0.995	1.291	0.002	0.082	170.490	9.93	63.68	82.62	0.13	5.24	10,911
0	8	Pumps	15	0.600	2.680	3.729	0.007	0.217	420.542	4.80	21.44	29.84	0.05	1.73	3,364
15	21		25	0.634	1.927	3.563	0.005	0.191	420.542	13.31	40.47	74.83	0.11	4.01	8,831
25	37		50	0.941	3.472	3.556	0.005	0.256	420.542	34.80	128.45	131.57	0.20	9.47	15,560
50	84		120	0.464	2.617	3.388	0.005	0.248	420.542	38.95	219.85	284.62	0.41	20.84	35,326
120	151		175	0.317	2.210	2.887	0.005	0.137	420.542	47.80	333.67	435.87	0.71	20.62	63,502
175	217		250	0.212	0.816	2.527	0.005	0.072	420.542	46.02	176.97	548.29	1.03	15.54	91,258
250	372		500	0.192	0.811	2.222	0.004	0.067	420.542	71.59	301.62	826.42	1.54	24.92	156,442
500	615		750	0.198	0.811	2.307	0.004	0.068	420.542	121.86	498.65	1,418.72	2.60	42.11	258,633
750	1460		9999	0.254	0.907	3.460	0.004	0.088	420.542	371.15	1,324.36	5,052.17	6.17	128.66	613,991
0	36	Rollers	50	0.495	1.180	1.964	0.002	0.172	218.635	17.64	42.11	70.09	0.07	6.15	7,801
50	87		120	0.247	1.064	2.178	0.002	0.160	197.013	21.43	92.39	189.21	0.16	13.93	17,113
120	144		175	0.133	1.059	1.590	0.002	0.074	196.123	19.07	152.24	228.66	0.27	10.63	28,198
175	213		250	0.121	1.063	1.649	0.002	0.056	196.817	25.79	226.60	351.64	0.40	12.00	41,971
250	335		500	0.131	1.075	1.672	0.002	0.065	199.035	43.92	359.85	559.90	0.64	21.75	66,652
500	521		750	0.026	1.061	0.260	0.002	0.003	196.512	13.68	552.23	135.12	0.98	1.74	102,285
0	47	Rough Terrain Forklifts	50	0.487	1.273	2.050	0.002	0.167	233.997	23.05	60.17	96.93	0.11	7.89	11,064
50	96		120	0.127	1.145	1.544	0.002	0.086	210.615	12.22	110.33	148.70	0.19	8.25	20,288
120	130		175	0.088	1.142	1.290	0.002	0.050	210.004	11.38	148.00	167.16	0.26	6.48	27,215
175	208		250	0.061	1.145	0.992	0.002	0.024	210.544	12.61	238.51	206.71	0.42	4.91	43,858
250	374		500	0.075	1.132	1.424	0.002	0.031	208.184	27.98	423.31	532.33	0.74	11.74	77,838
500	625		750	0.037	1.143	0.529	0.002	0.004	210.233	22.83	714.57	330.69	1.25	2.27	131,396
0	42	Rubber Tired Dozers	50	1.234	1.059	2.643	0.002	0.350	226.464	51.32	44.05	109.92	0.09	14.56	9,418
50	82		120	0.500	0.980	3.702	0.002	0.332	209.594	40.77	79.99	302.01	0.16	27.08	17,101
120	150		175	0.400	0.970	3.895	0.002	0.224	207.394	59.95	145.21	583.01	0.30	33.47	31,043
175	211		250	0.304	0.973	3.160	0.002	0.156	208.083	64.22	205.36	666.79	0.42	32.97	43,901
250	354		500	0.285	0.981	3.048	0.002	0.142	209.655	100.82	347.22	1,079.11	0.71	50.21	74,229
500	584		750	0.216	0.969	2.834	0.002	0.103	207.184	126.44	566.07	1,655.10	1.16	59.96	121,016
0	42	Rubber Tired Loaders	50	0.778	0.987	2.190	0.002	0.239	210.053	32.45	41.17	91.31	0.08	9.95	8,758
50	86		120	0.304	0.878	2.382	0.002	0.204	186.760	26.18	75.64	205.19	0.15	17.61	16,089
120	150		175	0.214	0.888	2.072	0.002	0.116	188.830	32.10	133.15	310.72	0.27	17.33	28,324
175	206		250	0.149	0.885	1.851	0.002	0.063	188.278	30.66	182.25	381.06	0.37	13.00	38,767
250	320		500	0.148	0.879	1.674	0.002	0.063	187.073	47.35	281.15	535.23	0.57	20.10	59,805
500	600		750	0.141	0.864	1.509	0.002	0.059	183.891	84.78	519.10	906.30	1.05	35.63	110,422
750	837		1000	0.161	0.887	2.433	0.002	0.072	188.699	134.50	742.33	2,035.78	1.51	59.89	157,906
1000	1521		9999	0.133	0.884	2.005	0.002	0.056	187.956	201.95	1,343.95	3,050.21	2.73	84.43	285,882
0	36	Scrapers	50	1.651	1.260	3.264	0.003	0.441	279.274	59.67	45.54	117.98	0.10	15.95	10,094
50	84		120	0.375	1.167	3.446	0.002	0.262	258.769	31.61	98.45	290.58	0.21	22.09	21,821
120	166		175	0.347	1.155	3.562	0.002	0.191	255.913	57.68	191.85	591.92	0.41	31.80	42,524
175	225		250	0.345	1.129	3.912	0.002	0.177	250.340	77.71	254.10	880.01	0.54	39.82	56,320
250	381		500	0.228	1.139	2.777	0.002	0.112	252.381	87.10	434.23	1,059.17	0.92	42.69	96,245
500	565		750	0.172	1.139	2.163	0.002	0.081	252.525	96.94	643.65	1,222.10	1.36	45.65	142,664
750	950		1000	0.593	1.138	6.460	0.002	0.301	252.280	562.94	1,081.30	6,137.29	2.29	286.14	239,666
1000	1923		9999	0.269	1.163	3.597	0.002	0.137	257.796	517.49	2,236.99	6,917.29	4.73	263.94	495,821
0	6	Signal Boards	15	0.542	2.845	3.397	0.007	0.133	466.006	3.25	17.07	20.38	0.04	0.80	2,796
15	37		50	1.022	3.842	3.715	0.006	0.269	443.274	37.81	142.16	137.46	0.21	9.94	16,401
50	82		120	0.484	2.804	3.447	0.005	0.258	443.274	39.66	229.93	282.67	0.43	21.19	36,348
120	158		175	0.336	2.377	2.897	0.005	0.143	443.274	53.13	375.62	457.78	0.79	22.62	70,037
175	216		250	0.277	1.049	3.043	0.006	0.089	535.623	59.81	226.48	657.22	1.30	19.24	115,694
0	43	Skid Steer Loaders	50	0.231	1.377	1.573	0.002	0.089	215.209	10.05	59.86	68.36	0.09	3.85	9,355
50	71		120	0.105	1.233	1.302	0.002	0.073	192.771	7.43	87.00	91.87	0.13	5.13	13,597
120	153		175	0.117	1.224	1.437	0.002	0.067	191.332	17.89	187.21	219.78	0.28	10.23	29,260
175	201		250	0.097	1.214	1.290	0.002	0.047	189.689	19.37	243.38	258.73	0.36	9.45	38,039
250	277		500	0.038	1.201	0.511	0.002	0.013	187.666	10.50	332.20	141.33	0.50	3.72	51,921
500	530		750	0.059	1.233	0.890	0.002	0.037	192.714	31.48	653.51	471.70	0.98	19.85	102,138
750	1000		1000	0.093	1.233	1.471	0.002	0.047	192.714	93.31	1,233.03	1,471.46	1.84	46.84	192,714
0	36	Surfacing Equipment	50	0.330	0.845	1.590	0.002	0.122	177.820	11.76	30.13	56.70	0.06	4.37	6,342
50	89		120	0.165	0.748	1.523	0.002	0.105	157.345	14.61	66.30	135.06	0.13	9.32	13,953
120	151		175	0.144	0.747	1.646	0.002	0.080	157.180	21.80	112.75	248.44	0.23	12.07	23,730
175	216		250	0.097	0.756	1.522	0.002	0.045	159.095	20.94	163.33	328.84	0.33	9.66	34,375
250	362		500	0.069	0.744	1.046	0.001	0.033	156.530	24.83	269.49	378.90	0.54	12.14	56,719
500	615		750	0.051	0.750	0.868	0.002	0.028	157.930	31.41	461.54	534.00	0.93	17.18	97,139
750	814		1000	0.096	0.752	1.740	0.002	0.043	158.248	77.81	612.26	1,416.54	1.23	34.90	128,859
1000	1141		9999	0.054	0.737	1.162	0.001	0.027	155.194	61.90	841.35	1,326.18	1.69	30.32	177,076
0	36	Sweepers/Scrubbers	50	0.849	1.544	2.609	0.003	0.275	265.154	30.23	54.93	92.84	0.09	9.77	9,436
50	78		120	0.373	1.393	2.940	0.002	0.260	239.305	28.93	108.00	227.96	0.18	20.16	18,552
120	159		175	0.356	1.390	3.548	0.002	0.191	238.803	56.70	221.69	565.80	0.36	30.43	38,082
175	204		250	0.248	1.381	3.090	0.002	0.123	237.291	50.75	282.36	631.64	0.46	25.13	48,504
250	303		500	0.226	1.387	2.767	0.002	0.121	238.264	68.49	419.57	836.87	0.69	36.53	72,075

		2016		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	**Equipment**	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2	**ROG**	**CO**	**NOX**	**SOX**	**PM**	**CO2**
500	848		1000	0.089	1.387	1.867	0.002	0.049	238.264	75.67	1,176.17	1,583.48	1.93	41.88	202,048
0	38	Tractors/Loaders/Backh	50	0.482	0.987	1.921	0.002	0.168	210.705	18.47	37.80	73.59	0.08	6.42	8,071
50	83		120	0.208	0.912	1.895	0.002	0.146	194.693	17.15	75.36	156.62	0.15	12.06	16,091
120	144		175	0.150	0.896	1.614	0.002	0.082	191.374	21.61	129.00	232.29	0.26	11.77	27,545
175	204		250	0.120	0.899	1.631	0.002	0.053	192.049	24.47	183.67	333.08	0.37	10.90	39,220
250	320		500	0.109	0.901	1.395	0.002	0.048	192.380	35.05	288.43	446.71	0.59	15.46	61,588
500	575		750	0.116	0.893	1.482	0.002	0.053	190.737	66.52	513.28	851.56	1.05	30.58	109,601
750	871		1000	0.072	0.912	1.418	0.002	0.032	194.680	62.32	794.47	1,235.33	1.62	28.20	169,644
1000	2006		9999	0.121	0.904	1.882	0.002	0.056	193.002	242.62	1,812.80	3,775.55	3.70	113.13	387,090
0	40	Trenchers	50	0.641	1.635	2.662	0.003	0.239	293.864	25.50	65.04	105.90	0.11	9.49	11,689
50	82		120	0.414	1.473	3.468	0.003	0.272	264.741	34.00	120.87	284.60	0.21	22.32	21,724
120	144		175	0.306	1.450	3.268	0.002	0.165	260.525	44.07	208.54	470.14	0.36	23.69	37,482
175	218		250	0.256	1.465	3.172	0.003	0.126	263.310	55.99	319.99	692.75	0.55	27.59	57,513
250	359		500	0.155	1.457	2.060	0.003	0.075	261.890	55.74	522.40	738.48	0.90	26.97	93,892
500	619		750	0.063	1.471	0.819	0.003	0.027	264.347	38.99	910.79	507.24	1.56	16.76	163,697
750	860		1000	0.599	1.462	6.619	0.003	0.302	262.792	515.43	1,257.44	5,692.37	2.16	259.50	226,001
0	11	Welders	15	0.365	1.630	2.268	0.004	0.132	255.735	4.01	17.93	24.95	0.04	1.45	2,813
15	20		25	0.386	1.172	2.167	0.003	0.116	255.735	7.71	23.44	43.34	0.06	2.32	5,115
25	46		50	0.711	2.461	2.252	0.003	0.181	255.735	32.70	113.22	103.61	0.15	8.32	11,764
50	70		120	0.323	1.676	2.160	0.003	0.174	255.735	22.63	117.32	151.20	0.21	12.18	17,901
120	174		175	0.224	1.413	1.841	0.003	0.096	255.735	39.05	245.92	320.30	0.50	16.67	44,498
175	211		250	0.152	0.521	1.614	0.003	0.049	255.735	32.14	109.96	340.60	0.61	10.24	53,960
250	297		500	0.141	0.512	1.403	0.003	0.045	255.735	41.87	152.04	416.74	0.75	13.44	75,953
0	29	Water Trucks	50	0.668	0.652	2.235	0.002	0.232	215.360	19.472	19.000	65.119	0.060	6.769	6275.662
50	87		120	0.258	0.596	2.039	0.002	0.164	196.937	22.504	51.911	177.515	0.164	14.297	17145.800
120	159		175	0.189	0.602	1.775	0.002	0.098	198.697	30.036	95.585	281.983	0.301	15.635	31570.801
175	211		250	0.178	0.600	1.843	0.002	0.079	198.272	37.596	126.672	388.949	0.400	16.741	41838.390
250	372		500	0.140	0.609	1.546	0.002	0.058	201.187	52.301	226.848	575.730	0.715	21.720	74925.493
500	656		750	0.167	0.607	1.773	0.002	0.071	200.607	109.574	398.383	1162.915	1.257	46.754	131581.753
750	897		1000	0.157	0.604	2.305	0.002	0.067	199.554	140.901	542.086	2067.973	1.710	60.107	179045.521
1000	1764		9999	0.163	0.608	2.145	0.002	0.066	200.748	288.370	1072.261	3783.945	3.382	116.536	354156.761

2017

		2017		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	Equipment	MaxHP	ROG	CO	NOX	SOX	PM	CO2	ROG	CO	NOX	SOX	PM	CO2
0	46	Aerial Lifts	50	0.067	0.866	1.069	0.002	0.024	179.282	3.11	39.91	49.31	0.08	1.12	8,267
50	74		120	0.046	0.778	0.728	0.002	0.026	161.199	3.41	57.61	53.92	0.11	1.90	11,932
120	130		175	0.046	0.778	0.576	0.002	0.025	161.168	6.04	101.52	75.14	0.20	3.25	21,028
175	210		250	0.355	0.778	3.657	0.002	0.190	161.179	74.56	163.42	768.00	0.32	39.89	33,848
250	380		500	0.079	0.778	1.436	0.002	0.032	161.179	30.12	295.70	545.49	0.58	12.25	61,248
0	12	Air Compressors	15	0.380	1.730	2.364	0.004	0.134	272.784	4.56	20.76	28.37	0.05	1.61	3,273
15	24		25	0.401	1.235	2.281	0.003	0.119	272.784	9.62	29.63	54.75	0.08	2.86	6,547
25	37		50	0.751	2.770	2.404	0.004	0.190	272.784	27.78	102.49	88.93	0.13	7.03	10,093
50	78		120	0.340	1.831	2.215	0.003	0.179	272.784	26.54	142.84	172.79	0.25	13.98	21,277
120	147		175	0.242	1.554	1.847	0.003	0.099	272.784	35.52	228.38	271.44	0.45	14.56	40,099
175	218		250	0.171	0.564	1.612	0.003	0.050	272.784	37.37	122.87	351.41	0.67	10.93	59,467
250	385		500	0.162	0.544	1.401	0.003	0.047	272.784	62.43	209.51	539.26	1.03	18.11	105,022
500	595		750	0.163	0.544	1.448	0.003	0.048	272.784	97.19	323.79	861.65	1.63	28.52	162,306
750	808		1000	0.183	0.605	2.276	0.003	0.062	272.784	147.66	488.69	1,839.18	2.22	49.73	220,409
0	39	Bore/Drill Rigs	50	0.423	1.195	2.544	0.003	0.176	297.409	16.61	46.93	99.93	0.11	6.92	11,680
50	82		120	0.157	1.028	1.852	0.002	0.106	255.958	12.90	84.66	152.47	0.20	8.73	21,073
120	149		175	0.129	1.067	1.499	0.003	0.066	265.687	19.10	158.54	222.61	0.38	9.80	39,464
175	208		250	0.091	1.047	1.267	0.002	0.036	260.607	18.96	217.51	263.23	0.52	7.57	54,142
250	349		500	0.087	1.037	1.190	0.002	0.036	258.141	30.46	362.13	415.41	0.86	12.69	90,138
500	612		750	0.081	1.070	1.084	0.003	0.036	266.402	49.80	654.96	663.17	1.56	21.98	163,028
750	919		1000	0.063	1.055	1.518	0.003	0.030	262.709	58.28	969.93	1,394.86	2.31	27.66	241,429
1000	2667		9999	0.099	1.056	2.156	0.003	0.054	262.792	263.63	2,815.34	5,749.17	6.69	143.11	700,778
0	9	Cement and Mor	15	0.371	1.943	2.321	0.005	0.093	318.248	3.34	17.49	20.89	0.04	0.83	2,864
15	25		25	0.430	1.381	2.558	0.004	0.121	318.248	10.75	34.53	63.94	0.10	3.03	7,956
0	18	Concrete/Industri	25	0.500	1.708	3.163	0.005	0.118	414.859	9.01	30.75	56.93	0.09	2.12	7,467
25	33		50	0.859	3.574	3.396	0.005	0.229	414.859	28.34	117.94	112.08	0.18	7.56	13,690
50	81		120	0.408	2.625	2.983	0.005	0.215	414.859	33.02	212.61	241.66	0.39	17.45	33,604
120	175		175	0.289	2.243	2.422	0.005	0.121	414.859	50.62	392.60	423.87	0.82	21.16	72,600
0	41	Cranes	50	0.655	0.826	1.770	0.002	0.179	165.333	26.62	33.54	71.93	0.06	7.26	6,717
50	89		120	0.331	0.749	2.637	0.001	0.195	149.903	29.41	66.58	234.57	0.13	17.37	13,333
120	148		175	0.210	0.757	2.120	0.001	0.114	151.518	31.04	111.89	313.58	0.21	16.93	22,407
175	217		250	0.169	0.754	1.917	0.001	0.085	150.998	36.68	163.62	416.07	0.31	18.55	32,766
250	336		500	0.124	0.753	1.507	0.001	0.061	150.715	41.57	252.96	506.61	0.48	20.57	50,657
500	567		750	0.086	0.751	1.198	0.001	0.042	150.337	49.02	425.81	679.43	0.81	24.04	85,269
750	938		1000	0.316	0.748	3.359	0.001	0.167	149.770	296.49	701.23	3,149.83	1.34	156.34	140,424
1000	1030		9999	0.046	0.752	0.669	0.001	0.017	150.667	47.24	774.95	689.07	1.48	17.06	155,187
0	43	Crawler Tractors	50	1.104	1.328	2.662	0.002	0.305	245.129	46.91	56.46	113.17	0.10	12.97	10,420
50	87		120	0.381	1.227	3.062	0.002	0.259	226.499	33.11	106.60	265.96	0.19	22.48	19,673
120	150		175	0.276	1.215	2.809	0.002	0.156	224.179	41.24	181.65	420.13	0.32	23.32	33,524
175	203		250	0.193	1.219	2.470	0.002	0.094	224.947	39.10	247.24	500.98	0.44	19.12	45,630
250	341		500	0.173	1.225	2.157	0.002	0.083	226.113	58.85	417.41	734.73	0.74	28.43	77,035
500	570		750	0.146	1.217	1.870	0.002	0.068	224.620	83.00	693.89	1,066.13	1.22	39.03	128,059
750	828		1000	0.218	1.224	3.230	0.002	0.096	225.868	180.58	1,013.57	2,674.84	1.79	79.31	187,056
1000	1527		9999	0.157	1.168	2.622	0.002	0.070	215.490	240.12	1,782.39	4,002.75	3.14	107.35	328,945
0	45	Crushing/Proc. E	50	1.095	4.387	3.765	0.006	0.277	443.274	49.27	197.41	169.43	0.26	12.45	19,947
50	85		120	0.506	2.958	3.312	0.005	0.258	443.274	43.00	251.39	281.49	0.44	21.94	37,678
120	171		175	0.366	2.525	2.693	0.005	0.145	443.274	62.58	431.72	460.44	0.85	24.73	75,800
175	250		250	0.266	0.905	2.331	0.005	0.073	443.274	66.44	226.25	582.86	1.25	18.33	110,818
250	382		500	0.253	0.873	2.030	0.004	0.069	443.274	96.72	333.35	775.44	1.66	26.38	169,331
500	602		750	0.252	0.870	2.078	0.004	0.069	443.274	151.72	523.54	1,251.07	2.68	41.68	266,851
750	1337		9999	0.295	0.960	3.450	0.004	0.091	443.274	394.66	1,283.92	4,612.77	5.96	122.08	592,657
0	16	Dumpers/Tender	25	0.261	0.889	1.658	0.003	0.065	215.954	4.18	14.23	26.52	0.04	1.04	3,455
0	36	Excavators	50	0.308	1.083	1.787	0.002	0.127	222.420	11.01	38.70	63.85	0.08	4.53	7,949
50	82		120	0.176	0.963	1.673	0.002	0.118	197.769	14.38	78.74	136.78	0.15	9.69	16,173
120	146		175	0.133	0.973	1.413	0.002	0.070	199.819	19.47	142.07	206.34	0.28	10.15	29,182
175	218		250	0.099	0.973	1.267	0.002	0.040	199.784	21.54	212.50	276.90	0.42	8.77	43,647
250	329		500	0.080	0.969	0.957	0.002	0.031	199.132	26.25	318.61	314.67	0.62	10.18	65,443
500	578		750	0.084	0.965	1.039	0.002	0.034	198.227	48.48	557.75	600.20	1.09	19.85	114,563
750	843		1000	0.099	0.962	1.805	0.002	0.043	197.524	83.05	810.55	1,521.57	1.59	36.37	166,488
1000	1569		9999	0.093	0.963	1.398	0.002	0.037	197.811	145.37	1,511.16	2,194.11	2.96	58.01	310,393
0	42	Forklifts	50	0.358	0.638	1.096	0.001	0.108	117.014	15.19	27.04	46.46	0.05	4.57	4,963
50	82		120	0.141	0.572	1.169	0.001	0.096	105.000	11.64	47.13	96.32	0.08	7.95	8,649
120	141		175	0.107	0.573	1.078	0.001	0.059	105.128	15.10	80.94	152.27	0.14	8.34	14,853
175	208		250	0.104	0.574	1.156	0.001	0.051	105.400	21.71	119.55	240.62	0.21	10.53	21,939
250	344		500	0.071	0.575	0.760	0.001	0.032	105.464	24.42	197.53	261.13	0.35	11.15	36,250
500	880		1000	0.327	0.573	3.140	0.001	0.175	105.117	288.17	504.07	2,762.92	0.88	154.30	92,503
0	11	Generator Sets	15	0.522	2.667	3.615	0.007	0.190	420.542	5.74	29.33	39.76	0.07	2.09	4,626
15	19		25	0.563	1.903	3.517	0.005	0.176	420.542	10.70	36.16	66.82	0.10	3.35	7,990
25	33		50	0.793	3.242	3.431	0.005	0.225	420.542	26.15	107.00	113.23	0.18	7.42	13,878
50	84		120	0.406	2.564	3.147	0.005	0.216	420.542	34.07	215.39	264.37	0.41	18.12	35,326
120	153		175	0.277	2.179	2.626	0.005	0.119	420.542	42.41	333.34	401.82	0.72	18.21	64,343
175	229		250	0.190	0.792	2.285	0.005	0.064	420.542	43.43	181.30	523.22	1.08	14.55	96,304
250	363		500	0.173	0.780	2.021	0.004	0.060	420.542	62.82	283.24	733.66	1.50	21.77	152,657
500	586		750	0.178	0.780	2.086	0.004	0.061	420.542	104.16	457.23	1,222.40	2.48	35.74	246,438
750	1130		9999	0.234	0.866	3.281	0.004	0.081	420.542	264.41	978.67	3,707.08	4.78	91.68	475,212
0	39	Graders	50	1.286	1.158	2.625	0.002	0.345	223.086	50.37	45.33	102.80	0.08	13.50	8,736
50	91		120	0.498	1.104	3.756	0.002	0.310	212.724	45.32	100.44	341.83	0.18	28.21	19,357
120	148		175	0.324	1.128	3.132	0.002	0.176	217.370	47.91	166.87	463.33	0.31	26.03	32,159
175	204		250	0.169	1.121	2.258	0.002	0.074	216.106	34.62	229.16	461.43	0.42	15.05	44,162
250	293		500	0.143	1.110	1.454	0.002	0.057	213.874	41.91	325.36	426.21	0.60	16.69	62,702
500	796		1000	0.303	1.109	3.798	0.002	0.132	213.737	241.58	882.83	3,023.02	1.62	105.21	170,135
1000	1993		9999	0.196	1.107	2.703	0.002	0.083	213.348	391.03	2,206.16	5,386.81	4.06	164.95	425,161
0	38	Off-Highway Trac	50	0.613	1.303	2.264	0.002	0.202	253.337	23.09	49.08	85.28	0.09	7.60	9,541
50	75		120	0.267	1.179	2.316	0.002	0.184	229.108	19.92	87.84	172.58	0.16	13.72	17,075
120	158		175	0.162	1.174	1.753	0.002	0.089	228.194	25.64	185.56	277.15	0.34	14.11	36,072
175	214		250	0.149	1.167	1.908	0.002	0.066	226.938	31.92	249.64	408.10	0.46	14.08	48,529
250	334		500	0.099	1.167	1.173	0.002	0.041	226.807	32.97	390.20	392.35	0.72	13.58	75,852
500	574		750	0.113	1.170	1.447	0.002	0.049	227.450	64.71	671.07	830.13	1.25	27.93	130,451
750	1000		1000	0.054	1.172	1.019	0.002	0.026	227.753	53.92	1,171.61	1,018.86	2.17	25.60	227,753
1000	1726		9999	0.102	1.200	1.643	0.002	0.042	233.221	176.84	2,071.05	2,835.69	3.84	72.86	402,598
0	29	Off-Highway Truc	50	0.574	0.654	2.114	0.002	0.202	215.970	16.73	19.05	61.59	0.06	5.88	6,293
50	87		120	0.232	0.596	1.829	0.002	0.145	196.923	20.23	51.91	159.25	0.16	12.65	17,145
120	159		175	0.176	0.602	1.618	0.002	0.089	198.777	28.03	95.62	257.07	0.30	14.16	31,584
175	211		250	0.167	0.600	1.668	0.002	0.072	198.324	35.19	126.71	351.99	0.40	15.21	41,849
250	372		500	0.130	0.609	1.401	0.002	0.052	200.987	48.42	226.62	521.74	0.71	19.37	74,851
500	656		750	0.157	0.607	1.626	0.002	0.065	200.491	103.21	398.15	1,066.25	1.26	42.63	131,505
750	897		1000	0.145	0.603	2.159	0.002	0.061	199.255	129.84	541.27	1,936.85	1.71	54.50	178,777
1000	1764		9999	0.149	0.609	1.970	0.002	0.058	201.280	263.24	1,075.11	3,474.59	3.39	103.14	355,096
0	38	Other Constructio	50	0.541	1.337	2.252	0.002	0.198	243.278	20.56	50.83	85.58	0.09	7.54	9,246
50	82		120	0.294	1.192	2.521	0.002	0.197	216.850	23.97	97.23	205.64	0.17	16.09	17,687
120	152		175	0.218	1.189	2.282	0.002	0.121	216.217	33.18	181.26	348.03	0.31	18.39	32,971
175	217		250	0.154	1.203	2.005	0.002	0.074	218.794	33.39	260.90	434.97	0.45	16.02	47,457
250	357		500	0.126	1.201	1.569	0.002	0.057	218.484	44.96	428.63	559.91	0.74	20.49	77,969
500	598		750	0.106	1.196	1.476	0.002	0.048	217.608	63.08	715.00	882.30	1.24	28.51	130,059
750	830		1000	0.078	1.190	1.590	0.002	0.038	216.552	64.87	988.30	1,319.83	1.72	31.19	179,771

		2017		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	Equipment	MaxHP	ROG	CO	NOX	SOX	PM	CO2	ROG	CO	NOX	SOX	PM	CO2
1000	1127		9999	0.115	1.167	1.853	0.002	0.050	212.304	129.24	1,314.99	2,087.49	2.28	55.81	239,196
0	35	Other General In	50	0.483	0.972	1.803	0.002	0.164	199.186	16.94	34.13	63.29	0.07	5.75	6,992
50	73		120	0.236	0.869	1.955	0.002	0.161	177.921	17.28	63.57	143.09	0.12	11.77	13,022
120	149		175	0.156	0.872	1.549	0.002	0.085	178.621	23.31	130.06	231.06	0.25	12.72	26,642
175	209		250	0.147	0.875	1.716	0.002	0.068	179.141	30.75	182.83	358.78	0.36	14.21	37,451
250	355		500	0.119	0.874	1.349	0.002	0.052	179.029	42.34	310.02	478.65	0.61	18.43	63,504
500	592		750	0.078	0.875	0.886	0.002	0.029	179.232	46.37	517.60	523.90	1.01	17.43	106,023
750	885		1000	0.090	0.872	1.636	0.002	0.039	178.698	79.33	772.06	1,447.46	1.51	34.61	158,148
1000	2000		9999	0.094	0.872	1.534	0.002	0.042	178.698	187.46	1,744.77	3,067.75	3.41	84.39	357,397
0	36	Other Material Ha	50	0.668	1.196	2.204	0.002	0.216	229.351	23.89	42.74	78.77	0.08	7.71	8,198
50	93		120	0.202	1.081	1.803	0.002	0.135	207.401	18.80	100.73	167.97	0.18	12.57	19,322
120	145		175	0.177	1.078	1.774	0.002	0.094	206.802	25.53	155.86	256.48	0.29	13.59	29,897
175	218		250	0.149	1.076	1.860	0.002	0.064	206.479	32.46	234.96	405.95	0.43	14.07	45,071
250	331		500	0.135	1.074	1.570	0.002	0.061	205.960	44.57	355.79	520.15	0.65	20.11	68,248
500	565		750	0.102	1.078	1.242	0.002	0.046	206.729	57.59	608.45	701.10	1.11	25.73	116,716
750	923		1000	0.027	1.078	0.908	0.002	0.007	206.729	24.91	994.72	838.36	1.82	6.88	190,811
1000	1050		9999	0.070	1.078	1.392	0.002	0.029	206.729	73.41	1,131.59	1,461.09	2.07	29.98	217,066
0	39	Pavers	50	0.752	1.429	2.258	0.002	0.224	242.604	29.06	55.20	87.23	0.09	8.66	9,371
50	80		120	0.272	1.274	2.365	0.002	0.182	216.215	21.63	101.37	188.19	0.16	14.46	17,207
120	158		175	0.169	1.282	1.808	0.002	0.089	217.541	26.74	202.66	285.95	0.33	14.07	34,401
175	213		250	0.091	1.283	1.582	0.002	0.041	217.800	19.31	273.57	337.33	0.44	8.83	46,438
250	327		500	0.073	1.263	1.033	0.002	0.036	214.409	23.87	413.53	338.18	0.67	11.89	70,193
500	750		750	0.082	1.280	1.024	0.002	0.045	217.241	61.79	959.87	767.75	1.56	33.92	162,931
0	35	Paving Equipmer	50	0.344	1.292	1.679	0.002	0.128	204.478	11.98	44.98	58.45	0.07	4.44	7,119
50	89		120	0.209	1.178	1.849	0.002	0.139	186.409	18.54	104.36	163.83	0.16	12.29	16,516
120	148		175	0.127	1.171	1.384	0.002	0.069	185.284	18.89	173.74	205.33	0.26	10.26	27,497
175	216		250	0.107	1.174	1.463	0.002	0.050	185.875	23.08	253.29	315.61	0.38	10.84	40,087
250	339		500	0.106	1.165	1.416	0.002	0.051	184.356	36.06	394.61	479.78	0.60	17.33	62,452
500	605		750	0.077	1.174	1.192	0.002	0.029	185.776	46.62	710.18	721.23	1.07	17.37	112,395
750	842		1000	0.087	1.175	1.652	0.002	0.041	185.931	73.46	989.20	1,390.69	1.50	34.65	156,554
0	8	Plate Compactor	15	0.284	1.492	1.781	0.004	0.070	244.369	2.28	11.94	14.25	0.03	0.56	1,955
0	13	Pressure Washer	15	0.211	1.081	1.465	0.003	0.077	170.490	2.75	14.05	19.05	0.03	1.00	2,216
15	19		25	0.228	0.772	1.426	0.002	0.072	170.490	4.34	14.66	27.09	0.04	1.36	3,239
25	38		50	0.240	1.105	1.338	0.002	0.077	170.490	9.11	42.01	50.84	0.08	2.91	6,479
50	64		120	0.140	0.989	1.217	0.002	0.074	170.490	8.98	63.31	77.91	0.13	4.76	10,911
0	8	Pumps	15	0.586	2.667	3.645	0.007	0.207	420.542	4.69	21.33	29.16	0.05	1.65	3,364
15	21		25	0.618	1.903	3.517	0.005	0.184	420.542	12.98	39.97	73.86	0.11	3.86	8,831
25	37		50	0.860	3.416	3.475	0.005	0.237	420.542	31.82	126.38	128.58	0.20	8.77	15,560
50	84		120	0.426	2.606	3.196	0.005	0.227	420.542	35.75	218.89	268.44	0.41	19.04	35,326
120	151		175	0.293	2.213	2.668	0.005	0.125	420.542	44.21	334.18	402.79	0.71	18.88	63,502
175	217		250	0.202	0.805	2.323	0.005	0.066	420.542	43.74	174.72	504.00	1.03	14.37	91,258
250	372		500	0.185	0.791	2.047	0.004	0.062	420.542	68.82	294.32	761.53	1.54	23.19	156,442
500	615		750	0.189	0.791	2.113	0.004	0.063	420.542	116.38	486.59	1,299.71	2.60	38.99	258,633
750	1460		9999	0.243	0.879	3.320	0.004	0.083	420.542	355.27	1,283.33	4,847.36	6.17	121.48	613,991
0	36	Rollers	50	0.470	1.180	1.913	0.002	0.163	218.562	16.78	42.10	68.24	0.07	5.83	7,798
50	87		120	0.228	1.063	2.030	0.002	0.147	196.955	19.78	92.36	176.36	0.16	12.78	17,108
120	144		175	0.123	1.059	1.453	0.002	0.068	196.072	17.72	152.20	208.98	0.27	9.73	28,191
175	213		250	0.108	1.062	1.471	0.002	0.049	196.778	22.96	226.56	313.72	0.40	10.35	41,963
250	335		500	0.117	1.075	1.441	0.002	0.056	199.192	39.03	360.13	482.54	0.64	18.86	66,704
500	521		750	0.028	1.061	0.261	0.002	0.003	196.512	14.58	552.23	135.72	0.98	1.77	102,285
0	47	Rough Terrain Fo	50	0.466	1.273	1.971	0.002	0.154	234.006	22.04	60.17	93.19	0.11	7.26	11,065
50	96		120	0.114	1.145	1.374	0.002	0.073	210.608	10.98	110.33	132.34	0.19	7.03	20,287
120	130		175	0.082	1.142	1.166	0.002	0.045	210.021	10.60	148.01	151.16	0.26	5.84	27,217
175	208		250	0.062	1.145	0.995	0.002	0.024	210.537	12.96	238.51	207.16	0.42	4.95	43,857
250	374		500	0.077	1.132	1.434	0.002	0.032	208.148	28.62	423.23	536.24	0.74	11.90	77,824
500	625		750	0.038	1.143	0.531	0.002	0.004	210.233	23.87	714.57	331.72	1.25	2.29	131,396
0	42	Rubber Tired Do	50	0.849	1.082	2.195	0.002	0.244	231.359	35.30	45.00	91.27	0.09	10.17	9,621
50	82		120	0.453	0.980	3.390	0.002	0.298	209.578	36.96	79.99	276.62	0.16	24.30	17,100
120	150		175	0.373	0.969	3.609	0.002	0.207	207.198	55.90	145.07	540.17	0.30	31.05	31,014
175	211		250	0.292	0.973	3.032	0.002	0.148	208.085	61.67	205.36	639.75	0.42	31.32	43,902
250	354		500	0.274	0.982	2.899	0.002	0.135	209.870	96.92	347.57	1,026.37	0.71	47.68	74,305
500	584		750	0.218	0.969	2.835	0.002	0.103	207.180	127.07	566.06	1,656.04	1.16	60.06	121,014
0	42	Rubber Tired Loa	50	0.741	0.988	2.154	0.002	0.229	210.210	30.89	41.20	89.82	0.08	9.55	8,765
50	86		120	0.287	0.878	2.256	0.002	0.192	186.770	24.69	75.64	194.35	0.15	16.51	16,090
120	150		175	0.197	0.888	1.880	0.002	0.105	188.858	29.62	133.17	281.94	0.27	15.71	28,328
175	206		250	0.141	0.885	1.720	0.002	0.059	188.325	29.06	182.29	354.21	0.37	12.07	38,777
250	320		500	0.140	0.879	1.539	0.002	0.058	186.930	44.70	280.94	491.93	0.57	18.54	59,760
500	600		750	0.139	0.865	1.465	0.002	0.058	183.927	83.48	519.21	879.98	1.05	34.74	110,444
750	837		1000	0.157	0.887	2.371	0.002	0.069	188.685	131.33	742.27	1,984.04	1.51	58.08	157,894
1000	1521		9999	0.093	0.884	1.614	0.002	0.039	188.123	141.29	1,345.15	2,454.88	2.73	58.66	286,135
0	36	Scrapers	50	1.669	1.260	3.275	0.003	0.445	279.274	60.32	45.54	118.36	0.10	16.09	10,094
50	84		120	0.380	1.168	3.463	0.002	0.266	258.777	32.08	98.45	292.05	0.21	22.41	21,822
120	166		175	0.318	1.154	3.218	0.002	0.173	255.850	52.79	191.81	534.71	0.41	28.81	42,513
175	225		250	0.317	1.130	3.569	0.002	0.160	250.378	71.21	254.14	802.96	0.54	36.10	56,328
250	381		500	0.215	1.139	2.576	0.002	0.103	252.370	81.84	434.21	982.27	0.92	39.42	96,241
500	565		750	0.164	1.139	2.034	0.002	0.075	252.489	92.66	643.56	1,149.13	1.36	42.46	142,644
750	950		1000	0.593	1.138	6.460	0.002	0.301	252.280	562.94	1,081.30	6,137.29	2.29	286.14	239,666
1000	1923		9999	0.275	1.163	3.631	0.002	0.140	257.796	528.87	2,236.99	6,983.96	4.73	268.74	495,821
0	6	Signal Boards	15	0.542	2.845	3.397	0.007	0.133	466.006	3.25	17.07	20.38	0.04	0.80	2,796
15	37		50	0.905	3.733	3.580	0.006	0.239	443.274	33.48	138.13	132.46	0.21	8.85	16,401
50	82		120	0.432	2.782	3.167	0.005	0.227	443.274	35.44	228.12	259.68	0.43	18.61	36,348
120	158		175	0.304	2.375	2.579	0.005	0.126	443.274	47.96	375.23	407.51	0.79	19.95	70,037
175	216		250	0.258	1.032	2.694	0.006	0.079	535.623	55.76	222.90	581.91	1.30	17.17	115,694
0	43	Skid Steer Loade	50	0.219	1.378	1.516	0.002	0.080	215.314	9.53	59.88	65.88	0.09	3.48	9,359
50	71		120	0.098	1.233	1.211	0.002	0.065	192.732	6.94	86.98	85.42	0.13	4.59	13,594
120	153		175	0.100	1.223	1.226	0.002	0.057	191.123	15.24	187.01	187.50	0.28	8.78	29,228
175	201		250	0.100	1.213	1.310	0.002	0.049	189.554	20.14	243.21	262.80	0.36	9.76	38,012
250	277		500	0.040	1.201	0.510	0.002	0.013	187.666	10.95	332.20	141.06	0.50	3.69	51,921
500	530		750	0.061	1.233	0.893	0.002	0.038	192.714	32.51	653.51	473.06	0.98	20.05	102,138
750	1000		1000	0.098	1.233	1.505	0.002	0.048	192.714	97.68	1,233.03	1,504.64	1.84	48.27	192,714
0	36	Surfacing Equipm	50	0.293	0.849	1.527	0.002	0.110	178.622	10.45	30.27	54.46	0.06	3.93	6,371
50	89		120	0.160	0.749	1.490	0.002	0.102	157.700	14.22	66.45	132.14	0.13	9.02	13,985
120	151		175	0.144	0.746	1.626	0.001	0.080	157.040	21.69	112.65	245.48	0.23	12.01	23,709
175	216		250	0.086	0.755	1.347	0.002	0.039	158.804	18.65	163.03	291.05	0.33	8.41	34,312
250	362		500	0.064	0.747	0.937	0.002	0.031	157.234	23.29	270.71	339.37	0.54	11.21	56,975
500	615		750	0.051	0.751	0.835	0.002	0.027	158.128	31.14	462.12	513.60	0.93	16.77	97,261
750	814		1000	0.096	0.752	1.744	0.002	0.043	158.252	78.44	612.27	1,420.49	1.23	35.15	128,862
1000	1141		9999	0.056	0.737	1.166	0.001	0.027	155.194	63.52	841.35	1,330.37	1.69	30.63	177,076
0	36	Sweepers/Scrubb	50	0.816	1.544	2.563	0.003	0.265	265.154	29.05	54.93	91.21	0.09	9.43	9,436
50	78		120	0.344	1.393	2.743	0.002	0.237	239.305	26.63	108.00	212.64	0.18	18.38	18,552
120	159		175	0.339	1.390	3.383	0.002	0.180	238.803	54.03	221.69	539.42	0.36	28.67	38,082
175	204		250	0.244	1.381	2.965	0.002	0.120	237.291	49.96	282.36	606.17	0.46	24.61	48,504
250	303		500	0.230	1.387	2.773	0.002	0.122	238.264	69.61	419.57	838.87	0.69	36.78	72,075
500	848		1000	0.096	1.387	1.882	0.002	0.051	238.264	81.45	1,176.17	1,596.21	1.93	43.00	202,048
0	38	Tractors/Loaders	50	0.461	0.987	1.883	0.002	0.160	210.756	17.64	37.81	72.12	0.08	6.11	8,073
50	83		120	0.193	0.911	1.772	0.002	0.133	194.460	15.95	75.27	146.46	0.15	11.01	16,072
120	144		175	0.136	0.895	1.429	0.002	0.073	191.025	19.63	128.76	205.73	0.26	10.46	27,495
175	204		250	0.112	0.900	1.489	0.002	0.049	192.159	22.94	183.78	304.07	0.37	9.92	39,242
250	320		500	0.105	0.900	1.286	0.002	0.045	192.263	33.58	288.25	411.71	0.59	14.39	61,551

		2017		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	**Equipment**	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2	**ROG**	**CO**	**NOX**	**SOX**	**PM**	**CO2**
500	575		750	0.114	0.893	1.423	0.002	0.051	190.654	65.68	513.05	817.76	1.05	29.52	109,553
750	871		1000	0.075	0.912	1.427	0.002	0.033	194.658	65.21	794.38	1,243.79	1.62	28.75	169,625
1000	2006		9999	0.107	0.904	1.709	0.002	0.048	193.002	214.94	1,812.80	3,427.42	3.70	97.01	387,090
0	40	Trenchers	50	0.604	1.636	2.596	0.003	0.226	294.003	24.04	65.07	103.26	0.11	8.97	11,695
50	82		120	0.401	1.473	3.356	0.003	0.263	264.749	32.86	120.87	275.39	0.21	21.57	21,724
120	144		175	0.282	1.449	2.978	0.002	0.151	260.410	40.58	208.45	428.51	0.36	21.71	37,465
175	218		250	0.255	1.465	3.113	0.003	0.126	263.292	55.79	319.97	679.87	0.55	27.45	57,509
250	359		500	0.140	1.458	1.729	0.003	0.065	262.127	50.03	522.88	620.02	0.90	23.22	93,977
500	619		750	0.060	1.471	0.718	0.003	0.023	264.323	37.07	910.70	444.85	1.56	14.23	163,682
750	860		1000	0.602	1.462	6.635	0.003	0.303	262.792	517.60	1,257.44	5,705.74	2.16	260.95	226,001
0	11	Welders	15	0.356	1.622	2.216	0.004	0.126	255.735	3.92	17.84	24.38	0.04	1.38	2,813
15	20		25	0.376	1.157	2.139	0.003	0.112	255.735	7.52	23.15	42.77	0.06	2.24	5,115
25	46		50	0.651	2.422	2.204	0.003	0.168	255.735	29.95	111.43	101.38	0.15	7.71	11,764
50	70		120	0.299	1.670	2.036	0.003	0.159	255.735	20.93	116.91	142.53	0.21	11.13	17,901
120	174		175	0.210	1.417	1.700	0.003	0.088	255.735	36.50	246.54	295.79	0.50	15.28	44,498
175	211		250	0.147	0.515	1.483	0.003	0.045	255.735	30.95	108.65	312.90	0.61	9.48	53,960
250	297		500	0.137	0.500	1.293	0.003	0.042	255.735	40.76	148.52	384.05	0.75	12.52	75,953
0	29	Water Trucks	50	0.574	0.654	2.114	0.002	0.202	215.970	16.726	19.054	61.589	0.060	5.884	6293.442
50	87		120	0.232	0.596	1.829	0.002	0.145	196.923	20.230	51.908	159.253	0.164	12.648	17144.580
120	159		175	0.176	0.602	1.618	0.002	0.089	198.777	28.026	95.624	257.069	0.302	14.162	31583.527
175	211		250	0.167	0.600	1.668	0.002	0.072	198.324	35.187	126.705	351.991	0.400	15.209	41849.455
250	372		500	0.130	0.609	1.401	0.002	0.052	200.987	48.418	226.623	521.744	0.715	19.368	74851.114
500	656		750	0.157	0.607	1.626	0.002	0.065	200.491	103.211	398.152	1066.246	1.256	42.629	131505.380
750	897		1000	0.145	0.603	2.159	0.002	0.061	199.255	129.838	541.275	1936.855	1.707	54.503	178777.420
1000	1764		9999	0.149	0.609	1.970	0.002	0.058	201.280	263.245	1075.105	3474.591	3.391	103.144	355096.192

2018

		2018		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	Equipment	MaxHP	ROG	CO	NOX	SOX	PM	CO2	ROG	CO	NOX	SOX	PM	CO2
0	46	Aerial Lifts	50	0.059	0.866	0.989	0.002	0.017	179.282	2.70	39.91	45.62	0.08	0.77	8,267
50	74		120	0.039	0.778	0.636	0.002	0.018	161.199	2.91	57.61	47.08	0.11	1.30	11,932
120	130		175	0.030	0.778	0.302	0.002	0.010	161.168	3.87	101.52	39.37	0.20	1.27	21,028
175	210		250	0.356	0.778	3.662	0.002	0.190	161.179	74.67	163.42	769.12	0.32	39.94	33,848
250	380		500	0.020	0.778	0.195	0.002	0.003	161.179	7.63	295.70	74.21	0.58	1.03	61,248
0	12	Air Compressors	15	0.372	1.722	2.311	0.004	0.127	272.784	4.46	20.66	27.73	0.05	1.53	3,273
15	24		25	0.392	1.221	2.252	0.003	0.115	272.784	9.41	29.30	54.04	0.08	2.76	6,547
25	37		50	0.675	2.719	2.349	0.004	0.173	272.784	24.97	100.59	86.91	0.13	6.42	10,093
50	78		120	0.312	1.825	2.073	0.003	0.160	272.784	24.37	142.32	161.73	0.25	12.52	21,277
120	147		175	0.226	1.558	1.690	0.003	0.089	272.784	33.17	229.02	248.40	0.45	13.16	40,099
175	218		250	0.166	0.558	1.466	0.003	0.046	272.784	36.14	121.71	319.49	0.67	10.05	59,467
250	385		500	0.158	0.535	1.288	0.003	0.044	272.784	61.01	206.15	496.05	1.03	16.86	105,022
500	595		750	0.159	0.535	1.325	0.003	0.044	272.784	94.78	318.60	788.26	1.63	26.43	162,306
750	808		1000	0.177	0.591	2.177	0.003	0.058	272.784	143.02	477.35	1,759.13	2.22	47.01	220,409
0	39	Bore/Drill Rigs	50	0.403	1.193	2.447	0.003	0.166	296.975	15.84	46.86	96.09	0.11	6.50	11,663
50	82		120	0.141	1.033	1.708	0.002	0.093	257.036	11.65	85.02	140.65	0.20	7.63	21,162
120	149		175	0.107	1.066	1.184	0.003	0.052	265.289	15.87	158.31	175.90	0.38	7.72	39,405
175	208		250	0.081	1.043	1.082	0.002	0.031	259.656	16.89	216.72	224.77	0.52	6.35	53,944
250	349		500	0.071	1.046	0.877	0.002	0.026	260.261	24.77	365.10	306.29	0.87	9.17	90,879
500	612		750	0.066	1.054	0.844	0.003	0.027	262.426	40.55	645.18	516.23	1.53	16.75	160,595
750	919		1000	0.066	1.055	1.523	0.003	0.030	262.701	60.53	969.90	1,399.95	2.31	27.90	241,422
1000	2667		9999	0.101	1.056	2.160	0.003	0.054	262.792	268.09	2,815.34	5,760.59	6.69	144.07	700,778
0	9	Cement and Mortar Mixers	15	0.370	1.943	2.320	0.005	0.092	318.248	3.33	17.49	20.88	0.04	0.82	2,864
15	25		25	0.420	1.366	2.522	0.004	0.115	318.248	10.49	34.16	63.06	0.10	2.88	7,956
0	18	Concrete/Industrial Saws	25	0.500	1.708	3.163	0.005	0.118	414.859	9.01	30.75	56.93	0.09	2.13	7,467
25	33		50	0.755	3.479	3.279	0.005	0.203	414.859	24.90	114.82	108.20	0.18	6.69	13,690
50	81		120	0.364	2.608	2.740	0.005	0.188	414.859	29.49	211.21	221.95	0.39	15.20	33,604
120	175		175	0.262	2.243	2.150	0.005	0.106	414.859	45.90	392.50	376.33	0.82	18.61	72,600
0	41	Cranes	50	0.625	0.826	1.730	0.002	0.180	165.325	25.39	33.54	70.28	0.06	7.30	6,717
50	89		120	0.281	0.749	2.285	0.001	0.168	149.962	24.99	66.61	203.23	0.13	14.94	13,338
120	148		175	0.187	0.756	1.889	0.001	0.101	151.476	27.70	111.86	279.37	0.21	14.96	22,401
175	217		250	0.146	0.754	1.663	0.001	0.072	150.973	31.61	163.60	360.91	0.31	15.62	32,761
250	336		500	0.111	0.753	1.335	0.001	0.054	150.814	37.47	253.13	448.75	0.48	18.11	50,690
500	567		750	0.082	0.750	1.086	0.001	0.039	150.250	46.28	425.56	615.85	0.81	22.36	85,220
750	938		1000	0.277	0.748	2.980	0.001	0.146	149.761	259.69	701.19	2,794.45	1.34	136.86	140,416
1000	1030		9999	0.049	0.752	0.673	0.001	0.017	150.667	50.40	774.95	693.03	1.48	17.35	155,187
0	43	Crawler Tractors	50	1.097	1.328	2.643	0.002	0.302	245.159	46.65	56.47	112.35	0.10	12.83	10,422
50	87		120	0.358	1.226	2.883	0.002	0.243	226.311	31.10	106.51	250.38	0.19	21.07	19,657
120	150		175	0.249	1.214	2.512	0.002	0.140	224.061	37.24	181.56	375.69	0.32	20.87	33,507
175	203		250	0.179	1.218	2.268	0.002	0.086	224.795	36.26	247.08	460.09	0.44	17.41	45,599
250	341		500	0.154	1.223	1.875	0.002	0.073	225.666	52.59	416.59	638.88	0.73	24.75	76,883
500	570		750	0.133	1.217	1.644	0.002	0.061	224.639	75.65	693.95	937.18	1.22	34.58	128,070
750	828		1000	0.219	1.224	3.243	0.002	0.096	225.938	181.71	1,013.88	2,685.99	1.79	79.85	187,114
1000	1527		9999	0.159	1.168	2.632	0.002	0.071	215.490	242.73	1,782.39	4,018.42	3.14	108.42	328,945
0	45	Crushing/Proc. Equipment	50	0.956	4.260	3.632	0.006	0.242	443.274	43.03	191.69	163.44	0.26	10.91	19,947
50	85		120	0.453	2.936	3.028	0.005	0.222	443.274	38.51	249.52	257.34	0.44	18.87	37,678
120	171		175	0.333	2.523	2.378	0.005	0.126	443.274	57.01	431.40	406.72	0.85	21.53	75,800
175	250		250	0.251	0.894	2.045	0.005	0.065	443.274	62.77	223.48	511.36	1.25	16.28	110,818
250	382		500	0.242	0.858	1.803	0.004	0.062	443.274	92.28	327.66	688.84	1.66	23.71	169,331
500	602		750	0.241	0.856	1.839	0.004	0.062	443.274	144.81	515.33	1,107.37	2.68	37.37	266,851
750	1337		9999	0.282	0.935	3.252	0.004	0.084	443.274	377.13	1,250.27	4,347.38	5.96	111.93	592,657
0	16	Dumpers/Tenders	25	0.261	0.889	1.653	0.003	0.064	215.954	4.18	14.23	26.45	0.04	1.03	3,455
0	36	Excavators	50	0.275	1.081	1.679	0.002	0.109	222.094	9.82	38.64	59.99	0.08	3.88	7,937
50	82		120	0.147	0.964	1.437	0.002	0.096	197.948	12.03	78.81	117.54	0.15	7.82	16,188
120	146		175	0.109	0.973	1.117	0.002	0.054	199.828	15.94	142.08	163.06	0.28	7.91	29,183
175	218		250	0.081	0.972	0.991	0.002	0.030	199.658	17.63	212.36	216.41	0.42	6.58	43,620
250	329		500	0.070	0.970	0.783	0.002	0.025	199.188	22.94	318.70	257.35	0.63	8.34	65,462
500	578		750	0.075	0.967	0.865	0.002	0.029	198.598	43.63	558.80	500.07	1.10	16.76	114,778
750	843		1000	0.069	0.962	1.436	0.002	0.029	197.497	58.28	810.44	1,210.01	1.59	24.85	166,466
1000	1569		9999	0.058	0.963	1.175	0.002	0.022	197.811	90.28	1,511.16	1,843.44	2.96	34.47	310,393
0	42	Forklifts	50	0.293	0.638	1.015	0.001	0.090	117.014	12.43	27.04	43.06	0.05	3.81	4,963
50	82		120	0.119	0.572	1.008	0.001	0.080	105.000	9.83	47.13	83.03	0.08	6.63	8,649
120	141		175	0.090	0.573	0.890	0.001	0.048	105.128	12.70	80.94	125.80	0.14	6.85	14,853
175	208		250	0.089	0.574	0.992	0.001	0.042	105.400	18.62	119.55	206.58	0.21	8.67	21,939
250	344		500	0.059	0.575	0.607	0.001	0.025	105.464	20.39	197.53	208.55	0.35	8.60	36,250
500	880		1000	0.327	0.573	3.140	0.001	0.175	105.117	288.17	504.07	2,762.92	0.88	154.30	92,503
0	11	Generator Sets	15	0.509	2.655	3.536	0.007	0.181	420.542	5.60	29.20	38.89	0.07	1.99	4,626
15	19		25	0.554	1.882	3.471	0.005	0.170	420.542	10.52	35.77	65.95	0.10	3.24	7,990
25	33		50	0.714	3.185	3.347	0.005	0.206	420.542	23.57	105.10	110.46	0.18	6.79	13,878
50	84		120	0.368	2.552	2.954	0.005	0.194	420.542	30.87	214.40	248.14	0.41	16.32	35,326
120	153		175	0.254	2.182	2.411	0.005	0.108	420.542	38.85	333.81	368.81	0.72	16.50	64,343
175	229		250	0.179	0.783	2.084	0.005	0.058	420.542	41.05	179.34	477.17	1.08	13.38	96,304
250	363		500	0.166	0.767	1.860	0.004	0.056	420.542	60.42	278.50	675.07	1.50	20.24	152,657
500	586		750	0.170	0.767	1.910	0.004	0.056	420.542	99.52	449.59	1,119.05	2.48	33.10	246,437
750	1130		9999	0.223	0.846	3.140	0.004	0.076	420.542	251.86	955.95	3,548.04	4.78	86.27	475,212
0	39	Graders	50	1.201	1.158	2.526	0.002	0.323	223.107	47.05	45.34	98.91	0.08	12.64	8,737
50	91		120	0.460	1.103	3.482	0.002	0.285	212.554	41.85	100.36	316.85	0.18	25.92	19,342
120	148		175	0.283	1.125	2.699	0.002	0.152	216.773	41.85	166.42	399.36	0.31	22.45	32,071
175	204		250	0.164	1.120	2.154	0.002	0.070	215.925	33.59	228.96	440.22	0.42	14.31	44,125
250	293		500	0.139	1.109	1.367	0.002	0.053	213.809	40.66	325.26	400.75	0.60	15.51	62,682
500	796		1000	0.303	1.109	3.798	0.002	0.132	213.737	241.58	882.83	3,023.02	1.62	105.21	170,135
1000	1993		9999	0.200	1.107	2.716	0.002	0.084	213.348	397.82	2,206.16	5,411.58	4.06	166.50	425,161
0	38	Off-Highway Tractors	50	0.538	1.303	2.156	0.002	0.179	253.214	20.28	49.06	81.21	0.09	6.72	9,536
50	75		120	0.238	1.177	2.085	0.002	0.162	228.895	17.73	87.76	155.38	0.16	12.10	17,059
120	158		175	0.144	1.174	1.523	0.002	0.076	228.171	22.69	185.54	240.79	0.34	12.09	36,068
175	214		250	0.124	1.167	1.504	0.002	0.052	226.947	26.48	249.65	321.68	0.46	11.04	48,531
250	334		500	0.084	1.166	0.929	0.002	0.032	226.662	28.21	389.95	310.72	0.72	10.62	75,804
500	574		750	0.089	1.171	0.943	0.002	0.035	227.646	51.11	671.64	540.91	1.25	20.12	130,563
750	1000		1000	0.059	1.172	1.027	0.002	0.026	227.753	58.83	1,171.61	1,027.23	2.17	26.22	227,753
1000	1726		9999	0.107	1.200	1.650	0.002	0.043	233.363	184.89	2,072.31	2,848.83	3.85	73.82	402,843
0	29	Off-Highway Trucks	50	0.445	0.659	1.954	0.002	0.162	217.804	12.95	19.22	56.93	0.06	4.72	6,347
50	87		120	0.228	0.596	1.778	0.002	0.140	196.753	19.88	51.86	154.83	0.16	12.16	17,130
120	159		175	0.153	0.602	1.353	0.002	0.073	198.757	24.35	95.61	214.97	0.30	11.66	31,580
175	211		250	0.136	0.601	1.318	0.002	0.054	198.591	28.73	126.88	278.08	0.40	11.38	41,906
250	372		500	0.115	0.609	1.180	0.002	0.043	200.982	42.73	226.62	439.47	0.71	16.04	74,849
500	656		750	0.139	0.607	1.409	0.002	0.055	200.415	91.19	398.00	924.46	1.26	35.84	131,455
750	897		1000	0.119	0.601	1.855	0.002	0.048	198.654	106.37	539.64	1,664.44	1.70	43.33	178,238
1000	1764		9999	0.124	0.611	1.683	0.002	0.046	201.845	219.07	1,078.12	2,968.46	3.40	80.73	356,092
0	38	Other Construction Equipment	50	0.508	1.337	2.190	0.002	0.187	243.167	19.31	50.81	83.23	0.09	7.09	9,242
50	82		120	0.260	1.193	2.260	0.002	0.173	217.066	21.19	97.33	184.35	0.17	14.12	17,704
120	152		175	0.190	1.188	1.975	0.002	0.104	216.166	28.93	181.22	301.20	0.31	15.85	32,963
175	217		250	0.134	1.202	1.717	0.002	0.062	218.670	29.04	260.75	372.51	0.45	13.48	47,430
250	357		500	0.109	1.201	1.316	0.002	0.048	218.547	38.93	428.76	469.47	0.74	16.99	77,991
500	598		750	0.095	1.197	1.249	0.002	0.041	217.818	56.76	715.69	746.70	1.24	24.55	130,184
750	830		1000	0.081	1.190	1.592	0.002	0.038	216.515	66.96	988.13	1,321.83	1.72	31.52	179,741
1000	1127		9999	0.117	1.167	1.867	0.002	0.050	212.268	132.35	1,314.76	2,103.15	2.28	56.56	239,155
0	35	Other General Industrial Equipm	50	0.413	0.972	1.701	0.002	0.141	199.186	14.49	34.13	59.71	0.07	4.96	6,992
50	73		120	0.199	0.869	1.693	0.002	0.134	177.921	14.59	63.57	123.91	0.12	9.80	13,022
120	149		175	0.114	0.872	1.106	0.002	0.059	178.621	16.94	130.06	164.96	0.25	8.77	26,642
175	209		250	0.108	0.875	1.247	0.002	0.046	179.141	22.66	182.83	260.61	0.36	9.63	37,451

		2018		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	Equipment	MaxHP	ROG	CO	NOX	SOX	PM	CO2	ROG	CO	NOX	SOX	PM	CO2
250	355		500	0.091	0.874	0.993	0.002	0.035	179.029	32.16	310.02	352.39	0.61	12.56	63,504
500	592		750	0.077	0.875	0.827	0.002	0.028	179.232	45.79	517.60	489.02	1.01	16.70	106,023
750	885		1000	0.092	0.872	1.644	0.002	0.040	178.698	81.44	772.06	1,454.59	1.51	35.03	158,148
1000	2000		9999	0.099	0.872	1.548	0.002	0.043	178.698	198.72	1,744.77	3,096.60	3.41	86.82	357,397
0	36	Other Material Handling Equipm	50	0.533	1.196	2.049	0.002	0.181	229.351	19.07	42.74	73.23	0.08	6.45	8,198
50	93		120	0.168	1.081	1.559	0.002	0.107	207.401	15.69	100.73	145.23	0.18	9.99	19,322
120	145		175	0.135	1.078	1.317	0.002	0.068	206.802	19.53	155.86	190.43	0.29	9.86	29,897
175	218		250	0.131	1.076	1.618	0.002	0.053	206.479	28.55	234.96	353.08	0.43	11.65	45,071
250	331		500	0.122	1.074	1.393	0.002	0.053	205.960	40.57	355.79	461.66	0.65	17.49	68,248
500	565		750	0.096	1.078	1.039	0.002	0.041	206.729	54.02	608.45	586.46	1.11	22.97	116,716
750	923		1000	0.030	1.078	0.916	0.002	0.008	206.729	27.67	994.72	845.71	1.82	7.10	190,811
1000	1050		9999	0.074	1.078	1.404	0.002	0.029	206.729	77.96	1,131.59	1,474.09	2.07	30.81	217,066
0	39	Pavers	50	0.669	1.428	2.127	0.002	0.199	242.343	25.84	55.14	82.17	0.09	7.67	9,360
50	80		120	0.233	1.274	2.085	0.002	0.156	216.253	18.53	101.39	165.93	0.16	12.40	17,210
120	158		175	0.147	1.282	1.557	0.002	0.076	217.644	23.29	202.76	246.15	0.33	12.03	34,417
175	213		250	0.086	1.283	1.443	0.002	0.038	217.742	18.37	273.50	307.72	0.44	8.17	46,425
250	327		500	0.071	1.264	0.964	0.002	0.034	214.524	23.39	413.75	315.51	0.67	11.23	70,231
500	750		750	0.086	1.280	1.028	0.002	0.046	217.241	64.15	959.87	770.87	1.56	34.38	162,931
0	35	Paving Equipment	50	0.274	1.294	1.531	0.002	0.102	204.715	9.54	45.04	53.32	0.07	3.54	7,128
50	89		120	0.167	1.177	1.516	0.002	0.107	186.352	14.80	104.32	134.35	0.16	9.51	16,511
120	148		175	0.105	1.171	1.126	0.002	0.055	185.248	15.65	173.71	167.17	0.26	8.18	27,492
175	216		250	0.096	1.174	1.274	0.002	0.044	185.809	20.70	253.20	274.67	0.38	9.41	40,073
250	339		500	0.089	1.165	1.134	0.002	0.041	184.391	30.16	394.68	384.17	0.60	13.95	62,464
500	605		750	0.079	1.174	1.197	0.002	0.029	185.779	48.09	710.19	724.37	1.07	17.62	112,396
750	842		1000	0.029	1.175	0.814	0.002	0.013	185.931	24.39	989.20	685.38	1.50	10.77	156,554
0	8	Plate Compactors	15	0.284	1.492	1.781	0.004	0.070	244.369	2.28	11.94	14.25	0.03	0.56	1,955
0	13	Pressure Washers	15	0.206	1.076	1.433	0.003	0.073	170.490	2.68	13.99	18.63	0.03	0.95	2,216
15	19		25	0.225	0.763	1.407	0.002	0.069	170.490	4.27	14.50	26.74	0.04	1.31	3,239
25	38		50	0.213	1.084	1.303	0.002	0.070	170.490	8.11	41.18	49.53	0.08	2.65	6,479
50	64		120	0.125	0.984	1.143	0.002	0.067	170.490	8.02	62.96	73.13	0.13	4.27	10,911
0	8	Pumps	15	0.573	2.655	3.563	0.007	0.196	420.542	4.59	21.24	28.50	0.05	1.57	3,364
15	21		25	0.604	1.882	3.471	0.005	0.177	420.542	12.69	39.53	72.90	0.11	3.72	8,831
25	37		50	0.777	3.357	3.392	0.005	0.217	420.542	28.76	124.20	125.49	0.20	8.03	15,560
50	84		120	0.387	2.595	2.999	0.005	0.204	420.542	32.52	217.95	251.96	0.41	17.16	35,326
120	151		175	0.269	2.217	2.449	0.005	0.113	420.542	40.69	334.77	369.72	0.71	17.13	63,502
175	217		250	0.191	0.797	2.118	0.005	0.061	420.542	41.55	172.85	459.66	1.03	13.21	91,258
250	372		500	0.179	0.777	1.884	0.004	0.058	420.542	66.44	289.21	700.93	1.54	21.57	156,442
500	615		750	0.182	0.777	1.935	0.004	0.059	420.542	111.69	478.13	1,190.15	2.60	36.13	258,633
750	1460		9999	0.233	0.858	3.178	0.004	0.078	420.542	339.85	1,252.81	4,640.01	6.17	114.45	613,991
0	36	Rollers	50	0.418	1.180	1.817	0.002	0.145	218.575	14.91	42.10	64.81	0.07	5.18	7,798
50	87		120	0.189	1.063	1.745	0.002	0.120	196.938	16.41	92.36	151.56	0.16	10.43	17,106
120	144		175	0.104	1.059	1.194	0.002	0.055	196.125	14.97	152.24	171.62	0.27	7.94	28,199
175	213		250	0.083	1.062	1.124	0.002	0.035	196.719	17.69	226.49	239.63	0.40	7.50	41,950
250	335		500	0.096	1.076	1.162	0.002	0.045	199.252	32.19	360.24	389.27	0.64	14.96	66,725
500	521		750	0.030	1.061	0.262	0.002	0.003	196.512	15.45	552.23	136.31	0.98	1.79	102,285
0	47	Rough Terrain Forklifts	50	0.450	1.273	1.903	0.002	0.144	234.007	21.28	60.17	90.00	0.11	6.81	11,065
50	96		120	0.093	1.145	1.144	0.002	0.055	210.576	9.00	110.31	110.17	0.19	5.27	20,284
120	130		175	0.069	1.142	0.941	0.002	0.035	210.051	8.92	148.03	121.99	0.26	4.56	27,221
175	208		250	0.064	1.145	1.000	0.002	0.024	210.528	13.33	238.50	208.30	0.42	5.01	43,855
250	374		500	0.061	1.133	1.086	0.002	0.024	208.322	22.84	423.59	405.91	0.74	9.00	77,889
500	625		750	0.040	1.143	0.532	0.002	0.004	210.233	24.89	714.57	332.74	1.25	2.31	131,396
0	42	Rubber Tired Dozers	50	0.496	1.072	1.758	0.002	0.148	229.159	20.64	44.58	73.10	0.09	6.14	9,530
50	82		120	0.418	0.979	3.139	0.002	0.273	209.366	34.09	79.90	256.08	0.16	22.23	17,082
120	150		175	0.332	0.969	3.171	0.002	0.182	207.185	49.68	145.06	474.59	0.30	27.25	31,012
175	211		250	0.277	0.973	2.849	0.002	0.139	208.087	58.41	205.36	601.14	0.42	29.22	43,902
250	354		500	0.247	0.982	2.570	0.002	0.119	210.007	87.60	347.80	909.98	0.71	42.02	74,353
500	584		750	0.210	0.969	2.659	0.002	0.098	207.176	122.38	566.05	1,553.12	1.16	57.27	121,012
0	42	Rubber Tired Loaders	50	0.668	0.989	2.055	0.002	0.208	210.291	27.87	41.22	85.67	0.08	8.69	8,768
50	86		120	0.248	0.878	1.979	0.002	0.163	186.772	21.38	75.64	170.50	0.15	14.08	16,090
120	150		175	0.170	0.888	1.580	0.002	0.088	188.862	25.45	133.18	237.05	0.27	13.15	28,329
175	206		250	0.126	0.885	1.495	0.002	0.051	188.242	26.00	182.21	307.77	0.37	10.44	38,760
250	320		500	0.126	0.879	1.348	0.002	0.050	186.956	40.41	280.97	430.97	0.57	16.14	59,768
500	600		750	0.125	0.864	1.282	0.002	0.051	183.868	75.18	519.04	769.88	1.05	30.41	110,409
750	837		1000	0.127	0.886	2.053	0.002	0.056	188.435	106.43	741.29	1,717.60	1.51	46.66	157,685
1000	1521		9999	0.078	0.884	1.476	0.002	0.032	187.956	118.56	1,343.95	2,245.45	2.73	48.82	285,882
0	36	Scrapers	50	1.686	1.260	3.285	0.003	0.449	279.274	60.94	45.54	118.72	0.10	16.23	10,094
50	84		120	0.374	1.167	3.394	0.002	0.262	258.667	31.52	98.41	286.21	0.21	22.07	21,813
120	166		175	0.272	1.154	2.721	0.002	0.146	255.844	45.18	191.80	452.17	0.41	24.28	42,512
175	225		250	0.281	1.130	3.166	0.002	0.140	250.520	63.22	254.28	712.27	0.54	31.48	56,360
250	381		500	0.186	1.139	2.203	0.002	0.087	252.466	71.07	434.37	840.29	0.92	33.12	96,278
500	565		750	0.148	1.139	1.807	0.002	0.065	252.365	83.79	643.25	1,020.86	1.36	36.79	142,574
750	950		1000	0.593	1.138	6.460	0.002	0.301	252.280	562.94	1,081.30	6,137.29	2.29	286.14	239,666
1000	1923		9999	0.281	1.163	3.666	0.002	0.142	257.796	540.23	2,236.99	7,051.51	4.73	273.60	495,821
0	6	Signal Boards	15	0.542	2.845	3.397	0.007	0.133	466.006	3.25	17.07	20.38	0.04	0.80	2,796
15	37		50	0.795	3.633	3.453	0.006	0.211	443.274	29.41	134.42	127.76	0.21	7.81	16,401
50	82		120	0.385	2.763	2.904	0.005	0.197	443.274	31.53	226.53	238.16	0.43	16.16	36,348
120	158		175	0.274	2.374	2.285	0.005	0.111	443.274	43.28	375.05	361.07	0.79	17.47	70,037
175	216		250	0.241	1.019	2.372	0.006	0.071	535.623	52.14	220.07	512.33	1.30	15.27	115,695
0	43	Skid Steer Loaders	50	0.188	1.377	1.433	0.002	0.066	215.170	8.17	59.84	62.31	0.09	2.86	9,353
50	71		120	0.083	1.232	1.054	0.002	0.052	192.589	5.87	86.92	74.34	0.13	3.63	13,584
120	153		175	0.074	1.220	0.935	0.002	0.043	190.661	11.31	186.55	143.01	0.28	6.59	29,157
175	201		250	0.044	1.204	0.632	0.002	0.018	188.182	8.77	241.45	126.83	0.36	3.57	37,737
250	277		500	0.025	1.201	0.221	0.002	0.003	187.666	6.94	332.20	61.10	0.50	0.89	51,921
500	530		750	0.063	1.233	0.895	0.002	0.038	192.714	33.45	653.51	474.30	0.98	20.23	102,138
750	1000		1000	0.102	1.233	1.540	0.002	0.050	192.714	102.16	1,233.03	1,540.49	1.84	49.80	192,714
0	36	Surfacing Equipment	50	0.246	0.849	1.453	0.002	0.096	178.678	8.77	30.28	51.83	0.06	3.44	6,373
50	89		120	0.131	0.751	1.292	0.002	0.081	157.966	11.59	66.56	114.54	0.13	7.18	14,008
120	151		175	0.118	0.746	1.349	0.001	0.065	157.041	17.87	112.65	203.71	0.23	9.79	23,709
175	216		250	0.076	0.755	1.203	0.002	0.034	158.873	16.43	163.10	259.83	0.33	7.34	34,327
250	362		500	0.050	0.745	0.664	0.001	0.023	156.858	18.00	270.06	240.78	0.54	8.31	56,839
500	615		750	0.045	0.747	0.684	0.002	0.024	157.176	27.65	459.34	420.71	0.92	14.51	96,675
750	814		1000	0.097	0.752	1.749	0.002	0.043	158.257	79.06	612.29	1,424.30	1.23	35.39	128,866
1000	1141		9999	0.057	0.737	1.170	0.001	0.027	155.194	65.09	841.35	1,334.42	1.69	30.94	177,076
0	36	Sweepers/Scrubbers	50	0.737	1.544	2.460	0.003	0.242	265.154	26.22	54.93	87.53	0.09	8.60	9,436
50	78		120	0.286	1.393	2.340	0.002	0.195	239.305	22.16	108.00	181.41	0.18	15.13	18,552
120	159		175	0.281	1.390	2.766	0.002	0.146	238.803	44.78	221.69	441.09	0.36	23.23	38,082
175	204		250	0.167	1.381	1.960	0.002	0.077	237.291	34.06	282.36	400.60	0.46	15.75	48,504
250	303		500	0.234	1.387	2.778	0.002	0.122	238.264	70.67	419.57	840.27	0.69	36.98	72,075
500	848		1000	0.103	1.387	1.897	0.002	0.052	238.264	87.22	1,176.17	1,608.94	1.93	44.13	202,048
0	38	Tractors/Loaders/Backhoes	50	0.383	0.987	1.756	0.002	0.134	210.672	14.66	37.79	67.25	0.08	5.12	8,070
50	83		120	0.162	0.909	1.531	0.002	0.108	194.172	13.40	75.16	126.53	0.15	8.96	16,048
120	144		175	0.115	0.894	1.167	0.002	0.059	190.892	16.49	128.67	168.03	0.26	8.46	27,476
175	204		250	0.100	0.901	1.275	0.002	0.041	192.338	20.39	183.95	260.35	0.38	8.40	39,279
250	320		500	0.086	0.895	0.983	0.002	0.034	191.096	27.44	286.50	314.84	0.58	10.87	61,177
500	575		750	0.105	0.893	1.254	0.002	0.046	190.591	60.10	512.89	720.44	1.05	26.31	109,517
750	871		1000	0.070	0.911	1.425	0.002	0.030	194.632	60.67	794.27	1,241.98	1.62	26.13	169,602
1000	2006		9999	0.083	0.904	1.458	0.002	0.035	193.002	167.23	1,812.80	2,923.39	3.70	70.03	387,090
0	40	Trenchers	50	0.546	1.635	2.492	0.003	0.206	293.844	21.73	65.03	99.14	0.11	8.18	11,688
50	82		120	0.346	1.472	2.972	0.003	0.226	264.562	28.40	120.79	243.91	0.21	18.55	21,709
120	144		175	0.247	1.449	2.577	0.002	0.131	260.387	35.59	208.43	370.69	0.36	18.89	37,462
175	218		250	0.220	1.466	2.661	0.003	0.106	263.409	48.13	320.11	581.22	0.55	23.25	57,534
250	359		500	0.135	1.460	1.614	0.003	0.061	262.372	48.27	523.36	578.50	0.90	21.84	94,065
500	619		750	0.049	1.475	0.515	0.003	0.014	265.059	30.61	913.24	319.02	1.57	8.91	164,138
750	860		1000	0.604	1.462	6.650	0.003	0.305	262.792	519.77	1,257.44	5,719.12	2.16	262.41	226,001

		2018		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	**Equipment**	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2	**ROG**	**CO**	**NOX**	**SOX**	**PM**	**CO2**
0	11	Welders	15	0.349	1.614	2.167	0.004	0.119	255.735	3.83	17.76	23.83	0.04	1.31	2,813
15	20		25	0.367	1.145	2.111	0.003	0.108	255.735	7.35	22.89	42.22	0.06	2.15	5,115
25	46		50	0.589	2.380	2.153	0.003	0.154	255.735	27.08	109.48	99.05	0.15	7.06	11,764
50	70		120	0.274	1.664	1.909	0.003	0.143	255.735	19.20	116.49	133.64	0.21	10.03	17,901
120	174		175	0.195	1.421	1.558	0.003	0.080	255.735	33.97	247.18	271.17	0.50	13.86	44,498
175	211		250	0.141	0.510	1.351	0.003	0.041	255.735	29.78	107.57	285.03	0.61	8.72	53,960
250	297		500	0.134	0.492	1.190	0.003	0.039	255.735	39.75	146.06	353.48	0.75	11.66	75,953
0	29	Water Trucks	50	0.445	0.659	1.954	0.002	0.162	217.804	12.953	19.216	56.932	0.061	4.724	6346.876
50	87		120	0.228	0.596	1.778	0.002	0.140	196.753	19.885	51.863	154.830	0.164	12.161	17129.788
120	159		175	0.153	0.602	1.353	0.002	0.073	198.757	24.351	95.614	214.972	0.302	11.664	31580.306
175	211		250	0.136	0.601	1.318	0.002	0.054	198.591	28.735	126.876	278.081	0.400	11.384	41905.682
250	372		500	0.115	0.609	1.180	0.002	0.043	200.982	42.726	226.616	439.472	0.715	16.041	74849.068
500	656		750	0.139	0.607	1.409	0.002	0.055	200.415	91.190	398.000	924.461	1.255	35.836	131455.371
750	897		1000	0.119	0.601	1.855	0.002	0.048	198.654	106.373	539.642	1664.443	1.702	43.330	178238.088
1000	1764		9999	0.124	0.611	1.683	0.002	0.046	201.845	219.074	1078.121	2968.459	3.400	80.726	356092.389

2019

		2019		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	Equipment	MaxHP	ROG	CO	NOX	SOX	PM	CO2	ROG	CO	NOX	SOX	PM	CO2
0	46	Aerial Lifts	50	0.055	0.866	0.949	0.002	0.013	179.282	2.56	39.91	43.76	0.08	0.59	8,267
50	74		120	0.038	0.778	0.609	0.002	0.015	161.199	2.82	57.61	45.09	0.11	1.11	11,932
120	130		175	0.030	0.778	0.303	0.002	0.010	161.168	3.97	101.52	39.49	0.20	1.28	21,028
175	210		250	0.015	0.778	0.079	0.002	0.003	161.179	3.23	163.42	16.66	0.32	0.56	33,848
250	380		500	0.021	0.778	0.196	0.002	0.003	161.179	8.03	295.70	74.47	0.58	1.04	61,248
0	12	Air Compressors	15	0.364	1.715	2.259	0.004	0.121	272.784	4.37	20.57	27.11	0.05	1.45	3,273
15	24		25	0.383	1.208	2.222	0.003	0.110	272.784	9.20	29.00	53.33	0.08	2.65	6,547
25	37		50	0.599	2.664	2.291	0.004	0.156	272.784	22.16	98.56	84.75	0.13	5.78	10,093
50	78		120	0.285	1.817	1.930	0.003	0.141	272.784	22.21	141.76	150.54	0.25	11.02	21,277
120	147		175	0.213	1.562	1.547	0.003	0.081	272.784	31.28	229.59	227.35	0.45	11.96	40,099
175	218		250	0.160	0.554	1.329	0.003	0.042	272.784	34.91	120.67	289.73	0.67	9.21	59,467
250	385		500	0.154	0.530	1.177	0.003	0.040	272.784	59.41	203.87	453.21	1.03	15.59	105,022
500	595		750	0.155	0.530	1.207	0.003	0.041	272.784	92.20	315.07	718.28	1.63	24.40	162,306
750	808		1000	0.171	0.580	2.073	0.003	0.055	272.784	138.19	468.50	1,675.18	2.22	44.15	220,409
0	39	Bore/Drill Rigs	50	0.379	1.193	2.371	0.003	0.152	296.964	14.90	46.86	93.11	0.11	5.97	11,663
50	82		120	0.141	1.034	1.669	0.002	0.091	257.296	11.57	85.10	137.39	0.20	7.45	21,183
120	149		175	0.095	1.066	1.014	0.003	0.044	265.411	14.16	158.38	150.60	0.38	6.54	39,423
175	208		250	0.075	1.041	0.952	0.002	0.027	259.113	15.66	216.27	197.76	0.51	5.61	53,832
250	349		500	0.068	1.044	0.779	0.002	0.024	259.797	23.72	364.45	272.14	0.87	8.40	90,717
500	612		750	0.061	1.054	0.728	0.003	0.024	262.406	37.49	645.13	445.48	1.53	14.71	160,582
750	919		1000	0.068	1.055	1.528	0.003	0.031	262.691	62.52	969.87	1,404.51	2.31	28.10	241,413
1000	2667		9999	0.102	1.056	2.163	0.003	0.054	262.792	270.84	2,815.34	5,767.64	6.69	144.66	700,778
0	9	Cement and Mortar Mixers	15	0.370	1.943	2.320	0.005	0.091	318.248	3.33	17.49	20.88	0.04	0.82	2,864
15	25		25	0.412	1.354	2.503	0.004	0.110	318.248	10.30	33.85	62.57	0.10	2.75	7,956
0	18	Concrete/Industrial Saws	25	0.500	1.708	3.163	0.005	0.118	414.859	9.01	30.75	56.93	0.09	2.13	7,467
25	33		50	0.657	3.391	3.166	0.005	0.177	414.859	21.69	111.91	104.49	0.18	5.85	13,690
50	81		120	0.324	2.592	2.512	0.005	0.161	414.859	26.25	209.96	203.48	0.39	13.06	33,604
120	175		175	0.241	2.243	1.912	0.005	0.094	414.859	42.21	392.51	334.53	0.82	16.47	72,600
0	41	Cranes	50	0.617	0.826	1.715	0.002	0.177	165.317	25.06	33.54	69.67	0.06	7.20	6,717
50	89		120	0.242	0.749	2.005	0.001	0.144	149.974	21.54	66.61	178.30	0.13	12.83	13,340
120	148		175	0.171	0.756	1.714	0.001	0.092	151.491	25.31	111.87	253.44	0.21	13.54	22,403
175	217		250	0.129	0.754	1.465	0.001	0.062	150.954	27.91	163.58	317.85	0.31	13.47	32,757
250	336		500	0.105	0.753	1.238	0.001	0.050	150.854	35.38	253.19	416.04	0.48	16.76	50,703
500	567		750	0.076	0.750	0.988	0.001	0.036	150.222	43.10	425.48	560.17	0.81	20.23	85,205
750	938		1000	0.241	0.748	2.635	0.001	0.127	149.752	225.86	701.15	2,470.72	1.34	118.82	140,408
1000	1030		9999	0.052	0.752	0.677	0.001	0.017	150.667	53.52	774.95	696.91	1.48	17.64	155,187
0	43	Crawler Tractors	50	0.999	1.324	2.511	0.002	0.275	244.433	42.46	56.30	106.72	0.10	11.67	10,391
50	87		120	0.340	1.226	2.742	0.002	0.229	226.315	29.52	106.51	238.12	0.19	19.91	19,657
120	150		175	0.232	1.213	2.308	0.002	0.128	223.820	34.69	181.36	345.11	0.32	19.21	33,471
175	203		250	0.170	1.217	2.132	0.002	0.080	224.669	34.56	246.94	432.47	0.44	16.31	45,573
250	341		500	0.143	1.223	1.687	0.002	0.066	225.792	48.73	416.82	574.73	0.73	22.33	76,926
500	570		750	0.120	1.217	1.433	0.002	0.053	224.641	68.13	693.95	817.13	1.22	30.07	128,071
750	828		1000	0.206	1.224	3.093	0.002	0.090	225.973	170.91	1,014.04	2,561.16	1.79	74.80	187,143
1000	1527		9999	0.149	1.168	2.516	0.002	0.066	215.490	227.30	1,782.39	3,840.82	3.14	100.46	328,945
0	45	Crushing/Proc. Equipment	50	0.831	4.147	3.505	0.006	0.210	443.274	37.40	186.59	157.74	0.26	9.45	19,947
50	85		120	0.405	2.917	2.764	0.005	0.188	443.274	34.44	247.92	234.95	0.44	16.01	37,678
120	171		175	0.308	2.522	2.106	0.005	0.110	443.274	52.62	431.30	360.17	0.85	18.90	75,800
175	250		250	0.238	0.885	1.795	0.005	0.058	443.274	59.44	221.24	448.65	1.25	14.44	110,818
250	382		500	0.230	0.848	1.596	0.004	0.056	443.274	88.02	323.87	609.54	1.66	21.21	169,331
500	602		750	0.230	0.847	1.626	0.004	0.056	443.274	138.29	509.85	979.08	2.68	33.43	266,851
750	1337		9999	0.270	0.916	3.064	0.004	0.076	443.274	360.40	1,224.33	4,096.03	5.96	102.24	592,657
0	16	Dumpers/Tenders	25	0.261	0.889	1.650	0.003	0.064	215.954	4.17	14.23	26.40	0.04	1.02	3,455
0	36	Excavators	50	0.255	1.082	1.603	0.002	0.096	222.224	9.10	38.67	57.30	0.08	3.42	7,942
50	82		120	0.130	0.964	1.287	0.002	0.080	197.942	10.62	78.81	105.21	0.15	6.58	16,187
120	146		175	0.098	0.973	0.967	0.002	0.047	199.779	14.37	142.04	141.25	0.28	6.81	29,176
175	218		250	0.074	0.972	0.856	0.002	0.026	199.600	16.21	212.30	187.05	0.42	5.67	43,607
250	329		500	0.065	0.970	0.680	0.002	0.022	199.180	21.29	318.69	223.39	0.63	7.25	65,459
500	578		750	0.070	0.966	0.759	0.002	0.026	198.374	40.70	558.17	438.47	1.09	14.81	114,648
750	843		1000	0.061	0.965	1.335	0.002	0.025	198.218	51.46	813.40	1,124.88	1.60	20.81	167,073
1000	1569		9999	0.059	0.963	1.179	0.002	0.022	197.811	92.04	1,511.16	1,849.25	2.96	34.64	310,393
0	42	Forklifts	50	0.262	0.638	0.977	0.001	0.081	117.014	11.10	27.04	41.44	0.05	3.42	4,963
50	82		120	0.107	0.572	0.914	0.001	0.071	105.000	8.83	47.13	75.32	0.08	5.84	8,649
120	141		175	0.080	0.573	0.777	0.001	0.042	105.128	11.36	80.94	109.75	0.14	5.97	14,853
175	208		250	0.079	0.574	0.854	0.001	0.035	105.400	16.39	119.55	177.81	0.21	7.34	21,939
250	344		500	0.056	0.575	0.553	0.001	0.023	105.464	19.34	197.53	190.09	0.35	7.73	36,250
500	880		1000	0.015	0.573	0.465	0.001	0.004	105.117	13.27	504.07	409.61	0.88	3.43	92,503
0	11	Generator Sets	15	0.496	2.643	3.458	0.007	0.173	420.542	5.46	29.08	38.04	0.07	1.90	4,626
15	19		25	0.545	1.863	3.426	0.005	0.164	420.542	10.36	35.39	65.09	0.10	3.12	7,990
25	33		50	0.635	3.124	3.259	0.005	0.186	420.542	20.95	103.11	107.56	0.18	6.13	13,878
50	84		120	0.330	2.541	2.759	0.005	0.172	420.542	27.71	213.42	231.75	0.41	14.49	35,326
120	153		175	0.236	2.185	2.212	0.005	0.098	420.542	36.09	334.31	338.40	0.72	15.04	64,343
175	229		250	0.170	0.776	1.895	0.005	0.054	420.542	38.97	177.61	433.85	1.08	12.26	96,304
250	363		500	0.160	0.758	1.700	0.004	0.052	420.542	58.12	275.19	617.11	1.50	18.70	152,657
500	586		750	0.163	0.758	1.741	0.004	0.052	420.542	95.38	444.25	1,020.52	2.48	30.54	246,438
750	1130		9999	0.212	0.830	2.994	0.004	0.071	420.542	239.05	938.03	3,383.08	4.78	80.76	475,212
0	39	Graders	50	1.119	1.158	2.430	0.002	0.301	223.130	43.83	45.34	95.15	0.08	11.79	8,738
50	91		120	0.441	1.103	3.335	0.002	0.272	212.566	40.17	100.37	303.44	0.18	24.74	19,343
120	148		175	0.260	1.124	2.458	0.002	0.138	216.615	38.53	166.29	363.61	0.31	20.35	32,048
175	204		250	0.154	1.118	1.989	0.002	0.064	215.413	31.46	228.42	406.38	0.42	13.04	44,020
250	293		500	0.138	1.109	1.315	0.002	0.051	213.756	40.47	325.18	385.57	0.60	14.91	62,667
500	796		1000	0.303	1.109	3.798	0.002	0.132	213.737	241.58	882.83	3,023.02	1.62	105.21	170,135
1000	1993		9999	0.203	1.107	2.728	0.002	0.084	213.348	404.33	2,206.16	5,435.79	4.06	167.97	425,161
0	38	Off-Highway Tractors	50	0.478	1.303	2.065	0.002	0.159	253.346	17.98	49.08	77.77	0.09	5.97	9,541
50	75		120	0.216	1.176	1.926	0.002	0.144	228.567	16.07	87.63	143.51	0.16	10.75	17,035
120	158		175	0.134	1.174	1.397	0.002	0.069	228.171	21.19	185.54	220.82	0.34	10.92	36,068
175	214		250	0.109	1.169	1.269	0.002	0.043	227.154	23.24	249.88	271.39	0.46	9.09	48,575
250	334		500	0.078	1.165	0.792	0.002	0.027	226.509	26.12	389.69	264.98	0.72	9.11	75,753
500	574		750	0.094	1.171	0.948	0.002	0.036	227.642	53.65	671.63	543.71	1.25	20.47	130,560
750	1000		1000	0.064	1.172	1.035	0.002	0.027	227.753	63.64	1,171.61	1,035.43	2.17	26.84	227,753
1000	1726		9999	0.112	1.201	1.658	0.002	0.043	233.512	192.77	2,073.63	2,861.55	3.85	74.74	403,100
0	29	Off-Highway Trucks	50	0.395	0.656	1.883	0.002	0.146	216.755	11.51	19.12	54.88	0.06	4.24	6,316
50	87		120	0.208	0.596	1.654	0.002	0.121	196.739	18.14	51.86	143.96	0.16	10.54	17,129
120	159		175	0.129	0.602	1.079	0.002	0.057	198.818	20.48	95.64	171.40	0.30	9.07	31,590
175	211		250	0.123	0.602	1.140	0.002	0.045	198.739	25.89	126.97	240.54	0.40	9.59	41,937
250	372		500	0.105	0.608	1.019	0.002	0.037	200.897	39.22	226.52	379.53	0.71	13.80	74,817
500	656		750	0.131	0.606	1.268	0.002	0.049	200.000	85.70	397.18	831.75	1.25	32.22	131,184
750	897		1000	0.118	0.602	1.820	0.002	0.047	198.812	105.86	540.07	1,632.72	1.70	42.54	178,380
1000	1764		9999	0.114	0.612	1.567	0.002	0.040	202.045	201.07	1,079.19	2,764.10	3.40	70.94	356,445
0	38	Other Construction Equipment	50	0.501	1.336	2.161	0.002	0.182	242.988	19.03	50.77	82.15	0.09	6.91	9,235
50	82		120	0.239	1.193	2.097	0.002	0.157	217.094	19.52	97.34	171.04	0.17	12.84	17,707
120	152		175	0.179	1.189	1.842	0.002	0.097	216.299	27.32	181.33	280.81	0.31	14.79	32,983
175	217		250	0.129	1.202	1.594	0.002	0.059	218.640	28.00	260.71	345.74	0.45	12.82	47,424
250	357		500	0.102	1.201	1.186	0.002	0.043	218.532	36.23	428.73	423.30	0.74	15.21	77,986
500	598		750	0.090	1.199	1.138	0.002	0.038	218.133	53.88	716.72	680.17	1.24	22.47	130,372
750	830		1000	0.083	1.190	1.599	0.002	0.038	216.522	69.17	988.16	1,327.07	1.72	31.93	179,747
1000	1127		9999	0.095	1.163	1.640	0.002	0.039	211.532	106.72	1,310.21	1,848.19	2.28	44.21	238,326
0	35	Other General Industrial Equipmen	50	0.373	0.972	1.642	0.002	0.128	199.186	13.08	34.13	57.65	0.07	4.48	6,992

		2019		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	Equipment	MaxHP	ROG	CO	NOX	SOX	PM	CO2	ROG	CO	NOX	SOX	PM	CO2
50	73		120	0.179	0.869	1.537	0.002	0.117	177.921	13.08	63.57	112.46	0.12	8.58	13,022
120	149		175	0.108	0.872	1.025	0.002	0.053	178.621	16.09	130.06	152.84	0.25	7.97	26,642
175	209		250	0.092	0.875	1.032	0.002	0.036	179.141	19.33	182.83	215.73	0.36	7.56	37,451
250	355		500	0.085	0.874	0.880	0.002	0.032	179.029	30.26	310.02	312.14	0.61	11.19	63,504
500	592		750	0.071	0.875	0.723	0.002	0.026	179.232	42.09	517.60	427.54	1.01	15.32	106,023
750	885		1000	0.094	0.872	1.652	0.002	0.040	178.698	83.56	772.06	1,461.72	1.51	35.46	158,148
1000	2000		9999	0.105	0.872	1.563	0.002	0.045	178.698	209.99	1,744.77	3,125.44	3.41	89.25	357,397
0	36	Other Material Handling Equipment	50	0.528	1.196	2.047	0.002	0.179	229.351	18.86	42.74	73.18	0.08	6.39	8,198
50	93		120	0.149	1.081	1.410	0.002	0.091	207.401	13.88	100.73	131.32	0.18	8.50	19,322
120	145		175	0.116	1.078	1.096	0.002	0.055	206.802	16.72	155.86	158.51	0.29	7.93	29,897
175	218		250	0.124	1.076	1.509	0.002	0.049	206.479	27.10	234.96	329.38	0.43	10.62	45,071
250	331		500	0.120	1.074	1.332	0.002	0.050	205.960	39.89	355.79	441.54	0.65	16.73	68,248
500	565		750	0.101	1.078	1.046	0.002	0.042	206.729	56.96	608.45	590.35	1.11	23.47	116,716
750	923		1000	0.033	1.078	0.924	0.002	0.008	206.729	30.43	994.72	853.07	1.82	7.32	190,811
1000	1050		9999	0.079	1.078	1.416	0.002	0.030	206.729	82.50	1,131.59	1,487.08	2.07	31.65	217,066
0	39	Pavers	50	0.616	1.428	2.042	0.002	0.181	242.353	23.80	55.15	78.88	0.09	7.00	9,361
50	80		120	0.216	1.274	1.940	0.002	0.144	216.208	17.15	101.37	154.40	0.16	11.42	17,207
120	158		175	0.130	1.282	1.348	0.002	0.066	217.623	20.54	202.74	213.14	0.33	10.44	34,414
175	213		250	0.081	1.283	1.292	0.002	0.035	217.705	17.31	273.46	275.52	0.44	7.46	46,417
250	327		500	0.072	1.265	0.943	0.002	0.034	214.732	23.70	414.15	308.70	0.67	11.02	70,299
500	750		750	0.050	1.280	0.498	0.002	0.022	217.241	37.15	959.87	373.61	1.56	16.29	162,931
0	35	Paving Equipment	50	0.262	1.293	1.505	0.002	0.096	204.685	9.12	45.03	52.39	0.07	3.33	7,127
50	89		120	0.158	1.178	1.435	0.002	0.100	186.415	14.00	104.36	127.15	0.16	8.84	16,516
120	148		175	0.094	1.170	0.956	0.002	0.047	185.198	14.01	173.66	141.89	0.26	7.04	27,485
175	216		250	0.089	1.174	1.154	0.002	0.040	185.744	19.30	253.12	248.98	0.38	8.55	40,059
250	339		500	0.085	1.165	1.057	0.002	0.038	184.385	28.67	394.67	358.21	0.60	12.81	62,462
500	605		750	0.082	1.174	1.202	0.002	0.030	185.781	49.52	710.20	727.42	1.07	17.86	112,398
750	842		1000	0.031	1.175	0.819	0.002	0.013	185.931	26.24	989.20	689.33	1.50	10.97	156,554
0	8	Plate Compactors	15	0.284	1.492	1.781	0.004	0.070	244.369	2.28	11.94	14.25	0.03	0.56	1,955
0	13	Pressure Washers	15	0.201	1.072	1.402	0.003	0.070	170.490	2.61	13.93	18.23	0.03	0.91	2,216
15	19		25	0.221	0.755	1.389	0.002	0.067	170.490	4.20	14.35	26.39	0.04	1.26	3,239
25	38		50	0.187	1.062	1.268	0.002	0.063	170.490	7.12	40.35	48.17	0.08	2.38	6,479
50	64		120	0.111	0.979	1.068	0.002	0.059	170.490	7.09	62.63	68.33	0.13	3.78	10,911
0	8	Pumps	15	0.561	2.643	3.483	0.007	0.186	420.542	4.49	21.15	27.86	0.05	1.49	3,364
15	21		25	0.591	1.863	3.426	0.005	0.170	420.542	12.41	39.12	71.94	0.11	3.57	8,831
25	37		50	0.693	3.294	3.304	0.005	0.196	420.542	25.65	121.89	122.24	0.20	7.26	15,560
50	84		120	0.349	2.583	2.801	0.005	0.182	420.542	29.31	217.01	235.29	0.41	15.25	35,326
120	151		175	0.251	2.221	2.247	0.005	0.104	420.542	37.95	335.36	339.28	0.71	15.63	63,502
175	217		250	0.183	0.789	1.926	0.005	0.056	420.542	39.60	171.20	418.00	1.03	12.12	91,258
250	372		500	0.172	0.768	1.723	0.004	0.054	420.542	64.11	285.74	640.94	1.54	19.94	156,442
500	615		750	0.175	0.768	1.765	0.004	0.054	420.542	107.43	472.39	1,085.69	2.60	33.36	258,633
750	1460		9999	0.222	0.842	3.031	0.004	0.073	420.542	324.09	1,229.20	4,424.59	6.17	107.27	613,991
0	36	Rollers	50	0.382	1.180	1.743	0.002	0.131	218.583	13.62	42.11	62.18	0.07	4.68	7,799
50	87		120	0.166	1.063	1.568	0.002	0.103	196.946	14.41	92.36	136.21	0.16	8.96	17,107
120	144		175	0.091	1.059	1.013	0.002	0.046	196.181	13.03	152.29	145.62	0.27	6.69	28,207
175	213		250	0.083	1.062	1.082	0.002	0.034	196.719	17.62	226.49	230.69	0.40	7.34	41,950
250	335		500	0.092	1.076	1.091	0.002	0.042	199.240	30.79	360.22	365.43	0.64	13.94	66,721
500	521		750	0.031	1.061	0.263	0.002	0.003	196.512	16.31	552.23	136.88	0.98	1.81	102,285
0	47	Rough Terrain Forklifts	50	0.425	1.273	1.832	0.002	0.132	234.101	20.07	60.20	86.63	0.11	6.23	11,069
50	96		120	0.085	1.145	1.054	0.002	0.047	210.567	8.18	110.31	101.54	0.19	4.52	20,283
120	130		175	0.063	1.142	0.827	0.002	0.030	210.048	8.14	148.03	107.19	0.26	3.92	27,220
175	208		250	0.046	1.145	0.659	0.002	0.015	210.470	9.58	238.43	137.25	0.42	3.05	43,843
250	374		500	0.049	1.131	0.788	0.002	0.017	207.928	18.28	422.79	294.76	0.74	6.45	77,742
500	625		750	0.041	1.143	0.534	0.002	0.004	210.233	25.89	714.57	333.73	1.25	2.33	131,396
0	42	Rubber Tired Dozers	50	0.503	1.072	1.769	0.002	0.147	229.177	20.91	44.58	73.55	0.09	6.13	9,530
50	82		120	0.398	0.980	2.991	0.002	0.257	209.538	32.44	79.97	244.06	0.16	20.96	17,096
120	150		175	0.314	0.969	2.973	0.002	0.171	207.164	46.99	145.05	444.98	0.30	25.60	31,009
175	211		250	0.269	0.972	2.739	0.002	0.134	207.855	56.83	205.13	577.90	0.42	28.18	43,853
250	354		500	0.237	0.983	2.428	0.002	0.112	210.088	83.80	347.93	859.80	0.71	39.58	74,382
500	584		750	0.188	0.969	2.420	0.002	0.086	207.172	109.88	566.04	1,413.65	1.16	50.36	121,009
0	42	Rubber Tired Loaders	50	0.607	0.988	1.965	0.002	0.187	210.259	25.29	41.21	81.94	0.08	7.81	8,767
50	86		120	0.225	0.877	1.811	0.002	0.145	186.590	19.40	75.57	156.03	0.15	12.53	16,074
120	150		175	0.153	0.888	1.396	0.002	0.077	188.893	23.01	133.20	209.43	0.27	11.58	28,333
175	206		250	0.117	0.885	1.355	0.002	0.045	188.251	24.12	182.22	278.95	0.37	9.35	38,762
250	320		500	0.116	0.879	1.189	0.002	0.044	187.052	37.01	281.12	380.25	0.57	14.19	59,799
500	600		750	0.111	0.869	1.092	0.002	0.043	184.757	66.67	521.55	655.83	1.06	25.73	110,942
750	837		1000	0.122	0.886	1.975	0.002	0.053	188.417	102.48	741.22	1,652.84	1.51	44.26	157,670
1000	1521		9999	0.080	0.884	1.480	0.002	0.032	187.942	121.27	1,343.85	2,251.56	2.73	49.01	285,860
0	36	Scrapers	50	1.703	1.260	3.294	0.003	0.453	279.274	61.54	45.54	119.07	0.10	16.36	10,094
50	84		120	0.363	1.165	3.300	0.002	0.253	258.321	30.57	98.28	278.30	0.21	21.38	21,783
120	166		175	0.258	1.154	2.539	0.002	0.137	255.788	42.79	191.76	421.92	0.41	22.71	42,503
175	225		250	0.253	1.130	2.813	0.002	0.124	250.443	56.94	254.20	632.82	0.54	27.86	56,343
250	381		500	0.173	1.139	2.005	0.002	0.079	252.378	66.01	434.22	764.63	0.92	29.96	96,244
500	565		750	0.140	1.138	1.655	0.002	0.059	252.307	78.95	643.10	935.06	1.36	33.57	142,541
750	950		1000	0.593	1.138	6.460	0.002	0.301	252.280	562.94	1,081.30	6,137.29	2.29	286.14	239,666
1000	1923		9999	0.287	1.163	3.702	0.002	0.145	257.796	551.58	2,236.99	7,120.10	4.73	278.53	495,821
0	6	Signal Boards	15	0.542	2.845	3.397	0.007	0.133	466.006	3.25	17.07	20.38	0.04	0.80	2,796
15	37		50	0.693	3.540	3.332	0.006	0.184	443.274	25.63	130.98	123.29	0.21	6.82	16,401
50	82		120	0.341	2.746	2.660	0.005	0.169	443.274	27.97	225.13	218.11	0.43	13.85	36,348
120	158		175	0.251	2.374	2.029	0.005	0.098	443.274	39.66	375.01	320.56	0.79	15.41	70,037
175	216		250	0.227	1.008	2.088	0.006	0.063	535.623	49.03	217.76	450.92	1.30	13.58	115,695
0	43	Skid Steer Loaders	50	0.172	1.378	1.382	0.002	0.057	215.367	7.48	59.90	60.07	0.09	2.46	9,362
50	71		120	0.077	1.233	0.979	0.002	0.045	192.650	5.42	86.94	69.03	0.13	3.16	13,589
120	153		175	0.065	1.223	0.774	0.002	0.034	191.090	9.98	186.97	118.41	0.28	5.17	29,223
175	201		250	0.038	1.203	0.478	0.002	0.014	188.095	7.72	241.34	95.89	0.36	2.88	37,719
250	277		500	0.027	1.201	0.220	0.002	0.003	187.666	7.36	332.20	60.98	0.50	0.90	51,921
500	530		750	0.065	1.233	0.897	0.002	0.038	192.714	34.28	653.51	475.40	0.98	20.39	102,138
750	1000		1000	0.107	1.233	1.579	0.002	0.051	192.714	106.82	1,233.03	1,579.42	1.84	51.44	192,714
0	36	Surfacing Equipment	50	0.203	0.849	1.333	0.002	0.075	178.751	7.24	30.29	47.53	0.06	2.69	6,375
50	89		120	0.112	0.752	1.153	0.002	0.068	158.175	9.94	66.65	102.22	0.13	6.03	14,027
120	151		175	0.113	0.745	1.278	0.001	0.061	156.736	17.01	112.43	192.94	0.23	9.27	23,663
175	216		250	0.068	0.756	1.025	0.002	0.030	159.079	14.76	163.31	221.48	0.33	6.56	34,371
250	362		500	0.046	0.748	0.573	0.002	0.021	157.463	16.63	271.10	207.51	0.54	7.44	57,058
500	615		750	0.045	0.745	0.657	0.001	0.023	156.898	27.53	458.53	404.05	0.92	14.15	96,504
750	814		1000	0.098	0.752	1.754	0.002	0.044	158.262	79.65	612.31	1,427.94	1.23	35.61	128,871
1000	1141		9999	0.058	0.737	1.173	0.001	0.027	155.194	66.60	841.35	1,338.31	1.69	31.23	177,076
0	36	Sweepers/Scrubbers	50	0.682	1.544	2.380	0.003	0.224	265.154	24.28	54.93	84.71	0.09	7.96	9,436
50	78		120	0.262	1.393	2.174	0.002	0.176	239.305	20.32	108.00	168.57	0.18	13.68	18,552
120	159		175	0.250	1.390	2.415	0.002	0.126	238.803	39.79	221.69	385.13	0.36	20.14	38,082
175	204		250	0.112	1.381	1.306	0.002	0.045	237.291	22.87	282.36	266.90	0.46	9.21	48,504
250	303		500	0.206	1.387	2.476	0.002	0.108	238.264	62.44	419.57	749.13	0.69	32.52	72,075
500	848		1000	0.110	1.387	1.912	0.002	0.053	238.264	93.00	1,176.17	1,621.68	1.93	45.25	202,048
0	38	Tractors/Loaders/Backhoes	50	0.355	0.987	1.699	0.002	0.122	210.741	13.59	37.80	65.06	0.08	4.66	8,072
50	83		120	0.142	0.909	1.361	0.002	0.091	194.036	11.72	75.10	112.46	0.15	7.51	16,037
120	144		175	0.104	0.894	1.026	0.002	0.052	190.865	15.01	128.66	147.67	0.26	7.43	27,472
175	204		250	0.094	0.900	1.160	0.002	0.038	192.265	19.29	183.88	236.81	0.37	7.67	39,264
250	320		500	0.079	0.896	0.864	0.002	0.030	191.331	25.44	286.86	276.59	0.58	9.63	61,253
500	575		750	0.101	0.896	1.150	0.002	0.043	191.267	58.08	514.70	660.75	1.05	24.73	109,905
750	871		1000	0.072	0.911	1.432	0.002	0.030	194.602	62.56	794.15	1,248.04	1.62	26.52	169,576
1000	2006		9999	0.076	0.904	1.359	0.002	0.030	193.002	152.58	1,812.80	2,725.83	3.70	60.83	387,090
0	40	Trenchers	50	0.502	1.634	2.404	0.003	0.189	293.594	19.98	64.98	95.64	0.11	7.53	11,678

		2019		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	**(g/hr)**	**(g/hr)**	**(g/hr)**	**(g/hr)**	**(g/hr)**	**(g/hr)**
	AvgHP	**Equipment**	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2	**ROG**	**CO**	**NOX**	**SOX**	**PM**	**CO2**
50	82		120	0.332	1.471	2.862	0.003	0.216	264.327	27.25	120.68	234.83	0.21	17.75	21,690
120	144		175	0.242	1.449	2.492	0.002	0.128	260.387	34.79	208.43	358.56	0.36	18.41	37,462
175	218		250	0.213	1.467	2.536	0.003	0.102	263.648	46.50	320.40	553.89	0.55	22.30	57,586
250	359		500	0.134	1.461	1.572	0.003	0.059	262.585	47.97	523.79	563.57	0.90	21.27	94,141
500	619		750	0.041	1.468	0.355	0.003	0.008	263.880	25.44	909.18	219.88	1.56	4.74	163,407
750	860		1000	0.607	1.462	6.666	0.003	0.307	262.792	521.94	1,257.44	5,732.49	2.16	263.86	226,001
0	11	Welders	15	0.341	1.607	2.118	0.004	0.113	255.735	3.75	17.68	23.30	0.04	1.25	2,813
15	20		25	0.359	1.133	2.083	0.003	0.103	255.735	7.18	22.65	41.67	0.06	2.07	5,115
25	46		50	0.525	2.334	2.099	0.003	0.139	255.735	24.14	107.36	96.57	0.15	6.38	11,764
50	70		120	0.249	1.658	1.780	0.003	0.127	255.735	17.46	116.03	124.60	0.21	8.89	17,901
120	174		175	0.184	1.424	1.428	0.003	0.073	255.735	31.96	247.77	248.54	0.50	12.63	44,498
175	211		250	0.136	0.505	1.227	0.003	0.038	255.735	28.69	106.61	258.89	0.61	8.00	53,960
250	297		500	0.130	0.486	1.088	0.003	0.036	255.735	38.68	144.40	323.16	0.75	10.78	75,953
0	29	Water Trucks	50	0.395	0.656	1.883	0.002	0.146	216.755	11.509	19.124	54.882	0.060	4.244	6316.311
50	87		120	0.208	0.596	1.654	0.002	0.121	196.739	18.143	51.859	143.959	0.164	10.544	17128.612
120	159		175	0.129	0.602	1.079	0.002	0.057	198.818	20.482	95.643	171.398	0.302	9.067	31590.040
175	211		250	0.123	0.602	1.140	0.002	0.045	198.739	25.894	126.970	240.536	0.400	9.587	41936.951
250	372		500	0.105	0.608	1.019	0.002	0.037	200.897	39.222	226.520	379.533	0.714	13.802	74817.383
500	656		750	0.131	0.606	1.268	0.002	0.049	200.000	85.703	397.178	831.754	1.253	32.218	131183.761
750	897		1000	0.118	0.602	1.820	0.002	0.047	198.812	105.862	540.073	1632.720	1.703	42.541	178380.423
1000	1764		9999	0.114	0.612	1.567	0.002	0.040	202.045	201.071	1079.189	2764.102	3.404	70.943	356444.954

2020

		2020		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	Equipment	MaxHP	ROG	CO	NOX	SOX	PM	CO2	ROG	CO	NOX	SOX	PM	CO2
0	46	Aerial Lifts	50	0.054	0.866	0.911	0.002	0.010	179.282	2.49	39.91	41.99	0.08	0.44	8,267
50	74		120	0.037	0.778	0.576	0.002	0.013	161.199	2.74	57.61	42.63	0.11	0.95	11,932
120	130		175	0.031	0.778	0.303	0.002	0.010	161.168	4.10	101.52	39.59	0.20	1.29	21,028
175	210		250	0.016	0.778	0.080	0.002	0.003	161.179	3.41	163.42	16.72	0.32	0.57	33,848
250	380		500	0.022	0.778	0.197	0.002	0.003	161.179	8.43	295.70	74.72	0.58	1.05	61,248
0	12	Air Compress	15	0.356	1.707	2.209	0.004	0.114	272.784	4.27	20.49	26.51	0.05	1.37	3,273
15	24		25	0.375	1.196	2.194	0.003	0.106	272.784	8.99	28.70	52.65	0.08	2.54	6,547
25	37		50	0.541	2.622	2.233	0.004	0.140	272.784	20.02	97.00	82.63	0.13	5.18	10,093
50	78		120	0.263	1.812	1.797	0.003	0.125	272.784	20.53	141.36	140.18	0.25	9.78	21,277
120	147		175	0.202	1.565	1.413	0.003	0.074	272.784	29.73	230.06	207.65	0.45	10.91	40,099
175	218		250	0.154	0.549	1.199	0.003	0.039	272.784	33.68	119.76	261.48	0.67	8.40	59,467
250	385		500	0.150	0.525	1.065	0.003	0.037	272.784	57.59	202.28	410.01	1.03	14.27	105,022
500	595		750	0.150	0.525	1.092	0.003	0.038	272.784	89.34	312.61	649.53	1.63	22.32	162,306
750	808		1000	0.165	0.570	1.965	0.003	0.051	272.784	132.99	460.77	1,587.62	2.22	41.10	220,409
0	39	Bore/Drill Rig	50	0.376	1.197	2.334	0.003	0.148	297.997	14.78	47.02	91.67	0.11	5.80	11,703
50	82		120	0.129	1.037	1.541	0.002	0.080	258.075	10.66	85.36	126.84	0.20	6.56	21,247
120	149		175	0.092	1.068	0.940	0.003	0.041	265.947	13.62	158.70	139.69	0.38	6.14	39,502
175	208		250	0.075	1.044	0.908	0.002	0.026	259.886	15.56	216.91	188.68	0.52	5.44	53,992
250	349		500	0.065	1.044	0.708	0.002	0.022	259.879	22.87	364.56	247.30	0.87	7.82	90,745
500	612		750	0.057	1.059	0.619	0.003	0.021	263.690	34.97	648.29	378.50	1.54	12.59	161,368
750	919		1000	0.070	1.055	1.533	0.003	0.031	262.677	64.23	969.82	1,408.52	2.31	28.26	241,401
1000	2667		9999	0.103	1.056	2.166	0.003	0.054	262.792	273.60	2,815.34	5,774.69	6.69	145.25	700,778
0	9	Cement and I	15	0.370	1.943	2.320	0.005	0.091	318.248	3.33	17.49	20.88	0.04	0.82	2,864
15	25		25	0.405	1.343	2.488	0.004	0.105	318.248	10.12	33.57	62.20	0.10	2.63	7,956
0	18	Concrete/Indu	25	0.500	1.708	3.163	0.005	0.118	414.859	9.01	30.75	56.93	0.09	2.13	7,467
25	33		50	0.583	3.324	3.063	0.005	0.155	414.859	19.25	109.68	101.08	0.18	5.11	13,690
50	81		120	0.294	2.581	2.309	0.005	0.140	414.859	23.78	209.05	187.06	0.39	11.30	33,604
120	175		175	0.224	2.243	1.697	0.005	0.084	414.859	39.22	392.55	297.02	0.82	14.64	72,600
0	41	Cranes	50	0.628	0.825	1.724	0.002	0.180	165.308	25.52	33.54	70.05	0.06	7.30	6,716
50	89		120	0.221	0.749	1.838	0.001	0.130	149.974	19.63	66.61	163.52	0.13	11.61	13,339
120	148		175	0.162	0.756	1.605	0.001	0.086	151.478	23.94	111.86	237.30	0.21	12.69	22,401
175	217		250	0.116	0.754	1.315	0.001	0.054	150.953	25.11	163.58	285.29	0.31	11.76	32,757
250	336		500	0.097	0.753	1.113	0.001	0.045	150.828	32.49	253.15	374.01	0.48	14.99	50,694
500	567		750	0.073	0.750	0.894	0.001	0.033	150.147	41.35	425.27	507.33	0.81	18.96	85,162
750	938		1000	0.243	0.748	2.646	0.001	0.127	149.743	227.53	701.11	2,481.05	1.34	119.47	140,399
1000	1030		9999	0.055	0.752	0.680	0.001	0.017	150.667	56.58	774.95	700.73	1.48	17.93	155,187
0	43	Crawler Tract	50	0.921	1.327	2.420	0.002	0.253	244.973	39.16	56.43	102.86	0.10	10.78	10,414
50	87		120	0.321	1.226	2.577	0.002	0.215	226.279	27.86	106.50	223.81	0.19	18.64	19,654
120	150		175	0.214	1.212	2.089	0.002	0.117	223.755	31.95	181.31	312.43	0.32	17.45	33,461
175	203		250	0.162	1.217	1.986	0.002	0.075	224.670	32.78	246.94	402.91	0.44	15.18	45,573
250	341		500	0.135	1.223	1.553	0.002	0.060	225.759	46.07	416.76	529.10	0.73	20.58	76,914
500	570		750	0.115	1.218	1.345	0.002	0.049	224.846	65.55	694.59	766.93	1.22	28.14	128,188
750	828		1000	0.208	1.224	3.103	0.002	0.091	225.958	172.09	1,013.97	2,569.92	1.79	75.27	187,131
1000	1527		9999	0.150	1.168	2.523	0.002	0.066	215.490	228.55	1,782.39	3,850.93	3.14	101.17	328,945
0	45	Crushing/Pro	50	0.739	4.065	3.391	0.006	0.182	443.274	33.28	182.91	152.58	0.26	8.18	19,947
50	85		120	0.369	2.904	2.534	0.005	0.161	443.274	31.38	246.82	215.42	0.44	13.71	37,678
120	171		175	0.287	2.523	1.866	0.005	0.097	443.274	49.08	431.36	319.13	0.85	16.67	75,800
175	250		250	0.226	0.878	1.572	0.005	0.051	443.274	56.38	219.48	392.96	1.25	12.77	110,818
250	382		500	0.220	0.841	1.403	0.004	0.049	443.274	83.90	321.35	535.95	1.66	18.84	169,331
500	602		750	0.219	0.841	1.432	0.004	0.049	443.274	132.03	506.17	861.87	2.68	29.71	266,851
750	1337		9999	0.257	0.900	2.886	0.004	0.070	443.274	344.06	1,202.77	3,857.99	5.96	92.93	592,657
0	16	Dumpers/Ten	25	0.261	0.889	1.648	0.003	0.063	215.954	4.17	14.23	26.37	0.04	1.00	3,455
0	36	Excavators	50	0.237	1.082	1.540	0.002	0.085	222.278	8.47	38.67	55.02	0.08	3.03	7,944
50	82		120	0.120	0.964	1.180	0.002	0.071	198.029	9.78	78.84	96.49	0.15	5.77	16,194
120	146		175	0.092	0.973	0.870	0.002	0.042	199.821	13.50	142.07	127.07	0.28	6.16	29,182
175	218		250	0.071	0.972	0.774	0.002	0.023	199.649	15.49	212.35	169.15	0.42	5.12	43,618
250	329		500	0.061	0.969	0.600	0.002	0.020	198.977	20.15	318.37	197.30	0.62	6.50	65,392
500	578		750	0.068	0.966	0.686	0.002	0.023	198.375	39.21	558.17	396.66	1.09	13.51	114,649
750	843		1000	0.063	0.965	1.343	0.002	0.025	198.224	53.47	813.42	1,131.75	1.60	21.11	167,078
1000	1569		9999	0.061	0.963	1.187	0.002	0.022	197.811	96.50	1,511.16	1,862.29	2.96	35.02	310,393
0	42	Forklifts	50	0.236	0.638	0.942	0.001	0.072	117.014	10.03	27.04	39.94	0.05	3.07	4,963
50	82		120	0.097	0.572	0.831	0.001	0.062	105.000	7.95	47.13	68.43	0.08	5.10	8,649
120	141		175	0.071	0.573	0.667	0.001	0.036	105.128	10.05	80.94	94.27	0.14	5.10	14,853
175	208		250	0.062	0.574	0.652	0.001	0.025	105.400	12.82	119.55	135.62	0.21	5.27	21,939
250	344		500	0.053	0.575	0.490	0.001	0.019	105.464	18.17	197.53	168.57	0.35	6.68	36,250
500	880		1000	0.017	0.573	0.469	0.001	0.004	105.117	14.57	504.07	413.08	0.88	3.53	92,503
0	11	Generator Se	15	0.484	2.632	3.384	0.007	0.164	420.542	5.33	28.95	37.22	0.07	1.80	4,626
15	19		25	0.537	1.843	3.382	0.005	0.158	420.542	10.21	35.03	64.26	0.10	3.00	7,990
25	33		50	0.574	3.078	3.174	0.005	0.167	420.542	18.95	101.58	104.74	0.18	5.52	13,878
50	84		120	0.301	2.533	2.577	0.005	0.154	420.542	25.30	212.73	216.44	0.41	12.96	35,326
120	153		175	0.222	2.188	2.024	0.005	0.090	420.542	33.90	334.77	309.70	0.72	13.76	64,343
175	229		250	0.162	0.769	1.714	0.005	0.049	420.542	37.13	176.12	392.46	1.08	11.20	96,304
250	363		500	0.154	0.752	1.539	0.004	0.047	420.542	55.79	272.86	558.77	1.50	17.12	152,657
500	586		750	0.156	0.752	1.576	0.004	0.048	420.542	91.40	440.49	923.79	2.48	27.97	246,438
750	1130		9999	0.200	0.816	2.843	0.004	0.066	420.542	225.84	922.42	3,212.34	4.78	75.02	475,212
0	39	Graders	50	1.076	1.158	2.381	0.002	0.290	223.158	42.15	45.35	93.24	0.08	11.34	8,739
50	91		120	0.418	1.103	3.157	0.002	0.254	212.507	37.99	100.34	287.30	0.18	23.13	19,337
120	148		175	0.242	1.123	2.260	0.002	0.126	216.447	35.86	166.17	334.40	0.31	18.65	32,023
175	204		250	0.151	1.117	1.912	0.002	0.061	215.208	30.76	228.20	390.69	0.42	12.49	43,979
250	293		500	0.138	1.109	1.270	0.002	0.049	213.703	40.38	325.10	372.31	0.60	14.45	62,651
500	796		1000	0.303	1.109	3.798	0.002	0.132	213.737	241.58	882.83	3,023.02	1.62	105.21	170,135
1000	1993		9999	0.206	1.107	2.740	0.002	0.085	213.348	410.57	2,206.16	5,459.53	4.06	169.35	425,161
0	38	Off-Highway	50	0.462	1.303	2.036	0.002	0.152	253.374	17.40	49.09	76.67	0.09	5.71	9,542
50	75		120	0.204	1.177	1.822	0.002	0.134	228.763	15.22	87.71	135.77	0.16	9.96	17,049
120	158		175	0.124	1.174	1.259	0.002	0.061	228.169	19.53	185.54	198.98	0.34	9.65	36,068
175	214		250	0.101	1.169	1.122	0.002	0.038	227.216	21.58	249.95	239.85	0.46	8.02	48,588
250	334		500	0.075	1.165	0.717	0.002	0.024	226.555	24.96	389.77	239.71	0.72	8.07	75,768
500	574		750	0.092	1.171	0.891	0.002	0.033	227.637	52.65	671.62	511.20	1.25	19.03	130,558
750	1000		1000	0.068	1.172	1.043	0.002	0.027	227.753	68.35	1,171.61	1,043.45	2.17	27.44	227,753
1000	1726		9999	0.116	1.202	1.665	0.002	0.044	233.668	200.50	2,075.02	2,873.82	3.85	75.64	403,370
0	29	Off-Highway	50	0.341	0.656	1.774	0.002	0.126	216.730	9.95	19.12	51.70	0.06	3.68	6,316
50	87		120	0.192	0.595	1.513	0.002	0.107	196.671	16.73	51.84	131.74	0.16	9.29	17,123
120	159		175	0.124	0.602	1.004	0.002	0.052	198.893	19.68	95.68	159.45	0.30	8.31	31,602
175	211		250	0.110	0.602	0.958	0.002	0.037	198.923	23.18	127.09	202.05	0.40	7.87	41,976
250	372		500	0.098	0.608	0.896	0.002	0.033	200.790	36.64	226.40	333.77	0.71	12.16	74,778
500	656		750	0.125	0.606	1.168	0.002	0.046	200.016	81.88	397.21	766.05	1.25	29.96	131,194
750	897		1000	0.121	0.602	1.831	0.002	0.048	198.806	108.67	540.05	1,642.55	1.70	42.90	178,374
1000	1764		9999	0.108	0.612	1.523	0.002	0.037	202.166	190.47	1,079.83	2,687.25	3.41	66.01	356,658
0	38	Other Constr	50	0.466	1.336	2.092	0.002	0.168	242.972	17.72	50.77	79.51	0.09	6.40	9,235
50	82		120	0.226	1.195	1.982	0.002	0.147	217.316	18.41	97.44	161.65	0.17	11.98	17,725
120	152		175	0.169	1.189	1.708	0.002	0.090	216.288	25.71	181.32	260.47	0.31	13.74	32,982
175	217		250	0.123	1.202	1.496	0.002	0.055	218.620	26.74	260.69	324.59	0.45	11.94	47,420

		2020		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	Equipment	MaxHP	ROG	CO	NOX	SOX	PM	CO2	ROG	CO	NOX	SOX	PM	CO2
250	357		500	0.097	1.202	1.095	0.002	0.040	218.704	34.78	429.07	390.87	0.75	14.23	78,047
500	598		750	0.089	1.199	1.091	0.002	0.036	218.025	53.34	716.37	652.06	1.24	21.56	130,308
750	830		1000	0.076	1.187	1.488	0.002	0.034	215.909	63.10	985.36	1,235.50	1.71	28.41	179,238
1000	1127		9999	0.097	1.163	1.648	0.002	0.040	211.523	109.49	1,310.15	1,856.58	2.28	44.64	238,316
0	35	Other Genera	50	0.338	0.972	1.579	0.002	0.114	199.186	11.88	34.13	55.44	0.07	4.01	6,992
50	73		120	0.159	0.869	1.388	0.002	0.101	177.921	11.67	63.57	101.56	0.12	7.40	13,022
120	149		175	0.096	0.872	0.880	0.002	0.046	178.621	14.31	130.06	131.24	0.25	6.88	26,642
175	209		250	0.085	0.875	0.912	0.002	0.031	179.141	17.70	182.83	190.58	0.36	6.44	37,451
250	355		500	0.074	0.874	0.705	0.002	0.025	179.029	26.33	310.02	249.91	0.61	8.77	63,504
500	592		750	0.062	0.875	0.573	0.002	0.021	179.232	36.95	517.60	338.75	1.01	12.57	106,023
750	885		1000	0.097	0.872	1.660	0.002	0.041	178.698	85.68	772.06	1,468.84	1.51	35.88	158,148
1000	2000		9999	0.021	0.872	0.779	0.002	0.006	178.698	42.33	1,744.77	1,558.74	3.41	12.54	357,397
0	36	Other Materia	50	0.515	1.196	2.032	0.002	0.174	229.351	18.41	42.74	72.62	0.08	6.21	8,198
50	93		120	0.127	1.081	1.227	0.002	0.072	207.401	11.81	100.73	114.31	0.18	6.71	19,322
120	145		175	0.104	1.078	0.935	0.002	0.047	206.802	15.07	155.86	135.24	0.29	6.75	29,897
175	218		250	0.120	1.076	1.423	0.002	0.046	206.479	26.26	234.96	310.54	0.43	9.94	45,071
250	331		500	0.117	1.074	1.269	0.002	0.047	205.960	38.73	355.79	420.44	0.65	15.69	68,248
500	565		750	0.081	1.078	0.820	0.002	0.030	206.729	45.76	608.45	462.77	1.11	17.20	116,716
750	923		1000	0.036	1.078	0.932	0.002	0.008	206.729	33.19	994.72	860.42	1.82	7.54	190,811
1000	1050		9999	0.083	1.078	1.429	0.002	0.031	206.729	87.05	1,131.59	1,500.08	2.07	32.48	217,066
0	39	Pavers	50	0.573	1.427	1.979	0.002	0.167	242.164	22.14	55.10	76.44	0.09	6.45	9,354
50	80		120	0.204	1.274	1.839	0.002	0.135	216.241	16.25	101.38	146.36	0.16	10.74	17,209
120	158		175	0.119	1.282	1.212	0.002	0.059	217.572	18.75	202.69	191.70	0.33	9.32	34,406
175	213		250	0.076	1.282	1.154	0.002	0.032	217.600	16.28	273.32	245.95	0.44	6.73	46,395
250	327		500	0.072	1.264	0.886	0.002	0.032	214.550	23.44	413.80	290.20	0.67	10.49	70,239
500	750		750	0.050	1.280	0.493	0.002	0.022	217.241	37.72	959.87	370.04	1.56	16.24	162,931
0	35	Paving Equip	50	0.231	1.293	1.403	0.002	0.077	204.616	8.04	45.02	48.86	0.07	2.68	7,124
50	89		120	0.148	1.177	1.343	0.002	0.091	186.206	13.08	104.24	118.95	0.16	8.05	16,498
120	148		175	0.092	1.170	0.907	0.002	0.045	185.187	13.65	173.65	134.64	0.26	6.73	27,483
175	216		250	0.090	1.174	1.143	0.002	0.039	185.744	19.52	253.12	246.61	0.38	8.48	40,059
250	339		500	0.080	1.165	0.968	0.002	0.035	184.377	27.10	394.66	327.77	0.60	11.72	62,460
500	605		750	0.070	1.174	0.971	0.002	0.023	185.784	42.25	710.20	587.69	1.07	13.62	112,399
750	842		1000	0.033	1.175	0.823	0.002	0.013	185.931	28.06	989.20	693.20	1.50	11.16	156,554
0	8	Plate Compa	15	0.284	1.492	1.781	0.004	0.070	244.369	2.28	11.94	14.25	0.03	0.56	1,955
0	13	Pressure Wa	15	0.196	1.067	1.372	0.003	0.066	170.490	2.55	13.87	17.83	0.03	0.86	2,216
15	19		25	0.218	0.747	1.371	0.002	0.064	170.490	4.14	14.20	26.05	0.04	1.21	3,239
25	38		50	0.167	1.045	1.233	0.002	0.056	170.490	6.36	39.72	46.85	0.08	2.13	6,479
50	64		120	0.100	0.975	0.997	0.002	0.053	170.490	6.38	62.38	63.83	0.13	3.36	10,911
0	8	Pumps	15	0.549	2.632	3.406	0.007	0.176	420.542	4.39	21.06	27.25	0.05	1.41	3,364
15	21		25	0.578	1.843	3.382	0.005	0.163	420.542	12.13	38.71	71.03	0.11	3.42	8,831
25	37		50	0.629	3.246	3.219	0.005	0.177	420.542	23.26	120.11	119.09	0.20	6.55	15,560
50	84		120	0.320	2.576	2.616	0.005	0.163	420.542	26.86	216.35	219.74	0.41	13.65	35,326
120	151		175	0.237	2.225	2.057	0.005	0.095	420.542	35.77	335.90	310.58	0.71	14.33	63,502
175	217		250	0.174	0.782	1.743	0.005	0.051	420.542	37.85	169.78	378.22	1.03	11.07	91,258
250	372		500	0.166	0.762	1.561	0.004	0.049	420.542	61.72	283.33	580.54	1.54	18.27	156,442
500	615		750	0.168	0.762	1.599	0.004	0.050	420.542	103.26	468.41	983.10	2.60	30.57	258,633
750	1460		9999	0.211	0.828	2.878	0.004	0.068	420.542	307.77	1,208.79	4,201.28	6.17	99.78	613,991
0	36	Rollers	50	0.364	1.180	1.701	0.002	0.123	218.591	12.97	42.11	60.70	0.07	4.40	7,799
50	87		120	0.152	1.063	1.456	0.002	0.093	196.968	13.24	92.37	126.50	0.16	8.06	17,109
120	144		175	0.085	1.059	0.920	0.002	0.042	196.161	12.15	152.27	132.26	0.27	6.08	28,204
175	213		250	0.082	1.062	1.032	0.002	0.033	196.763	17.46	226.54	220.11	0.40	7.13	41,960
250	335		500	0.092	1.076	1.061	0.002	0.041	199.240	30.91	360.22	355.35	0.64	13.75	66,721
500	521		750	0.033	1.061	0.264	0.002	0.004	196.512	17.15	552.23	137.45	0.98	1.83	102,285
0	47	Rough Terrai	50	0.420	1.273	1.807	0.002	0.127	234.090	19.87	60.20	85.43	0.11	6.01	11,069
50	96		120	0.080	1.146	0.986	0.002	0.041	210.647	7.67	110.35	94.96	0.19	3.97	20,291
120	130		175	0.060	1.142	0.751	0.002	0.027	210.082	7.79	148.06	97.36	0.26	3.56	27,225
175	208		250	0.047	1.145	0.647	0.002	0.015	210.462	9.77	238.42	134.74	0.42	3.07	43,841
250	374		500	0.037	1.128	0.523	0.002	0.011	207.435	13.94	421.78	195.69	0.74	4.22	77,558
500	625		750	0.043	1.143	0.536	0.002	0.004	210.233	26.85	714.57	334.69	1.25	2.35	131,396
0	42	Rubber Tired	50	0.509	1.072	1.779	0.002	0.147	229.196	21.18	44.58	73.98	0.09	6.12	9,531
50	82		120	0.389	0.980	2.922	0.002	0.249	209.495	31.75	79.95	238.43	0.16	20.35	17,093
120	150		175	0.301	0.969	2.840	0.002	0.162	207.149	44.98	145.04	425.15	0.30	24.30	31,007
175	211		250	0.256	0.973	2.571	0.002	0.126	207.929	54.07	205.20	542.38	0.42	26.56	43,869
250	354		500	0.221	0.983	2.230	0.002	0.102	210.103	78.36	347.96	789.48	0.71	36.26	74,387
500	584		750	0.189	0.969	2.420	0.002	0.086	207.168	110.31	566.03	1,413.66	1.16	50.37	121,007
0	42	Rubber Tired	50	0.561	0.989	1.901	0.002	0.172	210.310	23.38	41.22	79.26	0.08	7.15	8,769
50	86		120	0.210	0.877	1.696	0.002	0.133	186.652	18.12	75.59	146.07	0.15	11.44	16,080
120	150		175	0.143	0.888	1.273	0.002	0.070	188.873	21.51	133.18	190.88	0.27	10.51	28,330
175	206		250	0.110	0.885	1.238	0.002	0.041	188.191	22.63	182.17	254.86	0.37	8.46	38,750
250	320		500	0.109	0.880	1.091	0.002	0.041	187.097	34.99	281.19	348.92	0.57	12.97	59,813
500	600		750	0.105	0.871	1.001	0.002	0.039	185.257	62.95	522.96	601.19	1.06	23.34	111,243
750	837		1000	0.118	0.885	1.901	0.002	0.050	188.361	98.70	741.00	1,590.42	1.51	41.94	157,622
1000	1521		9999	0.082	0.884	1.486	0.002	0.032	187.942	125.23	1,343.85	2,260.93	2.73	49.30	285,859
0	36	Scrapers	50	1.719	1.260	3.304	0.003	0.456	279.274	62.12	45.54	119.40	0.10	16.49	10,094
50	84		120	0.354	1.166	3.221	0.002	0.246	258.528	29.84	98.36	271.60	0.21	20.75	21,801
120	166		175	0.241	1.154	2.349	0.002	0.126	255.782	40.07	191.76	390.25	0.41	21.00	42,502
175	225		250	0.225	1.131	2.455	0.002	0.108	250.641	50.68	254.40	552.29	0.54	24.23	56,388
250	381		500	0.161	1.138	1.825	0.002	0.071	252.344	61.53	434.16	695.85	0.92	27.14	96,231
500	565		750	0.132	1.138	1.508	0.002	0.055	252.132	74.78	642.65	851.91	1.36	30.85	142,442
750	950		1000	0.593	1.138	6.460	0.002	0.301	252.280	562.94	1,081.30	6,137.29	2.29	286.14	239,666
1000	1923		9999	0.293	1.163	3.738	0.002	0.147	257.796	562.94	2,236.99	7,189.87	4.73	283.54	495,821
0	6	Signal Boards	15	0.542	2.845	3.397	0.007	0.133	466.006	3.25	17.07	20.38	0.04	0.80	2,796
15	37		50	0.616	3.470	3.223	0.006	0.161	443.274	22.79	128.38	119.24	0.21	5.95	16,401
50	82		120	0.308	2.733	2.445	0.005	0.146	443.274	25.29	224.13	200.48	0.43	11.98	36,348
120	158		175	0.233	2.374	1.801	0.005	0.087	443.274	36.78	375.04	284.58	0.79	13.68	70,037
175	216		250	0.214	1.000	1.833	0.006	0.056	535.622	46.32	215.92	396.00	1.30	12.05	115,694
0	43	Skid Steer Lo	50	0.169	1.379	1.360	0.002	0.053	215.454	7.36	59.92	59.13	0.09	2.32	9,366
50	71		120	0.073	1.233	0.923	0.002	0.040	192.654	5.12	86.95	65.10	0.13	2.82	13,589
120	153		175	0.059	1.223	0.626	0.002	0.026	191.100	9.06	186.98	95.71	0.28	4.03	29,224
175	201		250	0.038	1.204	0.481	0.002	0.015	188.159	7.66	241.42	96.54	0.36	2.91	37,732
250	277		500	0.028	1.201	0.220	0.002	0.003	187.666	7.75	332.20	60.78	0.50	0.91	51,921
500	530		750	0.066	1.233	0.899	0.002	0.039	192.714	35.01	653.51	476.37	0.98	20.54	102,138
750	1000		1000	0.112	1.233	1.622	0.002	0.053	192.714	111.67	1,233.03	1,621.98	1.84	53.22	192,714
0	36	Surfacing Equ	50	0.169	0.850	1.278	0.002	0.065	178.876	6.03	30.31	45.58	0.06	2.33	6,380
50	89		120	0.104	0.752	1.089	0.002	0.062	158.264	9.23	66.68	96.58	0.13	5.51	14,035
120	151		175	0.097	0.745	1.107	0.001	0.053	156.724	14.65	112.43	167.16	0.23	7.94	23,662
175	216		250	0.067	0.756	0.972	0.002	0.029	159.135	14.44	163.37	209.92	0.33	6.33	34,383
250	362		500	0.046	0.749	0.554	0.002	0.020	157.534	16.64	271.22	200.75	0.55	7.30	57,083
500	615		750	0.045	0.745	0.631	0.001	0.022	156.864	27.54	458.43	388.28	0.92	13.79	96,483
750	814		1000	0.083	0.748	1.531	0.002	0.037	157.450	67.57	609.17	1,246.83	1.22	29.90	128,209
1000	1141		9999	0.060	0.737	1.176	0.001	0.028	155.194	68.05	841.35	1,342.05	1.69	31.51	177,076
0	36	Sweepers/Sc	50	0.641	1.544	2.321	0.003	0.211	265.154	22.80	54.93	82.61	0.09	7.51	9,436
50	78		120	0.248	1.393	2.042	0.002	0.164	239.305	19.22	108.00	158.31	0.18	12.72	18,552
120	159		175	0.220	1.390	2.099	0.002	0.108	238.803	35.10	221.69	334.80	0.36	17.22	38,082
175	204		250	0.099	1.381	1.132	0.002	0.036	237.291	20.19	282.36	231.48	0.46	7.36	48,504
250	303		500	0.208	1.387	2.478	0.002	0.108	238.264	62.90	419.57	749.74	0.69	32.61	72,075

		2020		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	Equipment	MaxHP	ROG	CO	NOX	SOX	PM	CO2	ROG	CO	NOX	SOX	PM	CO2
500	848		1000	0.116	1.387	1.927	0.002	0.055	238.264	98.78	1,176.17	1,634.41	1.93	46.38	202,048
0	38	Tractors/Load	50	0.320	0.986	1.621	0.002	0.106	210.603	12.26	37.78	62.08	0.08	4.06	8,067
50	83		120	0.128	0.908	1.226	0.002	0.077	193.979	10.55	75.08	101.29	0.15	6.41	16,032
120	144		175	0.095	0.894	0.890	0.002	0.045	190.860	13.63	128.65	128.07	0.26	6.45	27,471
175	204		250	0.087	0.900	1.009	0.002	0.033	192.079	17.74	183.70	206.04	0.37	6.76	39,226
250	320		500	0.075	0.895	0.766	0.002	0.027	191.159	23.92	286.60	245.35	0.58	8.62	61,197
500	575		750	0.103	0.896	1.149	0.002	0.043	191.328	59.35	514.87	660.49	1.05	24.85	109,941
750	871		1000	0.048	0.911	1.080	0.002	0.018	194.567	42.16	794.01	940.96	1.62	15.88	169,546
1000	2006		9999	0.069	0.904	1.269	0.002	0.026	193.002	138.92	1,812.80	2,544.23	3.70	52.16	387,090
0	40	Trenchers	50	0.476	1.633	2.350	0.003	0.179	293.433	18.93	64.94	93.47	0.11	7.12	11,672
50	82		120	0.321	1.472	2.774	0.003	0.208	264.502	26.33	120.76	227.59	0.21	17.04	21,704
120	144		175	0.221	1.449	2.241	0.002	0.115	260.387	31.83	208.43	322.47	0.36	16.49	37,462
175	218		250	0.206	1.467	2.417	0.003	0.098	263.649	45.03	320.40	527.83	0.55	21.39	57,587
250	359		500	0.122	1.458	1.394	0.003	0.053	262.002	43.84	522.63	499.93	0.90	18.96	93,932
500	619		750	0.037	1.464	0.281	0.003	0.005	263.126	22.84	906.58	174.27	1.56	2.81	162,941
750	860		1000	0.609	1.462	6.681	0.003	0.309	262.792	524.11	1,257.44	5,745.87	2.16	265.31	226,001
0	11	Welders	15	0.334	1.601	2.071	0.004	0.107	255.735	3.67	17.61	22.78	0.04	1.18	2,813
15	20		25	0.351	1.121	2.057	0.003	0.099	255.735	7.03	22.42	41.14	0.06	1.98	5,115
25	46		50	0.475	2.298	2.047	0.003	0.125	255.735	21.86	105.70	94.15	0.15	5.75	11,764
50	70		120	0.230	1.653	1.660	0.003	0.113	255.735	16.11	115.71	116.18	0.21	7.92	17,901
120	174		175	0.174	1.427	1.306	0.003	0.066	255.735	30.32	248.27	227.25	0.50	11.55	44,498
175	211		250	0.131	0.501	1.109	0.003	0.035	255.735	27.64	105.77	233.98	0.61	7.30	53,960
250	297		500	0.126	0.482	0.985	0.003	0.033	255.735	37.50	143.23	292.58	0.75	9.88	75,953
0	29	Water Trucks	50	0.341	0.656	1.774	0.002	0.126	216.730	9.947	19.121	51.697	0.060	3.684	6315.602
50	87		120	0.192	0.595	1.513	0.002	0.107	196.671	16.728	51.841	131.741	0.164	9.291	17122.663
120	159		175	0.124	0.602	1.004	0.002	0.052	198.893	19.680	95.679	159.447	0.302	8.311	31601.938
175	211		250	0.110	0.602	0.958	0.002	0.037	198.923	23.175	127.088	202.052	0.401	7.872	41975.853
250	372		500	0.098	0.608	0.896	0.002	0.033	200.790	36.636	226.400	333.773	0.714	12.161	74777.580
500	656		750	0.125	0.606	1.168	0.002	0.046	200.016	81.876	397.208	766.053	1.253	29.963	131193.860
750	897		1000	0.121	0.602	1.831	0.002	0.048	198.806	108.665	540.054	1642.554	1.703	42.905	178374.210
1000	1764		9999	0.108	0.612	1.523	0.002	0.037	202.166	190.467	1079.835	2687.248	3.406	66.010	356658.350

2021

		2021		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	Equipment	MaxHP	ROG	CO	NOX	SOX	PM	CO2	ROG	CO	NOX	SOX	PM	CO2
0	46	Aerial Lifts	50	0.053	0.866	0.901	0.002	0.008	179.282	2.45	39.91	41.53	0.08	0.38	8,267
50	74		120	0.035	0.778	0.537	0.002	0.010	161.199	2.60	57.61	39.78	0.11	0.76	11,932
120	130		175	0.031	0.778	0.274	0.002	0.009	161.168	4.04	101.52	35.71	0.20	1.22	21,028
175	210		250	0.017	0.778	0.080	0.002	0.003	161.179	3.60	163.42	16.78	0.32	0.57	33,848
250	380		500	0.023	0.778	0.197	0.002	0.003	161.179	8.83	295.70	74.98	0.58	1.06	61,248
0	12	Air Compressors	15	0.345	1.696	2.148	0.004	0.104	272.784	4.14	20.35	25.78	0.05	1.25	3,273
15	24		25	0.362	1.176	2.162	0.003	0.098	272.784	8.69	28.22	51.89	0.08	2.35	6,547
25	37		50	0.436	2.417	2.054	0.004	0.107	272.784	16.13	89.42	75.99	0.13	3.97	10,093
50	78		120	0.218	1.763	1.522	0.003	0.096	272.784	16.98	137.49	118.75	0.25	7.50	21,277
120	147		175	0.169	1.532	1.114	0.003	0.058	272.784	24.90	225.16	163.75	0.45	8.56	40,099
175	218		250	0.132	0.532	0.935	0.003	0.030	272.784	28.76	115.97	203.82	0.67	6.61	59,467
250	385		500	0.128	0.511	0.834	0.003	0.029	272.784	49.41	196.82	321.27	1.03	11.26	105,022
500	595		750	0.129	0.511	0.853	0.003	0.030	272.784	76.62	304.18	507.78	1.63	17.62	162,306
750	808		1000	0.140	0.545	1.744	0.003	0.041	272.784	112.95	440.50	1,408.75	2.22	33.42	220,409
0	39	Bore/Drill Rigs	50	0.374	1.197	2.329	0.003	0.146	298.044	14.68	47.03	91.46	0.11	5.74	11,705
50	82		120	0.114	1.040	1.375	0.002	0.066	258.849	9.39	85.62	113.22	0.20	5.42	21,311
120	149		175	0.081	1.067	0.803	0.003	0.035	265.572	12.04	158.48	119.30	0.38	5.20	39,447
175	208		250	0.070	1.047	0.779	0.002	0.024	260.530	14.47	217.45	161.92	0.52	4.91	54,126
250	349		500	0.062	1.051	0.613	0.002	0.021	261.545	21.49	366.90	214.19	0.87	7.17	91,327
500	612		750	0.051	1.060	0.480	0.003	0.017	263.919	31.41	648.85	293.72	1.54	10.26	161,508
750	919		1000	0.071	1.055	1.536	0.003	0.031	262.659	65.66	969.75	1,411.99	2.31	28.36	241,383
1000	2667		9999	0.104	1.056	2.168	0.003	0.055	262.792	276.35	2,815.34	5,781.74	6.69	145.85	700,778
0	9	Cement and Mortar Mixers	15	0.370	1.943	2.320	0.005	0.091	318.248	3.33	17.49	20.88	0.04	0.82	2,864
15	25		25	0.399	1.333	2.475	0.004	0.101	318.248	9.98	33.33	61.87	0.10	2.52	7,956
0	18	Concrete/Industrial Saws	25	0.500	1.708	3.163	0.005	0.118	414.859	9.01	30.75	56.93	0.09	2.13	7,467
25	33		50	0.528	3.272	2.966	0.005	0.135	414.859	17.42	107.97	97.88	0.18	4.44	13,690
50	81		120	0.270	2.573	2.127	0.005	0.121	414.859	21.90	208.38	172.30	0.39	9.84	33,604
120	175		175	0.209	2.243	1.501	0.005	0.074	414.859	36.63	392.56	262.60	0.82	12.98	72,600
0	41	Cranes	50	0.638	0.825	1.733	0.002	0.182	165.300	25.90	33.54	70.39	0.06	7.39	6,716
50	89		120	0.196	0.749	1.651	0.001	0.115	149.975	17.47	66.61	146.85	0.13	10.21	13,340
120	148		175	0.150	0.756	1.473	0.001	0.079	151.462	22.23	111.85	217.82	0.21	11.62	22,399
175	217		250	0.105	0.754	1.182	0.001	0.048	150.939	22.87	163.56	256.60	0.31	10.42	32,754
250	336		500	0.089	0.753	0.992	0.001	0.040	150.795	29.93	253.10	333.35	0.48	13.41	50,683
500	567		750	0.069	0.750	0.786	0.001	0.031	150.187	38.96	425.38	445.68	0.81	17.45	85,184
750	938		1000	0.245	0.748	2.657	0.001	0.128	149.743	229.28	701.11	2,491.47	1.34	120.12	140,399
1000	1030		9999	0.058	0.752	0.684	0.001	0.018	150.667	59.58	774.95	704.47	1.48	18.21	155,187
0	43	Crawler Tractors	50	0.926	1.328	2.408	0.002	0.253	245.176	39.38	56.47	102.35	0.10	10.76	10,422
50	87		120	0.302	1.226	2.426	0.002	0.200	226.331	26.23	106.52	210.71	0.19	17.35	19,658
120	150		175	0.195	1.213	1.884	0.002	0.105	223.948	29.23	181.46	281.81	0.32	15.68	33,490
175	203		250	0.154	1.217	1.858	0.002	0.070	224.662	31.19	246.93	376.97	0.44	14.18	45,572
250	341		500	0.127	1.221	1.405	0.002	0.055	225.403	43.30	416.10	478.64	0.73	18.84	76,793
500	570		750	0.107	1.218	1.211	0.002	0.045	224.743	61.24	694.27	690.56	1.22	25.37	128,129
750	828		1000	0.179	1.214	2.744	0.002	0.078	224.139	148.42	1,005.81	2,272.47	1.77	64.50	185,624
1000	1527		9999	0.151	1.168	2.529	0.002	0.067	215.490	230.16	1,782.39	3,860.84	3.14	101.84	328,945
0	45	Crushing/Proc. Equipment	50	0.673	4.006	3.284	0.006	0.157	443.274	30.29	180.29	147.80	0.26	7.06	19,947
50	85		120	0.342	2.895	2.332	0.005	0.139	443.274	29.08	246.10	198.24	0.44	11.84	37,678
120	171		175	0.269	2.524	1.649	0.005	0.086	443.274	46.00	431.52	282.06	0.85	14.67	75,800
175	250		250	0.214	0.873	1.370	0.005	0.045	443.274	53.54	218.19	342.54	1.25	11.22	110,818
250	382		500	0.209	0.836	1.228	0.004	0.043	443.274	79.96	319.47	469.15	1.66	16.58	169,331
500	602		750	0.209	0.836	1.253	0.004	0.043	443.274	126.02	503.45	754.20	2.68	26.18	266,851
750	1337		9999	0.246	0.886	2.721	0.004	0.063	443.274	328.44	1,184.89	3,637.48	5.96	84.09	592,657
0	16	Dumpers/Tenders	25	0.261	0.889	1.647	0.003	0.062	215.954	4.17	14.23	26.35	0.04	1.00	3,455
0	36	Excavators	50	0.225	1.082	1.497	0.002	0.077	222.282	8.03	38.68	53.48	0.08	2.75	7,944
50	82		120	0.110	0.964	1.088	0.002	0.061	197.918	8.99	78.80	88.97	0.15	5.02	16,185
120	146		175	0.087	0.973	0.777	0.002	0.038	199.850	12.63	142.09	113.42	0.28	5.50	29,186
175	218		250	0.065	0.972	0.651	0.002	0.020	199.611	14.22	212.31	142.32	0.42	4.36	43,609
250	329		500	0.057	0.967	0.509	0.002	0.017	198.690	18.78	317.90	167.15	0.62	5.59	65,298
500	578		750	0.066	0.967	0.618	0.002	0.021	198.661	38.18	558.98	357.24	1.10	12.41	114,814
750	843		1000	0.066	0.965	1.351	0.002	0.025	198.229	55.40	813.45	1,138.42	1.60	21.41	167,082
1000	1569		9999	0.064	0.963	1.195	0.002	0.023	197.811	100.77	1,511.16	1,874.89	2.96	35.38	310,393
0	42	Forklifts	50	0.211	0.638	0.909	0.001	0.064	117.014	8.94	27.04	38.53	0.05	2.71	4,963
50	82		120	0.087	0.572	0.755	0.001	0.054	105.000	7.14	47.13	62.18	0.08	4.41	8,649
120	141		175	0.065	0.573	0.587	0.001	0.032	105.128	9.16	80.94	82.94	0.14	4.48	14,853
175	208		250	0.052	0.574	0.519	0.001	0.020	105.400	10.90	119.55	108.03	0.21	4.15	21,939
250	344		500	0.053	0.575	0.463	0.001	0.019	105.464	18.34	197.53	159.08	0.35	6.48	36,250
500	880		1000	0.018	0.573	0.473	0.001	0.004	105.117	15.87	504.07	416.54	0.88	3.64	92,503
0	11	Generator Sets	15	0.470	2.614	3.295	0.007	0.151	420.542	5.18	28.76	36.24	0.07	1.66	4,626
15	19		25	0.528	1.813	3.333	0.005	0.147	420.542	10.03	34.44	63.33	0.10	2.79	7,990
25	33		50	0.466	2.902	2.937	0.005	0.129	420.542	15.37	95.75	96.93	0.18	4.26	13,878
50	84		120	0.248	2.490	2.197	0.005	0.119	420.542	20.86	209.17	184.58	0.41	10.04	35,326
120	153		175	0.185	2.165	1.601	0.005	0.071	420.542	28.37	331.22	244.96	0.72	10.87	64,343
175	229		250	0.139	0.752	1.341	0.005	0.039	420.542	31.83	172.32	307.05	1.08	8.87	96,304
250	363		500	0.133	0.737	1.209	0.004	0.037	420.542	48.23	267.70	438.79	1.50	13.59	152,657
500	586		750	0.134	0.737	1.235	0.004	0.038	420.542	78.78	432.16	723.88	2.48	22.20	246,438
750	1130		9999	0.168	0.787	2.541	0.004	0.054	420.542	189.67	888.87	2,871.44	4.78	61.23	475,212
0	39	Graders	50	0.956	1.158	2.242	0.002	0.258	223.192	37.44	45.35	87.78	0.08	10.10	8,740
50	91		120	0.385	1.102	2.912	0.002	0.233	212.386	35.07	100.28	265.00	0.18	21.19	19,326
120	148		175	0.216	1.124	1.978	0.002	0.110	216.669	31.98	166.34	292.62	0.31	16.32	32,055
175	204		250	0.143	1.115	1.791	0.002	0.057	214.862	29.28	227.84	365.93	0.42	11.59	43,908
250	293		500	0.138	1.109	1.231	0.002	0.048	213.666	40.38	325.04	360.96	0.60	14.02	62,641
500	796		1000	0.303	1.109	3.798	0.002	0.132	213.737	241.58	882.83	3,023.02	1.62	105.21	170,135
1000	1993		9999	0.209	1.107	2.751	0.002	0.086	213.348	416.55	2,206.16	5,482.92	4.06	170.65	425,161
0	38	Off-Highway Tractors	50	0.413	1.305	1.961	0.002	0.134	253.656	15.55	49.14	73.86	0.09	5.06	9,553
50	75		120	0.180	1.178	1.643	0.002	0.114	228.940	13.41	87.77	122.46	0.16	8.47	17,063
120	158		175	0.118	1.174	1.158	0.002	0.056	228.172	18.64	185.54	183.09	0.34	8.85	36,069
175	214		250	0.091	1.169	0.920	0.002	0.031	227.245	19.46	249.98	196.82	0.46	6.73	48,595
250	334		500	0.067	1.165	0.548	0.002	0.019	226.426	22.26	389.54	183.21	0.72	6.31	75,725
500	574		750	0.083	1.171	0.747	0.002	0.027	227.633	47.38	671.60	428.38	1.25	15.75	130,555
750	1000		1000	0.073	1.172	1.051	0.002	0.028	227.753	72.95	1,171.61	1,051.30	2.17	28.03	227,753
1000	1726		9999	0.121	1.203	1.672	0.002	0.044	233.833	208.07	2,076.49	2,885.66	3.85	76.51	403,655
0	29	Off-Highway Trucks	50	0.329	0.658	1.709	0.002	0.116	217.312	9.58	19.17	49.79	0.06	3.37	6,333
50	87		120	0.177	0.594	1.410	0.002	0.092	196.303	15.43	51.74	122.76	0.16	8.02	17,091
120	159		175	0.111	0.602	0.858	0.002	0.043	198.975	17.68	95.72	136.30	0.30	6.86	31,615
175	211		250	0.100	0.602	0.805	0.002	0.031	198.934	21.03	127.09	169.93	0.40	6.62	41,978
250	372		500	0.090	0.608	0.746	0.002	0.027	200.774	33.48	226.38	277.85	0.71	10.19	74,772
500	656		750	0.117	0.606	1.019	0.002	0.041	200.118	76.88	397.41	668.31	1.25	26.66	131,261
750	897		1000	0.102	0.603	1.588	0.002	0.038	199.299	91.73	541.39	1,424.81	1.71	33.86	178,817
1000	1764		9999	0.093	0.612	1.410	0.002	0.031	202.276	164.02	1,080.43	2,487.34	3.41	55.42	356,854
0	38	Other Construction Equipr	50	0.439	1.335	2.036	0.002	0.158	242.888	16.68	50.75	77.40	0.09	6.02	9,231
50	82		120	0.209	1.195	1.851	0.002	0.134	217.343	17.08	97.45	150.97	0.17	10.96	17,727
120	152		175	0.143	1.188	1.428	0.002	0.075	216.187	21.85	181.23	217.81	0.31	11.39	32,966
175	217		250	0.113	1.202	1.331	0.002	0.049	218.625	24.41	260.70	288.72	0.45	10.52	47,421
250	357		500	0.094	1.202	1.009	0.002	0.037	218.694	33.38	429.05	359.96	0.75	13.29	78,044
500	598		750	0.084	1.197	0.977	0.002	0.032	217.731	50.16	715.40	584.06	1.24	19.40	130,132
750	830		1000	0.071	1.190	1.399	0.002	0.031	216.451	58.70	987.84	1,161.20	1.72	25.76	179,687
1000	1127		9999	0.068	1.163	1.339	0.002	0.027	211.513	76.45	1,310.09	1,508.42	2.28	30.38	238,305
0	35	Other General Industrial E	50	0.297	0.972	1.512	0.002	0.099	199.186	10.44	34.13	53.08	0.07	3.47	6,992

		2021		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	Equipment	MaxHP	ROG	CO	NOX	SOX	PM	CO2	ROG	CO	NOX	SOX	PM	CO2
50	73		120	0.144	0.869	1.270	0.002	0.087	177.921	10.57	63.57	92.98	0.12	6.40	13,022
120	149		175	0.091	0.872	0.802	0.002	0.041	178.621	13.55	130.06	119.64	0.25	6.16	26,642
175	209		250	0.073	0.875	0.715	0.002	0.024	179.141	15.23	182.83	149.58	0.36	4.97	37,451
250	355		500	0.070	0.874	0.614	0.002	0.022	179.029	24.79	310.02	217.71	0.61	7.78	63,504
500	592		750	0.059	0.875	0.474	0.002	0.019	179.232	35.12	517.60	280.30	1.01	10.99	106,023
750	885		1000	0.099	0.872	1.666	0.002	0.041	178.698	87.40	772.06	1,474.40	1.51	36.18	158,148
1000	2000		9999	0.024	0.872	0.787	0.002	0.006	178.698	47.92	1,744.77	1,573.64	3.41	12.98	357,397
0	36	Other Material Handling E	50	0.458	1.196	1.963	0.002	0.156	229.351	16.39	42.74	70.18	0.08	5.59	8,198
50	93		120	0.122	1.081	1.169	0.002	0.065	207.401	11.33	100.73	108.87	0.18	6.10	19,322
120	145		175	0.103	1.078	0.888	0.002	0.045	206.802	14.88	155.86	128.37	0.29	6.50	29,897
175	218		250	0.111	1.076	1.218	0.002	0.040	206.479	24.33	234.96	265.93	0.43	8.84	45,071
250	331		500	0.105	1.074	1.028	0.002	0.040	205.960	34.84	355.79	340.79	0.65	13.25	68,248
500	565		750	0.085	1.078	0.824	0.002	0.031	206.729	47.77	608.45	465.43	1.11	17.52	116,716
750	923		1000	0.039	1.078	0.940	0.002	0.008	206.729	35.94	994.72	867.78	1.82	7.76	190,811
1000	1050		9999	0.030	1.078	0.916	0.002	0.008	206.729	31.48	1,131.59	962.08	2.07	8.08	217,066
0	39	Pavers	50	0.525	1.427	1.912	0.002	0.154	242.304	20.28	55.14	73.84	0.09	5.94	9,359
50	80		120	0.182	1.274	1.672	0.002	0.119	216.191	14.52	101.36	133.10	0.16	9.43	17,205
120	158		175	0.111	1.281	1.119	0.002	0.054	217.472	17.58	202.60	177.02	0.33	8.55	34,390
175	213		250	0.072	1.281	1.032	0.002	0.029	217.435	15.34	273.12	220.04	0.44	6.18	46,360
250	327		500	0.071	1.262	0.853	0.002	0.031	214.266	23.33	413.25	279.19	0.67	10.06	70,147
500	750		750	0.052	1.280	0.493	0.002	0.022	217.241	39.35	959.87	370.07	1.56	16.38	162,931
0	35	Paving Equipment	50	0.218	1.294	1.379	0.002	0.071	204.724	7.59	45.04	48.00	0.07	2.48	7,128
50	89		120	0.132	1.176	1.225	0.002	0.078	186.165	11.69	104.22	108.56	0.16	6.89	16,494
120	148		175	0.085	1.170	0.822	0.002	0.041	185.153	12.64	173.62	122.00	0.26	6.02	27,478
175	216		250	0.078	1.174	0.917	0.002	0.033	185.744	16.88	253.12	197.74	0.38	7.06	40,059
250	339		500	0.077	1.165	0.878	0.002	0.032	184.425	25.99	394.76	297.44	0.60	10.85	62,476
500	605		750	0.065	1.176	0.843	0.002	0.019	186.131	39.19	711.53	510.08	1.08	11.61	112,609
750	842		1000	0.035	1.175	0.828	0.002	0.013	185.931	29.85	989.20	697.02	1.50	11.35	156,554
0	8	Plate Compactors	15	0.284	1.492	1.781	0.004	0.070	244.369	2.28	11.94	14.25	0.03	0.56	1,955
0	13	Pressure Washers	15	0.191	1.060	1.336	0.003	0.061	170.490	2.48	13.78	17.37	0.03	0.80	2,216
15	19		25	0.214	0.735	1.351	0.002	0.059	170.490	4.07	13.96	25.67	0.04	1.13	3,239
25	38		50	0.136	1.002	1.145	0.002	0.043	170.490	5.15	38.09	43.50	0.08	1.64	6,479
50	64		120	0.082	0.964	0.853	0.002	0.041	170.490	5.23	61.70	54.59	0.13	2.60	10,911
0	8	Pumps	15	0.532	2.614	3.311	0.007	0.160	420.542	4.26	20.91	26.49	0.05	1.28	3,364
15	21		25	0.558	1.813	3.333	0.005	0.151	420.542	11.72	38.06	70.00	0.11	3.17	8,831
25	37		50	0.510	3.046	2.976	0.005	0.137	420.542	18.86	112.70	110.10	0.20	5.06	15,560
50	84		120	0.264	2.528	2.229	0.005	0.126	420.542	22.18	212.33	187.22	0.41	10.58	35,326
120	151		175	0.198	2.197	1.627	0.005	0.075	420.542	29.96	331.73	245.65	0.71	11.32	63,502
175	217		250	0.149	0.764	1.364	0.005	0.040	420.542	32.44	165.77	295.91	1.03	8.76	91,258
250	372		500	0.143	0.746	1.225	0.004	0.039	420.542	53.31	277.53	455.88	1.54	14.50	156,442
500	615		750	0.145	0.746	1.253	0.004	0.039	420.542	88.97	458.82	770.37	2.60	24.26	258,633
750	1460		9999	0.178	0.797	2.569	0.004	0.056	420.542	259.41	1,162.92	3,751.12	6.17	81.45	613,991
0	36	Rollers	50	0.333	1.180	1.632	0.002	0.110	218.554	11.87	42.10	58.24	0.07	3.93	7,798
50	87		120	0.139	1.064	1.347	0.002	0.082	196.985	12.06	92.38	116.96	0.16	7.15	17,111
120	144		175	0.076	1.059	0.794	0.002	0.037	196.187	10.89	152.29	114.20	0.27	5.25	28,208
175	213		250	0.077	1.063	0.935	0.002	0.030	196.806	16.45	226.59	199.49	0.40	6.48	41,969
250	335		500	0.087	1.076	0.972	0.002	0.037	199.242	29.00	360.22	325.34	0.64	12.53	66,721
500	521		750	0.035	1.061	0.265	0.002	0.004	196.512	17.96	552.23	138.00	0.98	1.85	102,285
0	47	Rough Terrain Forklifts	50	0.407	1.272	1.773	0.002	0.122	233.984	19.27	60.17	83.85	0.11	5.77	11,064
50	96		120	0.073	1.146	0.919	0.002	0.036	210.703	7.08	110.38	88.50	0.19	3.43	20,297
120	130		175	0.055	1.143	0.650	0.002	0.024	210.101	7.10	148.07	84.22	0.26	3.10	27,227
175	208		250	0.048	1.145	0.648	0.002	0.015	210.453	10.08	238.41	134.98	0.42	3.09	43,839
250	374		500	0.039	1.128	0.523	0.002	0.011	207.423	14.43	421.76	195.69	0.74	4.24	77,553
500	625		750	0.044	1.143	0.537	0.002	0.004	210.233	27.80	714.57	335.63	1.25	2.37	131,396
0	42	Rubber Tired Dozers	50	0.515	1.072	1.789	0.002	0.147	229.216	21.43	44.59	74.40	0.09	6.10	9,532
50	82		120	0.377	0.981	2.819	0.002	0.240	209.773	30.76	80.06	230.04	0.16	19.58	17,115
120	150		175	0.286	0.969	2.684	0.002	0.153	207.133	42.80	145.03	401.78	0.30	22.86	31,004
175	211		250	0.248	0.973	2.489	0.002	0.121	207.931	52.41	205.21	525.10	0.42	25.48	43,869
250	354		500	0.204	0.981	2.009	0.002	0.092	209.765	72.10	347.40	711.12	0.71	32.48	74,268
500	584		750	0.190	0.969	2.420	0.002	0.086	207.164	110.74	566.02	1,413.66	1.16	50.38	121,004
0	42	Rubber Tired Loaders	50	0.502	0.988	1.800	0.002	0.148	210.252	20.93	41.21	75.04	0.08	6.17	8,767
50	86		120	0.189	0.879	1.525	0.002	0.114	186.952	16.24	75.71	131.37	0.15	9.86	16,105
120	150		175	0.131	0.888	1.128	0.002	0.062	188.820	19.66	133.15	169.26	0.27	9.26	28,322
175	206		250	0.101	0.885	1.085	0.002	0.036	188.212	20.75	182.18	223.32	0.37	7.45	38,754
250	320		500	0.100	0.882	0.944	0.002	0.035	187.556	31.99	281.88	301.92	0.57	11.27	59,960
500	600		750	0.103	0.871	0.955	0.002	0.037	185.202	61.71	522.81	573.75	1.06	22.24	111,210
750	837		1000	0.111	0.888	1.800	0.002	0.046	188.891	93.22	743.08	1,506.19	1.51	38.72	158,066
1000	1521		9999	0.085	0.884	1.492	0.002	0.033	187.941	129.04	1,343.85	2,269.73	2.73	49.57	285,859
0	36	Scrapers	50	1.517	1.260	3.055	0.003	0.403	279.274	54.83	45.54	110.43	0.10	14.58	10,094
50	84		120	0.355	1.166	3.212	0.002	0.247	258.511	29.98	98.35	270.88	0.21	20.84	21,799
120	166		175	0.218	1.154	2.094	0.002	0.112	255.807	36.23	191.77	347.99	0.41	18.58	42,506
175	225		250	0.197	1.131	2.107	0.002	0.091	250.715	44.37	254.48	473.94	0.54	20.53	56,404
250	381		500	0.151	1.139	1.662	0.002	0.065	252.499	57.60	434.43	633.72	0.92	24.65	96,290
500	565		750	0.126	1.138	1.393	0.002	0.051	252.136	71.43	642.66	786.81	1.36	28.69	142,445
750	950		1000	0.593	1.138	6.460	0.002	0.301	252.280	562.94	1,081.30	6,137.29	2.29	286.14	239,666
1000	1923		9999	0.237	1.163	3.219	0.002	0.117	257.796	455.61	2,236.99	6,191.54	4.73	224.50	495,821
0	6	Signal Boards	15	0.542	2.845	3.397	0.007	0.133	466.006	3.25	17.07	20.38	0.04	0.80	2,796
15	37		50	0.558	3.417	3.121	0.006	0.140	443.274	20.66	126.42	115.49	0.21	5.17	16,401
50	82		120	0.284	2.725	2.254	0.005	0.127	443.274	23.27	223.43	184.82	0.43	10.43	36,348
120	158		175	0.217	2.374	1.594	0.005	0.077	443.274	34.31	375.08	251.88	0.79	12.11	70,037
175	216		250	0.203	0.993	1.602	0.006	0.049	535.623	43.88	214.51	346.02	1.30	10.64	115,695
0	43	Skid Steer Loaders	50	0.158	1.378	1.317	0.002	0.047	215.329	6.85	59.89	57.23	0.09	2.02	9,360
50	71		120	0.069	1.233	0.872	0.002	0.035	192.682	4.84	86.96	61.49	0.13	2.50	13,591
120	153		175	0.060	1.223	0.613	0.002	0.026	191.112	9.18	187.00	93.81	0.28	3.92	29,226
175	201		250	0.039	1.204	0.485	0.002	0.015	188.230	7.89	241.51	97.32	0.36	2.94	37,746
250	277		500	0.029	1.201	0.219	0.002	0.003	187.666	8.10	332.20	60.49	0.50	0.92	51,921
500	530		750	0.067	1.233	0.900	0.002	0.039	192.714	35.65	653.51	477.21	0.98	20.66	102,138
750	1000		1000	0.117	1.233	1.669	0.002	0.055	192.714	116.80	1,233.03	1,668.80	1.84	55.17	192,714
0	36	Surfacing Equipment	50	0.160	0.850	1.263	0.002	0.061	178.962	5.70	30.33	45.04	0.06	2.19	6,383
50	89		120	0.098	0.752	1.044	0.002	0.057	158.355	8.72	66.72	92.54	0.13	5.09	14,043
120	151		175	0.081	0.745	0.934	0.001	0.044	156.711	12.29	112.42	141.05	0.23	6.62	23,660
175	216		250	0.065	0.757	0.903	0.002	0.028	159.261	14.09	163.50	195.01	0.33	6.01	34,410
250	362		500	0.044	0.749	0.528	0.002	0.019	157.573	16.10	271.29	191.50	0.55	6.94	57,097
500	615		750	0.039	0.747	0.482	0.002	0.019	157.125	24.28	459.19	296.18	0.92	11.41	96,644
750	814		1000	0.054	0.748	1.106	0.002	0.023	157.385	43.73	608.92	900.99	1.22	18.95	128,157
1000	1141		9999	0.061	0.737	1.179	0.001	0.028	155.194	69.46	841.35	1,345.64	1.69	31.78	177,076
0	36	Sweepers/Scrubbers	50	0.581	1.544	2.209	0.003	0.188	265.154	20.69	54.93	78.62	0.09	6.67	9,436
50	78		120	0.210	1.393	1.805	0.002	0.133	239.305	16.27	108.00	139.94	0.18	10.29	18,552
120	159		175	0.183	1.390	1.689	0.002	0.085	238.803	29.26	221.69	269.35	0.36	13.60	38,082
175	204		250	0.078	1.381	0.801	0.002	0.025	237.291	16.01	282.36	163.74	0.46	5.12	48,504
250	303		500	0.210	1.387	2.481	0.002	0.108	238.264	63.64	419.57	750.44	0.69	32.71	72,075
500	848		1000	0.123	1.387	1.942	0.002	0.056	238.264	104.56	1,176.17	1,647.15	1.93	47.50	202,048
0	38	Tractors/Loaders/Backhoe	50	0.292	0.985	1.557	0.002	0.094	210.296	11.17	37.72	59.66	0.08	3.59	8,055
50	83		120	0.114	0.909	1.104	0.002	0.065	194.064	9.43	75.12	91.22	0.15	5.38	16,040
120	144		175	0.085	0.894	0.760	0.002	0.038	190.866	12.27	128.66	109.38	0.26	5.52	27,472
175	204		250	0.081	0.900	0.873	0.002	0.029	192.109	16.49	183.73	178.29	0.37	6.02	39,232
250	320		500	0.069	0.897	0.654	0.002	0.024	191.590	22.15	287.24	209.52	0.59	7.55	61,336
500	575		750	0.095	0.892	1.015	0.002	0.038	190.428	54.84	512.45	583.19	1.04	22.04	109,424
750	871		1000	0.051	0.911	1.087	0.002	0.019	194.525	44.75	793.84	947.27	1.62	16.18	169,509
1000	2006		9999	0.070	0.904	1.260	0.002	0.026	193.002	141.09	1,812.80	2,527.29	3.70	51.72	387,090
0	40	Trenchers	50	0.425	1.632	2.241	0.003	0.157	293.389	16.92	64.93	89.13	0.11	6.26	11,670

		2021		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	**Equipment**	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2	**ROG**	**CO**	**NOX**	**SOX**	**PM**	**CO2**
50	82		120	0.292	1.472	2.566	0.003	0.186	264.591	24.00	120.80	210.53	0.21	15.29	21,711
120	144		175	0.214	1.449	2.147	0.002	0.110	260.387	30.76	208.43	308.87	0.36	15.81	37,462
175	218		250	0.187	1.468	2.191	0.003	0.086	263.793	40.93	320.58	478.58	0.55	18.86	57,618
250	359		500	0.116	1.458	1.252	0.003	0.050	262.038	41.72	522.70	448.78	0.90	18.06	93,945
500	619		750	0.035	1.464	0.239	0.003	0.005	263.056	21.44	906.34	147.85	1.56	2.80	162,897
750	860		1000	0.612	1.462	6.697	0.003	0.310	262.792	526.28	1,257.44	5,759.24	2.16	266.77	226,001
0	11	Welders	15	0.324	1.590	2.014	0.004	0.097	255.735	3.56	17.49	22.15	0.04	1.07	2,813
15	20		25	0.339	1.102	2.027	0.003	0.092	255.735	6.79	22.04	40.54	0.06	1.83	5,115
25	46		50	0.383	2.128	1.886	0.003	0.096	255.735	17.61	97.87	86.74	0.15	4.42	11,764
50	70		120	0.190	1.612	1.408	0.003	0.087	255.735	13.31	112.87	98.59	0.21	6.11	17,901
120	174		175	0.146	1.401	1.031	0.003	0.052	255.735	25.40	243.71	179.38	0.50	9.09	44,498
175	211		250	0.112	0.487	0.866	0.003	0.027	255.735	23.66	102.70	182.65	0.61	5.77	53,960
250	297		500	0.109	0.470	0.773	0.003	0.026	255.735	32.29	139.67	229.44	0.75	7.82	75,953
0	29	Water Trucks	50	0.329	0.658	1.709	0.002	0.116	217.312	9.583	19.173	49.789	0.060	3.369	6332.546
50	87		120	0.177	0.594	1.410	0.002	0.092	196.303	15.433	51.744	122.765	0.163	8.016	17090.629
120	159		175	0.111	0.602	0.858	0.002	0.043	198.975	17.682	95.719	136.303	0.302	6.863	31614.923
175	211		250	0.100	0.602	0.805	0.002	0.031	198.934	21.031	127.095	169.933	0.401	6.618	41978.141
250	372		500	0.090	0.608	0.746	0.002	0.027	200.774	33.476	226.382	277.849	0.714	10.191	74771.790
500	656		750	0.117	0.606	1.019	0.002	0.041	200.118	76.877	397.411	668.314	1.253	26.664	131260.782
750	897		1000	0.102	0.603	1.588	0.002	0.038	199.299	91.726	541.394	1424.806	1.708	33.857	178816.827
1000	1764		9999	0.093	0.612	1.410	0.002	0.031	202.276	164.022	1080.427	2487.341	3.408	55.416	356854.035

2022															
		2022		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	Equipment	MaxHP	ROG	CO	NOX	SOX	PM	CO2	ROG	CO	NOX	SOX	PM	CO2
0	46	Aerial Lifts	50	0.052	0.866	0.896	0.002	0.007	179.282	2.41	39.91	41.31	0.08	0.34	8,267
50	74		120	0.034	0.778	0.501	0.002	0.009	161.199	2.50	57.61	37.11	0.11	0.69	11,932
120	130		175	0.029	0.778	0.221	0.002	0.008	161.168	3.85	101.52	28.89	0.20	1.09	21,028
175	210		250	0.018	0.778	0.080	0.002	0.003	161.179	3.78	163.42	16.84	0.32	0.58	33,848
250	380		500	0.024	0.778	0.198	0.002	0.003	161.179	9.23	295.70	75.23	0.58	1.07	61,248
0	12	Air Compress	15	0.341	1.690	2.122	0.004	0.099	272.784	4.09	20.28	25.47	0.05	1.19	3,273
15	24		25	0.356	1.166	2.150	0.003	0.094	272.784	8.55	27.98	51.59	0.08	2.25	6,547
25	37		50	0.402	2.390	1.995	0.004	0.093	272.784	14.86	88.44	73.80	0.13	3.45	10,093
50	78		120	0.204	1.760	1.409	0.003	0.084	272.784	15.91	137.26	109.88	0.25	6.57	21,277
120	147		175	0.160	1.533	0.992	0.003	0.052	272.784	23.47	225.42	145.80	0.45	7.59	40,099
175	218		250	0.126	0.529	0.819	0.003	0.027	272.784	27.44	115.41	178.58	0.67	5.84	59,467
250	385		500	0.123	0.509	0.744	0.003	0.026	272.784	47.31	195.85	286.50	1.03	9.97	105,022
500	595		750	0.123	0.509	0.760	0.003	0.026	272.784	73.34	302.68	452.15	1.63	15.59	162,306
750	808		1000	0.133	0.538	1.654	0.003	0.038	272.784	107.46	434.32	1,336.46	2.22	30.51	220,409
0	39	Bore/Drill Rig	50	0.332	1.185	2.153	0.003	0.121	294.978	13.04	46.54	84.56	0.11	4.75	11,585
50	82		120	0.101	1.034	1.218	0.002	0.054	257.343	8.27	85.12	100.31	0.20	4.43	21,187
120	149		175	0.072	1.068	0.647	0.003	0.029	265.752	10.69	158.58	96.16	0.38	4.24	39,473
175	208		250	0.060	1.048	0.584	0.002	0.019	260.958	12.56	217.81	121.41	0.52	3.90	54,215
250	349		500	0.057	1.045	0.520	0.002	0.018	260.085	19.75	364.85	181.65	0.87	6.17	90,817
500	612		750	0.048	1.067	0.388	0.003	0.014	265.623	29.23	653.04	237.73	1.55	8.63	162,551
750	919		1000	0.030	1.058	1.145	0.003	0.009	263.274	27.46	972.02	1,052.04	2.31	8.39	241,949
1000	2667		9999	0.105	1.056	2.171	0.003	0.055	262.792	279.11	2,815.34	5,788.79	6.69	146.44	700,778
0	9	Cement and I	15	0.370	1.943	2.320	0.005	0.091	318.248	3.33	17.49	20.88	0.04	0.82	2,864
15	25		25	0.395	1.326	2.464	0.004	0.099	318.248	9.87	33.15	61.60	0.10	2.46	7,956
0	18	Concrete/Indu	25	0.500	1.708	3.163	0.005	0.118	414.859	9.01	30.75	56.93	0.09	2.13	7,467
25	33		50	0.482	3.229	2.874	0.005	0.116	414.859	15.92	106.55	94.83	0.18	3.82	13,690
50	81		120	0.251	2.566	1.961	0.005	0.105	414.859	20.34	207.84	158.84	0.39	8.54	33,604
120	175		175	0.196	2.243	1.319	0.005	0.065	414.859	34.22	392.55	230.78	0.82	11.40	72,600
0	41	Cranes	50	0.612	0.825	1.700	0.002	0.174	165.291	24.85	33.54	69.05	0.06	7.06	6,716
50	89		120	0.174	0.749	1.483	0.001	0.100	150.009	15.50	66.63	131.94	0.13	8.86	13,343
120	148		175	0.138	0.756	1.330	0.001	0.071	151.476	20.37	111.86	196.71	0.21	10.49	22,401
175	217		250	0.095	0.754	1.020	0.001	0.042	150.964	20.66	163.59	221.41	0.31	9.19	32,759
250	336		500	0.079	0.753	0.834	0.001	0.034	150.707	26.44	252.95	280.20	0.48	11.36	50,654
500	567		750	0.060	0.750	0.648	0.001	0.026	150.163	34.25	425.32	367.81	0.81	14.52	85,171
750	938		1000	0.214	0.748	2.392	0.001	0.111	149.743	200.70	701.11	2,242.54	1.34	104.11	140,399
1000	1030		9999	0.061	0.752	0.688	0.001	0.018	150.667	62.53	774.95	708.15	1.48	18.48	155,187
0	43	Crawler Tract	50	0.852	1.329	2.307	0.002	0.231	245.195	36.22	56.48	98.06	0.10	9.82	10,423
50	87		120	0.269	1.225	2.187	0.002	0.175	226.134	23.39	106.43	189.98	0.19	15.19	19,641
120	150		175	0.175	1.214	1.641	0.002	0.092	224.017	26.12	181.52	245.38	0.32	13.70	33,500
175	203		250	0.137	1.215	1.602	0.002	0.060	224.269	27.85	246.50	325.02	0.43	12.26	45,492
250	341		500	0.114	1.221	1.177	0.002	0.048	225.369	38.87	416.04	400.92	0.73	16.23	76,781
500	570		750	0.089	1.217	0.911	0.002	0.034	224.639	50.62	693.95	519.62	1.22	19.40	128,070
750	828		1000	0.160	1.212	2.540	0.002	0.070	223.606	132.54	1,003.41	2,103.36	1.77	57.68	185,183
1000	1527		9999	0.152	1.168	2.534	0.002	0.067	215.490	231.45	1,782.39	3,868.66	3.14	102.41	328,945
0	45	Crushing/Pro	50	0.621	3.964	3.184	0.006	0.135	443.274	27.95	178.36	143.30	0.26	6.06	19,947
50	85		120	0.320	2.890	2.152	0.005	0.120	443.274	27.21	245.63	182.88	0.44	10.22	37,678
120	171		175	0.252	2.525	1.452	0.005	0.075	443.274	43.17	431.80	248.34	0.85	12.81	75,800
175	250		250	0.203	0.869	1.187	0.005	0.039	443.274	50.86	217.27	296.76	1.25	9.77	110,818
250	382		500	0.199	0.833	1.084	0.004	0.038	443.274	76.20	318.11	414.01	1.66	14.47	169,331
500	602		750	0.200	0.833	1.105	0.004	0.038	443.274	120.26	501.44	665.28	2.68	22.87	266,851
750	1337		9999	0.235	0.875	2.582	0.004	0.057	443.274	313.81	1,169.23	3,452.74	5.96	76.17	592,657
0	16	Dumpers/Ter	25	0.261	0.889	1.646	0.003	0.062	215.954	4.17	14.23	26.34	0.04	0.99	3,455
0	36	Excavators	50	0.191	1.082	1.413	0.002	0.061	222.311	6.83	38.68	50.50	0.08	2.18	7,945
50	82		120	0.101	0.963	0.995	0.002	0.053	197.848	8.23	78.77	81.40	0.15	4.30	16,179
120	146		175	0.076	0.973	0.641	0.002	0.031	199.780	11.16	142.04	93.59	0.28	4.53	29,176
175	218		250	0.059	0.972	0.529	0.002	0.017	199.716	12.96	212.43	115.65	0.42	3.63	43,632
250	329		500	0.051	0.968	0.397	0.002	0.013	198.730	16.81	317.97	130.51	0.62	4.38	65,311
500	578		750	0.060	0.967	0.491	0.002	0.018	198.552	34.64	558.67	283.95	1.10	10.42	114,751
750	843		1000	0.068	0.965	1.358	0.002	0.026	198.235	57.26	813.47	1,144.89	1.60	21.70	167,088
1000	1569		9999	0.032	0.963	0.875	0.002	0.009	197.811	50.05	1,511.16	1,372.45	2.96	13.52	310,393
0	42	Forklifts	50	0.181	0.638	0.867	0.001	0.054	117.014	7.67	27.04	36.76	0.05	2.30	4,963
50	82		120	0.076	0.572	0.675	0.001	0.045	105.000	6.27	47.13	55.63	0.08	3.69	8,649
120	141		175	0.057	0.573	0.498	0.001	0.027	105.128	8.10	80.94	70.42	0.14	3.76	14,853
175	208		250	0.050	0.574	0.466	0.001	0.018	105.400	10.33	119.55	97.04	0.21	3.76	21,939
250	344		500	0.049	0.575	0.400	0.001	0.015	105.464	16.76	197.53	137.57	0.35	5.31	36,250
500	880		1000	0.020	0.573	0.477	0.001	0.004	105.117	17.17	504.07	420.01	0.88	3.74	92,503
0	11	Generator Se	15	0.465	2.606	3.258	0.007	0.145	420.542	5.11	28.66	35.84	0.07	1.59	4,626
15	19		25	0.524	1.797	3.314	0.005	0.141	420.542	9.95	34.15	62.96	0.10	2.68	7,990
25	33		50	0.428	2.870	2.852	0.005	0.113	420.542	14.13	94.72	94.11	0.18	3.72	13,878
50	84		120	0.230	2.485	2.039	0.005	0.106	420.542	19.35	208.75	171.26	0.41	8.87	35,326
120	153		175	0.173	2.166	1.428	0.005	0.063	420.542	26.51	331.44	218.50	0.72	9.69	64,343
175	229		250	0.132	0.748	1.178	0.005	0.034	420.542	30.16	171.38	269.70	1.08	7.86	96,304
250	363		500	0.127	0.733	1.079	0.004	0.033	420.542	45.96	266.25	391.65	1.50	12.07	152,657
500	586		750	0.128	0.733	1.101	0.004	0.034	420.542	74.95	429.81	645.26	2.48	19.71	246,438
750	1130		9999	0.158	0.775	2.416	0.004	0.049	420.542	178.18	876.24	2,729.57	4.78	55.90	475,212
0	39	Graders	50	0.901	1.158	2.179	0.002	0.243	223.232	35.28	45.36	85.34	0.08	9.52	8,742
50	91		120	0.341	1.103	2.599	0.002	0.201	212.640	31.00	100.40	236.53	0.18	18.33	19,350
120	148		175	0.188	1.124	1.686	0.002	0.094	216.686	27.87	166.35	249.41	0.31	13.86	32,058
175	204		250	0.131	1.114	1.589	0.002	0.051	214.726	26.83	227.69	324.73	0.42	10.33	43,880
250	293		500	0.133	1.109	1.145	0.002	0.044	213.680	39.00	325.06	335.72	0.60	12.97	62,645
500	796		1000	0.042	1.109	0.977	0.002	0.009	213.737	33.45	882.83	777.47	1.62	7.03	170,135
1000	1993		9999	0.212	1.107	2.762	0.002	0.086	213.348	421.97	2,206.16	5,504.86	4.06	171.77	425,161
0	38	Off-Highway	50	0.354	1.303	1.863	0.002	0.113	253.380	13.32	49.09	70.17	0.09	4.24	9,542
50	75		120	0.159	1.179	1.481	0.002	0.096	229.287	11.83	87.91	110.35	0.16	7.12	17,089
120	158		175	0.105	1.173	0.975	0.002	0.047	228.118	16.66	185.50	154.12	0.34	7.39	36,060
175	214		250	0.082	1.169	0.754	0.002	0.026	227.307	17.50	250.05	161.34	0.46	5.59	48,608
250	334		500	0.060	1.165	0.435	0.002	0.015	226.496	20.10	389.67	145.58	0.72	5.15	75,748
500	574		750	0.078	1.171	0.624	0.002	0.024	227.697	44.69	671.79	357.95	1.25	13.61	130,592
750	1000		1000	0.077	1.172	1.059	0.002	0.029	227.753	77.45	1,171.61	1,058.97	2.17	28.60	227,753
1000	1726		9999	0.125	1.204	1.678	0.002	0.045	234.008	215.48	2,078.03	2,897.03	3.86	77.36	403,956
0	29	Off-Highway	50	0.313	0.658	1.640	0.002	0.103	217.399	9.12	19.18	47.80	0.06	2.99	6,335
50	87		120	0.163	0.596	1.291	0.002	0.078	196.774	14.18	51.87	112.38	0.16	6.80	17,132
120	159		175	0.096	0.602	0.692	0.002	0.033	198.929	15.29	95.70	109.89	0.30	5.32	31,608
175	211		250	0.086	0.602	0.618	0.002	0.024	198.690	18.09	126.94	130.38	0.40	5.13	41,927
250	372		500	0.078	0.608	0.569	0.002	0.021	200.847	29.19	226.46	211.88	0.71	7.70	74,799
500	656		750	0.105	0.607	0.866	0.002	0.033	200.535	69.04	398.24	568.12	1.26	21.96	131,534

		2022		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	**Equipment**	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2	**ROG**	**CO**	**NOX**	**SOX**	**PM**	**CO2**
750	897		1000	0.093	0.605	1.467	0.002	0.033	199.844	83.87	542.87	1,316.60	1.71	29.43	179,306
1000	1764		9999	0.077	0.613	1.275	0.002	0.025	202.442	136.70	1,081.31	2,248.97	3.41	43.91	357,147
0	38	Other Constru	50	0.400	1.339	1.969	0.002	0.144	243.532	15.20	50.88	74.85	0.09	5.49	9,256
50	82		120	0.191	1.195	1.702	0.002	0.120	217.362	15.60	97.46	138.86	0.17	9.77	17,729
120	152		175	0.128	1.188	1.244	0.002	0.065	216.117	19.56	181.18	189.68	0.31	9.90	32,956
175	217		250	0.096	1.203	1.056	0.002	0.040	218.776	20.82	260.88	229.07	0.45	8.63	47,453
250	357		500	0.082	1.204	0.821	0.002	0.031	219.056	29.18	429.76	292.84	0.75	11.01	78,173
500	598		750	0.078	1.198	0.845	0.002	0.028	217.902	46.45	715.97	504.87	1.24	16.96	130,234
750	830		1000	0.046	1.200	1.088	0.002	0.018	218.235	38.07	995.98	903.45	1.73	14.94	181,169
1000	1127		9999	0.070	1.163	1.345	0.002	0.027	211.503	79.08	1,310.02	1,515.15	2.28	30.75	238,293
0	35	Other Genera	50	0.251	0.972	1.434	0.002	0.081	199.186	8.81	34.13	50.34	0.07	2.85	6,992
50	73		120	0.121	0.869	1.093	0.002	0.068	177.921	8.87	63.57	80.02	0.12	4.98	13,022
120	149		175	0.087	0.872	0.735	0.002	0.038	178.621	12.99	130.06	109.56	0.25	5.65	26,642
175	209		250	0.067	0.875	0.601	0.002	0.019	179.141	13.96	182.83	125.64	0.36	4.06	37,451
250	355		500	0.063	0.874	0.490	0.002	0.017	179.029	22.17	310.02	173.75	0.61	6.05	63,504
500	592		750	0.053	0.875	0.363	0.002	0.016	179.232	31.51	517.60	214.76	1.01	9.26	106,023
750	885		1000	0.067	0.872	1.347	0.002	0.027	178.698	59.33	772.06	1,192.08	1.51	23.99	158,148
1000	2000		9999	0.027	0.872	0.794	0.002	0.007	178.698	53.50	1,744.77	1,588.53	3.41	13.43	357,397
0	36	Other Materia	50	0.456	1.196	1.945	0.002	0.152	229.351	16.32	42.74	69.53	0.08	5.44	8,198
50	93		120	0.102	1.081	1.015	0.002	0.048	207.401	9.53	100.73	94.53	0.18	4.45	19,322
120	145		175	0.093	1.078	0.749	0.002	0.041	206.802	13.49	155.86	108.23	0.29	5.87	29,897
175	218		250	0.095	1.076	0.959	0.002	0.033	206.479	20.66	234.96	209.29	0.43	7.13	45,071
250	331		500	0.094	1.074	0.815	0.002	0.033	205.960	31.04	355.79	270.17	0.65	10.92	68,248
500	565		750	0.078	1.078	0.619	0.002	0.026	206.729	43.97	608.45	349.21	1.11	14.56	116,716
750	923		1000	0.042	1.078	0.948	0.002	0.009	206.729	38.70	994.72	875.13	1.82	7.98	190,811
1000	1050		9999	0.031	1.078	0.920	0.002	0.008	206.729	33.04	1,131.59	966.26	2.07	8.20	217,066
0	39	Pavers	50	0.475	1.429	1.836	0.002	0.137	242.479	18.33	55.18	70.93	0.09	5.29	9,366
50	80		120	0.162	1.275	1.520	0.002	0.103	216.381	12.91	101.45	120.97	0.16	8.20	17,220
120	158		175	0.093	1.282	0.905	0.002	0.043	217.566	14.77	202.69	143.17	0.33	6.80	34,405
175	213		250	0.061	1.281	0.789	0.002	0.023	217.387	13.02	273.06	168.27	0.44	4.85	46,349
250	327		500	0.065	1.263	0.752	0.002	0.026	214.457	21.35	413.62	246.19	0.67	8.58	70,209
500	750		750	0.023	1.280	0.108	0.002	0.004	217.241	17.06	959.87	80.70	1.56	2.74	162,931
0	35	Paving Equip	50	0.212	1.294	1.362	0.002	0.067	204.827	7.40	45.06	47.43	0.07	2.33	7,132
50	89		120	0.110	1.177	1.065	0.002	0.061	186.254	9.73	104.27	94.37	0.16	5.38	16,502
120	148		175	0.079	1.170	0.736	0.002	0.036	185.159	11.73	173.63	109.26	0.26	5.33	27,479
175	216		250	0.073	1.174	0.791	0.002	0.029	185.751	15.67	253.13	170.64	0.38	6.36	40,060
250	339		500	0.066	1.166	0.664	0.002	0.026	184.486	22.26	394.89	224.87	0.60	8.67	62,496
500	605		750	0.055	1.176	0.626	0.002	0.014	186.140	33.03	711.57	378.81	1.08	8.25	112,615
750	842		1000	0.038	1.175	0.832	0.002	0.014	185.931	31.61	989.20	700.76	1.50	11.54	156,554
0	8	Plate Compa	15	0.284	1.492	1.781	0.004	0.070	244.369	2.28	11.94	14.25	0.03	0.56	1,955
0	13	Pressure Was	15	0.188	1.056	1.321	0.003	0.059	170.490	2.45	13.73	17.17	0.03	0.76	2,216
15	19		25	0.212	0.729	1.343	0.002	0.057	170.490	4.03	13.85	25.53	0.04	1.09	3,239
25	38		50	0.124	0.992	1.111	0.002	0.037	170.490	4.70	37.68	42.21	0.08	1.42	6,479
50	64		120	0.075	0.962	0.792	0.002	0.036	170.490	4.80	61.56	50.68	0.13	2.29	10,911
0	8	Pumps	15	0.525	2.606	3.272	0.007	0.153	420.542	4.20	20.85	26.17	0.05	1.22	3,364
15	21		25	0.549	1.797	3.314	0.005	0.145	420.542	11.53	37.75	69.59	0.11	3.04	8,831
25	37		50	0.469	3.013	2.889	0.005	0.120	420.542	17.37	111.48	106.91	0.20	4.43	15,560
50	84		120	0.246	2.523	2.068	0.005	0.111	420.542	20.63	211.92	173.67	0.41	9.36	35,326
120	151		175	0.186	2.199	1.451	0.005	0.067	420.542	28.07	331.99	219.16	0.71	10.10	63,502
175	217		250	0.142	0.760	1.198	0.005	0.036	420.542	30.80	164.87	259.98	1.03	7.77	91,258
250	372		500	0.137	0.742	1.094	0.004	0.035	420.542	50.90	276.02	407.00	1.54	12.88	156,442
500	615		750	0.138	0.742	1.117	0.004	0.035	420.542	84.83	456.33	686.86	2.60	21.55	258,633
750	1460		9999	0.168	0.785	2.442	0.004	0.051	420.542	244.78	1,146.30	3,565.15	6.17	74.43	613,991
0	36	Rollers	50	0.290	1.180	1.549	0.002	0.094	218.513	10.34	42.09	55.26	0.07	3.35	7,796
50	87		120	0.122	1.064	1.208	0.002	0.070	196.997	10.58	92.38	104.91	0.16	6.05	17,112
120	144		175	0.065	1.059	0.643	0.002	0.030	196.173	9.28	152.28	92.47	0.27	4.25	28,206
175	213		250	0.073	1.063	0.830	0.002	0.029	196.824	15.62	226.61	176.95	0.40	6.15	41,973
250	335		500	0.086	1.075	0.924	0.002	0.036	199.097	28.64	359.96	309.52	0.64	12.21	66,673
500	521		750	0.036	1.061	0.266	0.002	0.004	196.512	18.76	552.23	138.53	0.98	1.87	102,285
0	47	Rough Terrai	50	0.332	1.272	1.625	0.002	0.095	233.820	15.69	60.13	76.82	0.11	4.51	11,056
50	96		120	0.067	1.146	0.844	0.002	0.029	210.694	6.43	110.37	81.25	0.19	2.83	20,296
120	130		175	0.050	1.142	0.565	0.002	0.021	210.065	6.52	148.04	73.18	0.26	2.66	27,223
175	208		250	0.050	1.144	0.650	0.002	0.015	210.450	10.38	238.41	135.40	0.42	3.11	43,838
250	374		500	0.029	1.130	0.224	0.002	0.004	207.786	10.74	422.50	83.87	0.74	1.34	77,689
500	625		750	0.046	1.143	0.538	0.002	0.004	210.233	28.72	714.57	336.54	1.25	2.38	131,396
0	42	Rubber Tired	50	0.521	1.072	1.799	0.002	0.146	229.237	21.68	44.59	74.81	0.09	6.09	9,533
50	82		120	0.320	0.979	2.450	0.002	0.198	209.337	26.07	79.89	199.94	0.16	16.13	17,080
120	150		175	0.248	0.971	2.296	0.002	0.129	207.543	37.17	145.31	343.65	0.30	19.31	31,066
175	211		250	0.199	0.972	1.995	0.002	0.095	207.851	41.93	205.13	420.88	0.42	19.98	43,852
250	354		500	0.196	0.982	1.901	0.002	0.087	209.907	69.55	347.64	672.88	0.71	30.78	74,318
500	584		750	0.190	0.969	2.420	0.002	0.086	207.159	111.15	566.01	1,413.64	1.16	50.38	121,001
0	42	Rubber Tired	50	0.446	0.989	1.718	0.002	0.128	210.348	18.61	41.23	71.63	0.08	5.35	8,771
50	86		120	0.167	0.879	1.363	0.002	0.096	186.981	14.36	75.72	117.45	0.15	8.31	16,108
120	150		175	0.112	0.887	0.911	0.002	0.049	188.758	16.75	133.10	136.65	0.27	7.37	28,313
175	206		250	0.086	0.885	0.849	0.002	0.028	188.348	17.63	182.32	174.84	0.37	5.86	38,782
250	320		500	0.090	0.882	0.787	0.002	0.029	187.636	28.65	282.00	251.60	0.57	9.39	59,985
500	600		750	0.088	0.874	0.759	0.002	0.029	185.909	52.95	524.80	455.60	1.07	17.38	111,634
750	837		1000	0.073	0.891	1.308	0.002	0.027	189.532	61.00	745.60	1,094.94	1.51	22.55	158,603
1000	1521		9999	0.087	0.884	1.498	0.002	0.033	187.941	132.71	1,343.84	2,277.93	2.73	49.83	285,858
0	36	Scrapers	50	1.533	1.260	3.066	0.003	0.407	279.274	55.40	45.54	110.81	0.10	14.69	10,094
50	84		120	0.344	1.166	3.114	0.002	0.238	258.369	28.98	98.30	262.60	0.21	20.09	21,787
120	166		175	0.197	1.154	1.849	0.002	0.098	255.853	32.70	191.81	307.24	0.41	16.32	42,514
175	225		250	0.172	1.131	1.770	0.002	0.077	250.791	38.78	254.55	398.19	0.54	17.36	56,421
250	381		500	0.133	1.141	1.389	0.002	0.054	252.908	50.77	435.14	529.55	0.92	20.67	96,446
500	565		750	0.113	1.136	1.194	0.002	0.043	251.865	63.90	641.97	674.62	1.36	24.51	142,292
750	950		1000	0.593	1.138	6.460	0.002	0.301	252.280	562.94	1,081.30	6,137.29	2.29	286.14	239,666
1000	1923		9999	0.163	1.163	2.498	0.002	0.076	257.796	312.89	2,236.99	4,803.53	4.73	145.98	495,821
0	6	Signal Boards	15	0.542	2.845	3.397	0.007	0.133	466.006	3.25	17.07	20.38	0.04	0.80	2,796
15	37		50	0.512	3.375	3.027	0.006	0.121	443.274	18.93	124.86	111.98	0.21	4.46	16,401
50	82		120	0.264	2.718	2.082	0.005	0.111	443.274	21.62	222.90	170.73	0.43	9.08	36,348
120	158		175	0.203	2.374	1.405	0.005	0.067	443.274	32.07	375.17	222.02	0.79	10.65	70,037
175	216		250	0.193	0.988	1.391	0.006	0.043	535.622	41.64	213.45	300.45	1.30	9.33	115,694
0	43	Skid Steer Lo	50	0.141	1.377	1.265	0.002	0.038	215.256	6.12	59.87	54.98	0.09	1.65	9,357
50	71		120	0.063	1.234	0.807	0.002	0.030	192.868	4.46	87.04	56.90	0.13	2.11	13,604
120	153		175	0.060	1.223	0.576	0.002	0.026	191.125	9.15	187.01	88.16	0.28	4.00	29,228
175	201		250	0.041	1.205	0.490	0.002	0.015	188.307	8.17	241.61	98.16	0.36	2.98	37,762
250	277		500	0.030	1.201	0.217	0.002	0.003	187.666	8.43	332.20	60.12	0.50	0.93	51,921
500	530		750	0.068	1.233	0.902	0.002	0.039	192.714	36.29	653.51	478.06	0.98	20.79	102,138
750	1000		1000	0.122	1.233	1.721	0.002	0.057	192.714	122.26	1,233.03	1,720.67	1.84	57.31	192,714
0	36	Surfacing Equ	50	0.135	0.850	1.179	0.002	0.047	178.979	4.82	30.33	42.06	0.06	1.66	6,384

		2022		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	Equipment	MaxHP	ROG	CO	NOX	SOX	PM	CO2	ROG	CO	NOX	SOX	PM	CO2
50	89		120	0.092	0.752	0.980	0.002	0.053	158.203	8.20	66.66	86.89	0.13	4.67	14,029
120	151		175	0.075	0.745	0.814	0.001	0.039	156.697	11.37	112.41	122.96	0.23	5.93	23,657
175	216		250	0.062	0.757	0.804	0.002	0.026	159.311	13.36	163.55	173.74	0.33	5.55	34,421
250	362		500	0.042	0.747	0.470	0.002	0.017	157.164	15.12	270.59	170.14	0.54	6.28	56,949
500	615		750	0.036	0.747	0.409	0.002	0.016	157.122	22.31	459.18	251.28	0.92	9.70	96,642
750	814		1000	0.046	0.748	0.989	0.002	0.020	157.360	37.51	608.82	805.56	1.22	15.92	128,136
1000	1141		9999	0.025	0.737	0.673	0.001	0.009	155.194	28.91	841.35	768.17	1.69	10.77	177,076
0	36	Sweepers/Sc	50	0.481	1.544	2.046	0.003	0.152	265.154	17.11	54.93	72.80	0.09	5.42	9,436
50	78		120	0.178	1.393	1.582	0.002	0.106	239.305	13.77	108.00	122.64	0.18	8.20	18,552
120	159		175	0.153	1.390	1.368	0.002	0.066	238.803	24.44	221.69	218.14	0.36	10.51	38,082
175	204		250	0.073	1.381	0.731	0.002	0.023	237.291	14.85	282.36	149.46	0.46	4.65	48,504
250	303		500	0.213	1.387	2.483	0.002	0.108	238.264	64.38	419.57	751.15	0.69	32.81	72,075
500	848		1000	0.024	1.387	1.028	0.002	0.008	238.264	20.32	1,176.17	871.58	1.93	6.80	202,048
0	38	Tractors/Loac	50	0.265	0.984	1.485	0.002	0.080	210.026	10.16	37.68	56.89	0.08	3.07	8,045
50	83		120	0.100	0.910	0.975	0.002	0.052	194.283	8.29	75.20	80.62	0.15	4.34	16,058
120	144		175	0.077	0.894	0.646	0.002	0.033	190.977	11.10	128.73	92.96	0.26	4.73	27,488
175	204		250	0.072	0.899	0.716	0.002	0.025	191.926	14.73	183.55	146.18	0.37	5.04	39,195
250	320		500	0.062	0.897	0.530	0.002	0.020	191.572	19.79	287.22	169.52	0.59	6.25	61,330
500	575		750	0.090	0.892	0.904	0.002	0.035	190.500	51.48	512.64	519.46	1.05	19.98	109,465
750	871		1000	0.048	0.911	1.079	0.002	0.018	194.474	42.23	793.63	939.91	1.62	16.06	169,465
1000	2006		9999	0.064	0.904	1.180	0.002	0.023	193.002	128.96	1,812.80	2,366.45	3.70	45.15	387,090
0	40	Trenchers	50	0.380	1.632	2.145	0.003	0.138	293.394	15.11	64.93	85.32	0.11	5.50	11,670
50	82		120	0.278	1.472	2.469	0.003	0.175	264.613	22.83	120.81	202.60	0.21	14.36	21,713
120	144		175	0.208	1.449	2.062	0.002	0.106	260.386	29.92	208.43	296.65	0.36	15.29	37,462
175	218		250	0.176	1.468	1.936	0.003	0.081	263.792	38.47	320.58	422.89	0.55	17.61	57,618
250	359		500	0.111	1.458	1.112	0.003	0.047	261.973	39.95	522.57	398.55	0.90	16.88	93,922
500	619		750	0.030	1.469	0.151	0.003	0.004	264.035	18.52	909.71	93.78	1.56	2.78	163,504
750	860		1000	0.614	1.462	6.712	0.003	0.312	262.792	528.45	1,257.44	5,772.62	2.16	268.22	226,001
0	11	Welders	15	0.319	1.585	1.990	0.004	0.093	255.735	3.51	17.43	21.89	0.04	1.02	2,813
15	20		25	0.334	1.093	2.015	0.003	0.088	255.735	6.68	21.86	40.30	0.06	1.76	5,115
25	46		50	0.352	2.102	1.831	0.003	0.084	255.735	16.18	96.71	84.23	0.15	3.86	11,764
50	70		120	0.178	1.609	1.304	0.003	0.077	255.735	12.43	112.65	91.29	0.21	5.37	17,901
120	174		175	0.137	1.402	0.918	0.003	0.046	255.735	23.90	243.93	159.78	0.50	8.08	44,498
175	211		250	0.107	0.484	0.759	0.003	0.024	255.735	22.57	102.16	160.18	0.61	5.10	53,960
250	297		500	0.104	0.468	0.689	0.003	0.023	255.735	30.94	138.94	204.68	0.75	6.94	75,953
0	29	Water Trucks	50	0.313	0.658	1.640	0.002	0.103	217.399	9.116	19.180	47.802	0.060	2.990	6335.094
50	87		120	0.163	0.596	1.291	0.002	0.078	196.774	14.177	51.869	112.382	0.164	6.801	17131.671
120	159		175	0.096	0.602	0.692	0.002	0.033	198.929	15.292	95.697	109.886	0.302	5.322	31607.627
175	211		250	0.086	0.602	0.618	0.002	0.024	198.690	18.094	126.939	130.384	0.400	5.133	41926.530
250	372		500	0.078	0.608	0.569	0.002	0.021	200.847	29.195	226.464	211.881	0.714	7.705	74798.827
500	656		750	0.105	0.607	0.866	0.002	0.033	200.535	69.040	398.240	568.120	1.256	21.959	131534.479
750	897		1000	0.093	0.605	1.467	0.002	0.033	199.844	83.872	542.875	1316.601	1.712	29.433	179305.935
1000	1764		9999	0.077	0.613	1.275	0.002	0.025	202.442	136.698	1081.314	2248.971	3.411	43.908	357146.923

2023

		2023		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	Equipment	MaxHP	ROG	CO	NOX	SOX	PM	CO2	ROG	CO	NOX	SOX	PM	CO2
0	46	Aerial Lifts	50	0.052	0.866	0.893	0.002	0.007	179.282	2.42	39.91	41.17	0.08	0.33	8,267
50	74		120	0.032	0.778	0.477	0.002	0.008	161.199	2.40	57.61	35.32	0.11	0.61	11,932
120	130		175	0.027	0.778	0.176	0.002	0.007	161.168	3.58	101.52	22.98	0.20	0.97	21,028
175	210		250	0.019	0.778	0.080	0.002	0.003	161.179	3.96	163.42	16.90	0.32	0.58	33,848
250	380		500	0.025	0.778	0.199	0.002	0.003	161.179	9.63	295.70	75.49	0.58	1.08	61,248
0	12	Air Compress	15	0.336	1.685	2.099	0.004	0.095	272.784	4.03	20.22	25.19	0.05	1.13	3,273
15	24		25	0.351	1.157	2.138	0.003	0.090	272.784	8.42	27.77	51.32	0.08	2.16	6,547
25	37		50	0.373	2.371	1.939	0.004	0.081	272.784	13.79	87.74	71.74	0.13	2.98	10,093
50	78		120	0.192	1.758	1.307	0.003	0.073	272.784	14.98	137.15	101.93	0.25	5.73	21,277
120	147		175	0.151	1.536	0.892	0.003	0.046	272.784	22.21	225.78	131.11	0.45	6.70	40,099
175	218		250	0.120	0.528	0.725	0.003	0.023	272.784	26.23	115.12	158.05	0.67	5.11	59,467
250	385		500	0.118	0.507	0.665	0.003	0.023	272.784	45.37	195.30	255.88	1.03	8.75	105,022
500	595		750	0.118	0.507	0.679	0.003	0.023	272.784	70.31	301.82	403.72	1.63	13.68	162,306
750	808		1000	0.127	0.531	1.578	0.003	0.035	272.784	102.47	428.86	1,275.30	2.22	27.88	220,409
0	39	Bore/Drill Rig	50	0.319	1.190	2.115	0.003	0.113	296.155	12.52	46.73	83.05	0.11	4.46	11,631
50	82		120	0.098	1.032	1.184	0.002	0.051	256.757	8.11	84.92	97.49	0.20	4.20	21,139
120	149		175	0.066	1.073	0.542	0.003	0.024	267.018	9.79	159.34	80.44	0.38	3.57	39,662
175	208		250	0.058	1.051	0.526	0.002	0.017	261.484	12.06	218.25	109.25	0.52	3.54	54,324
250	349		500	0.053	1.038	0.451	0.002	0.015	258.330	18.56	362.39	157.50	0.86	5.30	90,204
500	612		750	0.048	1.072	0.360	0.003	0.013	266.781	29.22	655.89	220.38	1.56	8.11	163,260
750	919		1000	0.028	1.056	1.137	0.003	0.009	262.773	25.44	970.17	1,044.80	2.31	8.22	241,488
1000	2667		9999	0.106	1.056	2.173	0.003	0.055	262.792	281.86	2,815.34	5,795.84	6.69	147.03	700,778
0	9	Cement and I	15	0.370	1.943	2.320	0.005	0.091	318.248	3.33	17.49	20.88	0.04	0.82	2,864
15	25		25	0.391	1.320	2.454	0.004	0.097	318.248	9.77	33.00	61.36	0.10	2.42	7,956
0	18	Concrete/Indu	25	0.500	1.708	3.163	0.005	0.118	414.859	9.01	30.75	56.93	0.09	2.13	7,467
25	33		50	0.443	3.192	2.785	0.005	0.099	414.859	14.62	105.34	91.90	0.18	3.25	13,690
50	81		120	0.234	2.560	1.810	0.005	0.091	414.859	18.96	207.38	146.60	0.39	7.34	33,604
120	175		175	0.183	2.243	1.168	0.005	0.057	414.859	32.07	392.55	204.41	0.82	9.94	72,600
0	41	Cranes	50	0.617	0.825	1.706	0.002	0.175	165.291	25.07	33.54	69.32	0.06	7.11	6,716
50	89		120	0.166	0.749	1.404	0.001	0.093	149.976	14.80	66.61	124.91	0.13	8.27	13,340
120	148		175	0.128	0.756	1.216	0.001	0.064	151.478	18.87	111.86	179.87	0.21	9.53	22,401
175	217		250	0.090	0.754	0.930	0.001	0.039	150.961	19.46	163.58	201.89	0.31	8.43	32,758
250	336		500	0.071	0.753	0.723	0.001	0.029	150.744	23.95	253.01	243.10	0.48	9.83	50,666
500	567		750	0.059	0.750	0.597	0.001	0.024	150.092	33.35	425.11	338.67	0.81	13.74	85,130
750	938		1000	0.185	0.748	2.137	0.001	0.095	149.743	173.35	701.11	2,003.73	1.34	88.75	140,399
1000	1030		9999	0.064	0.752	0.691	0.001	0.018	150.667	65.42	774.95	711.76	1.48	18.75	155,187
0	43	Crawler Tract	50	0.840	1.329	2.283	0.002	0.226	245.201	35.73	56.48	97.07	0.10	9.59	10,423
50	87		120	0.250	1.226	2.042	0.002	0.160	226.198	21.75	106.46	177.36	0.19	13.89	19,647
120	150		175	0.156	1.214	1.428	0.002	0.079	224.119	23.30	181.60	213.53	0.32	11.88	33,515
175	203		250	0.124	1.214	1.367	0.002	0.053	224.045	25.15	246.25	277.24	0.43	10.75	45,446
250	341		500	0.108	1.222	1.062	0.002	0.044	225.464	36.78	416.22	361.77	0.73	14.85	76,814
500	570		750	0.082	1.216	0.800	0.002	0.030	224.475	46.98	693.44	456.33	1.22	16.97	127,976
750	828		1000	0.120	1.219	2.045	0.002	0.051	225.014	99.71	1,009.73	1,693.80	1.78	42.04	186,349
1000	1527		9999	0.140	1.168	2.419	0.002	0.062	215.490	214.36	1,782.39	3,693.04	3.14	94.18	328,945
0	45	Crushing/Pro	50	0.578	3.931	3.091	0.006	0.114	443.274	26.00	176.90	139.09	0.26	5.15	19,947
50	85		120	0.301	2.886	1.991	0.005	0.103	443.274	25.59	245.33	169.25	0.44	8.77	37,678
120	171		175	0.238	2.528	1.291	0.005	0.065	443.274	40.65	432.22	220.71	0.85	11.11	75,800
175	250		250	0.194	0.867	1.039	0.005	0.034	443.274	48.39	216.76	259.63	1.25	8.44	110,818
250	382		500	0.190	0.831	0.957	0.004	0.033	443.274	72.71	317.31	365.72	1.66	12.52	169,331
500	602		750	0.191	0.831	0.976	0.004	0.033	443.274	114.85	500.28	587.66	2.68	19.80	266,851
750	1337		9999	0.224	0.864	2.465	0.004	0.052	443.274	300.06	1,155.48	3,296.34	5.96	69.01	592,657
0	16	Dumpers/Ten	25	0.261	0.889	1.646	0.003	0.062	215.954	4.17	14.23	26.34	0.04	0.99	3,455
0	36	Excavators	50	0.180	1.082	1.372	0.002	0.053	222.304	6.43	38.68	49.05	0.08	1.90	7,945
50	82		120	0.092	0.962	0.909	0.002	0.044	197.650	7.52	78.69	74.35	0.15	3.63	16,163
120	146		175	0.071	0.973	0.559	0.002	0.027	199.816	10.40	142.07	81.56	0.28	3.99	29,181
175	218		250	0.057	0.973	0.462	0.002	0.015	199.789	12.40	212.50	100.91	0.42	3.23	43,648
250	329		500	0.049	0.968	0.341	0.002	0.012	198.806	16.02	318.09	112.09	0.62	3.79	65,336
500	578		750	0.058	0.965	0.442	0.002	0.017	198.295	33.24	557.95	255.73	1.09	9.54	114,603
750	843		1000	0.036	0.965	0.893	0.002	0.009	198.242	30.37	813.50	752.70	1.60	7.65	167,093
1000	1569		9999	0.034	0.963	0.880	0.002	0.009	197.811	53.54	1,511.16	1,381.05	2.96	13.80	310,393
0	42	Forklifts	50	0.161	0.638	0.835	0.001	0.047	117.014	6.84	27.04	35.39	0.05	1.98	4,963
50	82		120	0.069	0.572	0.614	0.001	0.038	105.000	5.66	47.13	50.61	0.08	3.13	8,649
120	141		175	0.051	0.573	0.425	0.001	0.022	105.128	7.24	80.94	59.98	0.14	3.14	14,853
175	208		250	0.043	0.574	0.363	0.001	0.014	105.400	8.92	119.55	75.61	0.21	2.88	21,939
250	344		500	0.046	0.575	0.359	0.001	0.014	105.464	15.90	197.53	123.51	0.35	4.75	36,250
500	880		1000	0.021	0.573	0.481	0.001	0.004	105.117	18.47	504.07	423.48	0.88	3.85	92,503
0	11	Generator Se	15	0.459	2.598	3.225	0.007	0.139	420.542	5.05	28.58	35.48	0.07	1.53	4,626
15	19		25	0.520	1.784	3.297	0.005	0.136	420.542	9.88	33.89	62.64	0.10	2.59	7,990
25	33		50	0.395	2.845	2.771	0.005	0.098	420.542	13.03	93.87	91.45	0.18	3.24	13,878
50	84		120	0.215	2.481	1.896	0.005	0.093	420.542	18.02	208.44	159.23	0.41	7.80	35,326
120	153		175	0.163	2.168	1.286	0.005	0.056	420.542	24.88	331.72	196.75	0.72	8.60	64,343
175	229		250	0.125	0.746	1.045	0.005	0.030	420.542	28.68	170.79	239.23	1.08	6.93	96,304
250	363		500	0.121	0.731	0.965	0.004	0.029	420.542	43.92	265.31	350.12	1.50	10.65	152,657
500	586		750	0.122	0.731	0.984	0.004	0.030	420.542	71.53	428.30	576.76	2.48	17.39	246,438
750	1130		9999	0.149	0.765	2.309	0.004	0.045	420.542	168.51	864.77	2,608.76	4.78	51.09	475,212
0	39	Graders	50	0.833	1.161	2.104	0.002	0.224	223.683	32.61	45.45	82.39	0.08	8.79	8,760
50	91		120	0.308	1.103	2.346	0.002	0.178	212.484	27.99	100.33	213.48	0.18	16.20	19,335
120	148		175	0.167	1.124	1.450	0.002	0.080	216.639	24.67	166.31	214.52	0.31	11.81	32,051
175	204		250	0.121	1.113	1.406	0.002	0.046	214.584	24.79	227.54	287.39	0.42	9.31	43,851
250	293		500	0.132	1.107	1.105	0.002	0.043	213.274	38.70	324.44	324.05	0.60	12.59	62,525
500	796		1000	0.045	1.109	0.986	0.002	0.009	213.737	36.14	882.83	784.66	1.62	7.25	170,135
1000	1993		9999	0.215	1.107	2.786	0.002	0.087	213.348	428.46	2,206.16	5,550.99	4.06	173.89	425,161
0	38	Off-Highway	50	0.300	1.302	1.741	0.002	0.089	253.015	11.30	49.02	65.57	0.09	3.34	9,529
50	75		120	0.144	1.182	1.348	0.002	0.081	229.698	10.74	88.06	100.46	0.16	6.07	17,119
120	158		175	0.092	1.174	0.777	0.002	0.037	228.207	14.48	185.57	122.87	0.34	5.88	36,074
175	214		250	0.078	1.169	0.650	0.002	0.023	227.169	16.67	249.90	138.90	0.46	4.93	48,578
250	334		500	0.059	1.165	0.401	0.002	0.014	226.558	19.87	389.77	134.27	0.72	4.66	75,769
500	574		750	0.077	1.171	0.561	0.002	0.022	227.694	43.90	671.78	321.88	1.25	12.69	130,590
750	1000		1000	0.082	1.172	1.066	0.002	0.029	227.753	81.85	1,171.61	1,066.47	2.17	29.16	227,753
1000	1726		9999	0.129	1.205	1.685	0.002	0.045	234.192	222.74	2,079.67	2,907.94	3.86	78.18	404,273
0	29	Off-Highway	50	0.302	0.658	1.585	0.002	0.090	217.468	8.81	19.19	46.18	0.06	2.63	6,337
50	87		120	0.157	0.596	1.236	0.002	0.072	196.847	13.67	51.89	107.64	0.16	6.31	17,138
120	159		175	0.094	0.602	0.643	0.002	0.031	198.976	14.97	95.72	102.11	0.30	4.90	31,615
175	211		250	0.083	0.601	0.556	0.002	0.023	198.618	17.45	126.89	117.31	0.40	4.75	41,911
250	372		500	0.075	0.609	0.506	0.002	0.018	200.989	27.84	226.62	188.35	0.71	6.81	74,852
500	656		750	0.105	0.607	0.833	0.002	0.032	200.446	68.89	398.06	546.46	1.26	21.14	131,476

		2023		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	**Equipment**	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2	**ROG**	**CO**	**NOX**	**SOX**	**PM**	**CO2**
750	897		1000	0.085	0.606	1.353	0.002	0.028	200.061	76.63	543.47	1,214.27	1.71	25.32	179,501
1000	1764		9999	0.071	0.613	1.204	0.002	0.022	202.569	124.99	1,081.99	2,123.98	3.41	38.22	357,369
0	38	Other Constru	50	0.376	1.339	1.909	0.002	0.134	243.604	14.31	50.90	72.54	0.09	5.08	9,259
50	82		120	0.176	1.194	1.574	0.002	0.108	217.211	14.39	97.40	128.41	0.17	8.77	17,716
120	152		175	0.119	1.188	1.121	0.002	0.058	216.092	18.13	181.15	170.92	0.31	8.90	32,952
175	217		250	0.088	1.203	0.937	0.002	0.035	218.760	19.19	260.86	203.18	0.45	7.62	47,450
250	357		500	0.078	1.205	0.753	0.002	0.029	219.142	27.99	429.93	268.65	0.75	10.20	78,203
500	598		750	0.072	1.199	0.751	0.002	0.025	218.123	43.07	716.69	448.86	1.24	14.79	130,367
750	830		1000	0.048	1.201	1.092	0.002	0.018	218.388	39.48	996.68	906.88	1.73	15.05	181,296
1000	1127		9999	0.072	1.163	1.350	0.002	0.028	211.491	81.54	1,309.95	1,521.44	2.28	31.09	238,280
0	35	Other Genera	50	0.216	0.972	1.364	0.002	0.066	199.186	7.57	34.13	47.89	0.07	2.33	6,992
50	73		120	0.110	0.869	0.999	0.002	0.058	177.921	8.05	63.57	73.13	0.12	4.21	13,022
120	149		175	0.072	0.872	0.550	0.002	0.027	178.621	10.69	130.06	82.02	0.25	4.09	26,642
175	209		250	0.065	0.875	0.523	0.002	0.017	179.141	13.50	182.83	109.33	0.36	3.65	37,451
250	355		500	0.059	0.874	0.429	0.002	0.015	179.029	20.80	310.02	152.26	0.61	5.22	63,504
500	592		750	0.040	0.875	0.214	0.002	0.008	179.232	23.39	517.60	126.48	1.01	4.57	106,023
750	885		1000	0.069	0.872	1.352	0.002	0.027	178.698	60.97	772.06	1,196.46	1.51	24.12	158,148
1000	2000		9999	0.030	0.872	0.802	0.002	0.007	178.698	59.09	1,744.77	1,603.42	3.41	13.88	357,397
0	36	Other Materia	50	0.418	1.196	1.852	0.002	0.134	229.351	14.95	42.74	66.19	0.08	4.81	8,198
50	93		120	0.093	1.081	0.908	0.002	0.041	207.401	8.66	100.73	84.62	0.18	3.82	19,322
120	145		175	0.090	1.078	0.699	0.002	0.038	206.802	12.97	155.86	101.09	0.29	5.48	29,897
175	218		250	0.086	1.076	0.792	0.002	0.027	206.479	18.69	234.96	172.89	0.43	5.96	45,071
250	331		500	0.090	1.074	0.739	0.002	0.031	205.960	29.82	355.79	244.98	0.65	10.23	68,248
500	565		750	0.067	1.078	0.505	0.002	0.022	206.729	37.82	608.45	285.32	1.11	12.31	116,716
750	923		1000	0.045	1.078	0.956	0.002	0.009	206.729	41.46	994.72	882.48	1.82	8.20	190,811
1000	1050		9999	0.023	1.078	0.896	0.002	0.007	206.729	23.63	1,131.59	941.17	2.07	7.45	217,066
0	39	Pavers	50	0.438	1.428	1.780	0.002	0.124	242.463	16.91	55.17	68.75	0.09	4.79	9,365
50	80		120	0.152	1.274	1.423	0.002	0.094	216.334	12.08	101.43	113.28	0.16	7.48	17,217
120	158		175	0.087	1.282	0.812	0.002	0.038	217.546	13.70	202.67	128.43	0.33	6.04	34,402
175	213		250	0.056	1.281	0.669	0.002	0.020	217.495	12.02	273.19	142.65	0.44	4.16	46,372
250	327		500	0.066	1.263	0.736	0.002	0.026	214.457	21.60	413.62	240.85	0.67	8.38	70,209
500	750		750	0.024	1.280	0.108	0.002	0.004	217.241	17.72	959.87	80.91	1.56	2.76	162,931
0	35	Paving Equip	50	0.201	1.295	1.340	0.002	0.061	205.006	7.00	45.10	46.67	0.07	2.14	7,138
50	89		120	0.103	1.177	1.007	0.002	0.054	186.246	9.17	104.26	89.26	0.16	4.80	16,501
120	148		175	0.076	1.170	0.679	0.002	0.033	185.159	11.23	173.63	100.79	0.26	4.90	27,479
175	216		250	0.065	1.174	0.669	0.002	0.025	185.751	14.02	253.13	144.36	0.38	5.37	40,060
250	339		500	0.058	1.166	0.555	0.002	0.020	184.510	19.54	394.94	187.93	0.60	6.92	62,504
500	605		750	0.047	1.172	0.456	0.002	0.013	185.456	28.64	708.95	276.15	1.07	8.05	112,201
750	842		1000	0.040	1.175	0.837	0.002	0.014	185.931	33.33	989.20	704.44	1.50	11.73	156,554
0	8	Plate Compa	15	0.284	1.492	1.781	0.004	0.070	244.369	2.28	11.94	14.25	0.03	0.56	1,955
0	13	Pressure Wa	15	0.186	1.053	1.307	0.003	0.057	170.490	2.42	13.69	17.00	0.03	0.73	2,216
15	19		25	0.211	0.723	1.337	0.002	0.055	170.490	4.01	13.74	25.39	0.04	1.05	3,239
25	38		50	0.113	0.983	1.079	0.002	0.032	170.490	4.30	37.34	41.00	0.08	1.23	6,479
50	64		120	0.069	0.960	0.737	0.002	0.031	170.490	4.42	61.44	47.15	0.13	2.01	10,911
0	8	Pumps	15	0.518	2.598	3.236	0.007	0.146	420.542	4.15	20.78	25.89	0.05	1.17	3,364
15	21		25	0.541	1.784	3.297	0.005	0.139	420.542	11.35	37.46	69.23	0.11	2.92	8,831
25	37		50	0.434	2.986	2.808	0.005	0.104	420.542	16.06	110.49	103.90	0.20	3.86	15,560
50	84		120	0.229	2.519	1.922	0.005	0.098	420.542	19.27	211.64	161.45	0.41	8.24	35,326
120	151		175	0.175	2.201	1.307	0.005	0.059	420.542	26.41	332.32	197.37	0.71	8.97	63,502
175	217		250	0.135	0.757	1.063	0.005	0.032	420.542	29.35	164.31	230.64	1.03	6.85	91,258
250	372		500	0.131	0.739	0.978	0.004	0.031	420.542	48.73	275.06	363.91	1.54	11.37	156,442
500	615		750	0.132	0.739	0.998	0.004	0.031	420.542	81.12	454.74	614.08	2.60	19.02	258,633
750	1460		9999	0.159	0.775	2.333	0.004	0.047	420.542	232.36	1,131.22	3,406.82	6.17	68.10	613,991
0	36	Rollers	50	0.259	1.180	1.471	0.002	0.079	218.584	9.26	42.11	52.49	0.07	2.83	7,799
50	87		120	0.113	1.064	1.127	0.002	0.062	197.000	9.78	92.39	97.87	0.16	5.38	17,112
120	144		175	0.059	1.059	0.557	0.002	0.025	196.168	8.46	152.28	80.02	0.27	3.65	28,205
175	213		250	0.074	1.063	0.815	0.002	0.029	196.825	15.75	226.61	173.84	0.40	6.11	41,973
250	335		500	0.083	1.073	0.859	0.002	0.035	198.815	27.80	359.45	287.73	0.64	11.63	66,578
500	521		750	0.038	1.061	0.267	0.002	0.004	196.512	19.53	552.23	139.05	0.98	1.89	102,285
0	47	Rough Terrai	50	0.290	1.271	1.549	0.002	0.082	233.725	13.73	60.10	73.25	0.11	3.87	11,052
50	96		120	0.063	1.146	0.797	0.002	0.026	210.725	6.08	110.39	76.81	0.19	2.47	20,299
120	130		175	0.047	1.142	0.490	0.002	0.017	210.041	6.07	148.03	63.45	0.26	2.26	27,219
175	208		250	0.049	1.145	0.593	0.002	0.014	210.556	10.13	238.53	123.43	0.42	2.88	43,860
250	374		500	0.029	1.130	0.224	0.002	0.004	207.784	10.86	422.49	83.94	0.74	1.34	77,688
500	625		750	0.047	1.143	0.540	0.002	0.004	210.233	29.61	714.57	337.43	1.25	2.40	131,396
0	42	Rubber Tired	50	0.219	1.066	1.437	0.002	0.056	227.865	9.10	44.33	59.75	0.09	2.33	9,476
50	82		120	0.305	0.979	2.343	0.002	0.187	209.321	24.92	79.89	191.18	0.16	15.23	17,079
120	150		175	0.243	0.971	2.236	0.002	0.125	207.538	36.43	145.31	334.68	0.30	18.69	31,065
175	211		250	0.163	0.972	1.617	0.002	0.073	207.843	34.30	205.12	341.12	0.42	15.36	43,851
250	354		500	0.185	0.982	1.743	0.002	0.080	209.976	65.42	347.75	616.98	0.71	28.20	74,342
500	584		750	0.175	0.969	2.108	0.002	0.077	207.154	102.14	565.99	1,231.57	1.16	45.26	120,999
0	42	Rubber Tired	50	0.397	0.988	1.636	0.002	0.110	210.153	16.57	41.19	68.20	0.08	4.58	8,763
50	86		120	0.156	0.879	1.271	0.002	0.086	187.007	13.44	75.74	109.46	0.15	7.43	16,110
120	150		175	0.102	0.887	0.794	0.002	0.043	188.651	15.29	133.03	119.17	0.27	6.38	28,297
175	206		250	0.079	0.885	0.745	0.002	0.025	188.316	16.36	182.29	153.43	0.37	5.14	38,775
250	320		500	0.082	0.883	0.675	0.002	0.025	187.772	26.29	282.20	215.86	0.57	8.03	60,029
500	600		750	0.086	0.875	0.697	0.002	0.027	186.204	51.50	525.63	418.69	1.07	16.18	111,811
750	837		1000	0.073	0.890	1.276	0.002	0.026	189.310	61.08	744.73	1,068.11	1.51	21.50	158,417
1000	1521		9999	0.090	0.884	1.503	0.002	0.033	187.940	136.22	1,343.84	2,285.46	2.73	50.07	285,857
0	36	Scrapers	50	1.548	1.260	3.076	0.003	0.410	279.274	55.94	45.54	111.16	0.10	14.81	10,094
50	84		120	0.318	1.165	2.907	0.002	0.221	258.145	26.82	98.21	245.13	0.21	18.63	21,769
120	166		175	0.182	1.154	1.678	0.002	0.089	255.822	30.31	191.78	278.88	0.41	14.74	42,509
175	225		250	0.160	1.132	1.584	0.002	0.069	250.947	36.05	254.71	356.38	0.54	15.63	56,456
250	381		500	0.128	1.141	1.286	0.002	0.050	252.880	48.76	435.09	490.46	0.92	19.23	96,436
500	565		750	0.112	1.136	1.151	0.002	0.042	251.874	63.18	642.00	650.23	1.36	23.75	142,297
750	950		1000	0.593	1.138	6.460	0.002	0.301	252.280	562.94	1,081.30	6,137.29	2.29	286.14	239,666
1000	1923		9999	0.134	1.163	2.204	0.002	0.059	257.796	257.05	2,236.99	4,238.87	4.73	114.12	495,821
0	6	Signal Boards	15	0.542	2.845	3.397	0.007	0.133	466.006	3.25	17.07	20.38	0.04	0.80	2,796
15	37		50	0.471	3.340	2.938	0.006	0.103	443.274	17.44	123.60	108.71	0.21	3.82	16,401
50	82		120	0.246	2.714	1.929	0.005	0.096	443.274	20.18	222.51	158.15	0.43	7.85	36,348
120	158		175	0.190	2.376	1.250	0.005	0.059	443.274	30.10	375.35	197.48	0.79	9.32	70,037
175	216		250	0.184	0.985	1.219	0.006	0.038	535.623	39.65	212.79	263.37	1.30	8.14	115,695
0	43	Skid Steer Lo	50	0.136	1.378	1.242	0.002	0.034	215.318	5.92	59.89	53.99	0.09	1.49	9,360
50	71		120	0.059	1.235	0.751	0.002	0.025	192.959	4.17	87.08	52.99	0.13	1.79	13,610
120	153		175	0.049	1.225	0.455	0.002	0.019	191.382	7.50	187.26	69.64	0.28	2.93	29,267
175	201		250	0.042	1.205	0.494	0.002	0.015	188.393	8.44	241.72	99.06	0.36	3.02	37,779
250	277		500	0.023	1.201	0.094	0.002	0.003	187.666	6.23	332.20	25.98	0.50	0.90	51,921
500	530		750	0.070	1.233	0.904	0.002	0.039	192.714	36.93	653.51	478.90	0.98	20.91	102,138
750	1000		1000	0.027	1.233	0.840	0.002	0.011	192.714	27.21	1,233.03	839.52	1.84	11.39	192,714
0	36	Surfacing Equ	50	0.138	0.851	1.183	0.002	0.047	179.010	4.92	30.34	42.20	0.06	1.67	6,385

		2023		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	**Equipment**	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2	**ROG**	**CO**	**NOX**	**SOX**	**PM**	**CO2**
50	89		120	0.085	0.753	0.922	0.002	0.047	158.482	7.55	66.78	81.76	0.13	4.19	14,054
120	151		175	0.071	0.746	0.740	0.001	0.036	156.993	10.69	112.62	111.76	0.23	5.42	23,702
175	216		250	0.060	0.757	0.754	0.002	0.025	159.314	13.06	163.55	162.96	0.33	5.32	34,422
250	362		500	0.041	0.747	0.445	0.002	0.017	157.114	15.03	270.50	161.21	0.54	6.08	56,931
500	615		750	0.032	0.750	0.326	0.002	0.012	157.806	19.49	461.18	200.40	0.93	7.47	97,063
750	814		1000	0.047	0.748	0.991	0.002	0.020	157.333	38.18	608.72	806.87	1.22	15.97	128,114
1000	1141		9999	0.027	0.737	0.676	0.001	0.010	155.194	30.25	841.35	770.80	1.69	10.89	177,076
0	36	Sweepers/Sc	50	0.362	1.544	1.880	0.003	0.113	265.154	12.88	54.93	66.92	0.09	4.03	9,436
50	78		120	0.167	1.393	1.497	0.002	0.095	239.305	12.96	108.00	116.04	0.18	7.40	18,552
120	159		175	0.139	1.390	1.188	0.002	0.057	238.803	22.22	221.69	189.52	0.36	9.15	38,082
175	204		250	0.076	1.381	0.734	0.002	0.023	237.291	15.45	282.36	149.96	0.46	4.68	48,504
250	303		500	0.096	1.387	1.084	0.002	0.037	238.264	29.11	419.57	327.81	0.69	11.18	72,075
500	848		1000	0.024	1.387	1.028	0.002	0.008	238.264	20.32	1,176.17	871.58	1.93	6.80	202,048
0	38	Tractors/Load	50	0.239	0.982	1.421	0.002	0.068	209.755	9.17	37.63	54.44	0.08	2.60	8,035
50	83		120	0.092	0.911	0.894	0.002	0.044	194.500	7.62	75.28	73.89	0.15	3.65	16,076
120	144		175	0.071	0.896	0.560	0.002	0.028	191.394	10.22	129.01	80.67	0.26	4.06	27,548
175	204		250	0.065	0.898	0.585	0.002	0.021	191.774	13.32	183.41	119.48	0.37	4.33	39,164
250	320		500	0.059	0.898	0.460	0.002	0.017	191.657	18.76	287.34	147.12	0.59	5.57	61,357
500	575		750	0.090	0.892	0.891	0.002	0.035	190.518	51.90	512.69	512.13	1.05	20.01	109,475
750	871		1000	0.050	0.910	1.083	0.002	0.019	194.411	43.91	793.37	943.66	1.62	16.27	169,410
1000	2006		9999	0.065	0.904	1.167	0.002	0.022	193.002	130.97	1,812.80	2,340.59	3.70	44.18	387,090
0	40	Trenchers	50	0.337	1.633	1.989	0.003	0.111	293.433	13.42	64.94	79.13	0.11	4.40	11,672
50	82		120	0.265	1.473	2.362	0.003	0.164	264.816	21.75	120.90	193.82	0.21	13.45	21,730
120	144		175	0.189	1.449	1.838	0.002	0.093	260.386	27.18	208.43	264.40	0.36	13.41	37,462
175	218		250	0.172	1.468	1.878	0.003	0.078	263.790	37.67	320.58	410.11	0.55	17.02	57,618
250	359		500	0.104	1.461	1.008	0.003	0.042	262.546	37.43	523.71	361.22	0.90	15.23	94,127
500	619		750	0.032	1.470	0.152	0.003	0.005	264.137	19.62	910.06	94.22	1.56	2.81	163,567
750	860		1000	0.617	1.462	6.728	0.003	0.314	262.792	530.62	1,257.44	5,785.99	2.16	269.68	226,001
0	11	Welders	15	0.315	1.580	1.968	0.004	0.089	255.735	3.47	17.38	21.65	0.04	0.97	2,813
15	20		25	0.329	1.085	2.005	0.003	0.085	255.735	6.58	21.69	40.10	0.06	1.69	5,115
25	46		50	0.325	2.083	1.780	0.003	0.073	255.735	14.94	95.81	81.88	0.15	3.34	11,764
50	70		120	0.167	1.607	1.210	0.003	0.067	255.735	11.67	112.51	84.71	0.21	4.69	17,901
120	174		175	0.130	1.404	0.826	0.003	0.041	255.735	22.58	244.24	143.69	0.50	7.15	44,498
175	211		250	0.102	0.483	0.672	0.003	0.021	255.735	21.59	101.85	141.84	0.61	4.49	53,960
250	297		500	0.100	0.466	0.616	0.003	0.021	255.735	29.69	138.50	182.86	0.75	6.11	75,953
0	29	Water Trucks	50	0.302	0.658	1.585	0.002	0.090	217.468	8.808	19.187	46.177	0.061	2.634	6337.108
50	87		120	0.157	0.596	1.236	0.002	0.072	196.847	13.667	51.888	107.641	0.164	6.305	17137.970
120	159		175	0.094	0.602	0.643	0.002	0.031	198.976	14.973	95.719	102.110	0.302	4.897	31615.051
175	211		250	0.083	0.601	0.556	0.002	0.023	198.618	17.451	126.893	117.312	0.400	4.754	41911.474
250	372		500	0.075	0.609	0.506	0.002	0.018	200.989	27.838	226.624	188.347	0.715	6.810	74851.649
500	656		750	0.105	0.607	0.833	0.002	0.032	200.446	68.891	398.063	546.458	1.256	21.140	131476.004
750	897		1000	0.085	0.606	1.353	0.002	0.028	200.061	76.626	543.465	1214.271	1.714	25.321	179500.946
1000	1764		9999	0.071	0.613	1.204	0.002	0.022	202.569	124.991	1081.987	2123.976	3.413	38.217	357369.342

2024

	AvgHP	2024 Equipment	MaxHP	g/hp/hr ROG	g/hp/hr CO	g/hp/hr NOX	g/hp/hr SOX	g/hp/hr PM	g/hp/hr CO2	(g/hr) ROG	(g/hr) CO	(g/hr) NOX	(g/hr) SOX	(g/hr) PM	(g/hr) CO2
0	46	Aerial Lifts	50	0.051	0.866	0.890	0.002	0.007	179.282	2.36	39.91	41.05	0.08	0.31	8,267
50	74		120	0.032	0.778	0.471	0.002	0.008	161.199	2.40	57.61	34.86	0.11	0.60	11,932
120	130		175	0.028	0.778	0.176	0.002	0.007	161.168	3.63	101.52	23.01	0.20	0.97	21,028
175	210		250	0.020	0.778	0.081	0.002	0.003	161.179	4.15	163.42	16.97	0.32	0.59	33,848
250	380		500	0.026	0.778	0.199	0.002	0.003	161.179	10.03	295.70	75.74	0.58	1.09	61,248
0	12	Air Compress	15	0.332	1.680	2.078	0.004	0.091	272.784	3.99	20.17	24.94	0.05	1.10	3,273
15	24		25	0.346	1.149	2.128	0.003	0.088	272.784	8.30	27.58	51.08	0.08	2.11	6,547
25	37		50	0.348	2.358	1.886	0.004	0.070	272.784	12.89	87.23	69.78	0.13	2.60	10,093
50	78		120	0.182	1.758	1.225	0.003	0.064	272.784	14.17	137.11	95.55	0.25	4.97	21,277
120	147		175	0.143	1.539	0.803	0.003	0.040	272.784	21.02	226.18	118.03	0.45	5.84	40,099
175	218		250	0.115	0.527	0.641	0.003	0.020	272.784	25.04	114.89	139.81	0.67	4.41	59,467
250	385		500	0.113	0.506	0.589	0.003	0.020	272.784	43.43	194.86	226.72	1.03	7.56	105,022
500	595		750	0.113	0.506	0.601	0.003	0.020	272.784	67.29	301.14	357.74	1.63	11.83	162,306
750	808		1000	0.121	0.525	1.510	0.003	0.031	272.784	97.66	424.08	1,220.18	2.22	25.37	220,409
0	39	Bore/Drill Rig	50	0.320	1.185	2.090	0.003	0.110	294.975	12.57	46.54	82.08	0.11	4.32	11,585
50	82		120	0.093	1.031	1.114	0.002	0.045	256.753	7.68	84.92	91.69	0.20	3.74	21,138
120	149		175	0.065	1.071	0.517	0.003	0.023	266.627	9.73	159.11	76.77	0.38	3.46	39,603
175	208		250	0.057	1.053	0.490	0.003	0.016	262.044	11.80	218.71	101.83	0.52	3.36	54,441
250	349		500	0.054	1.039	0.432	0.002	0.015	258.575	18.85	362.74	150.99	0.86	5.13	90,290
500	612		750	0.047	1.074	0.337	0.003	0.013	267.340	28.73	657.26	206.46	1.56	7.90	163,602
750	919		1000	0.030	1.055	1.142	0.003	0.009	262.720	27.35	969.97	1,049.69	2.31	8.37	241,440
1000	2667		9999	0.107	1.056	2.176	0.003	0.055	262.792	284.62	2,815.34	5,802.90	6.69	147.63	700,778
0	9	Cement and I	15	0.370	1.943	2.320	0.005	0.091	318.248	3.33	17.49	20.88	0.04	0.82	2,864
15	25		25	0.388	1.316	2.447	0.004	0.095	318.248	9.70	32.89	61.17	0.10	2.38	7,956
0	18	Concrete/Indu	25	0.500	1.708	3.163	0.005	0.118	414.859	9.01	30.75	56.93	0.09	2.13	7,467
25	33		50	0.411	3.162	2.702	0.005	0.085	414.859	13.55	104.35	89.15	0.18	2.79	13,690
50	81		120	0.220	2.556	1.690	0.005	0.077	414.859	17.78	207.02	136.92	0.39	6.28	33,604
120	175		175	0.172	2.243	1.036	0.005	0.049	414.859	30.10	392.56	181.25	0.82	8.57	72,600
0	41	Cranes	50	0.584	0.825	1.668	0.002	0.166	165.291	23.73	33.54	67.75	0.06	6.76	6,716
50	89		120	0.158	0.749	1.331	0.001	0.087	149.981	14.06	66.62	118.36	0.13	7.72	13,340
120	148		175	0.115	0.756	1.067	0.001	0.057	151.491	17.00	111.87	157.76	0.21	8.36	22,403
175	217		250	0.085	0.754	0.854	0.001	0.036	150.957	18.37	163.58	185.43	0.31	7.72	32,758
250	336		500	0.070	0.752	0.687	0.001	0.028	150.671	23.36	252.89	230.74	0.48	9.33	50,642
500	567		750	0.058	0.750	0.547	0.001	0.023	150.117	32.63	425.18	310.44	0.81	13.01	85,145
750	938		1000	0.180	0.747	2.057	0.001	0.092	149.631	168.90	700.58	1,928.21	1.34	86.38	140,294
1000	1030		9999	0.066	0.752	0.694	0.001	0.018	150.667	68.26	774.95	715.30	1.48	19.02	155,187
0	43	Crawler Tract	50	0.788	1.327	2.133	0.002	0.200	244.871	33.50	56.40	90.69	0.10	8.49	10,409
50	87		120	0.230	1.226	1.891	0.002	0.144	226.234	20.01	106.47	164.21	0.19	12.49	19,650
120	150		175	0.146	1.215	1.304	0.002	0.073	224.142	21.86	181.62	195.01	0.32	10.91	33,519
175	203		250	0.118	1.215	1.266	0.002	0.049	224.157	24.01	246.38	256.87	0.43	9.97	45,469
250	341		500	0.102	1.220	0.962	0.002	0.040	225.185	34.83	415.70	327.84	0.73	13.52	76,719
500	570		750	0.081	1.216	0.758	0.002	0.028	224.357	46.28	693.08	431.87	1.22	16.13	127,909
750	828		1000	0.118	1.222	2.011	0.002	0.049	225.479	97.78	1,011.82	1,665.31	1.78	40.76	186,735
1000	1527		9999	0.142	1.168	2.433	0.002	0.062	215.490	217.34	1,782.39	3,713.44	3.14	95.32	328,945
0	45	Crushing/Pro	50	0.542	3.907	3.003	0.006	0.098	443.274	24.40	175.82	135.16	0.26	4.42	19,947
50	85		120	0.285	2.884	1.864	0.005	0.088	443.274	24.19	245.15	158.42	0.44	7.50	37,678
120	171		175	0.224	2.530	1.149	0.005	0.056	443.274	38.31	432.68	196.45	0.85	9.52	75,800
175	250		250	0.184	0.865	0.909	0.005	0.029	443.274	46.06	216.36	227.32	1.25	7.21	110,818
250	382		500	0.182	0.829	0.840	0.004	0.028	443.274	69.36	316.67	320.98	1.66	10.71	169,331
500	602		750	0.182	0.829	0.857	0.004	0.028	443.274	109.63	499.35	515.67	2.68	16.94	266,851
750	1337		9999	0.214	0.855	2.363	0.004	0.047	443.274	286.59	1,143.66	3,158.77	5.96	62.38	592,657
0	16	Dumpers/Ten	25	0.261	0.889	1.646	0.003	0.062	215.954	4.17	14.23	26.34	0.04	0.98	3,455
0	36	Excavators	50	0.166	1.083	1.340	0.002	0.046	222.537	5.95	38.72	47.88	0.08	1.63	7,953
50	82		120	0.087	0.963	0.858	0.002	0.039	197.746	7.10	78.73	70.20	0.15	3.20	16,171
120	146		175	0.068	0.973	0.506	0.002	0.025	199.880	9.94	142.11	73.89	0.28	3.64	29,190
175	218		250	0.056	0.973	0.423	0.002	0.014	199.885	12.13	212.61	92.45	0.42	2.98	43,669
250	329		500	0.048	0.968	0.317	0.002	0.011	198.730	15.91	317.97	104.33	0.62	3.60	65,311
500	578		750	0.057	0.965	0.422	0.002	0.016	198.282	32.81	557.91	243.82	1.09	8.97	114,595
750	843		1000	0.039	0.965	0.900	0.002	0.009	198.249	32.48	813.53	758.21	1.60	7.83	167,099
1000	1569		9999	0.028	0.963	0.875	0.002	0.007	197.811	44.03	1,511.16	1,373.12	2.96	11.47	310,393
0	42	Forklifts	50	0.146	0.638	0.812	0.001	0.041	117.014	6.18	27.04	34.43	0.05	1.73	4,963
50	82		120	0.063	0.572	0.566	0.001	0.033	105.000	5.20	47.13	46.59	0.08	2.69	8,649
120	141		175	0.047	0.573	0.374	0.001	0.019	105.128	6.66	80.94	52.86	0.14	2.71	14,853
175	208		250	0.041	0.574	0.327	0.001	0.012	105.400	8.56	119.55	68.00	0.21	2.57	21,939
250	344		500	0.046	0.575	0.346	0.001	0.013	105.464	15.73	197.53	119.06	0.35	4.51	36,250
500	880		1000	0.022	0.573	0.485	0.001	0.004	105.117	19.78	504.07	426.95	0.88	3.95	92,503
0	11	Generator Se	15	0.455	2.591	3.195	0.007	0.136	420.542	5.00	28.50	35.15	0.07	1.49	4,626
15	19		25	0.517	1.771	3.281	0.005	0.133	420.542	9.82	33.66	62.34	0.10	2.53	7,990
25	33		50	0.366	2.823	2.695	0.005	0.086	420.542	12.09	93.17	88.93	0.18	2.84	13,878
50	84		120	0.201	2.479	1.780	0.005	0.081	420.542	16.86	208.20	149.52	0.41	6.82	35,326
120	153		175	0.153	2.170	1.159	0.005	0.049	420.542	23.39	332.01	177.34	0.72	7.56	64,343
175	229		250	0.119	0.744	0.926	0.005	0.026	420.542	27.28	170.28	212.10	1.08	6.03	96,304
250	363		500	0.116	0.729	0.856	0.004	0.026	420.542	41.93	264.50	310.61	1.50	9.28	152,657
500	586		750	0.116	0.729	0.873	0.004	0.026	420.542	68.24	426.99	511.76	2.48	15.15	246,438
750	1130		9999	0.141	0.756	2.212	0.004	0.041	420.542	159.73	854.53	2,499.54	4.78	46.54	475,212
0	39	Graders	50	0.791	1.160	2.055	0.002	0.213	223.579	30.99	45.43	80.47	0.08	8.33	8,756
50	91		120	0.292	1.104	2.221	0.002	0.167	212.726	26.57	100.45	202.09	0.18	15.17	19,357
120	148		175	0.156	1.124	1.309	0.002	0.072	216.654	23.03	166.32	193.62	0.31	10.69	32,053
175	204		250	0.112	1.113	1.256	0.002	0.041	214.468	22.92	227.42	256.67	0.42	8.32	43,827
250	293		500	0.125	1.105	0.994	0.002	0.039	212.928	36.69	323.92	291.36	0.60	11.42	62,424
500	796		1000	0.049	1.109	0.994	0.002	0.009	213.737	38.73	882.83	791.54	1.62	7.45	170,135
1000	1993		9999	0.182	1.107	2.514	0.002	0.073	213.348	361.72	2,206.16	5,009.75	4.06	146.14	425,161
0	38	Off-Highway	50	0.272	1.301	1.681	0.002	0.076	252.951	10.24	49.01	63.32	0.09	2.87	9,526
50	75		120	0.138	1.182	1.284	0.002	0.074	229.835	10.25	88.12	95.73	0.16	5.53	17,129
120	158		175	0.083	1.174	0.651	0.002	0.031	228.256	13.15	185.61	102.97	0.34	4.92	36,082
175	214		250	0.077	1.168	0.600	0.002	0.021	227.094	16.46	249.81	128.27	0.46	4.58	48,562
250	334		500	0.060	1.166	0.372	0.002	0.013	226.637	19.94	389.91	124.54	0.72	4.33	75,795
500	574		750	0.077	1.171	0.538	0.002	0.021	227.690	44.09	671.77	308.41	1.25	12.05	130,588
750	1000		1000	0.086	1.172	1.074	0.002	0.030	227.753	86.14	1,171.61	1,073.78	2.17	29.71	227,753
1000	1726		9999	0.133	1.206	1.691	0.002	0.046	234.386	229.84	2,081.40	2,918.37	3.86	78.97	404,609
0	29	Off-Highway	50	0.262	0.660	1.520	0.002	0.073	218.037	7.62	19.24	44.28	0.06	2.13	6,354
50	87		120	0.160	0.596	1.240	0.002	0.073	196.895	13.89	51.90	107.98	0.16	6.33	17,142
120	159		175	0.089	0.602	0.571	0.002	0.027	198.964	14.22	95.71	90.68	0.30	4.24	31,613
175	211		250	0.081	0.601	0.518	0.002	0.021	198.477	17.04	126.80	109.23	0.40	4.37	41,882
250	372		500	0.074	0.609	0.472	0.002	0.017	201.061	27.46	226.71	175.68	0.72	6.33	74,879
500	656		750	0.103	0.607	0.796	0.002	0.030	200.477	67.87	398.12	522.25	1.26	19.84	131,496

		2024		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	**Equipment**	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2	**ROG**	**CO**	**NOX**	**SOX**	**PM**	**CO2**
750	897		1000	0.083	0.606	1.313	0.002	0.027	200.163	74.86	543.74	1,178.46	1.72	23.79	179,592
1000	1764		9999	0.072	0.614	1.192	0.002	0.021	202.639	127.83	1,082.37	2,102.92	3.41	37.00	357,494
0	38	Other Constru	50	0.360	1.339	1.874	0.002	0.127	243.544	13.68	50.89	71.21	0.09	4.81	9,256
50	82		120	0.166	1.194	1.488	0.002	0.098	217.274	13.54	97.42	121.35	0.17	8.03	17,721
120	152		175	0.113	1.188	1.047	0.002	0.054	216.086	17.27	181.15	159.64	0.31	8.24	32,951
175	217		250	0.086	1.204	0.873	0.002	0.033	218.940	18.65	261.07	189.39	0.45	7.17	47,489
250	357		500	0.076	1.205	0.697	0.002	0.027	219.279	27.15	430.20	248.59	0.75	9.54	78,253
500	598		750	0.067	1.199	0.650	0.002	0.022	218.179	39.92	716.88	388.77	1.25	13.35	130,400
750	830		1000	0.050	1.201	1.098	0.002	0.018	218.447	41.35	996.95	911.14	1.73	15.20	181,345
1000	1127		9999	0.074	1.163	1.356	0.002	0.028	211.477	83.91	1,309.87	1,527.56	2.28	31.43	238,265
0	35	Other Genera	50	0.195	0.972	1.319	0.002	0.057	199.186	6.85	34.13	46.29	0.07	1.98	6,992
50	73		120	0.103	0.869	0.925	0.002	0.050	177.921	7.52	63.57	67.72	0.12	3.65	13,022
120	149		175	0.068	0.872	0.495	0.002	0.025	178.621	10.17	130.06	73.78	0.25	3.71	26,642
175	209		250	0.062	0.875	0.451	0.002	0.016	179.141	12.91	182.83	94.21	0.36	3.27	37,451
250	355		500	0.056	0.874	0.394	0.002	0.014	179.029	19.99	310.02	139.73	0.61	4.79	63,504
500	592		750	0.041	0.875	0.215	0.002	0.008	179.232	24.36	517.60	126.90	1.01	4.59	106,023
750	885		1000	0.071	0.872	1.357	0.002	0.027	178.698	62.61	772.06	1,200.84	1.51	24.25	158,148
1000	2000		9999	0.032	0.872	0.809	0.002	0.007	178.698	64.67	1,744.77	1,618.31	3.41	14.32	357,397
0	36	Other Materia	50	0.390	1.196	1.810	0.002	0.124	229.351	13.94	42.74	64.70	0.08	4.44	8,198
50	93		120	0.091	1.081	0.878	0.002	0.038	207.401	8.49	100.73	81.82	0.18	3.55	19,322
120	145		175	0.086	1.078	0.648	0.002	0.035	206.802	12.46	155.86	93.64	0.29	5.03	29,897
175	218		250	0.087	1.076	0.785	0.002	0.027	206.479	18.97	234.96	171.33	0.43	5.88	45,071
250	331		500	0.088	1.074	0.694	0.002	0.028	205.960	29.04	355.79	230.00	0.65	9.43	68,248
500	565		750	0.060	1.078	0.367	0.002	0.018	206.729	33.70	608.45	206.97	1.11	10.07	116,716
750	923		1000	0.021	1.078	0.892	0.002	0.007	206.729	19.39	994.72	823.65	1.82	6.44	190,811
1000	1050		9999	0.024	1.078	0.900	0.002	0.007	206.729	25.20	1,131.59	945.35	2.07	7.57	217,066
0	39	Pavers	50	0.413	1.428	1.746	0.002	0.116	242.461	15.96	55.17	67.44	0.09	4.48	9,365
50	80		120	0.147	1.275	1.361	0.002	0.088	216.400	11.67	101.46	108.34	0.16	7.03	17,222
120	158		175	0.083	1.281	0.751	0.002	0.035	217.520	13.11	202.64	118.82	0.33	5.55	34,397
175	213		250	0.052	1.283	0.558	0.002	0.017	217.785	11.05	273.56	118.97	0.44	3.65	46,434
250	327		500	0.062	1.267	0.643	0.002	0.022	214.994	20.31	414.65	210.52	0.67	7.30	70,385
500	750		750	0.025	1.280	0.109	0.002	0.004	217.241	19.11	959.87	81.38	1.56	2.80	162,931
0	35	Paving Equip	50	0.194	1.295	1.329	0.002	0.058	204.984	6.77	45.10	46.28	0.07	2.03	7,137
50	89		120	0.097	1.176	0.949	0.002	0.048	186.147	8.63	104.21	84.10	0.16	4.26	16,492
120	148		175	0.073	1.170	0.634	0.002	0.031	185.158	10.84	173.63	94.07	0.26	4.54	27,479
175	216		250	0.051	1.174	0.460	0.002	0.017	185.768	11.09	253.15	99.23	0.38	3.67	40,064
250	339		500	0.058	1.165	0.534	0.002	0.020	184.409	19.78	394.73	180.78	0.60	6.76	62,470
500	605		750	0.049	1.172	0.458	0.002	0.013	185.453	29.60	708.94	277.17	1.07	8.14	112,199
750	842		1000	0.042	1.175	0.841	0.002	0.014	185.931	35.03	989.20	708.06	1.50	11.91	156,554
0	8	Plate Compa	15	0.284	1.492	1.781	0.004	0.070	244.369	2.28	11.94	14.25	0.03	0.56	1,955
0	13	Pressure Wa	15	0.184	1.050	1.295	0.003	0.055	170.490	2.40	13.65	16.84	0.03	0.72	2,216
15	19		25	0.210	0.718	1.330	0.002	0.054	170.490	3.98	13.64	25.27	0.04	1.03	3,239
25	38		50	0.104	0.975	1.049	0.002	0.028	170.490	3.95	37.05	39.85	0.08	1.08	6,479
50	64		120	0.064	0.959	0.692	0.002	0.027	170.490	4.10	61.35	44.30	0.13	1.75	10,911
0	8	Pumps	15	0.512	2.591	3.204	0.007	0.141	420.542	4.10	20.73	25.63	0.05	1.13	3,364
15	21		25	0.533	1.771	3.281	0.005	0.135	420.542	11.20	37.20	68.90	0.11	2.84	8,831
25	37		50	0.403	2.964	2.731	0.005	0.091	420.542	14.91	109.67	101.06	0.20	3.38	15,560
50	84		120	0.215	2.517	1.804	0.005	0.086	420.542	18.07	211.42	151.56	0.41	7.21	35,326
120	151		175	0.165	2.203	1.178	0.005	0.052	420.542	24.88	332.66	177.91	0.71	7.89	63,502
175	217		250	0.129	0.755	0.942	0.005	0.027	420.542	27.96	163.83	204.50	1.03	5.96	91,258
250	372		500	0.125	0.737	0.868	0.004	0.027	420.542	46.61	274.23	322.88	1.54	9.90	156,442
500	615		750	0.126	0.737	0.886	0.004	0.027	420.542	77.52	453.37	544.94	2.60	16.58	258,633
750	1460		9999	0.151	0.766	2.235	0.004	0.043	420.542	220.98	1,117.74	3,263.60	6.17	62.09	613,991
0	36	Rollers	50	0.244	1.180	1.435	0.002	0.072	218.623	8.69	42.11	51.20	0.07	2.58	7,800
50	87		120	0.107	1.064	1.067	0.002	0.056	197.029	9.27	92.40	92.65	0.16	4.90	17,114
120	144		175	0.056	1.059	0.497	0.002	0.023	196.200	7.98	152.30	71.44	0.27	3.26	28,209
175	213		250	0.070	1.063	0.742	0.002	0.026	196.824	15.03	226.61	158.16	0.40	5.57	41,973
250	335		500	0.082	1.072	0.831	0.002	0.034	198.648	27.60	359.15	278.44	0.64	11.32	66,522
500	521		750	0.039	1.061	0.268	0.002	0.004	196.512	20.29	552.23	139.56	0.98	1.91	102,285
0	47	Rough Terrai	50	0.240	1.271	1.469	0.002	0.067	233.779	11.34	60.12	69.45	0.11	3.15	11,054
50	96		120	0.061	1.146	0.769	0.002	0.023	210.683	5.88	110.37	74.11	0.19	2.26	20,294
120	130		175	0.043	1.142	0.420	0.002	0.016	210.002	5.61	148.00	54.39	0.26	2.01	27,214
175	208		250	0.050	1.145	0.595	0.002	0.014	210.589	10.42	238.56	123.95	0.42	2.92	43,867
250	374		500	0.028	1.130	0.191	0.002	0.004	207.781	10.42	422.49	71.52	0.74	1.34	77,687
500	625		750	0.049	1.143	0.541	0.002	0.004	210.233	30.48	714.57	338.29	1.25	2.42	131,396
0	42	Rubber Tired	50	0.205	1.066	1.425	0.002	0.050	227.855	8.54	44.32	59.27	0.09	2.07	9,475
50	82		120	0.291	0.979	2.215	0.002	0.174	209.328	23.74	79.89	180.72	0.16	14.22	17,079
120	150		175	0.220	0.970	1.982	0.002	0.110	207.369	32.97	145.19	296.70	0.30	16.53	31,040
175	211		250	0.165	0.972	1.617	0.002	0.073	207.838	34.82	205.11	341.14	0.42	15.37	43,850
250	354		500	0.172	0.982	1.593	0.002	0.072	209.944	61.02	347.70	564.09	0.71	25.52	74,331
500	584		750	0.176	0.969	2.108	0.002	0.078	207.148	102.78	565.98	1,231.53	1.16	45.28	120,995
0	42	Rubber Tired	50	0.382	0.988	1.616	0.002	0.104	210.123	15.93	41.19	67.39	0.08	4.32	8,761
50	86		120	0.150	0.880	1.208	0.002	0.080	187.107	12.96	75.78	104.07	0.15	6.87	16,119
120	150		175	0.093	0.886	0.682	0.002	0.036	188.529	13.97	132.94	102.22	0.27	5.45	28,279
175	206		250	0.075	0.885	0.653	0.002	0.022	188.301	15.36	182.27	134.54	0.37	4.50	38,772
250	320		500	0.079	0.883	0.616	0.002	0.023	187.791	25.35	282.23	196.82	0.57	7.30	60,035
500	600		750	0.085	0.876	0.681	0.002	0.026	186.329	51.29	525.99	408.73	1.07	15.67	111,886
750	837		1000	0.076	0.890	1.282	0.002	0.026	189.327	63.57	744.80	1,072.85	1.51	21.63	158,431
1000	1521		9999	0.092	0.884	1.512	0.002	0.033	187.939	139.72	1,343.83	2,299.78	2.73	50.46	285,856
0	36	Scrapers	50	1.562	1.260	3.085	0.003	0.413	279.274	56.46	45.54	111.50	0.10	14.91	10,094
50	84		120	0.290	1.164	2.717	0.002	0.200	257.970	24.47	98.15	229.11	0.21	16.86	21,754
120	166		175	0.170	1.154	1.523	0.002	0.080	255.890	28.20	191.84	253.00	0.41	13.34	42,520
175	225		250	0.152	1.132	1.454	0.002	0.064	250.836	34.24	254.60	327.08	0.54	14.45	56,431
250	381		500	0.124	1.140	1.195	0.002	0.047	252.703	47.10	434.78	455.67	0.92	18.01	96,368
500	565		750	0.107	1.137	1.055	0.002	0.039	251.946	60.70	642.18	595.90	1.36	22.00	142,337
750	950		1000	0.593	1.138	6.460	0.002	0.301	252.280	562.94	1,081.30	6,137.29	2.29	286.14	239,666
1000	1923		9999	0.107	1.163	1.935	0.002	0.044	257.796	205.93	2,236.99	3,720.80	4.73	84.78	495,821
0	6	Signal Boards	15	0.542	2.845	3.397	0.007	0.133	466.006	3.25	17.07	20.38	0.04	0.80	2,796
15	37		50	0.437	3.313	2.856	0.006	0.089	443.274	16.18	122.59	105.69	0.21	3.30	16,401
50	82		120	0.231	2.710	1.806	0.005	0.082	443.274	18.95	222.23	148.10	0.43	6.75	36,348
120	158		175	0.179	2.377	1.113	0.005	0.051	443.274	28.31	375.58	175.91	0.79	8.07	70,037
175	216		250	0.175	0.983	1.069	0.006	0.032	535.622	37.77	212.27	230.99	1.30	7.01	115,694
0	43	Skid Steer Lo	50	0.135	1.379	1.233	0.002	0.033	215.472	5.86	59.93	53.59	0.09	1.42	9,366
50	71		120	0.057	1.235	0.718	0.002	0.023	193.037	4.00	87.12	50.64	0.13	1.63	13,616
120	153		175	0.050	1.225	0.457	0.002	0.019	191.391	7.69	187.27	69.82	0.28	2.96	29,269
175	201		250	0.043	1.206	0.499	0.002	0.015	188.489	8.70	241.84	100.00	0.36	3.06	37,798
250	277		500	0.024	1.201	0.094	0.002	0.003	187.666	6.58	332.20	26.10	0.50	0.91	51,921
500	530		750	0.071	1.233	0.905	0.002	0.040	192.714	37.56	653.51	479.74	0.98	21.03	102,138
750	1000		1000	0.028	1.233	0.843	0.002	0.011	192.714	28.33	1,233.03	842.65	1.84	11.33	192,714
0	36	Surfacing Equ	50	0.105	0.851	1.122	0.002	0.035	179.044	3.75	30.34	40.01	0.06	1.25	6,386

		2024		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	Equipment	MaxHP	ROG	CO	NOX	SOX	PM	CO2	ROG	CO	NOX	SOX	PM	CO2
50	89		120	0.079	0.754	0.869	0.002	0.043	158.786	7.03	66.90	77.08	0.13	3.81	14,081
120	151		175	0.072	0.746	0.743	0.001	0.036	157.014	10.86	112.63	112.15	0.23	5.47	23,705
175	216		250	0.055	0.757	0.674	0.002	0.021	159.359	11.98	163.60	145.68	0.33	4.62	34,432
250	362		500	0.042	0.746	0.446	0.001	0.017	157.073	15.29	270.43	161.44	0.54	6.11	56,916
500	615		750	0.030	0.751	0.285	0.002	0.010	157.985	18.30	461.70	175.56	0.93	6.39	97,173
750	814		1000	0.041	0.752	0.902	0.002	0.016	158.265	33.26	612.32	734.46	1.23	12.97	128,873
1000	1141		9999	0.028	0.737	0.678	0.001	0.010	155.194	31.55	841.35	773.35	1.69	11.00	177,076
0	36	Sweepers/Sc	50	0.356	1.544	1.858	0.003	0.109	265.154	12.66	54.93	66.13	0.09	3.87	9,436
50	78		120	0.158	1.393	1.412	0.002	0.086	239.305	12.27	108.00	109.44	0.18	6.66	18,552
120	159		175	0.127	1.390	1.027	0.002	0.049	238.803	20.24	221.69	163.71	0.36	7.79	38,082
175	204		250	0.078	1.381	0.735	0.002	0.023	237.291	16.02	282.36	150.27	0.46	4.71	48,504
250	303		500	0.100	1.387	1.086	0.002	0.037	238.264	30.10	419.57	328.60	0.69	11.29	72,075
500	848		1000	0.027	1.387	1.036	0.002	0.008	238.264	23.02	1,176.17	878.79	1.93	7.02	202,048
0	38	Tractors/Load	50	0.227	0.982	1.389	0.002	0.061	209.777	8.71	37.63	53.19	0.08	2.34	8,036
50	83		120	0.088	0.911	0.843	0.002	0.039	194.623	7.25	75.33	69.68	0.15	3.20	16,086
120	144		175	0.068	0.897	0.507	0.002	0.025	191.631	9.77	129.17	73.01	0.26	3.63	27,582
175	204		250	0.065	0.898	0.549	0.002	0.020	191.840	13.20	183.47	112.21	0.37	4.10	39,177
250	320		500	0.058	0.899	0.429	0.002	0.016	191.909	18.56	287.72	137.23	0.59	5.23	61,438
500	575		750	0.085	0.892	0.816	0.002	0.031	190.503	48.94	512.65	469.12	1.05	18.09	109,466
750	871		1000	0.053	0.910	1.089	0.002	0.019	194.331	46.26	793.04	949.08	1.62	16.51	169,340
1000	2006		9999	0.067	0.904	1.165	0.002	0.022	193.002	133.79	1,812.80	2,336.64	3.70	43.83	387,090
0	40	Trenchers	50	0.316	1.632	1.927	0.003	0.099	293.392	12.56	64.93	76.64	0.11	3.93	11,670
50	82		120	0.260	1.473	2.308	0.003	0.160	264.783	21.33	120.89	189.39	0.21	13.10	21,727
120	144		175	0.191	1.449	1.843	0.002	0.094	260.386	27.50	208.43	265.12	0.36	13.50	37,462
175	218		250	0.164	1.468	1.750	0.003	0.073	263.789	35.79	320.57	382.27	0.55	15.96	57,617
250	359		500	0.101	1.456	0.934	0.002	0.040	261.645	36.13	521.91	334.86	0.90	14.40	93,804
500	619		750	0.034	1.470	0.153	0.003	0.005	264.141	20.96	910.08	94.70	1.56	2.85	163,569
750	860		1000	0.617	1.462	6.729	0.003	0.314	262.792	530.84	1,257.44	5,787.35	2.16	269.83	226,001
0	11	Welders	15	0.312	1.575	1.948	0.004	0.086	255.735	3.43	17.33	21.43	0.04	0.94	2,813
15	20		25	0.324	1.077	1.995	0.003	0.082	255.735	6.49	21.54	39.90	0.06	1.65	5,115
25	46		50	0.302	2.068	1.731	0.003	0.064	255.735	13.88	95.12	79.64	0.15	2.92	11,764
50	70		120	0.157	1.606	1.134	0.003	0.058	255.735	11.00	112.43	79.40	0.21	4.08	17,901
120	174		175	0.123	1.406	0.743	0.003	0.036	255.735	21.34	244.58	129.35	0.50	6.26	44,498
175	211		250	0.098	0.482	0.595	0.003	0.018	255.735	20.62	101.61	125.53	0.61	3.89	53,960
250	297		500	0.096	0.465	0.546	0.003	0.018	255.735	28.45	138.13	162.10	0.75	5.31	75,953
0	29	Water Trucks	50	0.262	0.660	1.520	0.002	0.073	218.037	7.624	19.237	44.284	0.061	2.131	6353.682
50	87		120	0.160	0.596	1.240	0.002	0.073	196.895	13.895	51.900	107.984	0.164	6.328	17142.173
120	159		175	0.089	0.602	0.571	0.002	0.027	198.964	14.218	95.713	90.677	0.302	4.245	31613.174
175	211		250	0.081	0.601	0.518	0.002	0.021	198.477	17.039	126.803	109.230	0.400	4.369	41881.675
250	372		500	0.074	0.609	0.472	0.002	0.017	201.061	27.460	226.706	175.675	0.715	6.325	74878.664
500	656		750	0.103	0.607	0.796	0.002	0.030	200.477	67.866	398.124	522.247	1.256	19.836	131496.223
750	897		1000	0.083	0.606	1.313	0.002	0.027	200.163	74.863	543.740	1178.464	1.715	23.788	179591.867
1000	1764		9999	0.072	0.614	1.192	0.002	0.021	202.639	127.831	1082.366	2102.924	3.414	36.998	357494.391

2025

		2025		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	Equipment	MaxHP	ROG	CO	NOX	SOX	PM	CO2	ROG	CO	NOX	SOX	PM	CO2
0	46	Aerial Lifts	50	0.050	0.866	0.887	0.002	0.006	179.282	2.29	39.91	40.91	0.08	0.29	8,267
50	74		120	0.032	0.778	0.466	0.002	0.008	161.199	2.36	57.61	34.46	0.11	0.59	11,932
120	130		175	0.027	0.778	0.176	0.002	0.007	161.168	3.57	101.52	22.99	0.20	0.97	21,028
175	210		250	0.021	0.778	0.081	0.002	0.003	161.179	4.33	163.42	17.03	0.32	0.59	33,848
250	380		500	0.027	0.778	0.200	0.002	0.003	161.179	10.42	295.70	76.00	0.58	1.10	61,248
0	12	Air Compress	15	0.329	1.677	2.059	0.004	0.089	272.784	3.95	20.12	24.71	0.05	1.07	3,273
15	24		25	0.342	1.142	2.119	0.003	0.086	272.784	8.20	27.41	50.85	0.08	2.06	6,547
25	37		50	0.327	2.345	1.833	0.004	0.061	272.784	12.12	86.78	67.81	0.13	2.26	10,093
50	78		120	0.172	1.757	1.153	0.003	0.055	272.784	13.42	137.07	89.92	0.25	4.27	21,277
120	147		175	0.135	1.541	0.717	0.003	0.034	272.784	19.83	226.53	105.37	0.45	5.00	40,099
175	218		250	0.109	0.526	0.562	0.003	0.017	272.784	23.85	114.73	122.49	0.67	3.74	59,467
250	385		500	0.108	0.505	0.516	0.003	0.017	272.784	41.46	194.53	198.73	1.03	6.42	105,022
500	595		750	0.108	0.505	0.527	0.003	0.017	272.784	64.22	300.63	313.59	1.63	10.04	162,306
750	808		1000	0.115	0.520	1.447	0.003	0.028	272.784	92.85	419.97	1,168.82	2.22	22.92	220,409
0	39	Bore/Drill Rig	50	0.311	1.192	1.999	0.003	0.097	296.620	12.20	46.80	78.50	0.11	3.81	11,649
50	82		120	0.081	1.028	0.987	0.002	0.034	255.986	6.69	84.67	81.24	0.20	2.79	21,075
120	149		175	0.060	1.070	0.446	0.003	0.019	266.249	8.89	158.88	66.27	0.38	2.89	39,547
175	208		250	0.056	1.053	0.481	0.003	0.016	262.012	11.73	218.69	99.92	0.52	3.28	54,434
250	349		500	0.053	1.045	0.414	0.002	0.014	260.139	18.66	364.93	144.40	0.87	4.94	90,836
500	612		750	0.044	1.076	0.300	0.003	0.011	267.910	27.18	658.67	183.36	1.57	6.96	163,951
750	919		1000	0.033	1.055	1.150	0.003	0.009	262.715	30.16	969.95	1,057.16	2.31	8.59	241,435
1000	2667		9999	0.108	1.056	2.179	0.003	0.056	262.792	287.37	2,815.34	5,809.95	6.69	148.22	700,778
0	9	Cement and	15	0.370	1.943	2.320	0.005	0.091	318.248	3.33	17.49	20.88	0.04	0.82	2,864
15	25		25	0.386	1.313	2.440	0.004	0.094	318.248	9.65	32.82	61.01	0.10	2.35	7,956
0	18	Concrete/Ind	25	0.500	1.708	3.163	0.005	0.118	414.859	9.01	30.75	56.93	0.09	2.13	7,467
25	33		50	0.384	3.138	2.622	0.005	0.073	414.859	12.67	103.54	86.53	0.18	2.40	13,690
50	81		120	0.207	2.552	1.589	0.005	0.066	414.859	16.76	206.72	128.72	0.39	5.32	33,604
120	175		175	0.161	2.243	0.913	0.005	0.042	414.859	28.23	392.59	159.70	0.82	7.27	72,600
0	41	Cranes	50	0.546	0.825	1.624	0.002	0.156	165.291	22.19	33.54	65.97	0.06	6.35	6,716
50	89		120	0.140	0.748	1.191	0.001	0.075	149.862	12.43	66.56	105.97	0.13	6.67	13,330
120	148		175	0.101	0.757	0.911	0.001	0.048	151.527	14.90	111.90	134.65	0.21	7.09	22,408
175	217		250	0.080	0.754	0.772	0.001	0.033	150.963	17.32	163.59	167.63	0.31	7.13	32,759
250	336		500	0.066	0.752	0.621	0.001	0.025	150.639	22.13	252.83	208.60	0.48	8.51	50,631
500	567		750	0.052	0.750	0.472	0.001	0.020	150.099	29.36	425.14	267.60	0.81	11.07	85,135
750	938		1000	0.152	0.747	1.808	0.001	0.076	149.638	142.34	700.62	1,695.45	1.34	71.38	140,301
1000	1030		9999	0.069	0.752	0.698	0.001	0.019	150.667	71.04	774.95	718.77	1.48	19.28	155,187
0	43	Crawler Tract	50	0.783	1.329	2.116	0.002	0.196	245.186	33.26	56.48	89.97	0.10	8.31	10,423
50	87		120	0.204	1.226	1.699	0.002	0.122	226.187	17.70	106.45	147.53	0.19	10.61	19,646
120	150		175	0.134	1.214	1.152	0.002	0.064	224.029	19.98	181.53	172.34	0.32	9.62	33,502
175	203		250	0.104	1.214	1.056	0.002	0.041	224.044	21.16	246.25	214.11	0.43	8.36	45,446
250	341		500	0.093	1.220	0.823	0.002	0.035	225.177	31.79	415.69	280.50	0.73	11.76	76,716
500	570		750	0.075	1.216	0.662	0.002	0.024	224.417	42.72	693.26	377.58	1.22	13.86	127,943
750	828		1000	0.116	1.224	1.972	0.002	0.048	225.881	96.45	1,013.62	1,632.83	1.79	39.59	187,067
1000	1527		9999	0.065	1.168	1.458	0.002	0.026	215.490	98.58	1,782.39	2,226.29	3.14	40.07	328,945
0	45	Crushing/Pro	50	0.512	3.887	2.919	0.006	0.084	443.274	23.06	174.89	131.35	0.26	3.77	19,947
50	85		120	0.270	2.882	1.754	0.005	0.075	443.274	22.94	244.99	149.08	0.44	6.35	37,678
120	171		175	0.211	2.533	1.015	0.005	0.047	443.274	36.03	433.07	173.59	0.85	8.03	75,800
175	250		250	0.175	0.864	0.790	0.005	0.024	443.274	43.81	216.08	197.56	1.25	6.08	110,818
250	382		500	0.173	0.828	0.731	0.004	0.024	443.274	66.11	316.21	279.35	1.66	9.05	169,331
500	602		750	0.174	0.828	0.745	0.004	0.024	443.274	104.54	498.62	448.53	2.68	14.32	266,851
750	1337		9999	0.204	0.848	2.270	0.004	0.042	443.274	272.88	1,133.68	3,034.68	5.96	56.14	592,657
0	16	Dumpers/Ter	25	0.261	0.889	1.646	0.003	0.061	215.954	4.17	14.23	26.34	0.04	0.98	3,455
0	36	Excavators	50	0.161	1.083	1.319	0.002	0.041	222.451	5.76	38.70	47.13	0.08	1.47	7,950
50	82		120	0.080	0.961	0.795	0.002	0.033	197.472	6.56	78.62	65.04	0.15	2.66	16,149
120	146		175	0.063	0.973	0.441	0.002	0.022	199.909	9.21	142.14	64.34	0.28	3.15	29,195
175	218		250	0.052	0.973	0.367	0.002	0.012	199.935	11.42	212.66	80.27	0.42	2.64	43,680
250	329		500	0.046	0.969	0.277	0.002	0.010	198.976	15.13	318.36	91.17	0.62	3.23	65,392
500	578		750	0.056	0.965	0.392	0.002	0.015	198.242	32.09	557.80	226.39	1.09	8.38	114,572
750	843		1000	0.037	0.965	0.896	0.002	0.009	198.258	31.27	813.56	754.87	1.60	7.74	167,106
1000	1569		9999	0.028	0.963	0.875	0.002	0.007	197.811	43.80	1,511.16	1,372.52	2.96	11.45	310,393
0	42	Forklifts	50	0.134	0.638	0.790	0.001	0.036	117.014	5.68	27.04	33.52	0.05	1.52	4,963
50	82		120	0.058	0.572	0.524	0.001	0.028	105.000	4.80	47.13	43.17	0.08	2.31	8,649
120	141		175	0.044	0.573	0.332	0.001	0.017	105.128	6.20	80.94	46.94	0.14	2.39	14,853
175	208		250	0.040	0.574	0.295	0.001	0.011	105.400	8.34	119.55	61.35	0.21	2.35	21,939
250	344		500	0.045	0.575	0.333	0.001	0.012	105.464	15.53	197.53	114.58	0.35	4.26	36,250
500	880		1000	0.024	0.573	0.489	0.001	0.005	105.117	21.08	504.07	430.42	0.88	4.05	92,503
0	11	Generator Se	15	0.451	2.585	3.168	0.007	0.133	420.542	4.96	28.43	34.85	0.07	1.47	4,626
15	19		25	0.515	1.761	3.267	0.005	0.131	420.542	9.78	33.46	62.07	0.10	2.49	7,990
25	33		50	0.340	2.804	2.619	0.005	0.075	420.542	11.24	92.53	86.43	0.18	2.48	13,878
50	84		120	0.188	2.476	1.678	0.005	0.070	420.542	15.81	207.98	140.93	0.41	5.89	35,326
120	153		175	0.143	2.172	1.036	0.005	0.043	420.542	21.92	332.25	158.51	0.72	6.53	64,343
175	229		250	0.113	0.742	0.814	0.005	0.023	420.542	25.92	169.87	186.30	1.08	5.17	96,304
250	363		500	0.110	0.727	0.751	0.004	0.022	420.542	39.99	263.85	272.69	1.50	7.96	152,657
500	586		750	0.111	0.727	0.767	0.004	0.022	420.542	65.01	425.95	449.36	2.48	13.01	246,438
750	1130		9999	0.134	0.748	2.122	0.004	0.037	420.542	151.28	845.63	2,397.56	4.78	42.14	475,212
0	39	Graders	50	0.797	1.160	2.061	0.002	0.213	223.462	31.23	45.41	80.71	0.08	8.35	8,751
50	91		120	0.273	1.100	2.074	0.002	0.152	212.044	24.83	100.12	188.70	0.18	13.81	19,295
120	148		175	0.141	1.124	1.134	0.002	0.062	216.659	20.81	166.33	167.73	0.31	9.20	32,054
175	204		250	0.098	1.112	1.045	0.002	0.034	214.378	20.11	227.32	213.50	0.42	6.87	43,809
250	293		500	0.120	1.106	0.926	0.002	0.036	213.148	35.06	324.25	271.37	0.60	10.54	62,489
500	796		1000	0.052	1.109	1.003	0.002	0.010	213.737	41.19	882.83	798.11	1.62	7.65	170,135
1000	1993		9999	0.095	1.107	1.622	0.002	0.037	213.348	188.67	2,206.16	3,232.96	4.06	72.90	425,161
0	38	Off-Highway	50	0.236	1.301	1.605	0.002	0.061	252.904	8.88	49.00	60.44	0.09	2.30	9,525
50	75		120	0.126	1.184	1.179	0.002	0.063	230.101	9.37	88.22	87.88	0.16	4.67	17,149
120	158		175	0.080	1.175	0.587	0.002	0.028	228.355	12.63	185.69	92.84	0.34	4.45	36,097
175	214		250	0.070	1.169	0.486	0.002	0.017	227.177	15.06	249.91	103.95	0.46	3.73	48,580
250	334		500	0.056	1.167	0.313	0.002	0.011	226.837	18.71	390.25	104.69	0.72	3.58	75,862
500	574		750	0.076	1.171	0.487	0.002	0.020	227.686	43.73	671.76	279.26	1.25	11.25	130,586
750	1000		1000	0.090	1.172	1.081	0.002	0.030	227.753	90.33	1,171.61	1,080.93	2.17	30.25	227,753
1000	1726		9999	0.089	1.148	1.240	0.002	0.026	223.084	154.14	1,981.03	2,140.18	3.68	45.25	385,099
0	29	Off-Highway	50	0.268	0.660	1.516	0.002	0.070	217.904	7.82	19.22	44.17	0.06	2.04	6,350
50	87		120	0.137	0.596	1.084	0.002	0.061	196.947	11.91	51.91	94.40	0.16	5.31	17,147
120	159		175	0.085	0.602	0.510	0.002	0.025	198.854	13.57	95.66	81.03	0.30	3.93	31,596
175	211		250	0.074	0.601	0.431	0.002	0.016	198.483	15.59	126.81	90.97	0.40	3.48	41,883
250	372		500	0.071	0.608	0.406	0.002	0.015	200.955	26.39	226.59	151.30	0.71	5.41	74,839
500	656		750	0.094	0.610	0.669	0.002	0.025	201.524	61.68	400.20	438.50	1.26	16.53	132,183
750	897		1000	0.075	0.606	1.197	0.002	0.022	200.278	67.11	544.05	1,074.29	1.72	19.41	179,695
1000	1764		9999	0.064	0.614	1.109	0.002	0.017	202.777	113.61	1,083.10	1,957.12	3.42	30.31	357,737
0	38	Other Constr	50	0.329	1.338	1.789	0.002	0.111	243.426	12.51	50.86	67.98	0.09	4.23	9,252
50	82		120	0.148	1.196	1.351	0.002	0.084	217.560	12.10	97.55	110.19	0.17	6.88	17,745
120	152		175	0.102	1.189	0.900	0.002	0.047	216.223	15.56	181.26	137.29	0.31	7.10	32,972
175	217		250	0.083	1.205	0.799	0.002	0.031	219.101	18.04	261.26	173.27	0.45	6.73	47,524
250	357		500	0.073	1.205	0.645	0.002	0.025	219.193	26.13	430.03	230.13	0.75	8.81	78,222
500	598		750	0.062	1.198	0.567	0.002	0.020	217.926	37.07	716.04	338.59	1.24	11.87	130,248
750	830		1000	0.052	1.201	1.102	0.002	0.018	218.513	43.11	997.25	915.15	1.73	15.34	181,399

		2025		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	Equipment	MaxHP	ROG	CO	NOX	SOX	PM	CO2	ROG	CO	NOX	SOX	PM	CO2
1000	1127		9999	0.056	1.163	1.146	0.002	0.019	211.462	63.53	1,309.77	1,291.71	2.28	21.25	238,248
0	35	Other Genera	50	0.176	0.972	1.270	0.002	0.047	199.186	6.18	34.13	44.59	0.07	1.63	6,992
50	73		120	0.092	0.869	0.833	0.002	0.040	177.921	6.74	63.57	61.00	0.12	2.95	13,022
120	149		175	0.068	0.872	0.466	0.002	0.024	178.621	10.08	130.06	69.51	0.25	3.58	26,642
175	209		250	0.055	0.875	0.351	0.002	0.012	179.141	11.57	182.83	73.44	0.36	2.59	37,451
250	355		500	0.054	0.874	0.360	0.002	0.012	179.029	19.22	310.02	127.67	0.61	4.28	63,504
500	592		750	0.042	0.875	0.215	0.002	0.008	179.232	24.76	517.60	127.14	1.01	4.60	106,023
750	885		1000	0.073	0.872	1.362	0.002	0.028	178.698	64.26	772.06	1,205.22	1.51	24.38	158,148
1000	2000		9999	0.035	0.872	0.817	0.002	0.007	178.698	70.26	1,744.77	1,633.21	3.41	14.77	357,397
0	36	Other Materia	50	0.308	1.196	1.673	0.002	0.094	229.351	11.01	42.74	59.81	0.08	3.37	8,198
50	93		120	0.084	1.081	0.812	0.002	0.032	207.401	7.83	100.73	75.69	0.18	2.97	19,322
120	145		175	0.078	1.078	0.552	0.002	0.029	206.802	11.31	155.86	79.77	0.29	4.14	29,897
175	218		250	0.083	1.076	0.701	0.002	0.024	206.479	18.04	234.96	153.03	0.43	5.18	45,071
250	331		500	0.084	1.074	0.633	0.002	0.026	205.960	27.94	355.79	209.73	0.65	8.73	68,248
500	565		750	0.062	1.078	0.368	0.002	0.018	206.729	35.27	608.45	207.83	1.11	10.17	116,716
750	923		1000	0.021	1.078	0.892	0.002	0.007	206.729	19.39	994.72	823.65	1.82	6.44	190,811
1000	1050		9999	0.027	1.078	0.908	0.002	0.007	206.729	28.34	1,131.59	953.71	2.07	7.82	217,066
0	39	Pavers	50	0.399	1.428	1.716	0.002	0.110	242.460	15.42	55.17	66.28	0.09	4.25	9,365
50	80		120	0.136	1.274	1.274	0.002	0.079	216.249	10.86	101.39	101.42	0.16	6.30	17,210
120	158		175	0.078	1.281	0.683	0.002	0.032	217.439	12.41	202.57	107.99	0.33	5.06	34,385
175	213		250	0.047	1.284	0.430	0.002	0.014	217.899	9.92	273.70	91.66	0.44	2.99	46,459
250	327		500	0.050	1.263	0.471	0.002	0.016	214.401	16.34	413.51	154.15	0.67	5.31	70,191
500	750		750	0.027	1.280	0.109	0.002	0.004	217.241	20.47	959.87	81.83	1.56	2.84	162,931
0	35	Paving Equip	50	0.177	1.295	1.288	0.002	0.050	204.960	6.16	45.09	44.84	0.07	1.75	7,136
50	89		120	0.090	1.177	0.886	0.002	0.042	186.245	7.95	104.26	78.54	0.16	3.71	16,501
120	148		175	0.065	1.169	0.536	0.002	0.027	185.088	9.66	173.56	79.52	0.26	3.93	27,468
175	216		250	0.050	1.174	0.394	0.002	0.015	185.777	10.68	253.16	84.97	0.38	3.33	40,066
250	339		500	0.049	1.165	0.402	0.002	0.015	184.429	16.62	394.77	136.12	0.60	4.99	62,477
500	605		750	0.031	1.172	0.184	0.002	0.004	185.431	19.01	708.86	111.27	1.07	2.13	112,186
750	842		1000	0.044	1.175	0.845	0.002	0.014	185.931	36.69	989.20	711.61	1.50	12.08	156,554
0	8	Plate Compa	15	0.284	1.492	1.781	0.004	0.070	244.369	2.28	11.94	14.25	0.03	0.56	1,955
0	13	Pressure Wa	15	0.183	1.048	1.284	0.003	0.054	170.490	2.38	13.62	16.70	0.03	0.70	2,216
15	19		25	0.209	0.714	1.324	0.002	0.053	170.490	3.96	13.56	25.16	0.04	1.01	3,239
25	38		50	0.096	0.968	1.019	0.002	0.025	170.490	3.65	36.80	38.72	0.08	0.93	6,479
50	64		120	0.059	0.957	0.653	0.002	0.023	170.490	3.80	61.27	41.80	0.13	1.50	10,911
0	8	Pumps	15	0.507	2.585	3.175	0.007	0.137	420.542	4.06	20.68	25.40	0.05	1.10	3,364
15	21		25	0.527	1.761	3.267	0.005	0.133	420.542	11.06	36.98	68.60	0.11	2.79	8,831
25	37		50	0.375	2.944	2.655	0.005	0.080	420.542	13.88	108.91	98.22	0.20	2.96	15,560
50	84		120	0.202	2.515	1.700	0.005	0.074	420.542	16.98	211.22	142.81	0.41	6.23	35,326
120	151		175	0.155	2.205	1.053	0.005	0.045	420.542	23.37	332.95	159.01	0.71	6.82	63,502
175	217		250	0.123	0.753	0.828	0.005	0.024	420.542	26.60	163.45	179.62	1.03	5.11	91,258
250	372		500	0.120	0.735	0.762	0.004	0.023	420.542	44.51	273.57	283.47	1.54	8.50	156,442
500	615		750	0.120	0.735	0.778	0.004	0.023	420.542	73.97	452.28	478.52	2.60	14.22	258,633
750	1460		9999	0.144	0.758	2.144	0.004	0.039	420.542	209.95	1,106.01	3,129.73	6.17	56.28	613,991
0	36	Rollers	50	0.223	1.181	1.384	0.002	0.063	218.700	7.97	42.13	49.38	0.07	2.24	7,803
50	87		120	0.100	1.063	1.010	0.002	0.051	196.965	8.71	92.37	87.71	0.16	4.41	17,109
120	144		175	0.050	1.059	0.413	0.002	0.019	196.182	7.15	152.29	59.39	0.27	2.67	28,207
175	213		250	0.068	1.063	0.669	0.002	0.025	196.894	14.48	226.69	142.62	0.40	5.24	41,988
250	335		500	0.083	1.072	0.825	0.002	0.034	198.512	27.82	358.90	276.42	0.63	11.37	66,477
500	521		750	0.040	1.061	0.269	0.002	0.004	196.512	21.03	552.23	140.06	0.98	1.92	102,285
0	47	Rough Terrai	50	0.192	1.272	1.398	0.002	0.051	233.825	9.07	60.13	66.09	0.11	2.43	11,056
50	96		120	0.058	1.146	0.732	0.002	0.021	210.671	5.57	110.36	70.50	0.19	1.98	20,293
120	130		175	0.037	1.142	0.316	0.002	0.012	209.975	4.76	147.98	40.96	0.26	1.56	27,211
175	208		250	0.052	1.145	0.599	0.002	0.014	210.622	10.73	238.60	124.68	0.42	2.97	43,874
250	374		500	0.029	1.130	0.192	0.002	0.004	207.778	10.81	422.48	71.64	0.74	1.35	77,686
500	625		750	0.050	1.143	0.543	0.002	0.004	210.233	31.32	714.57	339.12	1.25	2.43	131,396
0	42	Rubber Tired	50	0.216	1.066	1.442	0.002	0.050	227.844	9.00	44.32	59.96	0.09	2.07	9,475
50	82		120	0.275	0.979	2.077	0.002	0.162	209.337	22.42	79.89	169.49	0.16	13.21	17,080
120	150		175	0.191	0.971	1.672	0.002	0.091	207.627	28.55	145.37	250.22	0.30	13.64	31,078
175	211		250	0.154	0.972	1.504	0.002	0.066	207.833	32.46	205.11	317.38	0.42	13.89	43,848
250	354		500	0.152	0.981	1.332	0.002	0.060	209.811	53.73	347.48	471.59	0.71	21.08	74,284
500	584		750	0.177	0.969	2.108	0.002	0.078	207.143	103.40	565.96	1,231.47	1.16	45.29	120,992
0	42	Rubber Tired	50	0.364	0.987	1.573	0.002	0.094	209.994	15.16	41.16	65.60	0.08	3.90	8,756
50	86		120	0.133	0.880	1.075	0.002	0.065	187.143	11.48	75.79	92.58	0.15	5.58	16,122
120	150		175	0.085	0.886	0.575	0.002	0.030	188.571	12.70	132.97	86.30	0.27	4.56	28,285
175	206		250	0.067	0.885	0.522	0.002	0.018	188.335	13.83	182.30	107.43	0.37	3.61	38,779
250	320		500	0.073	0.884	0.518	0.002	0.019	188.043	23.37	282.61	165.70	0.57	6.07	60,115
500	600		750	0.080	0.876	0.598	0.002	0.023	186.403	48.26	526.20	359.35	1.07	13.90	111,931
750	837		1000	0.063	0.890	1.117	0.002	0.019	189.371	52.43	744.97	935.08	1.51	15.76	158,468
1000	1521		9999	0.094	0.884	1.521	0.002	0.033	187.939	142.83	1,343.83	2,313.52	2.73	50.84	285,855
0	36	Scrapers	50	1.571	1.260	3.092	0.003	0.414	279.274	56.79	45.54	111.74	0.10	14.98	10,094
50	84		120	0.286	1.163	2.654	0.002	0.195	257.789	24.11	98.08	223.84	0.21	16.47	21,739
120	166		175	0.146	1.155	1.269	0.002	0.066	255.964	24.34	191.89	210.89	0.41	10.96	42,532
175	225		250	0.147	1.132	1.352	0.002	0.060	250.886	33.07	254.65	304.23	0.54	13.61	56,443
250	381		500	0.109	1.139	0.989	0.002	0.039	252.539	41.63	434.50	377.22	0.92	14.85	96,306
500	565		750	0.093	1.138	0.826	0.002	0.031	252.312	52.38	643.11	466.81	1.36	17.48	142,544
750	950		1000	0.593	1.138	6.460	0.002	0.301	252.280	562.94	1,081.30	6,137.29	2.29	286.14	239,666
1000	1923		9999	0.110	1.163	1.939	0.002	0.044	257.796	210.90	2,236.99	3,728.75	4.73	85.39	495,821
0	6	Signal Board	15	0.542	2.845	3.397	0.007	0.133	466.006	3.25	17.07	20.38	0.04	0.80	2,796
15	37		50	0.408	3.290	2.778	0.006	0.077	443.274	15.09	121.73	102.78	0.21	2.84	16,401
50	82		120	0.218	2.707	1.700	0.005	0.070	443.274	17.85	222.00	139.42	0.43	5.74	36,348
120	158		175	0.168	2.378	0.985	0.005	0.044	443.274	26.59	375.79	155.60	0.79	6.88	70,037
175	216		250	0.167	0.981	0.931	0.006	0.028	535.623	35.99	211.89	201.10	1.30	5.96	115,694
0	43	Skid Steer Lo	50	0.132	1.379	1.219	0.002	0.031	215.497	5.72	59.94	53.01	0.09	1.34	9,367
50	71		120	0.054	1.235	0.688	0.002	0.021	192.949	3.80	87.08	48.54	0.13	1.47	13,610
120	153		175	0.042	1.225	0.369	0.002	0.014	191.401	6.39	187.28	56.36	0.28	2.17	29,270
175	201		250	0.045	1.207	0.504	0.002	0.015	188.596	8.95	241.98	101.02	0.36	3.10	37,820
250	277		500	0.025	1.201	0.095	0.002	0.003	187.666	6.90	332.20	26.20	0.50	0.92	51,921
500	530		750	0.072	1.233	0.907	0.002	0.040	192.714	38.20	653.51	480.58	0.98	21.16	102,138
750	1000		1000	0.029	1.233	0.846	0.002	0.011	192.714	29.31	1,233.03	845.55	1.84	11.23	192,714
0	36	Surfacing Eq	50	0.074	0.851	1.078	0.002	0.025	179.081	2.64	30.35	38.46	0.06	0.88	6,387
50	89		120	0.073	0.757	0.802	0.002	0.037	159.249	6.50	67.10	71.10	0.13	3.32	14,122
120	151		175	0.059	0.748	0.603	0.002	0.028	157.336	8.91	112.86	90.98	0.23	4.29	23,754
175	216		250	0.047	0.757	0.527	0.002	0.017	159.364	10.08	163.60	113.83	0.33	3.58	34,433
250	362		500	0.040	0.746	0.400	0.002	0.015	157.083	14.62	270.45	144.95	0.54	5.57	56,920
500	615		750	0.027	0.747	0.232	0.002	0.008	157.173	16.55	459.33	142.43	0.92	4.94	96,673
750	814		1000	0.042	0.752	0.904	0.002	0.016	158.312	33.80	612.51	736.33	1.23	13.02	128,911
1000	1141		9999	0.029	0.737	0.680	0.001	0.010	155.194	32.80	841.35	775.82	1.69	11.11	177,076
0	36	Sweepers/Sc	50	0.297	1.544	1.757	0.003	0.087	265.154	10.56	54.93	62.51	0.09	3.10	9,436
50	78		120	0.145	1.393	1.284	0.002	0.073	239.305	11.21	108.00	99.51	0.18	5.64	18,552
120	159		175	0.102	1.390	0.746	0.002	0.033	238.803	16.22	221.69	119.02	0.36	5.24	38,082
175	204		250	0.081	1.381	0.736	0.002	0.023	237.291	16.56	282.36	150.48	0.46	4.72	48,504
250	303		500	0.102	1.387	1.087	0.002	0.037	238.264	30.76	419.57	328.95	0.69	11.33	72,075
500	848		1000	0.030	1.387	1.045	0.002	0.009	238.264	25.73	1,176.17	885.99	1.93	7.23	202,048
0	38	Tractors/Loa	50	0.212	0.982	1.349	0.002	0.053	209.757	8.13	37.63	51.69	0.08	2.05	8,035
50	83		120	0.081	0.912	0.777	0.002	0.031	194.810	6.65	75.40	64.24	0.15	2.60	16,101
120	144		175	0.062	0.897	0.435	0.002	0.022	191.601	8.98	129.15	62.61	0.26	3.10	27,578
175	204		250	0.059	0.900	0.455	0.002	0.017	192.119	12.14	183.74	92.91	0.37	3.56	39,234
250	320		500	0.056	0.900	0.385	0.002	0.015	192.247	17.83	288.23	123.37	0.59	4.64	61,546

		2025		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
	AvgHP	Equipment	MaxHP	ROG	CO	NOX	SOX	PM	CO2	ROG	CO	NOX	SOX	PM	CO2
500	575		750	0.072	0.892	0.608	0.002	0.025	190.427	41.52	512.44	349.10	1.04	14.26	109,423
750	871		1000	0.052	0.910	1.085	0.002	0.019	194.225	45.25	792.61	945.36	1.62	16.47	169,248
1000	2006		9999	0.062	0.904	1.108	0.002	0.019	193.002	124.49	1,812.80	2,222.71	3.70	38.82	387,090
0	40	Trenchers	50	0.285	1.633	1.838	0.003	0.082	293.469	11.34	64.95	73.09	0.11	3.26	11,673
50	82		120	0.240	1.474	2.150	0.003	0.143	264.933	19.70	120.96	176.44	0.21	11.75	21,739
120	144		175	0.188	1.449	1.783	0.002	0.090	260.385	27.09	208.43	256.58	0.36	12.95	37,462
175	218		250	0.161	1.468	1.666	0.003	0.072	263.828	35.23	320.62	363.87	0.55	15.81	57,626
250	359		500	0.100	1.457	0.918	0.003	0.040	261.893	36.01	522.41	328.99	0.90	14.17	93,893
500	619		750	0.035	1.470	0.153	0.003	0.005	264.145	21.70	910.09	94.99	1.56	2.87	163,572
750	860		1000	0.617	1.462	6.729	0.003	0.314	262.792	530.84	1,257.44	5,787.35	2.16	269.83	226,001
0	11	Welders	15	0.308	1.572	1.931	0.004	0.083	255.735	3.39	17.29	21.24	0.04	0.92	2,813
15	20		25	0.320	1.071	1.986	0.003	0.081	255.735	6.41	21.42	39.73	0.06	1.61	5,115
25	46		50	0.282	2.055	1.683	0.003	0.055	255.735	12.96	94.51	77.41	0.15	2.54	11,764
50	70		120	0.148	1.605	1.067	0.003	0.050	255.735	10.38	112.36	74.72	0.21	3.51	17,901
120	174		175	0.116	1.407	0.664	0.003	0.031	255.735	20.12	244.88	115.47	0.50	5.38	44,498
175	211		250	0.093	0.481	0.522	0.003	0.016	255.735	19.66	101.42	110.06	0.61	3.32	53,960
250	297		500	0.092	0.464	0.479	0.003	0.015	255.735	27.20	137.86	142.19	0.75	4.54	75,953
0	29	Water Trucks	50	0.268	0.660	1.516	0.002	0.070	217.904	7.819	19.225	44.166	0.061	2.038	6349.807
50	87		120	0.137	0.596	1.084	0.002	0.061	196.947	11.906	51.914	94.400	0.164	5.307	17146.715
120	159		175	0.085	0.602	0.510	0.002	0.025	198.854	13.569	95.660	81.032	0.302	3.931	31595.675
175	211		250	0.074	0.601	0.431	0.002	0.016	198.483	15.592	126.806	90.971	0.400	3.478	41882.845
250	372		500	0.071	0.608	0.406	0.002	0.015	200.955	26.386	226.586	151.298	0.715	5.407	74839.188
500	656		750	0.094	0.610	0.669	0.002	0.025	201.524	61.685	400.203	438.505	1.262	16.535	132182.940
750	897		1000	0.075	0.606	1.197	0.002	0.022	200.278	67.107	544.053	1074.287	1.716	19.411	179695.284
1000	1764		9999	0.064	0.614	1.109	0.002	0.017	202.777	113.609	1083.099	1957.119	3.416	30.306	357736.549

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