Software User's Guide:
URBEMIS2007 for Windows

Version 9.2
Emissions Estimation for
Land Use Development Projects

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- Bay Area Air Pollution Control District;
- Feather River Air Quality Management District;
- Imperial County Air Pollution Control District;
- Mendocino County Air Pollution Control District;
- Monterey Bay Unified Air Pollution Control District;
- Placer County Air Quality Management District;
- Sacramento Metropolitan Air Quality Management District;
- San Joaquin Valley Air Pollution Control District;
- San Luis Obispo County Air Pollution Control District;
- Santa Barbara Air Pollution Control District;
- South Coast Air Quality Management District; and
- Yolo-Solano Air Quality Management District.

The primary URBEMIS2007 (Version 9.2) improvements include:

- Incorporation of EMFAC2007 emission rates for on-road mobile sources;
- Incorporation of OFFROAD2007 emission rates for off-road mobile sources;
- Upgrading URBEMIS to the .net programming environment;
- Making URBEMIS easier to use for the novice user while enhancing capabilities for power users;
- Enhancing the construction module that provides for additional phasing options; and
- Improving the reporting options, including exporting results to Excel and PDF file formats.

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INTRODUCTION

URBEMIS2007 for Windows Version 9.2, like its predecessors, is designed to estimate air emissions from land use development projects.

The flowchart shown on the following page (Figure 1) provides a conceptual overview of URBEMIS2007. Once the URBEMIS2007 program has been initiated, the user must first either select an existing project or start a new one. For new projects, the air district in which the project is located must be selected. Then, the user typically goes to the land uses module to enter land use information relevant to his project. Once land use information has been entered, the user must select the relevant construction, area, and operational assumptions that apply to the project. Mitigation measures can also be selected as applicable. Once all information has been selected for a project, the user clicks the Recalc button to obtain the emission estimates. After reviewing the results, the user can either save the project or go back and edit the land use or construction/area/operational module assumptions for the project.

Differences from Previous Versions

Several versions of URBEMIS have been released by the California Air Resources Board (ARB) since the early 1980s: Urbemis1, Urbemis2, Urbemis3, and Urbemis5, URBEMIS7G for DOS, URBEMIS7G for Windows, URBEMIS2001 version 6.2.2, URBEMIS2002 version 7.4, URBEMIS2002 version 7.5, URBEMIS2002 version 8.7, and URBEMIS2007 Version 9.2. (Urbemis4 was not released for use by the public.) Previous versions of URBEMIS allowed the user to estimate motor vehicle emissions associated with vehicle trips generated by land use development projects. Generally, each new release of URBEMIS has been associated with ARB's update of its motor vehicle emission factors.

URBEMIS7G represented the successor to URBEMIS5. URBEMIS7G differed from URBEMIS5 in several ways. First, URBEMIS7G was an updated version of URBEMIS5 because it included EMFAC7G, ARB's California motor vehicle emission factors model.

Another difference is that, for the first time, URBEMIS7G provided users with the ability to estimate construction and area source emissions. In addition, URBEMIS7G gave the user the ability to select mitigation measures for construction, area source, and motor vehicle emissions, another option not available in previous versions. And, URBEMIS7G provided estimates of the emissions benefits of those mitigation measures.

URBEMIS7G also included a series of enhanced land use selection screens. The enhancements included additional land uses, updated trip generation rates, trip generation rates for certain land uses based on equations included in the ITE Trip Generation Manual Version 6.0 (Institute of Transportation Engineers 1996), and the option of specifying whether the project is located is an urban versus a rural environment.

Previous versions of URBEMIS did not allow for estimation of reentrained road dust. URBEMIS7G estimated road dust emissions for both paved and unpaved roads.

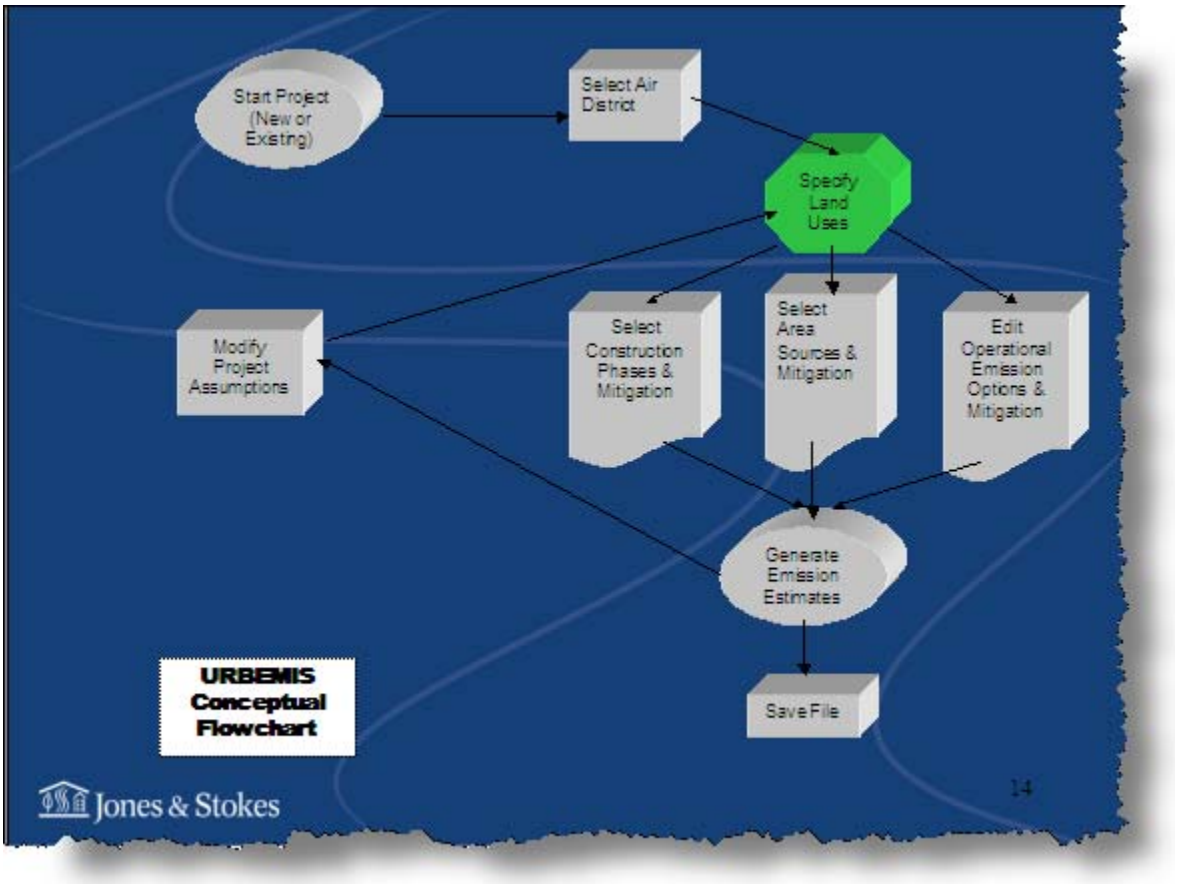

Figure 1. URBEMIS Conceptual Flowchart

URBEMIS7G also allowed the user to select a new "double-counting" option. This option was designed to minimize double counting of internal vehicle trips between residential and nonresidential land uses. Finally, URBEMIS7G allowed users to select a new "pass-by trips" option. With this option selected, URBEMIS7G could be used to estimate vehicle trip emissions based on the percentage of primary trips, diverted linked trips, and pass-by trips assumed for specific land use types.

URBEMIS7G was superceded by URBEMIS7G for Windows. The primary advantage of this enhancement is that it allowed the user to estimate emissions from within the Windows operating system environment. Several other minor improvements were made to fix previously identified bugs. URBEMIS2001 was released in early 2002, following by URBEMIS2002 in March 2003. URBEMIS2001 incorporated EMFAC2001 emissions factors, while URBEMIS2002 version 7.5 incorporated EMFAC2002 emissions factors and ITE Trip Generation, 7th edition emission factors. Additionally, EMFAC2002 included several additional land uses, contained a major enhancement to the construction emissions and mitigation measures module, and included a screening analysis option. URBEMIS2002 Version 8.7 included enhancements to the area source emission factors, and to the area source and operational mitigation measures. URBEMIS2007 version 9.2 includes updates that include adding EMFAC2007 input files, OFFROAD2007 input files, PM2.5 and CO2 emissions, enhanced construction phasing, and improved reporting capabilities.

Getting Started

Operating System Requirements

URBEMIS2007 is written in C++ within the Microsoft .net programming environment. Infragistrics controls have also been incorporated into URBEMIS. The program can be used within either the Microsoft XP or the Vista Operating Systems.

Disk Limits

URBEMIS2007 requires substantial amounts of hard disk space, primarily to store EMFAC2007 database files. Consequently, the program has been set up so that you can download only the EMFAC2007 files and associated air district default files needed.

Installation

URBEMIS2007 can be downloaded and installed by going to the following web site location: http://www.urbemis.com/software/download.html

Once you have navigated to this URBEMIS web site, follow the directions listed there to install URBEMIS directly onto your computer. You are given the option of either installing the .msi file directly from the web site or copying the .msi file to your computer, then using it to install URBEMIS. The later procedure is the recommended approach.

The installation routine provides an icon on the desktop that can be clicked to start URBEMIS. The URBEMIS icon is found in Figure 2 below.

Figure 2. URBEMIS2007 Desktop Icon

Starting URBEMIS2007

Once URBEMIS2007 has been successfully installed, it can be started by selecting the URBEMIS2007 icon from the desktop or by clicking on the Windows Start button, selecting Programs from the list, then selecting URBEMIS2007 from the list of programs. Figure 3 below consists of a portion of the Windows Desktop with the URBEMIS2007 icon. Double clicking on that icon starts the URBEMIS2007 program.

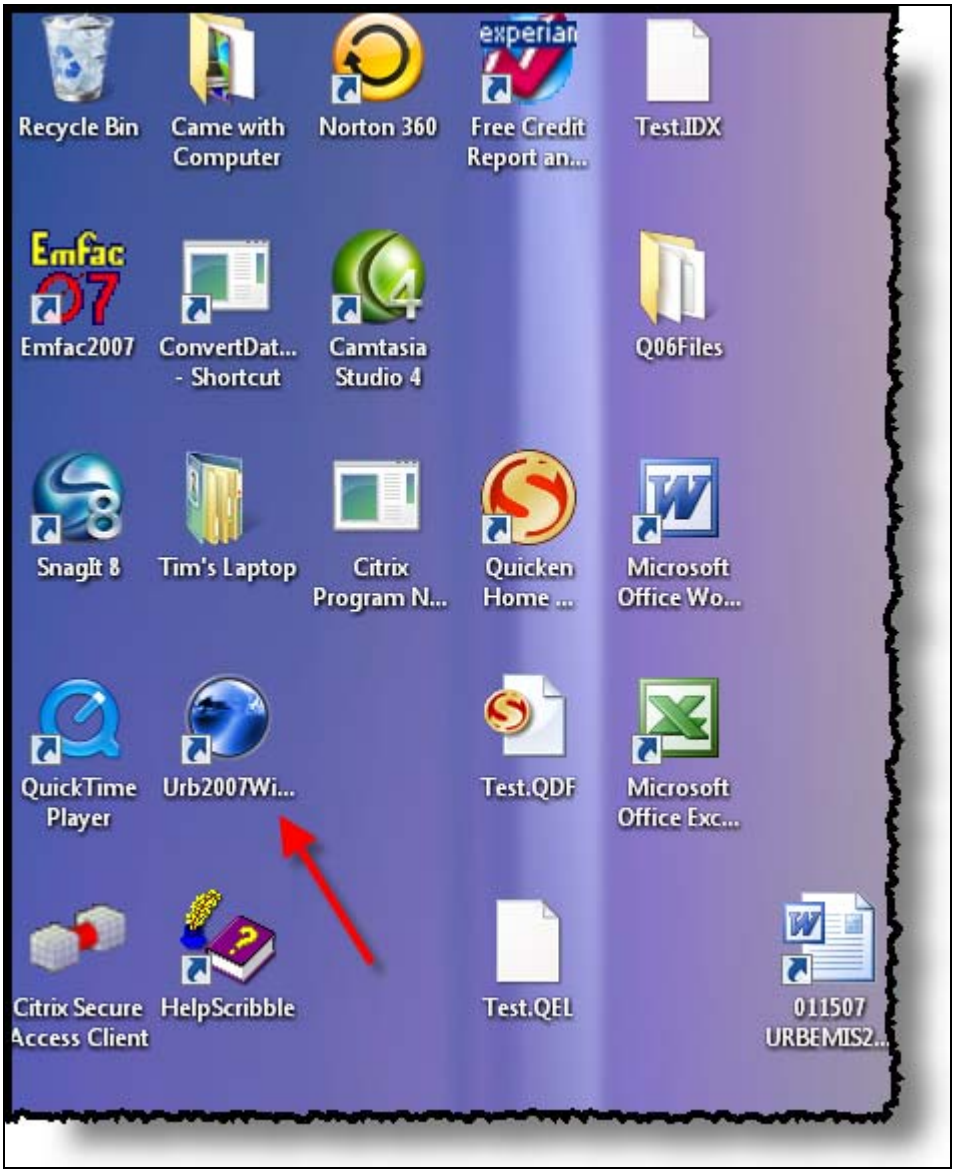

Figure 3. URBEMIS2007 Icon on Windows Desktop

One problem that frequently arises when starting URBEMIS2007 is that the program does not fit entirely within the computer screen. The optimal screen settings for running URBEMIS2002 are 1024 x 768 pixels, with the small fonts advanced setting option. These are Windows settings that can be changed by selecting the Start/Settings/Control Panel/Display from within the Windows operating system.

Quick Start

Once URBEMIS2007 has been started, you are first taken to STEP 1 – Open a New or Existing Project. Once you have started a new project, you can quickly obtain project results using the following steps. First, enter each of the land uses associated with your project (STEP 2). Then make sure that the construction phasing is correct (STEP 3). Then, check that the operational start year is correct (STEP 5). Finally, click on the dirty cloud icon at the top of the center bar. This will give you a quick estimate of your project's emissions. At this point, you may want to go back and refine your project's data by editing information in STEPS 3, 4, and 5. Before doing so, however, save your project (STEP 7). Then modify the project assumptions as necessary.

Where Else to Get Help

There are several options available to obtain help with URBEMIS. They include:

- Hitting the F1 key within any part of URBEMIS, which provides context sensitive help,
- Clicking on the Click for Instructions buttons found within each step of URBEMIS,
- Going to User Help forums located at www.urbemis.com/phpbb/index.php, and
- Consulting this URBEMIS2007 Users Manual.

Using URBEMIS2007

Appearance

When URBEMIS2007 is started, an introductory screen is presented (see Figure 4). The left side of the screen shows seven steps that can be completed for typical URBEMIS runs. Not all of these screens need to be completed to generate emission estimates, though they do provide the novice user with a roadmap for conducting URBEMIS runs. All users must complete Step 1. Open a New or Existing Project, before they can proceed. If a new project is selected, then the user should then go to Step 2. Enter Land Use Data specific to the project in question. Once land use data has been entered, the user can go directly to Step 6. View and Print Output, though its generally recommended that the user go to Steps 3, 4, and 5 to make sure that project specific information is accurately depicted.

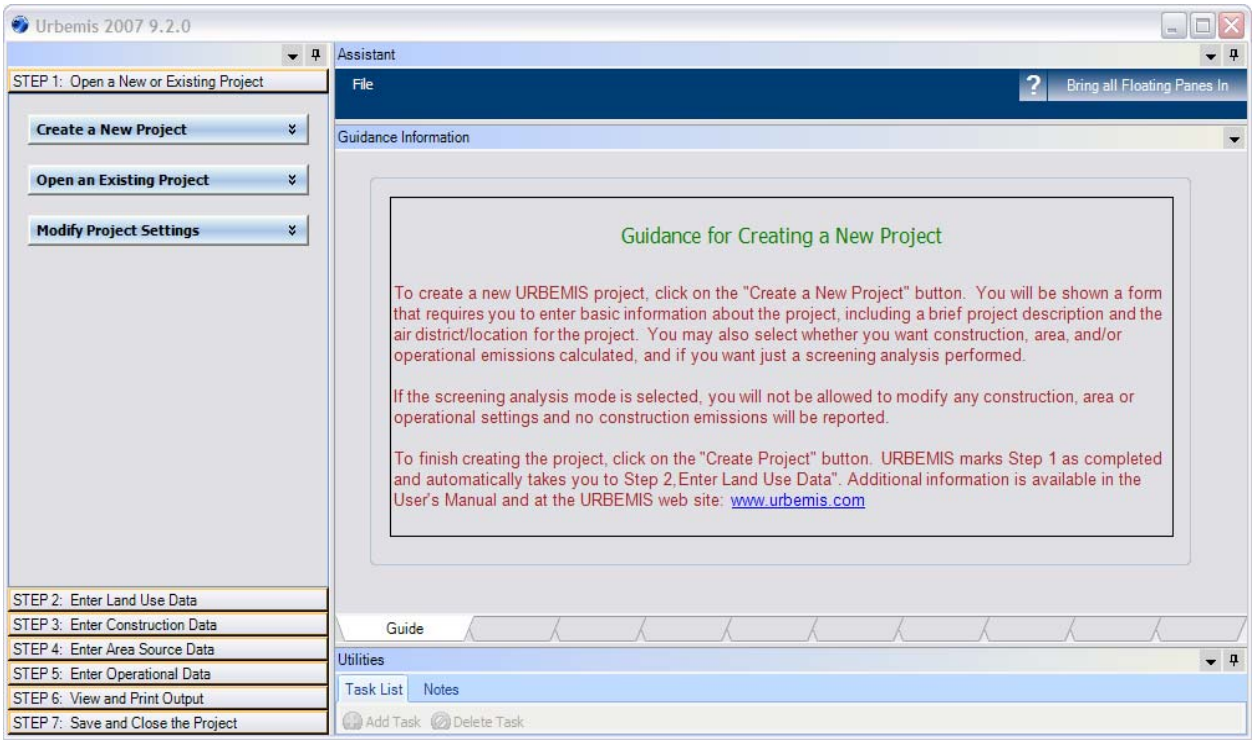

Figure 4. Introductory URBEMIS2007 Windows Screen

Step 1: Open A New or Existing Project

Figure 5 shows expanded and contracted views of the Step 1 menu. The three options within Step 1 include 1) Start a new project, 2) Open an Existing Project, 3) Modify Project Settings. As Figure 5 illustrates, each of these three Step 1 options can be expanded by clicking on the arrows at the right of each option.

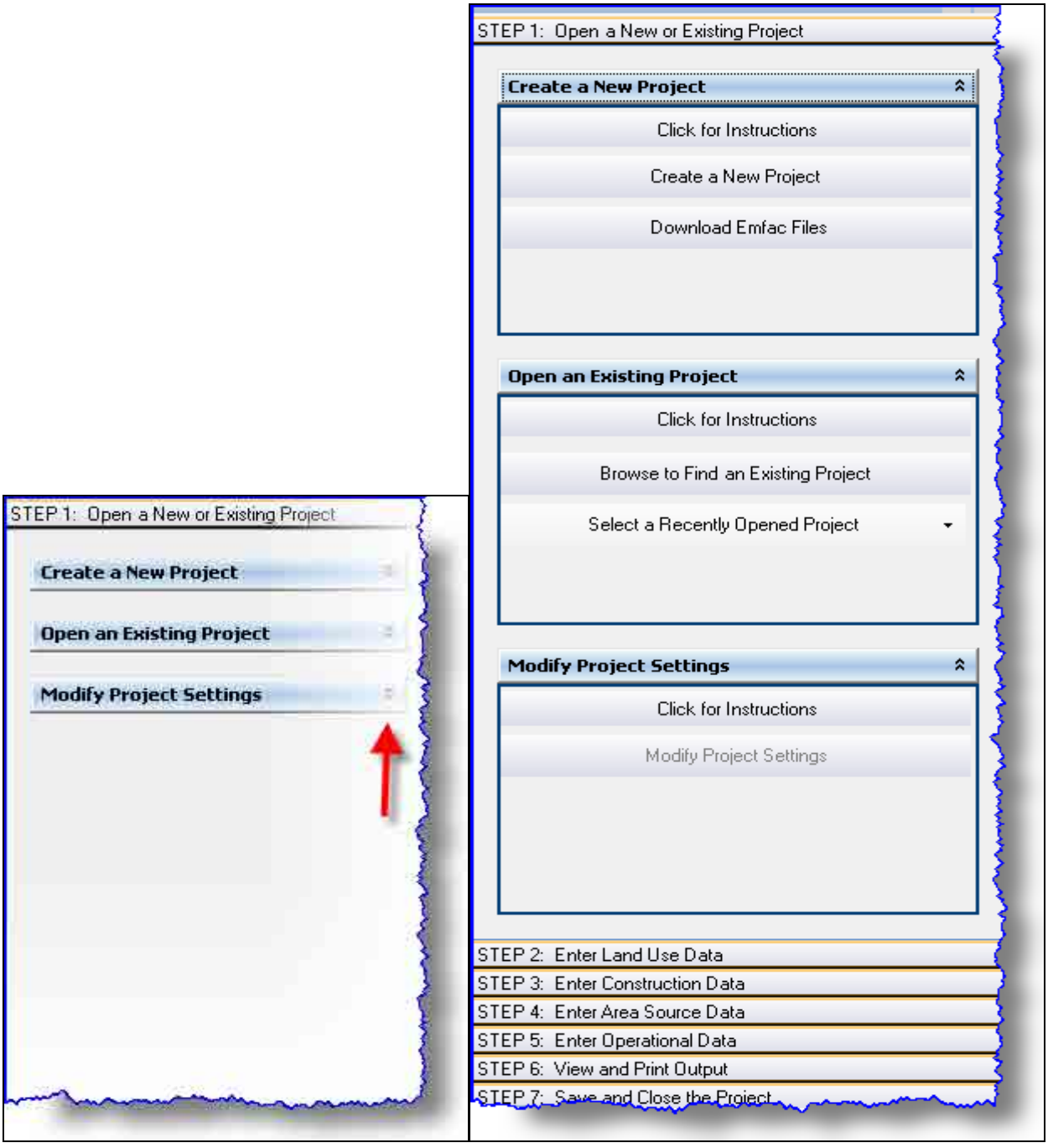

Figure 5. Step 1: Expanded and Contracted Screens

For example, clicking on Create a New Project expands this menu to include three suboptions: a) Click for Instructions, b) Create a New Project, or c) Download EMFAC files. If you attempt to Start a New Project in a location for which you have not downloaded the EMFAC files, then you will need to first download the EMFAC and air district and associated county default files.

Creating a New Project

Figure 6 shows the screen URBEMIS shows when the Create a New Project button is selected. In this example, the user wants to create a new project located in the Mountain Counties Air Basin. Since the Mountain Counties Air Basin is not shown in the list, that county's EMFAC files need to be downloaded first. To do this, you would need to cancel out of the Start a New Project screen and click on the Download EMFAC Files button within the Start a New Project button.

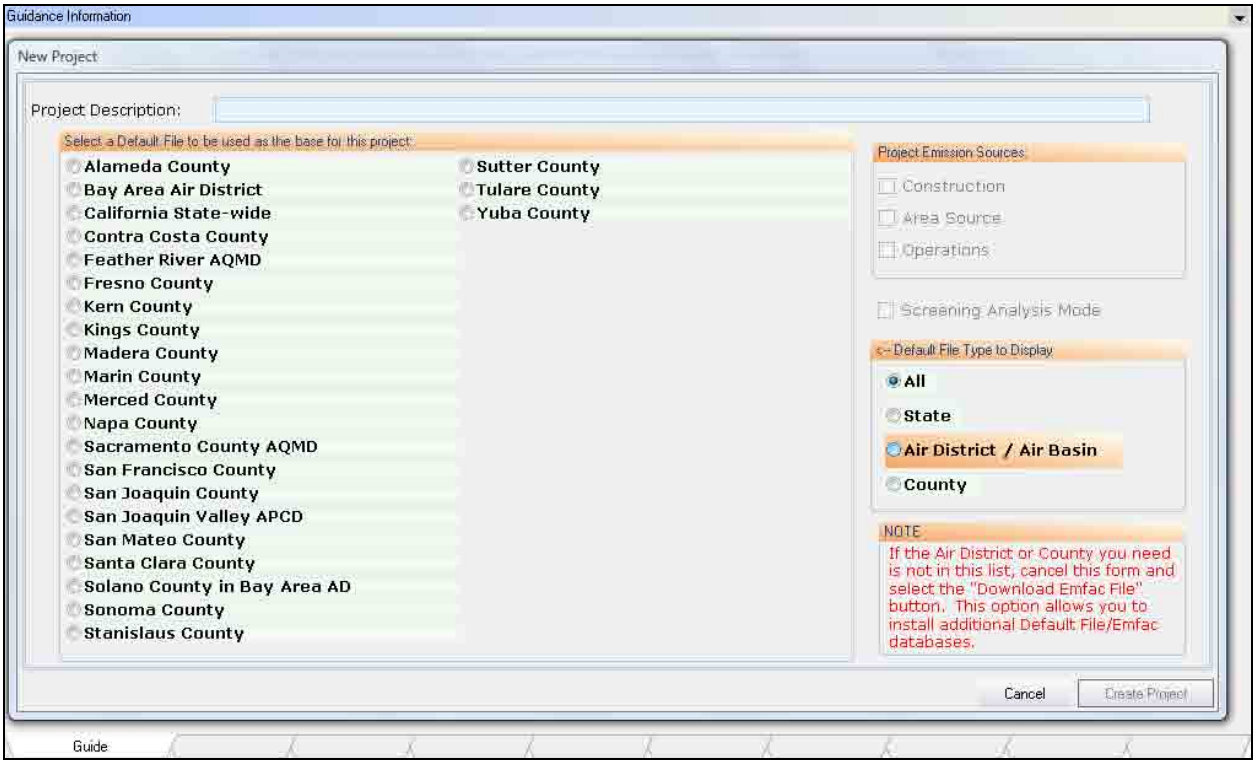

Figure 6. New Project Setup Screen

Figure 7 shows the Download EMFAC Files screen. In this example, the Mountain Counties Air Basin EMFAC database has been selected and is shown downloading. Once that database has downloaded, then you would need to Start New Project and select Mountain Counties Air Basin (see Figure 8). Also, on the Create a New Project Screen, you will need to enter a Project Description. This Project Description is not the same thing as the File Name used to store and retrieve the file on your computer. Once you have selected the project location and entered the Project Description, hit the Create Project button. URBEMIS then takes you to STEP 2.

One additional option to be aware of in the new project screen is the "screening analysis mode" checkbox located on the right side of menu. If the user turns on the "screening analysis option", they will not be able to edit the default values for construction, area sources, or operational emissions. In addition, because the construction module depends on several key assumptions that must be reviewed by the user, the screening analysis mode only generates emissions for the area and operational emission categories.

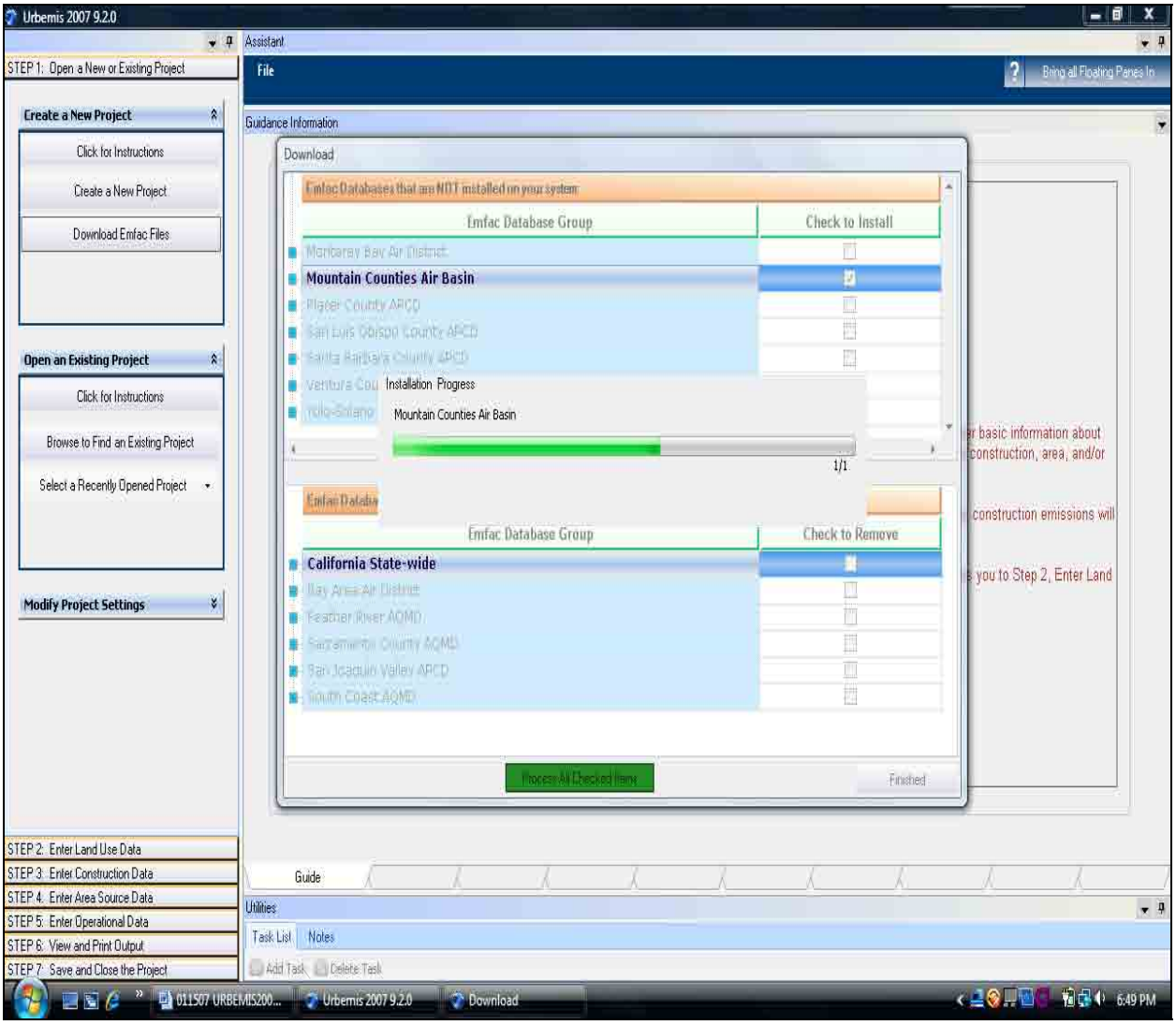

Figure 7. Download EMFAC Database Screen

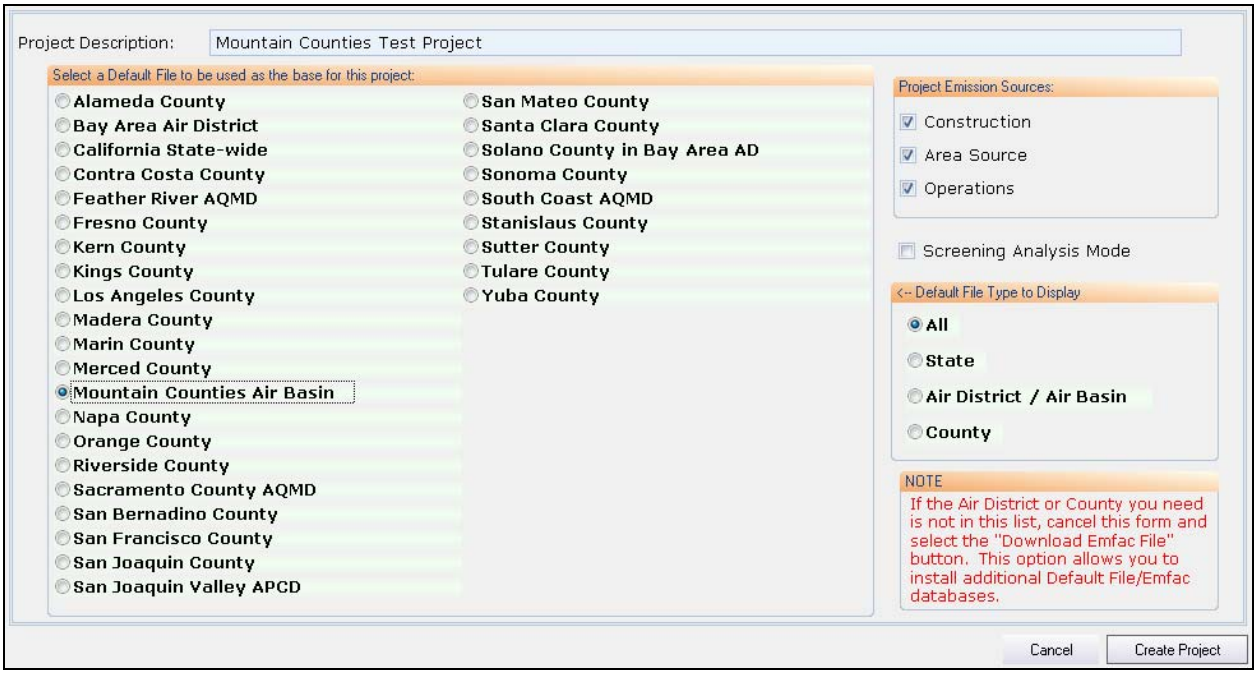

Figure 8. New Project Setup Screen

Open an Existing Project

To open an existing project, the user should click on either the a) Browse to Find an Existing Project or b) Select a Recently Opened Project bar (see Figure 5). Once you have opened a previously created project, URBEMIS takes you to STEP 2.

Another option for starting an existing or new project is to click on the word "File" shown on the project assistant bar (see Figure 9). Clicking on File reveals a drop down menu that can be used to start a new project or open an existing project

Modify Project Settings

The third option under STEP 1 involves modifying project settings. This option is available for projects that have already been created. Under this option, you can modify the project description, turn on or off the construction, area, and operational phases, and turn the screening analysis mode on or off.

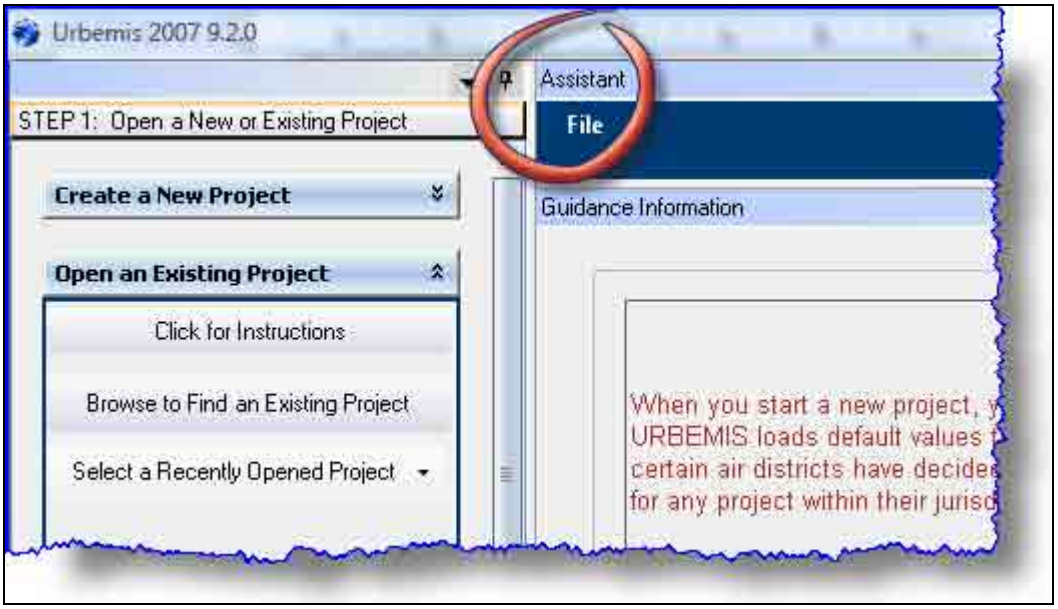

Figure 9. Select File from the Assistant Bar

Step 2 – Enter Land Use Data

Once you have opened an existing project or started a new one, URBEMIS takes you to Step 2 - Enter Land Use Data. The first land use screen displays residential land uses, which represent the first of eight possible land use screens.

- residential;
- educational;
- recreational;
- large retail;
- retail;
- commercial;

- industrial; and
- blank.

Figure 10 shows the residential land use screen with 222 single family residential uses entered. URBEMIS assumes 9.57 trips per day per residential land use. URBEMIS also assumes 3 single family residential land uses per acre. Both the trips per day and acreage values can be modified by the user.

You may access the land uses associated with either of the eight land use screens by either clicking on the appropriate tab (shown with arrow in Figure 10) or by double clicking on the appropriate land use name in the left window pane shown under Step 2.

Figure 10. Land Use Screens

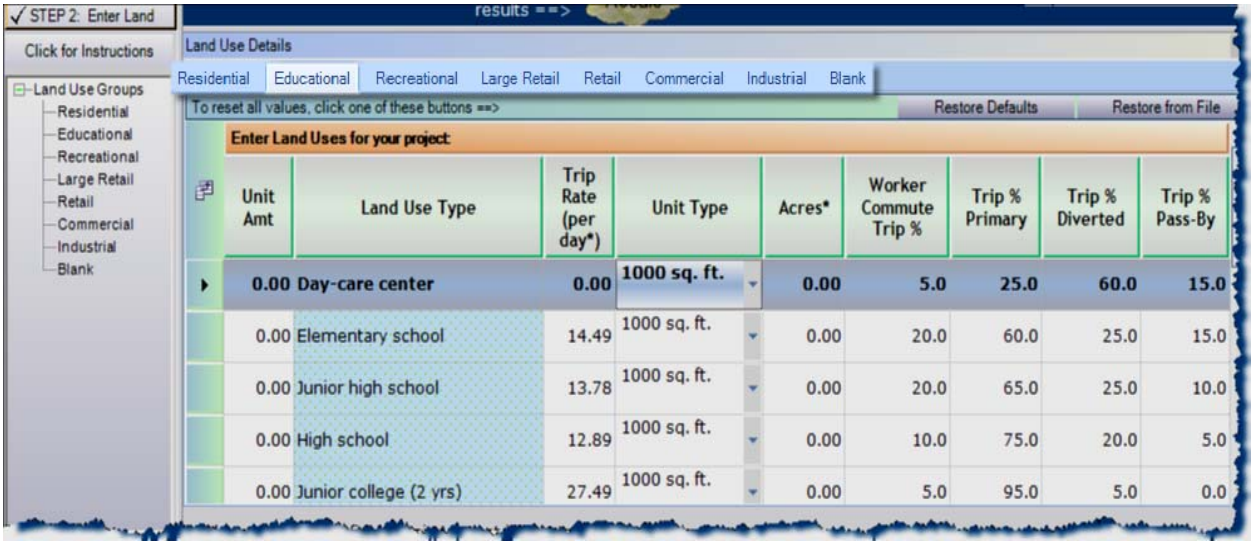

Figure 11. Land Use Tabs

In Figure 12, the educational tab has been selected and 20 has been entered as the unit amount for day-care center. The 20 represents 20,000 square feet with a daily trip generation rate of 79.26 per 1000 square feet.

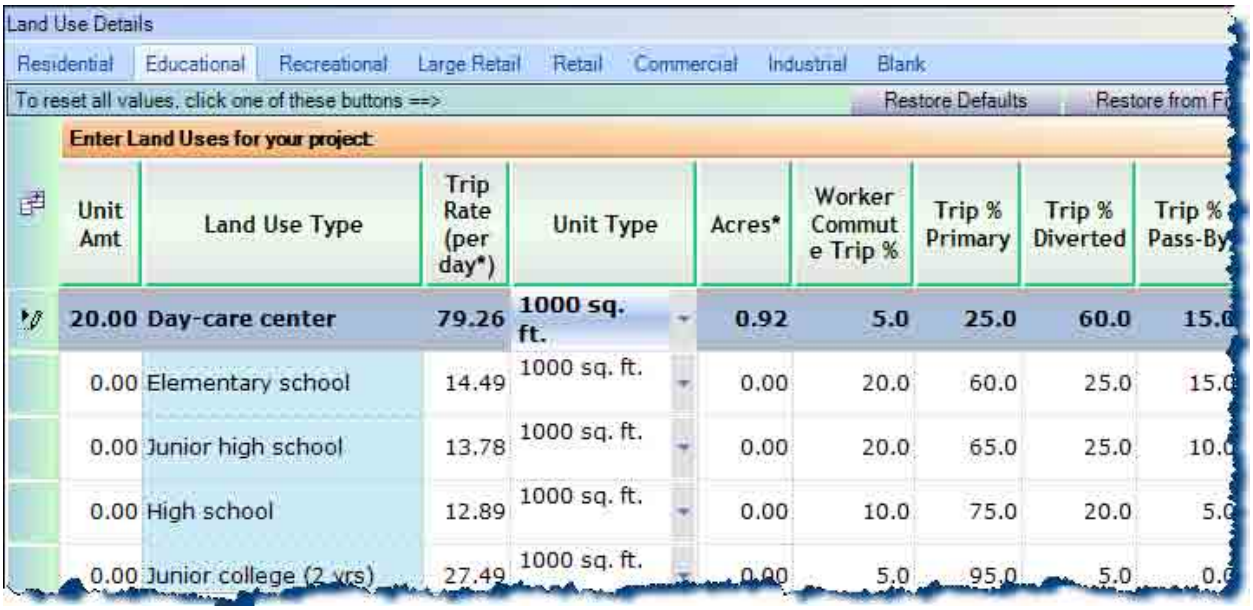

Figure 12. Educational Land Use Screen

Figure 13 shows the Blank land use tab. In this screen, the user can enter land uses that have not been entered in either of the seven previous screens. The user must enter unit amount, land use type, acres, and trip rate. Although URBEMIS will calculate acreage (as twice the building square footage), the user is urged to override this value if specific acreage data is available. Figure 14 shows an entry in the first row of the Blank Screen. A two acre dog park with 100 trips per acre has been entered.

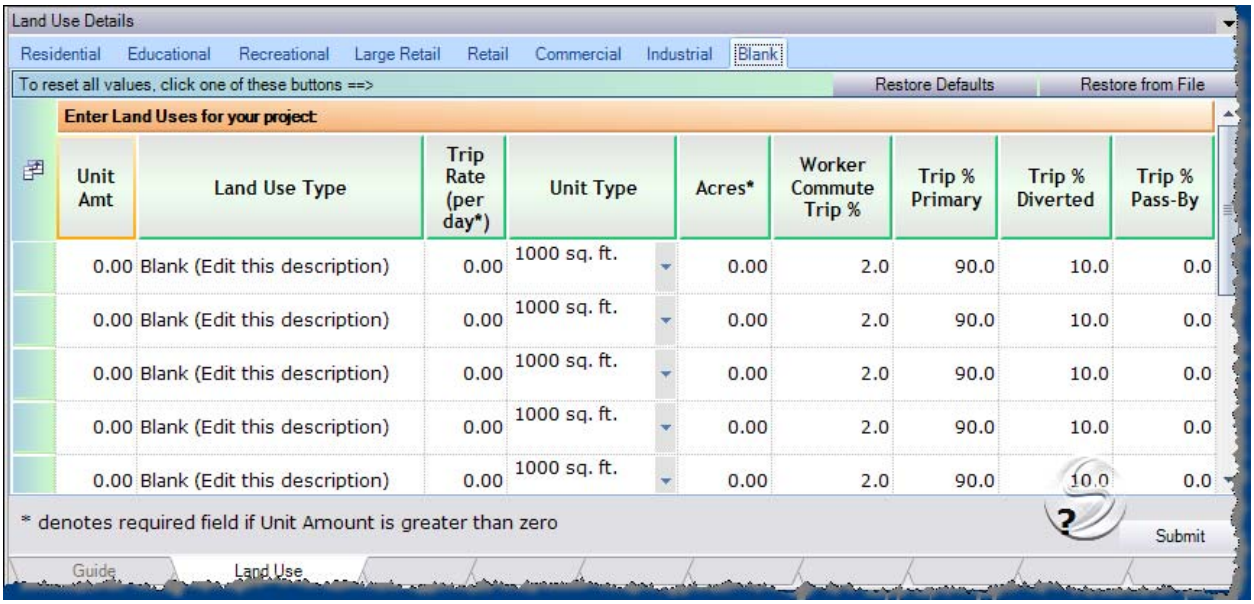

Figure 13. Blank Land Uses

Figure 14. Sample Blank Screen Entry

Table 1 lists each of the URBEMIS2007 land uses, provides a definition of each land use, and shows the percentage of worker commute trips associated with each land use. Those percentages are called Percent Worker Commute in Table 1.

For each land use type, you are given the option of entering the project size or unit amount. For all land uses, URBEMIS2007 automatically calculates the acreage associated with that land use type and the trip rate based on the unit amount. The user can and should modify the acreage for a project if it differs from the default values used by URBEMIS. For residential projects, changing the project acreage will, however, also change the trip rate using the procedure described in Appendix D of this manual. For non-residential land uses, URBEMIS estimates acreage by assuming that acreage equals twice the building square footage. For residential land uses, URBEMIS assumes the following acreage:

- single family residential – 3 units per acre;
- low rise apartments and condos/townhouse units – 16 units per acre;
- mid rise apartments – 38 units per acre;
- high rise apartments – 62 units per acre;
- high rise condos – 64 units per acre;
- mobile home parks – 6 units per acre;
- congregate care (assisted living) – 16 units per acre.

The equation or value used to estimate trip generation is shown in Table 2. You can override the trip rate by typing in a different rate. For certain land uses, you also can select a different unit type by clicking on the "Unit Type" arrow.

For all non-residential land uses, you also have the option of modifying the default "% Worker Commute" value. This value represents the percentage of worker commute trips attracted to that land use as a percentage of all trips generated by that land use.

Table 1. Land Use Definitions and Percent Worker Commute

	Land Use Definition	Percent Worker Commute
First Land Use Screen: Residential		
Single Family Housing	Detached homes on individual lots	N/A
Apartments, Low Rise	Buildings with one to three floors	N/A
Apartments, Medium Rise	Buildings with four to ten floors	
Apartments, High Rise	Buildings with more than ten floors	N/A
Condo/Townhouse General	Condos and townhomes in buildings with one or two levels.	N/A
Condo/Townhouse High Rise	Condos and townhomes in buildings with 3 or more levels.	N/A
Mobile Home Park	Trailers sited and installed on permanent foundations.	N/A
Retirement Community	Self-contained villages restricted to adults or senior citizens	N/A
Congregate Care (Assisted Living) Facility	One or more multiunit buildings designed for elderly living and may contain dining rooms, medical, and recreational facilities.	N/A
Second Land Use Screen: Educational		
Day-Care Center	Facilities that care for pre-school children, normally during daytime hours. May also include after-school care for older children.	5
Elementary School	Generally includes Kindergarten through either 6th or 8th grades.	20
Junior High School	Includes 7th, 8th, and often 9th grades.	20
High School	Includes 10th, 11th, and 12th grades and oftentimes 9th grade.	10
Junior College (2 years)	Most have facilities separate from other land uses and exclusive access points and parking facilities.	5
University/College (4 years)	Four year and graduate educational institutions.	5
Library	Public or private facility, which houses books, and includes reading rooms and possibly meeting rooms.	5
Place of Worship	Building(s) providing public worship services.	3
Blank (Edit all 5 columns)	Blank commercial land use that can be entered by the URBEMIS2007 user.	2
Third Land Use Screen: Recreational		
City Park	Owned and operated by a city, these facilities can vary widely as to location, type, and number of facilities. May including boating, swimming, ball fields, camp sites, and picnic facilities.	
Racquet Club	Privately owned facilities with tennis, racquetball, and/or handball courts, exercise rooms, and/or swimming pools and/or weight rooms	5
Racquet/Health Club	Privately owned facilities with tennis, racquetball, and/or handball courts.	5
Quality Restaurant	Typically with customer turnover rates of at least one hour.	8
High Turnover (sit-down Restaurant)	Typically with high customer turnover rates of less than one hour.	5
Fast Food Restaurant with Drive Through	Includes fast food restaurants with drive through windows, such as McDonald's, Burger King, and Taco Bell.	5
Fast Food Restaurant without Drive Through	Includes fast food restaurants without drive through windows, such as McDonald's, Burger King, and Taco Bell.	5
Hotel	Place of lodging providing sleeping accommodations, restaurants, and meeting or convention facilities.	5
Motel	Place of lodging providing accommodations and often, a restaurant.	5
Fourth Land Use Screen: Large Retail		
Free-Standing Discount Store	Free-standing store with off-street parking, can be part of neighborhood shopping centers.	2
Free-Standing Discount Superstore	Same as free-standing discount store but also include full service grocery department under the same roof.	2
Discount Club	Discount/warehouse store whose shoppers pay a membership fee to take advantage of discounted prices.	2

	Land Use Definition	Percent Worker Commute
Regional Shopping Center	Integrated group of commercial establishments that are planned, developed, owned, and managed as a unit.	2
Electronics Superstore	Free-standing warehouse type facilities specializing in the sale of home and vehicle electronic merchandise, as well as TVs, compact disc and cassette tape players, cameras, radios, videos, and general electronic accessories.	2
Home Improvement Superstore	Free-standing warehouse type facilities specializing in lumber, tools, paint, lighting, wallpaper and paneling, kitchen and bathroom fixtures, lawn equipment, and garden plants and accessories.	2
Fifth Land Use Screen: Retail		
Strip Mall	Neighborhood store complexes with a variety of retail outlets.	2
Hardware/Paint Store	Stores selling general hardware items and/or paints and supplies.	2
Supermarket	Free-standing stores selling a complete assortment of food, food preparation and wrapping materials, and household cleaning and servicing items. May also contain money machines, photo centers, pharmacies, and video rental areas.	2
Convenience market (24 hour)	These markets sell convenience foods, newspapers, etc. and do not have gasoline pumps. (Trip generation rates with gas pumps is approximately 12% higher than without.	2
Convenience market with gas pumps	These markets sell convenience foods, newspapers, etc. and do have gasoline pumps.	2
Gasoline/Service Station	Excludes gasoline stations with convenience stores or car washes.	2
Sixth Land Use Screen: Commercial		
Bank (with drive-through)	Banks with one or more drive-up windows.	2
General Office Building	Houses multiple tenants in a location where affairs of businesses, commercial or industrial organizations or professional persons or firms are conducted.	35
Office Park	Contain general office buildings and related support services, arranged in a park- or campus-like setting.	48
Government Office Building	Individual building containing the entire function or simply one agency of a city, county, state, or federal government.	10
Government (Civic Center)	Group of government buildings connected with pedestrian walkways	10
Pharmacy/Drugstore with Drive Through	Retail facilities selling prescription and non-prescription drugs. Also typically sell cosmetics, toiletries, medications, stationary, personal care products, limited food products, and general merchandise. These facilities include a drive-through window.	2
Pharmacy/Drugstore without Drive Through	Retail facilities selling prescription and non-prescription drugs. Also typically sell cosmetics, toiletries, medications, stationary, personal care products, limited food products, and general merchandise. These facilities do not contain a drive-through window.	2
Medical Office Building	Includes both medical and dental office buildings that provide diagnoses and outpatient care. Generally operated by one or more private physicians or dentists.	7
Hospital	Any institution where medical or surgical care is give to non-ambulatory and ambulatory patients and overnight accommodations are provided.	25
Seventh Land Use Screen: Industrial		
Warehouse	Buildings devoted to the storage of materials, also include office and maintenance areas.	2
General Light Industry	Typical light industrial activities include: print plants, material testing labs, and assemblers of data processing equipment. They employ fewer than 500 persons and tend to be free-standing.	50
General Heavy Industry	Could also be categorized as manufacturing facilities. However, heavy industrial uses are limited to the production of large items.	90
Industrial Park	Contain a number of industrial or related facilities and are characterized by a mix of manufacturing, service, and warehouse facilities. May contain highly diversified facilities, a number of small businesses, or one or two dominant industries.	41.5
Manufacturing	Sites where the primary activity is the conversion of raw materials or parts into finished products. May also included associated office, warehouse, research, and other functions.	48

Percent worker commute represents the percentage of total trips that are work-related commute trips.

Table 2. URBEMIS2007 Trip Generation Rates

Land Use	Trip Generation Rate	Units *	Source
Single Family Housing	9.57	Dwelling Unit	ITE (210)
Apartment, Low Rise	6.9	Dwelling Unit	ITE (221)
Apartment, Mid Rise	5.76	Dwelling Unit	ITE (223)
Apartment, High Rise	5.29	Dwelling Unit	ITE (222)
Condominium/Townhouse, General	6.9	Dwelling Unit	ITE (230)
Condominium/Townhouse, High Rise	5.26	Dwelling Unit	ITE (232)
Mobil Home Park	4.99	Dwelling Unit	ITE (240)
Retirement Community	3.71	Dwelling Unit	ITE (251)
Congregate Care (Assisted Living) Facility	2.02	Dwelling Unit	ITE (253)
Day-Care Center	79.3	1000 sq. ft.	ITE (565)
Elementary School	14.49	1000 sq. ft.	ITE (520)
Elementary School	1.29	Student	ITE (520)
Junior High School	13.78	1000 sq. ft.	ITE (522)
Junior High School	1.62	Student	ITE (522)
High School	12.89	1000 sq. ft.	ITE (530)
High School	1.71	Student	ITE (530)
Junior College (2 Years)	27.49	1000 sq. ft	ITE (540)
Junior College (2 Years)	1.2	Student	ITE (540)
University/College (4 Years)	2.38	Student	ITE (550)
Library	54	1000 sq. ft.	ITE (590)
Place of Worship	9.21	1000 sq. ft.	ITE (560)
City Park	1.59	Acre	ITE (411)
Racquet Club	14.03	1000 sq. ft.	ITE (491)
Racquetball/Health Club	32.93	1000 sq. ft.	ITE (492)
Quality Restaurant	89.95	1000 sq. ft.	ITE (931)
High-Turnover (Sit-Down) Restaurant	127.15	1000 sq. ft.	ITE (932)
Fast-Food Restaurant w/o Drive-Through Window	716	1000 sq. ft.	ITE (933)
Fast-Food Restaurant with Drive-Through Window	496.12	1000 sq. ft.	ITE (934)
Hotel	8.17	Rooms	ITE (310)
Motel	5.63	Rooms	ITE (320)
Free-Standing Discount Store	56.02	1000 sq. ft.	ITE (815)
Free-Standing Discount Superstore	49.21	1000 sq. ft.	ITE (813)
Discount Club	41.8	1000 sq. ft.	ITE (861)
Regional Shopping Center	42.94	1000 sq. ft.	ITE (820)
Electronics Superstore	45.04	1000 sq. ft.	ITE(863)
Home Improvement Superstore	29.8	1000 sq. ft.	ITE(862)
Strip Mall	42.94	1000 sq. ft.	ITE (820)
Hardware/Paint Store	51.29	1000 sq. ft	ITE(816)
Supermarket	102.24	1000 sq. ft.	ITE(850)
Convenience Market (24 hr.)	737.99	1000 sq. ft.	ITE (851)

Land Use	Trip Generation Rate	Units *	Source
Convenience Market with Gasoline Pumps	845.6	1000 sq. ft.	ITE (853)
Gasoline /Service Station	162.78	Fueling Positions	ITE (945)
Bank (with Drive-Through)	246.49	1000 sq. ft.	ITE (912)
General Office Building	3.32	1000 sq. ft.	ITE (710)
Office Park	11.42	1000 sq. ft.	ITE (750)
Government Office Building	68.93	1000 sq. ft.	ITE (730)
Government (Civic Center)	27.92	1000 sq. ft.	ITE (733)
Pharmacy/Drugstore without Drive Through	88.16	1000 sq. ft	ITE(880)
Pharmacy/Drugstore with Drive Through	90.06	1000 sq. ft	ITE(881)
Medical/Dental Office Building	36.13	1000 sq. ft.	ITE (720)
Hospital	17.57	1000 sq. ft.	ITE (610)
Hospital	11.81	Beds	ITE (610)
Warehouse	4.96	1000 sq. ft.	ITE(150)
General Light Industry	6.97	1000 sq. ft.	ITE (110)
General Light Industry	51.8	Acre	ITE (110)
General Light Industry	3.02	Employee	ITE (110)
General Heavy Industry	1.5	1000 sq. ft.	ITE (120)
General Heavy Industry	6.75	Acre	ITE (120)
Industrial Park	6.96	1000 sq. ft.	ITE (130)
Industrial Park	63.11	Acre	ITE (130)
Industrial Park	3.34	Employee	ITE (130)
Manufacturing	3.82	1000 sq. ft.	ITE (140)

Notes:

sq. ft. = Square Feet

All trip generation rates from ITE Trip Generation Rate Manual, 7th Edition.

* "Dwelling unit" is a residential housing unit (including 'single room occupancy' units and 'granny flats'). "Square feet" refers to the total floor area (on all levels) of buildings, but does not include parking structures even if they are within a building (also known as 'gross leasable area'). "Acres" refers to the gross surface of the entire site, including any structures, streets, sidewalks, parking, and landscaping (but not including building or parking lot floor areas above the first level).

Pass-by Trips

URBEMIS2007 allows users to select a pass-by trip option, which results in lower operational emissions. The pass-by trip option splits trips into percentages of primary, pass-by, and diverted-linked trips. Primary trips are trips made for the specific purpose of visiting the designated land use. The stop at that trip generator is the primary reason for the trip. Pass-by trips are trips made as intermediate stops on the way from an origin to a primary trip destination. Pass-by trips are attracted from traffic passing the site on an adjacent street that contains direct access to the generator. Diverted-linked trips are trips attracted from the traffic volume on roadways in the vicinity of the generator but which require a diversion from that roadway to another roadway to gain access to the site.

When the pass-by option is turned off, URBEMIS assumes all trips are primary trips. When pass-by is turned on, lower emissions result because a percentage of trips associated with each land use is assumed to be pass-by and diverted linked trips (see Table 3). Pass-by and diverted-linked trips have a lower trip distance than primary trips. URBEMIS assumes that pass-by trips result in virtually no

extra travel, with an assumed trip length of 0.1 miles. Diverted-linked trip lengths are assumed to equal 25% of the primary trip length.

As shown in Table 3, the "fast-food restaurant without drive-through window" land use consists of 50% primary trips, 40% diverted linked trips, and 10% pass-by trips. Assuming a trip length of 10 miles, emissions calculated using the pass-by trip option would be calculated by assuming that 50% of the trips would be 10 miles, 40% of the trips would be 2.5 miles, and 10% of the trips would be 0.1 miles.

Table 3. URBEMIS Land Uses Sorted by Category with Trip Percentages

Land Use	Land Use Category	Primary Trip (%)	Diverted Linked Trip (%)	Pass-By Trip (%)	Source
Single-Family Housing	Residential	85	10	5	Sandag 1996
Apartment, Low Rise	Residential	85	10	5	Sandag 1996
Apartment, High Rise	Residential	85	10	5	Sandag 1996
Condominium/Townhouse, General	Residential	85	10	5	Sandag 1996
Condominium/Townhouse, High Rise	Residential	85	10	5	Sandag 1996
Mobile Home Park	Residential	85	10	5	Sandag 1996
Retirement Community	Residential	85	10	5	Sandag 1996
Residential Planned Unit Development (PUD)	Residential	85	10	5	Sandag 1996
Congregate Care (Assisted Living) Facility	Residential	85	10	5	Sandag 1996
Day-Care Center	Educational	25	60	15	Sandag 1996
Elementary School	Educational	60	25	15	Sandag 1996
High School	Educational	75	20	5	Sandag 1996
Junior High School	Educational	65	25	10	Sandag 1996
Junior College (2 Years)	Educational	95	5	0	Sandag 1996
University/College (4 Years)	Educational	90	10	0	Sandag 1996
Library	Educational	45	45	10	Sandag 1996
Church	Educational	65	25	10	Sandag, 1996
City Park	Recreational	70	25	5	Sandag 1996
Racquet Club	Recreational	50	40	10	Sandag 1996
Racquetball/Health Club	Recreational	50	40	10	Sandag 1996
Quality Restaurant	Recreational	50	40	10	Sandag 1996
High-Turnover (Sit-Down) Restaurant	Recreational	30	40	30	ITE 1997
Fast-Food Restaurant without Drive-Through Window	Recreational	50	40	10	Sandag 1996
Fast-Food Restaurant with Drive-Through Window	Recreational	30	30	40	ITE 1997
Hotel	Recreational	60	35	5	Sandag 1996
Motel	Recreational	60	35	5	Sandag 1996
Free-Standing Discount Store	Large Retail	45	45	10	Sandag 1996
Free-Standing Discount Superstore	Large Retail	55	40	5	ITE 1997

Land Use	Land Use Category	Primary Trip (%)	Diverted Linked Trip (%)	Pass-By Trip (%)	Source
Discount Club	Large Retail	55	40	5	Sandag 1996
Regional Shopping Center	Large Retail	55	35	10	Sandag 1996
Electronics Superstore	Large Retail	45	40	15	Sandag 1996
Home Improvement Superstore	Large Retail	45	40	15	Sandag 1996
Strip Mall	Retail	45	40	15	Sandag 1996
Hardware/Paint Store	Retail	45	40	15	Sandag 1996
Supermarket	Retail	45	40	15	Sandag 1996
Convenience Market (24 hr.)	Retail	25	30	45	ITE 1997
Convenience Market (w/gas pumps)	Retail	25	30	45	ITE 1997
Gasoline/Service Station	Retail	20	40	40	ITE 1997
Bank (with Drive-Through)	Commercial	35	45	20	Sandag 1996
General Office Building	Commercial	75	20	5	Sandag 1996
Office Park	Commercial	80	15	5	Sandag 1996
Government Office Building	Commercial	50	35	15	Sandag 1996
Government (Civic Center)	Commercial	50	35	15	Sandag 1996
Pharmacy/Drugstore with Drive Through	Commercial	45	40	15	Sandag 1996
Pharmacy/Drugstore without Drive Through	Commercial	45	40	15	Sandag 1996
Medical Office Building	Commercial	60	30	10	Sandag 1996
Hospital	Commercial	75	25	0	Sandag 1996
Warehouse	Industrial	90	5	5	Sandag 1996
General Light Industry	Industrial	80	20	0	Sandag 1996
General Heavy Industry	Industrial	90	5	5	Sandag 1996
Industrial Park	Industrial	80	20	0	Sandag 1996
Manufacturing	Industrial	90	5	5	Sandag 1996

STEP 3: Enter Construction Data

The construction emissions portion of URBEMIS2007 has been substantially modified from previous versions. STEP 3 - Enter Construction Data represents the most complicated step within URBEMIS. This is primarily because construction phasing varies considerably from project to project.

The STEP 3: Enter Construction Data screen allows you to estimate area-source emissions for up to seven different types of construction phases. The emission factors and equations used by URBEMIS2007 to estimate construction emissions are described in detail in Appendix A.

When you enter URBEMIS, you can click on STEP 3 without either opening a project or entering land use data. If you then go to STEP 3, you will see the screen shown in the left half of Figure 15. That screen shows the seven construction phases allowed by URBEMIS. If you have opened an existing project, or started a new project, and have entered one or more land uses, you will see the right half of Figure 15 when you go to STEP 3. The only exception to this is for projects within the South Coast Air District, where all seven phases are assumed as part of the construction phase setup.

This list of generic phases and schedules should only be used if specific construction information is unavailable for the project in question.

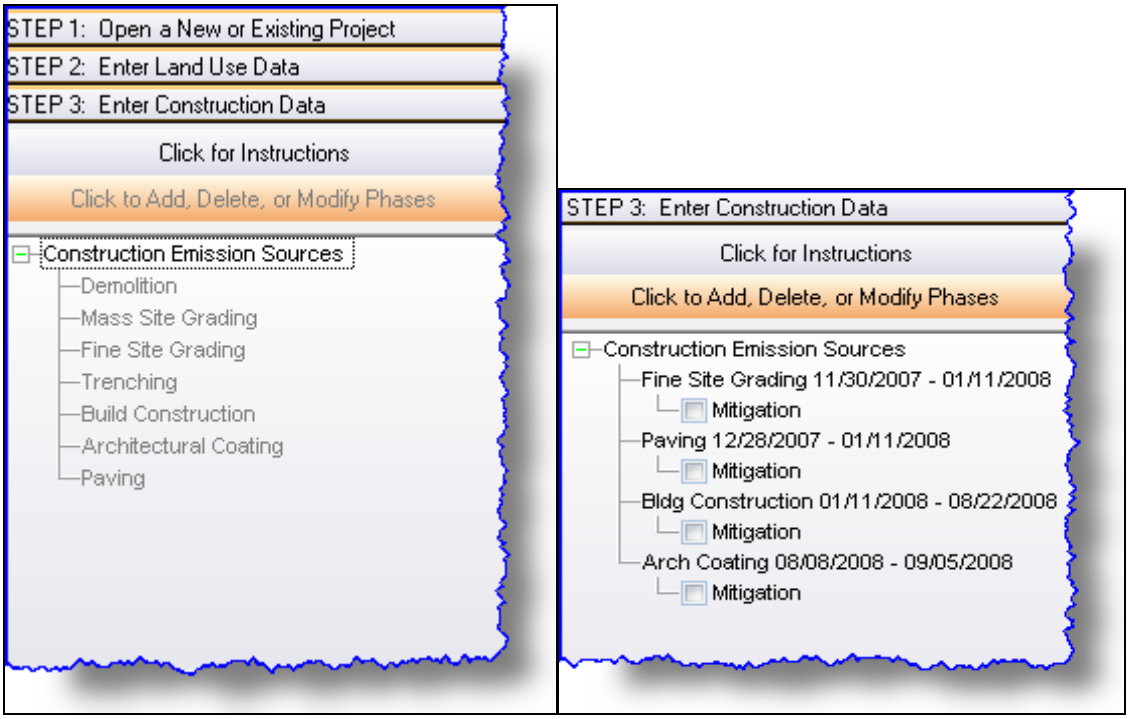

Figure 15. Construction Start Screens

Setting Up Construction Phases

The phases and schedules included in the generic construction phasing are as follows:

- Fine Site Grading,
- Asphalt,
- Building Construction, and
- Architectural Coatings.

These phases can be deleted or their phasing can be altered by clicking on the button: Click to Add, Delete, or Modify Phases (orange button just below the STEP3. Enter Construction Data button).

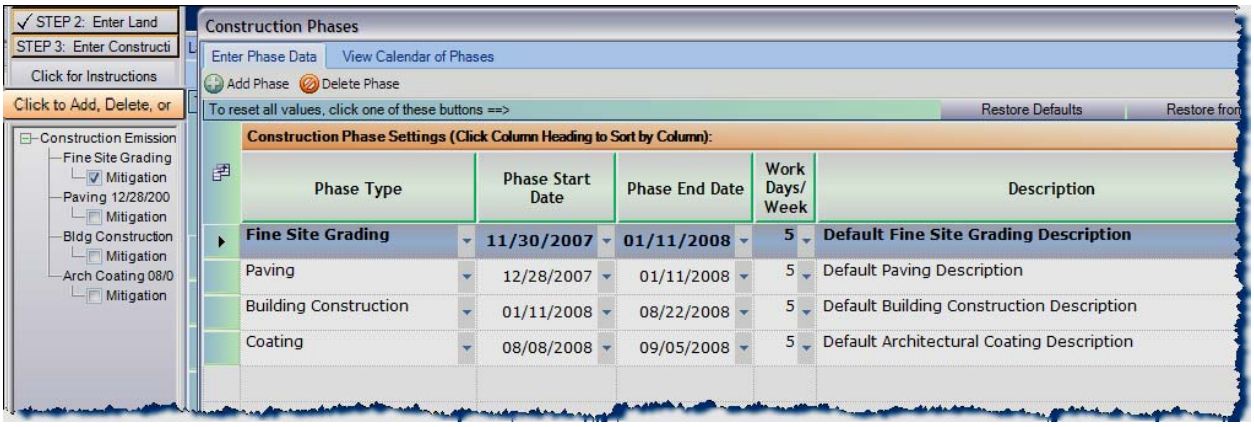

Figure 16. Adding, Deleting and Modifying Construction Phases

This will take you to a screen that allows you to add or delete phases. The seven types of phases that be included in URBEMIS are:

- Demolition,
- Mass Site Grading,
- Fine Site Grading,
- Trenching,
- Building Construction,
- Asphalt, and
- Coating (paints)

For each phase, you must identify construction phase settings that include phase type, start date, end date, work days/week, and a description. There is no limit to the number of phases that can be entered. More than one phase of any type can be entered. The only limitation is that phases of the same type must have a unique start date/end date pair. For any phase, the start and end dates must be on or after January 1, 2005 and the end date must be on or before December 31, 2040.

Phases can overlap, occur sequentially, or have time gaps between them.

As shown in Figure 16, a second tab allows you to View a Calendar of Phases. When you select that tab, you are shown a calendar (See Figure 17). This calendar shows all days that have any phase activity as bolded days. If you place your cursor over any bolded day, the number of phases occurring on that date are displayed, and if you click a day, the phases that occur on that day will be displayed in the box on the right.

Once you are satisfied that your project's construction phasing has been set up correctly, from within the Enter Phase Data tab click on the Done, Process these Changes Button. This will save your changes and display your project's phases in the left hand pane of STEP 3 (see Figure 18).

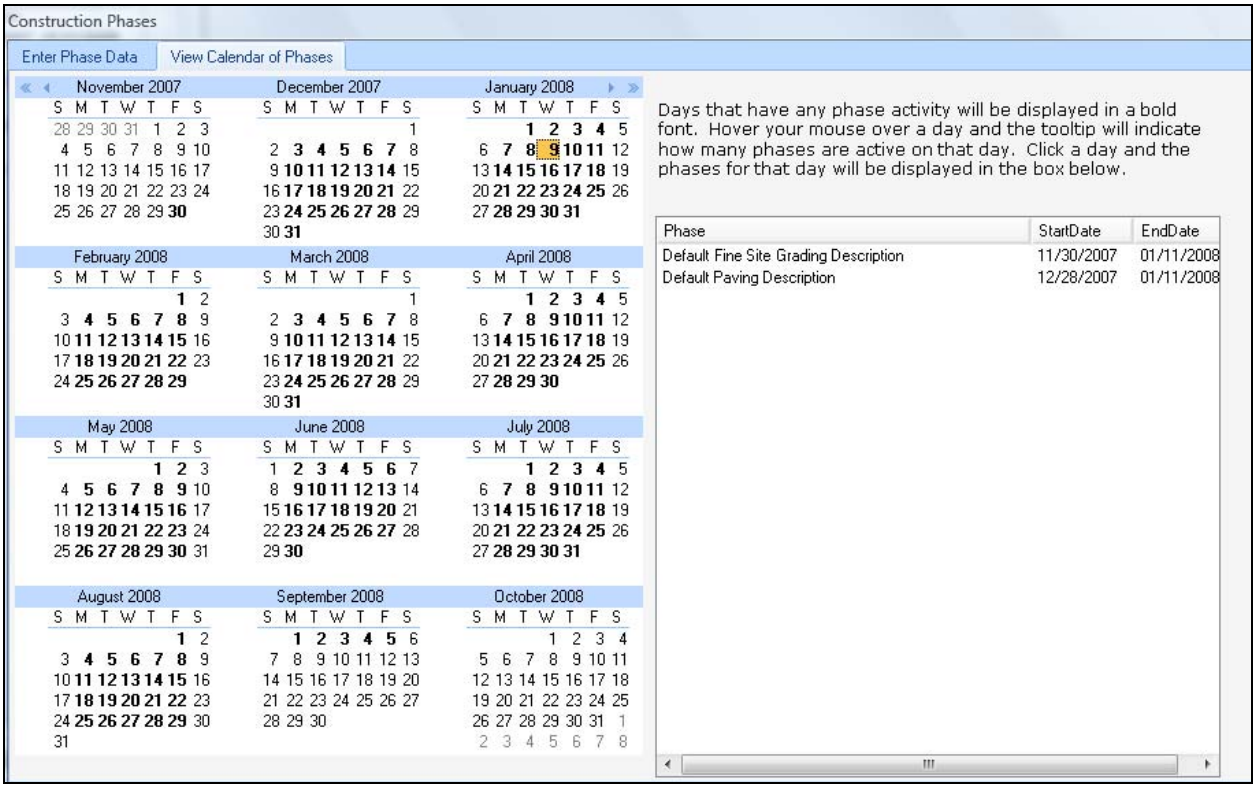

Figure 17. Construction Calendar of Phases

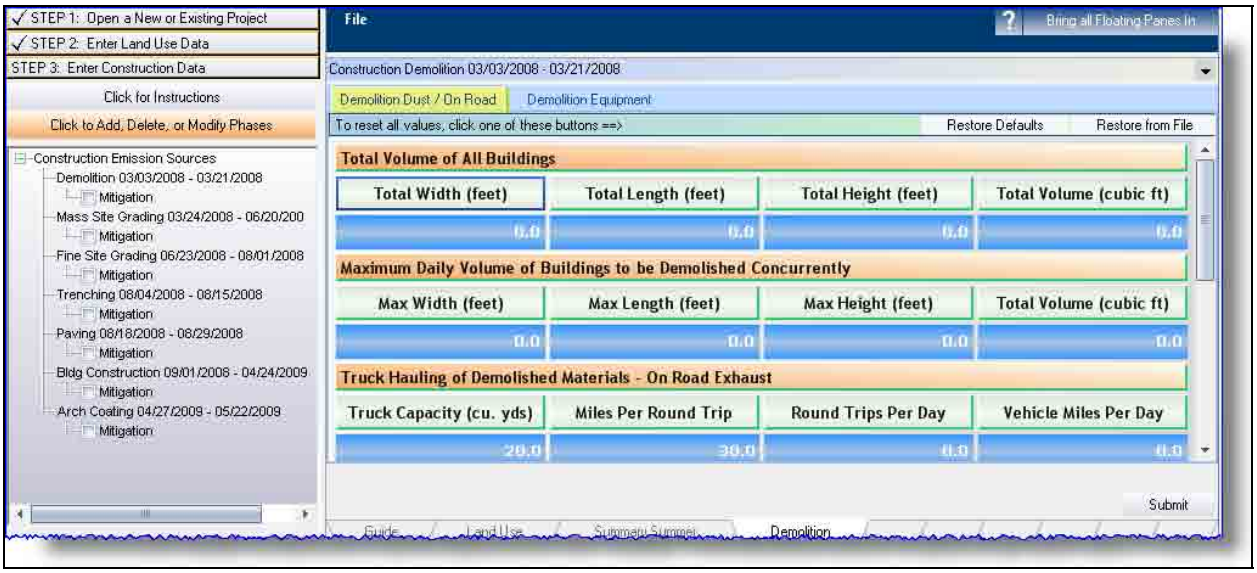

Figure 18. Seven Phase Example with Demolition Screen Showing

Demolition

Figure 18 shows the construction phasing in the left hand window pane. In this example, the demolition line has been selected, resulting in the first demolition tab being shown in the right hand pane. In this screen, the user is required to enter the volume of the building that will be demolished. URBEMIS then uses that information to estimate the amount of truck vehicle miles traveled needed to haul the demolished material away.

URBEMIS also generates estimates of the demolition equipment that would be needed to demolish the building. That estimate is based on the acreage of the demolition project. Figure 19 shows that URBEMIS estimates 3 excavators and 2 rubber tired dozers will be used in this demolition project. The user can change those values by entering different numbers in the column labeled Amt Model Uses (Click to Sort). For example, assume for your project that only 2 excavators and 2 rubber tired dozers would be used during demolition. You can enter the 2 in the third column. The user is cautioned, however, that URBEMIS will automatically override any values you enter if you change any land use values (STEP 2) unless you uncheck the box in the first column.

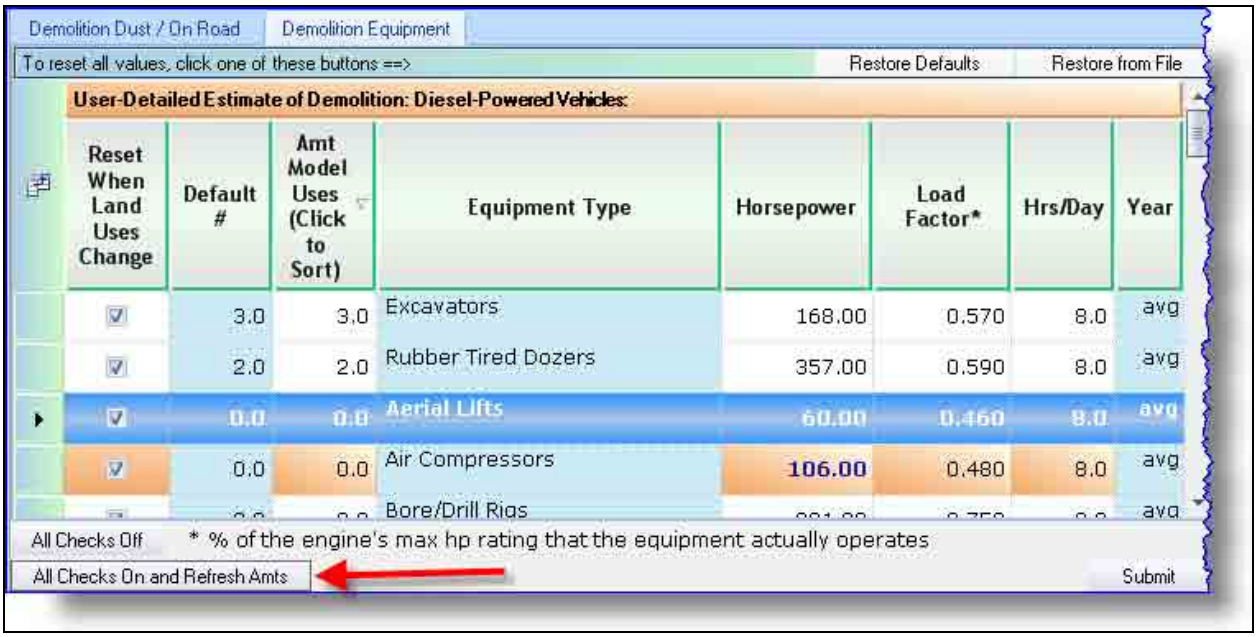

Figure 19. Demolition Equipment

Fine Site Grading

Figure 20 shows the first of the four tabs in the fine grading screen. This screen shows the acreage estimates that URBEMIS uses to estimate fugitive dust and fine site grading equipment emissions. The total acreage to be graded and maximum daily acreage disturbed estimates are shown at the bottom of the page.

URBEMIS uses the acreages entered in the residential and non-residential land use screens. For non-residential land uses, URBEMIS assumes that acreage is twice the size of the building square footage, unless the values are overridden by the user. URBEMIS also assumes that the maximum daily acreage disturbed is 25 percent of total acreage to be graded.

The user should change the maximum daily acreage disturbed value if they know that their project would have different values. The user should also be aware that if the maximum daily acreage disturbed value is changed, URBEMIS will reset that value whenever a land use is modified (STEP 2) unless the reset acreage with land use changes box has been unchecked (see arrow at bottom right of Figure 20).

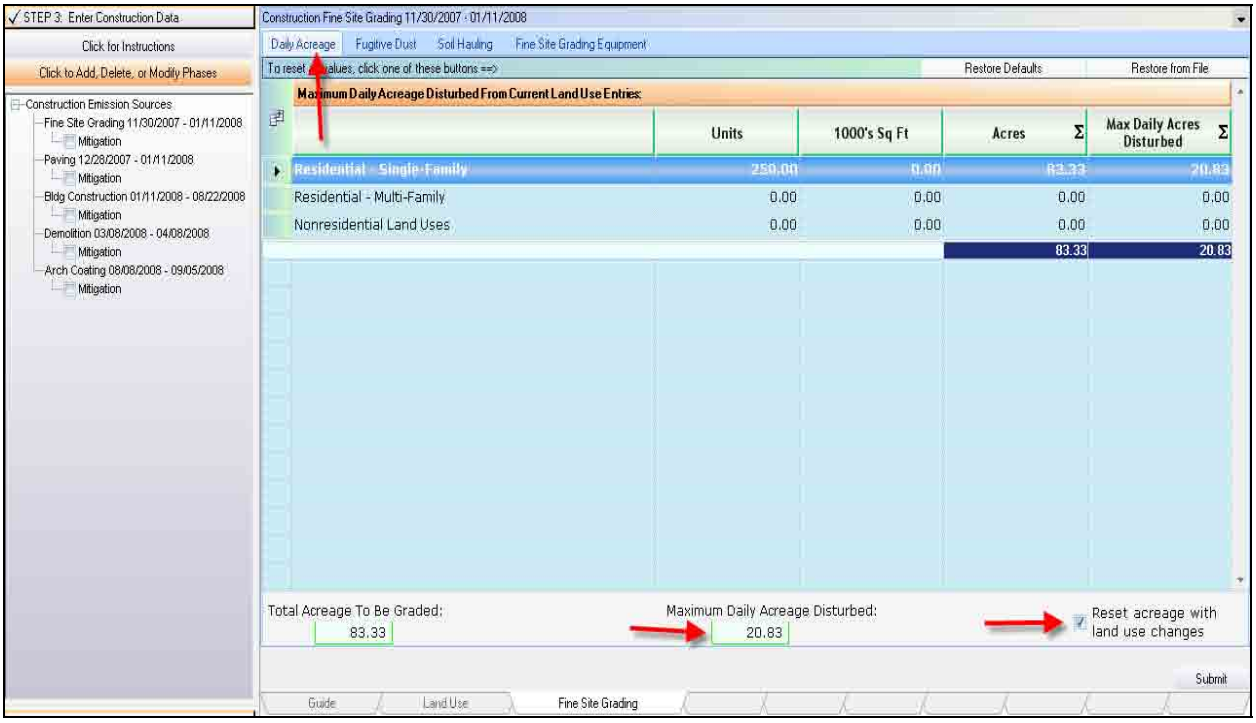

Figure 20. Construction Fine Grading

Figure 21 shows the Fine Site Grading tab. URBEMIS automatically estimates the number and type of construction equipment based on the maximum daily acreage disturbed (Daily Acreage tab). The amount of construction equipment the model uses can be overridden by the user. However, unless the box in column 1 is turned off, the amount of equipment entered by the user will change whenever the maximum daily acreage disturbed value changes. (See also Appendix H for the equipment list).

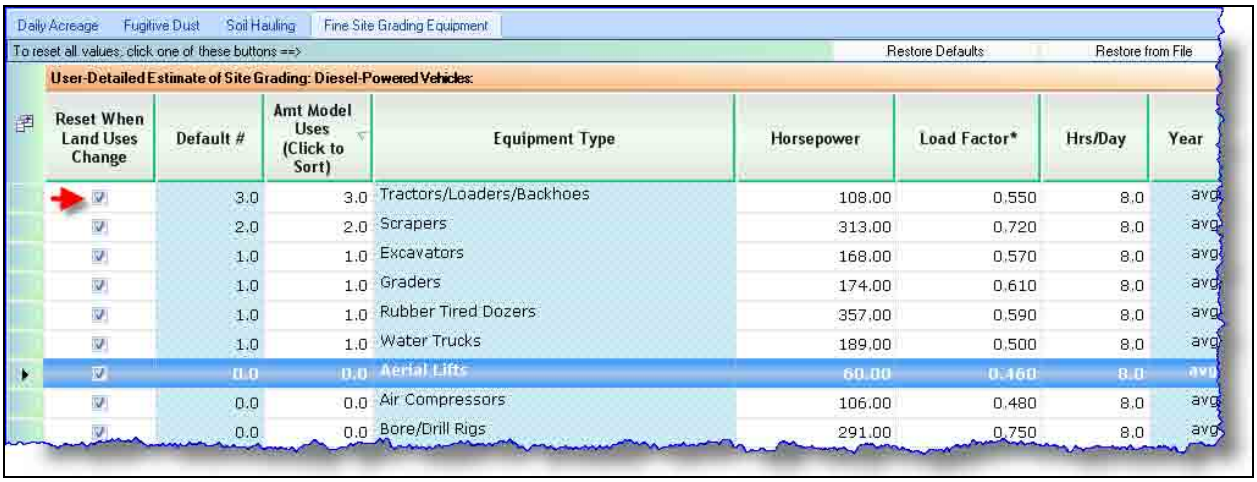

Figure 21. Fine Site Grading

Mass Site Grading

The mass site grading phase works identically to the fine site grading phase. Please refer to the fine site grading discussion above for more information.

Trenching

Trenching typically consists of digging trenches for installation of natural gas and water pipelines, and electric conduit. If trenching is selected as a phase, URBEMIS generates estimates of trenching equipment type and number based on the amount of disturbed acreage per day. URBEMIS uses 25% of the total project acreage (as entered on the land use screens) and determines the trenching equipment use based on the equipment values shown in Appendix H.

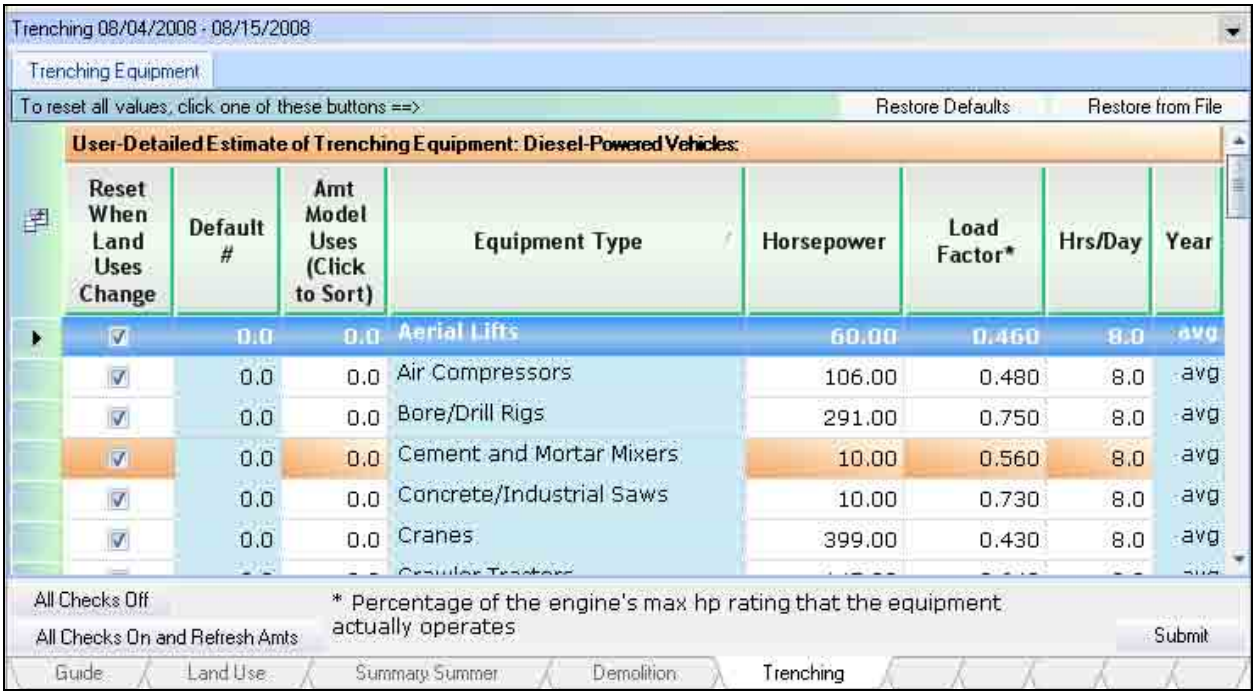

Figure 22. Trenching

Building Construction

Figure 23 shows the first tab of the building construction phase: worker trips. Two additional tabs are available, vendor trips and construction equipment. All of the values in each tab can be modified by the user. URBEMIS estimates on-road worker trips and vendor trips based on the values in these two tabs and on the land uses entered by the user.

URBEMIS uses 25% of the total project acreage (as entered on the land use screens) and determines the construction equipment use based on the equipment values shown in Appendix H.

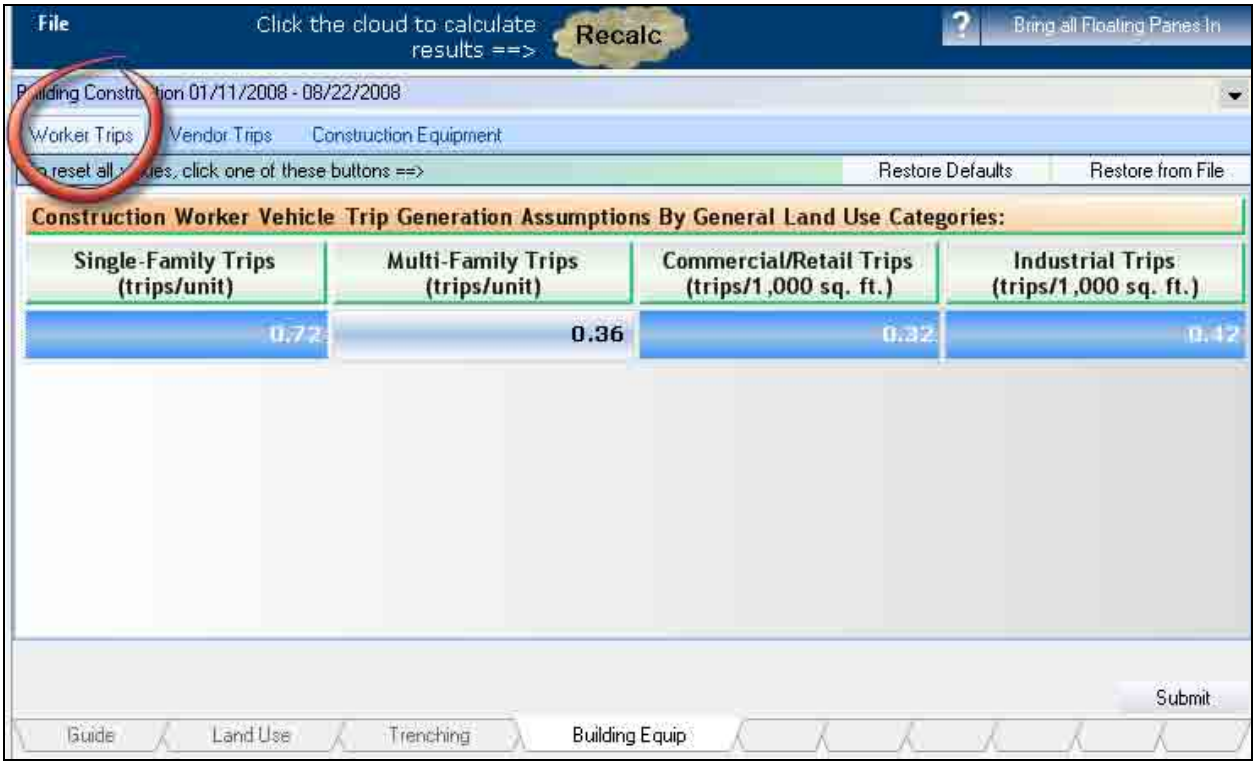

Figure 23. Building Construction

Asphalt

URBEMIS estimates asphalt emissions associated with asphalt off-gassing, asphalt off-road and on-road equipment, and worker trips. Figure 24 shows the first tab of the two asphalt paving tabs. Circled in red is URBEMIS' best estimate of the total acreage to be paved with asphalt. That value equals 25% of the total building project acreage. This value should be overridden if a more accurate, project-specific value is available. The user should understand that, to reset the default acreage, the "Reset Acreage with Land Use Changes" value box must be unchecked. Otherwise, URBEMIS will replace the user entered number with the URBEMIS generated number whenever land uses is modified.

The user can also select the Paving Equipment tab. URBEMIS will generate estimates of paving equipment based on total acreage to be paved. As with off-road construction equipment shown in other phases such as fine site grading, URBEMIS generates estimates of construction equipment that can be overridden by the user.

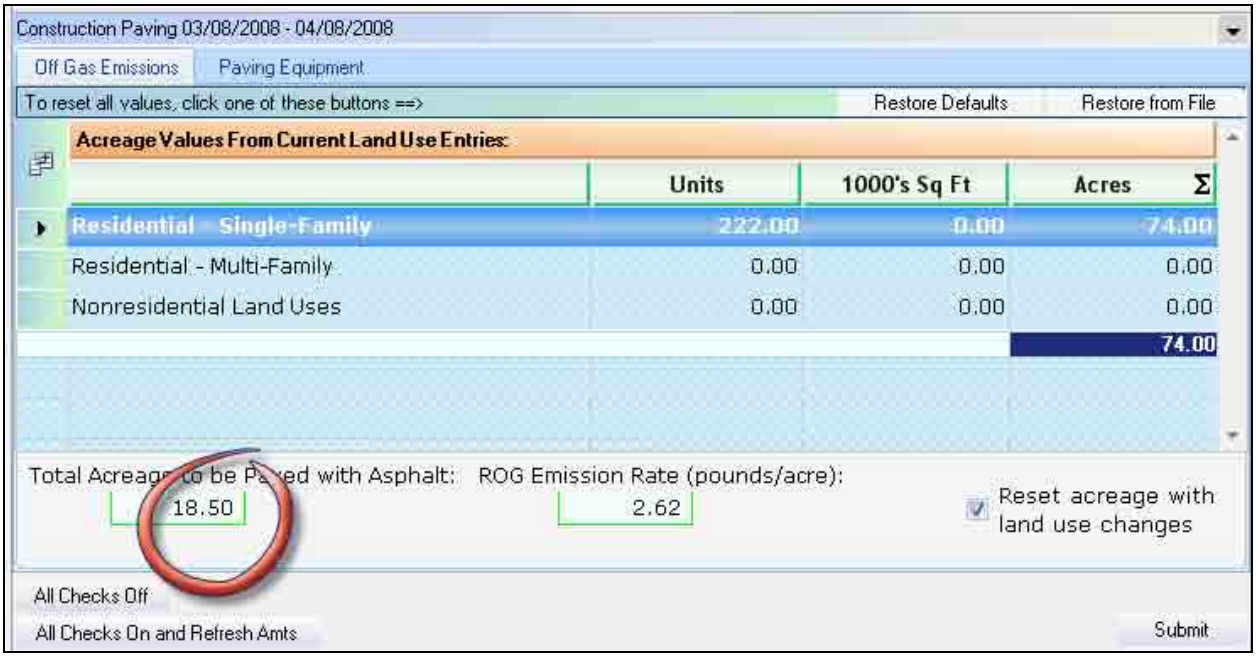

Figure 24. Asphalt Paving

Architectural Coating

When the user selects architectural coatings, the VOC content for each of four coating types are displayed. The VOC content is based on architectural coatings rules that have been developed by each air district. Consequently, they cannot be modified by the user.

Figure 25. Architectural Coatings

Construction Mitigation Measures

Construction mitigation measures include measures to reduce fugitive dust and off-road construction emissions. URBEMIS2007 allows the user to identify specific mitigation measures for individual

classes of construction equipment. Figure 26 shows the mitigation measures that can be selected for fine site grading. In this example, the excavator line has been checked to show the types of mitigation measures allowed for excavators. The options include use of aqueous diesel fuel, diesel particulate filters, and diesel oxidation catalysts. The user needs to turn on each mitigation measure that applies. In addition, several of the mitigation measures have drop down boxes (arrow on far right in Figure 26) that allows the user to select the stringency of each mitigation measure.

Construction Equipment Exhaust

The mitigation measure shown in Figure 26 works in the same way for all construction phases that have off-road construction equipment, which includes six of the seven phase types (does not include architectural coatings). However, the mitigation measures must be selected separately for each phase.

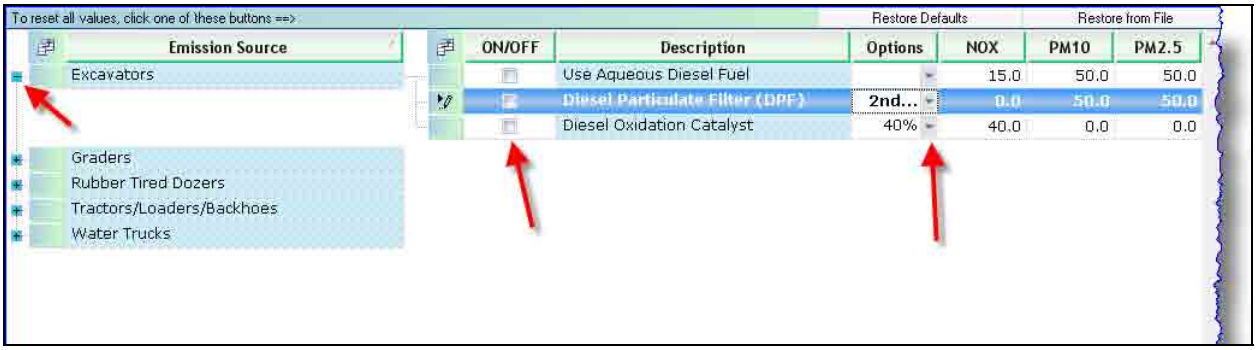

Figure 26. Construction Equipment Exhaust Mitigation Measures

Fugitive Dust Mitigation

Both fine and mass site grading also include methods to mitigated fugitive dust generated by travel on unpaved roads and by soil disturbance from off-road equipment operating on a construction site. To specify mitigation, the user needs to enter a check in on/off column for each mitigation measure that applies (see Figure 27). By clicking on the Unpaved Roads Mitigation tab, the user can also select those mitigation measures that apply.

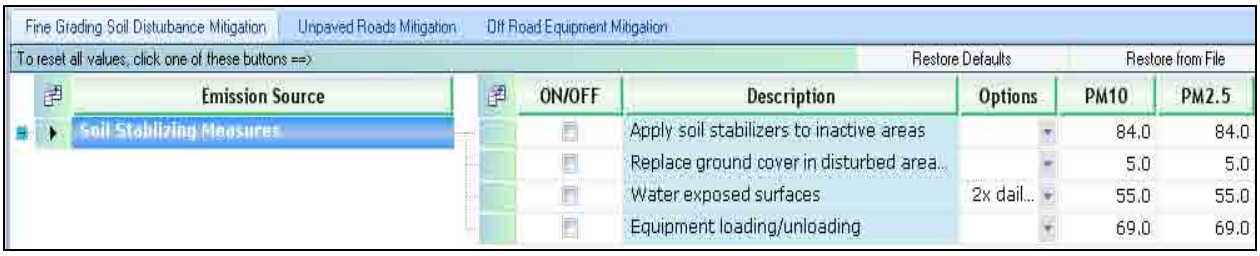

Figure 27. Soil Disturbance Mitigation

Figure 28 shows the architectural mitigation measures screen. The user simply turns on one or more of the four percentage reductions that apply. The user can also edit the ROG percent reduction.

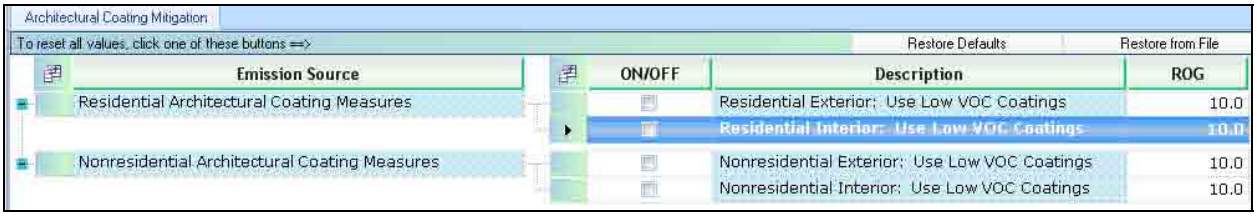

Figure 28. Architectural Coatings Mitigation

STEP 4 – Enter Area Source Data

The "Area-Source Emission" screen allows you to estimate area-source emissions for up to five categories of emission sources. Figure 29 lists those five categories in the left hand column. Three of these five categories are fuel combustion related: natural gas, hearths, and landscape maintenance. Two categories, consumer products and architectural coatings, consist of evaporative emissions. The emission factors and equations used by URBEMIS2007 to estimate area-source emissions are described in detail in Appendix B.

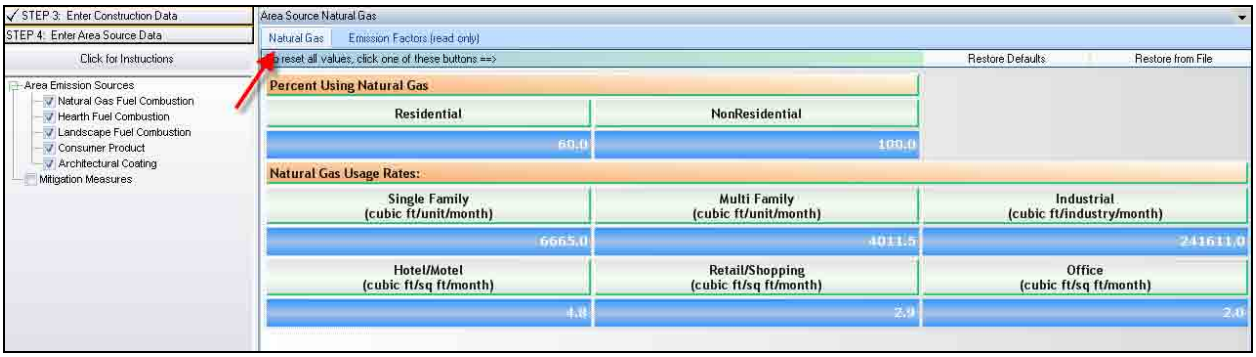

Figure 29. STEP 4 – Area Source Screen with Natural Gas Combustion Selected

Natural Gas Combustion

Figure 29 shows STEP 4 after the Natural Gas Fuel Combustion line has been selected in the left column. By double-clicking on the Natural Gas Fuel Combustion line, the screen on the right is presented. It shows the default values associated with this category. None of these values need be changed unless project specific information is available.

Hearth Fuel Combustion

Clicking on the second item in the left column, Hearth Fuel Combustion, results in the screen shown in Figure 30. URBEMIS shows the percentages of wood stoves, wood fireplaces, natural gas fireplaces associated with the project (assuming the project includes residential units). For projects that include no residential units, the Hearth Fuel Combustion category generates no emissions. The user can opt to change the percentages of the hearth categories, though they must total to 100 percent. (The user should also be aware that the hearth percentages screen looks slightly different for projects in the San Joaquin Valley. This is because the percentages are specified by the San Joaquin Valley Air Pollution Control District's wood fuel combustion rule.)

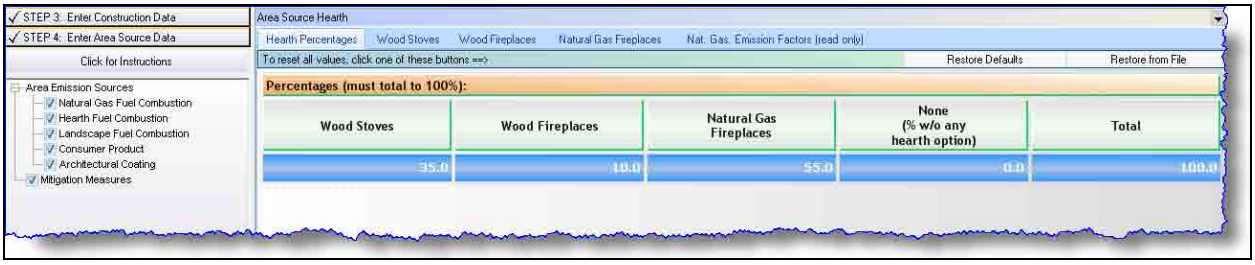

Figure 30. Area Source Hearth Fuel Combustion Screen

Wood Stoves

The Hearth Fuel Combustion category also includes additional tabs for wood stoves, wood fireplaces, natural gas fireplaces, and natural gas emission factors. Figure 31 shows the wood stoves tab. The screen shows emission factors (pounds of pollutant per ton fuel burned) by stove type, the percentage of each stove type assumed by URBEMIS, and, at the bottom of the screen, the amount of wood burned per stove each year, the number of days each stove is used, and pounds of wood per cord. All of these values except the emission factors can be modified by the user.

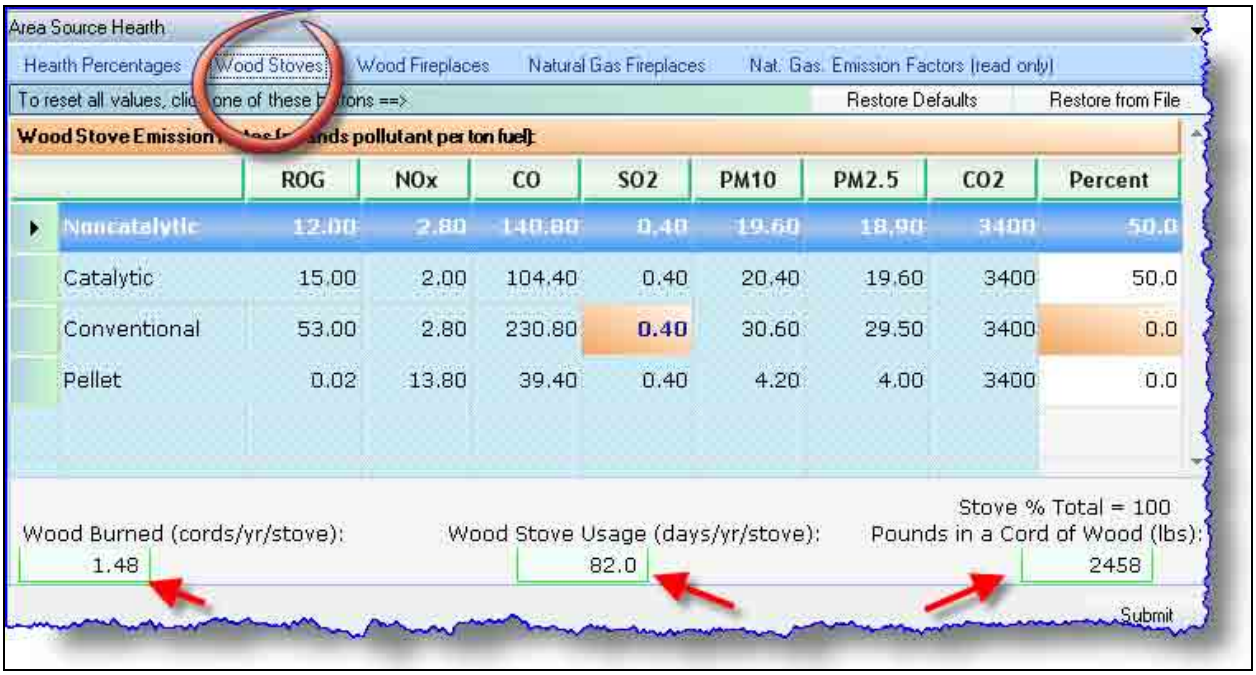

Figure 31. Wood Stoves Screen

Fireplaces

Figure 32 shows the wood fireplaces tab. It is similar to the wood stoves tab in that all of the values except the emission rates can be modified by the user. The user is cautioned about revising any of these values, however, because they represent defaults set by the individual air districts.

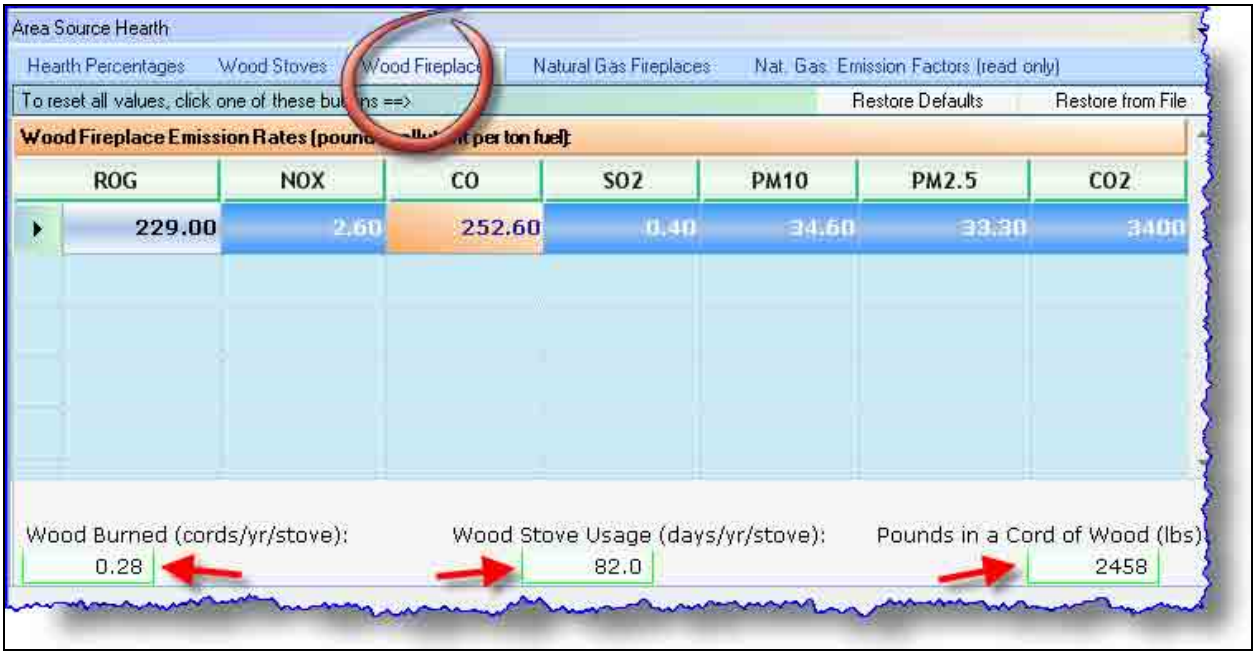

Figure 32. Wood Fireplace Screen

Natural Gas Fireplaces

Figure 33 shows the natural gas fireplace tab. This screen shows the default fireplace use information for single family and multi family fireplaces. These values can be modified by the user. The natural gas fireplace emission factors, which are in the fourth tab, cannot be modified by the user.

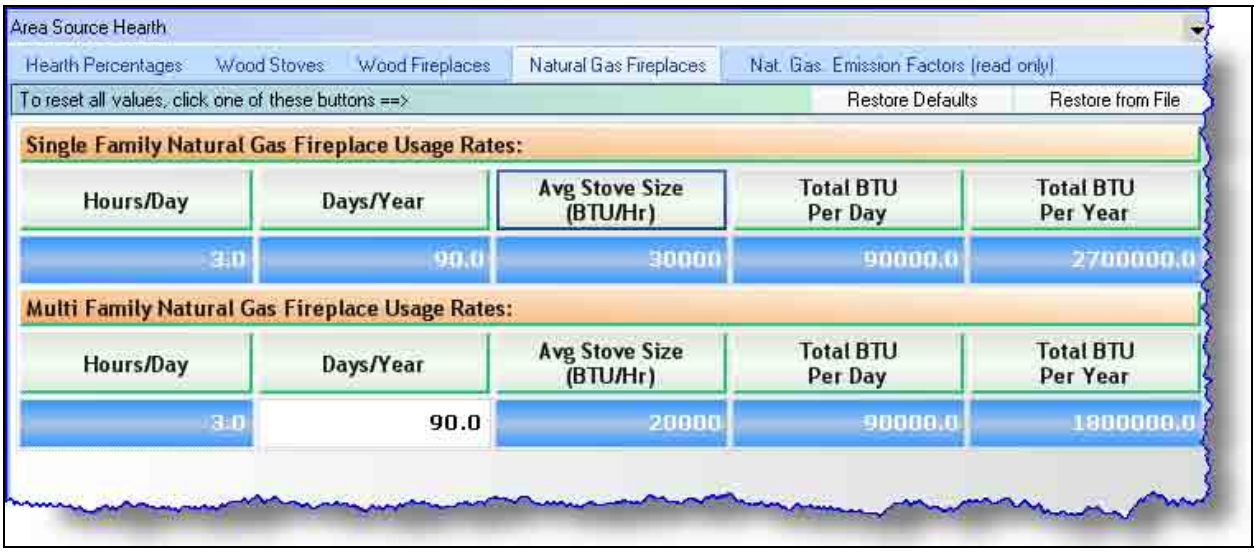

Figure 33. Natural Gas Fireplaces

Landscape Equipment Fuel Combustion

Figure 34 shows the screen when landscape equipment fuel combustion has been selected. Only one screen is available, which shows data for the length of the summer period and the year being analyzed. Landscape emissions can only be calculated for the summer period. Both of these values can be modified by the user. The year being analyzed should be consistent with the project's operational year.

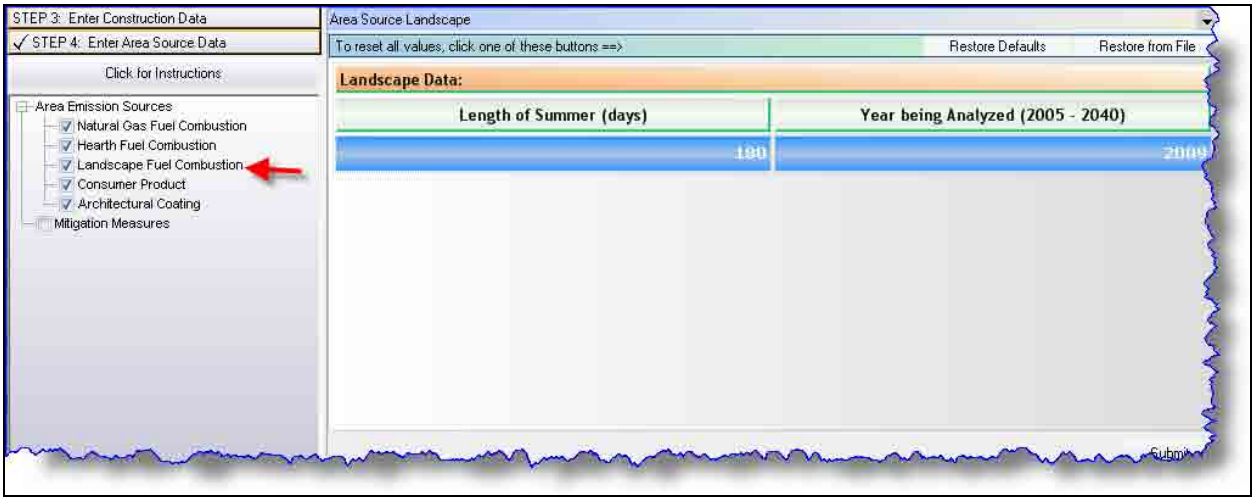

Figure 34. Landscape Fuel Combustion

Consumer Products

Figure 35 shows the consumer product screen. This screen includes the pounds of ROG emitted per person per day and the number of persons per residential unit. Consumer product emissions are only generated for residential land uses.

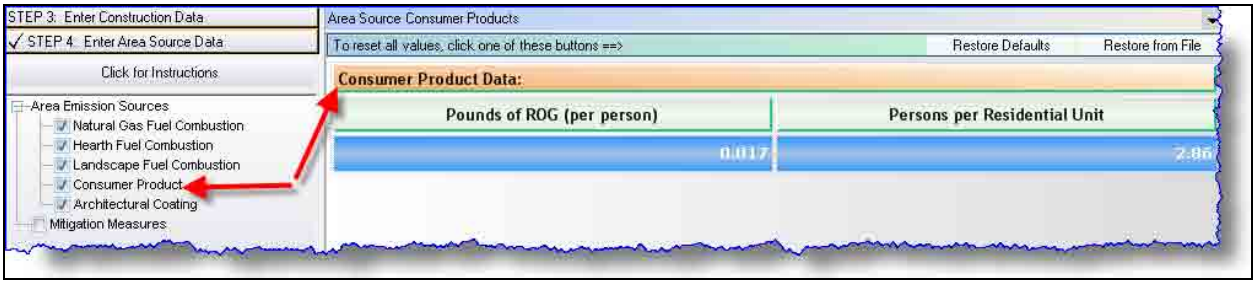

Figure 35. Consumer Products

Architectural Coatings

The last emission category for Step 4. Area Sources is architectural coatings. Architectural coatings is similar to architectural coatings included in construction (Phase 3), except that here a percentage of the buildings are assumed to be repainted each year. As a default, URBEMIS assumes 10% of residential and non-residential building surface area is repainted each year. These percentages can be modified by the user. The coatings rules upon which emission estimates are based, cannot be modified.

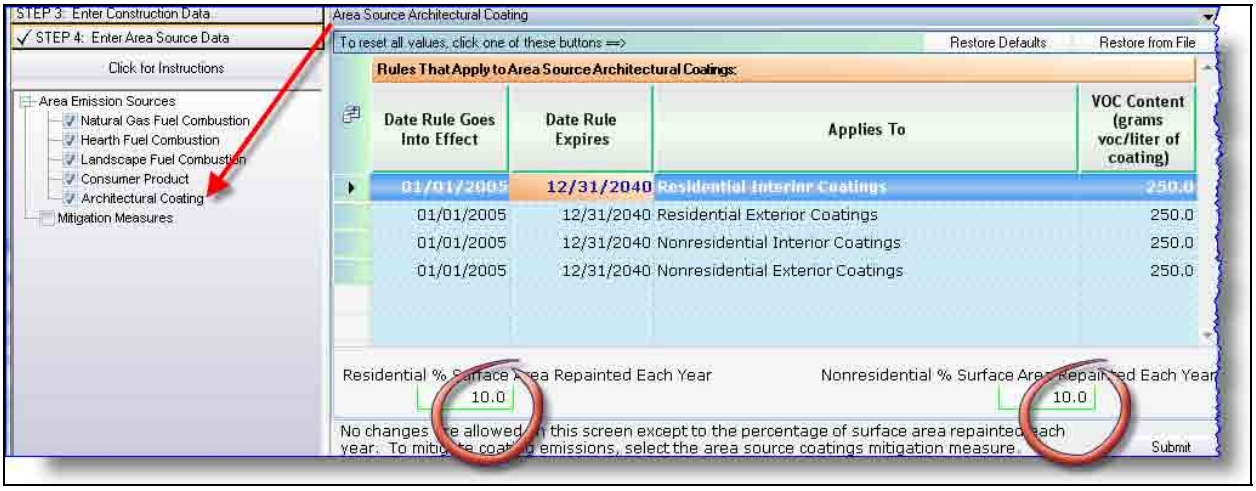

Figure 36. Architectural Coatings

Area-Source Mitigation Measures

From the "Area Source" main menu, you may select area-source mitigation measures by clicking the "Mitigation Measures" checkbox in the left pane list. This action forces URBEMIS2007 to display the area source mitigation measures in the right pane. The user can select one of three tabs in the right hand pane: Energy Efficiency, Landscape, or Architectural Coating. (A fourth tab for hearths is available for projects located within the San Joaquin Valley Air Basin.)

Energy Efficiency Mitigation

Figure 37 shows the Energy Efficiency tab. Users can turn on residential, commercial, and/or industrial energy efficiency mitigation and modify the % increase in efficiency.

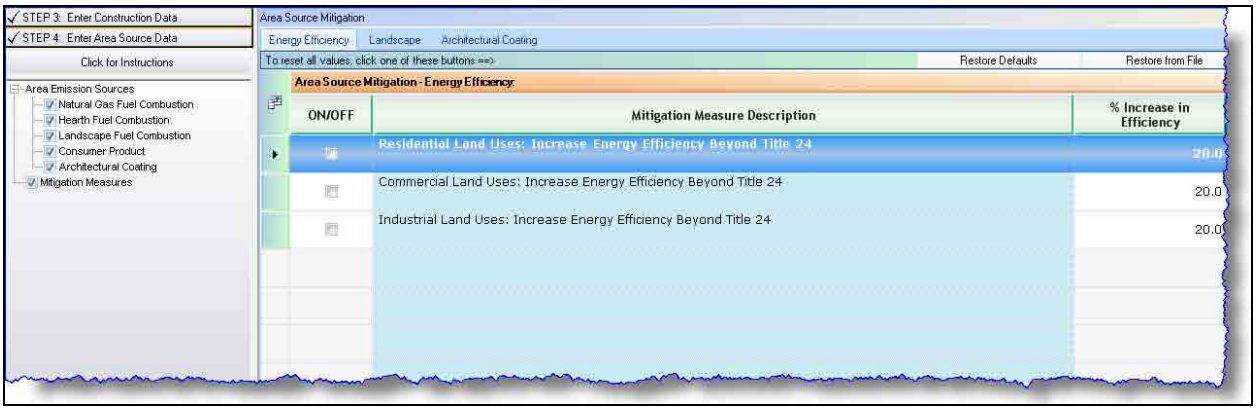

Figure 37. Energy Efficiency Mitigation Measures

Landscape Maintenance Equipment Mitigation

The second tab (see Figure 38) consists of landscape maintenance mitigation measures. Users can turn on the residential and/or commercial/industrial mitigation measures and alter the percentage of applicable equipment.

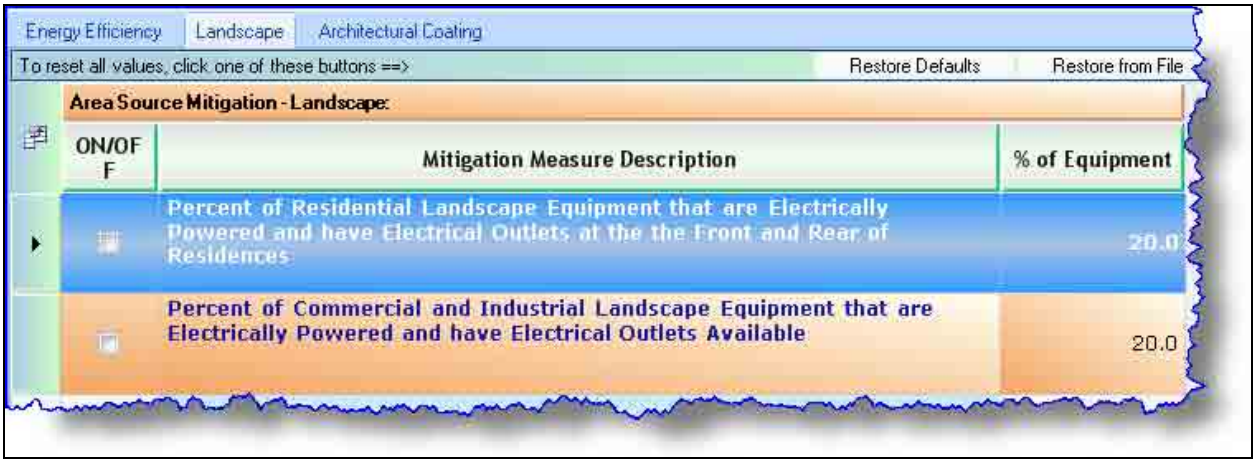

Figure 38. Landscape Mitigation Measures

Architectural Coatings Mitigation

Figure 39 shows the architectural coating mitigation tab. The user can select a % reduction of VOC for one or more of four coating types. The user can also modify the percentage reduction.

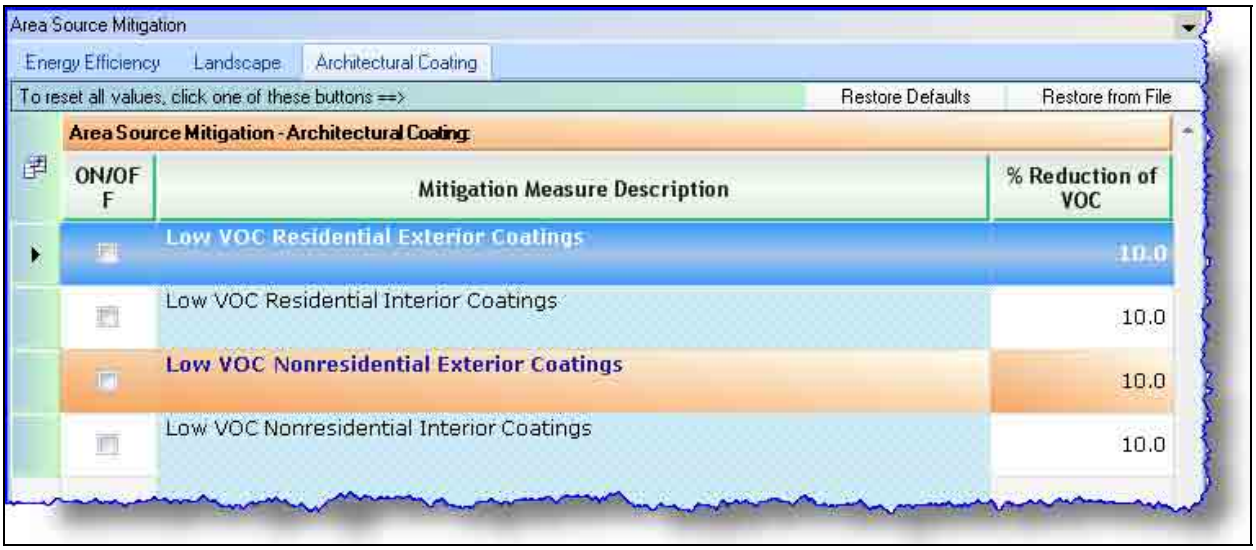

Figure 39. Architectural Coating

STEP 5 – Enter Operational Data

Step 5 involves entering operational data so as to generate estimates of on-road vehicle emissions. Figure 40 shows Step 5 in the left hand pane. Under Step 5, seven lines are listed under Operational Emission Sources, ignoring Mitigation Measures. Clicking on the first of those seven lines, Year & Vehicle Fleet, results in the screen shown on the right in Figure 40.

The user should be sure that the project start year is correct (see arrow in Figure 40). Changing the project start year also changes the fleet mix. URBEMIS uses the fleet mix information included in the EMFAC2007 files to generate the fleet mix estimates. For example, if the user changes the project start year to 2020 (and the project is in Los Angeles County), then URBEMIS goes to the 2020 Los Angeles County EMFAC file to obtain the average fleet mix for that location and year. For certain project types, the user may want to use a fleet mix that differs from the average vehicle fleet mix. For

example, a project may consist of an industrial land use with 80 percent heavy-heavy duty truck trips. In that situation, the user should click on the check mark to the right of the year. That check box reads "Keep Current Fleet Mix When Changing Years". If that check box is turned on, then URBEMIS will not update the fleet mix hat a user has entered if the user opts to change the year.

For each vehicle type, there are three fuel/technology classes: non-catalyst (gasoline), catalyst (gasoline), and diesel. Within the right pane, you can modify any of the fleet percentages or fuel/technology classes. The total fleet percentage must total to 100. Also, for each vehicle type, the three fuel/technology classes must subtotal to 100 percent.

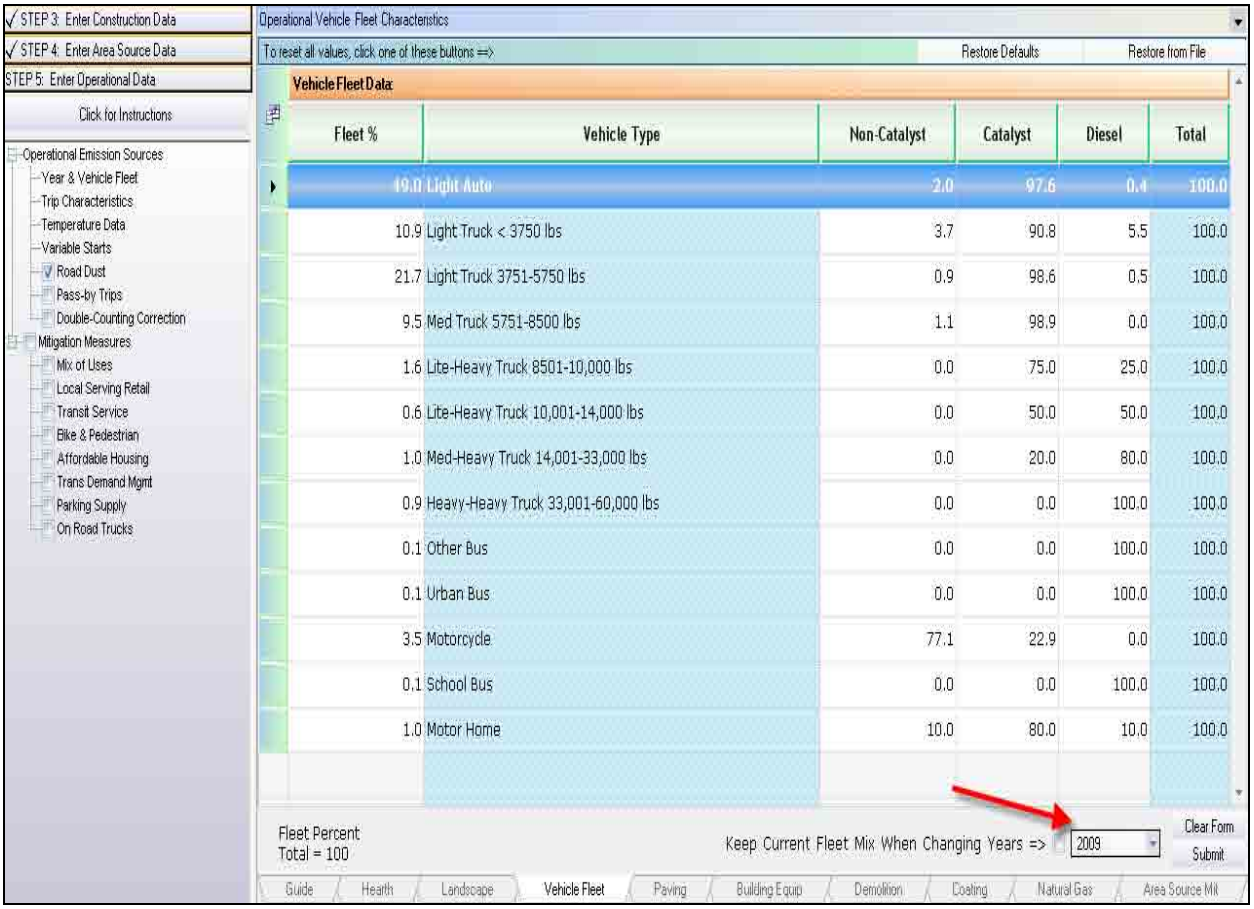

Figure 40. Operational Emissions Entry Screen

Trip Characteristics

The "Trip Characteristics" screen can be modified by clicking on the "Trip Characteristics Settings" node in the left pane. This action displays the trip characteristics in the right pane. Several pieces of information are contained in the "Trip Characteristics" screen: average trip speeds, trip percentages, and trip lengths for six different trip types (home-based work trips, home-based shopping trips, home-based other trips, work trips, commercial-based non-work trips, and commercial-based customer trips) (see Figure 41). The trip characteristics screen also includes an urban/rural project checkbox in the lower left hand corner. URBEMIS uses the urban trip lengths if the urban project check box is turned on, rural trip lengths if the rural project box is checked.

Note that the "Trip Characteristics" screen allows you to enter the trip percentages for home-based trips, which must total 100 percent. However, this same screen does not permit you to enter trip

percentages for commercial-based trips. Instead, commercial-based percentages are calculated separately by URBEMIS2007 for each nonresidential land use selected in the "Land Use" screens.

The "% Worker Commute" information from the land use screens corresponds to the commercial-based commute work trip value. The commercial-based commute trip percentage is then used to estimate commercial-based non commute work trip and customer based trip percentages for each land use. If the commercial-based commute trip value exceeds 50 percent, then the commercial-based non commute trip percentage equals 100 percent minus the commute trip percentage, multiplied by 50 percent. If the commercial-based commute trip value is less than 50 percent, then the commercial-based non commute trip percentage equals one half of the commercial-based commute trip value. Finally, for each land use, customer based trips are assumed to equal the 100 percent minus the total of the commercial commute and non commute percentages.

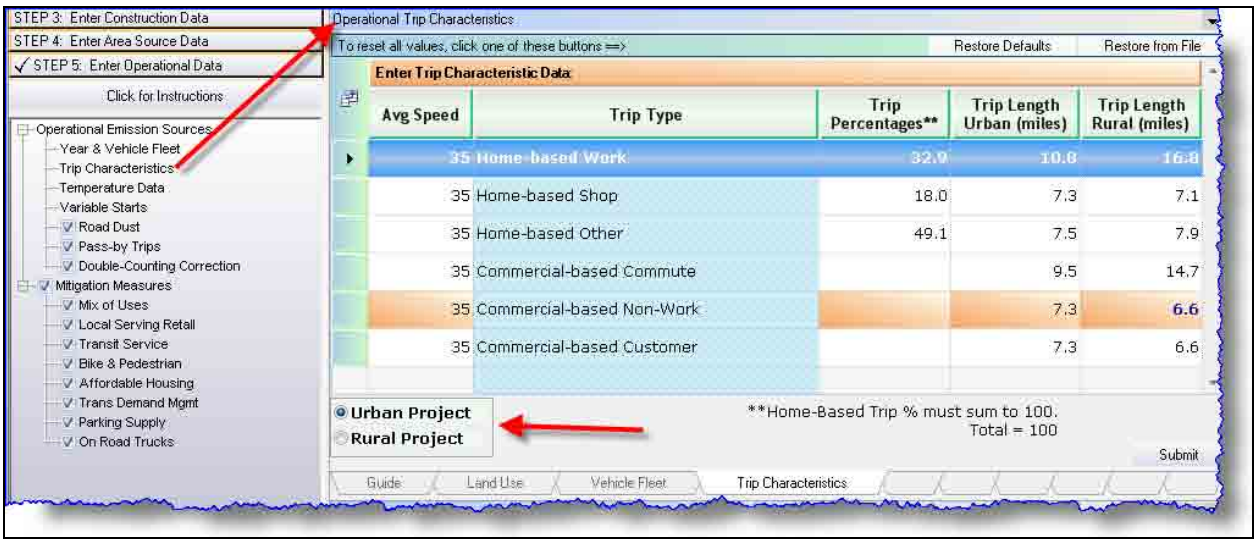

Figure 41. Trip Characteristics

Temperature Data

By clicking on the temperature data in the left pane, temperature options are presented in the right pane. You have the option of modifying both winter and summer ambient temperatures, which are used to estimate winter and summer emission estimates and which correspond to the summer versus winter gasoline specifications used in California outside of the South Coast Air Basin (greater Los Angeles).

Variable Starts

You may modify the "Variable Starts" information by clicking on the "Variable Starts" settings button shown in the left pane. This action causes URBEMIS2007 to display variable starts information in the right pane. That screen includes information on "Variable Start Percentages by Trip Type and Time since Engine Stopped". EMFAC2007 requires the vehicle engine shut-off percentages for 18 time increments, ranging from 5 minutes to 720 minutes. The information provided in this screen by trip type represents statewide averages of pre-start cool-down profiles from an ARB analysis of the 1991 California Department of Transportation household travel survey. These percentages should not be modified unless better information is available.

Road Dust

You may turn the Road Dust option on or off by clicking the check box in the left pane. This action will also display in the right pane information on "Entrained Road Dust Emissions". You have the option to modify the distribution of travel between paved and unpaved roads. You also have the option to modify the paved road or unpaved road defaults by clicking on the accompanying tabs.

If you click on the "Change Paved Road Defaults..." tab, you are taken to the "Paved Road Dust Emissions" screen. From within that screen, you may modify the default emission factors and percentage of travel for each of four road types.

You may also click on the "Change Unpaved Road Defaults" tab, where URBEMIS2007 will display the "Unpaved Road Dust Emissions" screen. From this screen, you can select either the U.S. EPA methodology for calculating emissions or you can use the California Air Resources Board's emission factor. If you select the U.S. EPA methodology, you are allowed to modify one or more of the five variables used to estimate unpaved road dust emissions.

Pass-by Trips

You may select the "Pass-By Trips" button from the left pane list. When you select "Pass-By Trips", no optional information is presented in the right pane. Selecting the "Pass-By Trips" button allows URBEMIS2007 to calculate emissions from vehicle trips that are generally lower than estimates without the pass-by trip option. The pass-by trip algorithm is described in Appendix C.

Double Counting

Another option available to URBEMIS2007 users is to adjust for double-counting.. The double-counting adjustment is designed to reduce double counting of internal trips between residential and nonresidential land uses. Consequently, selecting this option is available only when you have selected both residential and nonresidential land uses. You must click the check box in the left pane where URBEMIS2007 displays the "Double Counting Correction".

Then you are shown the number of residential and nonresidential trips that would be generated based on the land uses selected (see example in Figure 42). You are given the option of entering the number of internal trips between residential and nonresidential land uses. The value entered represents the number of internal trips that will not be included in the emissions estimate. This value can often be obtained from a traffic report prepared for the project.

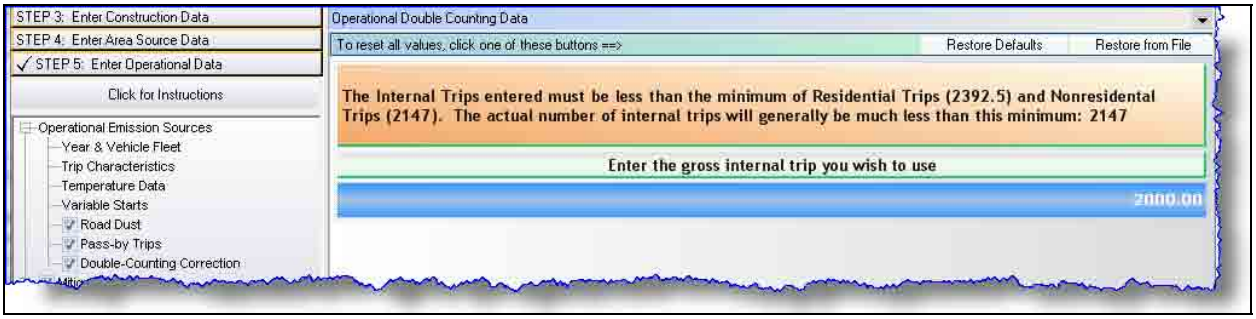

Figure 42. Double Counting Correction

Operational Mitigation Measures

Operational mitigation relies on a variety of smart growth measures that reduce the number of vehicle trips. From within STEP 5, you have the option of turning on operational mitigation measures by selecting one or more of eight optional "Mitigation Measures" options in the left pane (see Figure 43):

- Mix of uses
- Local serving retail
- Transit use
- Bike and pedestrian
- Affordable housing
- Transportation demand management
- Parking supply; and
- On-Road Trucks

Each of these is briefly described below. A much more detailed description is included in Appendix D.

Mix of Uses Mitigation

Figure 43 shows the Mix of Uses screen when the Mix of Uses line has been selected in the left hand pane. The following procedure is used to adjust trip generation rates as a function of the mix of land uses for any particular project.

Trip reduction = (1- (ABS (1.5 * h e) / (1.5 * h + e)) 0.25) / 0.25 * 0.03

Where: h = study area households (or housing units)
e = study area employment.

This formula assumes an "ideal" housing balance of 1.5 jobs per household and a baseline diversity of 0.25. The maximum possible reduction using this formula is 9%. Negative reductions of up to 3% can result when the housing to jobs ratio falls to levels less than the baseline diversity of 0.25. This reduction takes into account overall jobs-population balance.

The number of households or housing units and employment should be based on the area located within a 1/2 mile radius of the project's center.

In the example shown in Figure 43, the user has entered 500 residential uses located within ½ of the proposed project (which includes the 250 units from the project) and a study area employment of 750.

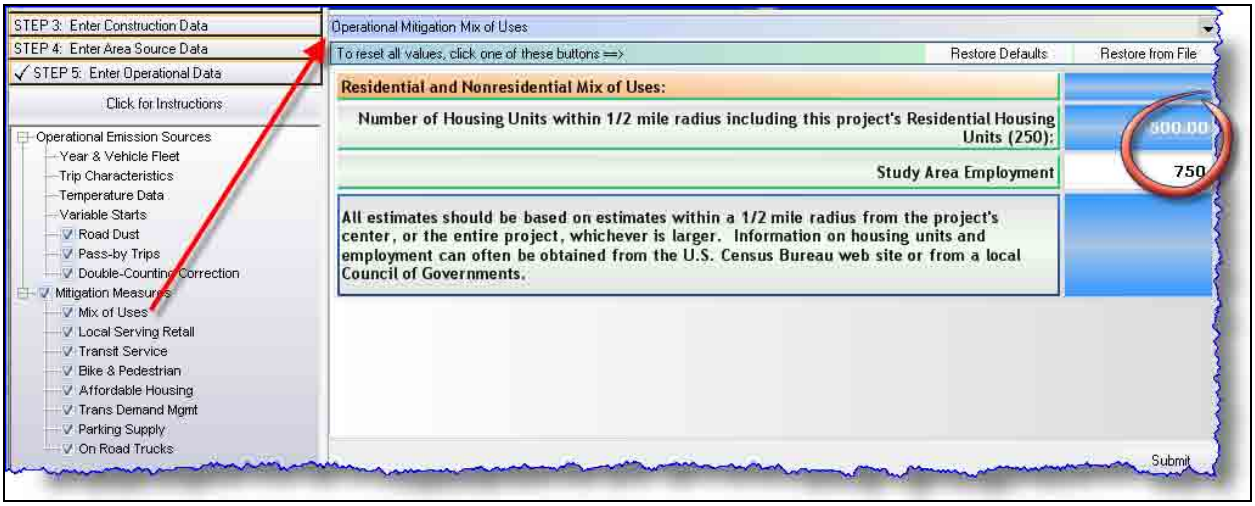

Figure 43. Mix of Uses Mitigation

Operational Local Serving Retail Mitigation

The presence of local serving retail can be expected to bring further trip reduction benefits, and an additional reduction of 2% is assumed. This is towards the lower end of the values presented in the research, in order to avoid double counting with the diversity indicator.

Operational Transit Mitigation

The Transit Service Index emphasizes frequency but with greater weighting given to rail services. Greater weight is also given to dedicated shuttles, in recognition of the fact that these are likely to be more closely targeted to the needs of the development. Information on transit availability and frequency can be obtained from transit agency maps and schedules.

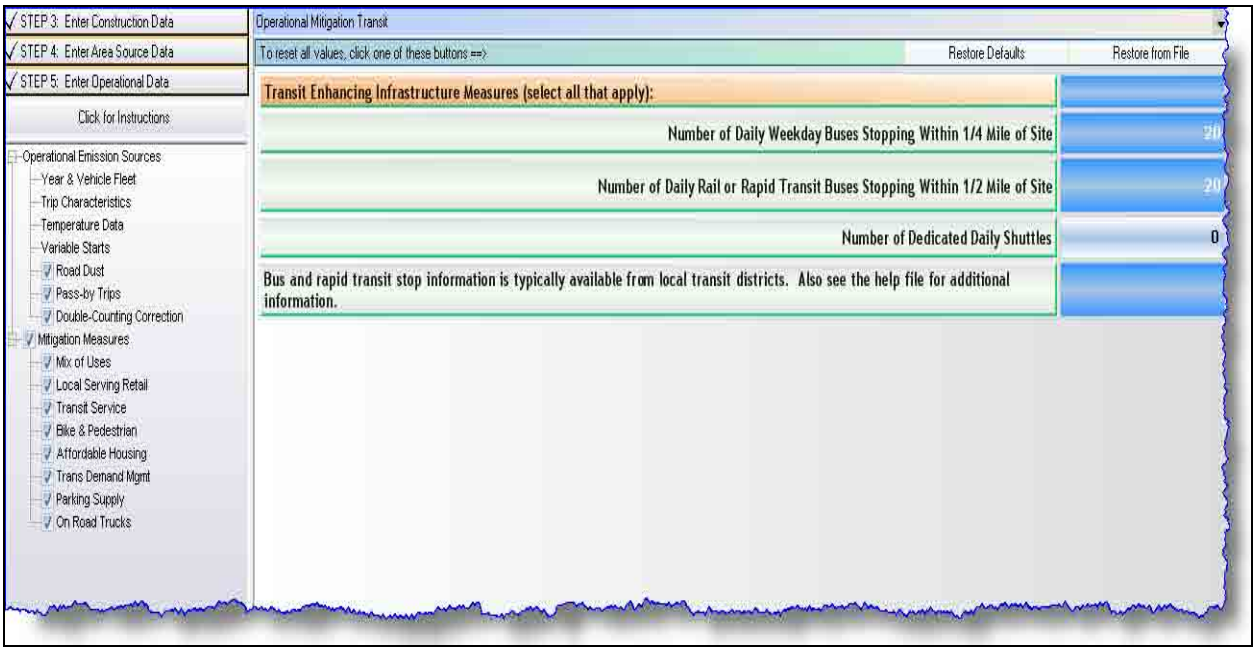

Figure 44. Transit Mitigation

The Transit Service Index is determined as follows:

- Number of average daily weekday buses stopping within 1/4 mile of the site; plus
- Twice the number of daily rail or bus rapid transit trips stopping within 1/2 mile of the site; plus
- Twice the number of dedicated daily shuttle trips;
- Divided by 900, the point at which the maximum benefits are assumed. (This equates to a BART station on a single line, plus four bus lines at 15-minute headways.)

Developments that are larger than 0.5 miles across in any direction must be broken into smaller units for purposes of determining the transit service index. The average of all units would then be used.

The figure shown below provides some examples of how service frequencies translate into Transit Service Index scores (note these are additive, if a location has more than one component).

Example Transit Service Index Scores

Transit Service	Score	Assumptions
BART (single line)	0.33	150 trips per day (15-20 minute headways in each direction from 4 AM-12 AM)
15-minute bus	0.17	4 buses per hour
30-minute bus	0.06	2 buses per hour
Amtrak San Joaquin	0.03	6 trips per day in each direction
Dedicated commute shuttle	0.02	5 trips per commute period (single direction)

As well as existing service, planned and funded transit service should be included in the calculation. Purely demand responsive service should not be included. A maximum trip reduction of 15% is assumed.

To account for non-motorized access to transit, half the reduction is dependent on the pedestrian/bicycle friendliness score. This ensures that places with good pedestrian and bicycle access to transit are rewarded.

Trip reduction = t * 0.075+ t * ped/bike score * 0.075

Where: t = transit service index

Operational Bike and Pedestrian Mitigation

Figure 45 shows the bike and pedestrian mitigation screen. The user must enter information on the project's number of intersections per square mile, the percent of streets with sidewalks on one or both sides, and the percent of arterials/collectors with bike lanes.

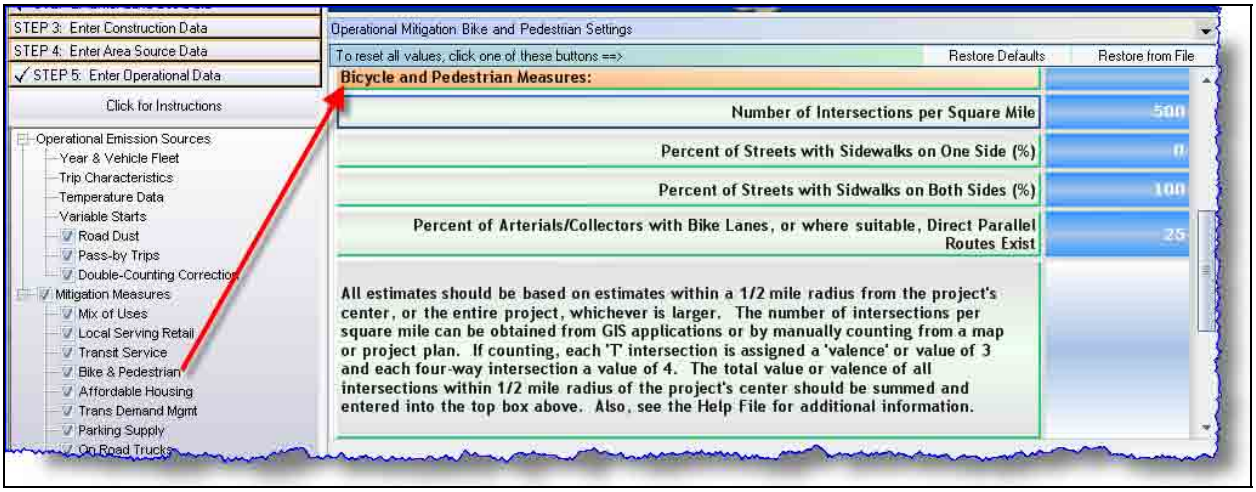

Figure 45. Bike and Pedestrian Mitigation

The pedestrian/bicycle factor is calculated as follows:

Ped/bike factor = (network density + sidewalk completeness + bike lane completeness) / 3

Where: Network density = intersections [sum of valences] per square mile / 1300 (or 1.0, whichever is less)

Note: In most GIS applications, intersections are counted based on the number of line segment terminations, or each "valence." Intersections have a valence of 3 or higher. A valence of 3 is a "T" intersection, 4 is a four-way intersection. Therefore, if intersections are counted manually on a map or project plan, care needs to be taken to distinguish between 3-, 4- and 5-way intersections, and factor them up accordingly. The 1,300 value roughly equates to a dense grid with four-way intersections every 300 feet. Intersections with dedicated routes for pedestrians and/or bicyclists should be included in this calculation.

Sidewalk completeness = % streets with sidewalks on both sides + 0.5 * % streets with sidewalk on one side

Bike lane completeness = % arterials and collectors with bicycle lanes, or where suitable, direct parallel routes exist

A maximum reduction of 9% is assumed. The trip reduction is calculated as:

Trip reduction = 9% * ped/bike factor

No reduction is allowed if the entire area within a half-mile walk of the project center consists of a single use. (Note that this applies to a half-mile walk, rather than straight-line distance, to account for barriers such as freeways.) However, the ped/bike factor can still be used to calculate pedestrian access to transit, as part of the transit mitigation measure.

Information on the number of intersections can be obtained from street plans or maps. Information on sidewalk completeness and bike lane completeness can be obtained from site observations or from

aerials such as those obtainable from http://terrraserver.microsoft.com or from Google's Google Earth software.

Operational Affordable Housing Mitigation

It is difficult if not impossible to account for the exact incomes of residents in URBEMIS, most obviously because the occupants are not known at the pre-development stage. However, the percentage of deed-restricted below-market-rate (BMR) housing does offer a way to incorporate this effect.

URBEMIS assumes a 4% reduction in vehicle trips for each deed-restricted BMR unit. Thus, the total reduction is as follows:

Trip reduction = % units that are BMR * 0.04

A development with 20% BMR units would thus gain a 0.8% reduction. A development with 100% BMR units would gain a 4% reduction.

Operational Transportation Demand Management

Figure 46 shows the first of three transit demand management screens: parking and transit passes. Figures 47 and 48 show the remaining two screens, telecommuting, and other transportation demand measures.

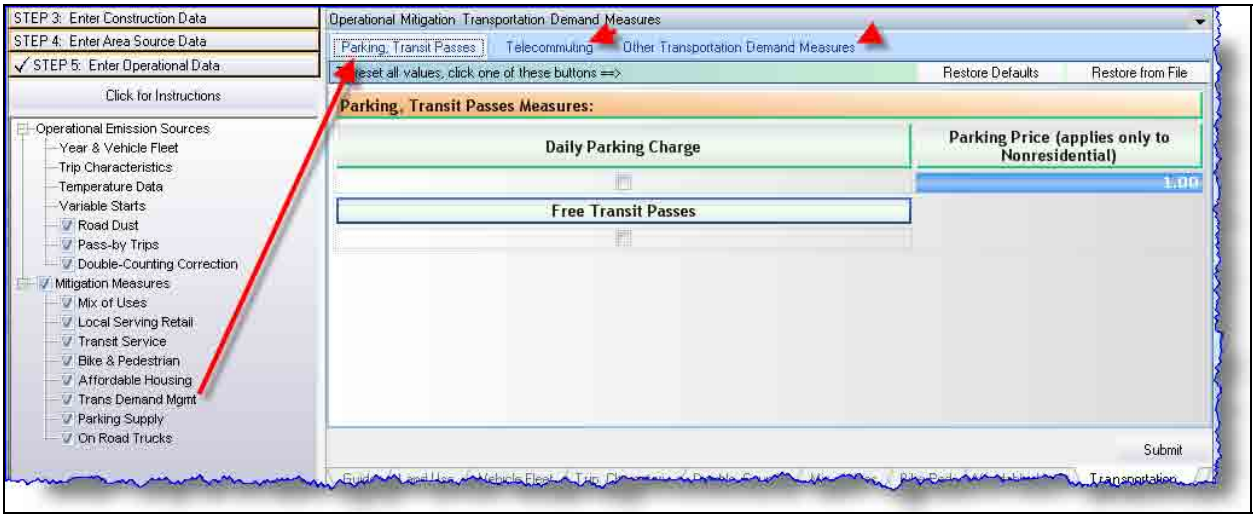

Figure 46. Transportation Demand Management

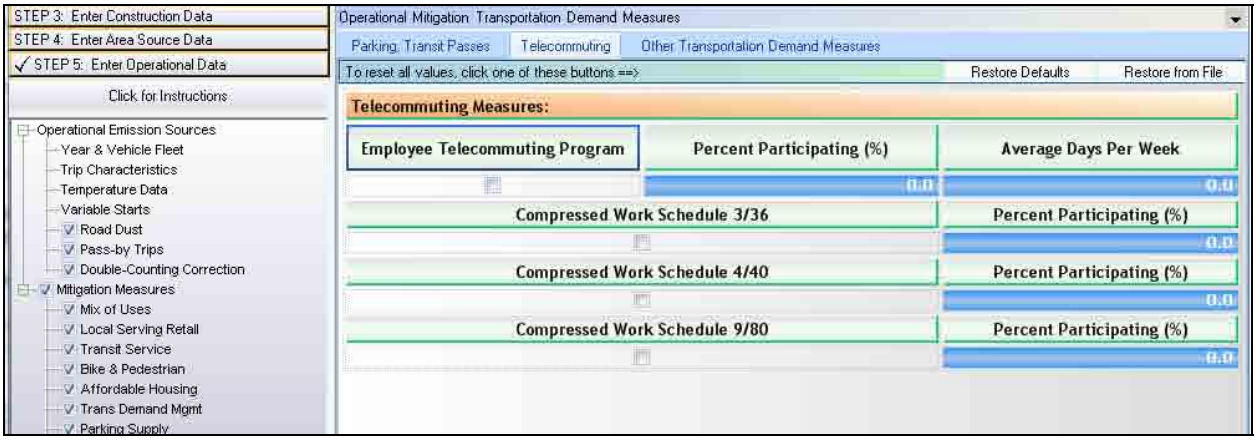

Figure 47. Transportation Demand Management – Telecommuting

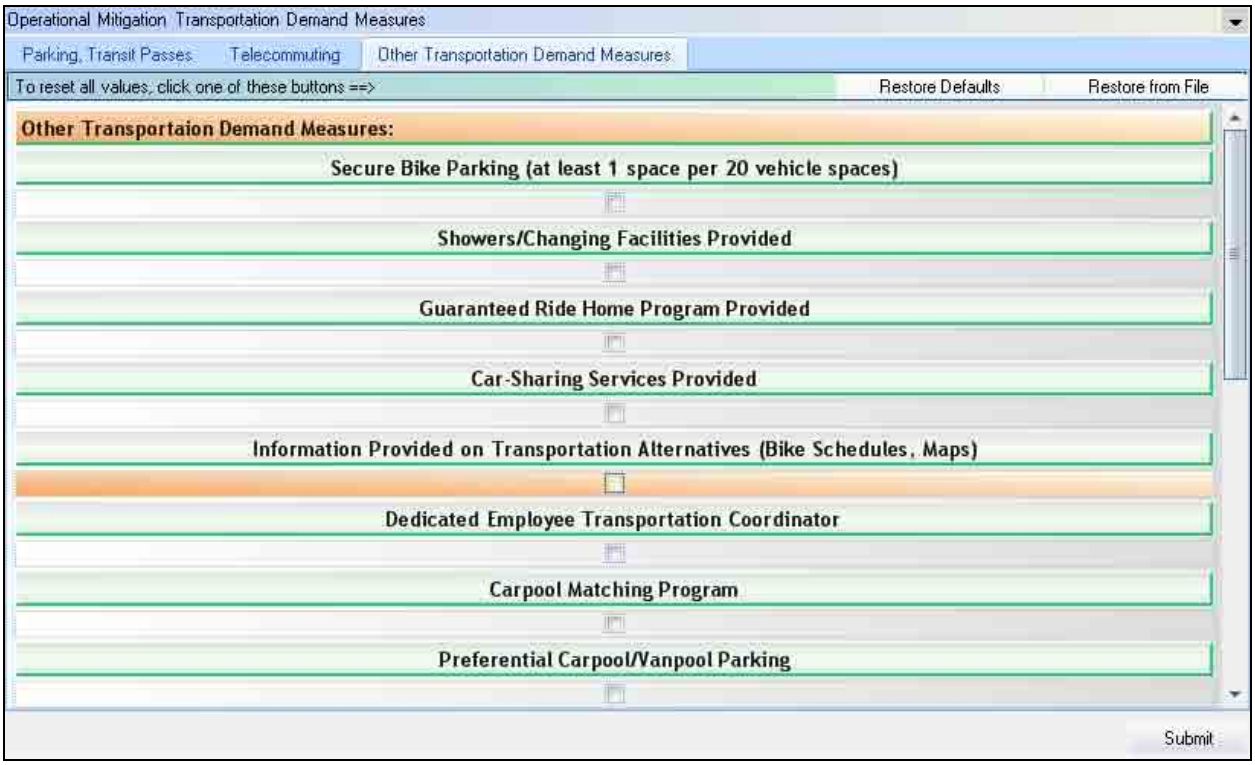

Figure 48. Transportation Demand Management – Other Transportation Demand Measures

Daily Parking Charge

URBEMIS assumes a maximum trip reduction of 25% for projects that commit to introducing parking pricing. The maximum reduction applies to prices of $6 per day or greater (in 2004 dollars).

The trip reduction will therefore be as follows:

Trip reduction = daily parking charge / 6 * 0.25

If the parking charge is more than $6, the 25% reduction is taken. If parking charges do not apply to all trips to a site (e.g. customers are exempt), the reduction is pro-rated by the percentage of trips that

the charges apply to. If little or no on-site parking is provided, the parking charges are applied to those of surrounding public facilities.

Free Transit Passes

Some California transit agencies, most notably VTA in Santa Clara County, have EcoPass or similar programs, whereby employers or property managers bulk-purchase transit passes for (free) distribution to their employees or tenants. Eco Pass programs have been shown to increase transit ridership by 50-79% and reduce vehicle trips by 19%. (Note that many of these new riders were making new trips, or ones previously made by walking or cycling.)

We therefore recommend that any project committing to providing free transit passes would receive an additional credit equivalent to 25% of the reduction granted for transit service. Thus, the credit is more valuable in places that have good transit service. This reduction only applies to the portion of trips generated by those granted the free transit passes (e.g. residents and/or employees, but excluding shoppers and other visitors).

Telecommuting

As with the reductions for other mitigation measures, there must be an enforceable commitment (e.g. development agreement) for telecommuting programs, which cover both the take-up rate (employees actually telecommuting or using compressed work schedules) as well as the provision of the option.

The percentage reduction is not additive (in contrast to most other trip reduction measures). For example, if 20% of employees telecommute, and other trip reduction measures are estimated to reduce vehicle trips from 1,000 to 800 per day, the 20% reduction is applied to the 800 trips, not the original 1,000.

Other TDMs

Other TDM program elements that do not include financial incentives tend to have a smaller impact on travel behavior. Trip and associated emission reductions for other TDMs selected within URBEMIS are based on the number of the following elements incorporated into the program.

- Secure bicycle parking (at least one space per 20 vehicle parking spaces)
- Showers/changing facilities
- Guaranteed Ride Home
- Car-sharing services
- Information on transportation alternatives, such as bus schedules and bike maps
- Dedicated employee transportation coordinator
- Carpool matching programs
- Preferential carpool/vanpool parking

The impact of a TDM program also depends on the travel alternatives available. A program will have more impact if the site is served by frequent transit, for example (although note that a TDM program can do much to promote carpooling even in other locations). For this reason, part of the TDM credit is used to adjust the credits granted for transit service and pedestrian/bicycle friendliness (see table below).

Recommended TDM Program Reductions

Level	Number of Elements	Trip Reduction
Major	At least 5 elements	2%, plus 10% of the credit for transit and pedestrian/bike friendliness
Minor	At least 3 elements	1%, plus 5% of the credit of transit and pedestrian/bike friendliness
No program	Less than 3	None

Operational Parking Supply Mitigation

The parking supply mitigation measure uses the Institute of Transportation Engineers Parking Generation, 3rd Edition handbook as the baseline. It applies only to non-residential land uses. The trip reduction is calculated as follows:

Trip reduction = 1- (Actual parking provision / (ITE Parking Generation rate * # units)

Since ITE parking generation rates use the same land use codes as the trip generation rates, URBEMIS calculates the ITE estimated values of parking demand. The user is only required to enter the actual parking provision for each land use.

The Parking Generation handbook covers most common land uses. For some land uses, however, no parking generation rates are available: in these cases, this particular mitigation measure may not be used. Those land uses without parking generation rates include:

- City Park
- Gas/Service Station

To avoid double counting with other trip reduction measures, the impacts of parking supply are assessed in conjunction with all other non-residential trip reduction measures as follows:

The total of all other non-residential trip reduction measures is used if this is greater than or equal to the trip reduction from parking supply measures. For example, if parking supply is reduced 10% from ITE levels, and transit, mixed use and pedestrian/bicycle trip reductions amount to 20%, the 20% figure is used.

If the total of all other non-residential trip reduction measures (r1) is less than the trip reduction from parking supply measures (r2), the total trip reduction is as follows:

r1 + 0.5 * (r2 - r1)

In effect, the parking supply reduction is only used if it is greater than the impact from other trip reduction measures, and the difference is discounted by 50%. For example, if parking supply is reduced 25% from ITE levels, and transit, mixed use and pedestrian/bicycle credits amount to 15%, the total reduction would be:

15 + 0.5 * (25-15) = 20%.

This reduction should only be granted if measures to control overspill are in place, such as Residential Permit Parking programs, time limits or meters.

Operational On-Road Truck Mitigation

For project applicants wishing to provide on-road mitigation for diesel trucks, the applicant has two choices.

The first choice requires that the user enter an estimate of the pounds per day and tons per year emission reductions associated with the project. This information will typically be provided as a result of consultation with the applicable air district. The district-approved emission reductions should be entered into the operational mitigation: on-road trucks screen.

The second choice requires that the user select a mitigation measure by diesel truck (or bus) fleet type category. This mitigation measure will only be applied to truck trips associated with non-residential land uses and only to the non-commute portion of those trips. Each mitigation measure has a specific emission reduction percentage applied to it. The user also has the option of entering their own mitigation and the associated emission reduction by pollutant class (ROG, NOx, CO, SO2, and PM10). The percentage reductions are only applied to the percentage of diesel vehicles within each truck class.

STEP 6 – View and Print Output

As mentioned earlier, to view and print output in Step 6, you do not need to proceed through each proceeding step. Instead, once you have entered one or more land uses, the Recalc button appears at the top of the screen (see Figure 49). This button, in the form of a dirty cloud, should be clicked to generate emission estimates. Once the Recalc button has been pressed, URBEMIS generates emission estimates that appear as part of Step 6 (see Figures 50 and 51).

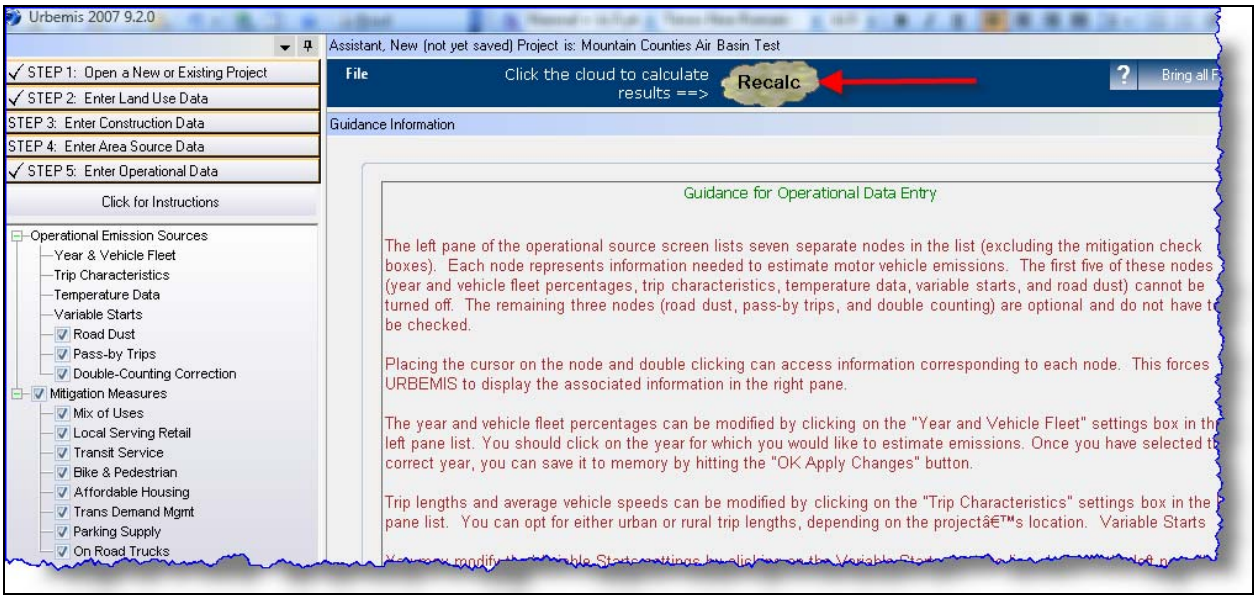

Figure 49. Recalc Button

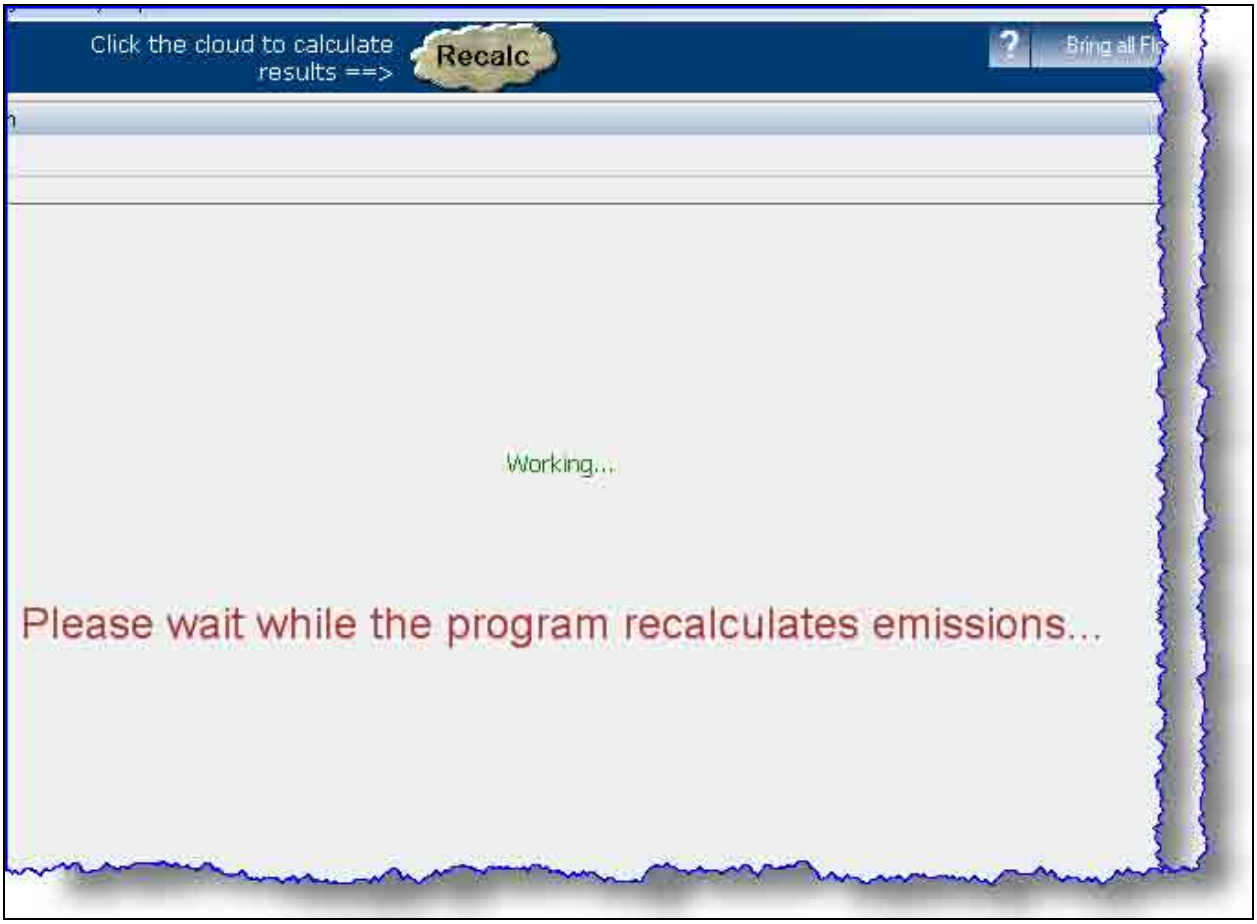

Figure 50. URBEMIS Recalculating After Recalc Pressed

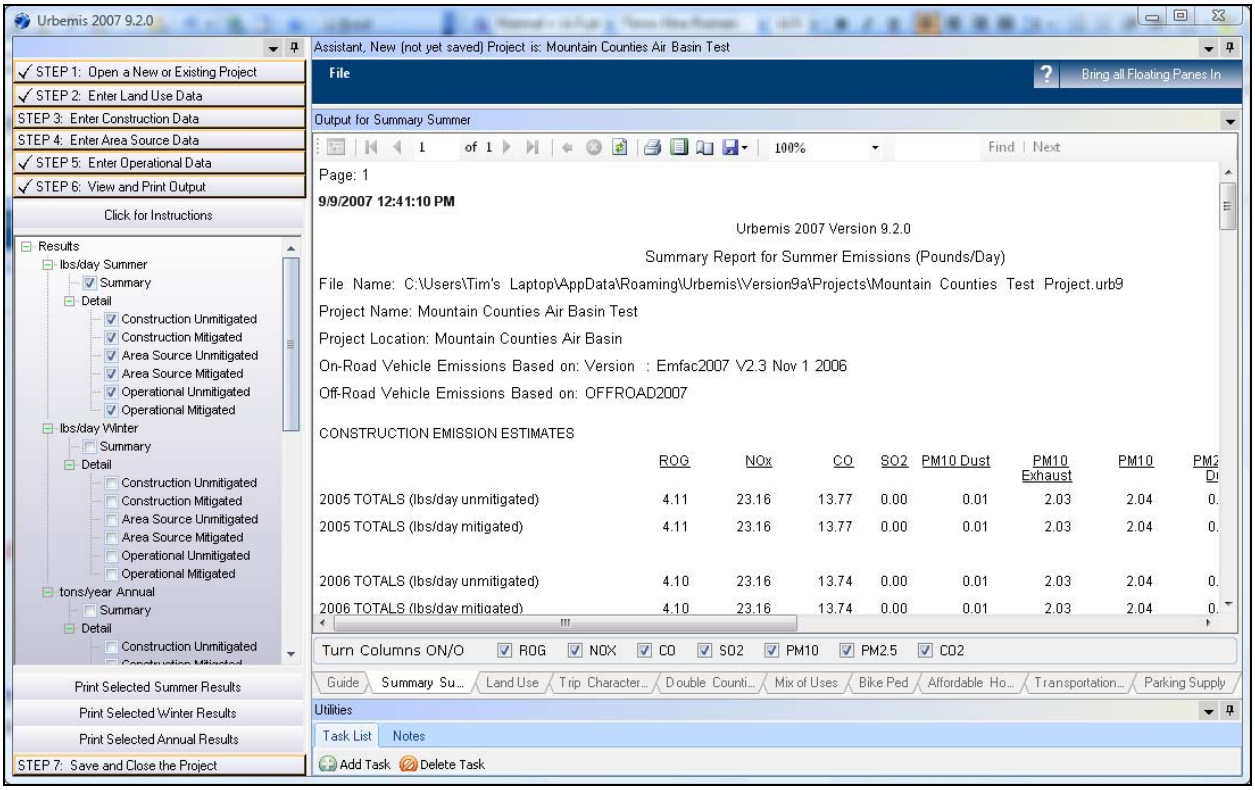

Figure 51. URBEMIS Recalc Results

As Figure 51 shows, when the Recalc button has been pressed, URBEMIS generates emission estimates and automatically shows the Summer summary results in the right hand pane. Double-clicking on any of the print results lines in the left hand pane forces URBEMIS to calculate emissions for that option. For example, if you click on the Construction Unmitigated line under lbs/day Winter, URBEMIS displays winter construction emissions in the right hand pane.

Figure 52 shows winter construction emissions. In this example, all pollutants except ROG, NO, and CO2 have been turned off. Pollutant can be turned off by unchecking them, as shown in the bottom of Figure 52 in the highlighted area. Also, the first time slice has been expanded by clicking the plus sign to the left of time slice. In addition, the asphalt phase in that time slice has been expanded to show the individual components of asphalt emissions (see red arrows in highlighted area). Time slices are described in detail in Appendix A.

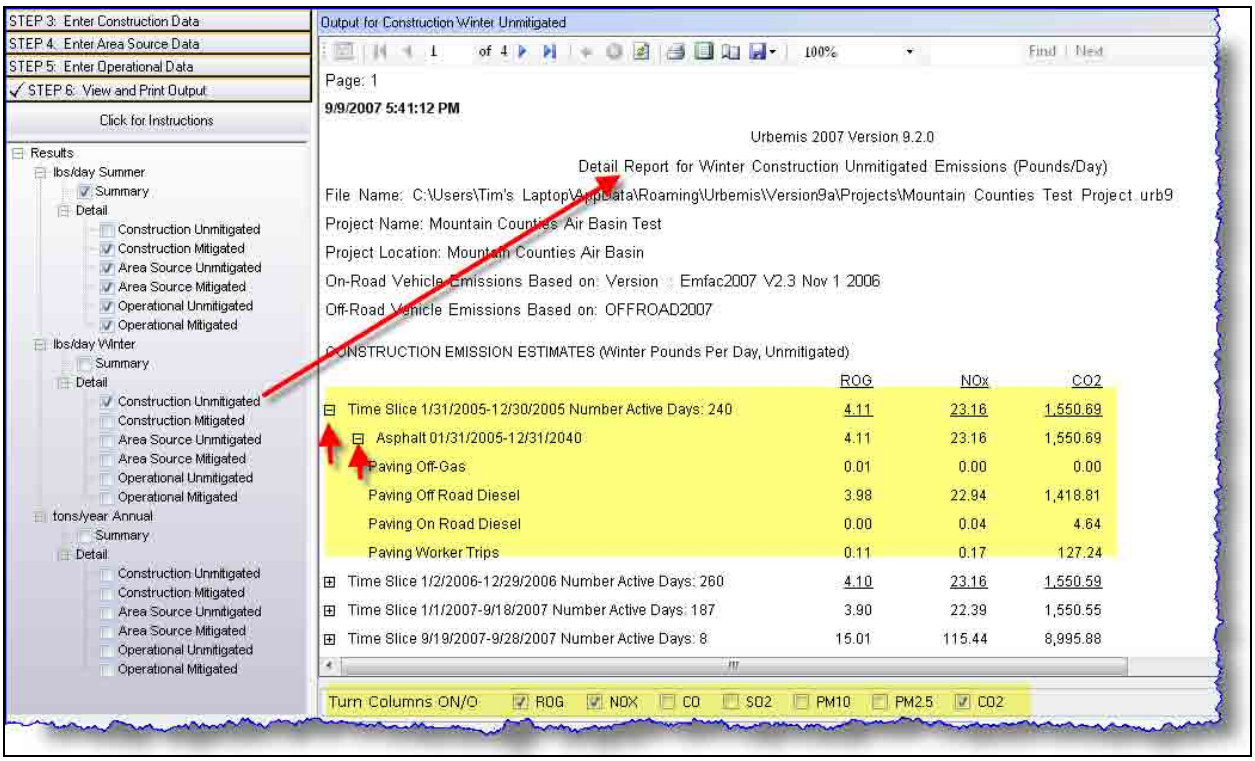

Figure 52. Winter Construction Emissions Results

URBEMIS also allows the user to send one or more of the items checked in the left hand pane to a single report that will be shown in the right hand pane. Three separate reports can be run: summer, winter, and annual. Figure 53 shows printing of the selected summer results. All of the summer emission categories have been checked (highlighted area). Then the Print Selected Summer Results button was clicked, which generated the report in the right hand pane.

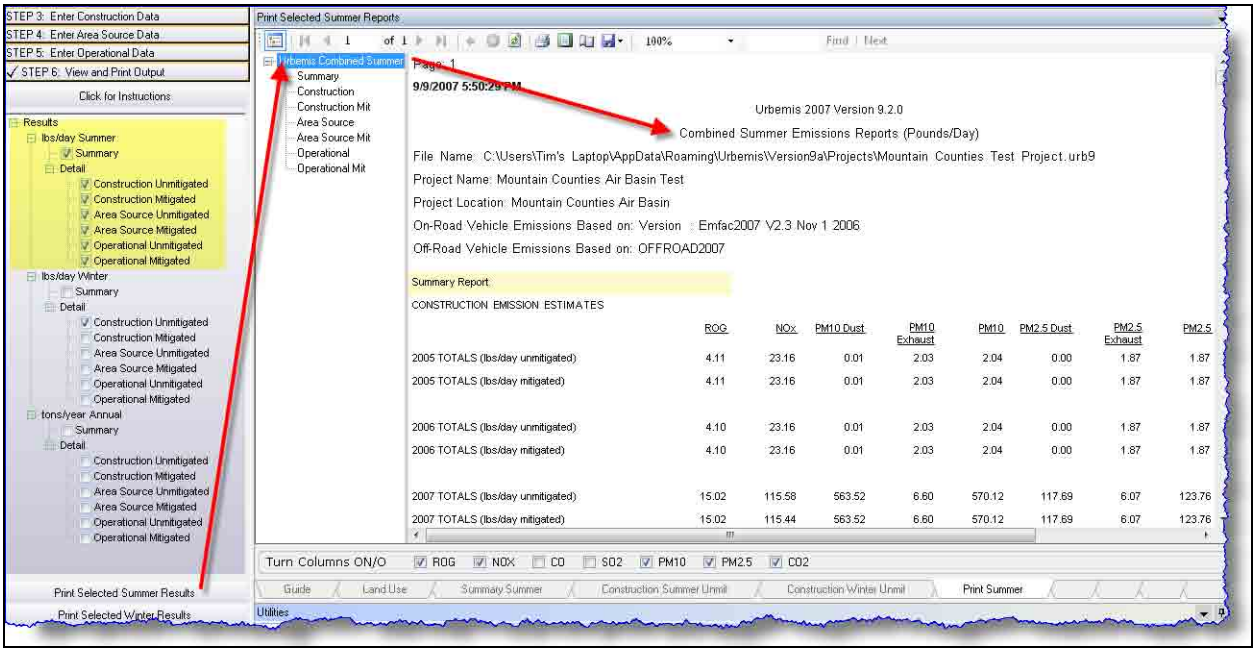

Figure 53. Combined Summer Emission Results

Printing Reports

Once a report has been generated and is displayed in the right hand pane, it can be sent to a printer, to an Excel file, or to a PDF file. Figure 54 illustrates how to print a report. First, click on the printer icon, shown circled. This will pop up the print window, which allows you to select a printer destination. Please note that you cannot print to a text file with URBEMIS2007. Once you have selected your printer destination and printer preferences (such as two sided printing), you must hit the apply button, then the print button.

Excel or PDF Reports

Although URBEMIS2007 does not allow a report to be sent to a text file, you can send it to either a PDF or Excel file by selecting the blue diskette icon, denoted with a arrow in the top line of Figure 54.

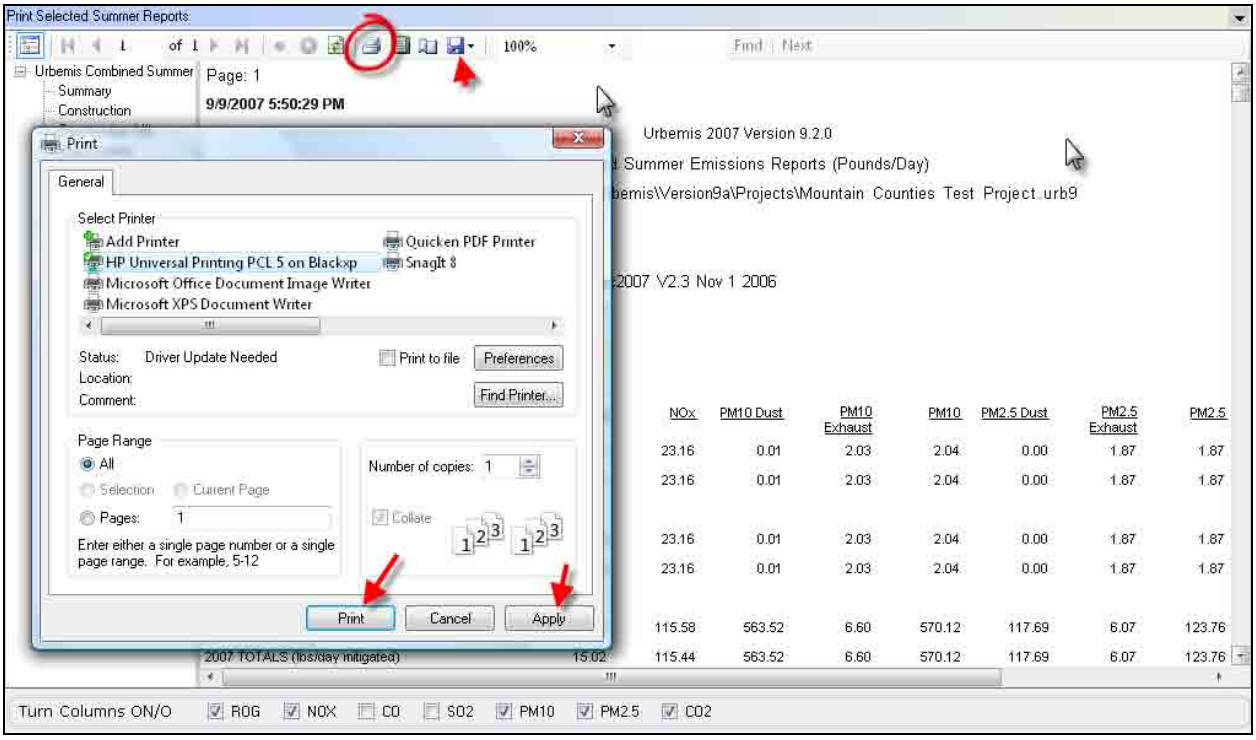

Figure 54. Printing a Report

STEP 7 – Save and Close the Project

Saving and/or closing a project is straightforward in URBEMIS2007. Clicking on Step 7 – Save and Close the Project results in the screen shown in Figure 55. A project can be saved with the current name, as a different project (with different name), or URBEMIS can be closed and exited. If you opt to close the project and you have turned on the "Save on Closing, Without a Prompt", then URBEMIS will save the current project with the current project name. Also, if you opt to just "X" out of the program by hitting the x in the top right hand corner of the program, the project will automatically be saved with the current project name.

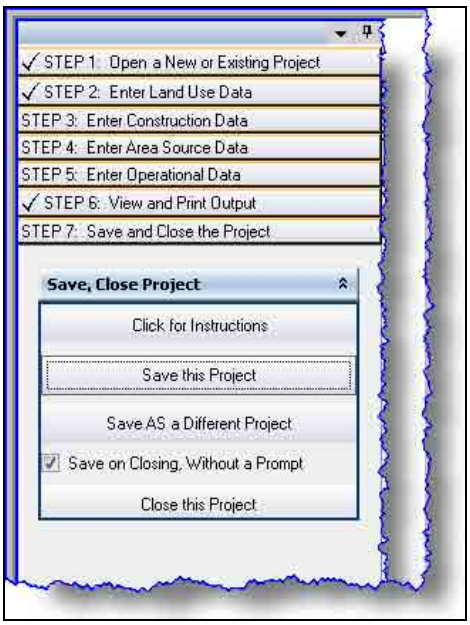

Figure 55. Saving and Closing a Project

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Appendix A. Construction Emissions

TABLES

Introduction

URBEMIS2007 allows users to generate estimates of construction emissions (inhalable particulate matter [PM10], fine particulate matter [PM2.5], carbon monoxide [CO], reactive organic gases [ROG], sulfur oxides [SOx], oxides of nitrogen [NOx]), and carbon dioxide [CO_2]. Emissions can be estimated as pounds per day or tons per years. The construction pounds per day estimates for summer versus winter do not differ.

URBEMIS includes seven phases:

1) Demolition
2) Fine Site Grading
3) Mass Site Grading
4) Trenching
5) Building Construction
6) Architectural Coating
7) Paving

Emissions are estimated separately by phase and by phase component. The user can opt to estimate emissions for any single phase or combination of phases. Each phase can be scheduled to overlap with other phases or to occur independently. Each independent grouping of emissions is called a time slice. When starting a new project, URBEMIS automatically assumes that specific phases would be used and assumes the start and end dates for each phase. Those phases can be deleted, and/or their start and end dates can be modified. Also, additional phases can be added.

Two or more phases of the same type can be added. For example, two demolition phases can be added, but each must have a unique set of start and end dates. As mentioned earlier, each phase has several components. Each of those components is assumed to generate emissions throughout the entire phase length. The seven phases and their associated components are identified in Table A-1.

Table A-1. URBEMIS Default Construction Phases, Phase Lengths, and Equipment Estimates

Phase	Off-Road Fugitive Dust	Off-Road Construction Exhaust	On-Road Vehicle Exhaust	Worker Trips	Vendor Trips	Off-Gassing
Demolition	X	X	X	X		
Mass Site Grading	X	X	X	X		
Fine Site Grading	X	X	X	X		
Trenching		X		X		
Asphalt		X	X	X		X
Building Construction		X	X	X	X	
Architectural Coatings				X		X

Table A-1 shows the phases and their individual components. There are six unique components that include:

- off-road fugitive dust,
- off-road construction equipment,
- on-road exhaust,
- worker trips,
- vendor trips and
- off-gassing.

Six of the seven phases include off-road construction emissions. Only architectural coatings do not include emissions from off-road construction equipment. All seven phases include emissions associated with worker trips.

Time Slices

A time slice represents a period of days when daily emissions are constant. A different time slice occurs whenever there is a change in a project's average daily emissions. This most typically happens when two phases overlap but can also occur when the same phase crosses over into a different year.

Table A-2 shows three separate time slices. The first time slice of nine active days results when trenching occurs without any other construction activities. The second time slice of six active days occurs when trenching and fine site-grading overlap. Emissions for this second time slice are the combination of fine grading and trenching. The third time slice of 14 days occurs when fine site grading occurs without any other construction activities.

Table A-2. Time Slice Example

Construction Unmitigated Detail Report:

CONSTRUCTION EMISSION ESTIMATES Summer Pounds Per Day, Unmitigated

	ROG	NOx	CO	SO2	PM10 Dust
Time Slice 11/19/2007-11/29/2007 Active Days: 9	1.52	15.78	4.65	0.00	0.00
Trenching 11/19/2007-12/08/2007	1.52	15.78	4.65	0.00	0.00
Time Slice 11/30/2007-12/7/2007 Active Days: 6	23.44	219.33	109.68	0.00	49,721.62
Fine Grading 11/30/2007-01/11/2008	21.92	203.55	105.03	0.00	49,721.62
Trenching 11/19/2007-12/08/2007	1.52	15.78	4.65	0.00	0.00
Time Slice 12/10/2007-12/27/2007 Active Days: 14	21.92	203.55	105.03	0.00	49,721.62
Fine Grading 11/30/2007-01/11/2008	21.92	203.55	105.03	0.00	49,721.62

Each phase within a time slice contains individual components that make up that phase. The procedure used to estimate emissions for each component of each phase is described below.

Demolition Emissions

Demolition Dust

If the user chooses to estimate construction emissions, the user will be prompted to select the types of construction emissions that they would like to estimate. If the user selects demolition emissions, then the user is prompted to enter the total volume of all buildings to be demolished and the maximum volume of all buildings to be demolished in a single day. URBEMIS2007 calculates the total days required to complete demolition activities.

The following equation is used to estimate daily PM10 generated by demolition:

PM10 (pounds/day) = (0.00042 pounds of PM10 / feet3) * (N * O * P) / Q.

Where: N = building width (feet)
O = building length (feet)
P = building height (feet)
Q = number of days required to demolish the building(s).

This equation is based on Table A9-9-H of the South Coast Air Quality Management District's (SCAQMD's) California Environmental Quality Act (CEQA) Air Quality Handbook (South Coast Air Quality Management District 1993).

URBEMIS2007 does not provide default information on building dimensions slated for demolition. The user must provide URBEMIS2007 with that information.

Demolition On-Road Diesel Exhaust

URBEMIS estimates exhaust emissions from the construction equipment used in demolition, including the on-road vehicles used to haul demolished materials to the nearest landfill. Based on information provided by the user regarding the building volume to be demolished, URBEMIS generates default information regarding demolition hauling. The user can override that information.

For example, URBEMIS assumes a hauling round trip of 20 miles and a truck capacity of 20 cubic yards unless overridden by the user. Similarly, URBEMIS generates a default estimate of the number of round trips required per day using the following equation:

Round trips/day = Total yd^3 to be demolished/days demolition * 0.25 * trip/20 yd^3

The user must enter total cubic yards to be demolished. The number of days required for demolition is calculated using the demolition phase length entered by the user. The number

of round trips per day and the vehicle miles traveled per day are based on the maximum daily volume of material to be demolished (reduced by 75% to account for air space), the truck capacity, and the miles per round trip. Maximum daily emissions are obtained from EMFAC2007 and are estimated by multiplying VMT by the grams per mile emissions for heavy-heavy duty trucks traveling at the commercial customer average speed found in the Operational Trip Characteristics screen.

Demolition – Off Road Diesel Exhaust

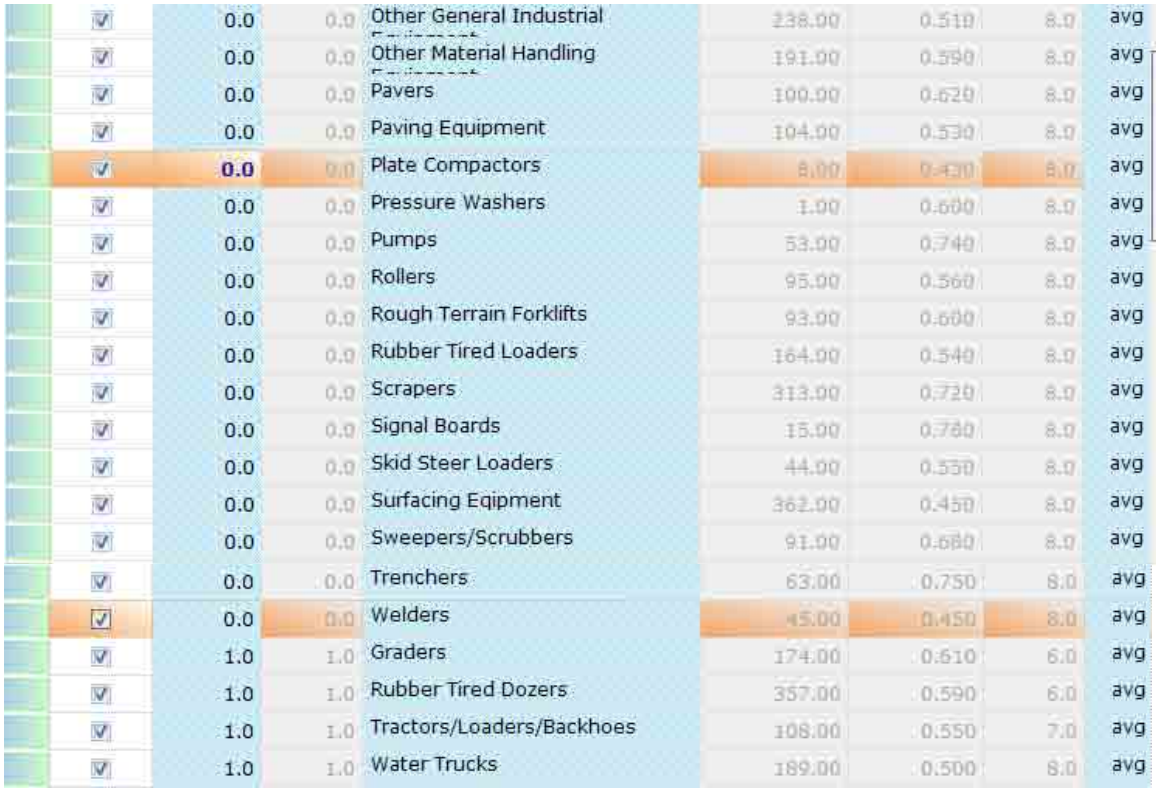
In addition to truck hauling, demolition emissions are generated by the operation of other construction equipment, such as concrete saws, cranes, and bulldozers. The URBEMIS user is presented with a list of construction equipment, as shown in Table A-3. Default values for these types of equipment are generated by URBEMIS using information found in the equipment selection spreadsheet shown in Appendix H. The user can and should override the default values if project specific information is available.

Table A-3. Construction Equipment Used for Demolition

To reset all values, click one of these buttons ==> Restore Defaults Restore from File

User-Detailed Estimate of Site Grading: Diesel-Powered Vehicles:

Reset When Acreage Changes	Default #	Amt Model Uses (Click to Sort)	Equipment Type	Horsepower	Load Factor*	Hrs/Day	Year
☑	0.0	0.0	Aerial Lifts	60.00	0.460	8.0	avg
☑	0.0	0.0	Air Compressors	105.00	0.480	8.0	avg
☑	0.0	0.0	Bore/Drill Rigs	291.00	0.750	8.0	avg
☑	0.0	0.0	Cement and Mortar Mixers	10.00	0.560	8.0	avg
☑	0.0	0.0	Concrete/Industrial Saws	10.00	0.730	8.0	avg
☑	0.0	0.0	Cranes	399.00	0.430	8.0	avg
☑	0.0	0.0	Crawler Tractors	147.00	0.640	8.0	avg
☑	0.0	0.0	Crushing/Processing Equip	142.00	0.780	8.0	avg
☑	0.0	0.0	Dumpers/Tenders	16.00	0.380	8.0	avg
☑	0.0	0.0	Excavators	168.00	0.570	8.0	avg
☑	0.0	0.0	Forklifts	145.00	0.300	8.0	avg
☑	0.0	0.0	Generator Sets	549.00	0.740	8.0	avg
☑	0.0	0.0	Off Highway Tractors	267.00	0.650	8.0	avg
☑	0.0	0.0	Off Highway Trucks	479.00	0.570	8.0	avg
☑	0.0	0.0	Other Equipment	190.00	0.620	8.0	avg



☑	0.0	0.0	Other General Industrial Equipment	238.00	0.510	8.0	avg
☑	0.0	0.0	Other Material Handling Equipment	191.00	0.590	8.0	avg
☑	0.0	0.0	Pavers	100.00	0.620	8.0	avg
☑	0.0	0.0	Paving Equipment	104.00	0.530	8.0	avg
☑	0.0	0.0	Plate Compactors	8.00	0.430	8.0	avg
☑	0.0	0.0	Pressure Washers	1.00	0.600	8.0	avg
☑	0.0	0.0	Pumps	53.00	0.740	8.0	avg
☑	0.0	0.0	Rollers	95.00	0.560	8.0	avg
☑	0.0	0.0	Rough Terrain Forklifts	93.00	0.600	8.0	avg
☑	0.0	0.0	Rubber Tired Loaders	164.00	0.540	8.0	avg
☑	0.0	0.0	Scrapers	313.00	0.720	8.0	avg
☑	0.0	0.0	Signal Boards	15.00	0.780	8.0	avg
☑	0.0	0.0	Skid Steer Loaders	44.00	0.550	8.0	avg
☑	0.0	0.0	Surfacing Eqipment	362.00	0.450	8.0	avg
☑	0.0	0.0	Sweepers/Scrubbers	91.00	0.680	8.0	avg
☑	0.0	0.0	Trenchers	63.00	0.750	8.0	avg
☑	0.0	0.0	Welders	46.00	0.450	8.0	avg
☑	1.0	1.0	Graders	174.00	0.610	6.0	avg
☑	1.0	1.0	Rubber Tired Dozers	357.00	0.590	6.0	avg
☑	1.0	1.0	Tractors/Loaders/Backhoes	108.00	0.550	7.0	avg
☑	1.0	1.0	Water Trucks	189.00	0.500	8.0	avg

For each piece of equipment selected, URBEMIS generates an emission estimate. The emission equation used by URBEMIS for each piece of equipment is as follows:

Equipment Emissions (pounds/day) = # of pieces of equipment * grams per brake horsepower-hour * equipment horsepower * hours/day * load factor

Where: ***grams per brake-horsepower hour is based on the construction year and represents a statewide average for each piece of equipment. Grams per brake horsepower per hour emissions are based on the California Air Resources Board's OFFROAD2007 model (California Air Resources Board, 2006). The pounds per day emission factors are found in Appendix I.***

Demolition Worker Commute Trips

Demolition worker commute trips assume that the number of workers equals 125% of the total pieces of construction equipment selected. The emission estimates assume a construction worker commute fleet mix of 50% light duty autos and 50% light duty trucks. The worker commute travel distance, speed, and temperature are based on the worker commute speed information included in the Operational Trip Characteristics screen.

Fine Site Grading Emissions

Fine Site Grading Fugitive Dust

The fugitive dust emission estimates within URBEMIS2007 use the methodology developed for SCAQMD by the Midwest Research Institute. That four-tiered methodology allows for more refined PM10 estimates based on the level of detail known for the construction project. URBEMIS estimates emissions using the level of detail known for a project, as shown in Table A-4.

Table A-4. Fugitive Dust Estimation Approach

Basis for Emission Factor	Recommended PM10 Construction Emission Factor
Default Level: Only area and duration known	Apply 0.22 tons/acre-month (average conditions)[1] Apply 0.42 ton/acre-month (worst-case conditions)
Low Level of Detail: Area and amount of earthmoving known	Apply 0.11 ton/acre-month for each month of construction activity Plus 0.059 ton/1,000 yd^3 of onsite cut/fill Plus 0.22 ton/1,000 yd^3 of offsite cut/fill These values assume that one scrapper can move 70,000 yd^3 of earth in one month and 35,000 yd^3 of material can be moved by truck in one month. If the on-/offsite fraction is not known, assume 100% onsite.
Medium Level of Detail: More detailed information available on duration of earthmoving and other material movement	Apply 0.13 lb/acre-work hr Plus 49 lb/scraper-hr for onsite haulage Plus 94 lb/hr for offsite haulage
High Level of Detail: Detailed information known on acres, hours or construction work, number of truck units or VMT, and truck travel distances.	Apply 0.13 lb/acre-work hr Plus 0.21 lb/ton-mile for onsite haulage Plus 0.62 lb/ton-mile for offsite haulage

A key component of the site grading dust emissions is the maximum acreage that will be disturbed on a daily basis. URBEMIS2007 estimates default acreage graded per day based on the land use sizes specified by the user. URBEMIS assumes the following number of residential units per acre:

- single-family residential units – 3
- low rise apartments and condos/townhouse units – 16
- mid rise apartments – 38
- high rise apartments – 62
- high rise condos – 64

[1] The Midwest Research Institute has derived a value of 0.11 tons/acre/month, which converts to 10 pounds per day, assuming 22 workdays per month. The California Air Resources Board review has reviewed this factor and concluded that it represents PM10 emissions with watering. Consequently, ARB concludes that 20 pounds per acre day is more appropriate for unmitigated fugitive dust conditions (http://www.arb.ca.gov/ei/areasrc/fullpdf/full7-7.pdf)

- mobile home parks – 6
- retirement community – 5
- congregate care (assisted living) – 16.

For commercial uses, URBEMIS2007 assumes that the total project acreage equals twice the size of each building's square footage. For example, URBEMIS2007 assumes that a 100,000-square-foot industrial park would require 200,000 square feet (4.6 acres) of land disturbance. As a default estimate, URBEMIS2007 assumes that 25% of total land acreage slated to be disturbed will actually be disturbed on the worst-case day.

URBEMIS provides the user with a form similar to that shown in Table A-5. The user has the option of modifying URBEMIS' estimates of the maximum acreage to be disturbed per day.

In the example shown in Table A-5, a project that includes 1200 units of single-family residential, 600 units of multi-family residential, and 100,000 square feet of commercial development will result in a total estimated acreage of 399.15 acres. Assuming that 25% of that total acreage is graded on the worse case day, the maximum acreage disturbed equals 99.84 acres. The user has the option of overriding the maximum daily disturbed. This acreage is important, because URBEMIS bases its estimates of both fugitive dust and construction equipment on the maximum daily acreage disturbed value.

Table A-5. Acreage Estimates for Grading

Land Use	User-Entered Values	Estimated Acreage	Estimated Maximum Acreage Disturbed per Day
Residential—Single Family	1200 units	370	92.5
Residential—Multi-family	600 units	24.55	6.14
Commercial	100,000 sq. ft.	4.6	1.2
Totals	Not applicable	399.15	99.84

Fine Site Grading Equipment Off-Road Diesel Exhaust

Site grading emissions are generated by the operation of off-road construction equipment, such as scrapers, bulldozers, and loaders. URBEMIS presents the user with a list of construction equipment, as shown previously in Table A-3. The user has the option of either selecting the number of each type of equipment that will be used or having URBEMIS generate estimates of construction use.

To estimate off-road construction equipment-related construction exhaust emissions, URBEMIS uses an approach based on ARB's OFFROAD2007 emissions model (California Air Resources Board, 2006). That model uses a methodology in which emission factors for construction equipment are based on an average fleet mix that accounts for the turnover rate and average emissions for specific types of construction equipment. URBEMIS generates default values and allows the user to override the defaults for equipment horsepower and load factors.

For each piece of equipment selected, URBEMIS generates an emission estimate. The emission equation that will be used by URBEMIS for each piece of equipment is as follows:

Equipment Emissions (pounds/day) = # of pieces of equipment * grams per brake horsepower-hour * equipment horsepower * hours/day * load factor

Where: ***grams per brake-horsepower hour is based on the construction year and vehicle type. Grams per brake horsepower per hour emissions are from the California Air Resources Board's (ARB's) OFFROAD2007 model (California Air Resources Board 2007). Appendix I lists the grams per horsepower hours for each year and each type of equipment.***

Fine Site Grading On-Road Diesel Exhaust

One additional enhancement to URBEMIS' treatment of grading equipment exhaust involves specifying whether the project will require soil to be imported to or exported from the site. If soil is to be imported or exported, the user must to enter the volume of soil. URBEMIS will use that information to calculate the number of on-road vehicle trucks trips and vehicle miles traveled per day (as shown in Table A-6). The user has the option of overriding the default assumptions programmed into URBEMIS.

Table A-6. Construction Grading Soil-Hauling Assumptions

Soil Import/Export Hauling	Parameter
Amount of soil to import (cubic yards)	0
Amount of soil to export (cubic yards)	0
Total soil imported + exported (cubic yards)	0
Haul-truck capacity (cubic yards)	20
Number of days to conduct hauling	Based on phase length
Round trips/day	Calculated
Round-trip distance (miles)	Calculated
Vehicle miles traveled/day (calculated)	Calculated

Once vehicle miles traveled per day is known, URBEMIS calculates haul-trip emissions using the following formula:

On-Road Haul Truck Emissions (pounds/day) = vehicle miles traveled/day * grams pollutant/mile (from EMFAC2007) * pound/454 grams

Fine Site Grading Worker Commute Trips

For site grading, the number of workers is estimated as 125% of the total number of construction equipment (vehicles and machines) selected. The emission estimates assume a

construction worker commute fleet mix of 50% light duty autos and 50% light duty trucks. The worker commute travel distance, speed, and temperature are based on the trip characteristics information for home to work trips found under the trip characteristics node of the operational emissions module.

Mass Site Grading

Mass Site Grading works in a manner similar to fine site grading. Mass site grading typically differs from fine site grading in that it applied to larger grading acreages. Each of the descriptions for the mass site grading components below is similar to those for fine site grading.

Mass Site Grading Fugitive Dust

The fugitive dust emission screen allows the user to select from one of four levels. The fugitive dust emission levels are based on a report prepared for the South Coast Air Quality Management District (Midwest Research Institute, 1996). The mass site grading fugitive dust calculations used by URBEMIS are identical to those used in the fine site grading fugitive dust calculations as described above and shown in Table A-4.

Mass Site Grading On-Road Diesel Exhaust

The amount of on-road emissions associated with soil hauling site grading is based on the amount of material that must be imported to and/or exported from site, the distance that trucks must travel, and haul truck capacity. URBEMIS includes default values for truck capacity (cubic yards) and round trip mileage, both of which can be modified by the user. The number of round trips per day and the vehicle miles traveled per day (VMT) are based on the maximum daily volume of material to be demolished, the truck capacity, and the miles per round trip. Maximum daily emissions are obtained from EMFAC2007 and are estimated by multiplying VMT by the grams per mile emissions for heavy heavy-duty trucks traveling at the commercial-based customer average speed found in the trip characteristics screen.

Mass Site Grading Off-Road Diesel Exhaust

Mass site grading off-road exhaust emissions are calculated based on equipment that the user must select from 36 equipment types. The user can enter the number of pieces of equipment to be used, and can edit default values for horsepower, load factor, and hours per day. The load factor is the percentage of time that the equipment is in use during the typical construction day. Based on the information entered by the user, emissions are estimated by multiplying by the grams per horsepower hour for the respective equipment. The equation for each equipment type is as follows:

Emissions (pounds per day) = Pieces of Equipment * hp * load factor * hours per day * grams/hp-hr * pounds / 454 grams

The grams per horsepower hour values, listed in Appendix I, vary by construction year. The construction emission rates found in the default file are based on the California Air Resources Board's OFFROAD2007 emissions model (California Air Resources Board, 2006).

Mass Site Grading Worker Commute Trips

Worker trips are estimated separately by each of the three construction phases. For site grading, the number of workers is estimated as 125% of the total number of construction equipment (vehicles and machines) selected. The emission estimates assume a construction-worker commute fleet mix of 50% light duty autos and 50% light duty trucks. The worker commute travel distance, speed, and temperature are based on the trip characteristics information for home to work trips found under the trip characteristics node of the operational emissions module.

Trenching

Trenching Off-Road Diesel

Off-road trenching exhaust emissions are calculated based on 36 equipment types that can be selected. The user can enter the number of pieces of equipment to be used, and can edit default values for horsepower, load factor, and hours per day. The load factor is the percentage of time that the equipment is in use during the typical construction day. Based on the information entered by the user, emissions are estimated by multiplying by the grams per horsepower hour for the respective equipment. The equation for each equipment type is as follows:

Emissions (pounds per day) = Pieces of Equipment * hp * load factor * hours per day * grams/hp-hr * pounds / 454 grams

The grams per horsepower hour values vary by construction year (see Appendix I) and are based on the California Air Resources Board's OFFROAD2007 model (California Air Resources Board, 2006).

Trenching Commute Trips

Construction trenching worker trip emissions are estimated by assuming that the number of workers equals 125% of the total number of construction equipment selected. The emission estimates assume a construction worker commute mix of 50% light duty autos and 50% light duty trucks. The worker commute travel distance and speed are based on the trip characteristics for home to work trips found under the trip characteristics node of the operational emissions module.

Building Construction

Building Construction Off-Road Diesel Exhaust

Building construction emissions consist of emissions from construction equipment. Table A-3 lists equipment that can be selected for building construction. The number and type of equipment can vary substantially, depending on the type of building and its location. The amount of concrete, masonry, wood, and metal products used in building construction varies widely, and can have a large impact on the type of construction equipment needed for a construction project.

Building Construction Worker Commute Trips

Emissions from construction worker vehicle commute trips are estimated by multiplying total daily employee vehicle miles traveled (VMT) by an emission rate (grams per mile). URBEMIS2007 estimates construction-related employee trip generation as follows. Each land use type selected as part of the project is grouped into one of four general land use categories: multifamily, single-family, commercial/retail, and office/industrial. Then, for each category, the number of trips is estimated using the following equations:

Multifamily Trips = 0.36 trips/unit * number of units
Single-Family Trips = 0.72 trips/unit * number of units
Commercial or Retail Trips = 0.32 trips/1,000 feet^2 * number of 1,000 feet^2
Office or Industrial Trips = 0.42 trips/1,000 feet^2 * number of 1,000 feet^2

These trip generation rates are based on information contained in the Sacramento Metropolitan Air Quality Management District's Air Quality Thresholds of Significance Handbook (Sacramento Metropolitan Air Quality Management District (1994).

URBEMIS2007 totals trips from the four general land use categories and multiplies by the average trip length to obtain daily VMT. Trip length is found under the trip characteristics tab of the operational emissions module of URBEMIS. URBEMIS2007 uses the construction year identified by the user to select EMFAC emission rates that will be multiplied by VMT/day.

Building Construction Vendor Trips

Vendor trips represent the on-road trips needed to bring building supplies to the worksite. URBEMIS estimates construction related vendor trips using the following trip generation rates:

Multifamily Construction Vendor Trips = 0.11 trips/unit * number of units
Single-Family Construction Vendor Trips = 0.11 trips/unit * number of units
Commercial or Retail Construction Worker Trips = 0.05 trips/1,000 feet^2 * number of 1,000 feet^2
Industrial Construction Worker Trips = 0.38 trips/1,000 feet^2 * number of 1,000 feet^2

These trip generation rates are based on information provided by the Sacramento Metropolitan Air Quality Management District. URBEMIS2007 totals trips from the four general land use categories and multiplies by the average trip length to obtain daily VMT. Trip length is based on the urban trip length found for commercial-based customer trips in the Operational Trip Characteristics screen. URBEMIS2007 uses the construction year in which the trips would occur and the trip speed for home to work trips to identify the appropriate EMFAC emission rates to use. Vendor trips are assumed to consist of 100% heavy heavy-duty trucks.

Vendor trip rates can be overridden if the actual number of total vendor trips is known.

Architectural Coatings

Off-Gas Emissions

URBEMIS72007 estimates ROG emissions resulting from the evaporation of solvents contained in paints, varnishes, primers, and other surface coatings. Separate procedures are used to estimate evaporative emissions from application of residential and nonresidential architectural coatings. The following emission factors are used for residential coating emissions:

Emission estimates are divided into four categories:

- residential interior,
- residential exterior,
- non-residential interior, and
- non-residential exterior.

For each of these four categories, each air district has specified an average VOC content. These VOC content limits may change as district rules become more stringent. The user cannot alter these VOC content limits as each air district has specified them. The statewide average is assumed to be 250 grams VOC per liter of paint. For each category of paint, VOC content is converted to an emission factor in pounds VOC per square feet of paint applied by assuming a coating coverage of 180 square feet per gallon.

The following equation is estimated for each of the four categories to obtain an emission factor in pounds of VOC (or ROG) per square foot:

ROG (pounds / square feet) = (grams VOC per liter paint / 454 grams per pound * 3.785 liters per gallon / 180 square feet per gallon).

Then, the square feet to be painted is estimated for each of the four categories as follows:

Residential

Square feet interior square footage to be coated = ((Number of single-family units * square feet per unit) + (Number of multi-family units * square feet per unit)) * 2.7)) * 0.75

Square feet exterior square footage to be coated = ((Number of single-family units * square feet per unit) + (Number of multi-family units * square feet per unit)) * 2.7)) * 0.25

The value 2.7 in each equation is used to convert total building square footage to surface area to be coated. As these equations indicate, 75% of total residential coatings assumed to be interior and 25% exterior.

URBEMIS assumes 1800 square feet per single-family residential unit and 850 square feet per multi-family residential unit.

Non-Residential

Non residential interior square footage to be coated = ((Total building square footage * 2.0) * 0.75

Non residential exterior square footage to be coated = ((Total building square footage * 2.0) * 0.25

The value 2.0 in each equation is used to convert non-residential building square footage to surface area to be coated. As these equations indicated, 75% of total non-residential coatings assumed to be interior and 25% exterior.

Total Emissions

To obtain total emissions, emissions for each of the four categories must be calculated by multiplying the emission factor per square feet times the total square footage for that category. Once emissions have been estimated for each of the four categories, the total emissions must be summed up over the four categories, providing total emissions. That value is then divided by the total number of days that coatings are applied to obtain an average daily emission estimate.

Architectural Painting Worker Commute Trips

Worker commute trips associated with architectural painting are assumed to equal 20 percent of worker commute trips for building construction. Consequently, architectural coating emissions from worker commute trips will equal approximately 20 percent of building construction worker commute trip emissions.

Asphalt Paving

Asphalt Paving Off-Gas Emissions

URBEMIS2007 estimates ROG emissions associated with asphalt paving. The emissions are estimated based on the procedure identified in the SMAQMD manual (Sacramento Metropolitan Air Quality Management District 1994). ROG emissions are estimated using the following formula:

ROG (pounds per day) = (2.62 pounds ROG / acre) * (total acres paved /paving days)

Asphalt Paving Off-Road Diesel Exhaust

Unless overridden by the user, URBEMIS assumes that 25% of the total project area will be paved. URBEMIS generates an estimate of the number and types of equipment based on the acreage to be paved. See Appendix H for the types of equipment assumed to be used by URBEMIS for paving.

The user can override URBEMIS' estimates of the equipment to be used, and can edit default values for horsepower, load factor, and hours per day. The equation for each equipment type is as follows:

Emissions (pounds per day) = Pieces of Equipment * hp * load factor * hours per day * grams/hp-hr * pounds / 454 grams

The grams per horsepower hour values vary by construction year. The construction emission rates are based on the California Air Resources Board's OFFROAD2007 model (see Appendix I).

Asphalt Paving On-Road Diesel Exhaust

URBEMIS estimates vehicle miles traveled per day for asphalt hauling using information entered by the user regarding acreage to be paved per day. Using that information, URBEMIS estimates the total volume per day of asphalt required by multiplying acreage by an assumed asphalt thickness of 3 inches (Asphalt Institute, 2002). The asphalt volume is then used to estimate the number of truck trips, assuming a truck volume capacity of 20 cubic yards. Vehicle miles are estimated based on the number of truck trips, and haul emissions are estimated using the following equation:

On-Road Asphalt Haul Truck Emissions (pounds/day) = vehicle miles traveled/day * grams pollutant/mile * pound/454 grams

Asphalt Worker Trips

Asphalt worker trips are estimated separately. For asphalt paving, the number of workers is estimated as 125% of the total number of construction equipment (vehicles and machines) selected. The emission estimates assume a construction worker commute fleet mix of 50% light duty autos and 50% light duty trucks. The worker commute travel distance and speed are based on the trip characteristics information for home to work trips found under the trip characteristics node of the operational emissions module.

References

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Sacramento Metropolitan Air Quality Management District. 1994. Air quality thresholds of significance, first edition. Sacramento, CA.

South Coast Air Quality Management District. 1993. CEQA air quality handbook. Diamond Bar, CA.

Appendix B. Area Source Emissions

TABLES

Area Source Emissions

URBEMIS2007 has been enhanced so that both novice and experienced users can generate accurate estimates of area source emissions. Novice users can generate estimates using default assumptions programmed into URBEMIS2007. Users experienced in estimating area source emissions can modify the area source assumptions to suit their particular project.

URBEMIS2007 allows the user to estimate area source emissions from:

- fuel combustion emissions from space and water heating, including wood stoves, fireplaces, and natural gas fired stoves;
- fuel combustion emissions from landscape maintenance equipment;
- consumer product ROG emissions; and
- architectural coatings.

Natural Gas Combustion

URBEMIS2007 can be used to estimate fuel combustion emissions from water and space heating using the approach described in Tables A9-12, A9-12-A, and A9-12-B in the South Coast Air Quality Management District CEQA handbook (South Coast Air Quality Management District 1993) and emission factors developed by the U.S. Environmental Protection Agency (U.S. EPA 1995). With one exception, all emission estimates assume natural gas is used as the primary source of water and space heating. The one exception is wood used for fireplaces and wood stoves. The equation used to estimate CO, ROG, NOx, and PM10 emissions from natural gas combustion is as follows for each land use type:

Emissions = H * ({[F*G]/30}/1,000,000) * P

Where: H = emission factor for each criteria pollutant in pounds of pollutant per million cubic feet of natural gas consumed:
CO: 40 pounds/million cubic feet
ROG: 7.26 pounds/Million cubic feet
NOx: 94.0 pounds/Million cubic feet [residential]
NOx 100.0 pounds/Million cubic feet [nonresidential]
PM10: 0.18 pounds/Million cubic feet
PM2.5: 0.18 pounds/Million cubic feet
CO2: 120,000 pounds/Million cubic feet

F = units per land use type:
residential (number of units)
industrial (customers)
hotel/retail/office (square feet)

G = Natural gas usage rates:
Residential: Single-Family: 6,665.0 feet^3 / unit / month
Multifamily: 4,011.5 feet^3 / unit / month

Nonresidential: industrial: 241,611 feet^3 / customer / month
hotel/motel: 4.8 feet^3 / square feet / month
retail/shopping: 2.9 feet^3 / square feet / month
office: 2.0 feet^3 / square feet / month

P = percentage using natural gas
Residential 60%
Nonresidential 100%

The percentage of residential and nonresidential using natural gas may differ based on default values specified by individual air districts.

Hearth Fuel Combustion

The hearth fuel combustion category consists of wood stoves, fireplaces, and natural gas fired stoves. The user is required to enter the percentage of each associated with a project. If the San Joaquin Valley Air District is selected, the percentage of each hearth type is limited based on the District's wood stove rule.

Wood Combustion –Wood Stoves

Wood stove emissions can be estimated using the following equation:

Wood Stove Emissions (pounds per day) = ((A * C) + (B * D) + (E * F) + (J * K)) * (G) * (H * I)

Where:
A = EPA-certified noncatalytic stove emission rate (grams pollutant per ton of kilogram wood burned)
B = EPA-certified catalytic stove emission rate (grams pollutant per kilogram of wood burned)
C = Percent of all stoves assumed to be noncatalytic
D = Percent of all stoves assumed to be catalytic
E = Conventional wood stove emission rate (grams pollutant per kilogram wood)
F = Percent of all stoves assumed to be conventional
G = Cords of wood burned per year per residential unit
H = Number of residential units
I = Percentage of residential units with wood stoves
J = Pellet stove emission rate (grams pollutant per kilogram wood burned)
K = Percent of all stoves assumed to be pellet

URBEMIS2007 assumes the following defaults for wood stove emissions:

A = 9.8 grams PM10 / kilogram, 70.4 grams CO / kilogram, 7.5 grams ROG / kilogram, 1.4 grams NOx / kilogram
B = 10.2 grams PM10 / kilogram, 52.2 grams CO / kilogram, 7.8 grams ROG / kilogram, 1.0 grams NOx / kilogram
C = 50% (entered as 0.50)
D = 50% (entered as 0.50)
E = 15.3 grams PM10 / kilogram, 115.4 grams CO / kilogram, 21.9 grams ROG / kilogram, 1.4 grams NOx / kilogram
F = 0.0%
G = 1.48 cords per year per residential unit
H = based on land uses specified by the user
I = 35% (entered as 0.35)
J = 2.1 grams PM10 / kilogram, 19.7 grams CO / kilogram, 0.01 grams ROG / kilogram, 6.9 grams NOx / kilogram
K = 0.0%

The emission factors shown above are based on EPA's AP-42 document (U.S. Environmental Protection Agency 1995). The emission factor assumes an even split between noncatalytic and catalytic stoves. The default assumption assumes that no conventional nor pellet stoves will be included, although the equation will allow the user to include conventional and pellet stoves in the emission calculation. Annual emissions assume a specific amount of wood would be burned per stove per residential unit during the heating season. That amount of wood varies by air district.

Wood Combustion –Fireplaces

Fireplace emissions are estimated using the following equation:

Fireplace Emissions (pounds per day) = (J * K * L * M)

Where: J = Fireplace emission rate (pounds of pollutant per residential unit per ton of wood burned)
K = Cords of wood burned per day year residential unit
L = Number of residential units
M = Percentage of residential units with wood stoves

URBEMIS2007 will assume the following defaults for fireplace emissions:

J = 34.6 pounds of PM10 / ton, 252.6 pounds of CO / ton, 229.0 pounds of ROG / ton, 2.6 pounds of NOx / ton
K = 1.48 cords burned per year per residential unit
L = residential units are based on the residential land uses specified by the user
M = 10% (entered as 0.10)

These emission rates are based on information published by EPA (U.S. Environmental Protection Agency 1995). As with wood stove emissions, the user can modify each of the variables used to estimate fireplace emissions. Annual emissions are estimated based on annual wood combustion.

Natural Gas Fired Stoves

URBEMIS uses AP-42 emission factors to estimate emissions from natural gas combustion in natural gas fireplaces/stoves. The emission equation assumes that the average stove is 30,000 Btus for single family, 20,000 Btus for multi-family, that there are 1,020 Btus per standard cubic foot of natural gas, that the stove is used for an average of two hours per day during the winter months, and 100 days per year (200 hours per year). The values for single and multi-family Btus per stove can vary by air district.

Landscape Maintenance

Landscape maintenance equipment generates emissions from fuel combustion, from evaporation of unburned fuel, and from fugitive dust generated by equipment such as leaf blowers. Emissions include NOx, ROG, CO, SO2, PM10, PM2.5, and CO2. The emission factors used to estimate equipment emissions include exhaust and evaporation. Emission factors have not yet been developed for the fugitive dust generated by certain types of equipment generate.

Equipment in the landscape category includes lawn mowers, roto tillers, shredders/grinders, blowers, trimmers, chain saws, and hedge trimmers used in residential and commercial applications. Engines in this category are 25 horsepower or less. This category also includes air compressors, generators, and pumps used primarily in commercial applications.

The California Air Resources Board has enacted regulations to limit emissions from landscape maintenance equipment. Beginning in 1994 these regulations imposed emission limits on all landscape maintenance equipment sold. Those regulations became more stringent for equipment sold in 1999 and later. Consequently, the emissions from this source category are similar to automobile emissions in that the turnover in the equipment fleet plays an important part in how quickly emission reductions are achieved.

URBEMIS2007 estimates emissions from this source category based on the year in which the user is attempting to estimate emissions. The California Air Resources Board's OFFROAD2007 model was used to generate estimates of landscape maintenance equipment emissions in 2000 and 2010. Separate modeling runs were made for residential and non-residential equipment use. Residential emissions were limited to single-family residential units. The commercial equation is based on emissions per business unit and includes multifamily residential land uses.

The emission factors used by URBEMIS2007 are shown in Tables B-1 and B-2.

Table B-1. Landscape Maintenance Emission Factors (pounds per residential unit per day)

Year	ROG	CO	NOx	SO2	PM	PM10	PM2.5	CO2
2000	0.011192	0.062226	0.000468	0.000003	0.000171	0.000171	0.000169	0.071478
2001	0.010879	0.060467	0.000471	0.000003	0.000166	0.000166	0.000164	0.071497
2002	0.010567	0.058709	0.000475	0.000003	0.000160	0.000160	0.000159	0.071517
2003	0.010255	0.056950	0.000478	0.000003	0.000155	0.000155	0.000153	0.071537
2004	0.009942	0.055192	0.000482	0.000003	0.000150	0.000150	0.000148	0.071557
2005	0.009630	0.053433	0.000485	0.000003	0.000144	0.000144	0.000143	0.071577
2006	0.009317	0.051675	0.000489	0.000003	0.000139	0.000139	0.000138	0.071597
2007	0.009005	0.049916	0.000492	0.000003	0.000134	0.000134	0.000132	0.071617
2008	0.008693	0.048158	0.000496	0.000002	0.000129	0.000129	0.000127	0.071637
2009	0.008380	0.046399	0.000499	0.000002	0.000123	0.000123	0.000122	0.071657
2010	0.008068	0.044640	0.000503	0.000002	0.000118	0.000118	0.000117	0.071677

The residential emission factors shown for 2000 are based on total California single-family landscape maintenance emissions divided by total California single-family housing units in 2000. Similarly, the commercial emission factors for 2000 are based on total California non-farm business emissions divided by the California's total 2000 business units. For the commercial equations, URBEMIS2007 bases the number of business units on the number of non single-family housing land uses specified by the user.

Table B-2. Landscape Maintenance Emission Factors (pounds per business unit/day)

Year	ROG	CO	NOx	SO2	PM	PM10	PM2.5	CO2
2000	0.199471	2.127123	0.019558	0.000120	0.005154	0.005154	0.005103	2.776671
2001	0.191818	2.068940	0.019670	0.000117	0.005200	0.005200	0.005148	2.779879
2002	0.184166	2.010757	0.019782	0.000113	0.005245	0.005245	0.005192	2.783087
2003	0.176513	1.952574	0.019895	0.000110	0.005290	0.005290	0.005237	2.786295
2004	0.168861	1.894391	0.020007	0.000107	0.005335	0.005335	0.005282	2.789504
2005	0.161208	1.836208	0.020119	0.000103	0.005381	0.005381	0.005327	2.792712
2006	0.153556	1.778025	0.020231	0.000100	0.005426	0.005426	0.005371	2.795920
2007	0.145903	1.719842	0.020344	0.000097	0.005471	0.005471	0.005416	2.799128
2008	0.138250	1.661659	0.020456	0.000093	0.005516	0.005516	0.005461	2.802336
2009	0.130598	1.603476	0.020568	0.000090	0.005561	0.005561	0.005506	2.805544
2010	0.122945	1.545293	0.020681	0.000087	0.005607	0.005607	0.005551	2.808752

The 2010 emission rates were estimated using the OFFROAD2007 model, with separate emission estimates for the residential and commercial categories.

For emission factors between 2001 through 2009, URBEMIS2007 interpolates emission factors by assuming a uniform decrease in the emission rate each year between 2000 and 2010. In 2010 and succeeding years, the 2010 emission rates are used.

Average annual emissions assume that daily emissions would occur only during the summer period of 180 days. The end user can modify the length of the summer period.

Consumer Product Emissions

Consumer product emissions are generated by a wide range of product categories, including air fresheners, automotive products, household cleaners, and personal care products. Emissions associated with these products primarily depend on the increased population associated with residential development. Consequently, URBEMIS2007 can be used to estimate consumer product emissions when the user has selected one or more residential land uses. Emissions are based on the following equation:

ROG (pounds/day) = 0.0171 pounds of ROG per person * Number of residential units * 2.861 persons per unit

The ROG emission factor is based on the total estimated ROG emissions from consumer products divided by the total California population (California Air Resources Board 2006; California Department of Finance 1994).

URBEMIS2007 will base the number of residential units on information provided by the user on residential land uses. The user can modify each of the variables in the ROG emissions equation.

Annual emissions are estimated by multiplying pounds of ROG emitted per day by 365 days per year.

Architectural Coatings

Architectural coatings emissions associated with area sources is estimated using the same set of equations as construction related architectural coatings (described in Appendix A), with one exception. In the area source architectural coatings screens, the user can enter the percentage of total building square footage to be repainted each year. The default is set to 10% for both residential and nonresidential land uses.

Area Source Mitigation Measures

The area source mitigation measures allow three different types of mitigation measures to be specified. They include energy efficiency (primarily space heating), landscape maintenance measures, and architectural coatings measures. With one exception, URBEMIS does not currently have mitigation measures for hearth fuel combustion or for consumer products. The exception is that for projects in the San Joaquin Valley, the user can select hearth fuel combustion mitigation measures.

Energy Efficiency Mitigation Measures

URBEMIS includes three mitigation measures for natural gas combustion. Each measure is based on building energy efficiency relative to Title 24, California's energy efficiency regulation for residential and non-residential buildings. The user can turn on the appropriate measure and enter the percentage increase in energy efficiency above Title 24. Emission

reductions are assumed to be proportional to the increase in building energy efficiency beyond Title 24. For example, if the user enters a mitigation measure showing an increase in residential energy efficiency of 10 % beyond Title 24, URBEMIS calculates a 10% reduction in emissions generated by residential energy consumption. Title 24 requires that compliance (with Title 24) be demonstrated before a building permit can be issued. This requirement applies to any heated building in California. Consequently, the percentage increase in energy efficiency beyond Title 24 should be based on the required compliance documentation.

Landscape Maintenance Mitigation Measures

URBEMIS includes two mitigation measures for landscape maintenance equipment. The first measure applies to residences, the second measure applies to commercial and industrial landscape equipment. For each of these measures, the user can specify the percentage of landscape equipment that would be electrically powered.

Architectural Coatings Mitigation Measures

For architectural coatings, URBEMIS allows the user to specify low VOC coatings percentages. The percentages reflect the reduction in VOC emissions as compared to existing coatings rules.

Hearth Fuel Combustion Mitigation Measures

Hearth mitigation measures only apply when a project has been selected for the San Joaquin Valley or one of the eight counties within the Valley. URBEMIS automatically selects the highest emitting percentage of wood stove, wood fireplaces, and natural gas fireplaces allowed by Rule 4901. Under the hearth fuel mitigation option, the user can select different percentages as long as they are allowed by the rule.

Appendix B References

California Air Resources Board. 2006. Offroad2007 Model. http://www.arb.ca.gov/msei/offroad/offroad.htm.

California Department of Finance. 1994. California statistical abstract. Sacramento, CA.

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U.S. Environmental Protection Agency. 1995. AIR CHIEF CD-ROM Version 4.0. Research Triangle Park, North Carolina.

Appendix C. Operational (Motor Vehicle) Emissions

Exhaust Emission Factors

URBEMIS2007 estimates vehicle exhaust emissions using several pieces of input entered by the user. That information is found within the URBEMIS input screens of the operational emissions module. The operational emissions module input screens include project year, vehicle fleet percentages, winter and summer temperature, trip characteristics, variable start information, and the percentage of travel on paved versus unpaved roads.

Once the user has entered the appropriate information into the operational emissions input screens and selects the emissions output, URBEMIS2007 calls the appropriate summertime and wintertime EMFAC2002 files based on the analysis year selected by the user. URBEMIS then goes to the appropriate locations within those files based on the average vehicle speeds and temperature. For each pollutant, URBEMIS obtains information from several locations within the EMFAC input file. For certain pollutants, URBEMIS generates pounds per mile emission estimates by multiplying the grams per mile values for each technology class within EMFAC (fleet mix vehicle type and technology class [non-catalyst, catalyst, diesel] by the percentage supplied by the user in the fleet mix screen. This results in a fleet average grams per mile value, which is then converted to pounds per day.

A similar approach is used to estimate trip emissions for certain pollutants. Separate tables in EMFAC2007 contain grams per trip emissions based on the length of time since the vehicle engine was turned off. URBEMIS uses the variable starts table, which shows the percentage of vehicles in several time classes (minutes since the vehicle engine was turned off) and for the six trip modes. URBEMIS uses the information in the variable starts table and the grams per trip values within EMFAC2002 to estimate weighted grams per trip values. The weighted grams per trip value is then multiplied by the number of trips calculated from the land use information to estimate total emissions per trip per pollutant.

Once the EMFAC2007 file has been read, URBEMIS2007 calculates criteria pollutant emissions for:

- running exhaust (grams per mile of ROG, CO, NOx, PM10),
- tire wear particulates (grams per mile, PM10),
- brake wear particulates (grams per mile, PM10),
- variable starts (grams per trip, ROG, CO, NOx),
- hot soaks (grams per trip, ROG),
- diurnals (grams per hour, ROG) ,
- resting losses (grams per hour, ROG), and
- evaporative running losses (grams per mile, ROG).

The estimated operational criteria pollutant emissions are summed in the emissions output page.

Entrained Road Dust Emissions

Entrained road dust emissions are generated by vehicles traveling on both paved and unpaved roads. URBEMIS2007 provides end users with a default percentage of VMT for paved versus unpaved roads. End users are asked whether they want to modify those percentages. Default percentages assume that 100 percent of VMT occurs on paved roads and 0 percent on unpaved roads.

Paved Roads

For paved roads, URBEMIS2007 uses the following equation:

PAVED = k (sL/2)0.65 (W/3)1.5

Where: PAVED = particulate emission factor (lb/VMT);
k = particle size multiplier for particle size range and units of interest;
sL = road surface silt loading (grams per square meter);
W = average weight of the vehicles traveling the road (megagrams).

The following default assumptions are used by URBEMIS2007:

k = 0.016 (for the 10 microns and under particle size cutoff)
sL = 0.1 (allowable range of 0.02 – 400 grams per square meter)
W = 2.2 (allowable range of 1.8-38 megagrams)

This equation is based on the paved roads emission factor found in AP-42 (U.S. Environmental Protection Agency 2003a). URBEMIS2007 allows the user to modify silt loading (sL) and average vehicle fleet weight (W). The equation was developed using silt loads ranging from 0.02 – 400 grams per square meter and mean average fleet vehicle weight ranging from 1.8-39 megagrams (2.0-42 tons). The equation was also developed using vehicles traveling at speeds ranging from 10-55 miles per hour, although speed is not used in the equation. A particle size multiplier (k) of 0.016 lbs PM10 per VMT is used by URBEMIS2007. This particle size multiplier cannot be changed by the user.

URBEMIS2007 uses the emission factor equation to calculate emissions per vehicle mile traveled. That value is then multiplied by the total vehicle miles traveled per day and by the percentage of vehicles traveling on paved roads.

Unpaved Roads

The unpaved road equation is as follows:

UNPAVED = (k (s/12)1.0 (S/30)0.5)/ ((M/0.5)0.2)

Where: ***UNPAVED = the fleet average unpaved road dust emissions (pounds/VMT)***
k = the fraction of particles less than or equal to the particle size cutoff of 10 microns
s = surface material silt content (%)
S = the average vehicle speed (mph, input by the user)
M = surface moisture content (%)

This equation is based on EPA's emission factor equation for unpaved roads (Environmental Protection Agency 2003b). The following default assumptions are used by URBEMIS2007:

k = 1.8 (for the 10 microns and under particle size cutoff)
s = 4.3 % (allowable range [1.8 - 25.2 %])
S = 40 miles per hour (allowable range [10 - 43 mph])
M = 0.5 % (allowable range 0.03 – 13 %)

Of these default assumptions, all except k can be modified by the user. Once calculated, the emission rate in pounds per vehicle mile traveled is multiplied by the total VMT for the project and then by the percentage of travel on unpaved roads.

Double Counting of Mixed-Use Projects

URBEMIS2007 contains a procedure that reduces double counting of internal trips in a mixed-use project or community plan area. The procedure only applies when at least one residential and one non-residential land use are specified by the URBEMIS2007 user and the user selects the double-counting correction algorithm.

Because trip generation rates account for both trip productions and attractions, adding the gross trip generation for two land uses in a project double counts the trips between them. The procedure described below is designed to count the internal trips only once.

URBEMIS2007 displays a screen showing the number of residential and nonresidential trips. Then the user is prompted to enter the gross internal trip number, which limits the number of internal trips estimated by URBEMIS2007. The gross internal trip limit reported by the program is based on a comparison of residential trips versus nonresidential trips; the smaller of the two is the limiting value.

As presented above, the proposed double-counting correction is applied only to trips between residential and nonresidential land uses. A small amount of double counting may remain for trips between different residential land uses and/or between non-residential uses.

Pass-By Trips

According to the Institute of Transportation Engineers' (ITE) document Trip Generation, 5th Edition (ITE 1991), vehicle trips associated with a trip generator can be divided into three categories:

- *Primary Trips* are trips made for the specific purpose of visiting the generator. The stop at that generator is the primary reason for the trip. For example, a home to shopping to home combination of trips is a primary trip set.
- *Pass-By Trips* are trips made as intermediate stops on the way from an origin to a primary trip destination. Pass-by trips are attracted from traffic passing the site on an adjacent street that contains direct access to the generator. These trips do not require a diversion from another roadway.
- *Diverted Linked Trips* are trips attracted from the traffic volume on roadways within the vicinity of the generator but which require a diversions from that roadway to another roadway to gain access to the site. These roadways could include streets or freeways adjacent to the generator, but without access to the generator.

In calculating the emissions associated with a proposed project, the distinction between these three categories of trips is important. Pass-by and diverted linked trips associated with a proposed project generate substantially lower levels of net emissions than a primary trip.

For air quality impact analysis, the major difference between a pass-by trip and a diverted linked trip is the added vehicle miles traveled associated with the diverted linked trip. Pass-by trips, by definition, do not require a diversion from the original trip route. Conversely, diverted linked trips do involve diversion from the original trip route. A major difficulty in estimating the additional travel associated with a diverted linked trip is that the amount of additional travel is sensitive to local site factors. In particular, the distance from the project site to major arterials or freeways strongly influences the amount of additional travel.

Pass-by and diverted linked trips are most important for retail commercial land uses. As an example of how important these trips are, the February 1995 update to ITE's Trip Generation, 5th Edition, notes that an average of 87% of trips made to gasoline stations in the p.m. peak hour are pass-by and diverted linked trips. Not accounting for pass-by and diverted linked trips substantially overstates the amount of indirect source emissions associated with a proposed gasoline station.

URBEMIS2007 has an option that allows the user to account for pass-by and diverted linked trips. The primary data sources for appropriate pass-by and diverted linked trip adjustments are ITE's Trip Generation, 5th Edition, and the February 1995 update (ITE 1991; ITE 1995). The San Diego Association of Governments (SANDAG) has also produced a document that includes estimates of pass-by and diverted linked trips for specific land uses (SANDAG 1990). These three documents present pass-by and diverted linked trip values as a percentage of total trips for several land use categories. One distinction between the ITE versus SANDAG estimates are that for pass-by trips, SANDAG assumes that any diversion requiring 1 additional mile or less is a pass-by trip. In contrast, ITE assumes that any diversion off of the intended travel route is a diverted linked trip.

Table 3 shows estimates of pass-by and diverted linked trip percentages using data contained in ITE's Trip Generation, 5th Edition, the February 1995 update to the 5th edition, and the SANDAG report (ITE 1991, ITE 1995; SANDAG 1990). The ITE and SANDAG trip generation data primarily describe peak-hour versus average daily conditions. Jones & Stokes Associates has developed average daily percentages of primary trips, diverted-linked trips and pass-by trips associated with each land use for the URBEMIS2007 model.

When the pass-by trip correction algorithm is selected by the user, URBEMIS2007 adjusts trip end emissions (i.e., cold start, hot start, and hot soak) associated with pass-by and diverted linked trips.

For traffic impact analyses, pass-by trips are generally eliminated from consideration; they have no net effect on traffic volumes. Similarly, diverted linked trips may have a minimal effect on traffic volumes. Conversely, pass-by and diverted linked trips may have a substantial effect on air quality, and this effect may increase in the future as trip end emissions become a larger portion of total vehicle trip emissions. A pass-by or diverted linked trip associated with a shopping center is a good example of how these trips can affect air quality. Such a trip would have little or no net effect on traffic volumes. However, if the shopper stays at the shopping center for 1 hour, a substantial portion of a hot soak episode would occur and, for a catalytic converter-equipped vehicle, the trip leaving the shopping center would begin in a cold-start mode.

URBEMIS2007 estimates trip end emissions associated with pass-by and diverted linked trips and additional travel associated with diverted linked trips. Jones & Stokes Associates has modified URBEMIS2007 so that it makes separate emission estimates for primary trips, pass-by trips, and diverted-linked trips.

For primary trips, the emission estimating procedure do not change except that the trip generation rate for each land use would be multiplied by that land use's primary trip percentage shown in Table 3.

For pass-by trips, the trip generation rate for each land use are multiplied by that land use's pass-by trip percentage shown in Table 3. In addition, the trip length for each trip type (e.g., home-work, home-shop) is set to 0.1 miles. The change in trip length reflects the pass-by trip definition in that these trips result in virtually no additional travel. However, emissions associated with pass-by trips still occur. Consequently, the hot and cold start percentages are increased by 10 percent to reflect additional emissions from these operating modes.

For diverted-linked trips, the trip generation rate for each land use is multiplied by that land use's diverted-linked trip percentage shown in Table 3. The trip length is also adjusted downward to equal 25 percent of the primary trip length for each trip type. By doing so, it accounts for the additional travel associated with diverted-linked trips. Also, the hot and cold start percentages for each trip type are increased by 10 percent to reflect additional emissions from these operating modes.

Method for Calculating Default Trip Lengths from Travel Survey Data

Trip lengths are one of the most important data elements used in calculating project emissions. Air districts or other agencies responsible environmental review should ensure that default trip length values used in their area have a sound basis. Unfortunately, the data most readily available from regional travel models for this purpose is typically formatted differently than is used in URBEMIS. This section provides a method for converting available data for use as URBEMIS2007 defaults.

One source of data is the Caltrans Statewide Travel Survey. The most recent version was published in 1991. The data is stratified by trip purpose. The trip categories are home to work (H-W), home to shop (H-S), home to other (H-O), other to work (O-W), and other to other (O-O). The survey provides trip lengths for only H-W and total trips. More detailed breakdowns may be available from the Regional Transportation Planning Agency in your area. The survey and most RTPA models provide trip lengths in terms of minutes. The average speed is used to convert minutes to miles.

The H-W, H-S, and H-O trip lengths can be used directly in URBEMIS. However, for non-home based trips, URBEMIS uses work (W) and non-work (N-W) trips when analyzing all non-residential projects (commercial, industrial, institutional, etc). To produce work-related trip lengths for non-residential projects analyzed in URBEMIS, a composite work trip length is calculated that is a composite of H-W and O-W trip lengths. For URBEMIS, non-work trips are a composite of H-S, H-O, and O-O trip lengths. Both are based on the relative occurrence of the individual trip types.

The following table illustrates this concept using Southern California data as an example:

Travel Survey Trip Types:	H-W	H-S	H-O	O-W	O-O	Total
Percent trip type:	20%	9%	43%	11%	17%	100%
Trip length in minutes:	19.63	7.91	9.58	15.06	8.96	
Trip length in miles:	11.5	4.87	6.02	9.07	5.66	

URBEMIS non-residential Work trip lengths = composite of H-W + O-W.

Work Trip Length Formula:

(%H-W / (%H-W + %O-W) x H-W TRIP LENGTH) +
(%O-W / (%H-W + %O-W) x O-W TRIP LENGTH)

URBEMIS non-residential Non-Work trip lengths = composite of H-S + H-O + O-O.

Non-Work Trip Length Formula:

(%H-S / (%H-S + %H-O + %O-O) x H-S TRIP LENGTH) +
(%H-O / (%H-S + %H-O + %O-O) x H-O TRIP LENGTH) +
(%O-O / (%H-S + %H-O + %O-O) x O-O TRIP LENGTH)

Example Calculation Using South Coast Data:

Commute Trip (W)

(20%/(20%+11%) X 11.5 mi.) + (11%/(20%+11%) X 9.07 mi.) = 10.6 mile W trip

Non-Work Trip (N-W)

(9%/(9%+43%+17%) X 4.87 mi.) + (43%/(9%+43%+17%) X 6.02 mi.) +
(17%/(9%+43%+17%) X 5.66 mi.) = 5.78 mile N-W trip

Default Values for Emission Calculations

Diurnal Soak Hours per Day:	7.1
Resting Loss Hours per Day:	12.9
Vehicles per Household:	1.8

Appendix C References

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Appendix D. URBEMIS2007 Mobile Source Mitigation Component

TABLES

Mobile Source Mitigation Component

Background

The purpose of this appendix is to document the basis of the emission reduction quantification system used in the URBEMIS2007 Mobile Source Mitigation Measures module. The mitigation measures module is based on an approach developed by Nelson\Nygaard Consulting Associates specifically for the URBEMIS module. Nelson\Nygaard's findings are described in the remainder of this appendix.

Introduction

The following discussion is based on procedures for operational smart growth mitigation developed for URBEMIS2002. Those same procedures have been incorporated into URBEMIS2007.

This report sets out recommendations to revise the operational mitigation component of URBEMIS 2002. These have been developed with three main aims in mind:

- **Simplify** the existing mitigation component (of URBEMIS version 7.5), which while extremely detailed, is daunting to new users and has extensive data requirements. In particularly, the division between "environment factors" and "mitigation measures" can be confusing.
- **Improve consistency.** Many of the inputs to the URBEMIS 7.5 mitigation component are extremely subjective (e.g. whether some, few or no bike routes provide wide paved shoulders and have few curb cuts). We propose making these more quantitative, and/or providing additional guidance in the users' manual or within the program itself.
- **Improve accuracy and transparency.** While many of the inputs to the current mitigation component (of URBEMIS 7.5) have been proven to have an impact on travel behavior, research is still at an early stage of assessing quantitative impacts, and how these interrelate with other mitigation strategies. The recommendations here update the current mitigation component in the light of new research.

An extensive body of research has been compiled as to the impacts of particular mitigation strategies on travel behavior. However, in general, this has either had an academic focus, or been undertaken for the purposes of developing citywide or regional travel models. For example, many agencies have sophisticated procedures for assessing non-single occupancy auto travel at the level of TAZ or above, but not at the development level. There is extremely little guidance on how to use this data in the type of application needed for URBEMIS 2002 – namely, to provide quantitative estimates of the impact on trip generation and vehicle miles traveled (VMT) at the development level.

Many agencies do provide credits for individual developments that implement mitigation measures, for example when assessing impact fees or conducting traffic studies. Some California examples include C/CAG in San Mateo County and VTA in Santa Clara County. A brief, national review was also conducted for purposes of this report.[1] In general, however, these credit programs are only loosely based on the latest travel research, and it could be argued that they function more at a policy level, in providing incentives for developers to incorporate elements such as demand management programs that the agency considers desirable.

The recommendations here therefore attempt to bridge the gap between academic studies and complex regional or area-wide models on the one hand, and more site-specific traffic assessments on the other hand. The emphasis is on providing the best possible estimate while minimizing data requirements. The overall effect, compared to the existing mitigation component, is to reduce the number of inputs required, but make them more quantitative.

[1] Agencies contacted included: New York Metropolitan Transportation Council; Atlanta Regional Commission; Alameda County, CA; and San Luis Obispo County, CA.

It cannot be too highly stressed that the trip reductions recommended here are valid at a sketch-planning level only, and are subject to considerable uncertainty. While they should ideally be expressed as a range, in order to expressly account for this uncertainty, a single value is needed for purposes of the Indirect Source Review in order to allow the appropriate fee to be calculated. The same limitations noted in the documentation for the existing mitigation component still apply, and are worth repeating here:

> The URBEMIS 2002 mitigation component is a significant advance over past attempts to quantify the benefits of air quality mitigation measures, however, users should recognize that travel behavior is very complex and difficult to predict. The component relies on the user to determine factors critical to travel behavior that are somewhat subjective. As GIS and electronic traffic monitoring and data collection become a reality in many cities, the ability to identify factors critical to walking, bicycling, and transit use will be enhanced. The URBEMIS 2002 mitigation component provides a starting point for using currently available data to demonstrate the benefits of urban design and traditional mitigation measures in reducing air quality impacts.

The mitigation component results, however, should still be interpreted as the mid-point of a range. Recent research has pointed towards the dangers inherent in reporting precise values, when the results are the subject of considerable uncertainty (Shoup, 2003). However, although the methodological dangers are obvious, there is generally no question about the *direction* of the relationship, only its size and the appropriate variable. Some adjustment is better than none at all – which is what most conventional trip generation methodologies provide (Ewing & Cervero, 2001). In addition, existing project-level trip generation methodologies, even though well-accepted within the transportation planning and engineering profession, are themselves subject to considerable uncertainty, and results are reported with unwarranted precision (Shoup, 2003).

Other considerations that should be noted include:

- The key output that is sought here is reduction in *vehicle trips.* Research results, however, often report results in terms of VMT. Where no alternative is available, we assume that VMT is proportional to vehicle trips.
- Elasticities are generally used to make the calculations, since when used with care, they provide a satisfactory, means of preparing first-cut aggregate response estimates for various types of transportation system changes (Pratt *et. al.,* 2000). They also provide a transparent and accessible method of reporting results, that can be transferred from one region to another (Ewing & Cervero, 2001).
- There are major theoretical issues regarding the direction of causality that have still to be resolved in the research. For example, does an increase in density lower vehicle trip generation rates, or do more dense places attract people who tend to make fewer vehicle trips? For the purposes of this analysis, however, the distinction is unimportant. The key issue (using the same example) is that more dense places are associated with fewer vehicle trips.
- Local planning controls and development economics are assumed to provide an important "reasonableness" check on the recommended trip reductions. For example, reductions in parking supply will not normally be allowed unless the local jurisdiction is confident that complementary trip reduction measures will be applied. Equally, it is unlikely that frequent transit service will be provided to a destination with low potential ridership, given competing demands on an agency for service.

About the Trip Generation Manual

At its heart, the URBEMIS mitigation component is a tool for modifying the average trip rates reported in the Institute for Transportation Engineers' *Trip Generation* manual to make them more accurate, so that they fairly reflect the particular characteristics of a proposed development. Before modifying these average rates, it is therefore useful to understand the manual itself: how the average rates were derived; the original data sources that underlie the manual; and the manual's own recommendations about when, and why, its average trip generation rates should be modified. Some key points are these:

- The ITE manual normally predicts trip generation from new buildings using just two variables. Typically, the user first selects a broad *land use type* (e.g. "High-Rise Residential Condominium/Townhouse"). Second, the user inputs the *quantity* of that land use type (e.g. "100 dwelling units").
- An important advantage of this simple approach is that very little information about a project is needed to predict trip generation, and trip generation calculations are simple.
- A primary disadvantage of such two-variable formulas is that they do not take into account the multiple other variables (parking price, transit service, etc.) that transportation research has shown to strongly affect trip generation, and so the variation in trip rates *within* each land use category is frequently very high.

Recognizing these points, the *Trip Generation* manual therefore advises the reader that the average trip generation rates reported in the manual "represent weighted averages from studies conducted throughout the United States and Canada since the 1960s. Data were primarily collected at suburban locations having little or no transit service, nearby pedestrian amenities, or travel demand management (TDM) programs. At specific sites, the user may wish to modify trip generation rates presented in this document to reflect the presence of public transportation service, ridesharing or other TDM measures, enhanced pedestrian and bicycle trip-making opportunities, or other special characteristics of the site or surrounding area."

However, while the studies may have been *primarily* conducted at such suburban sites, it appears from the sources referenced that for some land uses, particularly higher density residential land uses, many sites studied included at least some transit service, sidewalks, and other characteristics associated with lower vehicle trip rates. For the "High-Rise Residential Condominium/Townhouse", for example, the manual's text shows that sites were surveyed in such cities as Vancouver, Canada: a city where it is difficult to find high-density condominiums that lack sidewalks, transit service, and a mix of uses nearby.

As part of our research, we made several calls to and exchanged correspondence with the staff at the Institute for Transportation Engineers. The staff was unable to provide any additional data (beyond the text of the manual itself) on the characteristics of the developments used in its trip generation studies, and was also unable to provide the actual studies – the original data – which underlie the manual's conclusions. Therefore, it is not possible to define with certainty the precise characteristics of an "average site".

Given this paucity of information available on the original sources for the *Trip Generation* manual's, conclusions about the average characteristics of the different land uses in the manual (e.g., average residential density, or the percentage of neighborhood streets with sidewalks) necessarily must be estimated, rather than precisely calculated. Fortunately, a large body of other research on travel behavior and land use is available, and reasonable estimates can be made based upon this research.

Recommendations

1. Combine "environmental factors" and "mitigation measures."

URBEMIS 2002 distinguishes between "environmental factors" for pedestrians, cyclists and transit (i.e., the character of the existing neighborhood), and "mitigation measures" (i.e. those added by the development). The environmental factors both provide a mitigation measure in themselves (e.g. the credit for existing or planned transit service), and are also used to weight the mitigation measures (i.e., a lower credit is given for a mitigation measure in an area that has a low environmental factor).

The distinction does make it easier to give credits for specific mitigation measures (e.g. bus bulbs, sidewalks and bicycle parking). However, we recommend that the distinction be removed, since it also brings several important disadvantages. Most of these relate to either complexity, or the relative advantages of infill vs. greenfield development, as follows:

- The pedestrian environmental factors appear to be given less weight than the mitigation measures, even when it is taken into account that the environmental factors are also used to weight the mitigation measures. The credit for the surrounding pedestrian environment is 2%, compared to the maximum allowable reduction of 9%. This means that smaller, infill developments will be eligible for lower credits, since by their nature they will be more dependent on the surrounding environment and have more limited ability to fund mitigation measures.
- On a related point, the importance of the environmental factors compared to mitigation measures is largely a function of scale, i.e. development size. Larger projects, particularly on greenfield sites, will be starting from a "blank sheet," and on-site mitigation measures will be paramount. The appropriate trip reductions for smaller, infill developments, in contrast, will be more a function of the surrounding environment.
- Combining the environmental factors and mitigation measures would make the component easier to understand, particularly for inexperienced users. At present, the separation can be confusing.

2. Scale

This question relates to the area that should be analyzed. We recommend that this should be either the area within a half-mile radius from the center of the project, or the entire project area, whichever is larger. This is the same approach taken in the existing URBEMIS mitigation component. In effect, the smaller the development, the greater the consideration given to the wider project area.

3. Provide Post-Modeling Adjustments to Reward Other Mitigation Measures

One of the impacts of these recommendations would be to narrow the range of mitigation measures that are considered in the analysis. Some potential mitigation measures are excluded even though they are likely to have a travel behavior impact, either because they cannot be readily quantified, or because this would risk double counting an impact already quantified elsewhere (i.e. another variable, such as intersection density, serves as a proxy). We therefore recommend consideration of how post-model adjustments can be used to provide financial incentives for developers to incorporate these mitigation measures. This may include all those that are in the current mitigation component, but are not recommended for continued inclusion, including:

- Street trees
- Traffic calming
- Design maximizing visual interest for pedestrians, and "eyes on the street"
- Zero building setbacks
- Direct pedestrian connections
- Street furniture and artwork
- Pedestrian signalization and signage
- Street lighting
- Low speed limits on bicycle routes
- Safe routes to schools
- Bicycle parking ordinance
- Transit stop amenities
- Route signs and displays
- Bus turnouts and bulbs
- Structured parking

4. Modifying Average Trip Generation Rates

In general, both the recommended trip rate modifications and the overall philosophy of the mitigation component are similar to those in the existing URBEMIS model, and build extensively off this work. The major differences between the existing mitigation component and these recommendations are found in (a) the input variables, which are designed to be more quantitative and less subjective, and are fewer in number, and (b) the formulas, which take advantage of the latest research on residential travel behavior.

Neighborhood-level trip generation and vehicle miles traveled vary by more than 80% in California cities (Figure D-1). As the documentation for the existing mitigation component recognizes, areas with low trip generation and VMT levels have the highest development densities, a wide variety of uses within walking distance, safe and comfortable pedestrian access, paid parking requirements, and a high level of transit service.

Similarly, residential trip rates reported in the *Trip Generation* manual vary widely, both *within* individual land use types, and *between* land use types (Figure D-2). For the land use type "Single Family Detached Housing", for example, reported rates ranged from a low of 4.31 daily trips per dwelling unit, to a high of 21.85 daily trips. The *Trip Generation* manual reports that, "This land use included data from a wide variety of units with different sizes, price ranges, locations and ages. Consequently, there was a wide variation in trips generated within this category." Between residential land use categories, the variation is still greater, as would be expected. For example, the average trip rate for the "Residential Condominium/Townhouse" land use type is 5.86 (or 39% lower than the average single-family detached house), while the lowest trip rate is 1.83 (or 80.9% lower). At the extremes, considering all residential land uses, the highest residential rate reported (21.85 trips/day) is more than ten-fold higher than the lowest rate reported (1.83 trips/day).

Figure D-1. Daily Trips by Density, San Francisco Bay Area

	Households/Residential Acre					
	<2	**2-5**	**5-10**	**10-20**	**20-50**	**>50**
Mean Households/Residential Acre	1.4	3.6	6.7	13.5	30.6	121.9
Daily Vehicle Trips/Household	6.4	5.9	5.0	3.8	2.9	1.2
% Reduction in Daily Vehicle Trips/Household compared to lowest density areas	0%	9%	23%	41%	55%	82%

Source: MTC Household Travel Survey, 1990, cited in Holtzclaw, 2002

Figure D-2. ITE Trip Rates for Selected Residential Land Uses

		ITE Trip Rate		
Land Use Code	**Land Use Type**	**Low**	**Average**	**High**
210	Single-Family Detached Housing	4.31	9.57	21.85
221	Low-Rise Apartment	5.1	6.59	9.24
230	Residential Condominium/Townhouse	1.83	5.86	11.79
222	High-Rise Apartment	3	4.2	6.45
232	High-Rise Residential Condo./Townhouse	3.91	4.18	4.93

Based on these data in Figures 1 and 2, and a wide range of additional transportation research, we have developed a set of formulas for modifying the average trip rates for residential land uses has been developed. For the URBEMIS user, the procedure for modifying residential trip generation rates will remain generally similar to the existing process, with three basic steps:

1. In the "Land Use Selection" screen, the user will enter the land use types (e.g. "Apartment, Low-Rise") and the number of dwelling units of each type.
2. Next, if the mitigation component is used, the user will be prompted to review the default values for several key variables (e.g. residential density, level of transit service) for each residential land use type. If the project's land uses have characteristics that are different from the default values (as they usually will be), the user will enter the correct values, in place of the default values.
3. Within the program, the formulas described hereafter will be used to calculate the resulting trip generation rates.

In keeping with the conclusions of current transportation research, a single set of formulas is used to modify the trip rates for all residential land use types. The input variables for these formulas assess five key land use characteristics (or "mitigation measures", in URBEMIS terms):

- Net residential density (measured by Households per Residential Acre)
- Mix of uses (using a jobs/housing measure)
- Presence of local-serving retail
- Level of transit service (measured by a transit service index)

- Bicycle and pedestrian friendliness (measured by an "pedestrian factor" index based on intersection density, sidewalk completeness, and bike lane completeness)

For each ITE residential land use type, a set of default values for these variables has been defined. If the default values for a residential land use type are left unchanged when running the mitigation component, then the resulting trip generation rate will be the standard ITE average trip generation rate for that land use type. For single-family detached housing, for example, the default values include a residential density of three units per residential acre, a transit service index score of 0 (representing no transit service within one-quarter mile of the site), and an intersection density of 250 intersections per square mile (typical of post-war cul-de-sac residential subdivisions). Figure D-4 shows the default values for each land use type.

To achieve the lowest residential trip rate reported in *Trip Generation* (a manual which primarily measures stand-alone, single-use projects with little or no transit service), the input values required would include a density of 160 units per residential acre, the maximum level of transit service, the best possible mix of uses and local retail, and a pedestrian score equivalent to a complete sidewalk coverage with a network of blocks no larger than 300 feet on a side. This would result in a rate of 1.83 trips/day, or an 81% reduction from the average single-family house rate).

This is similar to the 82% difference in household trip generation between the lowest density areas with the poorest transit service (6.4 vehicle trips per household per day), and the highest-density areas with good transit and a higher quality pedestrian environment (1.2 vehicle trips per household per day), as shown in Figure D-1. Figure D-4 shows the input values that would be required to achieve this rate, as well as the input values required to achieve maximum possible reduction allowed.

In theory, choosing the maximum possible values for each of the *physical design variables* described above could result in a residential trip generation rate as low as 0.9 daily trips per unit. This represents a 90% reduction from the average rate for a single-family detached house. To achieve this rate, however, a neighborhood would have to have remarkable characteristics, similar to Manhattan or Hong Kong: a density of 380 units per acre, or more than three times the average density of San Francisco's densest neighborhoods (North Beach and Chinatown), the highest possible level of transit service, and so on.[2]

The recommended reductions for the individual physical design mitigation measures for residential uses are summarized in Figure D-3. The remainder of the report discusses the justification for these levels, along with the mitigation measures for non-residential uses. In general, the recommended maximums for individual components have been set at a level so that this overall 90% maximum reduction from the average single-family house rate is maintained for residential land uses. While a greater reduction may sometimes seem warranted for an individual measure, a lower value has been selected to stay within this 90% maximum – a practice that helps avoid the considerable dangers of double counting.

In addition to the variables above, which primarily measure physical design characteristics, the formulas include mitigation measures that assess *demand management programs and similar measure*s. A maximum additional reduction of 7.75% from the average single-family house rate is possible through these measures.

[2] While rare in California, these extreme cases of Manhattan-like densities can be seen in projects such as San Francisco's single-room occupancy hotels for very low income residents, which achieve such densities by omitting parking and providing very small living quarters.

Non-Residential Land Uses

For non-residential land uses, the general procedure for modifying rates is similar, and based upon many of the same research results. To modify non-residential trip generation rates, the following procedure is used:

1. For *physical design* mitigation measures, the formulas to determine percentage reductions are identical to the formulas for residential land uses, except for the 'Residential Density' measure, which cannot apply.
2. Additional mitigation measures are applied for *demand management programs and similar measures.* For non-residential uses, the number of available demand management measures is greater, as is the possible percentage reduction.

However, there is a key difference between the formulas used to modify residential rates, and the formulas used to modify non-residential rates:

1. For residential land uses, the percentage reductions shown for each mitigation measure refer to the percentage reduction from 9.57 trips per day (the rate for single family homes). The default values for each residential land use (Figure D-4) are set at levels such that keeping these values generates the average trip rate for that land use.
2. For non-residential land uses, the percentage reductions shown for each mitigation measure refer simply to the percentage reduction from the average ITE trip generation rate for that land use. No special default values are required: they are simply set to create a 0% reduction as the starting value.

Figure D-3. Summary of Recommended Trip Reductions

	Residential	Non-Residential	Comments
Physical Measures			
Net Residential Density	Up to 55%	N/A	
Mix of Uses	Up to 9%	Up to 9%	
Local-Serving Retail	2%	2%	
Transit Service	Up to 15%	Up to 15%	
Pedestrian/Bicycle Friendliness	Up to 9%	Up to 9%	
Physical Measures sub-total	*Up to 90%*	*Up to 35%*	
Demand Management and Similar Measures			
Affordable Housing	Up to 4%	N/A	
Parking Supply	N/A	No limit	Only if greater than sum of other trip reduction measures
Parking Pricing/Cash Out	N/A	Up to 25%	
Free Transit Passes	25% * reduction for transit service	25% * reduction for transit service	
Telecommuting	N/A	No limit	Not additive with other trip reduction measures (see text)
Other TDM Programs	N/A	Up to 2%, plus 10% of the credit for transit and ped/bike friendliness	
Demand Management sub-total[3]	*Up to 7.75%*	*Up to 31.65%*	

[3] This sub-total excepts the measures for parking supply and telecommuting, which have no limit.

Figure D-4. Default Values for Residential Land Use Trip Generation Formulas

DEFAULT VALUES FOR RESIDENTIAL TRIP RATE FORMULAS

Land Use Code	Land Use Type	Residential Density	Housing Units	Employees	Retail?	Transit Service	Intersection Density	Sidewalks	Bike Lanes	Ped Factor	ITE Trip Rate		
											Low	Average	High
210	Single-Family Detached Housing	3	100	17	no	0.00	250	0	0	0.06	**4.31**	**9.57**	**21.85**
221	Low-Rise Apartment	16	100	26	no	0.06	250	0.5	0	0.23	**5.1**	**6.59**	**9.24**
230	Residential Condominium/Townhouse	16	100	60	yes	0.10	400	1	0	0.44	**1.83**	**5.86**	**11.79**
223	Mid-Rise Apartment	38	100	60	yes	0.14	400	1	0	0.44	**NA**	**4.68**	**NA**
222	High-Rise Apartment	62	100	60	yes	0.14	400	1	0	0.44	**3**	**4.2**	**6.45**
232	High-Rise Residential Condo./Townhouse	64	100	60	yes	0.14	400	1	0	0.44	**3.91**	**4.18**	**4.93**

TRIP RATES RESULTING WHEN DEFAULT VALUES ARE USED

Land Use Code	Land Use Type	Reductions						Resulting Trip Rate
		Residential Density	Mix of Uses	Local Retail	Transit	Bike/Ped	Total	
210	Single-Family Detached Housing	0.0%	-0.6%	0.0%	0.0%	0.6%	0.0%	9.57
221	Low-Rise Apartment	27.9%	0.5%	0.0%	0.6%	2.1%	31.1%	6.59
230	Residential Condominium/Townhouse	27.9%	3.9%	2.0%	1.1%	3.9%	38.8%	5.86
223	Mid-Rise Apartment	39.8%	3.9%	2.0%	1.5%	3.9%	51.1%	4.68
222	High-Rise Apartment	44.8%	3.9%	2.0%	1.5%	3.9%	56.1%	4.20
232	High-Rise Residential Condo./Townhouse	45.1%	3.9%	2.0%	1.5%	3.9%	56.3%	4.18

EXAMPLE RESIDENTIAL TRIP RATE CALCULATIONS

Land Use Code	Land Use Type	Residential Density	Housing Units	Employees	Retail?	Transit Service	Intersection Density	Sidewalks	Bike Lanes	Ped Factor	ITE Trip Rate		
											Low	Average	High
210	"Worst Case" Singe-Family Detached	0.1	100	0	no	0.00	80	0	0	0.02	**-**	**-**	**21.85**
230	"Best Case" Res. Condo/Townhouse	160	100	150	yes	1.00	1300	1	0	0.67	**1.83**	**-**	**-**
N/A	Maximum Possible Reduction	380	100	150	yes	1.00	1300	1	1	1.00	**NA**	**NA**	**NA**

TRIP RATES RESULTING WHEN EXAMPLE VALUES ARE USED

Land Use Code	Land Use Type	Reductions						Resulting Trip Rate
		Residential Density	Mix of Uses	Local Retail	Transit	Bike/Ped	Total	
210	"Worst Case" Singe-Family Detached	-20.7%	-3.0%	2.0%	0.0%	0.2%	-21.5%	11.63
230	"Best Case" Res. Condo/Townhouse	51.4%	9.0%	2.0%	12.5%	6.0%	80.9%	1.82
N/A	Maximum Possible Reduction	55.0%	9.0%	2.0%	15.0%	9.0%	90.0%	0.95

5. Data Requirements

Figure D-5 shows the inputs that are required to complete the mitigation component in full, along with suggested data sources. Note, however, that the mitigation component can still be run, even if some of these inputs are missing. While no reduction would be granted for the particular mitigation measure for which the input was required, credits could be granted for other trip reduction measures.

Figure D-5. Data Requirements and Suggested Sources

Required Input	Suggested Source		Comments
	Project	Surrounding Development	
Net residential density	Project plans	Block-level census data	Net residential data excludes land not devoted to residential uses
Number of housing units	Project plans	Block-level census data	Same basic source as for net residential density
Number of jobs	Project plans	Census Transportation Planning Package. Local jurisdiction may provide more current or fine-grained data	If data are only available per square foot, US Dept. Energy produces figures on average employee density
Local serving retail	Project plans	Site observations	
Below-market-rate units	Project plans	N/A	
Parking supply	Project plans	N/A	
Transit service	Transit agency maps/schedules		
Intersection density	Project plans	Street plans	Count can be automated if available in GIS
Sidewalk completeness	Project plans	Site observations	Count can be automated if available in GIS
Bike lane completeness	Project plans	Site observations	Count can be automated if available in GIS
Parking pricing	Development agreement or similar	Site observations (if applicable)	
Free transit pass provision	Development agreement or similar	N/A	
Telecommuting/flexible work schedules	Development agreement or similar	N/A	
Other TDM programs	Development agreement or similar	N/A	

6. Procedure for Small Projects

For developments in an established urban area below a certain size threshold, we recommend allowing them to adjust their trip generation rates based on the mode share in that census tract. This would avoid a disproportionate burden in gathering the data to document their likely trip reduction. (The analyst would need to certify that the project was similar in character to the existing development.) The recommended threshold is 50 average daily

baseline vehicle trips, with the baseline being that calculated by URBEMIS before any of the reductions from mitigation measures are applied.

7. Substitute Methodologies

The recommended mitigation levels are, in our judgment, the most appropriate for a model that must apply to an extremely wide range of projects and geographic contexts. However, it must be recognized that there may be "special cases," where these standard reductions may not apply. For this reason, we recommend that any methodology for calculating reductions in VMT and vehicle trips may be substituted, provided that this is mutually agreed between the Air District and project proponent.

8. Measures Reducing VMT

The existing mitigation component allows for reductions in VMT (but not trip generation) for park-and-ride lots and satellite telecommuting centers. We do not recommend any changes to this aspect of the mitigation component.

9. Correction Factors

The existing mitigation component provides for trip type correction factors, based on evidence suggesting that certain trips are more likely to be captured by one mode rather than another. We do not recommend any changes to this aspect of the mitigation component.

A second correction factor in the existing mitigation component relates to trip distance, because, the documentation argues, bicycle and walking trips replace mostly shorter automobile trips. We recommend that this correction factor be eliminated, as there is little evidence to suggest that this phenomenon exists. Indeed, more complex changes in travel behavior are likely, such as mode shift to bicycling and walking trips being accompanied by a shift to closer destinations. For example, rather than drive to a grocery store on a freeway interchange, a household may walk to a smaller store in the neighborhood. Mixed use, compact neighborhoods are characterized by short overall trip lengths (see, for example, Kuzmyak et. al., 2003). Further evidence comes from the elasticities for trip reduction with respect to density, which are the same for both vehicle trips and VMT (Ewing & Cervero, 2001), suggesting that there is no impact on trip length.

Detailed Justification of Recommended Mitigation Levels

Default Values for Residential Land Uses

To develop the default values for residential land uses shown in Figure D-4, we had to overcome a significant hurdle: ITE retains no data on the characteristics of the developments used in their trip generation studies. Default values for average density, transit service levels, and other variables had to be estimated using two alternative methods. First, we reviewed representative projects through research of literature and discussions with professionals in the fields of architecture and town planning, to ascertain typical ranges for density and other

characteristics of each land use type (for useful summaries, see Calthorpe, 1993, and Local Government Commission,2002).

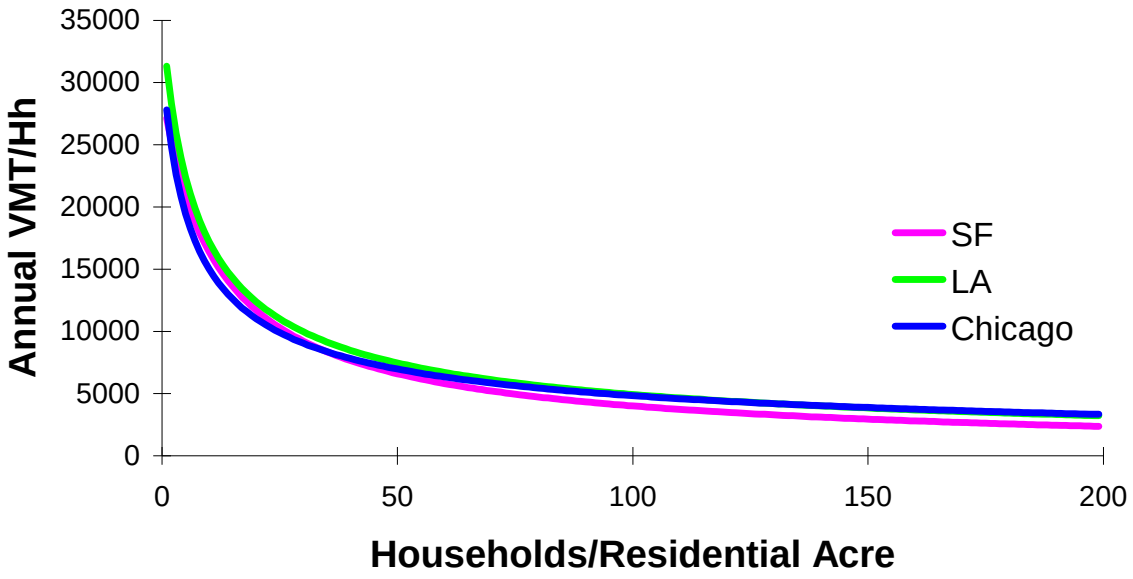
Second, these ranges of values were plugged into the formulas for the mitigation measures, and adjusted until the baseline values for each characteristic equaled the average ITE trip generation rates for each land use. For example, baseline density for Mid-Rise Apartments (64 units per residential acre) falls within the typical range observed from research of 45 to 125 units/acre, and when combined with other baseline characteristics for the land use, results in a 56.1% reduction in trip generation from the average rate for single family homes – the average reduction set forth in the ITE manual.

Finally, since the *Trip Generation* manual provides no daily trip generation rate for the "Mid-Rise Apartment" land use, we estimated a rate by extrapolating from the daily trip rate for the "High-Rise Apartment" land use type. The PM peak hour trip rate of 0.39 trips per unit for mid-rise apartments is 11.4% higher than the PM peak hour rate for high-rise apartments (0.35 trips/unit). Therefore, the daily trip rate for the "Mid-Rise Apartment" land use was estimated to be 4.68 trips per unit, or 11.4% higher than the daily trip for high-rise apartments (4.2 trips/unit).

Density

A considerable volume of research has investigated the links between density, particularly residential density, and travel behavior (for summaries, see Kuzmyak et. al, 2003; Boarnet & Crane, 2001). Overall, the conclusions can be summarized thus: there is a significant, quantifiable relationship between residential density and automobile use (see Figure D-6), but there is uncertainty regarding the degree to which this effect is due to the inherent effects of density, as opposed to factors for which density serves as a proxy, such as parking price, local retail, transit service frequency and pedestrian friendliness.

Figure D-6. Residential Density Vs. Vehicle Travel



Source: Holtzclaw et. al. (2002).

Fewer studies have attempted to disentangle the effects of density itself. Three of the main exceptions are:

- Typical elasticities for vehicular travel with respect to density are –0.1 to –0.04. These elasticities refer to the effect of density itself, isolated from variables that tend to be correlated with density such as transit frequency, and are additive to elasticities of other built environment factors. When these factors are not isolated, typical elasticities for VMT with respect to density are –0.22 to –0.27 (Kuzmyak et. al, 2003).
- The elasticity of density, when isolated from three other variables (diversity, design and destinations), is –0.043 with respect to vehicle trips, and – 0.035 with respect to VMT (Criterion and Fehr & Peers, 2001). However, this does not control for transit service levels.
- Cervero & Ewing (2001), in an update to this work, suggest a slightly higher elasticity of –0.05 with respect to both vehicle trips and VMT.

Note that density has been shown to have a nonlinear relationship with vehicle travel, with a threshold value of 25-30 units per acre below which the travel impacts of increased density are particularly large (Holtzclaw et. al, 2002). Holtzclaw et. al found that the best single variable equations to predict household vehicle travel (VMT per household, or VMT/Hh) relied on Households per Residential Acre (Hh/RA). For the Los Angeles region, San Francisco and Chicago regions, these equations varied only slightly, producing the curves shown in Figure D-6. For the Los Angeles region, this formula takes the form:

$$\frac{\text{VMT}}{\text{Hh}} = 19749\left(\frac{4.814 + \text{Hh/RA}}{4.814 + 7.140}\right)^{-0.639}$$

Based on this formula, the following elasticity formula is recommended for vehicle trips with respect to density. It is the same as Holtzclaw et. al' work, but reduced by 40% to take account of the fact that much of this impact will be realized through transit service, mix of uses and bicycle and pedestrian levels (which tends to correlate with density). The baseline assumed to correspond to a zero percent trip reduction is three units per acre, at which density the Holtzclaw formula results in 25,914 annual vehicle miles traveled per household. This translates into the following formula:

Trip reduction = 0.6*(1-(19749*((4.814+ households per residential acre)/ (4.814+7.14))-0.639)/25914)

An apartment development of 16 units per residential acre, for example, would be estimated to generate 27.9% fewer trips than a three unit per acre project. The maximum allowable reduction recommended is 55% (equivalent to a 380 unit per acre development).

With this formula, "negative" reductions also apply, with less dense developments below the baseline level of three units per acre (for example large-lot housing) resulting in higher trip generation rates. (However, as long as the mitigation component is optional for developers or project proponents to complete, they will be unlikely to use it for projects whose overall score, for all components, will result in a finding to their disadvantage. For purposes of more accurately predicting vehicle trips and emissions, however, this negative reduction is useful and reflects the findings of the research literature.

Trip generation at the non-residential end is also influenced by density, but to a much lesser degree (Cervero, 1989, cited in Kuzmyak et. al, 2003). There are also far fewer studies investigating this relationship, and there is no comparable dataset to that for residential density. No reduction is recommended here.

Mix of Uses

Many references point to the impact of "diversity" or mix of uses on travel behavior. This is true both at the macro-scale, e.g. jobs-housing balance, and the micro-scale, e.g. the availability of services within walking distance. Key references, related to both the direction and magnitude of this relationship, include:

- Higher densities are most beneficial to transit ridership when they result in a mix of residential, commercial and office uses (Lund et. al., 2004).
- The elasticity of vehicle trips with respect to "diversity" is –0.051. The elasticity of VMT is –0.032. In this case, "diversity" is a measure of how the project affects regional population/employment balance. (Criterion and Fehr & Peers, 2001)
- Typical elasticities for vehicle trips with respect to local diversity (mix) are –0.03, and those for VMT are –0.05 (Ewing & Cervero, 2001).

- A balance of 1.5 jobs per household is estimated to produce a bus mode share 2 percentage points over the share for a single use area, although the degree of mix is not a useful estimating variable (Messenger & Ewing, 1996, cited in Kuzmyak et. al, 2003).
- Suburban activity centers with some on-site housing had 3-5% more transit, bike and walk commute trips (Cervero, 1989, cited in Kuzmyak et. al, 2003).
- The presence of retail reduces auto mode share by 2-5%, depending on neighborhood density. (Parsons Brinkerhoff, 1996, cited in Kuzmyak et. al, 2003).
- At suburban activity centers, the presence of retail in office buildings lowers vehicle trip rates by 6-8% (NTI, 2000, cited in Kuzmyak et. al, 2003).

4. Employment sites with "good" nearby retail and commercial services have a vehicle trip rate 21.5% below the ambient rate. Sites with "fair" services showed an 8.3% reduction, and those with "poor" services a 5.3% reduction. This is attributed not just to the presence of these services, but the fact that they make TDM programs more likely to succeed (Comsis, 1994, cited in Kuzmyak et. al, 2003).

The analysis is complicated by the fact that some of the most beneficial developments from this perspective may be single-use, in an area where another use is predominant (e.g. residential in an employment area). To take this into account, the following procedure is proposed (adapted from Criteron and Fehr & Peers, 2001):

Trip reduction = (1- (ABS (1.5 * h – e) / (1.5 * h + e)) – 0.25) / 0.25 * 0.03

Where: h = study area households (or housing units)
e = study area employment

Negative reductions of up to 3% can result, and should be included.

This formula assumes an "ideal" housing balance of 1.5 jobs per household, based on Messenger & Ewing (1996), and a baseline diversity of 0.25. The maximum possible reduction using this formula is 9%.

This reduction takes into account overall jobs-population balance. The presence of local serving *retail* can be expected to bring further trip reduction benefits, and an additional reduction of 2% is recommended. This is towards the lower end of the values presented in the research discussed above, in order to avoid double counting with the diversity indicator.

Transit

The existing URBEMIS 2002 mitigation model places its primary emphasis on mode, i.e. whether service is provided by high-speed rail, commuter rail or bus. Within this framework, consideration is given to frequency (e.g. bus headways of 15 minutes or less score more highly than headways of 15-30 minutes).

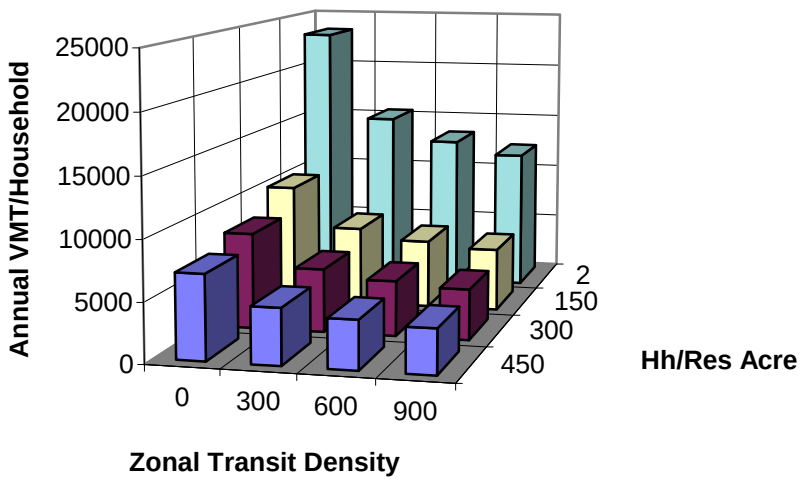
For example, the current mitigation component would award the maximum score of 100 to a development 0.5 miles from a BART station, even if no other transit were available. A part of the city with several bus lines offering 10-minute service, in contrast, would score much lower, even though these transit lines would carry many more passengers.

Current transit planning thinking, however, emphasizes that frequency and speed are two of the most important factors determining mode choice, rather than whether the service is provided by bus, bus rapid transit, or rail. Researchers have found that there is no *inherent* preference for rail over bus, provided that the quality of service is the same (for example, Ben-Akiva & Morikawa, cited in Transportation & Land Use Coalition, 2002).

Key references include:

- The average elasticity of ridership with respect to frequency is +0.3 to +0.5. Higher elasticities of +1.0 have been observed in suburban systems, with the +0.3 value more typical of urban systems. (Kittselson & Associates et. al, 2003).
- Pratt et. al. (2003) suggest an elasticity of ridership with respect to service hours (i.e. a combined measure of frequency and service span) of +0.5. Ridership is most sensitive to frequency changes when the past service was infrequent.
- Modeling in Massachusetts suggests that halving transit service headways from 30 to 15 minutes leads to an 8% drop in vehicle trips. A further decrease to 5 minutes leads to a further 4% drop in vehicle trips (Pratt et. al., 2003).
- Holtzclaw et. al. (2002) show that vehicle travel falls as transit service levels increase, even when holding density constant (Figure D-7). In the San Francisco Bay Area, a doubling of transit service from 300 to 600 (using the index described below) is associated with a 13% drop in VMT. An increase from 300 to 900 is associated with a 20% drop in VMT. In the Los Angeles region, the decreases in VMT are 12% and 18% respectively. However, the variable was omitted from the vehicle travel model presented in this paper, since density was used as a proxy for transit service.
- The maximum distance that people are willing to walk to transit tends to be 0.25 miles for bus, and 0.5 miles for rail (and, presumably bus rapid transit). (Kittelson & Associates et. al, 2003). It is unclear whether there is a "distance decay" effect, whereas people are more likely to use transit at closer distances within this range (see Lund et. al, 2004).

Figure D-7. VMT vs. Residential Density and Transit Use, San Francisco Bay Area



Source: Holtzclaw et. al. (2002).

Unfortunately, the elasticity of service with respect to transit ridership is difficult to convert to vehicle trip reduction, firstly because the baseline ridership needs to be known, and secondly because only a proportion (18-67% is cited by Pratt et. al., 2003) of new transit trips were formerly made by private auto. While it is clear that there is a direct correlation between transit service and vehicle trips, it is difficult to employ these elasticities directly. For this reason, the approach here is more in line with the existing mitigation component, which assumes a maximum percentage reduction for transit, and then reduces this based on a transit environment factor.

Various frequency-based transit service indices have been developed which have shown strong correlations with ridership. For example:

- In Los Angeles, the quality of four components of transit service (MTA rail, Rapid Bus, local bus and regional services) were rated on a scale of 0-3 for each community area, and then summed to provide the Transit Service Index on a scale of 0-12. (Nelson\Nygaard, 2002b).
- The studies by Holtzclaw et. al. (2002) used Zonal Transit Density, defined as the daily average number of buses or trains per hour times the fraction of the zone within 1/4 mile of the bus stop, or 1/2 mile of the rail station or ferry terminal, summed for all transit routes in or near the zone.

The Transit Service Index recommended here would combine the important features of all these approaches, with emphasis on frequency but with greater weighting given to rail services. Greater weight is also given to dedicated shuttles, in recognition of the fact that these are likely to be more closely targeted to the needs of the development. The Transit Service Index would be determined as follows:

- Number of average daily weekday buses stopping within 1/4 mile of the site; plus

- *Twice* the number of daily rail or bus rapid transit trips stopping within 1/2 mile of the site
- *Twice* the number of dedicated daily shuttle trips
- Divided by 900, the point at which the maximum benefits are assumed. (This equates to a BART station on a single line, plus four bus lines at 15-minute headways.)
- Developments that are larger than 0.5 miles across in any direction must be broken into smaller units for purposes of determining the transit service index. The average of all units would then be used.

Figure D-8 shows some examples of how service frequencies translate into Transit Service Index scores (note these are additive, if a location has more than one component).

Figure D-8. Example Transit Service Index Scores

Transit Service	Score	Assumptions
BART (single line)	0.33	150 trips per day (15-20 minute headways in each direction from 4 AM-12 AM)
15-minute bus, 5 AM – 12 AM	0.17	
30-minute bus, 5 AM – 7 PM	0.06	
Amtrak San Joaquin	0.03	6 trips per day in each direction
Dedicated commute shuttle	0.02	5 trips per commute period (single direction)

As well as existing service, planned and funded transit service would be included in the calculation. Purely demand responsive service would not be included.

A maximum trip reduction of 15% is recommended. This is the same as the existing URBEMIS 2002 trip reduction for existing and planned transit service.

In order to account for non-motorized access to transit, we also recommend that half the reduction be dependent on the pedestrian/bicycle friendliness score (calculated in the following section), similar to the approach taken in the existing mitigation component. This ensures that places with good pedestrian and bicycle access to transit are rewarded.

Trip reduction = t * 0.075+ t * ped/bike score * 0.075

Where t = transit service index

Bicycle and Pedestrian

Since bicycle mode share and pedestrian mode share depend on similar neighborhood characteristics, such as a fine-grained street grid, we recommend that a single factor be used to account for both modes. The bicycle and pedestrian components of the URBEMIS 2002 mitigation component are already well developed. However, the inputs are largely subjective, and there is still little evidence to justify the precise amount of credits for many of the individual mitigation measures (e.g. street trees).

Many street design factors have, however, been shown to promote walking and cycling. These include:

- Street connectivity, with traditional street networks that are more New Urbanist or grid-like, as opposed to the loops, lollipops and cul-de-sacs of most conventional subdivision. There are various measures of connectivity (summarized in Dill, 2003), such as:
    - Block length, size or density
    - Intersection density
    - Street density
    - Connected node ratio (number of street intersections divided by the number of intersections plus cul-de-sacs)
    - Link-node ratio (links are roadway or pathway segments between two nodes, which are intersections or cul-de-sac ends)
    - Grid pattern (percentage of intersections that are four- or more way).
    - Pedestrian Route Directness (ratio of route distance to straight line distance)
    - Effective Walking Area (% of parcels within 1/4 mile, that are also within 1/4 mile walking distance)
- Human-scale streetscapes with adequate pedestrian amenities, access to shopping and other amenities, and higher densities (Lund et. al., 2004)

Other relevant research includes:

- A composite indicator, the "Pedestrian Environment Factor," provides a statistically significant correlation with trip generation and VMT. It is comprised of four inputs (Parsons Brinkerhoff, 1993):
    - Ease of street crossings
    - Sidewalk continuity
    - Local street characteristics (grid vs. cul de sac)
    - Topography
- In Portland, OR, an increase in the PEF from "pedestrian hostile" to "almost average" reduces daily vehicle trips by 0.4 per household (7%). An increase from "almost average" to "fairly good" provides a daily reduction of 0.2 trips (Parsons Brinkerhoff, 1993, cited in Kuzmyak et. al, 2003).
- Sidewalk completeness, route directness and network density together have a vehicle trip elasticity of –0.05 (Ewing & Cervero, 2001).
    - For a high degree of walkability, block lengths of approximately 300 feet are recommended. Short blocks provide more pedestrian crossing opportunities and direct walking routes, and mean that traffic is more likely to be dispersed. Downtown Los Angeles, for comparison, has about 150 intersections per square mile. (Ewing, 1999).

There is a strong tradeoff here between simplicity and low data requirements on the one hand, and robustness and accuracy on the other. Pedestrian and bicycle level of service work for the Florida Department of Transportation and FHWA, for example, has shown that there are numerous statistically significant factors that can be included to assess the quality of the bicycle and pedestrian environment. These include motor vehicle volumes and speeds, truck

volumes, roadway widths, urban design, and lateral separation between pedestrians and motor vehicles (for example, FHWA, 1998; Landis et. al, 2001).

However, we recommend that in order to keep data requirements to a minimum, one or two of the street design indicators discussed by Dill (2003) and Ewing and Cervero (2001) be used, together with a single bicycle measure. Since route directness and network density measure similar characteristics, we recommend the use of one of these (network density, which is inversely related to block size) plus sidewalk completeness and bicycle network completeness. The pedestrian/bicycle factor would then be calculated as follows:

Ped/bike factor = (network density + sidewalk completeness + bike lane completeness) / 3

Where: Network density = intersections per square mile / 1300 (or 1.0, whichever is less)

Note: In most GIS applications, intersections are counted based on the number of line segment terminations, or each "valence." Intersections have a valence of 3 or higher – a valence of 3 is a "T" intersection, 4 is a four-way intersection, and so on.[4] (Georgia Institute of Technology, 2002). Therefore, if intersections are counted manually on a map or project plan, care needs to be taken to distinguish between 3-, 4- and 5-way intersections, and factor them up accordingly. The 1,300 value roughly equates to a dense grid with four-way intersections every 300 feet, per the recommendation of Ewing (1999). Intersections with dedicated routes for pedestrians and/or bicyclists should be included in this calculation.

Sidewalk completeness = % streets with sidewalks on both sides + 0.5 * % streets with sidewalk on one side

Bike lane completeness = % arterials and collectors with bicycle lanes, or where suitable, direct parallel routes exist

A maximum reduction of 9% is proposed, based on the existing URBEMIS mitigation component.[5] The trip reduction would then be calculated as:

Trip reduction = 9% * ped/bike factor

No reduction should be allowed if the entire area within a half-mile walk of the project center consists of a single use. (Note that this applies to a half-mile walk, rather than straight-line

[4] A valence of 1 indicates that a line segment has terminated, e.g. in a cul-de-sac. A valence of 2 means that the street is continuing.

[5] Note that this excludes the bicycle reduction in the current mitigation component. However, this compensates for the fact that the reductions recommended for the mixed use and density variables will be realized in practice through pedestrian and bicycle mode share.

distance, to account for barriers such as freeways.) However, the ped/bike factor can still be used to calculate pedestrian access to transit, as part of the transit mitigation measure.

Affordable and Senior Housing

A significant amount of evidence points to the fact that lower-income households and senior citizens own fewer vehicles and drive less. Research includes:

- Russo (2001) cites evidence from the San Francisco Bay Area travel survey, which shows that households earning under $25,000 per year make 5.5 vehicle trips per day, compared to a regional average of 7.6. High income households (earning more than $75,000 per year) make an average of 10.5 trips. Note that this data does not control for other factors, such as density and transit access.
- In the San Francisco Bay Area, Los Angeles and Chicago, income was one of four variables with sufficient independent explanatory power to include in the model of VMT and vehicle ownership (Holtzclaw et. al., 2002).

Obviously, it is difficult if not impossible to account for the exact incomes of residents in URBEMIS, most obviously because the occupants are not known at the pre-development stage. However, the percentage of deed-restricted below-market-rate (BMR) housing does offer a way to incorporate this effect.

We recommend a 3% reduction in vehicle trips for each deed-restricted BMR unit.[6] Thus, the total reduction is as follows:

Trip reduction = % units that are BMR * 0.04

A development with 20% BMR units would thus gain a 0.8% reduction. A development with 100% BMR units would gain a 4% reduction.

Parking Supply

Significant correlations between parking supply and employee mode split have been observed. For example, a study of the link between parking availability and transit use in eight Canadian downtowns found an extremely high elasticity of –0.77 (Morrall & Bolger, 1996, cited in Kuzmyak et. al., 2003b). In California, the number of parking spaces per worker was found to be one of the main two elements of a binomial logit model predicting transit mode share among TOD office workers (Lund et. al, 2004).

As with residential density, the extent to which parking supply itself is a causal factor is uncertain. In practice, it probably serves as a proxy for variables such as price, high quality public transit, mix of uses, and pedestrian friendliness (Kuzmyak et. al., 2003b). Indeed, in

[6] Calculated from Holtzclaw et. al. (2002), assuming 12,000 average annual VMT per vehicle, median per capita income of $33,000 (2002 figures per California State Department of Finance), and an average income in BMR units 25% below median. Holtzclaw calculate the coefficient of -0.0565. Therefore, expected VMT reduction can be calculated as 0.0565 * 33,000 * 0.25 / 12,000 = 4%

practice there is a two-way relationship between parking supply and mode split. Free parking, for example, can be seen as both a cause of high parking supply (more parking is needed to satisfy the greater demand), and a consequence (the market price of parking is zero once an effectively unlimited supply is provided) (see, for example, Shoup, 1999).

Theoretically, it is possible to reduce parking provision to below the level of actual demand, should drivers park in neighboring lots or on-street in surrounding areas. However, planning approval is not likely to be granted for developments that significantly under-provide parking, unless complementary Residential Permit Parking programs or other measures to combat this type of overspill are introduced. Indeed, the main reason for minimum parking requirements levied by local jurisdictions is to address these overspill issues (Shoup, 1999).

Similarly, market realities are likely to prevent a developer from providing too little parking. The challenges in persuading lenders to finance developments that have below-code parking are difficult enough to overcome, even where there is clear, documented evidence to show that parking supply will be enough to meet demand (see for example, Parzen & Sigal, 2004). In contrast, the opposite tendency is likely to be apparent – that developments are prevented from taking full advantage of the opportunities to reduce parking supply by zoning codes (see, for example, Nelson\Nygaard, 2002).

The measure proposed here uses the Institute of Transportation Engineers' *Parking Generation* handbook as the baseline. This is assumed to equate to unconstrained demand. The trip reduction can therefore be calculated as follows:

Trip reduction = Actual parking provision / ITE Parking Generation rate

Since ITE parking generation rates use the same land use codes as the trip generation rates, these could be provided within the URBEMIS model itself. The user would only be required to enter the actual parking provision for each land use.

For land uses with rates for both weekday and weekend, the formula will use whichever rate is higher. The *Parking Generation* handbook covers most common land uses. For some land uses, however, no parking generation rates are available: in these cases, this particular mitigation measure may not be used.[7] Those land uses without parking generation rates include:

- Single Family Detached Housing
- Mid-rise Apartments
- High-rise Condominium/Townhouse
- Mobile Home Parks

[7] The next edition of *Parking Generation*, currently under development by an ITE Task Force, is likely to provide date for some of these missing land uses. While it would be ideal to have parking generation data for every single land use before introducing this mitigation measure into URBEMIS, the data does not yet exist. Rather than abandoning this mitigation measure entirely until perfect data exists, we recommend allowing the measure to be used for the many land uses where reasonable data is available.

- Residential Planned Unit Development (PUD)
- Day-care center
- Elementary school
- Junior High school
- Library
- City Park
- Discount Superstore
- Discount Club
- Electronic Superstore
- Home Improvement Superstore
- Gas/Service Station
- Pharmacy/Drugstore with and with/out Drive Through
- Medical Office Building
- General Heavy Industry

To avoid double counting with other trip reduction measures, the impacts of parking supply are proposed to be assessed in conjunction with all other non-residential trip reduction measures as follows:

- The total of all other non-residential trip reduction measures should be used if this is greater than or equal to the trip reduction from parking supply measures. For example, if parking supply is reduced 10% from ITE levels, and transit, mixed use and pedestrian/bicycle trip reductions amount to 20%, the 20% figure would be used.
- If the total of all other non-residential trip reduction measures (r_1) is less than the trip reduction from parking supply measures (r_2), the total trip reduction is as follows:

$$r_1 + 0.5 * (r_2 - r_1)$$

In effect, the parking supply reduction is only used if it is greater than the impact from other trip reduction measures, and the difference is discounted by 50%. For example, if parking supply is reduced 25% from ITE levels, and transit, mixed use and pedestrian/bicycle credits amount to 15%, the total reduction would be:

$$15 + 0.5 * (25-15) = 20\%.$$

This reduction should only be granted if measures to control overspill are in place, such as Residential Permit Parking programs, time limits or meters.

Transportation Demand Management

Transportation Demand Management programs have been shown to have a major impact on travel behavior. Site-level employee vehicle trip reductions of up to 38% have been achieved, particularly for programs that have included parking pricing (Shoup & Willson, 1980; Comsis, 1993; Valk & Wasch, 1998; Pratt, 2000). Parking price elasticities of –0.1 to –0.3 have been reported (Pratt, 2000).

This component of the existing URBEMIS 2002 mitigation component is well developed. However, there is considerable scope to adapt it in two ways:

- Provide greater emphasis for the three elements that have the greatest impact on travel behavior – parking pricing/cash out; free transit passes; and telecommuting.
- Simplify the remaining elements, through offering broader options such as "major program", "minor program", and "no program," for elements that are likely to have a smaller trip reduction potential.

We recommend that none of these reductions be permitted, unless they form part of a legally enforceable agreement specifying, for example, minimum parking prices and other TDM measures. This might form part of a development agreement, be enforced through any TDM ordinance in the local jurisdiction, or consist of another mechanisms mutually agreed by the air district and project proponent. Otherwise, there is little to guarantee that some of the promised measures (e.g. parking pricing) will actually be implemented and maintained.

Parking Pricing and Cash Out

We recommend that a maximum trip reduction of 25% be applied to projects that commit to introducing parking pricing. This is based on the approximate midpoint of observed reductions, which range from 15% to 38% (Shoup & Willson, 1990; Comsis, 1993; Pratt, 2000). Note that most of these studies apply to before-after or with-without comparisons, with no increase in transit service or other measures to reduce vehicle trips. This maximum reduction should apply to prices of $6 per day or greater (in 2004 dollars).

The trip reduction will therefore be as follows:

Trip reduction = daily parking charge / 6 * 0.25

If the parking charge is more than $6, the 25% reduction is taken. If parking charges do not apply to all trips to a site (e.g. customers are exempt), the reduction is pro-rated by the percentage of trips that the charges apply to. If little or no on-site parking is provided, the parking charges should be those of surrounding public facilities.

Parking cash-out programs should be eligible for 50% of the reduction for direct parking charges, in recognition of the fact that their impacts tend to be significantly lower (Pratt, 2000). This is partly due to the fact that cash-out payments are a taxable benefit.

Free Transit Passes

Some California transit agencies, most notably VTA in Santa Clara County, have EcoPass or similar programs, whereby employers or property manager's bulk-purchase transit passes for (free) distribution to their employees or tenants. Eco Pass programs have been shown to increase transit ridership by 50-79% (City of Boulder, undated; Caltrans, 2002), and reduce vehicle trips by 19% (Shoup, 1999). (Note that many of these new riders were making new trips, or ones previously made by walking or cycling.)

We therefore recommend that any project committing to providing free transit passes would receive an additional credit equivalent to 25% of the reduction granted for transit service. Thus, the credit is more valuable in places that have good transit service. This reduction would only apply to the portion of trips generated by those granted the free transit passes (e.g. residents and/or employees, but excluding shoppers and other visitors).

Telecommuting

We recommend the retention of the reductions granted for telecommuting and compressed work schedules in the existing mitigation component, with two clarifications:

- As with the reductions for other mitigation measures, there must be an enforceable commitment (e.g. development agreement), which covers both the take-up rate (employees actually telecommuting or using compressed work schedules) as well as the provision of the option.
- The percentage reduction should not be additive (in contrast to most other trip reduction measures). For example, if 20% of employees telecommute, and other trip reduction measures are estimated to reduce vehicle trips from 1,000 to 800 per day, the 20% reduction would apply to the 800 trips, not the original 1,000.

Other TDM Programs

Other TDM program elements, that do not include financial incentives, tend to have a smaller impact on travel behavior. We recommend that reductions be based on the number of the following elements incorporated into the program, per Figure D-7:

- Secure bicycle parking (at least one space per 20 vehicle parking spaces)
- Showers/changing facilities
- Guaranteed Ride Home
- Car-sharing services
- Information on transportation alternatives, such as bus schedules and bike maps
- Dedicated employee transportation coordinator
- Carpool matching programs
- Preferential carpool/vanpool parking

The impact of a TDM program will also depend on the travel alternatives available. A program will have more impact if the site is served by frequent transit, for example (although

note that a TDM program can do much to promote carpooling even in other locations). For this reason, we recommend that part of the TDM credit be used to adjust the credits granted for transit service and pedestrian/bicycle friendliness (see Figure D-9).

Figure D-9. Recommended TDM Program Reductions

Level	Number of Elements	Recommended Reduction
Major	At least 5 elements	2%, plus 10% of the credit for transit and pedestrian/ bike friendliness
Minor	At least 3 elements	1%, plus 5% of the credit of transit and pedestrian/bike friendliness
No program	None	None

Examples

It is important to recognize that any type of calibration is beyond the scope of this analysis, which relies on existing references to build on the ranges established in the existing mitigation component. Figure D-10, however, does provide some examples to indicate the trip reductions that would apply to specific places.

The data are drawn from the database compiled for the Location Efficient Mortgage program (for details, see Holtzclaw et. al., 2002), and from the San Francisco Bay Area Metropolitan Transportation Commission's TAZ files. For these reasons, the examples are limited to the San Francisco Bay Area. Transit service was estimated from schedules and route maps. Sidewalk and bike lane completeness were estimated based on local knowledge. For these reasons of limited data, the examples are intended as illustrations only, rather than to refer to a particular project.

The reductions are calculated for the physical and environmental factors only, for residential uses. They exclude any additional reductions from TDM programs and affordable housing.

The final column compares average vehicle miles traveled (no vehicle trip data were readily available) in these neighborhoods to the Brentwood baseline, as a rough comparison to the reductions granted through the proposed trip reductions for URBEMIS. As can be seen, while there are significant discrepancies, the overall correspondence is acceptable for this type of sketch planning model.

Figure D-10. Example Trip Reductions

Example	TAZ	Vehicle Trip Reduction Granted For:					Total Reduction	% Reduction in VMT from Brentwood
		Residential Density`	Mix of Uses	Local Retail	Transit	Ped/Bike Friendliness		
Brentwood	899	1.4%	-3.0%	0.0%	0.1%	1.7%	0.3%	0.0%
Orinda	831	-9.5%	5.8%	0.0%	3.7%	1.4%	1.4%	5.6%
Pleasant Hill BART	806	14.4%	7.2%	3.0%	8.3%	3.3%	36.3%	40.2%
Emeryville	723	39.0%	1.7%	3.0%	4.4%	4.9%	53.1%	47.8%
Downtown Palo Alto	245	19.8%	4.4%	3.0%	6.1%	7.5%	40.8%	50.6%

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Appendix E. California Air District Contacts

Go to the following web site for a list of air district contacts:

http://www.arb.ca.gov/capcoa/roster.htm

Appendix F. State Of California Counties and Air Basins

A California Air Basin map is available on the internet at:
http://www.arb.ca.gov/knowzone/basin/basin.swf

and information on local air districts can be found at:
www.arb.ca.gov/capcoa/roster.htm

Appendix G. Construction Equipment Emission Factors

Equipment	MaxHP	AvgHP	Load
Aerial Lifts	15	15	0.46
Aerial Lifts	25	19	0.46
Aerial Lifts	50	34	0.46
Aerial Lifts	120	66	0.46
Aerial Lifts	500	369	0.46
Aerial Lifts	750	667	0.46
Air Compressors	15	12	0.48
Air Compressors	25	24	0.48
Air Compressors	50	37	0.48
Air Compressors	120	78	0.48
Air Compressors	175	147	0.48
Air Compressors	250	218	0.48
Air Compressors	500	385	0.48
Air Compressors	750	595	0.48
Air Compressors	1000	808	0.48
Bore/Drill Rigs	15	11	0.75
Bore/Drill Rigs	25	17	0.75
Bore/Drill Rigs	50	33	0.75
Bore/Drill Rigs	120	82	0.75
Bore/Drill Rigs	175	150	0.75
Bore/Drill Rigs	250	200	0.75
Bore/Drill Rigs	500	331	0.75
Bore/Drill Rigs	750	654	0.75
Bore/Drill Rigs	1000	987	0.75
Cement and Mortar Mixers	15	9	0.56
Cement and Mortar Mixers	25	25	0.56
Concrete/Industrial Saws	25	18	0.73
Concrete/Industrial Saws	50	33	0.73
Concrete/Industrial Saws	120	81	0.73
Concrete/Industrial Saws	175	175	0.73
Cranes	50	43	0.43
Cranes	120	93	0.43
Cranes	175	149	0.43
Cranes	250	208	0.43
Cranes	500	334	0.43
Cranes	750	562	0.43
Cranes	9999	1800	0.43
Crushing/Proc. Equipment	50	45	0.78

Equipment	MaxHP	AvgHP	Load
Crushing/Proc. Equipment	120	85	0.78
Crushing/Proc. Equipment	175	171	0.78
Crushing/Proc. Equipment	250	250	0.78
Crushing/Proc. Equipment	500	382	0.78
Crushing/Proc. Equipment	750	602	0.78
Crushing/Proc. Equipment	1000	1337	0.78
Dumpers/Tenders	50	16	0.38
Excavators	120	23	0.57
Excavators	175	35	0.57
Excavators	250	103	0.57
Excavators	500	157	0.57
Excavators	750	222	0.57
Excavators	9999	327	0.57
Excavators	25	542	0.57
Forklifts	25	39	0.3
Forklifts	50	83	0.3
Forklifts	120	149	0.3
Forklifts	175	205	0.3
Forklifts	250	295	0.3
Generator Sets	500	11	0.74
Generator Sets	750	19	0.74
Generator Sets	50	33	0.74
Generator Sets	120	84	0.74
Generator Sets	175	153	0.74
Generator Sets	250	229	0.74
Generator Sets	500	363	0.74
Generator Sets	15	586	0.74
Generator Sets	25	1130	0.74
Graders	50	36	0.61
Graders	120	98	0.61
Graders	175	162	0.61
Graders	250	225	0.61
Graders	500	300	0.61
Graders	750	635	0.61
Off-Highway Tractors	9999	115	0.65
Off-Highway Tractors	50	160	0.65
Off-Highway Tractors	120	160	0.65
Off-Highway Tractors	175	697	0.65
Off-Highway Tractors	250	999	0.65
Off-Highway Trucks	500	175	0.57
Off-Highway Trucks	750	233	0.57

Equipment	MaxHP	AvgHP	Load
Off-Highway Trucks	120	381	0.57
Off-Highway Trucks	175	618	0.57
Off-Highway Trucks	250	874	0.57
Other General Industrial Equipment	750	10	0.51
Other General Industrial Equipment	1000	24	0.51
Other General Industrial Equipment	175	34	0.51
Other General Industrial Equipment	250	97	0.51
Other General Industrial Equipment	500	150	0.51
Other General Industrial Equipment	750	212	0.51
Other General Industrial Equipment	1000	415	0.51
Other General Industrial Equipment	15	684	0.51
Other General Industrial Equipment	25	875	0.51
Other Material Handling Equipment	50	41	0.59
Other Material Handling Equipment	120	82	0.59
Other Material Handling Equipment	175	165	0.59
Other Material Handling Equipment	500	196	0.59
Other Material Handling Equipment	15	259	0.59
Other Material Handling Equipment	25	1002	0.59
Pavers	50	24	0.62
Pavers	120	36	0.62
Pavers	175	89	0.62
Pavers	250	165	0.62
Pavers	500	250	0.62
Pavers	750	300	0.62
Paving Equipment	1000	19	0.53
Paving Equipment	50	36	0.53
Paving Equipment	120	82	0.53
Paving Equipment	175	152	0.53
Paving Equipment	250	184	0.53
Pressure Washers	500	13	0.3
Pressure Washers	9999	19	0.3
Pressure Washers	25	38	0.3
Pressure Washers	50	64	0.3
Pressure Washers	120	152	0.6
Pressure Washers	175	191	0.6
Pumps	250	8	0.74
Pumps	500	21	0.74
Pumps	25	37	0.74
Pumps	50	84	0.74
Pumps	120	151	0.74
Pumps	175	217	0.74

Equipment	MaxHP	AvgHP	Load
Pumps	250	372	0.74
Pumps	15	615	0.74
Pumps	15	1460	0.74
Rollers	25	9	0.56
Rollers	50	19	0.56
Rollers	120	37	0.56
Rollers	15	84	0.56
Rollers	25	154	0.56
Rollers	50	218	0.56
Rollers	120	312	0.56
Rough Terrain Forklifts	175	45	0.6
Rough Terrain Forklifts	250	83	0.6
Rough Terrain Forklifts	500	166	0.6
Rough Terrain Forklifts	750	227	0.6
Rough Terrain Forklifts	9999	341	0.6
Rubber Tired Dozers	15	175	0.59
Rubber Tired Dozers	25	248	0.59
Rubber Tired Dozers	50	358	0.59
Rubber Tired Dozers	120	539	0.59
Rubber Tired Dozers	175	800	0.59
Rubber Tired Loaders	250	25	0.54
Rubber Tired Loaders	500	46	0.54
Rubber Tired Loaders	50	87	0.54
Rubber Tired Loaders	120	157	0.54
Rubber Tired Loaders	175	220	0.54
Rubber Tired Loaders	250	350	0.54
Rubber Tired Loaders	500	717	0.54
Rubber Tired Loaders	175	877	0.54
Scrapers	250	104	0.72
Scrapers	500	164	0.72
Scrapers	750	232	0.72
Scrapers	1000	356	0.72
Scrapers	25	615	0.72
Signal Boards	50	6	0.82
Signal Boards	120	37	0.78
Signal Boards	175	82	0.78
Signal Boards	250	158	0.78
Signal Boards	500	216	0.78
Skid Steer Loaders	750	20	0.55
Skid Steer Loaders	1000	37	0.55
Skid Steer Loaders	120	62	0.55

Equipment	MaxHP	AvgHP	Load
Surfacing Equipment	175	25	0.45
Surfacing Equipment	250	113	0.45
Surfacing Equipment	500	152	0.45
Surfacing Equipment	750	239	0.45
Surfacing Equipment	15	392	0.45
Surfacing Equipment	50	615	0.45
Sweepers/Scrubbers	120	14	0.68
Sweepers/Scrubbers	175	23	0.68
Sweepers/Scrubbers	250	37	0.68
Sweepers/Scrubbers	25	88	0.68
Sweepers/Scrubbers	50	163	0.68
Sweepers/Scrubbers	120	190	0.68
Tractors/Loaders/Backhoes	50	23	0.55
Tractors/Loaders/Backhoes	120	44	0.55
Tractors/Loaders/Backhoes	175	75	0.55
Tractors/Loaders/Backhoes	250	147	0.55
Tractors/Loaders/Backhoes	500	249	0.55
Tractors/Loaders/Backhoes	750	500	0.55
Tractors/Loaders/Backhoes	15	750	0.55
Trenchers	25	9	0.75
Trenchers	50	35	0.75
Trenchers	120	35	0.75
Trenchers	175	69	0.75
Trenchers	250	153	0.75
Trenchers	25	237	0.75
Trenchers	50	331	0.75
Trenchers	120	624	0.75
Welders	175	11	0.45
Welders	250	20	0.45
Welders	500	46	0.45
Welders	750	70	0.45
Welders	15	174	0.45
Welders	25	211	0.45
Welders	50	297	0.45

Appendix H. Equipment Selection Spreadsheet

Demolition One Acre		
Equipment Type	No. of Equip	hr/day
Rubber Tired Dozers	1	1
Concrete Saw	1	8
Excavator		
Bore/Drill Rigs		
Other Equip (Water Truck)		
Tractor/Loader/Backhoe	2	6
	4	

Demolition Two Acre		
Equipment Type	No. of Equip	hr/day
Rubber Tired Dozers	1	1
Concrete Saw	1	8
Excavator		
Bore/Drill Rigs		
Other Equip (Water Truck)		
Tractor/Loader/Backhoe	2	6
	4	

Demolition Three Acre		
Equipment Type	No. of Equip	hr/day
Rubber Tired Dozers	1	1
Concrete Saw	1	8
Excavator		
Bore/Drill Rigs		
Other Equip (Water Truck)		
Tractor/Loader/Backhoe	2	6
	4	

Demolition Five Acre		
Equipment Type	No. of Equip	hr/day
Rubber Tired Dozers	1	1
Concrete Saw	1	8
Excavator		
Bore/Drill Rigs		
Other Equip (Water Truck)		
Tractor/Loader/Backhoe	2	6
	4	

Demolition Ten Acre		
Equipment Type	No. of Equip	hr/day
Rubber Tired Dozers	1	8
Concrete Saw	1	8
Excavator		
Bore/Drill Rigs		
Other Equip (Water Truck)		
Tractor/Loader/Backhoe	3	8
	5	

Demolition Fifteen Acre		
Equipment Type	No. of Equip	hr/day
Rubber Tired Dozers	1	8
Concrete Saw		
Excavator		
Bore/Drill Rigs		
Other Equip (Water Truck)		
Tractor/Loader/Backhoe	3	8
	4	

Demolition Twenty Acre		
Equipment Type	No. of Equip	hr/day
Rubber Tired Dozers	2	8
Concrete Saw		
Excavator	3	8
Bore/Drill Rigs		
Other Equip (Water Truck)		
Tractor/Loader/Backhoe		
	5	

Demolition Twenty-five Acre		
Equipment Type	No. of Equip	hr/day
Rubber Tired Dozers	2	8
Concrete Saw		
Excavator	3	8
Bore/Drill Rigs		
Other Equip (Water Truck)		
Tractor/Loader/Backhoe		
	5	

Demolition Thirty Acre		
Equipment Type	No. of Equip	hr/day
Rubber Tired Dozers	2	8
Concrete Saw		
Excavator	3	8
Bore/Drill Rigs		
Other Equip (Water Truck)		
Tractor/Loader/Backhoe		
	5	

Demolition Thirty-four Acre		
Equipment Type	No. of Equip	hr/day
Rubber Tired Dozers	2	8
Concrete Saw		
Excavator	3	8
Bore/Drill Rigs		
Other Equip (Water Truck)		
Tractor/Loader/Backhoe		
	5	

Grading One Acre		
Equipment Type	No. of Equip	hr/day
Rubber Tired Dozers	1	6
Excavators		
Graders	1	6
Scrapers		
Tractor/Loader/Backhoe	1	7
Water Truck	1	8
	4	

Grading Two Acre		
Equipment Type	No. of Equip	hr/day
Rubber Tired Dozers	1	6
Excavators		
Graders	1	6
Scrapers		
Tractor/Loader/Backhoe	1	7
Water Truck	1	8
	4	

Grading Three Acre		
Equipment Type	No. of Equip	hr/day
Rubber Tired Dozers	1	6
Excavators		
Graders	1	6
Scrapers		
Tractor/Loader/Backhoe	1	7
Water Truck	1	8
	4	

Grading Five Acre		
Equipment Type	No. of Equip	hr/day
Rubber Tired Dozers	1	6
Excavators		
Graders	1	6
Scrapers		
Tractor/Loader/Backhoe	1	7
Water Truck	1	8
	4	

Grading Ten Acre		
Equipment Type	No. of Equip	hr/day
Rubber Tired Dozers	1	8
Excavators		
Graders	1	8
Scrapers		
Tractor/Loader/Backhoe	2	7
Water Truck	1	8
	5	

Grading Fifteen Acre		
Equipment Type	No. of Equip	hr/day
Rubber Tired Dozers	1	8
Excavators		
Graders	1	8
Scrapers		
Tractor/Loader/Backhoe	2	7
Water Truck	1	8
	5	

Grading Twenty Acre		
Equipment Type	No. of Equip	hr/day
Rubber Tired Dozers	1	8
Excavators	1	8
Graders	1	8
Scrapers		
Tractor/Loader/Backhoe	3	8
Water Truck	1	8
	7	

Grading Twenty-five Acre		
Equipment Type	No. of Equip	hr/day
Rubber Tired Dozers	1	8
Excavators	1	8
Graders	1	8
Scrapers	2	8
Tractor/Loader/Backhoe	3	8
Water Truck	1	8
	9	

Grading Thirty Acre		
Equipment Type	No. of Equip	hr/day
Rubber Tired Dozers	1	8
Excavators	1	8
Graders	1	8
Scrapers	2	8
Tractor/Loader/Backhoe	3	8
Water Truck	1	8
	9	

Grading Thirty-four Acre		
Equipment Type	No. of Equip	hr/day
Rubber Tired Dozers	1	8
Excavators	1	8
Graders	1	8
Scrapers	2	8
Tractor/Loader/Backhoe	3	8
Water Truck	1	8
	9	

Grading 73 acres			Grading 78 acres			Grading 86 acres			Grading 112 acres			Grading 138 acres		
Equipment Type	No. of Equip	hr/day	Equipment Type	No. of Equip	hr/day	Equipment Type	No. of Equip	hr/day	Equipment Type	No. of Equip	hr/day	Equipment Type	No. of Equip	hr/day
Rubber Tired Dozers	1	8	Rubber Tired Dozers	1	8	Rubber Tired Dozers	2	8	Rubber Tired Dozers	2	8	Rubber Tired Dozers	2	8
Excavators	1	8	Excavators	1	8	Excavators	1	8	Excavators			Excavators		
Graders	1	8	Graders	1	8	Graders	1	8	Graders	2	8	Graders	2	8
Scrapers	3	8	Scrapers	3	8	Scrapers	3	8	Scrapers	4	8	Scrapers	4	8
Tractor/Loader/Backhoe	3	8	Tractor/Loader/Backhoe	3	8	Tractor/Loader/Backhoe	2	8	Tractor/Loader/Backhoe	2	8	Tractor/Loader/Backhoe	1	8
Water Truck	1	8	Water Truck	1	8	Water Truck	1	8	Water Truck	2	8	Water Truck	2	8
											8	Compactor	1	8
	10			**10**			**10**			**12**			**12**	

Grading 151 acres			Grading 189 acres		
Equipment Type	No. of Equip	hr/day	Equipment Type	No. of Equip	hr/day
Rubber Tired Dozers	2	8	Rubber Tired Dozers	3	8
Excavators			Excavators		
Graders	2	8	Graders	2	8
Scrapers	5	8	Scrapers	6	8
Tractor/Loader/Backhoe	1	8	Tractor/Loader/Backhoe		
Water Truck	2	8	Water Truck	2	8
Compactor	1	8	Compactor	1	8
	13			**14**	

Construction One Acre			Construction Two Acre			Construction Three Acre			Construction Five Acre			Construction Ten Acre		
Equipment Type	No. of Equip	hr/day	Equipment Type	No. of Equip	hr/day	Equipment Type	No. of Equip	hr/day	Equipment Type	No. of Equip	hr/day	Equipment Type	No. of Equip	hr/day
Crane	1	4	Crane	1	6	Crane	1	6	Crane	1	6	Crane	1	6
Electric Welders			Electric Welders	3	8	Electric Welders	3	8	Electric Welders	3	8	Electric Welders	3	8
Excavator			Excavator			Excavator			Excavator			Excavator		
Fork Lift	2	6	Fork Lift	2	6	Fork Lift	2	6	Fork Lift	2	6	Fork Lift	2	6
Generator Sets			Generator Sets	1	8	Generator Sets	1	8	Generator Sets	1	8	Generator Sets	1	8
Tractor/Loader/Backhoe	1	8	Tractor/Loader/Backhoe	1	8	Tractor/Loader/Backhoe	1	8	Tractor/Loader/Backhoe	1	8	Tractor/Loader/Backhoe	1	8
	4			**8**			**8**			**8**			**8**	

Construction Fifteen Acre			Construction Twenty Acre			Construction Twenty-five Acre			Construction Thirty Acre			Construction Thirty-four Acre		
Equipment Type	No. of Equip	hr/day	Equipment Type	No. of Equip	hr/day	Equipment Type	No. of Equip	hr/day	Equipment Type	No. of Equip	hr/day	Equipment Type	No. of Equip	hr/day
Crane	1	7	Crane	1	7	Crane	1	7	Crane	1	7	Crane	1	7
Electric Welders	3	8	Electric Welders	1	8	Electric Welders	1	8	Electric Welders	1	8	Electric Welders	1	8
Excavator			Excavator			Excavator			Excavator			Excavator		
Fork Lift	2	7	Fork Lift	3	8	Fork Lift	3	8	Fork Lift	3	8	Fork Lift	3	8
Generator Sets	1	8	Generator Sets	1	8	Generator Sets	1	8	Generator Sets	1	8	Generator Sets	1	8
Tractor/Loader/Backhoe	1	8	Tractor/Loader/Backhoe	3	7	Tractor/Loader/Backhoe	3	7	Tractor/Loader/Backhoe	3	7	Tractor/Loader/Backhoe	3	7
	8			**9**			**9**			**9**			**9**	

Coating/Paving One Acre			Coating/Paving Two Acre			Coating/Paving Three Acre			Coating/Paving Five Acre			Coating/Paving Ten Acre		
Equipment Type	No. of Equip	hr/day	Equipment Type	No. of Equip	hr/day	Equipment Type	No. of Equip	hr/day	Equipment Type	No. of Equip	hr/day	Equipment Type	No. of Equip	hr/day
Pavers	1	7	Pavers	1	7	Pavers	1	7	Pavers	1	7	Pavers	1	7
Paving Equipment			Paving Equipment	1	8	Paving Equipment	1	8	Paving Equipment	2	6	Paving Equipment	2	6
Cement Mortar Mixers	4	6	Cement Mortar Mixers	4	6	Cement Mortar Mixers	4	6	Cement Mortar Mixers	4	6	Cement Mortar Mixers	4	6
Plate Compactor			Plate Compactor			Plate Compactor			Plate Compactor			Plate Compactor		
Roller	1	7	Roller	1	7	Roller	1	7	Roller	1	7	Roller	1	7
Tractor/Loader/Backhoe	1	7	Tractor/Loader/Backhoe	1	7	Tractor/Loader/Backhoe	1	7	Tractor/Loader/Backhoe	1	7	Tractor/Loader/Backhoe		
	7			**8**			**8**			**9**			**8**	

Coating/Paving Fifteen Acre			Coating/Paving Twenty Acre			Coating/Paving Twenty-five Acre			Coating/Paving Thirty Acre			Coating/Paving Thirty-four Acre		
Equipment Type	No. of Equip	hr/day	Equipment Type	No. of Equip	hr/day	Equipment Type	No. of Equip	hr/day	Equipment Type	No. of Equip	hr/day	Equipment Type	No. of Equip	hr/day
Pavers	1	8	Pavers	1	8	Pavers	1	8	Pavers	1	8	Pavers	1	8
Paving Equipment	2	6	Paving Equipment	2	6	Paving Equipment	2	6	Paving Equipment	2	8	Paving Equipment	2	8
Cement Mortar Mixers			Cement Mortar Mixers			Cement Mortar Mixers			Cement Mortar Mixers			Cement Mortar Mixers		
Plate Compactor			Plate Compactor			Plate Compactor			Plate Compactor			Plate Compactor		
Roller	2	6	Roller	2	6	Roller	2	6	Roller	2	6	Roller	2	6
Tractor/Loader/Backhoe			Tractor/Loader/Backhoe			Tractor/Loader/Backhoe			Tractor/Loader/Backhoe			Tractor/Loader/Backhoe		
	5			**5**			**5**			**5**			**5**	

Trenching 1-90 acres	No. of Equip	hr/day	Trenching 90+ acres	No. of Equip	hr/day
Boom Trucks (Other Industrial)	1	8	Boom Trucks (Other Industrial)	2	8
Excavators	2	8	Excavators	4	8
Loader	1	8	Loader	2	8

Trenching based on information from SMAQMD and assumes 1 trenching crew for up to 90 acres, 2 crews for projects in excess of 90 acres.

Appendix I. Construction Equipment Emission Factors (grams per brake-horsepower hour)

2005		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
Aerial Lifts	15	0.386	1.649	2.533	0.036	0.181	261.653
	25	0.680	1.687	2.695	0.030	0.212	261.653
	50	1.194	2.756	2.781	0.030	0.295	261.653
	120	0.585	1.774	3.600	0.027	0.290	261.653
	500	0.238	0.975	2.843	0.023	0.094	261.653
	750	0.244	0.975	2.908	0.024	0.095	261.653
Air Compressors	15	0.640	2.065	3.615	0.038	0.287	273.029
	25	0.740	1.816	2.830	0.031	0.225	273.029
	50	1.639	3.619	3.053	0.032	0.372	273.029
	120	0.697	1.996	4.025	0.029	0.362	273.029
	175	0.458	1.593	3.679	0.028	0.200	273.029
	250	0.320	0.893	3.465	0.028	0.126	273.029
	500	0.283	1.135	3.129	0.024	0.114	273.029
	750	0.289	1.135	3.201	0.025	0.115	273.029
	1000	0.353	1.397	3.757	0.025	0.124	273.029
Bore/Drill Rigs	15	0.540	2.605	3.562	0.060	0.255	426.608
	25	0.633	1.898	3.885	0.049	0.251	426.608
	50	1.575	4.183	4.161	0.050	0.437	426.608
	120	0.770	2.814	4.894	0.045	0.432	426.608
	175	0.482	2.279	4.404	0.043	0.225	426.608
	250	0.275	0.810	4.140	0.043	0.104	426.608
	500	0.234	0.787	3.399	0.038	0.096	426.608
	750	0.247	0.787	3.591	0.040	0.099	426.608
	1000	0.361	0.968	4.832	0.040	0.127	426.608
Cement and Mortar Mixers	15	0.497	2.044	3.206	0.045	0.232	318.534
	25	0.821	2.042	3.269	0.037	0.256	318.534
Concrete/Industrial Saws	25	0.574	1.776	3.699	0.048	0.236	415.232
	50	2.201	4.972	4.533	0.049	0.518	415.232
	120	0.984	2.921	5.917	0.044	0.501	415.232
	175	0.645	2.335	5.405	0.042	0.276	415.232
Cranes	50	1.725	3.738	2.855	0.029	0.376	244.589
	120	0.688	1.905	3.878	0.026	0.363	244.589
	175	0.455	1.530	3.539	0.025	0.202	244.589
	250	0.343	0.956	3.380	0.025	0.138	244.589
	500	0.305	1.272	3.027	0.022	0.123	244.589
	750	0.308	1.270	3.091	0.023	0.124	244.589
	9999	0.342	1.450	3.543	0.023	0.120	244.589
Crawler Tractors	50	2.651	5.713	4.299	0.043	0.573	364.039
	120	1.073	2.925	6.034	0.039	0.559	364.039
	175	0.712	2.373	5.494	0.037	0.317	364.039
	250	0.552	1.551	5.268	0.037	0.225	364.039
	500	0.490	2.328	4.735	0.032	0.198	364.039
	750	0.494	2.324	4.823	0.034	0.200	364.039

2005		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
	1000	0.542	2.580	5.471	0.034	0.195	364.039
Crushing/Proc. Equipment	50	2.742	6.051	4.979	0.052	0.619	443.672
	120	1.144	3.276	6.553	0.047	0.601	443.672
	175	0.751	2.615	5.987	0.045	0.331	443.672
	250	0.518	1.434	5.633	0.045	0.205	443.672
	500	0.458	1.800	5.047	0.039	0.184	443.672
	750	0.462	1.726	5.167	0.041	0.184	443.672
	9999	0.573	2.193	6.122	0.041	0.200	443.672
Dumpers/Tenders	25	0.440	1.175	2.094	0.025	0.152	216.148
Excavators	25	0.419	1.342	2.812	0.037	0.179	324.222
	50	2.114	4.737	3.670	0.038	0.477	324.222
	120	0.844	2.453	4.727	0.034	0.463	324.222
	175	0.555	1.960	4.314	0.033	0.251	324.222
	250	0.378	1.010	4.072	0.033	0.146	324.222
	500	0.337	1.149	3.550	0.029	0.132	324.222
	750	0.342	1.148	3.661	0.030	0.134	324.222
Forklifts	50	1.162	2.554	1.949	0.020	0.258	170.643
	120	0.457	1.292	2.483	0.018	0.253	170.643
	175	0.303	1.022	2.286	0.017	0.137	170.643
	250	0.184	0.466	2.118	0.017	0.069	170.643
	500	0.164	0.480	1.852	0.015	0.063	170.643
Generator Sets	15	0.852	3.183	5.429	0.059	0.359	420.920
	25	0.875	2.799	4.364	0.048	0.311	420.920
	50	1.841	4.286	4.445	0.049	0.461	420.920
	120	0.923	2.822	5.727	0.045	0.454	420.920
	175	0.602	2.255	5.233	0.043	0.250	420.920
	250	0.417	1.249	4.929	0.043	0.159	420.920
	500	0.374	1.504	4.535	0.037	0.147	420.920
	750	0.386	1.504	4.640	0.038	0.149	420.920
	9999	0.503	1.876	5.458	0.038	0.180	420.920
Graders	50	2.312	5.089	3.970	0.041	0.514	346.974
	120	0.934	2.653	5.299	0.037	0.498	346.974
	175	0.615	2.129	4.834	0.035	0.275	346.974
	250	0.449	1.244	4.599	0.035	0.179	346.974
	500	0.398	1.610	4.086	0.031	0.160	346.974
	750	0.403	1.608	4.185	0.032	0.162	346.974
Off-Highway Tractors	120	1.163	3.084	6.557	0.039	0.590	369.727
	175	0.781	2.535	5.981	0.038	0.345	369.727
	250	0.638	1.817	5.777	0.038	0.263	369.727
	750	0.568	3.043	5.323	0.034	0.231	369.727
	1000	0.608	3.279	5.887	0.034	0.224	369.727
Off-Highway Trucks	175	0.579	2.004	4.418	0.033	0.261	324.222
	250	0.401	1.057	4.176	0.033	0.154	324.222
	500	0.361	1.220	3.644	0.029	0.139	324.222
	750	0.364	1.219	3.754	0.030	0.141	324.222
	1000	0.416	1.472	4.502	0.030	0.145	324.222
Other Construction Equipment	15	0.447	2.153	2.945	0.050	0.211	352.662

2005		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
	25	0.523	1.569	3.211	0.040	0.208	352.663
	50	1.843	4.255	3.781	0.041	0.440	352.663
	120	0.805	2.476	4.803	0.037	0.426	352.663
	175	0.524	1.981	4.381	0.036	0.231	352.663
	500	0.314	1.164	3.652	0.031	0.127	352.663
Other General Industrial Equipment	15	0.314	1.771	2.211	0.040	0.164	290.093
	25	0.373	1.201	2.521	0.033	0.160	290.093
	50	2.024	4.391	3.362	0.034	0.444	290.093
	120	0.806	2.235	4.471	0.030	0.432	290.093
	175	0.532	1.782	4.086	0.029	0.238	290.093
	250	0.365	0.984	3.843	0.029	0.143	290.093
	500	0.324	1.242	3.433	0.025	0.129	290.093
	750	0.329	1.242	3.514	0.026	0.131	290.093
	1000	0.392	1.540	4.134	0.026	0.137	290.093
Other Material Handling Equipment	50	2.310	5.016	3.874	0.039	0.507	335.598
	120	0.925	2.571	5.150	0.035	0.493	335.598
	175	0.610	2.051	4.707	0.034	0.272	335.598
	250	0.419	1.135	4.427	0.034	0.165	335.598
	500	0.372	1.434	3.959	0.029	0.148	335.598
	9999	0.452	1.777	4.766	0.029	0.157	335.598
Pavers	25	0.776	2.022	3.475	0.040	0.259	352.663
	50	2.466	5.310	4.129	0.041	0.536	352.663
	120	1.026	2.805	5.883	0.037	0.523	352.663
	175	0.682	2.286	5.353	0.036	0.300	352.663
	250	0.545	1.566	5.152	0.036	0.225	352.663
	500	0.482	2.452	4.671	0.031	0.197	352.663
Paving Equipment	25	0.447	1.341	2.745	0.035	0.177	301.470
	50	2.086	4.493	3.522	0.035	0.454	301.470
	120	0.871	2.383	5.005	0.032	0.443	301.470
	175	0.577	1.939	4.551	0.031	0.253	301.470
	250	0.463	1.334	4.381	0.031	0.191	301.470
Plate Compactors	15	0.321	1.496	2.147	0.034	0.152	244.588
Pressure Washers	15	0.345	1.291	2.201	0.024	0.145	170.643
	25	0.355	1.135	1.769	0.020	0.126	170.643
	50	0.612	1.486	1.752	0.020	0.165	170.643
	120	0.344	1.093	2.223	0.018	0.163	170.643
Pumps	15	0.986	3.183	5.574	0.059	0.442	420.920
	25	1.141	2.799	4.364	0.048	0.347	420.920
	50	1.953	4.495	4.487	0.049	0.479	420.920
	120	0.948	2.864	5.808	0.045	0.471	420.920
	175	0.619	2.289	5.307	0.043	0.260	420.920
	250	0.430	1.273	4.999	0.043	0.166	420.920
	500	0.385	1.578	4.585	0.037	0.152	420.920
	750	0.396	1.578	4.690	0.038	0.154	420.920
	9999	0.511	1.954	5.514	0.038	0.182	420.920
Rollers	15	0.403	1.945	2.660	0.045	0.190	318.534

2005		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
	25	0.473	1.417	2.901	0.037	0.187	318.534
	50	1.955	4.312	3.591	0.037	0.441	318.534
	120	0.828	2.368	4.841	0.034	0.427	318.534
	175	0.545	1.905	4.417	0.032	0.238	318.534
	250	0.415	1.192	4.222	0.032	0.168	318.534
	500	0.367	1.608	3.810	0.028	0.149	318.534
Rough Terrain Forklifts	50	2.171	4.823	3.845	0.040	0.489	341.286
	120	0.878	2.543	5.011	0.036	0.472	341.286
	175	0.577	2.031	4.575	0.035	0.258	341.286
	250	0.406	1.115	4.330	0.035	0.160	341.286
	500	0.359	1.314	3.831	0.030	0.144	341.286
Rubber Tired Dozers	175	0.732	2.350	5.534	0.034	0.324	335.598
	250	0.599	1.690	5.348	0.034	0.246	335.598
	500	0.532	2.862	4.849	0.030	0.215	335.598
	750	0.534	2.857	4.919	0.031	0.216	335.598
	1000	0.566	3.068	5.432	0.031	0.210	335.598
Rubber Tired Loaders	25	0.424	1.314	2.736	0.035	0.175	307.158
	50	2.024	4.460	3.502	0.036	0.451	307.158
	120	0.819	2.334	4.656	0.033	0.436	307.158
	175	0.539	1.872	4.251	0.031	0.241	307.158
	250	0.392	1.087	4.042	0.031	0.156	307.158
	500	0.347	1.385	3.590	0.027	0.140	307.158
	750	0.352	1.383	3.679	0.029	0.141	307.158
	1000	0.403	1.611	4.302	0.029	0.141	307.158
Scrapers	120	1.211	3.295	6.829	0.043	0.628	409.544
	175	0.804	2.676	6.216	0.042	0.357	409.544
	250	0.629	1.776	5.968	0.042	0.257	409.544
	500	0.558	2.699	5.375	0.036	0.226	409.544
	750	0.563	2.695	5.472	0.038	0.228	409.544
Signal Boards	15	0.558	2.848	3.552	0.066	0.263	466.425
	50	2.229	5.076	4.779	0.052	0.534	443.672
	120	1.032	3.085	6.207	0.047	0.523	443.672
	175	0.674	2.467	5.667	0.045	0.288	443.672
	250	0.563	1.634	6.449	0.055	0.220	536.104
Skid Steer Loaders	25	0.770	1.941	3.165	0.036	0.244	312.846
	50	1.520	3.627	3.263	0.037	0.375	312.846
	120	0.673	2.165	4.020	0.033	0.367	312.846
Surfacing Equipment	50	1.351	3.053	2.800	0.030	0.318	255.965
	120	0.620	1.830	3.750	0.027	0.311	255.965
	175	0.406	1.476	3.417	0.026	0.174	255.965
	250	0.308	0.917	3.268	0.026	0.123	255.965
	500	0.275	1.248	2.972	0.023	0.111	255.965
	750	0.280	1.246	3.035	0.024	0.112	255.965
Sweepers/Scrubbers	15	0.419	2.362	2.947	0.054	0.218	386.791
	25	0.509	1.657	3.453	0.044	0.216	386.791
	50	2.534	5.546	4.383	0.045	0.565	386.791
	120	1.019	2.878	5.646	0.041	0.550	386.791

2005		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
	175	0.671	2.276	5.188	0.039	0.299	386.791
	250	0.428	1.121	4.829	0.039	0.164	386.791
Tractors/Loaders/Backhoes	25	0.572	1.583	2.970	0.036	0.206	312.846
	50	1.879	4.261	3.454	0.037	0.433	312.846
	120	0.768	2.294	4.396	0.033	0.419	312.846
	175	0.503	1.832	4.016	0.032	0.227	312.846
	250	0.337	0.914	3.785	0.032	0.131	312.846
	500	0.298	1.007	3.299	0.032	0.118	312.846
	750	0.304	1.006	3.406	0.033	0.120	312.846
Trenchers	15	0.510	2.605	3.249	0.060	0.241	426.608
	25	0.589	1.824	3.800	0.049	0.242	426.608
	50	2.840	6.142	4.943	0.050	0.624	426.608
	120	1.217	3.351	7.074	0.045	0.611	426.608
	175	0.809	2.739	6.439	0.043	0.353	426.608
	250	0.655	1.906	6.207	0.043	0.271	426.608
	500	0.579	3.060	5.655	0.038	0.238	426.608
	750	0.586	3.054	5.743	0.040	0.239	426.608
Welders	15	0.600	1.936	3.389	0.036	0.269	255.965
	25	0.694	1.702	2.654	0.029	0.211	255.965
	50	1.411	3.154	2.813	0.030	0.328	255.965
	120	0.626	1.825	3.689	0.027	0.320	255.965
	175	0.410	1.458	3.371	0.026	0.177	255.965
	250	0.287	0.817	3.176	0.026	0.113	255.965
	500	0.255	1.049	2.883	0.023	0.102	255.965
Water Trucks	175	0.579	2.004	4.418	0.033	0.261	324.222
	250	0.401	1.057	4.176	0.033	0.154	324.222
	500	0.361	1.220	3.644	0.029	0.139	324.222
	750	0.364	1.219	3.754	0.030	0.141	324.222
	1000	0.416	1.472	4.502	0.030	0.145	324.222

2006		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
Aerial Lifts	15	0.386	1.649	2.533	0.036	0.181	261.653
	25	0.680	1.687	2.695	0.030	0.212	261.653
	50	1.194	2.756	2.781	0.030	0.295	261.653
	120	0.585	1.774	3.600	0.027	0.290	261.653
	500	0.238	0.975	2.843	0.023	0.094	261.653
	750	0.244	0.975	2.908	0.024	0.095	261.653
Air Compressors	15	0.640	2.065	3.615	0.038	0.287	273.029
	25	0.740	1.816	2.830	0.031	0.225	273.029
	50	1.639	3.619	3.053	0.032	0.372	273.029
	120	0.697	1.996	4.025	0.029	0.362	273.029
	175	0.458	1.593	3.679	0.028	0.200	273.029
	250	0.320	0.893	3.465	0.028	0.126	273.029
	500	0.283	1.135	3.129	0.024	0.114	273.029
	750	0.289	1.135	3.201	0.025	0.115	273.029
	1000	0.353	1.397	3.757	0.025	0.124	273.029
Bore/Drill Rigs	15	0.540	2.605	3.562	0.060	0.255	426.608
	25	0.633	1.898	3.885	0.049	0.251	426.608
	50	1.575	4.183	4.161	0.050	0.437	426.608
	120	0.770	2.814	4.894	0.045	0.432	426.608
	175	0.482	2.279	4.404	0.043	0.225	426.608
	250	0.275	0.810	4.140	0.043	0.104	426.608
	500	0.234	0.787	3.399	0.038	0.096	426.608
	750	0.247	0.787	3.591	0.040	0.099	426.608
	1000	0.361	0.968	4.832	0.040	0.127	426.608
Cement and Mortar Mixers	15	0.497	2.044	3.206	0.045	0.232	318.534
	25	0.821	2.042	3.269	0.037	0.256	318.534
Concrete/Industrial Saws	25	0.574	1.776	3.699	0.048	0.236	415.232
	50	2.201	4.972	4.533	0.049	0.518	415.232
	120	0.984	2.921	5.917	0.044	0.501	415.232
	175	0.645	2.335	5.405	0.042	0.276	415.232
Cranes	50	1.725	3.738	2.855	0.029	0.376	244.589
	120	0.688	1.905	3.878	0.026	0.363	244.589
	175	0.455	1.530	3.539	0.025	0.202	244.589
	250	0.343	0.956	3.380	0.025	0.138	244.589
	500	0.305	1.272	3.027	0.022	0.123	244.589
	750	0.308	1.270	3.091	0.023	0.124	244.589
	9999	0.342	1.450	3.543	0.023	0.120	244.589
Crawler Tractors	50	2.651	5.713	4.299	0.043	0.573	364.039
	120	1.073	2.925	6.034	0.039	0.559	364.039
	175	0.712	2.373	5.494	0.037	0.317	364.039
	250	0.552	1.551	5.268	0.037	0.225	364.039
	500	0.490	2.328	4.735	0.032	0.198	364.039
	750	0.494	2.324	4.823	0.034	0.200	364.039
	1000	0.542	2.580	5.471	0.034	0.195	364.039
Crushing/Proc. Equipment	50	2.742	6.051	4.979	0.052	0.619	443.672
	120	1.144	3.276	6.553	0.047	0.601	443.672

2006		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
	175	0.751	2.615	5.987	0.045	0.331	443.672
	250	0.518	1.434	5.633	0.045	0.205	443.672
	500	0.458	1.800	5.047	0.039	0.184	443.672
	750	0.462	1.726	5.167	0.041	0.184	443.672
	9999	0.573	2.193	6.122	0.041	0.200	443.672
Dumpers/Tenders	25	0.440	1.175	2.094	0.025	0.152	216.148
Excavators	25	0.419	1.342	2.812	0.037	0.179	324.222
	50	2.114	4.737	3.670	0.038	0.477	324.222
	120	0.844	2.453	4.727	0.034	0.463	324.222
	175	0.555	1.960	4.314	0.033	0.251	324.222
	250	0.378	1.010	4.072	0.033	0.146	324.222
	500	0.337	1.149	3.550	0.029	0.132	324.222
	750	0.342	1.148	3.661	0.030	0.134	324.222
Forklifts	50	1.162	2.554	1.949	0.020	0.258	170.643
	120	0.457	1.292	2.483	0.018	0.253	170.643
	175	0.303	1.022	2.286	0.017	0.137	170.643
	250	0.184	0.466	2.118	0.017	0.069	170.643
	500	0.164	0.480	1.852	0.015	0.063	170.643
Generator Sets	15	0.852	3.183	5.429	0.059	0.359	420.920
	25	0.875	2.799	4.364	0.048	0.311	420.920
	50	1.841	4.286	4.445	0.049	0.461	420.920
	120	0.923	2.822	5.727	0.045	0.454	420.920
	175	0.602	2.255	5.233	0.043	0.250	420.920
	250	0.417	1.249	4.929	0.043	0.159	420.920
	500	0.374	1.504	4.535	0.037	0.147	420.920
	750	0.386	1.504	4.640	0.038	0.149	420.920
	9999	0.503	1.876	5.458	0.038	0.180	420.920
Graders	50	2.312	5.089	3.970	0.041	0.514	346.974
	120	0.934	2.653	5.299	0.037	0.498	346.974
	175	0.615	2.129	4.834	0.035	0.275	346.974
	250	0.449	1.244	4.599	0.035	0.179	346.974
	500	0.398	1.610	4.086	0.031	0.160	346.974
	750	0.403	1.608	4.185	0.032	0.162	346.974
Off-Highway Tractors	120	1.163	3.084	6.557	0.039	0.590	369.727
	175	0.781	2.535	5.981	0.038	0.345	369.727
	250	0.638	1.817	5.777	0.038	0.263	369.727
	750	0.568	3.043	5.323	0.034	0.231	369.727
	1000	0.608	3.279	5.887	0.034	0.224	369.727
Off-Highway Trucks	175	0.579	2.004	4.418	0.033	0.261	324.222
	250	0.401	1.057	4.176	0.033	0.154	324.222
	500	0.361	1.220	3.644	0.029	0.139	324.222
	750	0.364	1.219	3.754	0.030	0.141	324.222
	1000	0.416	1.472	4.502	0.030	0.145	324.222
Other Construction Equipment	15	0.447	2.153	2.945	0.050	0.211	352.662
	25	0.523	1.569	3.211	0.040	0.208	352.663
	50	1.843	4.255	3.781	0.041	0.440	352.663
	120	0.805	2.476	4.803	0.037	0.426	352.663

2006		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
	175	0.524	1.981	4.381	0.036	0.231	352.663
	500	0.314	1.164	3.652	0.031	0.127	352.663
Other General Industrial Equipment	15	0.314	1.771	2.211	0.040	0.164	290.093
	25	0.373	1.201	2.521	0.033	0.160	290.093
	50	2.024	4.391	3.362	0.034	0.444	290.093
	120	0.806	2.235	4.471	0.030	0.432	290.093
	175	0.532	1.782	4.086	0.029	0.238	290.093
	250	0.365	0.984	3.843	0.029	0.143	290.093
	500	0.324	1.242	3.433	0.025	0.129	290.093
	750	0.329	1.242	3.514	0.026	0.131	290.093
	1000	0.392	1.540	4.134	0.026	0.137	290.093
Other Material Handling Equipment	50	2.310	5.016	3.874	0.039	0.507	335.598
	120	0.925	2.571	5.150	0.035	0.493	335.598
	175	0.610	2.051	4.707	0.034	0.272	335.598
	250	0.419	1.135	4.427	0.034	0.165	335.598
	500	0.372	1.434	3.959	0.029	0.148	335.598
	9999	0.452	1.777	4.766	0.029	0.157	335.598
Pavers	25	0.776	2.022	3.475	0.040	0.259	352.663
	50	2.466	5.310	4.129	0.041	0.536	352.663
	120	1.026	2.805	5.883	0.037	0.523	352.663
	175	0.682	2.286	5.353	0.036	0.300	352.663
	250	0.545	1.566	5.152	0.036	0.225	352.663
	500	0.482	2.452	4.671	0.031	0.197	352.663
Paving Equipment	25	0.447	1.341	2.745	0.035	0.177	301.470
	50	2.086	4.493	3.522	0.035	0.454	301.470
	120	0.871	2.383	5.005	0.032	0.443	301.470
	175	0.577	1.939	4.551	0.031	0.253	301.470
	250	0.463	1.334	4.381	0.031	0.191	301.470
Plate Compactors	15	0.321	1.496	2.147	0.034	0.152	244.588
Pressure Washers	15	0.345	1.291	2.201	0.024	0.145	170.643
	25	0.355	1.135	1.769	0.020	0.126	170.643
	50	0.612	1.486	1.752	0.020	0.165	170.643
	120	0.344	1.093	2.223	0.018	0.163	170.643
Pumps	15	0.986	3.183	5.574	0.059	0.442	420.920
	25	1.141	2.799	4.364	0.048	0.347	420.920
	50	1.953	4.495	4.487	0.049	0.479	420.920
	120	0.948	2.864	5.808	0.045	0.471	420.920
	175	0.619	2.289	5.307	0.043	0.260	420.920
	250	0.430	1.273	4.999	0.043	0.166	420.920
	500	0.385	1.578	4.585	0.037	0.152	420.920
	750	0.396	1.578	4.690	0.038	0.154	420.920
	9999	0.511	1.954	5.514	0.038	0.182	420.920
Rollers	15	0.403	1.945	2.660	0.045	0.190	318.534
	25	0.473	1.417	2.901	0.037	0.187	318.534
	50	1.955	4.312	3.591	0.037	0.441	318.534
	120	0.828	2.368	4.841	0.034	0.427	318.534
	175	0.545	1.905	4.417	0.032	0.238	318.534

2006		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
	250	0.415	1.192	4.222	0.032	0.168	318.534
	500	0.367	1.608	3.810	0.028	0.149	318.534
Rough Terrain Forklifts	50	2.171	4.823	3.845	0.040	0.489	341.286
	120	0.878	2.543	5.011	0.036	0.472	341.286
	175	0.577	2.031	4.575	0.035	0.258	341.286
	250	0.406	1.115	4.330	0.035	0.160	341.286
	500	0.359	1.314	3.831	0.030	0.144	341.286
Rubber Tired Dozers	175	0.732	2.350	5.534	0.034	0.324	335.598
	250	0.599	1.690	5.348	0.034	0.246	335.598
	500	0.532	2.862	4.849	0.030	0.215	335.598
	750	0.534	2.857	4.919	0.031	0.216	335.598
	1000	0.566	3.068	5.432	0.031	0.210	335.598
Rubber Tired Loaders	25	0.424	1.314	2.736	0.035	0.175	307.158
	50	2.024	4.460	3.502	0.036	0.451	307.158
	120	0.819	2.334	4.656	0.033	0.436	307.158
	175	0.539	1.872	4.251	0.031	0.241	307.158
	250	0.392	1.087	4.042	0.031	0.156	307.158
	500	0.347	1.385	3.590	0.027	0.140	307.158
	750	0.352	1.383	3.679	0.029	0.141	307.158
	1000	0.403	1.611	4.302	0.029	0.141	307.158
Scrapers	120	1.211	3.295	6.829	0.043	0.628	409.544
	175	0.804	2.676	6.216	0.042	0.357	409.544
	250	0.629	1.776	5.968	0.042	0.257	409.544
	500	0.558	2.699	5.375	0.036	0.226	409.544
	750	0.563	2.695	5.472	0.038	0.228	409.544
Signal Boards	15	0.558	2.848	3.552	0.066	0.263	466.425
	50	2.229	5.076	4.779	0.052	0.534	443.672
	120	1.032	3.085	6.207	0.047	0.523	443.672
	175	0.674	2.467	5.667	0.045	0.288	443.672
	250	0.563	1.634	6.449	0.055	0.220	536.104
Skid Steer Loaders	25	0.770	1.941	3.165	0.036	0.244	312.846
	50	1.520	3.627	3.263	0.037	0.375	312.846
	120	0.673	2.165	4.020	0.033	0.367	312.846
Surfacing Equipment	50	1.351	3.053	2.800	0.030	0.318	255.965
	120	0.620	1.830	3.750	0.027	0.311	255.965
	175	0.406	1.476	3.417	0.026	0.174	255.965
	250	0.308	0.917	3.268	0.026	0.123	255.965
	500	0.275	1.248	2.972	0.023	0.111	255.965
	750	0.280	1.246	3.035	0.024	0.112	255.965
Sweepers/Scrubbers	15	0.419	2.362	2.947	0.054	0.218	386.791
	25	0.509	1.657	3.453	0.044	0.216	386.791
	50	2.534	5.546	4.383	0.045	0.565	386.791
	120	1.019	2.878	5.646	0.041	0.550	386.791
	175	0.671	2.276	5.188	0.039	0.299	386.791
	250	0.428	1.121	4.829	0.039	0.164	386.791
Tractors/Loaders/Backhoes	25	0.572	1.583	2.970	0.036	0.206	312.846
	50	1.879	4.261	3.454	0.037	0.433	312.846

2006		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
	120	0.768	2.294	4.396	0.033	0.419	312.846
	175	0.503	1.832	4.016	0.032	0.227	312.846
	250	0.337	0.914	3.785	0.032	0.131	312.846
	500	0.298	1.007	3.299	0.032	0.118	312.846
	750	0.304	1.006	3.406	0.033	0.120	312.846
Trenchers	15	0.510	2.605	3.249	0.060	0.241	426.608
	25	0.589	1.824	3.800	0.049	0.242	426.608
	50	2.840	6.142	4.943	0.050	0.624	426.608
	120	1.217	3.351	7.074	0.045	0.611	426.608
	175	0.809	2.739	6.439	0.043	0.353	426.608
	250	0.655	1.906	6.207	0.043	0.271	426.608
	500	0.579	3.060	5.655	0.038	0.238	426.608
	750	0.586	3.054	5.743	0.040	0.239	426.608
Welders	15	0.600	1.936	3.389	0.036	0.269	255.965
	25	0.694	1.702	2.654	0.029	0.211	255.965
	50	1.411	3.154	2.813	0.030	0.328	255.965
	120	0.626	1.825	3.689	0.027	0.320	255.965
	175	0.410	1.458	3.371	0.026	0.177	255.965
	250	0.287	0.817	3.176	0.026	0.113	255.965
	500	0.255	1.049	2.883	0.023	0.102	255.965
Water Trucks	175	0.579	2.004	4.418	0.033	0.261	324.222
	250	0.401	1.057	4.176	0.033	0.154	324.222
	500	0.361	1.220	3.644	0.029	0.139	324.222
	750	0.364	1.219	3.754	0.030	0.141	324.222
	1000	0.416	1.472	4.502	0.030	0.145	324.222

2007		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
Aerial Lifts	15	0.361	1.628	2.367	0.004	0.166	261.653
	25	0.636	1.611	2.629	0.003	0.198	261.653
	50	1.147	2.710	2.745	0.003	0.279	261.653
	120	0.559	1.758	3.499	0.003	0.272	261.653
	500	0.222	0.900	2.708	0.003	0.086	261.653
	750	0.229	0.900	2.773	0.003	0.087	261.653
Air Compressors	15	0.614	2.031	3.493	0.004	0.268	273.029
	25	0.705	1.756	2.779	0.003	0.213	273.029
	50	1.588	3.576	3.018	0.004	0.353	273.029
	120	0.669	1.982	3.916	0.003	0.342	273.029
	175	0.439	1.586	3.524	0.003	0.188	273.029
	250	0.301	0.842	3.314	0.003	0.115	273.029
	500	0.267	1.036	2.982	0.003	0.104	273.029
	750	0.273	1.036	3.054	0.003	0.105	273.029
	1000	0.336	1.294	3.658	0.003	0.115	273.029
Bore/Drill Rigs	15	0.510	2.605	3.251	0.007	0.234	426.608
	25	0.591	1.839	3.726	0.005	0.238	426.608
	50	1.347	3.967	4.067	0.006	0.396	426.608
	120	0.668	2.772	4.653	0.005	0.376	426.608
	175	0.418	2.280	3.906	0.005	0.196	426.608
	250	0.255	0.801	3.700	0.005	0.097	426.608
	500	0.223	0.778	3.061	0.004	0.090	426.608
	750	0.233	0.778	3.223	0.004	0.093	426.608
	1000	0.322	0.889	4.540	0.004	0.114	426.608
Cement and Mortar Mixers	15	0.464	2.011	3.005	0.005	0.212	318.534
	25	0.777	1.966	3.199	0.004	0.241	318.534
Concrete/Industrial Saws	25	0.541	1.737	3.532	0.005	0.225	415.232
	50	2.079	4.833	4.451	0.005	0.484	415.232
	120	0.926	2.885	5.705	0.005	0.465	415.232
	175	0.606	2.317	5.102	0.005	0.256	415.232
Cranes	50	1.640	3.644	2.812	0.003	0.353	244.589
	120	0.652	1.880	3.740	0.003	0.338	244.589
	175	0.432	1.514	3.351	0.003	0.187	244.589
	250	0.322	0.898	3.198	0.003	0.124	244.589
	500	0.288	1.152	2.859	0.002	0.111	244.589
	750	0.291	1.151	2.922	0.002	0.112	244.589
	9999	0.323	1.322	3.421	0.002	0.110	244.589
Crawler Tractors	50	2.527	5.578	4.239	0.005	0.538	364.039
	120	1.020	2.886	5.830	0.004	0.521	364.039
	175	0.678	2.347	5.217	0.004	0.294	364.039
	250	0.523	1.469	5.001	0.004	0.204	364.039
	500	0.467	2.143	4.490	0.004	0.181	364.039
	750	0.470	2.140	4.577	0.004	0.183	364.039
	1000	0.514	2.381	5.289	0.004	0.180	364.039
Crushing/Proc. Equipment	50	2.644	5.964	4.918	0.006	0.586	443.672
	120	1.094	3.251	6.362	0.005	0.566	443.672

2007		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
	175	0.718	2.605	5.710	0.005	0.311	443.672
	250	0.487	1.348	5.364	0.005	0.185	443.672
	500	0.431	1.639	4.791	0.004	0.168	443.672
	750	0.437	1.580	4.925	0.004	0.168	443.672
	9999	0.545	2.035	5.958	0.004	0.185	443.672
Dumpers/Tenders	25	0.388	1.087	2.009	0.003	0.138	216.148
Excavators	25	0.405	1.335	2.668	0.004	0.173	324.222
	50	1.958	4.569	3.601	0.004	0.442	324.222
	120	0.787	2.424	4.538	0.004	0.424	324.222
	175	0.518	1.952	4.015	0.004	0.229	324.222
	250	0.353	0.948	3.792	0.004	0.131	324.222
	500	0.318	1.061	3.303	0.003	0.119	324.222
	750	0.322	1.061	3.408	0.003	0.121	324.222
Forklifts	50	1.077	2.454	1.907	0.002	0.239	170.643
	120	0.427	1.276	2.375	0.002	0.233	170.643
	175	0.283	1.017	2.129	0.002	0.126	170.643
	250	0.168	0.423	1.968	0.002	0.060	170.643
	500	0.151	0.425	1.712	0.002	0.056	170.643
Generator Sets	15	0.813	3.131	5.245	0.007	0.335	420.920
	25	0.830	2.707	4.284	0.005	0.293	420.920
	50	1.764	4.209	4.385	0.005	0.435	420.920
	120	0.879	2.796	5.563	0.005	0.425	420.920
	175	0.572	2.241	4.999	0.005	0.234	420.920
	250	0.389	1.177	4.702	0.005	0.145	420.920
	500	0.350	1.391	4.316	0.004	0.135	420.920
	750	0.360	1.391	4.419	0.004	0.136	420.920
	9999	0.476	1.754	5.304	0.004	0.165	420.920
Graders	50	2.183	4.950	3.907	0.004	0.480	346.974
	120	0.881	2.618	5.103	0.004	0.461	346.974
	175	0.580	2.111	4.552	0.004	0.254	346.974
	250	0.421	1.171	4.331	0.004	0.162	346.974
	500	0.376	1.462	3.842	0.003	0.145	346.974
	750	0.380	1.460	3.938	0.003	0.147	346.974
Off-Highway Tractors	120	1.116	3.046	6.367	0.004	0.553	369.727
	175	0.749	2.506	5.729	0.004	0.322	369.727
	250	0.609	1.736	5.532	0.004	0.242	369.727
	750	0.544	2.847	5.095	0.004	0.213	369.727
	1000	0.581	3.073	5.716	0.004	0.207	369.727
Off-Highway Trucks	175	0.543	1.995	4.116	0.004	0.238	324.222
	250	0.376	0.992	3.892	0.004	0.138	324.222
	500	0.342	1.125	3.397	0.003	0.125	324.222
	750	0.344	1.124	3.501	0.003	0.127	324.222
	1000	0.391	1.356	4.324	0.003	0.133	324.222
Other Construction Equipment	15	0.422	2.153	2.687	0.005	0.194	352.662
	25	0.489	1.520	3.080	0.004	0.196	352.662
	50	1.708	4.109	3.707	0.005	0.408	352.662
	120	0.746	2.446	4.614	0.004	0.391	352.663

2007		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
	175	0.485	1.972	4.076	0.004	0.212	352.663
	500	0.291	1.067	3.395	0.003	0.114	352.663
Other General Industrial Equipment	15	0.303	1.771	2.133	0.005	0.156	290.093
	25	0.363	1.194	2.391	0.004	0.155	290.093
	50	1.954	4.326	3.325	0.004	0.420	290.093
	120	0.776	2.219	4.348	0.003	0.408	290.093
	175	0.512	1.775	3.915	0.003	0.224	290.093
	250	0.346	0.928	3.676	0.003	0.130	290.093
	500	0.309	1.135	3.272	0.003	0.118	290.093
	750	0.313	1.135	3.354	0.003	0.120	290.093
	1000	0.375	1.425	4.026	0.003	0.127	290.093
Other Material Handling Equipment	50	2.232	4.945	3.832	0.004	0.481	335.598
	120	0.891	2.554	5.009	0.004	0.466	335.598
	175	0.587	2.043	4.511	0.004	0.257	335.598
	250	0.397	1.070	4.236	0.004	0.150	335.598
	500	0.354	1.310	3.775	0.003	0.136	335.598
	9999	0.431	1.645	4.642	0.003	0.146	335.598
Pavers	25	0.695	1.884	3.345	0.004	0.237	352.663
	50	2.370	5.205	4.075	0.005	0.505	352.663
	120	0.979	2.767	5.694	0.004	0.488	352.663
	175	0.650	2.258	5.102	0.004	0.279	352.663
	250	0.516	1.485	4.908	0.004	0.205	352.663
	500	0.458	2.259	4.444	0.003	0.181	352.662
Paving Equipment	25	0.418	1.300	2.633	0.004	0.168	301.470
	50	2.007	4.407	3.476	0.004	0.428	301.470
	120	0.830	2.350	4.842	0.004	0.414	301.470
	175	0.550	1.914	4.340	0.003	0.236	301.470
	250	0.437	1.263	4.175	0.003	0.174	301.470
Plate Compactors	15	0.305	1.493	1.991	0.004	0.140	244.589
Pressure Washers	15	0.329	1.269	2.126	0.003	0.136	170.643
	25	0.336	1.098	1.737	0.002	0.119	170.643
	50	0.582	1.454	1.726	0.002	0.155	170.643
	120	0.326	1.082	2.158	0.002	0.153	170.643
Pumps	15	0.946	3.131	5.385	0.007	0.413	420.920
	25	1.087	2.707	4.284	0.005	0.328	420.920
	50	1.875	4.418	4.427	0.005	0.453	420.920
	120	0.905	2.838	5.643	0.005	0.442	420.920
	175	0.590	2.275	5.071	0.005	0.244	420.920
	250	0.403	1.199	4.771	0.005	0.151	420.920
	500	0.360	1.455	4.364	0.004	0.139	420.920
	750	0.371	1.455	4.468	0.004	0.141	420.920
	9999	0.484	1.823	5.360	0.004	0.168	420.920
Rollers	15	0.381	1.945	2.427	0.005	0.175	318.534
	25	0.442	1.373	2.782	0.004	0.177	318.534
	50	1.864	4.212	3.536	0.004	0.414	318.534
	120	0.783	2.336	4.671	0.004	0.397	318.534
	175	0.515	1.885	4.181	0.004	0.220	318.534

2007		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
	250	0.388	1.122	3.994	0.004	0.152	318.534
	500	0.345	1.456	3.598	0.003	0.136	318.534
Rough Terrain Forklifts	50	2.035	4.672	3.776	0.004	0.455	341.286
	120	0.824	2.513	4.819	0.004	0.436	341.286
	175	0.541	2.019	4.290	0.004	0.238	341.286
	250	0.376	1.040	4.057	0.004	0.143	341.286
	500	0.335	1.196	3.581	0.003	0.129	341.286
Rubber Tired Dozers	175	0.703	2.323	5.300	0.004	0.302	335.598
	250	0.574	1.617	5.122	0.004	0.226	335.598
	500	0.512	2.685	4.641	0.003	0.198	335.598
	750	0.514	2.681	4.710	0.003	0.199	335.598
	1000	0.542	2.883	5.277	0.003	0.194	335.598
Rubber Tired Loaders	25	0.401	1.285	2.613	0.004	0.167	307.158
	50	1.911	4.338	3.446	0.004	0.422	307.158
	120	0.772	2.304	4.484	0.004	0.404	307.158
	175	0.508	1.856	4.001	0.003	0.222	307.158
	250	0.367	1.022	3.804	0.003	0.141	307.158
	500	0.328	1.258	3.374	0.003	0.127	307.158
	750	0.332	1.256	3.460	0.003	0.128	307.158
	1000	0.379	1.469	4.144	0.003	0.129	307.158
Scrapers	120	1.153	3.250	6.600	0.005	0.585	409.544
	175	0.766	2.646	5.910	0.005	0.332	409.544
	250	0.595	1.682	5.672	0.005	0.234	409.544
	500	0.531	2.482	5.102	0.004	0.207	409.544
	750	0.535	2.478	5.197	0.004	0.208	409.544
Signal Boards	15	0.546	2.848	3.428	0.007	0.251	466.425
	50	2.133	4.980	4.711	0.006	0.503	443.672
	120	0.980	3.055	6.017	0.005	0.489	443.672
	175	0.639	2.452	5.393	0.005	0.269	443.672
	250	0.526	1.536	6.129	0.006	0.200	536.104
Skid Steer Loaders	25	0.715	1.846	3.079	0.004	0.227	312.846
	50	1.381	3.484	3.194	0.004	0.346	312.846
	120	0.614	2.139	3.845	0.004	0.333	312.846
Surfacing Equipment	50	1.285	2.982	2.756	0.003	0.299	255.965
	120	0.584	1.805	3.619	0.003	0.288	255.965
	175	0.382	1.461	3.232	0.003	0.161	255.965
	250	0.289	0.866	3.090	0.003	0.112	255.965
	500	0.258	1.144	2.808	0.003	0.101	255.965
	750	0.263	1.143	2.868	0.003	0.102	255.965
Sweepers/Scrubbers	15	0.404	2.362	2.843	0.006	0.208	386.791
	25	0.494	1.619	3.298	0.005	0.208	386.791
	50	2.400	5.398	4.307	0.005	0.529	386.791
	120	0.966	2.850	5.444	0.005	0.514	386.791
	175	0.635	2.267	4.895	0.004	0.279	386.791
	250	0.394	1.032	4.546	0.004	0.145	386.791
Tractors/Loaders/Backhoes	25	0.500	1.462	2.845	0.004	0.187	312.846
	50	1.736	4.108	3.387	0.004	0.401	312.846

2007		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
	120	0.713	2.267	4.221	0.004	0.384	312.846
	175	0.467	1.826	3.729	0.004	0.207	312.846
	250	0.312	0.859	3.518	0.004	0.117	312.846
	500	0.279	0.932	3.064	0.004	0.107	312.846
	750	0.284	0.932	3.165	0.004	0.109	312.846
Trenchers	15	0.499	2.605	3.135	0.007	0.229	426.608
	25	0.556	1.784	3.629	0.005	0.231	426.608
	50	2.734	6.028	4.878	0.006	0.588	426.608
	120	1.162	3.307	6.854	0.005	0.571	426.608
	175	0.771	2.706	6.144	0.005	0.329	426.608
	250	0.621	1.812	5.921	0.005	0.247	426.608
	500	0.551	2.833	5.388	0.004	0.218	426.608
	750	0.557	2.829	5.474	0.004	0.219	426.608
Welders	15	0.575	1.904	3.275	0.004	0.251	255.965
	25	0.661	1.646	2.605	0.003	0.200	255.965
	50	1.362	3.108	2.778	0.003	0.311	255.965
	120	0.599	1.810	3.586	0.003	0.301	255.965
	175	0.392	1.450	3.225	0.003	0.166	255.965
	250	0.269	0.770	3.034	0.003	0.103	255.965
	500	0.240	0.957	2.746	0.003	0.093	255.965
Water Trucks	175	0.543	1.995	4.116	0.004	0.238	324.222
	250	0.376	0.992	3.892	0.004	0.138	324.222
	500	0.342	1.125	3.397	0.003	0.125	324.222
	750	0.344	1.124	3.501	0.003	0.127	324.222
	1000	0.391	1.356	4.324	0.003	0.133	324.222

2008		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
Aerial Lifts	15	0.341	1.613	2.223	0.004	0.145	261.653
	25	0.589	1.530	2.557	0.003	0.184	261.653
	50	1.101	2.668	2.711	0.003	0.270	261.653
	120	0.532	1.744	3.358	0.003	0.264	261.653
	500	0.209	0.832	2.585	0.003	0.081	261.653
	750	0.215	0.832	2.649	0.003	0.083	261.653
Air Compressors	15	0.589	1.999	3.380	0.004	0.255	273.029
	25	0.673	1.701	2.730	0.003	0.204	273.029
	50	1.536	3.535	2.985	0.004	0.344	273.029
	120	0.641	1.969	3.764	0.003	0.334	273.029
	175	0.423	1.582	3.381	0.003	0.184	273.029
	250	0.285	0.795	3.173	0.003	0.108	273.029
	500	0.253	0.947	2.847	0.003	0.099	273.029
	750	0.258	0.947	2.918	0.003	0.100	273.029
	1000	0.320	1.200	3.562	0.003	0.110	273.029
Bore/Drill Rigs	15	0.502	2.605	3.164	0.007	0.193	426.608
	25	0.560	1.798	3.584	0.005	0.213	426.608
	50	1.118	3.759	3.984	0.006	0.348	426.608
	120	0.565	2.729	4.183	0.005	0.330	426.608
	175	0.364	2.280	3.468	0.005	0.177	426.608
	250	0.239	0.794	3.312	0.005	0.093	426.608
	500	0.215	0.772	2.772	0.004	0.088	426.608
	750	0.222	0.772	2.904	0.004	0.090	426.608
	1000	0.289	0.832	4.262	0.004	0.106	426.608
Cement and Mortar Mixers	15	0.437	1.987	2.831	0.005	0.187	318.534
	25	0.729	1.884	3.125	0.004	0.226	318.534
Concrete/Industrial Saws	25	0.520	1.716	3.387	0.005	0.200	415.232
	50	1.949	4.690	4.369	0.005	0.460	415.232
	120	0.865	2.849	5.394	0.005	0.444	415.232
	175	0.568	2.301	4.810	0.005	0.245	415.232
Cranes	50	1.547	3.543	2.768	0.003	0.337	244.589
	120	0.615	1.857	3.548	0.003	0.324	244.589
	175	0.410	1.503	3.171	0.003	0.179	244.589
	250	0.304	0.846	3.024	0.003	0.117	244.589
	500	0.273	1.054	2.699	0.002	0.105	244.589
	750	0.275	1.053	2.762	0.002	0.106	244.589
	9999	0.305	1.215	3.300	0.002	0.105	244.588
Crawler Tractors	50	2.392	5.435	4.179	0.005	0.516	364.039
	120	0.964	2.847	5.542	0.004	0.499	364.039
	175	0.645	2.323	4.949	0.004	0.282	364.039
	250	0.496	1.393	4.744	0.004	0.193	364.039
	500	0.446	1.973	4.256	0.004	0.172	364.039
	750	0.448	1.970	4.341	0.004	0.173	364.039
	1000	0.488	2.196	5.107	0.004	0.171	364.039
Crushing/Proc. Equipment	50	2.539	5.875	4.859	0.006	0.568	443.672
	120	1.044	3.227	6.089	0.005	0.550	443.672

2008		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
	175	0.689	2.597	5.453	0.005	0.303	443.672
	250	0.459	1.271	5.115	0.005	0.174	443.672
	500	0.409	1.495	4.556	0.004	0.159	443.672
	750	0.415	1.448	4.700	0.004	0.160	443.672
	9999	0.519	1.891	5.796	0.004	0.177	443.672
Dumpers/Tenders	25	0.342	1.009	1.932	0.003	0.122	216.148
Excavators	25	0.397	1.335	2.547	0.004	0.151	324.222
	50	1.790	4.397	3.534	0.004	0.414	324.222
	120	0.726	2.394	4.242	0.004	0.397	324.222
	175	0.484	1.946	3.731	0.004	0.216	324.222
	250	0.331	0.894	3.527	0.004	0.122	324.222
	500	0.302	0.984	3.074	0.003	0.111	324.222
	750	0.304	0.983	3.173	0.003	0.113	324.222
Forklifts	50	0.976	2.339	1.861	0.002	0.223	170.643
	120	0.393	1.257	2.208	0.002	0.218	170.643
	175	0.262	1.012	1.967	0.002	0.118	170.643
	250	0.157	0.402	1.832	0.002	0.056	170.643
	500	0.143	0.394	1.587	0.002	0.052	170.643
Generator Sets	15	0.777	3.082	5.074	0.007	0.317	420.920
	25	0.789	2.623	4.209	0.005	0.280	420.920
	50	1.686	4.133	4.326	0.005	0.420	420.920
	120	0.835	2.771	5.331	0.005	0.412	420.920
	175	0.545	2.230	4.782	0.005	0.227	420.920
	250	0.365	1.111	4.491	0.005	0.137	420.920
	500	0.328	1.287	4.113	0.004	0.127	420.920
	750	0.338	1.287	4.215	0.004	0.129	420.920
	9999	0.451	1.641	5.154	0.004	0.158	420.920
Graders	50	2.044	4.804	3.844	0.004	0.456	346.974
	120	0.824	2.585	4.816	0.004	0.439	346.974
	175	0.548	2.096	4.284	0.004	0.242	346.974
	250	0.396	1.105	4.076	0.004	0.151	346.974
	500	0.357	1.335	3.615	0.003	0.137	346.974
	750	0.360	1.333	3.707	0.003	0.138	346.974
Off-Highway Tractors	120	1.066	3.008	6.105	0.004	0.534	369.727
	175	0.718	2.478	5.482	0.004	0.310	369.727
	250	0.582	1.659	5.293	0.004	0.230	369.727
	750	0.522	2.661	4.873	0.004	0.204	369.727
	1000	0.556	2.876	5.543	0.004	0.199	369.727
Off-Highway Trucks	175	0.509	1.988	3.831	0.004	0.225	324.222
	250	0.355	0.934	3.624	0.004	0.128	324.222
	500	0.325	1.040	3.167	0.003	0.117	324.222
	750	0.327	1.040	3.264	0.003	0.119	324.222
	1000	0.369	1.252	4.143	0.003	0.127	324.222
Other Construction Equipment	15	0.415	2.153	2.615	0.005	0.159	352.663
	25	0.463	1.487	2.963	0.004	0.176	352.663
	50	1.567	3.962	3.634	0.005	0.381	352.663
	120	0.685	2.415	4.311	0.004	0.367	352.663

2008		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
	175	0.449	1.964	3.791	0.004	0.201	352.663
	500	0.270	0.980	3.159	0.003	0.107	352.663
Other General Industrial Equipment	15	0.301	1.771	2.115	0.005	0.118	290.093
	25	0.355	1.194	2.281	0.004	0.136	290.093
	50	1.878	4.258	3.290	0.004	0.408	290.093
	120	0.745	2.204	4.177	0.003	0.397	290.093
	175	0.494	1.769	3.753	0.003	0.218	290.093
	250	0.329	0.878	3.519	0.003	0.123	290.093
	500	0.296	1.038	3.123	0.003	0.112	290.093
	750	0.299	1.038	3.205	0.003	0.113	290.093
	1000	0.359	1.320	3.918	0.003	0.123	290.093
Other Material Handling Equipment	50	2.148	4.871	3.792	0.004	0.468	335.598
	120	0.855	2.536	4.814	0.004	0.454	335.598
	175	0.566	2.036	4.327	0.004	0.250	335.598
	250	0.378	1.012	4.056	0.004	0.141	335.598
	500	0.339	1.199	3.605	0.003	0.129	335.598
	9999	0.413	1.524	4.519	0.003	0.141	335.598
Pavers	25	0.621	1.757	3.223	0.004	0.212	352.663
	50	2.264	5.092	4.020	0.005	0.486	352.663
	120	0.929	2.730	5.432	0.004	0.471	352.663
	175	0.619	2.232	4.860	0.004	0.269	352.663
	250	0.489	1.409	4.673	0.004	0.193	352.663
	500	0.435	2.079	4.228	0.003	0.171	352.663
Paving Equipment	25	0.396	1.271	2.533	0.004	0.151	301.470
	50	1.921	4.316	3.430	0.004	0.413	301.470
	120	0.788	2.317	4.620	0.004	0.399	301.470
	175	0.524	1.891	4.136	0.003	0.227	301.470
	250	0.414	1.196	3.976	0.003	0.164	301.470
Plate Compactors	15	0.292	1.493	1.862	0.004	0.118	244.589
Pressure Washers	15	0.315	1.249	2.057	0.003	0.128	170.643
	25	0.320	1.063	1.706	0.002	0.114	170.643
	50	0.552	1.423	1.702	0.002	0.149	170.643
	120	0.308	1.072	2.066	0.002	0.147	170.643
Pumps	15	0.909	3.082	5.210	0.007	0.393	420.920
	25	1.038	2.623	4.209	0.005	0.314	420.920
	50	1.795	4.343	4.370	0.005	0.438	420.920
	120	0.860	2.814	5.409	0.005	0.428	420.920
	175	0.562	2.264	4.853	0.005	0.236	420.920
	250	0.378	1.132	4.559	0.005	0.143	420.920
	500	0.338	1.342	4.160	0.004	0.132	420.920
	750	0.348	1.342	4.262	0.004	0.134	420.920
	9999	0.459	1.701	5.209	0.004	0.160	420.920
Rollers	15	0.375	1.945	2.362	0.005	0.144	318.534
	25	0.418	1.343	2.676	0.004	0.159	318.534
	50	1.762	4.104	3.480	0.004	0.395	318.534
	120	0.736	2.306	4.430	0.004	0.380	318.534
	175	0.487	1.869	3.957	0.004	0.211	318.534

2008		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
	250	0.364	1.057	3.777	0.004	0.142	318.534
	500	0.325	1.329	3.399	0.003	0.128	318.534
Rough Terrain Forklifts	50	1.889	4.515	3.707	0.004	0.430	341.286
	120	0.767	2.483	4.532	0.004	0.414	341.286
	175	0.508	2.009	4.018	0.004	0.226	341.286
	250	0.349	0.970	3.797	0.004	0.132	341.286
	500	0.313	1.089	3.346	0.003	0.120	341.286
Rubber Tired Dozers	175	0.675	2.298	5.071	0.004	0.290	335.598
	250	0.551	1.548	4.900	0.004	0.216	335.598
	500	0.494	2.517	4.441	0.003	0.189	335.598
	750	0.495	2.513	4.508	0.003	0.191	335.598
	1000	0.520	2.706	5.120	0.003	0.186	335.598
Rubber Tired Loaders	25	0.385	1.269	2.505	0.004	0.148	307.158
	50	1.787	4.207	3.389	0.004	0.400	307.158
	120	0.722	2.275	4.232	0.004	0.384	307.158
	175	0.479	1.844	3.764	0.003	0.212	307.158
	250	0.345	0.965	3.579	0.003	0.132	307.158
	500	0.310	1.151	3.173	0.003	0.119	307.158
	750	0.314	1.150	3.256	0.003	0.121	307.158
	1000	0.357	1.347	3.987	0.003	0.122	307.158
Scrapers	120	1.091	3.206	6.282	0.005	0.562	409.544
	175	0.729	2.617	5.614	0.005	0.318	409.544
	250	0.565	1.595	5.387	0.005	0.220	409.544
	500	0.507	2.282	4.842	0.004	0.196	409.544
	750	0.510	2.279	4.935	0.004	0.198	409.544
Signal Boards	15	0.543	2.848	3.400	0.007	0.189	466.425
	50	2.037	4.890	4.648	0.006	0.485	443.672
	120	0.929	3.027	5.748	0.005	0.472	443.672
	175	0.608	2.440	5.142	0.005	0.261	443.672
	250	0.493	1.449	5.837	0.006	0.188	536.104
Skid Steer Loaders	25	0.662	1.755	2.996	0.004	0.211	312.846
	50	1.235	3.339	3.129	0.004	0.318	312.846
	120	0.553	2.112	3.547	0.004	0.308	312.846
Surfacing Equipment	50	1.213	2.907	2.712	0.003	0.285	255.965
	120	0.547	1.781	3.430	0.003	0.275	255.965
	175	0.360	1.448	3.057	0.003	0.154	255.965
	250	0.270	0.819	2.922	0.003	0.105	255.965
	500	0.242	1.051	2.653	0.003	0.096	255.965
	750	0.247	1.050	2.711	0.003	0.096	255.965
Sweepers/Scrubbers	15	0.401	2.362	2.820	0.006	0.157	386.791
	25	0.483	1.599	3.162	0.005	0.187	386.791
	50	2.224	5.198	4.218	0.005	0.499	386.791
	120	0.900	2.815	5.111	0.005	0.490	386.791
	175	0.595	2.257	4.577	0.004	0.266	386.791
	250	0.358	0.942	4.241	0.004	0.131	386.791
Tractors/Loaders/Backhoes	25	0.467	1.411	2.754	0.004	0.170	312.846
	50	1.584	3.950	3.322	0.004	0.374	312.846

2008		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
	120	0.655	2.240	3.937	0.004	0.360	312.846
	175	0.434	1.822	3.460	0.004	0.196	312.846
	250	0.291	0.811	3.268	0.004	0.109	312.846
	500	0.263	0.870	2.847	0.004	0.100	312.846
	750	0.267	0.870	2.942	0.004	0.102	312.846
Trenchers	15	0.497	2.605	3.110	0.007	0.173	426.608
	25	0.534	1.763	3.480	0.005	0.206	426.608
	50	2.617	5.904	4.813	0.006	0.567	426.608
	120	1.103	3.263	6.548	0.005	0.551	426.608
	175	0.735	2.676	5.861	0.005	0.317	426.608
	250	0.589	1.724	5.646	0.005	0.235	426.608
	500	0.524	2.621	5.134	0.004	0.208	426.608
	750	0.529	2.617	5.218	0.004	0.209	426.608
Welders	15	0.552	1.874	3.168	0.004	0.239	255.965
	25	0.631	1.595	2.559	0.003	0.191	255.965
	50	1.312	3.065	2.745	0.003	0.302	255.965
	120	0.572	1.796	3.442	0.003	0.293	255.965
	175	0.376	1.444	3.090	0.003	0.162	255.965
	250	0.254	0.727	2.902	0.003	0.097	255.965
	500	0.226	0.874	2.620	0.003	0.088	255.965
Water Trucks	175	0.509	1.988	3.831	0.004	0.225	324.222
	250	0.355	0.934	3.624	0.004	0.128	324.222
	500	0.325	1.040	3.167	0.003	0.117	324.222
	750	0.327	1.040	3.264	0.003	0.119	324.222
	1000	0.369	1.252	4.143	0.003	0.127	324.222

2009		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
Aerial Lifts	15	0.326	1.604	2.100	0.004	0.127	261.653
	25	0.542	1.449	2.484	0.003	0.169	261.653
	50	1.053	2.623	2.677	0.003	0.260	261.653
	120	0.506	1.730	3.222	0.003	0.256	261.653
	500	0.197	0.769	2.467	0.003	0.077	261.653
	750	0.202	0.769	2.529	0.003	0.078	261.653
Air Compressors	15	0.566	1.968	3.268	0.004	0.242	273.029
	25	0.642	1.647	2.682	0.003	0.194	273.029
	50	1.479	3.489	2.952	0.004	0.334	273.029
	120	0.614	1.957	3.614	0.003	0.325	273.029
	175	0.407	1.579	3.239	0.003	0.179	273.029
	250	0.269	0.751	3.035	0.003	0.102	273.029
	500	0.240	0.867	2.716	0.003	0.093	273.029
	750	0.245	0.867	2.786	0.003	0.095	273.029
	1000	0.305	1.115	3.468	0.003	0.105	273.029
Bore/Drill Rigs	15	0.498	2.605	3.121	0.007	0.157	426.608
	25	0.538	1.773	3.459	0.005	0.191	426.608
	50	0.921	3.590	3.925	0.006	0.305	426.608
	120	0.475	2.693	3.767	0.005	0.289	426.608
	175	0.318	2.281	3.088	0.005	0.160	426.608
	250	0.227	0.789	2.974	0.005	0.090	426.608
	500	0.208	0.767	2.531	0.004	0.086	426.608
	750	0.214	0.767	2.634	0.004	0.087	426.608
	1000	0.264	0.795	4.027	0.004	0.099	426.608
Cement and Mortar Mixers	15	0.415	1.970	2.679	0.005	0.166	318.534
	25	0.679	1.798	3.045	0.004	0.211	318.534
Concrete/Industrial Saws	25	0.508	1.710	3.263	0.005	0.178	415.232
	50	1.820	4.550	4.292	0.005	0.437	415.232
	120	0.807	2.816	5.099	0.005	0.423	415.232
	175	0.533	2.288	4.532	0.005	0.234	415.232
Cranes	50	1.451	3.441	2.726	0.003	0.321	244.589
	120	0.579	1.836	3.366	0.003	0.309	244.589
	175	0.389	1.493	2.998	0.003	0.172	244.589
	250	0.287	0.799	2.858	0.003	0.109	244.589
	500	0.260	0.972	2.549	0.002	0.099	244.589
	750	0.261	0.971	2.610	0.002	0.100	244.589
	9999	0.290	1.124	3.186	0.002	0.100	244.589
Crawler Tractors	50	2.255	5.292	4.121	0.005	0.492	364.039
	120	0.910	2.810	5.265	0.004	0.476	364.039
	175	0.613	2.301	4.690	0.004	0.269	364.039
	250	0.472	1.323	4.496	0.004	0.182	364.039
	500	0.427	1.817	4.035	0.004	0.163	364.039
	750	0.429	1.814	4.117	0.004	0.164	364.039
	1000	0.464	2.027	4.933	0.004	0.163	364.039
Crushing/Proc. Equipment	50	2.425	5.772	4.802	0.006	0.548	443.672
	120	0.993	3.205	5.822	0.005	0.533	443.672

2009		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
	175	0.660	2.590	5.201	0.005	0.294	443.672
	250	0.433	1.200	4.873	0.005	0.163	443.672
	500	0.388	1.369	4.331	0.004	0.150	443.672
	750	0.394	1.332	4.482	0.004	0.152	443.672
	9999	0.495	1.761	5.636	0.004	0.170	443.672
Dumpers/Tenders	25	0.322	0.977	1.876	0.003	0.112	216.148
Excavators	25	0.394	1.335	2.509	0.004	0.131	324.222
	50	1.625	4.232	3.473	0.004	0.385	324.222
	120	0.669	2.367	3.962	0.004	0.370	324.222
	175	0.452	1.940	3.465	0.004	0.203	324.222
	250	0.312	0.845	3.279	0.004	0.113	324.222
	500	0.287	0.915	2.865	0.003	0.105	324.222
	750	0.290	0.914	2.956	0.003	0.106	324.222
Forklifts	50	0.872	2.224	1.817	0.002	0.206	170.643
	120	0.359	1.240	2.045	0.002	0.203	170.643
	175	0.242	1.008	1.819	0.002	0.110	170.643
	250	0.150	0.388	1.702	0.002	0.053	170.643
	500	0.138	0.374	1.472	0.002	0.049	170.643
Generator Sets	15	0.742	3.034	4.907	0.007	0.299	420.920
	25	0.750	2.540	4.135	0.005	0.267	420.920
	50	1.606	4.057	4.269	0.005	0.404	420.920
	120	0.791	2.748	5.106	0.005	0.398	420.920
	175	0.518	2.221	4.571	0.005	0.220	420.920
	250	0.341	1.050	4.288	0.005	0.129	420.920
	500	0.306	1.191	3.918	0.004	0.121	420.920
	750	0.316	1.191	4.017	0.004	0.122	420.920
	9999	0.427	1.535	5.009	0.004	0.151	420.920
Graders	50	1.903	4.659	3.785	0.004	0.432	346.974
	120	0.770	2.554	4.545	0.004	0.416	346.974
	175	0.517	2.084	4.030	0.004	0.230	346.974
	250	0.374	1.047	3.836	0.004	0.142	346.974
	500	0.340	1.227	3.402	0.003	0.129	346.974
	750	0.343	1.225	3.491	0.003	0.131	346.974
Off-Highway Tractors	120	1.017	2.970	5.850	0.004	0.515	369.727
	175	0.688	2.452	5.242	0.004	0.299	369.727
	250	0.557	1.585	5.060	0.004	0.219	369.727
	750	0.501	2.485	4.659	0.004	0.195	369.727
	1000	0.532	2.690	5.377	0.004	0.190	369.727
Off-Highway Trucks	175	0.477	1.982	3.564	0.004	0.212	324.222
	250	0.336	0.883	3.375	0.004	0.120	324.222
	500	0.310	0.965	2.955	0.003	0.110	324.222
	750	0.312	0.964	3.045	0.003	0.112	324.222
	1000	0.351	1.157	3.973	0.003	0.121	324.222
Other Construction Equipment	15	0.411	2.153	2.580	0.005	0.130	352.663
	25	0.445	1.465	2.859	0.004	0.158	352.663
	50	1.431	3.823	3.569	0.005	0.356	352.663
	120	0.628	2.388	4.031	0.004	0.345	352.663

2009		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
	175	0.416	1.958	3.529	0.004	0.190	352.663
	500	0.252	0.905	2.944	0.003	0.100	352.663
Other General Industrial Equipment	15	0.301	1.771	2.115	0.005	0.087	290.093
	25	0.352	1.194	2.246	0.004	0.118	290.093
	50	1.793	4.178	3.253	0.004	0.395	290.093
	120	0.713	2.188	4.006	0.003	0.384	290.093
	175	0.475	1.763	3.590	0.003	0.211	290.093
	250	0.314	0.831	3.361	0.003	0.116	290.093
	500	0.284	0.952	2.977	0.003	0.106	290.093
	750	0.287	0.952	3.058	0.003	0.108	290.093
	1000	0.344	1.224	3.812	0.003	0.118	290.093
Other Material Handling Equipment	50	2.054	4.783	3.750	0.004	0.452	335.598
	120	0.818	2.518	4.619	0.004	0.441	335.598
	175	0.545	2.030	4.141	0.004	0.242	335.598
	250	0.359	0.957	3.877	0.004	0.133	335.598
	500	0.325	1.099	3.437	0.003	0.122	335.598
	9999	0.396	1.414	4.397	0.003	0.136	335.598
Pavers	25	0.555	1.644	3.111	0.004	0.189	352.663
	50	2.156	4.978	3.968	0.005	0.468	352.663
	120	0.881	2.695	5.180	0.004	0.453	352.663
	175	0.590	2.209	4.628	0.004	0.258	352.663
	250	0.463	1.338	4.449	0.004	0.183	352.663
	500	0.415	1.914	4.023	0.003	0.163	352.663
Paving Equipment	25	0.380	1.253	2.444	0.004	0.135	301.470
	50	1.833	4.223	3.386	0.004	0.398	301.470
	120	0.748	2.287	4.407	0.004	0.384	301.470
	175	0.500	1.870	3.941	0.003	0.218	301.470
	250	0.392	1.133	3.786	0.003	0.155	301.470
Plate Compactors	15	0.289	1.493	1.822	0.004	0.101	244.589
Pressure Washers	15	0.301	1.230	1.990	0.003	0.121	170.643
	25	0.304	1.030	1.677	0.002	0.108	170.643
	50	0.521	1.391	1.678	0.002	0.143	170.643
	120	0.291	1.062	1.977	0.002	0.141	170.643
Pumps	15	0.872	3.034	5.038	0.007	0.372	420.920
	25	0.990	2.540	4.135	0.005	0.300	420.920
	50	1.714	4.267	4.313	0.005	0.422	420.920
	120	0.817	2.791	5.183	0.005	0.414	420.920
	175	0.536	2.255	4.641	0.005	0.229	420.920
	250	0.354	1.070	4.353	0.005	0.135	420.920
	500	0.317	1.238	3.963	0.004	0.125	420.920
	750	0.326	1.238	4.064	0.004	0.127	420.920
	9999	0.434	1.588	5.064	0.004	0.153	420.920
Rollers	15	0.372	1.945	2.331	0.005	0.117	318.534
	25	0.402	1.324	2.582	0.004	0.143	318.534
	50	1.660	3.994	3.426	0.004	0.377	318.534
	120	0.691	2.279	4.202	0.004	0.363	318.534
	175	0.460	1.857	3.743	0.004	0.202	318.534

2009		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
	250	0.342	0.999	3.572	0.004	0.134	318.534
	500	0.306	1.222	3.212	0.003	0.121	318.534
Rough Terrain Forklifts	50	1.744	4.364	3.644	0.004	0.405	341.286
	120	0.714	2.455	4.261	0.004	0.392	341.286
	175	0.477	2.002	3.761	0.004	0.215	341.286
	250	0.325	0.908	3.553	0.004	0.122	341.286
	500	0.295	0.996	3.127	0.003	0.112	341.286
Rubber Tired Dozers	175	0.647	2.274	4.849	0.004	0.279	335.598
	250	0.528	1.482	4.685	0.004	0.206	335.598
	500	0.476	2.357	4.248	0.003	0.181	335.598
	750	0.477	2.354	4.313	0.003	0.182	335.598
	1000	0.500	2.538	4.967	0.003	0.179	335.598
Rubber Tired Loaders	25	0.376	1.265	2.414	0.004	0.132	307.158
	50	1.662	4.077	3.336	0.004	0.378	307.158
	120	0.674	2.249	3.994	0.004	0.365	307.158
	175	0.452	1.835	3.540	0.003	0.202	307.158
	250	0.325	0.914	3.367	0.003	0.124	307.158
	500	0.295	1.065	2.985	0.003	0.112	307.158
	750	0.298	1.064	3.064	0.003	0.114	307.158
	1000	0.337	1.245	3.839	0.003	0.117	307.158
Scrapers	120	1.032	3.165	5.977	0.005	0.538	409.544
	175	0.694	2.592	5.330	0.005	0.305	409.544
	250	0.537	1.515	5.114	0.005	0.208	409.544
	500	0.485	2.099	4.596	0.004	0.186	409.544
	750	0.487	2.097	4.686	0.004	0.188	409.544
Signal Boards	15	0.543	2.848	3.400	0.007	0.139	466.425
	50	1.939	4.799	4.587	0.006	0.466	443.672
	120	0.879	3.002	5.491	0.005	0.456	443.672
	175	0.578	2.431	4.902	0.005	0.252	443.672
	250	0.462	1.369	5.557	0.006	0.177	536.104
Skid Steer Loaders	25	0.612	1.669	2.916	0.004	0.195	312.846
	50	1.095	3.202	3.071	0.004	0.291	312.846
	120	0.496	2.087	3.273	0.004	0.284	312.846
Surfacing Equipment	50	1.141	2.832	2.671	0.003	0.271	255.965
	120	0.512	1.759	3.251	0.003	0.263	255.965
	175	0.339	1.437	2.892	0.003	0.147	255.965
	250	0.253	0.776	2.764	0.003	0.099	255.965
	500	0.228	0.970	2.509	0.003	0.090	255.965
	750	0.232	0.969	2.564	0.003	0.091	255.965
Sweepers/Scrubbers	15	0.401	2.362	2.820	0.006	0.115	386.791
	25	0.474	1.593	3.044	0.005	0.166	386.791
	50	2.029	4.972	4.124	0.005	0.466	386.791
	120	0.830	2.778	4.767	0.005	0.461	386.791
	175	0.553	2.246	4.247	0.004	0.252	386.791
	250	0.336	0.897	3.964	0.004	0.122	386.791
Tractors/Loaders/Backhoes	25	0.442	1.374	2.672	0.004	0.156	312.846
	50	1.437	3.799	3.263	0.004	0.347	312.846

2009		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
	120	0.601	2.214	3.672	0.004	0.335	312.846
	175	0.403	1.818	3.209	0.004	0.184	312.846
	250	0.273	0.770	3.036	0.004	0.102	312.846
	500	0.250	0.817	2.650	0.004	0.094	312.846
	750	0.252	0.816	2.738	0.004	0.096	312.846
Trenchers	15	0.497	2.605	3.110	0.007	0.127	426.608
	25	0.522	1.757	3.353	0.005	0.183	426.608
	50	2.499	5.780	4.751	0.006	0.546	426.608
	120	1.046	3.221	6.253	0.005	0.530	426.608
	175	0.701	2.647	5.589	0.005	0.305	426.608
	250	0.558	1.640	5.382	0.005	0.223	426.608
	500	0.498	2.423	4.891	0.004	0.198	426.608
	750	0.503	2.420	4.973	0.004	0.199	426.608
Welders	15	0.530	1.845	3.064	0.004	0.226	255.965
	25	0.602	1.544	2.515	0.003	0.182	255.965
	50	1.259	3.019	2.713	0.003	0.292	255.965
	120	0.546	1.784	3.302	0.003	0.285	255.965
	175	0.361	1.439	2.958	0.003	0.157	255.965
	250	0.239	0.686	2.774	0.003	0.091	255.965
	500	0.214	0.800	2.498	0.003	0.084	255.965
Water Trucks	175	0.477	1.982	3.564	0.004	0.212	324.222
	250	0.336	0.883	3.375	0.004	0.120	324.222
	500	0.310	0.965	2.955	0.003	0.110	324.222
	750	0.312	0.964	3.045	0.003	0.112	324.222
	1000	0.351	1.157	3.973	0.003	0.121	324.222

2010		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
Aerial Lifts	15	0.314	1.599	2.001	0.004	0.111	261.653
	25	0.497	1.370	2.412	0.003	0.155	261.653
	50	0.996	2.566	2.639	0.003	0.249	261.653
	120	0.477	1.715	3.074	0.003	0.246	261.653
	500	0.183	0.707	2.340	0.003	0.073	261.653
	750	0.188	0.707	2.402	0.003	0.074	261.653
Air Compressors	15	0.540	1.935	3.149	0.004	0.228	273.029
	25	0.609	1.590	2.632	0.003	0.185	273.029
	50	1.408	3.421	2.915	0.004	0.321	273.029
	120	0.583	1.943	3.451	0.003	0.314	273.029
	175	0.389	1.575	3.086	0.003	0.174	273.029
	250	0.252	0.705	2.887	0.003	0.095	273.029
	500	0.227	0.792	2.577	0.003	0.088	273.029
	750	0.231	0.792	2.646	0.003	0.089	273.029
	1000	0.289	1.032	3.360	0.003	0.101	273.029
Bore/Drill Rigs	15	0.497	2.605	3.110	0.007	0.127	426.608
	25	0.524	1.760	3.354	0.005	0.173	426.608
	50	0.749	3.443	3.877	0.006	0.267	426.608
	120	0.400	2.662	3.405	0.005	0.252	426.608
	175	0.281	2.281	2.767	0.005	0.146	426.608
	250	0.217	0.785	2.687	0.005	0.087	426.608
	500	0.204	0.763	2.337	0.004	0.084	426.608
	750	0.208	0.763	2.412	0.004	0.085	426.608
	1000	0.246	0.785	3.818	0.004	0.095	426.608
Cement and Mortar Mixers	15	0.398	1.958	2.548	0.005	0.146	318.534
	25	0.628	1.709	2.963	0.004	0.194	318.534
Concrete/Industrial Saws	25	0.505	1.710	3.223	0.005	0.158	415.232
	50	1.692	4.413	4.219	0.005	0.413	415.232
	120	0.752	2.786	4.817	0.005	0.403	415.232
	175	0.500	2.277	4.266	0.005	0.224	415.232
Cranes	50	1.354	3.340	2.686	0.003	0.304	244.589
	120	0.545	1.816	3.191	0.003	0.294	244.589
	175	0.369	1.485	2.832	0.003	0.164	244.589
	250	0.271	0.755	2.698	0.003	0.102	244.589
	500	0.247	0.900	2.407	0.002	0.093	244.589
	750	0.249	0.899	2.465	0.002	0.094	244.589
	9999	0.275	1.044	3.072	0.002	0.096	244.588
Crawler Tractors	50	2.117	5.150	4.067	0.005	0.469	364.039
	120	0.858	2.776	5.000	0.004	0.453	364.039
	175	0.583	2.282	4.442	0.004	0.257	364.039
	250	0.450	1.258	4.260	0.004	0.172	364.039
	500	0.409	1.675	3.827	0.004	0.155	364.039
	750	0.411	1.673	3.905	0.004	0.156	364.039
	1000	0.442	1.872	4.759	0.004	0.156	364.039
Crushing/Proc. Equipment	50	2.289	5.637	4.737	0.006	0.524	443.672
	120	0.939	3.178	5.540	0.005	0.512	443.672
	175	0.628	2.583	4.936	0.005	0.283	443.672

2010		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
	250	0.407	1.129	4.620	0.005	0.153	443.672
	500	0.367	1.252	4.098	0.004	0.141	443.672
	750	0.373	1.224	4.254	0.004	0.143	443.672
	9999	0.469	1.633	5.455	0.004	0.163	443.672
Dumpers/Tenders	25	0.307	0.954	1.827	0.003	0.103	216.148
Excavators	25	0.392	1.335	2.486	0.004	0.113	324.222
	50	1.466	4.076	3.419	0.004	0.357	324.222
	120	0.616	2.342	3.700	0.004	0.344	324.222
	175	0.423	1.936	3.220	0.004	0.192	324.222
	250	0.297	0.804	3.052	0.004	0.106	324.222
	500	0.275	0.855	2.675	0.003	0.099	324.222
	750	0.277	0.854	2.759	0.003	0.100	324.222
Forklifts	50	0.768	2.112	1.777	0.002	0.188	170.643
	120	0.326	1.224	1.903	0.002	0.186	170.643
	175	0.223	1.006	1.677	0.002	0.102	170.643
	250	0.143	0.377	1.577	0.002	0.050	170.643
	500	0.133	0.359	1.362	0.002	0.047	170.643
Generator Sets	15	0.706	2.983	4.731	0.007	0.282	420.920
	25	0.712	2.451	4.057	0.005	0.254	420.920
	50	1.515	3.965	4.207	0.005	0.387	420.920
	120	0.745	2.724	4.869	0.005	0.382	420.920
	175	0.490	2.212	4.348	0.005	0.212	420.920
	250	0.317	0.988	4.075	0.005	0.121	420.920
	500	0.285	1.098	3.715	0.004	0.114	420.920
	750	0.294	1.098	3.812	0.004	0.115	420.920
	9999	0.400	1.430	4.848	0.004	0.143	420.920
Graders	50	1.764	4.516	3.730	0.004	0.407	346.974
	120	0.719	2.527	4.290	0.004	0.393	346.974
	175	0.488	2.074	3.789	0.004	0.219	346.974
	250	0.355	0.995	3.610	0.004	0.134	346.974
	500	0.325	1.137	3.205	0.003	0.122	346.974
	750	0.327	1.137	3.289	0.003	0.124	346.974
Off-Highway Tractors	120	0.969	2.934	5.601	0.004	0.495	369.727
	175	0.659	2.427	5.008	0.004	0.287	369.727
	250	0.533	1.516	4.834	0.004	0.208	369.727
	750	0.482	2.319	4.454	0.004	0.186	369.727
	1000	0.509	2.514	5.208	0.004	0.182	369.727
Off-Highway Trucks	175	0.449	1.976	3.317	0.004	0.200	324.222
	250	0.319	0.837	3.144	0.004	0.112	324.222
	500	0.297	0.898	2.761	0.003	0.104	324.222
	750	0.299	0.897	2.845	0.003	0.105	324.222
	1000	0.334	1.072	3.802	0.003	0.115	324.222
Other Construction Equipment	15	0.411	2.153	2.571	0.005	0.105	352.663
	25	0.433	1.455	2.773	0.004	0.143	352.663
	50	1.302	3.692	3.511	0.005	0.332	352.663
	120	0.576	2.363	3.772	0.004	0.323	352.663
	175	0.387	1.954	3.287	0.004	0.180	352.663
	500	0.237	0.842	2.750	0.003	0.094	352.663

2010		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
Other General Industrial Equipment	15	0.301	1.771	2.115	0.005	0.079	290.093
	25	0.351	1.194	2.225	0.004	0.101	290.093
	50	1.689	4.071	3.210	0.004	0.378	290.093
	120	0.676	2.168	3.817	0.003	0.368	290.093
	175	0.454	1.756	3.408	0.003	0.203	290.093
	250	0.297	0.781	3.188	0.003	0.108	290.093
	500	0.271	0.870	2.819	0.003	0.100	290.093
	750	0.273	0.870	2.899	0.003	0.101	290.093
	1000	0.327	1.130	3.688	0.003	0.114	290.093
Other Material Handling Equipment	50	1.938	4.664	3.700	0.004	0.433	335.598
	120	0.776	2.496	4.403	0.004	0.423	335.598
	175	0.521	2.022	3.934	0.004	0.233	335.598
	250	0.340	0.901	3.679	0.004	0.124	335.598
	500	0.309	1.004	3.255	0.003	0.115	335.598
	9999	0.376	1.305	4.255	0.003	0.131	335.598
Pavers	25	0.525	1.597	3.030	0.004	0.175	352.663
	50	2.047	4.863	3.919	0.005	0.449	352.663
	120	0.835	2.662	4.940	0.004	0.435	352.663
	175	0.563	2.188	4.406	0.004	0.248	352.663
	250	0.440	1.272	4.234	0.004	0.173	352.663
	500	0.396	1.763	3.828	0.003	0.155	352.662
Paving Equipment	25	0.370	1.244	2.370	0.004	0.122	301.470
	50	1.744	4.129	3.344	0.004	0.382	301.470
	120	0.709	2.259	4.204	0.004	0.370	301.470
	175	0.477	1.853	3.753	0.003	0.210	301.470
	250	0.371	1.075	3.604	0.003	0.146	301.470
Plate Compactors	15	0.286	1.493	1.798	0.004	0.086	244.589
Pressure Washers	15	0.286	1.209	1.918	0.003	0.114	170.643
	25	0.289	0.994	1.645	0.002	0.103	170.643
	50	0.487	1.357	1.652	0.002	0.136	170.643
	120	0.272	1.052	1.884	0.002	0.136	170.643
Pumps	15	0.833	2.983	4.855	0.007	0.351	420.920
	25	0.939	2.451	4.057	0.005	0.284	420.920
	50	1.621	4.174	4.252	0.005	0.404	420.920
	120	0.770	2.767	4.944	0.005	0.399	420.920
	175	0.508	2.247	4.416	0.005	0.221	420.920
	250	0.329	1.007	4.138	0.005	0.126	420.920
	500	0.295	1.138	3.758	0.004	0.118	420.920
	750	0.304	1.138	3.857	0.004	0.119	420.920
	9999	0.408	1.475	4.901	0.004	0.145	420.920
Rollers	15	0.371	1.945	2.322	0.005	0.095	318.534
	25	0.391	1.314	2.504	0.004	0.129	318.534
	50	1.557	3.885	3.375	0.004	0.358	318.534
	120	0.649	2.255	3.987	0.004	0.346	318.534
	175	0.435	1.847	3.541	0.004	0.194	318.534
	250	0.321	0.945	3.377	0.004	0.125	318.534
	500	0.289	1.132	3.036	0.003	0.114	318.534
Rough Terrain Forklifts	50	1.603	4.219	3.586	0.004	0.380	341.286

2010		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
	120	0.663	2.430	4.004	0.004	0.369	341.286
	175	0.448	1.995	3.518	0.004	0.205	341.286
	250	0.304	0.853	3.323	0.004	0.113	341.286
	500	0.279	0.914	2.925	0.003	0.105	341.286
Rubber Tired Dozers	175	0.622	2.251	4.635	0.004	0.269	335.598
	250	0.508	1.419	4.478	0.004	0.196	335.598
	500	0.459	2.206	4.063	0.003	0.174	335.598
	750	0.460	2.203	4.126	0.003	0.175	335.598
	1000	0.481	2.379	4.812	0.003	0.171	335.598
Rubber Tired Loaders	25	0.374	1.265	2.384	0.004	0.117	307.158
	50	1.538	3.949	3.286	0.004	0.356	307.158
	120	0.629	2.225	3.768	0.004	0.344	307.158
	175	0.426	1.828	3.326	0.003	0.192	307.158
	250	0.308	0.868	3.166	0.003	0.116	307.158
	500	0.282	0.991	2.810	0.003	0.106	307.158
	750	0.284	0.990	2.885	0.003	0.108	307.158
	1000	0.318	1.157	3.691	0.003	0.112	307.158
Scrapers	120	0.975	3.127	5.685	0.005	0.513	409.544
	175	0.661	2.569	5.057	0.005	0.291	409.544
	250	0.512	1.440	4.852	0.005	0.197	409.544
	500	0.465	1.934	4.364	0.004	0.177	409.544
	750	0.467	1.932	4.450	0.004	0.178	409.544
Signal Boards	15	0.543	2.848	3.400	0.007	0.127	466.425
	50	1.830	4.691	4.522	0.006	0.446	443.672
	120	0.827	2.976	5.225	0.005	0.438	443.672
	175	0.548	2.422	4.652	0.005	0.243	443.672
	250	0.430	1.289	5.270	0.006	0.166	536.104
Skid Steer Loaders	25	0.564	1.587	2.838	0.004	0.179	312.846
	50	0.962	3.073	3.020	0.004	0.266	312.846
	120	0.444	2.064	3.022	0.004	0.260	312.846
Surfacing Equipment	50	1.070	2.758	2.632	0.003	0.258	255.965
	120	0.479	1.740	3.084	0.003	0.251	255.965
	175	0.320	1.429	2.736	0.003	0.141	255.965
	250	0.238	0.737	2.616	0.003	0.094	255.965
	500	0.215	0.901	2.374	0.003	0.086	255.965
	750	0.218	0.900	2.427	0.003	0.087	255.965
Sweepers/Scrubbers	15	0.401	2.362	2.820	0.006	0.106	386.791
	25	0.471	1.593	3.005	0.005	0.148	386.791
	50	1.828	4.745	4.033	0.005	0.432	386.791
	120	0.762	2.742	4.434	0.005	0.431	386.791
	175	0.512	2.237	3.947	0.004	0.236	386.791
	250	0.319	0.867	3.701	0.004	0.116	386.791
Tractors/Loaders/Backhoes	25	0.421	1.344	2.596	0.004	0.142	312.846
	50	1.296	3.658	3.211	0.004	0.322	312.846
	120	0.550	2.191	3.426	0.004	0.312	312.846
	175	0.375	1.815	2.977	0.004	0.173	312.846
	250	0.258	0.735	2.822	0.004	0.095	312.846
	500	0.239	0.771	2.471	0.004	0.089	312.846
	750	0.241	0.770	2.552	0.004	0.090	312.846

2010		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
Trenchers	15	0.497	2.605	3.110	0.007	0.117	426.608
	25	0.519	1.757	3.311	0.005	0.162	426.608
	50	2.381	5.657	4.692	0.006	0.525	426.608
	120	0.992	3.182	5.971	0.005	0.510	426.608
	175	0.668	2.622	5.328	0.005	0.294	426.608
	250	0.530	1.562	5.130	0.005	0.211	426.608
	500	0.475	2.240	4.661	0.004	0.188	426.608
	750	0.479	2.238	4.740	0.004	0.189	426.608
Welders	15	0.507	1.814	2.952	0.004	0.213	255.965
	25	0.571	1.491	2.467	0.003	0.173	255.965
	50	1.197	2.960	2.677	0.003	0.281	255.965
	120	0.518	1.770	3.152	0.003	0.275	255.965
	175	0.344	1.435	2.818	0.003	0.152	255.965
	250	0.224	0.645	2.638	0.003	0.085	255.965
	500	0.201	0.730	2.370	0.003	0.079	255.965
Water Trucks	175	0.449	1.976	3.317	0.004	0.200	324.222
	250	0.319	0.837	3.144	0.004	0.112	324.222
	500	0.297	0.898	2.761	0.003	0.104	324.222
	750	0.299	0.897	2.845	0.003	0.105	324.222
	1000	0.334	1.072	3.802	0.003	0.115	324.222

2011		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
Aerial Lifts	15	0.310	1.598	1.964	0.004	0.099	261.653
	25	0.454	1.296	2.344	0.003	0.142	261.653
	50	0.925	2.490	2.594	0.003	0.236	261.653
	120	0.444	1.697	2.907	0.003	0.235	261.653
	500	0.167	0.646	2.168	0.003	0.065	261.653
	750	0.172	0.646	2.228	0.003	0.066	261.653
Air Compressors	15	0.513	1.899	3.019	0.004	0.212	273.029
	25	0.573	1.528	2.576	0.003	0.174	273.029
	50	1.317	3.324	2.869	0.004	0.306	273.029
	120	0.548	1.925	3.270	0.003	0.301	273.029
	175	0.368	1.568	2.914	0.003	0.167	273.029
	250	0.233	0.659	2.692	0.003	0.085	273.029
	500	0.211	0.720	2.393	0.003	0.079	273.029
	750	0.214	0.720	2.462	0.003	0.081	273.029
	1000	0.270	0.947	3.189	0.003	0.095	273.029
Bore/Drill Rigs	15	0.497	2.605	3.110	0.007	0.122	426.608
	25	0.519	1.757	3.315	0.005	0.157	426.608
	50	0.599	3.311	3.835	0.006	0.233	426.608
	120	0.335	2.634	3.087	0.005	0.221	426.608
	175	0.251	2.280	2.495	0.005	0.135	426.608
	250	0.202	0.781	2.297	0.005	0.073	426.608
	500	0.194	0.759	2.043	0.004	0.071	426.608
	750	0.196	0.759	2.084	0.004	0.072	426.608
	1000	0.225	0.777	3.400	0.004	0.086	426.608
Cement and Mortar Mixers	15	0.384	1.950	2.439	0.005	0.130	318.534
	25	0.578	1.624	2.884	0.004	0.179	318.534
Concrete/Industrial Saws	25	0.503	1.710	3.194	0.005	0.141	415.232
	50	1.566	4.278	4.150	0.005	0.391	415.232
	120	0.699	2.759	4.546	0.005	0.383	415.232
	175	0.468	2.268	4.012	0.005	0.214	415.232
Cranes	50	1.257	3.240	2.649	0.003	0.288	244.588
	120	0.511	1.798	3.022	0.003	0.279	244.589
	175	0.350	1.479	2.672	0.003	0.157	244.589
	250	0.255	0.714	2.513	0.003	0.093	244.589
	500	0.234	0.833	2.240	0.002	0.085	244.589
	750	0.236	0.833	2.296	0.002	0.086	244.589
	9999	0.262	0.970	2.912	0.002	0.090	244.589
Crawler Tractors	50	1.979	5.010	4.017	0.005	0.446	364.039
	120	0.808	2.743	4.746	0.004	0.430	364.039
	175	0.555	2.265	4.208	0.004	0.246	364.039
	250	0.427	1.199	3.990	0.004	0.159	364.039
	500	0.391	1.548	3.586	0.004	0.143	364.039
	750	0.392	1.546	3.660	0.004	0.145	364.039
	1000	0.420	1.732	4.521	0.004	0.147	364.039
Crushing/Proc. Equipment	50	2.126	5.461	4.663	0.006	0.497	443.672
	120	0.879	3.146	5.234	0.005	0.488	443.672
	175	0.593	2.572	4.648	0.005	0.271	443.672

2011		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
	250	0.378	1.059	4.293	0.005	0.137	443.672
	500	0.343	1.142	3.793	0.004	0.127	443.672
	750	0.348	1.121	3.946	0.004	0.129	443.672
	9999	0.441	1.502	5.160	0.004	0.154	443.672
Dumpers/Tenders	25	0.293	0.934	1.782	0.003	0.096	216.148
Excavators	25	0.391	1.335	2.475	0.004	0.098	324.222
	50	1.319	3.933	3.371	0.004	0.331	324.222
	120	0.567	2.319	3.458	0.004	0.319	324.222
	175	0.397	1.932	2.994	0.004	0.181	324.222
	250	0.280	0.769	2.785	0.004	0.095	324.222
	500	0.262	0.803	2.444	0.003	0.089	324.222
	750	0.264	0.803	2.522	0.003	0.090	324.222
Forklifts	50	0.675	2.022	1.749	0.002	0.172	170.643
	120	0.295	1.210	1.771	0.002	0.169	170.643
	175	0.205	1.005	1.542	0.002	0.094	170.643
	250	0.137	0.368	1.428	0.002	0.045	170.643
	500	0.128	0.350	1.229	0.002	0.042	170.643
Generator Sets	15	0.673	2.928	4.544	0.007	0.266	420.920
	25	0.681	2.355	3.971	0.005	0.241	420.920
	50	1.409	3.851	4.137	0.005	0.367	420.920
	120	0.694	2.697	4.611	0.005	0.365	420.920
	175	0.459	2.203	4.106	0.005	0.203	420.920
	250	0.290	0.925	3.796	0.005	0.109	420.920
	500	0.260	1.008	3.448	0.004	0.102	420.920
	750	0.268	1.008	3.543	0.004	0.104	420.920
	9999	0.372	1.322	4.594	0.004	0.133	420.920
Graders	50	1.625	4.376	3.679	0.004	0.384	346.974
	120	0.671	2.502	4.050	0.004	0.371	346.974
	175	0.461	2.067	3.562	0.004	0.209	346.974
	250	0.336	0.949	3.344	0.004	0.122	346.974
	500	0.309	1.066	2.970	0.003	0.111	346.974
	750	0.311	1.065	3.048	0.003	0.113	346.974
Off-Highway Tractors	120	0.923	2.900	5.359	0.004	0.475	369.727
	175	0.632	2.404	4.782	0.004	0.277	369.727
	250	0.510	1.450	4.578	0.004	0.195	369.727
	750	0.463	2.162	4.219	0.004	0.175	369.727
	1000	0.487	2.348	4.987	0.004	0.173	369.727
Off-Highway Trucks	175	0.423	1.972	3.088	0.004	0.189	324.222
	250	0.302	0.798	2.876	0.004	0.100	324.222
	500	0.282	0.840	2.529	0.003	0.094	324.222
	750	0.284	0.840	2.606	0.003	0.095	324.222
	1000	0.317	0.996	3.554	0.003	0.108	324.222
Other Construction Equipment	15	0.411	2.153	2.571	0.005	0.101	352.663
	25	0.429	1.452	2.740	0.004	0.130	352.663
	50	1.179	3.569	3.459	0.005	0.309	352.663
	120	0.527	2.341	3.532	0.004	0.303	352.663
	175	0.360	1.950	3.064	0.004	0.171	352.663
	500	0.221	0.788	2.510	0.003	0.084	352.663

2011		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
Other General Industrial Equipment	15	0.301	1.771	2.115	0.005	0.080	290.093
	25	0.350	1.194	2.214	0.004	0.088	290.093
	50	1.559	3.927	3.155	0.004	0.356	290.093
	120	0.632	2.142	3.599	0.003	0.349	290.093
	175	0.429	1.746	3.202	0.003	0.193	290.093
	250	0.276	0.729	2.958	0.003	0.097	290.093
	500	0.254	0.790	2.608	0.003	0.090	290.093
	750	0.256	0.790	2.686	0.003	0.091	290.093
	1000	0.307	1.035	3.490	0.003	0.107	290.093
Other Material Handling Equipment	50	1.792	4.502	3.638	0.004	0.409	335.598
	120	0.726	2.467	4.154	0.004	0.401	335.598
	175	0.492	2.011	3.697	0.004	0.222	335.598
	250	0.316	0.841	3.415	0.004	0.111	335.598
	500	0.290	0.911	3.012	0.003	0.103	335.598
	9999	0.355	1.195	4.027	0.003	0.123	335.598
Pavers	25	0.502	1.562	2.959	0.004	0.163	352.663
	50	1.938	4.750	3.872	0.005	0.430	352.663
	120	0.791	2.631	4.710	0.004	0.417	352.663
	175	0.537	2.170	4.194	0.004	0.239	352.663
	250	0.417	1.211	3.989	0.004	0.160	352.663
	500	0.378	1.627	3.603	0.003	0.144	352.663
Paving Equipment	25	0.367	1.241	2.342	0.004	0.111	301.470
	50	1.652	4.033	3.303	0.004	0.367	301.470
	120	0.672	2.234	4.010	0.004	0.355	301.470
	175	0.455	1.837	3.574	0.003	0.202	301.470
	250	0.351	1.022	3.397	0.003	0.135	301.470
Plate Compactors	15	0.285	1.493	1.786	0.004	0.074	244.589
Pressure Washers	15	0.273	1.187	1.842	0.003	0.108	170.643
	25	0.276	0.955	1.610	0.002	0.098	170.643
	50	0.449	1.316	1.623	0.002	0.129	170.643
	120	0.252	1.041	1.783	0.002	0.129	170.643
Pumps	15	0.791	2.928	4.654	0.007	0.327	420.920
	25	0.883	2.355	3.971	0.005	0.268	420.920
	50	1.510	4.055	4.182	0.005	0.384	420.920
	120	0.718	2.740	4.683	0.005	0.381	420.920
	175	0.476	2.237	4.171	0.005	0.212	420.920
	250	0.302	0.943	3.856	0.005	0.113	420.920
	500	0.270	1.041	3.489	0.004	0.106	420.920
	750	0.279	1.041	3.586	0.004	0.108	420.920
	9999	0.380	1.360	4.646	0.004	0.136	420.920
Rollers	15	0.371	1.945	2.322	0.005	0.091	318.534
	25	0.388	1.312	2.475	0.004	0.117	318.534
	50	1.454	3.776	3.327	0.004	0.340	318.534
	120	0.608	2.233	3.782	0.004	0.330	318.534
	175	0.412	1.839	3.349	0.004	0.186	318.534
	250	0.300	0.895	3.150	0.004	0.114	318.534
	500	0.271	1.052	2.827	0.003	0.104	318.534
Rough Terrain Forklifts	50	1.463	4.078	3.532	0.004	0.357	341.286

2011		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
	120	0.614	2.407	3.760	0.004	0.347	341.286
	175	0.421	1.990	3.288	0.004	0.194	341.286
	250	0.285	0.807	3.056	0.004	0.101	341.286
	500	0.263	0.844	2.685	0.003	0.094	341.286
Rubber Tired Dozers	175	0.597	2.230	4.429	0.004	0.259	335.598
	250	0.486	1.359	4.245	0.004	0.184	335.598
	500	0.441	2.063	3.853	0.003	0.163	335.598
	750	0.442	2.060	3.913	0.003	0.164	335.598
	1000	0.462	2.228	4.610	0.003	0.163	335.598
Rubber Tired Loaders	25	0.372	1.265	2.363	0.004	0.105	307.158
	50	1.416	3.824	3.240	0.004	0.335	307.158
	120	0.586	2.203	3.555	0.004	0.325	307.158
	175	0.402	1.822	3.125	0.003	0.183	307.158
	250	0.290	0.827	2.930	0.003	0.105	307.158
	500	0.267	0.929	2.600	0.003	0.097	307.158
	750	0.269	0.928	2.670	0.003	0.098	307.158
	1000	0.300	1.080	3.477	0.003	0.105	307.158
Scrapers	120	0.921	3.091	5.405	0.005	0.489	409.544
	175	0.631	2.550	4.798	0.005	0.279	409.544
	250	0.487	1.372	4.555	0.005	0.182	409.544
	500	0.444	1.787	4.096	0.004	0.164	409.544
	750	0.446	1.785	4.179	0.004	0.165	409.544
Signal Boards	15	0.543	2.848	3.400	0.007	0.129	466.425
	50	1.701	4.555	4.449	0.006	0.423	443.672
	120	0.770	2.946	4.940	0.005	0.418	443.672
	175	0.514	2.413	4.384	0.005	0.233	443.672
	250	0.395	1.209	4.897	0.006	0.148	536.104
Skid Steer Loaders	25	0.519	1.511	2.765	0.004	0.165	312.846
	50	0.839	2.956	2.976	0.004	0.242	312.846
	120	0.397	2.044	2.806	0.004	0.238	312.846
Surfacing Equipment	50	1.000	2.686	2.595	0.003	0.245	255.965
	120	0.447	1.722	2.927	0.003	0.239	255.965
	175	0.301	1.422	2.589	0.003	0.135	255.965
	250	0.222	0.701	2.441	0.003	0.086	255.965
	500	0.201	0.841	2.213	0.003	0.079	255.965
	750	0.205	0.840	2.263	0.003	0.079	255.965
Sweepers/Scrubbers	15	0.401	2.362	2.820	0.006	0.107	386.791
	25	0.469	1.593	2.977	0.005	0.132	386.791
	50	1.625	4.519	3.947	0.005	0.398	386.791
	120	0.694	2.707	4.142	0.005	0.399	386.791
	175	0.472	2.230	3.655	0.004	0.220	386.791
	250	0.301	0.840	3.381	0.004	0.105	386.791
Tractors/Loaders/Backhoes	25	0.405	1.321	2.526	0.004	0.131	312.846
	50	1.162	3.528	3.165	0.004	0.298	312.846
	120	0.504	2.170	3.198	0.004	0.289	312.846
	175	0.350	1.812	2.763	0.004	0.164	312.846
	250	0.243	0.707	2.567	0.004	0.085	312.846
	500	0.227	0.732	2.251	0.004	0.080	312.846
	750	0.229	0.731	2.324	0.004	0.081	312.846

2011		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
Trenchers	15	0.497	2.605	3.110	0.007	0.118	426.608
	25	0.517	1.757	3.282	0.005	0.145	426.608
	50	2.263	5.534	4.636	0.006	0.504	426.608
	120	0.940	3.145	5.701	0.005	0.491	426.608
	175	0.638	2.598	5.080	0.005	0.283	426.608
	250	0.502	1.488	4.841	0.005	0.196	426.608
	500	0.452	2.072	4.394	0.004	0.175	426.608
	750	0.455	2.070	4.471	0.004	0.177	426.608
Welders	15	0.481	1.780	2.830	0.004	0.199	255.965
	25	0.537	1.432	2.415	0.003	0.163	255.965
	50	1.121	2.879	2.635	0.003	0.267	255.965
	120	0.485	1.753	2.987	0.003	0.263	255.965
	175	0.324	1.430	2.662	0.003	0.146	255.965
	250	0.206	0.604	2.461	0.003	0.077	255.965
	500	0.185	0.664	2.201	0.003	0.071	255.965
Water Trucks	175	0.423	1.972	3.088	0.004	0.189	324.222
	250	0.302	0.798	2.876	0.004	0.100	324.222
	500	0.282	0.840	2.529	0.003	0.094	324.222
	750	0.284	0.840	2.606	0.003	0.095	324.222
	1000	0.317	0.996	3.554	0.003	0.108	324.222

2012		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
Aerial Lifts	15	0.308	1.598	1.941	0.004	0.090	261.653
	25	0.414	1.229	2.280	0.003	0.129	261.653
	50	0.849	2.407	2.547	0.003	0.223	261.653
	120	0.410	1.679	2.728	0.003	0.219	261.653
	500	0.154	0.602	2.007	0.003	0.059	261.653
	750	0.159	0.602	2.066	0.003	0.060	261.653
Air Compressors	15	0.484	1.861	2.882	0.004	0.196	273.029
	25	0.535	1.462	2.517	0.003	0.162	273.029
	50	1.215	3.210	2.820	0.004	0.289	273.029
	120	0.510	1.904	3.070	0.003	0.282	273.029
	175	0.345	1.562	2.731	0.003	0.156	273.029
	250	0.219	0.631	2.506	0.003	0.078	273.029
	500	0.199	0.669	2.219	0.003	0.072	273.029
	750	0.202	0.669	2.286	0.003	0.074	273.029
	1000	0.251	0.865	3.009	0.003	0.088	273.029
Bore/Drill Rigs	15	0.497	2.605	3.110	0.007	0.120	426.608
	25	0.517	1.757	3.289	0.005	0.143	426.608
	50	0.482	3.209	3.805	0.006	0.205	426.608
	120	0.284	2.613	2.780	0.005	0.182	426.608
	175	0.227	2.279	2.261	0.005	0.111	426.608
	250	0.190	0.779	1.978	0.005	0.061	426.608
	500	0.185	0.757	1.802	0.004	0.060	426.608
	750	0.186	0.757	1.827	0.004	0.060	426.608
	1000	0.207	0.771	3.042	0.004	0.078	426.608
Cement and Mortar Mixers	15	0.378	1.946	2.395	0.005	0.118	318.534
	25	0.532	1.546	2.809	0.004	0.164	318.534
Concrete/Industrial Saws	25	0.502	1.710	3.177	0.005	0.127	415.232
	50	1.439	4.144	4.084	0.005	0.368	415.232
	120	0.647	2.733	4.270	0.005	0.358	415.232
	175	0.437	2.261	3.760	0.005	0.199	415.232
Cranes	50	1.162	3.143	2.614	0.003	0.272	244.589
	120	0.479	1.780	2.850	0.003	0.260	244.589
	175	0.331	1.473	2.514	0.003	0.146	244.589
	250	0.241	0.677	2.336	0.003	0.085	244.589
	500	0.222	0.773	2.082	0.002	0.078	244.589
	750	0.223	0.772	2.135	0.002	0.079	244.589
	9999	0.250	0.902	2.758	0.002	0.085	244.589
Crawler Tractors	50	1.846	4.877	3.969	0.005	0.423	364.039
	120	0.760	2.714	4.492	0.004	0.403	364.039
	175	0.528	2.250	3.979	0.004	0.230	364.039
	250	0.406	1.145	3.735	0.004	0.146	364.039
	500	0.373	1.435	3.358	0.004	0.132	364.039
	750	0.375	1.433	3.428	0.004	0.134	364.039
	1000	0.400	1.606	4.293	0.004	0.139	364.039
Crushing/Proc. Equipment	50	1.943	5.257	4.581	0.006	0.466	443.672
	120	0.814	3.111	4.895	0.005	0.454	443.672
	175	0.554	2.561	4.335	0.005	0.251	443.672

2012		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
	250	0.354	1.015	3.973	0.005	0.124	443.672
	500	0.325	1.064	3.498	0.004	0.115	443.672
	750	0.328	1.048	3.640	0.004	0.117	443.672
	9999	0.411	1.370	4.838	0.004	0.143	443.672
Dumpers/Tenders	25	0.282	0.919	1.740	0.003	0.089	216.148
Excavators	25	0.391	1.335	2.472	0.004	0.094	324.222
	50	1.183	3.802	3.328	0.004	0.307	324.222
	120	0.521	2.299	3.215	0.004	0.290	324.222
	175	0.372	1.929	2.777	0.004	0.164	324.222
	250	0.266	0.742	2.542	0.004	0.085	324.222
	500	0.250	0.762	2.235	0.003	0.080	324.222
	750	0.252	0.762	2.305	0.003	0.081	324.222
Forklifts	50	0.589	1.946	1.727	0.002	0.157	170.643
	120	0.264	1.198	1.638	0.002	0.150	170.643
	175	0.188	1.005	1.409	0.002	0.084	170.643
	250	0.131	0.362	1.288	0.002	0.041	170.643
	500	0.123	0.344	1.106	0.002	0.038	170.643
Generator Sets	15	0.641	2.870	4.351	0.007	0.251	420.920
	25	0.655	2.254	3.881	0.005	0.228	420.920
	50	1.293	3.726	4.063	0.005	0.346	420.920
	120	0.641	2.669	4.332	0.005	0.341	420.920
	175	0.426	2.195	3.851	0.005	0.189	420.920
	250	0.268	0.887	3.533	0.005	0.099	420.920
	500	0.240	0.944	3.196	0.004	0.093	420.920
	750	0.248	0.944	3.290	0.004	0.095	420.920
	9999	0.343	1.214	4.332	0.004	0.123	420.920
Graders	50	1.490	4.240	3.631	0.004	0.360	346.974
	120	0.624	2.479	3.806	0.004	0.343	346.974
	175	0.435	2.062	3.341	0.004	0.193	346.974
	250	0.317	0.909	3.094	0.004	0.110	346.974
	500	0.294	1.004	2.751	0.003	0.101	346.974
	750	0.296	1.003	2.823	0.003	0.103	346.974
Off-Highway Tractors	120	0.877	2.867	5.114	0.004	0.451	369.727
	175	0.605	2.383	4.560	0.004	0.262	369.727
	250	0.487	1.388	4.332	0.004	0.183	369.727
	750	0.444	2.016	3.995	0.004	0.164	369.727
	1000	0.466	2.193	4.772	0.004	0.165	369.727
Off-Highway Trucks	175	0.397	1.968	2.870	0.004	0.173	324.222
	250	0.286	0.768	2.631	0.004	0.090	324.222
	500	0.269	0.793	2.317	0.003	0.084	324.222
	750	0.271	0.793	2.389	0.003	0.085	324.222
	1000	0.301	0.928	3.321	0.003	0.100	324.222
Other Construction Equipment	15	0.411	2.153	2.571	0.005	0.099	352.663
	25	0.428	1.452	2.719	0.004	0.118	352.663
	50	1.061	3.452	3.411	0.005	0.287	352.663
	120	0.482	2.320	3.289	0.004	0.276	352.663
	175	0.334	1.947	2.847	0.004	0.155	352.663
	500	0.210	0.753	2.299	0.003	0.076	352.662

2012		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
Other General Industrial Equipment	15	0.301	1.771	2.115	0.005	0.082	290.093
	25	0.350	1.194	2.211	0.004	0.085	290.093
	50	1.421	3.773	3.099	0.004	0.334	290.093
	120	0.587	2.116	3.367	0.003	0.324	290.093
	175	0.402	1.737	2.988	0.003	0.179	290.093
	250	0.261	0.697	2.742	0.003	0.088	290.093
	500	0.241	0.734	2.412	0.003	0.082	290.093
	750	0.243	0.734	2.487	0.003	0.083	290.093
	1000	0.287	0.943	3.286	0.003	0.100	290.093
Other Material Handling Equipment	50	1.635	4.328	3.573	0.004	0.384	335.598
	120	0.674	2.438	3.887	0.004	0.373	335.598
	175	0.461	2.000	3.450	0.004	0.206	335.598
	250	0.298	0.804	3.166	0.004	0.101	335.598
	500	0.275	0.846	2.785	0.003	0.094	335.598
	9999	0.334	1.089	3.793	0.003	0.115	335.598
Pavers	25	0.482	1.533	2.894	0.004	0.152	352.663
	50	1.829	4.637	3.827	0.005	0.412	352.663
	120	0.748	2.603	4.479	0.004	0.395	352.663
	175	0.512	2.153	3.985	0.004	0.225	352.663
	250	0.396	1.155	3.756	0.004	0.148	352.663
	500	0.360	1.505	3.390	0.003	0.134	352.663
Paving Equipment	25	0.366	1.241	2.324	0.004	0.101	301.470
	50	1.561	3.937	3.264	0.004	0.351	301.470
	120	0.636	2.211	3.815	0.004	0.337	301.470
	175	0.434	1.825	3.397	0.003	0.191	301.470
	250	0.332	0.973	3.199	0.003	0.125	301.470
Plate Compactors	15	0.285	1.493	1.783	0.004	0.071	244.589
Pressure Washers	15	0.260	1.163	1.764	0.003	0.102	170.643
	25	0.266	0.914	1.573	0.002	0.092	170.643
	50	0.409	1.273	1.593	0.002	0.121	170.643
	120	0.231	1.031	1.675	0.002	0.120	170.643
Pumps	15	0.746	2.870	4.443	0.007	0.302	420.920
	25	0.824	2.254	3.881	0.005	0.250	420.920
	50	1.389	3.923	4.107	0.005	0.362	420.920
	120	0.664	2.711	4.399	0.005	0.357	420.920
	175	0.443	2.229	3.911	0.005	0.197	420.920
	250	0.280	0.903	3.589	0.005	0.103	420.920
	500	0.251	0.971	3.235	0.004	0.097	420.920
	750	0.259	0.971	3.329	0.004	0.098	420.920
	9999	0.351	1.246	4.382	0.004	0.125	420.920
Rollers	15	0.371	1.945	2.322	0.005	0.089	318.534
	25	0.386	1.312	2.456	0.004	0.107	318.534
	50	1.354	3.671	3.282	0.004	0.323	318.534
	120	0.569	2.213	3.574	0.004	0.310	318.534
	175	0.389	1.832	3.159	0.004	0.174	318.534
	250	0.280	0.850	2.935	0.004	0.104	318.534
	500	0.255	0.981	2.630	0.003	0.095	318.534
Rough Terrain Forklifts	50	1.326	3.941	3.482	0.004	0.333	341.286

2012		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
	120	0.567	2.385	3.511	0.004	0.320	341.286
	175	0.395	1.986	3.062	0.004	0.178	341.286
	250	0.270	0.779	2.814	0.004	0.092	341.286
	500	0.252	0.796	2.471	0.003	0.085	341.286
Rubber Tired Dozers	175	0.573	2.210	4.226	0.004	0.245	335.598
	250	0.466	1.303	4.021	0.004	0.172	335.598
	500	0.424	1.928	3.652	0.003	0.153	335.598
	750	0.425	1.926	3.710	0.003	0.154	335.598
	1000	0.443	2.085	4.414	0.003	0.155	335.598
Rubber Tired Loaders	25	0.371	1.265	2.350	0.004	0.094	307.158
	50	1.297	3.704	3.197	0.004	0.314	307.158
	120	0.545	2.183	3.339	0.004	0.300	307.158
	175	0.379	1.817	2.928	0.003	0.168	307.158
	250	0.274	0.791	2.707	0.003	0.095	307.158
	500	0.254	0.875	2.405	0.003	0.088	307.158
	750	0.256	0.875	2.470	0.003	0.089	307.158
	1000	0.283	1.013	3.274	0.003	0.099	307.158
Scrapers	120	0.868	3.058	5.124	0.005	0.460	409.544
	175	0.601	2.533	4.544	0.005	0.262	409.544
	250	0.463	1.310	4.272	0.005	0.168	409.544
	500	0.425	1.656	3.843	0.004	0.152	409.544
	750	0.426	1.655	3.922	0.004	0.153	409.544
Signal Boards	15	0.543	2.848	3.400	0.007	0.132	466.425
	50	1.558	4.398	4.369	0.006	0.397	443.672
	120	0.710	2.915	4.624	0.005	0.389	443.672
	175	0.477	2.403	4.096	0.005	0.215	443.672
	250	0.367	1.158	4.536	0.006	0.134	536.104
Skid Steer Loaders	25	0.479	1.441	2.697	0.004	0.152	312.846
	50	0.731	2.859	2.945	0.004	0.221	312.846
	120	0.353	2.026	2.587	0.004	0.209	312.846
Surfacing Equipment	50	0.931	2.614	2.560	0.003	0.232	255.965
	120	0.418	1.706	2.768	0.003	0.224	255.965
	175	0.283	1.416	2.446	0.003	0.126	255.965
	250	0.208	0.669	2.276	0.003	0.078	255.965
	500	0.189	0.788	2.062	0.003	0.072	255.965
	750	0.192	0.788	2.110	0.003	0.073	255.965
Sweepers/Scrubbers	15	0.401	2.362	2.820	0.006	0.109	386.791
	25	0.467	1.593	2.961	0.005	0.119	386.791
	50	1.442	4.338	3.887	0.005	0.367	386.791
	120	0.628	2.676	3.854	0.005	0.360	386.791
	175	0.433	2.225	3.367	0.004	0.197	386.791
	250	0.285	0.820	3.077	0.004	0.095	386.791
Tractors/Loaders/Backhoes	25	0.392	1.305	2.465	0.004	0.121	312.846
	50	1.037	3.407	3.124	0.004	0.275	312.846
	120	0.460	2.151	2.970	0.004	0.261	312.846
	175	0.327	1.810	2.560	0.004	0.147	312.846
	250	0.230	0.684	2.334	0.004	0.076	312.846
	500	0.217	0.700	2.052	0.004	0.071	312.846
	750	0.218	0.700	2.118	0.004	0.072	312.846

2012		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
Trenchers	15	0.497	2.605	3.110	0.007	0.121	426.608
	25	0.516	1.757	3.264	0.005	0.130	426.608
	50	2.146	5.412	4.583	0.006	0.484	426.608
	120	0.890	3.111	5.428	0.005	0.466	426.608
	175	0.608	2.577	4.834	0.005	0.267	426.608
	250	0.475	1.420	4.565	0.005	0.182	426.608
	500	0.430	1.920	4.141	0.004	0.163	426.608
	750	0.433	1.918	4.215	0.004	0.164	426.608
Welders	15	0.454	1.745	2.702	0.004	0.184	255.965
	25	0.501	1.371	2.360	0.003	0.152	255.965
	50	1.036	2.786	2.590	0.003	0.253	255.965
	120	0.451	1.735	2.807	0.003	0.247	255.965
	175	0.304	1.424	2.497	0.003	0.137	255.965
	250	0.193	0.577	2.292	0.003	0.070	255.965
	500	0.174	0.617	2.041	0.003	0.065	255.965
Water Trucks	175	0.397	1.968	2.870	0.004	0.173	324.222
	250	0.286	0.768	2.631	0.004	0.090	324.222
	500	0.269	0.793	2.317	0.003	0.084	324.222
	750	0.271	0.793	2.389	0.003	0.085	324.222
	1000	0.301	0.928	3.321	0.003	0.100	324.222

2013		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
Aerial Lifts	15	0.306	1.598	1.925	0.004	0.081	261.653
	25	0.394	1.197	2.231	0.003	0.121	261.653
	50	0.772	2.322	2.444	0.003	0.204	261.653
	120	0.376	1.662	2.555	0.003	0.202	261.653
	500	0.144	0.570	1.855	0.003	0.054	261.653
	750	0.149	0.570	1.913	0.003	0.055	261.653
Air Compressors	15	0.456	1.824	2.746	0.004	0.180	273.029
	25	0.497	1.397	2.459	0.003	0.151	273.029
	50	1.106	3.089	2.711	0.004	0.266	273.029
	120	0.472	1.884	2.872	0.003	0.261	273.029
	175	0.322	1.556	2.557	0.003	0.144	273.029
	250	0.207	0.611	2.325	0.003	0.071	273.029
	500	0.189	0.631	2.051	0.003	0.066	273.029
	750	0.192	0.631	2.117	0.003	0.067	273.029
	1000	0.232	0.788	2.827	0.003	0.082	273.029
Bore/Drill Rigs	15	0.497	2.605	3.110	0.007	0.121	426.608
	25	0.516	1.757	3.271	0.005	0.131	426.608
	50	0.397	3.136	3.530	0.006	0.165	426.608
	120	0.247	2.599	2.535	0.005	0.142	426.608
	175	0.213	2.279	2.096	0.005	0.091	426.608
	250	0.180	0.778	1.731	0.005	0.050	426.608
	500	0.177	0.756	1.606	0.004	0.049	426.608
	750	0.178	0.756	1.622	0.004	0.050	426.608
	1000	0.191	0.766	2.739	0.004	0.071	426.608
Cement and Mortar Mixers	15	0.375	1.945	2.367	0.005	0.108	318.534
	25	0.491	1.474	2.739	0.004	0.151	318.534
Concrete/Industrial Saws	25	0.501	1.710	3.168	0.005	0.123	415.232
	50	1.313	4.011	3.929	0.005	0.339	415.232
	120	0.596	2.708	4.006	0.005	0.330	415.232
	175	0.407	2.255	3.528	0.005	0.183	415.232
Cranes	50	1.071	3.050	2.526	0.003	0.252	244.589
	120	0.448	1.765	2.687	0.003	0.240	244.589
	175	0.314	1.468	2.365	0.003	0.136	244.589
	250	0.227	0.643	2.169	0.003	0.077	244.589
	500	0.211	0.719	1.933	0.002	0.070	244.589
	750	0.212	0.718	1.983	0.002	0.071	244.589
	9999	0.239	0.839	2.611	0.002	0.080	244.589
Crawler Tractors	50	1.720	4.750	3.844	0.005	0.395	364.039
	120	0.715	2.687	4.252	0.004	0.375	364.039
	175	0.503	2.237	3.764	0.004	0.214	364.039
	250	0.387	1.096	3.494	0.004	0.134	364.039
	500	0.357	1.335	3.144	0.004	0.122	364.039
	750	0.358	1.333	3.210	0.004	0.123	364.039
	1000	0.382	1.495	4.077	0.004	0.131	364.039
Crushing/Proc. Equipment	50	1.755	5.049	4.394	0.006	0.426	443.672
	120	0.748	3.076	4.564	0.005	0.416	443.672
	175	0.515	2.551	4.042	0.005	0.229	443.672

2013		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
	250	0.335	0.984	3.666	0.005	0.113	443.672
	500	0.310	1.007	3.218	0.004	0.105	443.672
	750	0.312	0.995	3.346	0.004	0.107	443.672
	9999	0.382	1.249	4.517	0.004	0.132	443.672
Dumpers/Tenders	25	0.274	0.907	1.703	0.003	0.082	216.148
Excavators	25	0.391	1.335	2.472	0.004	0.093	324.222
	50	1.057	3.681	3.186	0.004	0.275	324.222
	120	0.478	2.280	2.991	0.004	0.258	324.222
	175	0.349	1.927	2.581	0.004	0.148	324.222
	250	0.254	0.724	2.321	0.004	0.076	324.222
	500	0.241	0.731	2.048	0.003	0.072	324.222
	750	0.242	0.731	2.112	0.003	0.073	324.222
Forklifts	50	0.510	1.878	1.660	0.002	0.139	170.643
	120	0.237	1.187	1.513	0.002	0.130	170.643
	175	0.173	1.006	1.287	0.002	0.074	170.643
	250	0.125	0.356	1.158	0.002	0.037	170.643
	500	0.119	0.339	1.004	0.002	0.035	170.643
Generator Sets	15	0.610	2.812	4.160	0.007	0.236	420.920
	25	0.631	2.154	3.791	0.005	0.215	420.920
	50	1.175	3.596	3.898	0.005	0.317	420.920
	120	0.587	2.642	4.058	0.005	0.314	420.920
	175	0.393	2.187	3.610	0.005	0.173	420.920
	250	0.249	0.860	3.280	0.005	0.091	420.920
	500	0.224	0.897	2.955	0.004	0.085	420.920
	750	0.232	0.897	3.046	0.004	0.087	420.920
	9999	0.315	1.113	4.070	0.004	0.113	420.920
Graders	50	1.361	4.111	3.493	0.004	0.330	346.974
	120	0.580	2.458	3.577	0.004	0.313	346.974
	175	0.411	2.057	3.134	0.004	0.177	346.974
	250	0.301	0.873	2.860	0.004	0.100	346.974
	500	0.281	0.951	2.547	0.003	0.092	346.974
	750	0.282	0.950	2.614	0.003	0.093	346.974
Off-Highway Tractors	120	0.834	2.836	4.878	0.004	0.425	369.727
	175	0.580	2.363	4.348	0.004	0.247	369.727
	250	0.465	1.330	4.097	0.004	0.170	369.727
	750	0.426	1.881	3.780	0.004	0.153	369.727
	1000	0.446	2.049	4.566	0.004	0.156	369.727
Off-Highway Trucks	175	0.374	1.965	2.671	0.004	0.156	324.222
	250	0.272	0.747	2.409	0.004	0.080	324.222
	500	0.258	0.757	2.127	0.003	0.075	324.222
	750	0.260	0.757	2.192	0.003	0.077	324.222
	1000	0.285	0.867	3.102	0.003	0.093	324.222
Other Construction Equipment	15	0.411	2.153	2.571	0.005	0.100	352.663
	25	0.427	1.452	2.704	0.004	0.108	352.663
	50	0.949	3.343	3.258	0.005	0.258	352.663
	120	0.439	2.302	3.064	0.004	0.247	352.663
	175	0.310	1.944	2.652	0.004	0.139	352.663
	500	0.201	0.726	2.107	0.003	0.068	352.663

2013		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
Other General Industrial Equipment	15	0.301	1.771	2.115	0.005	0.083	290.093
	25	0.350	1.194	2.211	0.004	0.083	290.093
	50	1.282	3.619	2.979	0.004	0.306	290.093
	120	0.541	2.091	3.140	0.003	0.297	290.093
	175	0.375	1.729	2.787	0.003	0.164	290.093
	250	0.248	0.675	2.534	0.003	0.080	290.093
	500	0.231	0.692	2.224	0.003	0.075	290.093
	750	0.233	0.692	2.298	0.003	0.076	290.093
	1000	0.268	0.859	3.082	0.003	0.092	290.093
Other Material Handling Equipment	50	1.476	4.151	3.435	0.004	0.352	335.598
	120	0.622	2.409	3.626	0.004	0.342	335.598
	175	0.431	1.991	3.219	0.004	0.188	335.598
	250	0.284	0.778	2.927	0.004	0.092	335.598
	500	0.263	0.798	2.569	0.003	0.086	335.598
	9999	0.314	0.991	3.558	0.003	0.106	335.598
Pavers	25	0.466	1.510	2.836	0.004	0.142	352.663
	50	1.721	4.526	3.714	0.005	0.388	352.663
	120	0.707	2.577	4.259	0.004	0.372	352.663
	175	0.489	2.140	3.785	0.004	0.211	352.663
	250	0.376	1.103	3.532	0.004	0.137	352.663
	500	0.344	1.399	3.187	0.003	0.124	352.663
Paving Equipment	25	0.365	1.241	2.311	0.004	0.093	301.470
	50	1.470	3.841	3.168	0.004	0.331	301.470
	120	0.602	2.190	3.629	0.004	0.317	301.470
	175	0.414	1.814	3.228	0.003	0.180	301.470
	250	0.315	0.928	3.009	0.003	0.115	301.470
Plate Compactors	15	0.285	1.493	1.783	0.004	0.070	244.589
Pressure Washers	15	0.247	1.140	1.686	0.003	0.096	170.643
	25	0.256	0.873	1.537	0.002	0.087	170.643
	50	0.369	1.229	1.527	0.002	0.110	170.643
	120	0.211	1.021	1.569	0.002	0.110	170.643
Pumps	15	0.702	2.812	4.234	0.007	0.277	420.920
	25	0.766	2.154	3.791	0.005	0.233	420.920
	50	1.264	3.786	3.943	0.005	0.332	420.920
	120	0.610	2.684	4.120	0.005	0.328	420.920
	175	0.409	2.221	3.666	0.005	0.181	420.920
	250	0.261	0.875	3.332	0.005	0.094	420.920
	500	0.235	0.919	2.991	0.004	0.088	420.920
	750	0.242	0.919	3.084	0.004	0.090	420.920
	9999	0.323	1.139	4.117	0.004	0.115	420.920
Rollers	15	0.371	1.945	2.322	0.005	0.090	318.534
	25	0.385	1.312	2.442	0.004	0.098	318.534
	50	1.256	3.569	3.166	0.004	0.300	318.534
	120	0.533	2.194	3.377	0.004	0.288	318.534
	175	0.367	1.826	2.979	0.004	0.162	318.534
	250	0.263	0.809	2.731	0.004	0.094	318.534
	500	0.240	0.918	2.445	0.003	0.086	318.534
Rough Terrain Forklifts	50	1.191	3.808	3.343	0.004	0.303	341.286

2013		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
	120	0.522	2.364	3.276	0.004	0.289	341.286
	175	0.369	1.983	2.855	0.004	0.162	341.286
	250	0.259	0.759	2.589	0.004	0.083	341.286
	500	0.243	0.760	2.274	0.003	0.078	341.286
Rubber Tired Dozers	175	0.549	2.192	4.033	0.004	0.231	335.598
	250	0.445	1.250	3.807	0.004	0.161	335.598
	500	0.407	1.803	3.460	0.003	0.144	335.598
	750	0.408	1.800	3.515	0.003	0.145	335.598
	1000	0.426	1.952	4.225	0.003	0.147	335.598
Rubber Tired Loaders	25	0.371	1.265	2.343	0.004	0.091	307.158
	50	1.183	3.591	3.075	0.004	0.288	307.158
	120	0.506	2.165	3.136	0.004	0.274	307.158
	175	0.358	1.813	2.745	0.003	0.155	307.158
	250	0.259	0.760	2.500	0.003	0.086	307.158
	500	0.242	0.829	2.224	0.003	0.079	307.158
	750	0.243	0.829	2.284	0.003	0.081	307.158
	1000	0.268	0.953	3.084	0.003	0.093	307.158
Scrapers	120	0.819	3.028	4.859	0.005	0.429	409.544
	175	0.573	2.519	4.305	0.005	0.244	409.544
	250	0.440	1.253	4.005	0.005	0.155	409.544
	500	0.406	1.543	3.604	0.004	0.140	409.544
	750	0.408	1.542	3.679	0.004	0.141	409.544
Signal Boards	15	0.543	2.848	3.400	0.007	0.133	466.425
	50	1.412	4.237	4.187	0.006	0.363	443.672
	120	0.650	2.884	4.319	0.005	0.356	443.672
	175	0.441	2.394	3.828	0.005	0.197	443.672
	250	0.343	1.123	4.192	0.006	0.122	536.104
Skid Steer Loaders	25	0.457	1.407	2.643	0.004	0.143	312.846
	50	0.634	2.774	2.794	0.004	0.192	312.846
	120	0.314	2.010	2.390	0.004	0.179	312.846
Surfacing Equipment	50	0.865	2.546	2.466	0.003	0.215	255.965
	120	0.389	1.692	2.619	0.003	0.207	255.965
	175	0.267	1.411	2.310	0.003	0.117	255.965
	250	0.195	0.640	2.121	0.003	0.071	255.965
	500	0.177	0.743	1.921	0.003	0.066	255.965
	750	0.180	0.742	1.966	0.003	0.066	255.965
Sweepers/Scrubbers	15	0.401	2.362	2.820	0.006	0.110	386.791
	25	0.467	1.593	2.951	0.005	0.115	386.791
	50	1.265	4.170	3.735	0.005	0.328	386.791
	120	0.564	2.647	3.575	0.005	0.317	386.791
	175	0.396	2.223	3.090	0.004	0.175	386.791
	250	0.271	0.805	2.784	0.004	0.085	386.791
Tractors/Loaders/Backhoes	25	0.385	1.295	2.439	0.004	0.111	312.846
	50	0.921	3.298	2.983	0.004	0.246	312.846
	120	0.420	2.134	2.761	0.004	0.232	312.846
	175	0.305	1.809	2.375	0.004	0.132	312.846
	250	0.219	0.668	2.124	0.004	0.067	312.846
	500	0.208	0.675	1.874	0.004	0.064	312.846
	750	0.209	0.675	1.933	0.004	0.065	312.846

2013		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
Trenchers	15	0.497	2.605	3.110	0.007	0.121	426.608
	25	0.515	1.757	3.255	0.005	0.126	426.608
	50	2.030	5.291	4.448	0.006	0.458	426.608
	120	0.842	3.079	5.169	0.005	0.440	426.608
	175	0.580	2.559	4.601	0.005	0.252	426.608
	250	0.450	1.357	4.304	0.005	0.168	426.608
	500	0.409	1.783	3.901	0.004	0.151	426.608
	750	0.412	1.781	3.973	0.004	0.153	426.608
Welders	15	0.427	1.710	2.575	0.004	0.168	255.965
	25	0.466	1.310	2.305	0.003	0.142	255.965
	50	0.946	2.688	2.489	0.003	0.233	255.965
	120	0.417	1.717	2.629	0.003	0.229	255.965
	175	0.282	1.419	2.340	0.003	0.126	255.965
	250	0.181	0.559	2.128	0.003	0.064	255.965
	500	0.164	0.582	1.888	0.003	0.059	255.965
Water Trucks	175	0.374	1.965	2.671	0.004	0.156	324.222
	250	0.272	0.747	2.409	0.004	0.080	324.222
	500	0.258	0.757	2.127	0.003	0.075	324.222
	750	0.260	0.757	2.192	0.003	0.077	324.222
	1000	0.285	0.867	3.102	0.003	0.093	324.222

2014		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
Aerial Lifts	15	0.305	1.598	1.914	0.004	0.078	261.653
	25	0.380	1.176	2.189	0.003	0.115	261.653
	50	0.696	2.239	2.344	0.003	0.186	261.653
	120	0.343	1.645	2.400	0.003	0.184	261.653
	500	0.134	0.542	1.675	0.003	0.049	261.653
	750	0.138	0.542	1.732	0.003	0.050	261.653
Air Compressors	15	0.429	1.789	2.616	0.004	0.164	273.029
	25	0.462	1.336	2.402	0.003	0.140	273.029
	50	0.998	2.970	2.605	0.004	0.243	273.029
	120	0.433	1.864	2.695	0.003	0.238	273.029
	175	0.299	1.551	2.389	0.003	0.131	273.029
	250	0.195	0.594	2.114	0.003	0.065	273.029
	500	0.180	0.600	1.852	0.003	0.060	273.029
	750	0.182	0.600	1.918	0.003	0.062	273.029
	1000	0.214	0.718	2.649	0.003	0.076	273.029
Bore/Drill Rigs	15	0.497	2.605	3.110	0.007	0.121	426.608
	25	0.515	1.757	3.259	0.005	0.127	426.608
	50	0.351	3.097	3.290	0.006	0.131	426.608
	120	0.226	2.591	2.353	0.005	0.113	426.608
	175	0.203	2.280	1.974	0.005	0.074	426.608
	250	0.167	0.777	1.393	0.005	0.041	426.608
	500	0.165	0.755	1.304	0.004	0.040	426.608
	750	0.166	0.755	1.316	0.004	0.040	426.608
	1000	0.179	0.763	2.487	0.004	0.065	426.608
Cement and Mortar Mixers	15	0.373	1.945	2.349	0.005	0.099	318.534
	25	0.470	1.441	2.687	0.004	0.142	318.534
Concrete/Industrial Saws	25	0.501	1.710	3.165	0.005	0.120	415.232
	50	1.188	3.883	3.780	0.005	0.310	415.232
	120	0.548	2.686	3.771	0.005	0.301	415.232
	175	0.378	2.251	3.311	0.005	0.167	415.232
Cranes	50	0.983	2.963	2.440	0.003	0.233	244.589
	120	0.419	1.750	2.531	0.003	0.221	244.589
	175	0.297	1.463	2.224	0.003	0.125	244.589
	250	0.214	0.614	1.982	0.003	0.069	244.589
	500	0.199	0.672	1.763	0.002	0.064	244.589
	750	0.200	0.672	1.811	0.002	0.065	244.588
	9999	0.230	0.782	2.470	0.002	0.076	244.589
Crawler Tractors	50	1.601	4.630	3.723	0.005	0.367	364.039
	120	0.673	2.663	4.027	0.004	0.347	364.039
	175	0.479	2.227	3.562	0.004	0.199	364.039
	250	0.366	1.051	3.222	0.004	0.123	364.039
	500	0.340	1.248	2.898	0.004	0.112	364.039
	750	0.341	1.247	2.960	0.004	0.113	364.039
	1000	0.365	1.396	3.873	0.004	0.123	364.039
Crushing/Proc. Equipment	50	1.571	4.850	4.215	0.006	0.386	443.672
	120	0.685	3.043	4.269	0.005	0.376	443.672
	175	0.478	2.542	3.766	0.005	0.207	443.672

2014		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
	250	0.316	0.959	3.310	0.005	0.102	443.672
	500	0.295	0.961	2.890	0.004	0.095	443.672
	750	0.296	0.952	3.001	0.004	0.097	443.672
	9999	0.356	1.140	4.209	0.004	0.121	443.672
Dumpers/Tenders	25	0.268	0.899	1.686	0.003	0.076	216.148
Excavators	25	0.391	1.335	2.472	0.004	0.092	324.222
	50	0.943	3.573	3.051	0.004	0.245	324.222
	120	0.439	2.262	2.788	0.004	0.228	324.222
	175	0.328	1.924	2.405	0.004	0.132	324.222
	250	0.241	0.711	2.064	0.004	0.068	324.222
	500	0.230	0.708	1.821	0.003	0.064	324.222
	750	0.231	0.708	1.878	0.003	0.065	324.222
Forklifts	50	0.436	1.815	1.595	0.002	0.122	170.643
	120	0.211	1.177	1.395	0.002	0.111	170.643
	175	0.158	1.007	1.173	0.002	0.064	170.643
	250	0.119	0.352	1.008	0.002	0.033	170.643
	500	0.115	0.335	0.889	0.002	0.031	170.643
Generator Sets	15	0.581	2.758	3.977	0.007	0.221	420.920
	25	0.608	2.059	3.704	0.005	0.202	420.920
	50	1.057	3.469	3.739	0.005	0.289	420.920
	120	0.535	2.616	3.813	0.005	0.286	420.920
	175	0.360	2.181	3.382	0.005	0.157	420.920
	250	0.231	0.837	2.981	0.005	0.082	420.920
	500	0.207	0.857	2.669	0.004	0.077	420.920
	750	0.214	0.857	2.758	0.004	0.079	420.920
	9999	0.288	1.020	3.815	0.004	0.103	420.920
Graders	50	1.241	3.992	3.362	0.004	0.301	346.974
	120	0.540	2.438	3.365	0.004	0.284	346.974
	175	0.388	2.053	2.943	0.004	0.162	346.974
	250	0.284	0.842	2.590	0.004	0.090	346.974
	500	0.266	0.906	2.305	0.003	0.083	346.974
	750	0.267	0.906	2.367	0.003	0.084	346.974
Off-Highway Tractors	120	0.792	2.808	4.654	0.004	0.400	369.727
	175	0.556	2.345	4.146	0.004	0.233	369.727
	250	0.443	1.275	3.835	0.004	0.159	369.727
	750	0.407	1.756	3.538	0.004	0.143	369.727
	1000	0.428	1.915	4.368	0.004	0.148	369.727
Off-Highway Trucks	175	0.351	1.962	2.492	0.004	0.140	324.222
	250	0.258	0.732	2.151	0.004	0.072	324.222
	500	0.246	0.730	1.898	0.003	0.068	324.222
	750	0.247	0.730	1.958	0.003	0.069	324.222
	1000	0.269	0.814	2.897	0.003	0.086	324.222
Other Construction Equipment	15	0.411	2.153	2.571	0.005	0.100	352.663
	25	0.426	1.452	2.694	0.004	0.105	352.662
	50	0.844	3.242	3.114	0.005	0.230	352.663
	120	0.399	2.284	2.866	0.004	0.219	352.663
	175	0.288	1.943	2.475	0.004	0.124	352.663
	500	0.191	0.705	1.867	0.003	0.061	352.663

2014		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
Other General Industrial Equipment	15	0.301	1.771	2.115	0.005	0.083	290.093
	25	0.350	1.194	2.211	0.004	0.082	290.093
	50	1.147	3.472	2.863	0.004	0.277	290.093
	120	0.497	2.067	2.936	0.003	0.268	290.093
	175	0.350	1.722	2.596	0.003	0.148	290.093
	250	0.235	0.657	2.297	0.003	0.073	290.093
	500	0.220	0.658	2.006	0.003	0.068	290.093
	750	0.221	0.658	2.077	0.003	0.069	290.093
	1000	0.250	0.783	2.882	0.003	0.085	290.093
Other Material Handling Equipment	50	1.320	3.982	3.301	0.004	0.319	335.598
	120	0.572	2.382	3.391	0.004	0.309	335.598
	175	0.401	1.983	2.999	0.004	0.171	335.598
	250	0.268	0.757	2.654	0.004	0.084	335.598
	500	0.251	0.759	2.317	0.003	0.078	335.598
	9999	0.296	0.904	3.328	0.003	0.098	335.598
Pavers	25	0.452	1.490	2.782	0.004	0.133	352.663
	50	1.614	4.417	3.604	0.005	0.365	352.663
	120	0.668	2.554	4.051	0.004	0.348	352.663
	175	0.466	2.128	3.596	0.004	0.198	352.663
	250	0.356	1.056	3.280	0.004	0.126	352.663
	500	0.327	1.307	2.956	0.003	0.114	352.663
Paving Equipment	25	0.364	1.241	2.303	0.004	0.090	301.470
	50	1.379	3.747	3.074	0.004	0.311	301.470
	120	0.569	2.170	3.453	0.004	0.298	301.470
	175	0.395	1.805	3.066	0.003	0.169	301.470
	250	0.298	0.886	2.794	0.003	0.106	301.470
Plate Compactors	15	0.285	1.493	1.783	0.004	0.069	244.589
Pressure Washers	15	0.235	1.118	1.612	0.003	0.090	170.643
	25	0.247	0.835	1.502	0.002	0.082	170.643
	50	0.329	1.187	1.463	0.002	0.100	170.643
	120	0.191	1.011	1.475	0.002	0.100	170.643
Pumps	15	0.661	2.758	4.034	0.007	0.253	420.920
	25	0.712	2.059	3.704	0.005	0.216	420.920
	50	1.139	3.651	3.783	0.005	0.303	420.920
	120	0.556	2.657	3.871	0.005	0.299	420.920
	175	0.376	2.215	3.434	0.005	0.165	420.920
	250	0.242	0.852	3.030	0.005	0.086	420.920
	500	0.218	0.875	2.702	0.004	0.080	420.920
	750	0.225	0.875	2.793	0.004	0.082	420.920
	9999	0.296	1.042	3.859	0.004	0.105	420.920
Rollers	15	0.371	1.945	2.322	0.005	0.090	318.534
	25	0.385	1.312	2.434	0.004	0.095	318.534
	50	1.161	3.471	3.055	0.004	0.278	318.534
	120	0.497	2.176	3.189	0.004	0.267	318.534
	175	0.347	1.821	2.809	0.004	0.150	318.534
	250	0.246	0.773	2.497	0.004	0.085	318.534
	500	0.226	0.861	2.230	0.003	0.078	318.534
Rough Terrain Forklifts	50	1.063	3.684	3.210	0.004	0.273	341.286

2014		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
	120	0.479	2.345	3.067	0.004	0.259	341.286
	175	0.346	1.980	2.664	0.004	0.146	341.286
	250	0.246	0.743	2.325	0.004	0.075	341.286
	500	0.232	0.732	2.037	0.003	0.070	341.286
Rubber Tired Dozers	175	0.527	2.175	3.850	0.004	0.218	335.598
	250	0.425	1.200	3.570	0.004	0.150	335.598
	500	0.389	1.686	3.243	0.003	0.134	335.598
	750	0.390	1.684	3.296	0.003	0.135	335.598
	1000	0.408	1.828	4.045	0.003	0.140	335.598
Rubber Tired Loaders	25	0.371	1.265	2.342	0.004	0.089	307.158
	50	1.077	3.486	2.958	0.004	0.263	307.158
	120	0.470	2.148	2.948	0.004	0.249	307.158
	175	0.338	1.809	2.576	0.003	0.141	307.158
	250	0.245	0.733	2.261	0.003	0.077	307.158
	500	0.229	0.789	2.010	0.003	0.072	307.158
	750	0.231	0.788	2.066	0.003	0.073	307.158
	1000	0.255	0.899	2.905	0.003	0.087	307.158
Scrapers	120	0.772	3.002	4.611	0.005	0.398	409.544
	175	0.546	2.507	4.080	0.005	0.228	409.544
	250	0.417	1.201	3.703	0.005	0.142	409.544
	500	0.386	1.447	3.331	0.004	0.129	409.544
	750	0.388	1.446	3.401	0.004	0.130	409.544
Signal Boards	15	0.543	2.848	3.400	0.007	0.133	466.425
	50	1.269	4.084	4.013	0.006	0.330	443.672
	120	0.593	2.856	4.049	0.005	0.323	443.672
	175	0.406	2.388	3.578	0.005	0.178	443.672
	250	0.319	1.095	3.792	0.006	0.110	536.104
Skid Steer Loaders	25	0.442	1.384	2.596	0.004	0.135	312.846
	50	0.543	2.693	2.649	0.004	0.165	312.846
	120	0.278	1.995	2.209	0.004	0.150	312.846
Surfacing Equipment	50	0.801	2.481	2.377	0.003	0.199	255.965
	120	0.363	1.679	2.478	0.003	0.192	255.965
	175	0.251	1.407	2.184	0.003	0.108	255.965
	250	0.181	0.614	1.941	0.003	0.065	255.965
	500	0.166	0.702	1.754	0.003	0.060	255.965
	750	0.168	0.702	1.797	0.003	0.060	255.965
Sweepers/Scrubbers	15	0.401	2.362	2.820	0.006	0.110	386.791
	25	0.467	1.593	2.949	0.005	0.112	386.791
	50	1.098	4.018	3.591	0.005	0.291	386.791
	120	0.504	2.622	3.314	0.005	0.276	386.791
	175	0.362	2.222	2.835	0.004	0.154	386.791
	250	0.257	0.792	2.455	0.004	0.076	386.791
Tractors/Loaders/Backhoes	25	0.381	1.290	2.421	0.004	0.103	312.846
	50	0.817	3.200	2.851	0.004	0.218	312.846
	120	0.384	2.119	2.572	0.004	0.204	312.846
	175	0.285	1.807	2.210	0.004	0.117	312.846
	250	0.208	0.657	1.875	0.004	0.060	312.846
	500	0.198	0.657	1.656	0.004	0.057	312.846
	750	0.200	0.657	1.708	0.004	0.058	312.846

2014		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
Trenchers	15	0.497	2.605	3.110	0.007	0.122	426.608
	25	0.515	1.757	3.252	0.005	0.124	426.608
	50	1.915	5.172	4.318	0.006	0.431	426.608
	120	0.797	3.050	4.923	0.005	0.413	426.608
	175	0.553	2.543	4.380	0.005	0.237	426.608
	250	0.426	1.299	4.007	0.005	0.156	426.608
	500	0.389	1.661	3.627	0.004	0.140	426.608
	750	0.391	1.660	3.696	0.004	0.142	426.608
Welders	15	0.402	1.677	2.453	0.004	0.154	255.965
	25	0.433	1.252	2.252	0.003	0.131	255.965
	50	0.856	2.590	2.391	0.003	0.213	255.965
	120	0.382	1.700	2.469	0.003	0.209	255.965
	175	0.262	1.415	2.190	0.003	0.115	255.965
	250	0.170	0.544	1.936	0.003	0.058	255.965
	500	0.155	0.553	1.706	0.003	0.054	255.965
Water Trucks	175	0.351	1.962	2.492	0.004	0.140	324.222
	250	0.258	0.732	2.151	0.004	0.072	324.222
	500	0.246	0.730	1.898	0.003	0.068	324.222
	750	0.247	0.730	1.958	0.003	0.069	324.222
	1000	0.269	0.814	2.897	0.003	0.086	324.222

2015		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
Aerial Lifts	15	0.305	1.598	1.909	0.004	0.077	261.653
	25	0.368	1.157	2.150	0.003	0.108	261.653
	50	0.626	2.169	2.256	0.003	0.169	261.653
	120	0.310	1.630	2.223	0.003	0.166	261.653
	500	0.124	0.520	1.502	0.003	0.044	261.653
	750	0.128	0.520	1.556	0.003	0.045	261.653
Air Compressors	15	0.404	1.757	2.497	0.004	0.150	273.029
	25	0.430	1.281	2.349	0.003	0.130	273.029
	50	0.898	2.868	2.510	0.004	0.221	273.029
	120	0.395	1.845	2.493	0.003	0.214	273.029
	175	0.274	1.546	2.164	0.003	0.118	273.029
	250	0.183	0.580	1.906	0.003	0.059	273.029
	500	0.170	0.576	1.660	0.003	0.054	273.029
	750	0.172	0.576	1.723	0.003	0.056	273.029
	1000	0.197	0.658	2.478	0.003	0.069	273.029
Bore/Drill Rigs	15	0.497	2.605	3.110	0.007	0.121	426.608
	25	0.515	1.757	3.254	0.005	0.125	426.608
	50	0.322	3.072	3.079	0.006	0.103	426.608
	120	0.208	2.587	2.067	0.005	0.089	426.608
	175	0.187	2.280	1.622	0.005	0.060	426.608
	250	0.154	0.777	1.111	0.005	0.033	426.608
	500	0.153	0.755	1.054	0.004	0.032	426.608
	750	0.153	0.755	1.061	0.004	0.032	426.608
	1000	0.164	0.760	2.285	0.004	0.055	426.608
Cement and Mortar Mixers	15	0.372	1.945	2.336	0.005	0.096	318.534
	25	0.455	1.419	2.641	0.004	0.135	318.534
Concrete/Industrial Saws	25	0.501	1.710	3.165	0.005	0.119	415.232
	50	1.075	3.774	3.646	0.005	0.283	415.232
	120	0.500	2.665	3.499	0.005	0.272	415.232
	175	0.347	2.248	3.005	0.005	0.152	415.232
Cranes	50	0.900	2.879	2.357	0.003	0.214	244.589
	120	0.390	1.736	2.352	0.003	0.202	244.589
	175	0.280	1.459	2.035	0.003	0.115	244.589
	250	0.202	0.592	1.807	0.003	0.062	244.589
	500	0.189	0.633	1.604	0.002	0.058	244.589
	750	0.190	0.633	1.650	0.002	0.059	244.589
	9999	0.219	0.730	2.335	0.002	0.070	244.589
Crawler Tractors	50	1.488	4.517	3.605	0.005	0.340	364.039
	120	0.632	2.641	3.770	0.004	0.320	364.039
	175	0.453	2.218	3.290	0.004	0.184	364.039
	250	0.347	1.011	2.965	0.004	0.113	364.039
	500	0.323	1.173	2.666	0.004	0.103	364.039
	750	0.324	1.172	2.725	0.004	0.104	364.039
	1000	0.347	1.310	3.680	0.004	0.115	364.039
Crushing/Proc. Equipment	50	1.403	4.682	4.056	0.006	0.349	443.672
	120	0.623	3.013	3.935	0.005	0.336	443.672
	175	0.439	2.536	3.391	0.005	0.186	443.672

2015		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
	250	0.299	0.938	2.968	0.005	0.092	443.672
	500	0.280	0.925	2.579	0.004	0.086	443.672
	750	0.280	0.918	2.672	0.004	0.087	443.672
	9999	0.330	1.049	3.919	0.004	0.109	443.672
Dumpers/Tenders	25	0.265	0.894	1.675	0.003	0.071	216.148
Excavators	25	0.391	1.335	2.472	0.004	0.092	324.222
	50	0.842	3.478	2.924	0.004	0.217	324.222
	120	0.402	2.247	2.549	0.004	0.200	324.222
	175	0.304	1.922	2.141	0.004	0.117	324.222
	250	0.228	0.701	1.826	0.004	0.061	324.222
	500	0.219	0.689	1.612	0.003	0.057	324.222
	750	0.220	0.689	1.663	0.003	0.058	324.222
Forklifts	50	0.371	1.761	1.534	0.002	0.105	170.643
	120	0.186	1.169	1.261	0.002	0.094	170.643
	175	0.146	1.008	1.038	0.002	0.057	170.643
	250	0.114	0.349	0.882	0.002	0.029	170.643
	500	0.110	0.332	0.785	0.002	0.028	170.643
Generator Sets	15	0.554	2.709	3.808	0.007	0.208	420.920
	25	0.588	1.975	3.622	0.005	0.190	420.920
	50	0.950	3.362	3.598	0.005	0.262	420.920
	120	0.482	2.592	3.532	0.005	0.257	420.920
	175	0.326	2.177	3.065	0.005	0.142	420.920
	250	0.213	0.818	2.691	0.005	0.074	420.920
	500	0.192	0.825	2.394	0.004	0.070	420.920
	750	0.198	0.825	2.479	0.004	0.071	420.920
	9999	0.261	0.941	3.572	0.004	0.092	420.920
Graders	50	1.131	3.883	3.237	0.004	0.273	346.974
	120	0.501	2.421	3.113	0.004	0.257	346.974
	175	0.364	2.049	2.670	0.004	0.147	346.974
	250	0.267	0.816	2.338	0.004	0.081	346.974
	500	0.252	0.868	2.081	0.003	0.075	346.974
	750	0.253	0.867	2.138	0.003	0.076	346.974
Off-Highway Tractors	120	0.751	2.781	4.402	0.004	0.376	369.727
	175	0.530	2.329	3.885	0.004	0.219	369.727
	250	0.422	1.225	3.585	0.004	0.147	369.727
	750	0.389	1.642	3.307	0.004	0.133	369.727
	1000	0.409	1.793	4.180	0.004	0.139	369.727
Off-Highway Trucks	175	0.326	1.959	2.228	0.004	0.124	324.222
	250	0.244	0.721	1.911	0.004	0.064	324.222
	500	0.233	0.708	1.686	0.003	0.060	324.222
	750	0.235	0.708	1.740	0.003	0.061	324.222
	1000	0.253	0.769	2.707	0.003	0.078	324.222
Other Construction Equipment	15	0.411	2.153	2.571	0.005	0.100	352.663
	25	0.426	1.452	2.690	0.004	0.103	352.663
	50	0.752	3.158	2.985	0.005	0.205	352.663
	120	0.361	2.269	2.622	0.004	0.193	352.663
	175	0.264	1.941	2.197	0.004	0.110	352.663
	500	0.182	0.688	1.646	0.003	0.055	352.663

2015		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
Other General Industrial Equipment	15	0.301	1.771	2.115	0.005	0.083	290.093
	25	0.350	1.194	2.211	0.004	0.082	290.093
	50	1.026	3.350	2.759	0.004	0.250	290.093
	120	0.454	2.046	2.710	0.003	0.240	290.093
	175	0.323	1.717	2.346	0.003	0.133	290.093
	250	0.222	0.642	2.066	0.003	0.066	290.093
	500	0.209	0.631	1.796	0.003	0.061	290.093
	750	0.210	0.631	1.864	0.003	0.063	290.093
	1000	0.233	0.719	2.692	0.003	0.077	290.093
Other Material Handling Equipment	50	1.181	3.840	3.180	0.004	0.288	335.598
	120	0.521	2.356	3.130	0.004	0.276	335.598
	175	0.369	1.977	2.710	0.004	0.153	335.598
	250	0.254	0.739	2.387	0.004	0.076	335.598
	500	0.238	0.728	2.075	0.003	0.070	335.598
	9999	0.277	0.830	3.108	0.003	0.089	335.598
Pavers	25	0.442	1.474	2.755	0.004	0.124	352.663
	50	1.509	4.310	3.497	0.005	0.341	352.663
	120	0.630	2.532	3.811	0.004	0.324	352.663
	175	0.442	2.119	3.342	0.004	0.185	352.663
	250	0.337	1.013	3.039	0.004	0.116	352.663
	500	0.311	1.227	2.736	0.003	0.105	352.663
Paving Equipment	25	0.364	1.241	2.299	0.004	0.088	301.470
	50	1.289	3.655	2.982	0.004	0.292	301.470
	120	0.536	2.153	3.249	0.004	0.278	301.470
	175	0.374	1.798	2.850	0.003	0.158	301.470
	250	0.281	0.848	2.588	0.003	0.097	301.470
Plate Compactors	15	0.285	1.493	1.783	0.004	0.069	244.589
Pressure Washers	15	0.224	1.098	1.544	0.003	0.084	170.643
	25	0.238	0.801	1.468	0.002	0.077	170.643
	50	0.293	1.151	1.407	0.002	0.090	170.643
	120	0.170	1.002	1.367	0.002	0.089	170.643
Pumps	15	0.623	2.709	3.849	0.007	0.231	420.920
	25	0.662	1.975	3.622	0.005	0.200	420.920
	50	1.026	3.537	3.641	0.005	0.275	420.920
	120	0.503	2.632	3.587	0.005	0.270	420.920
	175	0.342	2.210	3.113	0.005	0.148	420.920
	250	0.224	0.832	2.735	0.005	0.077	420.920
	500	0.203	0.840	2.424	0.004	0.072	420.920
	750	0.209	0.840	2.511	0.004	0.074	420.920
	9999	0.269	0.958	3.614	0.004	0.094	420.920
Rollers	15	0.371	1.945	2.322	0.005	0.091	318.534
	25	0.384	1.312	2.430	0.004	0.093	318.534
	50	1.068	3.376	2.949	0.004	0.256	318.534
	120	0.463	2.160	2.969	0.004	0.245	318.534
	175	0.325	1.816	2.572	0.004	0.139	318.534
	250	0.230	0.744	2.278	0.004	0.077	318.534
	500	0.213	0.813	2.029	0.003	0.071	318.534
Rough Terrain Forklifts	50	0.950	3.580	3.090	0.004	0.245	341.286

2015		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
	120	0.438	2.328	2.822	0.004	0.230	341.286
	175	0.320	1.978	2.390	0.004	0.130	341.286
	250	0.233	0.729	2.075	0.004	0.068	341.286
	500	0.222	0.710	1.815	0.003	0.063	341.286
Rubber Tired Dozers	175	0.503	2.160	3.615	0.004	0.205	335.598
	250	0.404	1.153	3.342	0.004	0.139	335.598
	500	0.371	1.578	3.035	0.003	0.125	335.598
	750	0.373	1.577	3.086	0.003	0.126	335.598
	1000	0.391	1.714	3.872	0.003	0.131	335.598
Rubber Tired Loaders	25	0.371	1.265	2.342	0.004	0.088	307.158
	50	0.979	3.390	2.848	0.004	0.238	307.158
	120	0.435	2.132	2.725	0.004	0.225	307.158
	175	0.316	1.806	2.334	0.003	0.128	307.158
	250	0.231	0.710	2.039	0.003	0.069	307.158
	500	0.217	0.754	1.812	0.003	0.065	307.158
	750	0.219	0.754	1.863	0.003	0.066	307.158
	1000	0.241	0.850	2.737	0.003	0.080	307.158
Scrapers	120	0.726	2.977	4.325	0.005	0.369	409.544
	175	0.517	2.497	3.777	0.005	0.212	409.544
	250	0.395	1.155	3.416	0.005	0.130	409.544
	500	0.367	1.362	3.071	0.004	0.118	409.544
	750	0.369	1.361	3.138	0.004	0.120	409.544
Signal Boards	15	0.543	2.848	3.400	0.007	0.133	466.425
	50	1.141	3.957	3.859	0.006	0.299	443.672
	120	0.537	2.830	3.741	0.005	0.290	443.672
	175	0.370	2.383	3.230	0.005	0.160	443.672
	250	0.297	1.071	3.408	0.006	0.099	536.104
Skid Steer Loaders	25	0.428	1.364	2.551	0.004	0.127	312.846
	50	0.464	2.621	2.516	0.004	0.139	312.846
	120	0.245	1.983	1.975	0.004	0.124	312.846
Surfacing Equipment	50	0.740	2.418	2.292	0.003	0.183	255.965
	120	0.337	1.666	2.311	0.003	0.176	255.965
	175	0.235	1.404	2.001	0.003	0.100	255.965
	250	0.169	0.591	1.772	0.003	0.059	255.965
	500	0.155	0.666	1.598	0.003	0.054	255.965
	750	0.158	0.666	1.638	0.003	0.055	255.965
Sweepers/Scrubbers	15	0.401	2.362	2.820	0.006	0.110	386.791
	25	0.467	1.593	2.949	0.005	0.111	386.791
	50	0.942	3.881	3.453	0.005	0.255	386.791
	120	0.447	2.601	3.011	0.005	0.237	386.791
	175	0.328	2.223	2.493	0.004	0.134	386.791
	250	0.243	0.782	2.143	0.004	0.068	386.791
Tractors/Loaders/Backhoes	25	0.379	1.288	2.408	0.004	0.097	312.846
	50	0.724	3.114	2.728	0.004	0.192	312.846
	120	0.349	2.105	2.341	0.004	0.177	312.846
	175	0.264	1.806	1.954	0.004	0.103	312.846
	250	0.197	0.650	1.648	0.004	0.053	312.846
	500	0.189	0.643	1.458	0.004	0.051	312.846
	750	0.190	0.643	1.503	0.004	0.052	312.846

2015		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
Trenchers	15	0.497	2.605	3.110	0.007	0.122	426.608
	25	0.515	1.757	3.252	0.005	0.122	426.608
	50	1.802	5.055	4.192	0.006	0.405	426.608
	120	0.752	3.024	4.641	0.005	0.388	426.608
	175	0.525	2.530	4.082	0.005	0.222	426.608
	250	0.403	1.246	3.724	0.005	0.144	426.608
	500	0.369	1.555	3.366	0.004	0.130	426.608
	750	0.371	1.554	3.432	0.004	0.131	426.608
Welders	15	0.379	1.648	2.341	0.004	0.140	255.965
	25	0.403	1.201	2.203	0.003	0.122	255.965
	50	0.773	2.505	2.303	0.003	0.194	255.965
	120	0.348	1.684	2.287	0.003	0.189	255.965
	175	0.240	1.412	1.986	0.003	0.104	255.965
	250	0.159	0.531	1.748	0.003	0.052	255.965
	500	0.146	0.530	1.531	0.003	0.049	255.965
Water Trucks	175	0.326	1.959	2.228	0.004	0.124	324.222
	250	0.244	0.721	1.911	0.004	0.064	324.222
	500	0.233	0.708	1.686	0.003	0.060	324.222
	750	0.235	0.708	1.740	0.003	0.061	324.222
	1000	0.253	0.769	2.707	0.003	0.078	324.222

2016		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
Aerial Lifts	15	0.305	1.598	1.907	0.004	0.076	261.653
	25	0.357	1.141	2.114	0.003	0.102	261.653
	50	0.560	2.106	2.175	0.003	0.152	261.653
	120	0.278	1.615	2.053	0.003	0.148	261.653
	500	0.115	0.502	1.338	0.003	0.040	261.653
	750	0.119	0.502	1.389	0.003	0.041	261.653
Air Compressors	15	0.389	1.740	2.414	0.004	0.139	273.029
	25	0.411	1.251	2.308	0.003	0.123	273.029
	50	0.803	2.777	2.423	0.004	0.199	273.029
	120	0.358	1.828	2.302	0.003	0.191	273.029
	175	0.251	1.543	1.947	0.003	0.105	273.029
	250	0.173	0.568	1.707	0.003	0.053	273.029
	500	0.162	0.555	1.480	0.003	0.049	273.029
	750	0.163	0.555	1.538	0.003	0.050	273.029
	1000	0.184	0.622	2.332	0.003	0.063	273.029
Bore/Drill Rigs	15	0.497	2.605	3.110	0.007	0.122	426.608
	25	0.515	1.757	3.252	0.005	0.123	426.608
	50	0.303	3.056	2.895	0.006	0.080	426.608
	120	0.193	2.584	1.830	0.005	0.069	426.608
	175	0.171	2.280	1.323	0.005	0.047	426.608
	250	0.142	0.777	0.882	0.005	0.026	426.608
	500	0.142	0.755	0.857	0.004	0.026	426.608
	750	0.142	0.755	0.862	0.004	0.026	426.608
	1000	0.150	0.758	2.136	0.004	0.046	426.608
Cement and Mortar Mixers	15	0.371	1.945	2.328	0.005	0.094	318.534
	25	0.442	1.399	2.599	0.004	0.128	318.534
Concrete/Industrial Saws	25	0.501	1.710	3.165	0.005	0.118	415.232
	50	0.966	3.674	3.521	0.005	0.256	415.232
	120	0.453	2.646	3.239	0.005	0.244	415.232
	175	0.318	2.247	2.710	0.005	0.136	415.232
Cranes	50	0.821	2.801	2.278	0.003	0.195	244.589
	120	0.363	1.723	2.183	0.003	0.184	244.589
	175	0.263	1.456	1.857	0.003	0.105	244.589
	250	0.191	0.574	1.643	0.003	0.057	244.589
	500	0.180	0.602	1.456	0.002	0.053	244.589
	750	0.181	0.602	1.500	0.002	0.053	244.589
	9999	0.208	0.682	2.207	0.002	0.064	244.589
Crawler Tractors	50	1.382	4.411	3.492	0.005	0.314	364.039
	120	0.594	2.621	3.529	0.004	0.295	364.039
	175	0.429	2.211	3.033	0.004	0.170	364.039
	250	0.328	0.975	2.724	0.004	0.103	364.039
	500	0.307	1.110	2.449	0.004	0.094	364.039
	750	0.308	1.109	2.504	0.004	0.095	364.039
	1000	0.330	1.236	3.499	0.004	0.107	364.039
Crushing/Proc. Equipment	50	1.244	4.529	3.908	0.006	0.312	443.672
	120	0.562	2.985	3.615	0.005	0.296	443.672
	175	0.401	2.530	3.032	0.005	0.165	443.672

2016		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
	250	0.282	0.920	2.640	0.005	0.082	443.672
	500	0.266	0.895	2.287	0.004	0.077	443.672
	750	0.265	0.891	2.359	0.004	0.078	443.672
	9999	0.310	0.995	3.670	0.004	0.100	443.672
Dumpers/Tenders	25	0.263	0.891	1.665	0.003	0.067	216.148
Excavators	25	0.391	1.335	2.472	0.004	0.092	324.222
	50	0.754	3.397	2.807	0.004	0.191	324.222
	120	0.367	2.233	2.331	0.004	0.174	324.222
	175	0.281	1.921	1.896	0.004	0.102	324.222
	250	0.215	0.692	1.607	0.004	0.054	324.222
	500	0.207	0.673	1.420	0.003	0.051	324.222
	750	0.208	0.673	1.464	0.003	0.052	324.222
Forklifts	50	0.325	1.724	1.478	0.002	0.091	170.643
	120	0.169	1.164	1.147	0.002	0.080	170.643
	175	0.137	1.010	0.919	0.002	0.050	170.643
	250	0.108	0.347	0.771	0.002	0.026	170.643
	500	0.106	0.330	0.688	0.002	0.025	170.643
Generator Sets	15	0.534	2.683	3.688	0.007	0.196	420.920
	25	0.573	1.929	3.558	0.005	0.181	420.920
	50	0.849	3.267	3.470	0.005	0.236	420.920
	120	0.432	2.570	3.267	0.005	0.230	420.920
	175	0.294	2.173	2.763	0.005	0.127	420.920
	250	0.196	0.801	2.414	0.005	0.067	420.920
	500	0.178	0.798	2.135	0.004	0.063	420.920
	750	0.183	0.798	2.214	0.004	0.064	420.920
	9999	0.240	0.892	3.365	0.004	0.084	420.920
Graders	50	1.029	3.784	3.119	0.004	0.247	346.974
	120	0.464	2.405	2.879	0.004	0.231	346.974
	175	0.340	2.047	2.415	0.004	0.133	346.974
	250	0.252	0.794	2.106	0.004	0.072	346.974
	500	0.239	0.835	1.874	0.003	0.067	346.974
	750	0.240	0.835	1.926	0.003	0.068	346.974
Off-Highway Tractors	120	0.712	2.756	4.162	0.004	0.352	369.727
	175	0.505	2.315	3.636	0.004	0.205	369.727
	250	0.401	1.178	3.346	0.004	0.137	369.727
	750	0.371	1.538	3.087	0.004	0.124	369.727
	1000	0.391	1.681	4.000	0.004	0.131	369.727
Off-Highway Trucks	175	0.302	1.957	1.982	0.004	0.108	324.222
	250	0.230	0.711	1.690	0.004	0.057	324.222
	500	0.221	0.690	1.491	0.003	0.053	324.222
	750	0.222	0.690	1.539	0.003	0.054	324.222
	1000	0.237	0.733	2.537	0.003	0.071	324.222
Other Construction Equipment	15	0.411	2.153	2.571	0.005	0.100	352.663
	25	0.425	1.452	2.688	0.004	0.102	352.663
	50	0.668	3.083	2.866	0.005	0.180	352.663
	120	0.326	2.255	2.397	0.004	0.167	352.663
	175	0.241	1.941	1.939	0.004	0.096	352.663
	500	0.172	0.675	1.445	0.003	0.049	352.663

2016		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
Other General Industrial Equipment	15	0.301	1.771	2.115	0.005	0.083	290.093
	25	0.350	1.194	2.211	0.004	0.083	290.093
	50	0.915	3.245	2.662	0.004	0.224	290.093
	120	0.412	2.027	2.494	0.003	0.212	290.093
	175	0.296	1.713	2.106	0.003	0.118	290.093
	250	0.210	0.629	1.844	0.003	0.059	290.093
	500	0.198	0.609	1.598	0.003	0.055	290.093
	750	0.200	0.609	1.660	0.003	0.056	290.093
	1000	0.220	0.680	2.528	0.003	0.071	290.093
Other Material Handling Equipment	50	1.052	3.716	3.069	0.004	0.258	335.598
	120	0.473	2.334	2.881	0.004	0.244	335.598
	175	0.339	1.972	2.433	0.004	0.136	335.598
	250	0.239	0.724	2.131	0.004	0.068	335.598
	500	0.226	0.702	1.846	0.003	0.063	335.598
	9999	0.263	0.785	2.919	0.003	0.082	335.598
Pavers	25	0.435	1.464	2.736	0.004	0.116	352.663
	50	1.408	4.207	3.394	0.005	0.318	352.663
	120	0.593	2.513	3.583	0.004	0.301	352.663
	175	0.419	2.111	3.100	0.004	0.172	352.663
	250	0.319	0.974	2.810	0.004	0.106	352.663
	500	0.296	1.156	2.528	0.003	0.097	352.663
Paving Equipment	25	0.364	1.241	2.298	0.004	0.087	301.470
	50	1.201	3.565	2.894	0.004	0.272	301.470
	120	0.505	2.136	3.055	0.004	0.259	301.470
	175	0.355	1.792	2.643	0.003	0.147	301.470
	250	0.265	0.814	2.392	0.003	0.089	301.470
Plate Compactors	15	0.285	1.493	1.783	0.004	0.070	244.589
Pressure Washers	15	0.216	1.088	1.495	0.003	0.080	170.643
	25	0.232	0.782	1.442	0.002	0.073	170.643
	50	0.260	1.120	1.356	0.002	0.081	170.643
	120	0.151	0.994	1.264	0.002	0.079	170.643
Pumps	15	0.599	2.683	3.721	0.007	0.215	420.920
	25	0.634	1.929	3.558	0.005	0.189	420.920
	50	0.919	3.437	3.513	0.005	0.249	420.920
	120	0.452	2.609	3.317	0.005	0.241	420.920
	175	0.309	2.206	2.807	0.005	0.133	420.920
	250	0.208	0.814	2.454	0.005	0.070	420.920
	500	0.189	0.810	2.162	0.004	0.065	420.920
	750	0.194	0.810	2.243	0.004	0.067	420.920
	9999	0.249	0.906	3.404	0.004	0.086	420.920
Rollers	15	0.371	1.945	2.322	0.005	0.091	318.534
	25	0.384	1.312	2.428	0.004	0.092	318.534
	50	0.979	3.286	2.848	0.004	0.235	318.534
	120	0.430	2.144	2.761	0.004	0.225	318.534
	175	0.304	1.812	2.347	0.004	0.127	318.534
	250	0.217	0.721	2.073	0.004	0.069	318.534
	500	0.202	0.773	1.842	0.003	0.064	318.534
Rough Terrain Forklifts	50	0.847	3.487	2.978	0.004	0.218	341.286

2016		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
	120	0.398	2.312	2.592	0.004	0.202	341.286
	175	0.295	1.977	2.131	0.004	0.116	341.286
	250	0.221	0.718	1.840	0.004	0.060	341.286
	500	0.211	0.692	1.608	0.003	0.057	341.286
Rubber Tired Dozers	175	0.480	2.146	3.389	0.004	0.192	335.598
	250	0.384	1.109	3.125	0.004	0.129	335.598
	500	0.354	1.479	2.836	0.003	0.116	335.598
	750	0.355	1.478	2.885	0.003	0.117	335.598
	1000	0.373	1.608	3.707	0.003	0.123	335.598
Rubber Tired Loaders	25	0.371	1.265	2.342	0.004	0.087	307.158
	50	0.889	3.303	2.744	0.004	0.215	307.158
	120	0.403	2.118	2.517	0.004	0.202	307.158
	175	0.295	1.803	2.108	0.003	0.116	307.158
	250	0.218	0.692	1.835	0.003	0.062	307.158
	500	0.206	0.725	1.630	0.003	0.058	307.158
	750	0.208	0.725	1.677	0.003	0.059	307.158
	1000	0.227	0.806	2.581	0.003	0.074	307.158
Scrapers	120	0.683	2.955	4.054	0.005	0.341	409.544
	175	0.490	2.489	3.490	0.005	0.196	409.544
	250	0.374	1.112	3.145	0.005	0.119	409.544
	500	0.349	1.288	2.827	0.004	0.108	409.544
	750	0.350	1.287	2.890	0.004	0.110	409.544
Signal Boards	15	0.543	2.848	3.400	0.007	0.133	466.425
	50	1.020	3.843	3.717	0.006	0.268	443.672
	120	0.483	2.806	3.447	0.005	0.258	443.672
	175	0.336	2.379	2.895	0.005	0.143	443.672
	250	0.277	1.050	3.040	0.006	0.089	536.104
Skid Steer Loaders	25	0.416	1.347	2.510	0.004	0.121	312.846
	50	0.396	2.561	2.394	0.004	0.116	312.846
	120	0.216	1.972	1.764	0.004	0.101	312.846
Surfacing Equipment	50	0.682	2.360	2.213	0.003	0.168	255.965
	120	0.313	1.655	2.153	0.003	0.162	255.965
	175	0.219	1.401	1.829	0.003	0.092	255.965
	250	0.158	0.572	1.615	0.003	0.053	255.965
	500	0.146	0.635	1.453	0.003	0.049	255.965
	750	0.148	0.634	1.491	0.003	0.050	255.965
Sweepers/Scrubbers	15	0.401	2.362	2.820	0.006	0.110	386.791
	25	0.467	1.593	2.949	0.005	0.110	386.791
	50	0.798	3.759	3.323	0.005	0.220	386.791
	120	0.393	2.581	2.720	0.005	0.199	386.791
	175	0.303	2.225	2.203	0.004	0.118	386.791
	250	0.232	0.775	1.873	0.004	0.061	386.791
Tractors/Loaders/Backhoes	25	0.378	1.288	2.399	0.004	0.094	312.846
	50	0.642	3.040	2.614	0.004	0.167	312.846
	120	0.317	2.092	2.133	0.004	0.153	312.846
	175	0.243	1.805	1.720	0.004	0.090	312.846
	250	0.187	0.644	1.442	0.004	0.047	312.846
	500	0.180	0.632	1.279	0.004	0.045	312.846
	750	0.181	0.632	1.317	0.004	0.046	312.846

2016		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
Trenchers	15	0.497	2.605	3.110	0.007	0.122	426.608
	25	0.515	1.757	3.252	0.005	0.121	426.608
	50	1.691	4.942	4.071	0.006	0.380	426.608
	120	0.710	3.000	4.374	0.005	0.362	426.608
	175	0.498	2.519	3.798	0.005	0.208	426.608
	250	0.381	1.198	3.455	0.005	0.132	426.608
	500	0.351	1.463	3.119	0.004	0.120	426.608
	750	0.353	1.462	3.183	0.004	0.121	426.608
Welders	15	0.365	1.631	2.263	0.004	0.131	255.965
	25	0.385	1.173	2.164	0.003	0.115	255.965
	50	0.694	2.430	2.223	0.003	0.175	255.965
	120	0.315	1.669	2.114	0.003	0.169	255.965
	175	0.219	1.409	1.790	0.003	0.093	255.965
	250	0.149	0.520	1.568	0.003	0.047	255.965
	500	0.138	0.511	1.366	0.003	0.044	255.965
Water Trucks	175	0.302	1.957	1.982	0.004	0.108	324.222
	250	0.230	0.711	1.690	0.004	0.057	324.222
	500	0.221	0.690	1.491	0.003	0.053	324.222
	750	0.222	0.690	1.539	0.003	0.054	324.222
	1000	0.237	0.733	2.537	0.003	0.071	324.222

2017		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
Aerial Lifts	15	0.305	1.598	1.907	0.004	0.075	261.653
	25	0.348	1.128	2.082	0.003	0.097	261.653
	50	0.497	2.049	2.099	0.003	0.136	261.653
	120	0.248	1.602	1.894	0.003	0.131	261.653
	500	0.108	0.488	1.197	0.003	0.036	261.653
	750	0.110	0.488	1.234	0.003	0.037	261.653
Air Compressors	15	0.378	1.729	2.348	0.004	0.131	273.029
	25	0.399	1.232	2.272	0.003	0.117	273.029
	50	0.712	2.693	2.340	0.004	0.179	273.029
	120	0.323	1.813	2.120	0.003	0.168	273.029
	175	0.229	1.541	1.743	0.003	0.093	273.029
	250	0.163	0.558	1.520	0.003	0.047	273.029
	500	0.155	0.540	1.324	0.003	0.044	273.029
	750	0.156	0.540	1.367	0.003	0.045	273.029
	1000	0.174	0.599	2.202	0.003	0.058	273.029
Bore/Drill Rigs	15	0.497	2.605	3.110	0.007	0.122	426.608
	25	0.515	1.757	3.252	0.005	0.122	426.608
	50	0.289	3.045	2.738	0.006	0.061	426.608
	120	0.181	2.582	1.639	0.005	0.053	426.608
	175	0.157	2.280	1.085	0.005	0.037	426.608
	250	0.131	0.777	0.708	0.005	0.020	426.608
	500	0.131	0.755	0.690	0.004	0.020	426.608
	750	0.131	0.755	0.694	0.004	0.020	426.608
	1000	0.139	0.756	2.021	0.004	0.039	426.608
Cement and Mortar Mixers	15	0.371	1.945	2.323	0.005	0.093	318.534
	25	0.430	1.383	2.560	0.004	0.121	318.534
Concrete/Industrial Saws	25	0.501	1.710	3.165	0.005	0.118	415.232
	50	0.859	3.576	3.400	0.005	0.229	415.232
	120	0.407	2.627	2.985	0.005	0.215	415.232
	175	0.289	2.245	2.423	0.005	0.121	415.232
Cranes	50	0.749	2.730	2.202	0.003	0.177	244.589
	120	0.337	1.711	2.027	0.003	0.167	244.589
	175	0.246	1.453	1.690	0.003	0.096	244.589
	250	0.181	0.561	1.490	0.003	0.051	244.589
	500	0.171	0.576	1.318	0.002	0.048	244.589
	750	0.172	0.576	1.359	0.002	0.048	244.589
	9999	0.197	0.639	2.085	0.002	0.059	244.589
Crawler Tractors	50	1.282	4.312	3.383	0.005	0.289	364.039
	120	0.557	2.604	3.303	0.004	0.271	364.039
	175	0.405	2.206	2.792	0.004	0.157	364.039
	250	0.310	0.944	2.498	0.004	0.093	364.039
	500	0.291	1.057	2.245	0.004	0.086	364.039
	750	0.292	1.057	2.297	0.004	0.087	364.039
	1000	0.314	1.174	3.329	0.004	0.099	364.039
Crushing/Proc. Equipment	50	1.095	4.390	3.769	0.006	0.277	443.672
	120	0.506	2.960	3.314	0.005	0.258	443.672
	175	0.366	2.527	2.694	0.005	0.145	443.672

2017		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
	250	0.266	0.906	2.332	0.005	0.073	443.672
	500	0.253	0.874	2.032	0.004	0.069	443.672
	750	0.252	0.870	2.080	0.004	0.069	443.672
	9999	0.295	0.961	3.453	0.004	0.091	443.672
Dumpers/Tenders	25	0.262	0.890	1.659	0.003	0.065	216.148
Excavators	25	0.391	1.335	2.472	0.004	0.092	324.222
	50	0.676	3.328	2.698	0.004	0.166	324.222
	120	0.335	2.220	2.132	0.004	0.150	324.222
	175	0.259	1.919	1.671	0.004	0.089	324.222
	250	0.203	0.685	1.405	0.004	0.047	324.222
	500	0.196	0.661	1.247	0.003	0.045	324.222
	750	0.197	0.660	1.283	0.003	0.045	324.222
Forklifts	50	0.291	1.696	1.424	0.002	0.079	170.643
	120	0.155	1.160	1.044	0.002	0.069	170.643
	175	0.128	1.011	0.810	0.002	0.044	170.643
	250	0.103	0.346	0.667	0.002	0.022	170.643
	500	0.101	0.329	0.598	0.002	0.022	170.643
Generator Sets	15	0.518	2.666	3.590	0.007	0.186	420.920
	25	0.561	1.900	3.503	0.005	0.173	420.920
	50	0.754	3.180	3.350	0.005	0.212	420.920
	120	0.386	2.550	3.017	0.005	0.203	420.920
	175	0.264	2.171	2.480	0.005	0.112	420.920
	250	0.182	0.788	2.155	0.005	0.060	420.920
	500	0.166	0.777	1.911	0.004	0.057	420.920
	750	0.170	0.777	1.970	0.004	0.058	420.920
	9999	0.223	0.860	3.180	0.004	0.077	420.920
Graders	50	0.936	3.694	3.008	0.004	0.222	346.974
	120	0.430	2.391	2.663	0.004	0.207	346.974
	175	0.318	2.044	2.179	0.004	0.120	346.974
	250	0.238	0.776	1.892	0.004	0.065	346.974
	500	0.226	0.808	1.684	0.003	0.061	346.974
	750	0.227	0.808	1.731	0.003	0.061	346.974
Off-Highway Tractors	120	0.675	2.734	3.934	0.004	0.329	369.727
	175	0.481	2.303	3.399	0.004	0.192	369.727
	250	0.381	1.134	3.120	0.004	0.126	369.727
	750	0.354	1.446	2.878	0.004	0.115	369.727
	1000	0.373	1.581	3.829	0.004	0.122	369.727
Off-Highway Trucks	175	0.278	1.956	1.753	0.004	0.094	324.222
	250	0.216	0.702	1.485	0.004	0.050	324.222
	500	0.209	0.676	1.314	0.003	0.047	324.222
	750	0.210	0.676	1.353	0.003	0.048	324.222
	1000	0.224	0.709	2.387	0.003	0.064	324.222
Other Construction Equipment	15	0.411	2.153	2.571	0.005	0.100	352.663
	25	0.425	1.452	2.688	0.004	0.101	352.663
	50	0.589	3.014	2.753	0.005	0.157	352.663
	120	0.293	2.242	2.187	0.004	0.144	352.663
	175	0.220	1.940	1.699	0.004	0.084	352.663
	500	0.164	0.665	1.267	0.003	0.043	352.663

2017		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
Other General Industrial Equipment	15	0.301	1.771	2.115	0.005	0.083	290.093
	25	0.350	1.194	2.211	0.004	0.083	290.093
	50	0.812	3.152	2.572	0.004	0.200	290.093
	120	0.373	2.011	2.292	0.003	0.186	290.093
	175	0.272	1.712	1.882	0.003	0.104	290.093
	250	0.198	0.618	1.638	0.003	0.052	290.093
	500	0.189	0.593	1.426	0.003	0.049	290.093
	750	0.190	0.593	1.473	0.003	0.050	290.093
	1000	0.209	0.655	2.382	0.003	0.065	290.093
Other Material Handling Equipment	50	0.932	3.608	2.964	0.004	0.230	335.598
	120	0.428	2.315	2.648	0.004	0.214	335.598
	175	0.311	1.970	2.174	0.004	0.120	335.598
	250	0.226	0.712	1.892	0.004	0.061	335.598
	500	0.216	0.683	1.648	0.003	0.057	335.598
	9999	0.252	0.756	2.751	0.003	0.075	335.598
Pavers	25	0.430	1.457	2.721	0.004	0.110	352.663
	50	1.311	4.110	3.295	0.005	0.295	352.663
	120	0.558	2.495	3.367	0.004	0.279	352.663
	175	0.397	2.104	2.870	0.004	0.160	352.663
	250	0.302	0.939	2.593	0.004	0.097	352.663
	500	0.281	1.094	2.331	0.003	0.089	352.663
Paving Equipment	25	0.364	1.241	2.298	0.004	0.086	301.470
	50	1.116	3.478	2.809	0.004	0.252	301.470
	120	0.474	2.121	2.870	0.004	0.240	301.470
	175	0.336	1.787	2.446	0.003	0.137	301.470
	250	0.251	0.783	2.206	0.003	0.081	301.470
Plate Compactors	15	0.285	1.493	1.783	0.004	0.070	244.589
Pressure Washers	15	0.210	1.081	1.456	0.003	0.075	170.643
	25	0.228	0.770	1.420	0.002	0.070	170.643
	50	0.228	1.091	1.308	0.002	0.072	170.643
	120	0.133	0.986	1.168	0.002	0.070	170.643
Pumps	15	0.583	2.666	3.620	0.007	0.202	420.920
	25	0.615	1.900	3.503	0.005	0.180	420.920
	50	0.818	3.344	3.391	0.005	0.223	420.920
	120	0.405	2.589	3.062	0.005	0.213	420.920
	175	0.279	2.204	2.519	0.005	0.118	420.920
	250	0.193	0.800	2.191	0.005	0.063	420.920
	500	0.177	0.787	1.935	0.004	0.059	420.920
	750	0.181	0.787	1.996	0.004	0.060	420.920
	9999	0.232	0.872	3.217	0.004	0.079	420.920
Rollers	15	0.371	1.945	2.322	0.005	0.091	318.534
	25	0.384	1.312	2.428	0.004	0.091	318.534
	50	0.893	3.202	2.752	0.004	0.214	318.534
	120	0.398	2.130	2.565	0.004	0.204	318.534
	175	0.284	1.809	2.135	0.004	0.116	318.534
	250	0.205	0.702	1.880	0.004	0.063	318.534
	500	0.192	0.740	1.667	0.003	0.058	318.534
Rough Terrain Forklifts	50	0.749	3.400	2.869	0.004	0.192	341.286

2017		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
	120	0.361	2.297	2.372	0.004	0.175	341.286
	175	0.271	1.976	1.885	0.004	0.101	341.286
	250	0.209	0.708	1.618	0.004	0.054	341.286
	500	0.201	0.679	1.424	0.003	0.051	341.286
Rubber Tired Dozers	175	0.457	2.134	3.173	0.004	0.179	335.598
	250	0.364	1.069	2.918	0.004	0.120	335.598
	500	0.337	1.390	2.647	0.003	0.108	335.598
	750	0.338	1.389	2.694	0.003	0.108	335.598
	1000	0.356	1.512	3.551	0.003	0.115	335.598
Rubber Tired Loaders	25	0.371	1.265	2.342	0.004	0.087	307.158
	50	0.807	3.224	2.647	0.004	0.193	307.158
	120	0.372	2.105	2.325	0.004	0.180	307.158
	175	0.276	1.801	1.899	0.003	0.105	307.158
	250	0.206	0.678	1.646	0.003	0.056	307.158
	500	0.196	0.701	1.463	0.003	0.052	307.158
	750	0.197	0.701	1.506	0.003	0.053	307.158
	1000	0.214	0.767	2.436	0.003	0.067	307.158
Scrapers	120	0.642	2.935	3.800	0.005	0.314	409.544
	175	0.463	2.482	3.219	0.005	0.181	409.544
	250	0.353	1.074	2.890	0.005	0.108	409.544
	500	0.331	1.223	2.596	0.004	0.099	409.544
	750	0.332	1.223	2.656	0.004	0.100	409.544
Signal Boards	15	0.543	2.848	3.400	0.007	0.133	466.425
	50	0.905	3.736	3.584	0.006	0.239	443.672
	120	0.432	2.784	3.169	0.005	0.227	443.672
	175	0.304	2.377	2.580	0.005	0.126	443.672
	250	0.258	1.033	2.695	0.006	0.080	536.104
Skid Steer Loaders	25	0.407	1.333	2.473	0.004	0.114	312.846
	50	0.353	2.521	2.286	0.004	0.096	312.846
	120	0.196	1.965	1.589	0.004	0.084	312.846
Surfacing Equipment	50	0.627	2.304	2.137	0.003	0.154	255.965
	120	0.290	1.644	2.005	0.003	0.148	255.965
	175	0.204	1.398	1.668	0.003	0.084	255.965
	250	0.148	0.555	1.468	0.003	0.048	255.965
	500	0.137	0.607	1.318	0.003	0.045	255.965
	750	0.139	0.607	1.354	0.003	0.045	255.965
Sweepers/Scrubbers	15	0.401	2.362	2.820	0.006	0.110	386.791
	25	0.467	1.593	2.949	0.005	0.110	386.791
	50	0.700	3.682	3.208	0.005	0.191	386.791
	120	0.357	2.571	2.481	0.005	0.170	386.791
	175	0.283	2.229	1.954	0.004	0.105	386.791
	250	0.221	0.770	1.640	0.004	0.054	386.791
Tractors/Loaders/Backhoes	25	0.378	1.288	2.392	0.004	0.093	312.846
	50	0.572	2.979	2.511	0.004	0.145	312.846
	120	0.289	2.082	1.945	0.004	0.131	312.846
	175	0.224	1.804	1.508	0.004	0.078	312.846
	250	0.176	0.639	1.255	0.004	0.042	312.846
	500	0.171	0.622	1.117	0.004	0.040	312.846
	750	0.172	0.622	1.149	0.004	0.040	312.846

2017		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
Trenchers	15	0.497	2.605	3.110	0.007	0.122	426.608
	25	0.515	1.757	3.252	0.005	0.121	426.608
	50	1.584	4.832	3.955	0.006	0.355	426.608
	120	0.669	2.977	4.119	0.005	0.338	426.608
	175	0.471	2.509	3.526	0.005	0.194	426.608
	250	0.360	1.154	3.199	0.005	0.122	426.608
	500	0.333	1.382	2.885	0.004	0.110	426.608
	750	0.335	1.381	2.945	0.004	0.112	426.608
Welders	15	0.354	1.621	2.201	0.004	0.123	255.965
	25	0.374	1.155	2.130	0.003	0.110	255.965
	50	0.618	2.360	2.148	0.003	0.158	255.965
	120	0.284	1.655	1.949	0.003	0.150	255.965
	175	0.199	1.407	1.605	0.003	0.083	255.965
	250	0.140	0.511	1.399	0.003	0.042	255.965
	500	0.131	0.497	1.222	0.003	0.040	255.965
Water Trucks	175	0.278	1.956	1.753	0.004	0.094	324.222
	250	0.216	0.702	1.485	0.004	0.050	324.222
	500	0.209	0.676	1.314	0.003	0.047	324.222
	750	0.210	0.676	1.353	0.003	0.048	324.222
	1000	0.224	0.709	2.387	0.003	0.064	324.222

2018		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
Aerial Lifts	15	0.305	1.598	1.907	0.004	0.074	261.653
	25	0.340	1.115	2.063	0.003	0.092	261.653
	50	0.438	1.995	2.026	0.003	0.121	261.653
	120	0.220	1.591	1.744	0.003	0.114	261.653
	500	0.102	0.478	1.070	0.003	0.033	261.653
	750	0.104	0.478	1.099	0.003	0.033	261.653
Air Compressors	15	0.368	1.720	2.288	0.004	0.123	273.029
	25	0.388	1.216	2.239	0.003	0.112	273.029
	50	0.625	2.613	2.262	0.004	0.158	273.029
	120	0.290	1.799	1.946	0.003	0.146	273.029
	175	0.209	1.540	1.551	0.003	0.082	273.029
	250	0.154	0.551	1.344	0.003	0.042	273.029
	500	0.148	0.529	1.185	0.003	0.040	273.029
	750	0.149	0.529	1.217	0.003	0.041	273.029
	1000	0.165	0.581	2.078	0.003	0.054	273.029
Bore/Drill Rigs	15	0.497	2.605	3.110	0.007	0.122	426.608
	25	0.515	1.757	3.252	0.005	0.121	426.608
	50	0.280	3.039	2.607	0.006	0.047	426.608
	120	0.171	2.581	1.499	0.005	0.040	426.608
	175	0.144	2.281	0.880	0.005	0.028	426.608
	250	0.122	0.777	0.567	0.005	0.015	426.608
	500	0.122	0.755	0.553	0.004	0.015	426.608
	750	0.122	0.755	0.556	0.004	0.015	426.608
	1000	0.128	0.756	1.935	0.004	0.033	426.608
Cement and Mortar Mixers	15	0.371	1.945	2.322	0.005	0.092	318.534
	25	0.420	1.368	2.525	0.004	0.115	318.534
Concrete/Industrial Saws	25	0.501	1.710	3.165	0.005	0.118	415.232
	50	0.755	3.482	3.282	0.005	0.203	415.232
	120	0.364	2.610	2.743	0.005	0.188	415.232
	175	0.262	2.245	2.152	0.005	0.106	415.232
Cranes	50	0.681	2.666	2.130	0.003	0.160	244.589
	120	0.312	1.700	1.882	0.003	0.149	244.589
	175	0.229	1.451	1.531	0.003	0.086	244.589
	250	0.172	0.550	1.345	0.003	0.046	244.589
	500	0.163	0.555	1.188	0.002	0.043	244.589
	750	0.164	0.555	1.226	0.002	0.044	244.589
	9999	0.187	0.604	1.972	0.002	0.054	244.589
Crawler Tractors	50	1.190	4.220	3.278	0.005	0.265	364.039
	120	0.523	2.588	3.092	0.004	0.248	364.039
	175	0.381	2.201	2.564	0.004	0.144	364.039
	250	0.292	0.916	2.286	0.004	0.084	364.039
	500	0.275	1.011	2.054	0.004	0.078	364.039
	750	0.276	1.011	2.102	0.004	0.079	364.039
	1000	0.298	1.117	3.169	0.004	0.092	364.039
Crushing/Proc. Equipment	50	0.957	4.264	3.636	0.006	0.243	443.672
	120	0.453	2.938	3.031	0.005	0.222	443.672
	175	0.334	2.525	2.381	0.005	0.126	443.672

2018		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
	250	0.251	0.895	2.047	0.005	0.065	443.672
	500	0.242	0.859	1.805	0.004	0.062	443.672
	750	0.241	0.857	1.841	0.004	0.062	443.672
	9999	0.282	0.936	3.254	0.004	0.084	443.672
Dumpers/Tenders	25	0.261	0.890	1.655	0.003	0.064	216.148
Excavators	25	0.391	1.335	2.472	0.004	0.092	324.222
	50	0.607	3.267	2.595	0.004	0.143	324.222
	120	0.305	2.210	1.949	0.004	0.127	324.222
	175	0.238	1.919	1.465	0.004	0.076	324.222
	250	0.191	0.679	1.223	0.004	0.041	324.222
	500	0.186	0.650	1.093	0.003	0.039	324.222
	750	0.186	0.650	1.119	0.003	0.040	324.222
Forklifts	50	0.263	1.670	1.368	0.002	0.066	170.643
	120	0.143	1.156	0.947	0.002	0.058	170.643
	175	0.119	1.011	0.702	0.002	0.038	170.643
	250	0.097	0.345	0.566	0.002	0.019	170.643
	500	0.095	0.328	0.521	0.002	0.019	170.643
Generator Sets	15	0.504	2.652	3.502	0.007	0.176	420.920
	25	0.551	1.875	3.452	0.005	0.166	420.920
	50	0.663	3.098	3.234	0.005	0.188	420.920
	120	0.342	2.532	2.779	0.005	0.178	420.920
	175	0.237	2.170	2.214	0.005	0.099	420.920
	250	0.168	0.777	1.912	0.005	0.054	420.920
	500	0.157	0.762	1.711	0.004	0.051	420.920
	750	0.160	0.762	1.755	0.004	0.052	420.920
	9999	0.208	0.836	3.006	0.004	0.071	420.920
Graders	50	0.852	3.614	2.904	0.004	0.198	346.975
	120	0.398	2.378	2.464	0.004	0.184	346.974
	175	0.297	2.042	1.961	0.004	0.108	346.974
	250	0.225	0.762	1.696	0.004	0.058	346.974
	500	0.215	0.785	1.510	0.003	0.054	346.974
	750	0.216	0.785	1.553	0.003	0.055	346.974
Off-Highway Tractors	120	0.640	2.713	3.718	0.004	0.307	369.727
	175	0.458	2.292	3.173	0.004	0.179	369.727
	250	0.362	1.094	2.904	0.004	0.117	369.727
	750	0.337	1.364	2.680	0.004	0.106	369.727
	1000	0.356	1.491	3.667	0.004	0.115	369.727
Off-Highway Trucks	175	0.255	1.955	1.541	0.004	0.081	324.222
	250	0.203	0.695	1.297	0.004	0.044	324.222
	500	0.197	0.664	1.156	0.003	0.042	324.222
	750	0.198	0.664	1.185	0.003	0.042	324.222
	1000	0.211	0.693	2.252	0.003	0.058	324.222
Other Construction Equipment	15	0.411	2.153	2.571	0.005	0.100	352.663
	25	0.425	1.452	2.688	0.004	0.100	352.663
	50	0.519	2.951	2.649	0.005	0.136	352.663
	120	0.263	2.231	1.994	0.004	0.122	352.663
	175	0.201	1.940	1.482	0.004	0.072	352.663
	500	0.156	0.658	1.110	0.003	0.038	352.663

2018		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
Other General Industrial Equipment	15	0.301	1.771	2.115	0.005	0.083	290.093
	25	0.350	1.194	2.211	0.004	0.083	290.093
	50	0.717	3.070	2.484	0.004	0.176	290.093
	120	0.337	1.997	2.102	0.003	0.161	290.093
	175	0.249	1.712	1.673	0.003	0.091	290.093
	250	0.188	0.611	1.445	0.003	0.047	290.093
	500	0.181	0.582	1.274	0.003	0.044	290.093
	750	0.181	0.582	1.309	0.003	0.045	290.093
	1000	0.199	0.637	2.245	0.003	0.060	290.093
Other Material Handling Equipment	50	0.822	3.511	2.864	0.004	0.203	335.598
	120	0.386	2.299	2.428	0.004	0.185	335.598
	175	0.285	1.970	1.932	0.004	0.105	335.598
	250	0.214	0.703	1.670	0.004	0.054	335.598
	500	0.206	0.670	1.472	0.003	0.051	335.598
	9999	0.242	0.734	2.592	0.003	0.069	335.598
Pavers	25	0.428	1.453	2.711	0.004	0.107	352.663
	50	1.219	4.017	3.200	0.005	0.273	352.663
	120	0.525	2.478	3.163	0.004	0.258	352.663
	175	0.375	2.098	2.651	0.004	0.148	352.663
	250	0.286	0.907	2.388	0.004	0.089	352.663
	500	0.267	1.041	2.145	0.003	0.081	352.663
Paving Equipment	25	0.364	1.241	2.298	0.004	0.086	301.470
	50	1.035	3.397	2.728	0.004	0.234	301.470
	120	0.446	2.107	2.693	0.004	0.221	301.470
	175	0.317	1.782	2.258	0.003	0.127	301.470
	250	0.237	0.756	2.031	0.003	0.074	301.470
Plate Compactors	15	0.285	1.493	1.783	0.004	0.070	244.589
Pressure Washers	15	0.204	1.075	1.420	0.003	0.071	170.643
	25	0.223	0.760	1.400	0.002	0.067	170.643
	50	0.199	1.064	1.262	0.002	0.064	170.643
	120	0.117	0.979	1.076	0.002	0.061	170.643
Pumps	15	0.568	2.652	3.528	0.007	0.190	420.920
	25	0.598	1.875	3.452	0.005	0.172	420.920
	50	0.721	3.257	3.275	0.005	0.198	420.920
	120	0.360	2.571	2.821	0.005	0.187	420.920
	175	0.251	2.203	2.249	0.005	0.104	420.920
	250	0.179	0.789	1.944	0.005	0.056	420.920
	500	0.168	0.772	1.733	0.004	0.053	420.920
	750	0.170	0.772	1.779	0.004	0.054	420.920
	9999	0.217	0.847	3.041	0.004	0.073	420.920
Rollers	15	0.371	1.945	2.322	0.005	0.091	318.534
	25	0.384	1.312	2.428	0.004	0.091	318.534
	50	0.812	3.123	2.662	0.004	0.194	318.534
	120	0.367	2.116	2.382	0.004	0.184	318.534
	175	0.264	1.806	1.935	0.004	0.105	318.534
	250	0.194	0.688	1.699	0.004	0.057	318.534
	500	0.183	0.713	1.504	0.003	0.053	318.534
Rough Terrain Forklifts	50	0.660	3.320	2.765	0.004	0.167	341.286

2018		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
	120	0.326	2.284	2.168	0.004	0.149	341.286
	175	0.249	1.976	1.659	0.004	0.088	341.286
	250	0.197	0.700	1.414	0.004	0.047	341.286
	500	0.192	0.669	1.259	0.003	0.045	341.286
Rubber Tired Dozers	175	0.434	2.123	2.966	0.004	0.167	335.598
	250	0.346	1.031	2.722	0.004	0.111	335.598
	500	0.321	1.310	2.468	0.003	0.100	335.598
	750	0.322	1.309	2.513	0.003	0.101	335.598
	1000	0.340	1.425	3.404	0.003	0.108	335.598
Rubber Tired Loaders	25	0.371	1.265	2.342	0.004	0.087	307.158
	50	0.732	3.154	2.555	0.004	0.172	307.158
	120	0.344	2.094	2.149	0.004	0.160	307.158
	175	0.257	1.799	1.705	0.003	0.093	307.158
	250	0.195	0.667	1.473	0.003	0.050	307.158
	500	0.187	0.681	1.309	0.003	0.047	307.158
	750	0.188	0.681	1.348	0.003	0.048	307.158
	1000	0.202	0.733	2.302	0.003	0.061	307.158
Scrapers	120	0.603	2.916	3.561	0.005	0.288	409.544
	175	0.437	2.476	2.963	0.005	0.167	409.544
	250	0.333	1.041	2.651	0.005	0.098	409.544
	500	0.313	1.168	2.380	0.004	0.090	409.544
	750	0.315	1.167	2.436	0.004	0.091	409.544
Signal Boards	15	0.543	2.848	3.400	0.007	0.133	466.425
	50	0.795	3.636	3.457	0.006	0.211	443.672
	120	0.385	2.765	2.907	0.005	0.197	443.672
	175	0.274	2.376	2.287	0.005	0.111	443.672
	250	0.242	1.020	2.374	0.006	0.071	536.104
Skid Steer Loaders	25	0.399	1.321	2.453	0.004	0.109	312.846
	50	0.323	2.494	2.191	0.004	0.080	312.846
	120	0.181	1.961	1.441	0.004	0.069	312.846
Surfacing Equipment	50	0.575	2.253	2.067	0.003	0.140	255.965
	120	0.268	1.634	1.867	0.003	0.134	255.965
	175	0.190	1.396	1.517	0.003	0.077	255.965
	250	0.139	0.542	1.331	0.003	0.044	255.965
	500	0.130	0.584	1.194	0.003	0.040	255.965
	750	0.131	0.584	1.227	0.003	0.041	255.965
Sweepers/Scrubbers	15	0.401	2.362	2.820	0.006	0.110	386.791
	25	0.467	1.593	2.949	0.005	0.110	386.791
	50	0.630	3.630	3.102	0.005	0.165	386.791
	120	0.329	2.565	2.271	0.005	0.147	386.791
	175	0.266	2.233	1.729	0.004	0.093	386.791
	250	0.212	0.767	1.429	0.004	0.048	386.791
Tractors/Loaders/Backhoes	25	0.378	1.288	2.388	0.004	0.092	312.846
	50	0.512	2.926	2.415	0.004	0.125	312.846
	120	0.263	2.072	1.776	0.004	0.111	312.846
	175	0.206	1.803	1.316	0.004	0.067	312.846
	250	0.166	0.634	1.086	0.004	0.037	312.846
	500	0.162	0.614	0.974	0.004	0.035	312.846
	750	0.163	0.614	0.998	0.004	0.035	312.846

2018		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
Trenchers	15	0.497	2.605	3.110	0.007	0.122	426.608
	25	0.515	1.757	3.252	0.005	0.121	426.608
	50	1.480	4.726	3.843	0.006	0.330	426.608
	120	0.630	2.957	3.878	0.005	0.314	426.608
	175	0.446	2.501	3.268	0.005	0.180	426.608
	250	0.341	1.115	2.957	0.005	0.111	426.608
	500	0.317	1.310	2.663	0.004	0.101	426.608
	750	0.318	1.310	2.721	0.004	0.103	426.608
Welders	15	0.345	1.612	2.145	0.004	0.116	255.965
	25	0.364	1.140	2.099	0.003	0.105	255.965
	50	0.545	2.294	2.075	0.003	0.140	255.965
	120	0.254	1.643	1.793	0.003	0.131	255.965
	175	0.181	1.407	1.431	0.003	0.073	255.965
	250	0.132	0.504	1.239	0.003	0.038	255.965
	500	0.125	0.487	1.095	0.003	0.036	255.965
Water Trucks	175	0.255	1.955	1.541	0.004	0.081	324.222
	250	0.203	0.695	1.297	0.004	0.044	324.222
	500	0.197	0.664	1.156	0.003	0.042	324.222
	750	0.198	0.664	1.185	0.003	0.042	324.222
	1000	0.211	0.693	2.252	0.003	0.058	324.222

2019		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
Aerial Lifts	15	0.305	1.598	1.907	0.004	0.074	261.653
	25	0.334	1.105	2.049	0.003	0.088	261.653
	50	0.382	1.943	1.955	0.003	0.106	261.653
	120	0.194	1.580	1.600	0.003	0.099	261.653
	500	0.096	0.471	0.952	0.003	0.029	261.653
	750	0.098	0.471	0.975	0.003	0.030	261.653
Air Compressors	15	0.360	1.712	2.233	0.004	0.116	273.029
	25	0.378	1.202	2.209	0.003	0.107	273.029
	50	0.543	2.538	2.184	0.004	0.138	273.029
	120	0.259	1.786	1.781	0.003	0.125	273.029
	175	0.193	1.540	1.381	0.003	0.072	273.029
	250	0.146	0.544	1.187	0.003	0.038	273.029
	500	0.141	0.522	1.054	0.003	0.036	273.029
	750	0.142	0.522	1.080	0.003	0.037	273.029
	1000	0.156	0.568	1.957	0.003	0.049	273.029
Bore/Drill Rigs	15	0.497	2.605	3.110	0.007	0.122	426.608
	25	0.515	1.757	3.252	0.005	0.121	426.608
	50	0.274	3.034	2.499	0.006	0.036	426.608
	120	0.162	2.580	1.383	0.005	0.030	426.608
	175	0.132	2.281	0.706	0.005	0.021	426.608
	250	0.114	0.777	0.454	0.005	0.012	426.608
	500	0.114	0.755	0.444	0.004	0.012	426.608
	750	0.114	0.755	0.446	0.004	0.012	426.608
	1000	0.119	0.755	1.872	0.004	0.028	426.608
Cement and Mortar Mixers	15	0.371	1.945	2.322	0.005	0.091	318.534
	25	0.412	1.355	2.505	0.004	0.110	318.534
Concrete/Industrial Saws	25	0.501	1.710	3.165	0.005	0.118	415.232
	50	0.657	3.394	3.170	0.005	0.177	415.232
	120	0.324	2.594	2.515	0.005	0.161	415.232
	175	0.241	2.245	1.913	0.005	0.094	415.232
Cranes	50	0.619	2.608	2.063	0.003	0.143	244.589
	120	0.287	1.690	1.746	0.003	0.133	244.589
	175	0.213	1.449	1.381	0.003	0.077	244.589
	250	0.162	0.540	1.208	0.003	0.042	244.589
	500	0.155	0.537	1.068	0.002	0.039	244.589
	750	0.156	0.537	1.101	0.002	0.039	244.589
	9999	0.178	0.575	1.869	0.002	0.049	244.589
Crawler Tractors	50	1.103	4.134	3.178	0.005	0.242	364.039
	120	0.490	2.573	2.894	0.004	0.226	364.039
	175	0.359	2.197	2.349	0.004	0.131	364.039
	250	0.276	0.891	2.087	0.004	0.076	364.039
	500	0.261	0.971	1.875	0.004	0.071	364.039
	750	0.262	0.971	1.920	0.004	0.071	364.039
	1000	0.282	1.067	3.020	0.004	0.085	364.039
Crushing/Proc. Equipment	50	0.831	4.151	3.509	0.006	0.210	443.672
	120	0.405	2.919	2.767	0.005	0.188	443.672
	175	0.308	2.525	2.108	0.005	0.111	443.672

2019		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
	250	0.238	0.886	1.796	0.005	0.058	443.672
	500	0.231	0.849	1.598	0.004	0.056	443.672
	750	0.230	0.848	1.628	0.004	0.056	443.672
	9999	0.270	0.916	3.066	0.004	0.077	443.672
Dumpers/Tenders	25	0.261	0.890	1.651	0.003	0.064	216.148
Excavators	25	0.391	1.335	2.472	0.004	0.092	324.222
	50	0.547	3.214	2.499	0.004	0.122	324.222
	120	0.279	2.200	1.783	0.004	0.108	324.222
	175	0.219	1.918	1.279	0.004	0.065	324.222
	250	0.179	0.674	1.060	0.004	0.036	324.222
	500	0.176	0.643	0.957	0.003	0.035	324.222
	750	0.176	0.642	0.976	0.003	0.035	324.222
Forklifts	50	0.238	1.646	1.312	0.002	0.054	170.643
	120	0.132	1.152	0.854	0.002	0.048	170.643
	175	0.110	1.010	0.615	0.002	0.032	170.643
	250	0.091	0.344	0.485	0.002	0.016	170.643
	500	0.090	0.327	0.451	0.002	0.016	170.643
Generator Sets	15	0.490	2.639	3.420	0.007	0.166	420.920
	25	0.542	1.853	3.405	0.005	0.159	420.920
	50	0.577	3.019	3.122	0.005	0.165	420.920
	120	0.301	2.516	2.553	0.005	0.153	420.920
	175	0.215	2.170	1.977	0.005	0.088	420.920
	250	0.157	0.768	1.693	0.005	0.048	420.920
	500	0.148	0.752	1.523	0.004	0.046	420.920
	750	0.150	0.752	1.559	0.004	0.047	420.920
	9999	0.193	0.817	2.836	0.004	0.065	420.920
Graders	50	0.777	3.543	2.807	0.004	0.177	346.974
	120	0.369	2.366	2.281	0.004	0.163	346.974
	175	0.276	2.041	1.759	0.004	0.096	346.974
	250	0.213	0.751	1.516	0.004	0.052	346.974
	500	0.204	0.767	1.352	0.003	0.049	346.974
	750	0.205	0.767	1.390	0.003	0.049	346.974
Off-Highway Tractors	120	0.606	2.695	3.515	0.004	0.286	369.727
	175	0.435	2.283	2.958	0.004	0.167	369.727
	250	0.343	1.058	2.701	0.004	0.107	369.727
	750	0.320	1.292	2.492	0.004	0.098	369.727
	1000	0.340	1.411	3.514	0.004	0.107	369.727
Off-Highway Trucks	175	0.234	1.954	1.350	0.004	0.070	324.222
	250	0.191	0.689	1.129	0.004	0.038	324.222
	500	0.187	0.655	1.015	0.003	0.037	324.222
	750	0.187	0.655	1.036	0.003	0.037	324.222
	1000	0.199	0.680	2.131	0.003	0.052	324.222
Other Construction Equipment	15	0.411	2.153	2.571	0.005	0.100	352.663
	25	0.425	1.452	2.688	0.004	0.100	352.662
	50	0.458	2.896	2.552	0.005	0.116	352.662
	120	0.238	2.222	1.821	0.004	0.102	352.663
	175	0.186	1.940	1.295	0.004	0.063	352.663
	500	0.148	0.653	0.969	0.003	0.034	352.663

2019		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
Other General Industrial Equipment	15	0.301	1.771	2.115	0.005	0.083	290.093
	25	0.350	1.194	2.211	0.004	0.083	290.093
	50	0.629	2.993	2.398	0.004	0.153	290.093
	120	0.304	1.985	1.922	0.003	0.137	290.093
	175	0.231	1.712	1.488	0.003	0.080	290.093
	250	0.177	0.604	1.273	0.003	0.041	290.093
	500	0.172	0.574	1.131	0.003	0.040	290.093
	750	0.173	0.574	1.159	0.003	0.040	290.093
	1000	0.188	0.623	2.112	0.003	0.055	290.093
Other Material Handling Equipment	50	0.720	3.423	2.765	0.004	0.176	335.598
	120	0.347	2.284	2.219	0.004	0.158	335.598
	175	0.264	1.971	1.719	0.004	0.093	335.598
	250	0.203	0.695	1.471	0.004	0.048	335.598
	500	0.196	0.662	1.307	0.003	0.046	335.598
	9999	0.231	0.718	2.439	0.003	0.063	335.598
Pavers	25	0.426	1.452	2.702	0.004	0.105	352.663
	50	1.133	3.931	3.108	0.005	0.252	352.663
	120	0.494	2.463	2.970	0.004	0.238	352.663
	175	0.355	2.093	2.445	0.004	0.137	352.663
	250	0.270	0.879	2.196	0.004	0.081	352.663
	500	0.254	0.994	1.971	0.003	0.074	352.663
Paving Equipment	25	0.364	1.241	2.298	0.004	0.086	301.470
	50	0.958	3.320	2.650	0.004	0.215	301.470
	120	0.418	2.094	2.526	0.004	0.204	301.470
	175	0.299	1.778	2.080	0.003	0.117	301.470
	250	0.225	0.733	1.864	0.003	0.067	301.470
Plate Compactors	15	0.285	1.493	1.783	0.004	0.070	244.589
Pressure Washers	15	0.199	1.070	1.386	0.003	0.067	170.643
	25	0.220	0.751	1.380	0.002	0.064	170.643
	50	0.171	1.038	1.217	0.002	0.056	170.643
	120	0.101	0.973	0.990	0.002	0.052	170.643
Pumps	15	0.554	2.639	3.442	0.007	0.179	420.920
	25	0.583	1.853	3.405	0.005	0.165	420.920
	50	0.629	3.173	3.162	0.005	0.174	420.920
	120	0.318	2.555	2.590	0.005	0.161	420.920
	175	0.229	2.203	2.008	0.005	0.092	420.920
	250	0.168	0.780	1.721	0.005	0.050	420.920
	500	0.159	0.761	1.544	0.004	0.048	420.920
	750	0.161	0.761	1.580	0.004	0.049	420.920
	9999	0.203	0.828	2.869	0.004	0.066	420.920
Rollers	15	0.371	1.945	2.322	0.005	0.091	318.534
	25	0.384	1.312	2.428	0.004	0.091	318.534
	50	0.736	3.051	2.578	0.004	0.175	318.534
	120	0.338	2.103	2.211	0.004	0.165	318.534
	175	0.246	1.803	1.747	0.004	0.094	318.534
	250	0.184	0.676	1.529	0.004	0.052	318.534
	500	0.175	0.690	1.353	0.003	0.048	318.534
Rough Terrain Forklifts	50	0.582	3.249	2.667	0.004	0.144	341.286

2019		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
	120	0.294	2.272	1.981	0.004	0.126	341.286
	175	0.231	1.976	1.462	0.004	0.077	341.286
	250	0.186	0.693	1.234	0.004	0.042	341.286
	500	0.182	0.662	1.109	0.003	0.040	341.286
Rubber Tired Dozers	175	0.412	2.114	2.769	0.004	0.156	335.598
	250	0.328	0.997	2.535	0.004	0.102	335.598
	500	0.305	1.238	2.298	0.003	0.092	335.598
	750	0.306	1.237	2.341	0.003	0.093	335.598
	1000	0.324	1.347	3.265	0.003	0.101	335.598
Rubber Tired Loaders	25	0.371	1.265	2.342	0.004	0.087	307.158
	50	0.665	3.092	2.469	0.004	0.153	307.158
	120	0.318	2.083	1.988	0.004	0.141	307.158
	175	0.239	1.797	1.526	0.003	0.083	307.158
	250	0.185	0.659	1.313	0.003	0.045	307.158
	500	0.177	0.664	1.169	0.003	0.042	307.158
	750	0.178	0.664	1.202	0.003	0.043	307.158
	1000	0.191	0.705	2.180	0.003	0.056	307.158
Scrapers	120	0.566	2.899	3.337	0.005	0.264	409.544
	175	0.412	2.472	2.722	0.005	0.153	409.544
	250	0.315	1.011	2.427	0.005	0.089	409.544
	500	0.297	1.119	2.178	0.004	0.082	409.544
	750	0.298	1.119	2.230	0.004	0.083	409.544
Signal Boards	15	0.543	2.848	3.400	0.007	0.133	466.425
	50	0.693	3.543	3.336	0.006	0.184	443.672
	120	0.341	2.748	2.662	0.005	0.169	443.672
	175	0.251	2.376	2.031	0.005	0.098	443.672
	250	0.227	1.009	2.089	0.006	0.063	536.104
Skid Steer Loaders	25	0.393	1.311	2.438	0.004	0.103	312.846
	50	0.300	2.475	2.105	0.004	0.065	312.846
	120	0.170	1.958	1.314	0.004	0.057	312.846
Surfacing Equipment	50	0.526	2.205	2.001	0.003	0.127	255.965
	120	0.248	1.625	1.739	0.003	0.121	255.965
	175	0.177	1.394	1.376	0.003	0.070	255.965
	250	0.131	0.532	1.204	0.003	0.039	255.965
	500	0.123	0.564	1.078	0.003	0.037	255.965
	750	0.124	0.564	1.109	0.003	0.037	255.965
Sweepers/Scrubbers	15	0.401	2.362	2.820	0.006	0.110	386.791
	25	0.467	1.593	2.949	0.005	0.110	386.791
	50	0.572	3.587	2.998	0.005	0.142	386.791
	120	0.306	2.560	2.078	0.005	0.127	386.791
	175	0.249	2.236	1.518	0.004	0.081	386.791
	250	0.201	0.765	1.230	0.004	0.042	386.791
Tractors/Loaders/Backhoes	25	0.377	1.288	2.386	0.004	0.091	312.846
	50	0.462	2.882	2.327	0.004	0.106	312.846
	120	0.241	2.064	1.625	0.004	0.093	312.846
	175	0.190	1.803	1.144	0.004	0.058	312.846
	250	0.157	0.631	0.937	0.004	0.032	312.846
	500	0.154	0.608	0.848	0.004	0.031	312.846
	750	0.154	0.608	0.865	0.004	0.031	312.846

2019		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
Trenchers	15	0.497	2.605	3.110	0.007	0.122	426.608
	25	0.515	1.757	3.252	0.005	0.121	426.608
	50	1.379	4.625	3.736	0.006	0.306	426.608
	120	0.593	2.938	3.649	0.005	0.290	426.608
	175	0.422	2.494	3.022	0.005	0.167	426.608
	250	0.323	1.079	2.727	0.005	0.102	426.608
	500	0.301	1.248	2.455	0.004	0.093	426.608
	750	0.303	1.247	2.510	0.004	0.094	426.608
Welders	15	0.337	1.605	2.093	0.004	0.109	255.965
	25	0.355	1.127	2.070	0.003	0.100	255.965
	50	0.475	2.230	2.004	0.003	0.123	255.965
	120	0.227	1.632	1.643	0.003	0.113	255.965
	175	0.167	1.406	1.276	0.003	0.065	255.965
	250	0.124	0.497	1.096	0.003	0.034	255.965
	500	0.119	0.480	0.974	0.003	0.032	255.965
Water Trucks	175	0.234	1.954	1.350	0.004	0.070	324.222
	250	0.191	0.689	1.129	0.004	0.038	324.222
	500	0.187	0.655	1.015	0.003	0.037	324.222
	750	0.187	0.655	1.036	0.003	0.037	324.222
	1000	0.199	0.680	2.131	0.003	0.052	324.222

2020		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
Aerial Lifts	15	0.305	1.598	1.907	0.004	0.074	261.653
	25	0.328	1.096	2.037	0.003	0.084	261.653
	50	0.339	1.904	1.890	0.003	0.093	261.653
	120	0.175	1.573	1.472	0.003	0.086	261.653
	500	0.091	0.467	0.840	0.003	0.026	261.653
	750	0.092	0.467	0.860	0.003	0.026	261.653
Air Compressors	15	0.352	1.704	2.182	0.004	0.109	273.029
	25	0.369	1.188	2.180	0.003	0.102	273.029
	50	0.481	2.481	2.113	0.004	0.121	273.029
	120	0.235	1.777	1.634	0.003	0.108	273.029
	175	0.180	1.539	1.229	0.003	0.064	273.029
	250	0.139	0.539	1.044	0.003	0.033	273.029
	500	0.134	0.517	0.930	0.003	0.032	273.029
	750	0.135	0.517	0.952	0.003	0.033	273.029
	1000	0.147	0.557	1.839	0.003	0.045	273.029
Bore/Drill Rigs	15	0.497	2.605	3.110	0.007	0.122	426.608
	25	0.515	1.757	3.252	0.005	0.121	426.608
	50	0.269	3.030	2.414	0.006	0.027	426.608
	120	0.155	2.579	1.288	0.005	0.022	426.608
	175	0.122	2.281	0.563	0.005	0.015	426.608
	250	0.108	0.777	0.367	0.005	0.010	426.608
	500	0.107	0.755	0.359	0.004	0.010	426.608
	750	0.107	0.755	0.361	0.004	0.010	426.608
	1000	0.112	0.755	1.832	0.004	0.024	426.608
Cement and Mortar Mixers	15	0.371	1.945	2.322	0.005	0.091	318.534
	25	0.405	1.344	2.490	0.004	0.105	318.534
Concrete/Industrial Saws	25	0.501	1.710	3.165	0.005	0.118	415.232
	50	0.583	3.326	3.066	0.005	0.155	415.232
	120	0.294	2.583	2.311	0.005	0.140	415.232
	175	0.224	2.245	1.699	0.005	0.084	415.232
Cranes	50	0.562	2.556	1.998	0.003	0.128	244.589
	120	0.265	1.681	1.618	0.003	0.117	244.589
	175	0.197	1.447	1.239	0.003	0.068	244.589
	250	0.154	0.532	1.079	0.003	0.037	244.589
	500	0.148	0.521	0.957	0.002	0.035	244.589
	750	0.148	0.521	0.985	0.002	0.035	244.589
	9999	0.169	0.553	1.774	0.002	0.045	244.589
Crawler Tractors	50	1.023	4.055	3.083	0.005	0.220	364.039
	120	0.460	2.560	2.709	0.004	0.205	364.039
	175	0.337	2.193	2.148	0.004	0.120	364.039
	250	0.260	0.869	1.903	0.004	0.069	364.039
	500	0.247	0.936	1.709	0.004	0.064	364.039
	750	0.248	0.936	1.750	0.004	0.065	364.039
	1000	0.267	1.022	2.882	0.004	0.079	364.039
Crushing/Proc. Equipment	50	0.740	4.068	3.394	0.006	0.182	443.672
	120	0.369	2.906	2.537	0.005	0.161	443.672
	175	0.287	2.525	1.868	0.005	0.098	443.672

2020		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
	250	0.226	0.879	1.573	0.005	0.051	443.672
	500	0.220	0.842	1.405	0.004	0.049	443.672
	750	0.220	0.842	1.433	0.004	0.049	443.672
	9999	0.258	0.900	2.888	0.004	0.070	443.672
Dumpers/Tenders	25	0.261	0.890	1.649	0.003	0.063	216.148
Excavators	25	0.391	1.335	2.472	0.004	0.092	324.222
	50	0.498	3.170	2.413	0.004	0.104	324.222
	120	0.257	2.193	1.637	0.004	0.091	324.222
	175	0.203	1.918	1.117	0.004	0.056	324.222
	250	0.169	0.669	0.918	0.004	0.031	324.222
	500	0.166	0.637	0.836	0.003	0.030	324.222
	750	0.166	0.637	0.850	0.003	0.031	324.222
Forklifts	50	0.220	1.626	1.257	0.002	0.045	170.643
	120	0.122	1.148	0.784	0.002	0.040	170.643
	175	0.102	1.009	0.535	0.002	0.026	170.643
	250	0.085	0.344	0.412	0.002	0.014	170.643
	500	0.084	0.327	0.384	0.002	0.013	170.643
Generator Sets	15	0.479	2.627	3.345	0.007	0.158	420.920
	25	0.534	1.832	3.362	0.005	0.152	420.920
	50	0.512	2.959	3.019	0.005	0.144	420.920
	120	0.270	2.504	2.351	0.005	0.133	420.920
	175	0.198	2.170	1.763	0.005	0.078	420.920
	250	0.147	0.760	1.493	0.005	0.043	420.920
	500	0.140	0.745	1.346	0.004	0.041	420.920
	750	0.142	0.745	1.377	0.004	0.042	420.920
	9999	0.179	0.802	2.673	0.004	0.059	420.920
Graders	50	0.710	3.480	2.716	0.004	0.156	346.974
	120	0.342	2.356	2.115	0.004	0.144	346.974
	175	0.257	2.039	1.574	0.004	0.085	346.974
	250	0.201	0.742	1.351	0.004	0.046	346.974
	500	0.194	0.751	1.207	0.003	0.044	346.974
	750	0.195	0.751	1.240	0.003	0.044	346.974
Off-Highway Tractors	120	0.574	2.678	3.322	0.004	0.266	369.727
	175	0.412	2.275	2.754	0.004	0.155	369.727
	250	0.325	1.025	2.507	0.004	0.099	369.727
	750	0.305	1.227	2.313	0.004	0.090	369.727
	1000	0.324	1.339	3.370	0.004	0.100	369.727
Off-Highway Trucks	175	0.217	1.954	1.183	0.004	0.061	324.222
	250	0.181	0.684	0.982	0.004	0.034	324.222
	500	0.177	0.648	0.891	0.003	0.033	324.222
	750	0.177	0.648	0.907	0.003	0.033	324.222
	1000	0.188	0.670	2.021	0.003	0.047	324.222
Other Construction Equipment	15	0.411	2.153	2.571	0.005	0.100	352.663
	25	0.425	1.452	2.688	0.004	0.100	352.663
	50	0.414	2.856	2.465	0.005	0.099	352.663
	120	0.219	2.216	1.672	0.004	0.087	352.663
	175	0.174	1.940	1.130	0.004	0.054	352.663
	500	0.140	0.649	0.841	0.003	0.029	352.663

2020		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
Other General Industrial Equipment	15	0.301	1.771	2.115	0.005	0.083	290.093
	25	0.350	1.194	2.211	0.004	0.083	290.093
	50	0.564	2.936	2.318	0.004	0.132	290.093
	120	0.278	1.976	1.762	0.003	0.118	290.093
	175	0.215	1.713	1.323	0.003	0.071	290.093
	250	0.168	0.599	1.118	0.003	0.036	290.093
	500	0.163	0.569	0.997	0.003	0.035	290.093
	750	0.164	0.569	1.020	0.003	0.035	290.093
	1000	0.178	0.611	1.984	0.003	0.050	290.093
Other Material Handling Equipment	50	0.645	3.357	2.674	0.004	0.153	335.598
	120	0.318	2.274	2.035	0.004	0.136	335.598
	175	0.246	1.971	1.529	0.004	0.082	335.598
	250	0.192	0.689	1.292	0.004	0.042	335.598
	500	0.187	0.656	1.152	0.003	0.040	335.598
	9999	0.221	0.705	2.291	0.003	0.057	335.598
Pavers	25	0.426	1.452	2.697	0.004	0.104	352.663
	50	1.052	3.850	3.021	0.005	0.231	352.663
	120	0.464	2.449	2.789	0.004	0.218	352.663
	175	0.335	2.089	2.251	0.004	0.126	352.663
	250	0.256	0.855	2.015	0.004	0.074	352.663
	500	0.241	0.953	1.808	0.003	0.068	352.663
Paving Equipment	25	0.364	1.241	2.298	0.004	0.086	301.470
	50	0.885	3.247	2.575	0.004	0.197	301.470
	120	0.392	2.081	2.368	0.004	0.187	301.470
	175	0.282	1.774	1.911	0.003	0.107	301.470
	250	0.213	0.713	1.708	0.003	0.061	301.470
Plate Compactors	15	0.285	1.493	1.783	0.004	0.070	244.589
Pressure Washers	15	0.194	1.065	1.356	0.003	0.064	170.643
	25	0.217	0.743	1.363	0.002	0.062	170.643
	50	0.150	1.019	1.176	0.002	0.048	170.643
	120	0.090	0.969	0.912	0.002	0.045	170.643
Pumps	15	0.542	2.627	3.365	0.007	0.169	420.920
	25	0.570	1.832	3.362	0.005	0.157	420.920
	50	0.560	3.109	3.058	0.005	0.153	420.920
	120	0.286	2.543	2.385	0.005	0.140	420.920
	175	0.212	2.203	1.791	0.005	0.082	420.920
	250	0.158	0.772	1.519	0.005	0.044	420.920
	500	0.150	0.754	1.364	0.004	0.043	420.920
	750	0.152	0.754	1.396	0.004	0.043	420.920
	9999	0.189	0.812	2.703	0.004	0.060	420.920
Rollers	15	0.371	1.945	2.322	0.005	0.091	318.534
	25	0.384	1.312	2.428	0.004	0.091	318.534
	50	0.666	2.986	2.499	0.004	0.157	318.534
	120	0.311	2.092	2.052	0.004	0.146	318.534
	175	0.228	1.801	1.570	0.004	0.084	318.534
	250	0.175	0.666	1.369	0.004	0.046	318.534
	500	0.167	0.670	1.215	0.003	0.044	318.534
Rough Terrain Forklifts	50	0.525	3.197	2.577	0.004	0.123	341.286

2020		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
	120	0.270	2.264	1.818	0.004	0.108	341.286
	175	0.215	1.975	1.287	0.004	0.067	341.286
	250	0.176	0.688	1.075	0.004	0.036	341.286
	500	0.172	0.657	0.969	0.003	0.035	341.286
Rubber Tired Dozers	175	0.391	2.106	2.582	0.004	0.146	335.598
	250	0.311	0.965	2.359	0.004	0.094	335.598
	500	0.290	1.175	2.137	0.003	0.085	335.598
	750	0.291	1.175	2.178	0.003	0.086	335.598
	1000	0.308	1.278	3.133	0.003	0.095	335.598
Rubber Tired Loaders	25	0.371	1.265	2.342	0.004	0.087	307.158
	50	0.606	3.037	2.390	0.004	0.135	307.158
	120	0.293	2.073	1.840	0.004	0.124	307.158
	175	0.222	1.796	1.362	0.003	0.073	307.158
	250	0.175	0.651	1.166	0.003	0.040	307.158
	500	0.169	0.650	1.041	0.003	0.038	307.158
	750	0.169	0.650	1.070	0.003	0.038	307.158
	1000	0.180	0.681	2.069	0.003	0.051	307.158
Scrapers	120	0.531	2.884	3.127	0.005	0.240	409.544
	175	0.387	2.467	2.495	0.005	0.140	409.544
	250	0.298	0.986	2.218	0.005	0.081	409.544
	500	0.282	1.077	1.990	0.004	0.074	409.544
	750	0.283	1.077	2.039	0.004	0.075	409.544
Signal Boards	15	0.543	2.848	3.400	0.007	0.133	466.425
	50	0.616	3.473	3.226	0.006	0.161	443.672
	120	0.308	2.736	2.447	0.005	0.146	443.672
	175	0.233	2.376	1.803	0.005	0.087	443.672
	250	0.215	1.001	1.835	0.006	0.056	536.104
Skid Steer Loaders	25	0.388	1.303	2.426	0.004	0.099	312.846
	50	0.282	2.459	2.029	0.004	0.053	312.846
	120	0.159	1.955	1.205	0.004	0.047	312.846
Surfacing Equipment	50	0.481	2.161	1.939	0.003	0.115	255.965
	120	0.229	1.617	1.620	0.003	0.109	255.965
	175	0.164	1.392	1.244	0.003	0.063	255.965
	250	0.124	0.523	1.086	0.003	0.036	255.965
	500	0.117	0.547	0.972	0.003	0.033	255.965
	750	0.118	0.547	0.999	0.003	0.034	255.965
Sweepers/Scrubbers	15	0.401	2.362	2.820	0.006	0.110	386.791
	25	0.467	1.593	2.949	0.005	0.110	386.791
	50	0.520	3.542	2.890	0.005	0.118	386.791
	120	0.283	2.554	1.890	0.005	0.106	386.791
	175	0.233	2.237	1.340	0.004	0.069	386.791
	250	0.190	0.763	1.065	0.004	0.036	386.791
Tractors/Loaders/Backhoes	25	0.377	1.288	2.385	0.004	0.090	312.846
	50	0.420	2.846	2.246	0.004	0.090	312.846
	120	0.221	2.058	1.492	0.004	0.078	312.846
	175	0.176	1.802	0.994	0.004	0.049	312.846
	250	0.148	0.628	0.807	0.004	0.028	312.846
	500	0.146	0.603	0.738	0.004	0.027	312.846
	750	0.146	0.602	0.750	0.004	0.027	312.846

2020		g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr	g/hp/hr
Equipment	**MaxHP**	ROG	CO	NOX	SOX	PM	CO2
Trenchers	15	0.497	2.605	3.110	0.007	0.122	426.608
	25	0.515	1.757	3.252	0.005	0.122	426.608
	50	1.284	4.529	3.634	0.006	0.283	426.608
	120	0.558	2.921	3.434	0.005	0.268	426.608
	175	0.399	2.488	2.791	0.005	0.155	426.608
	250	0.306	1.047	2.511	0.005	0.093	426.608
	500	0.287	1.194	2.260	0.004	0.085	426.608
	750	0.288	1.193	2.311	0.004	0.086	426.608
Welders	15	0.330	1.597	2.046	0.004	0.102	255.965
	25	0.346	1.114	2.044	0.003	0.096	255.965
	50	0.422	2.180	1.939	0.003	0.108	255.965
	120	0.205	1.624	1.510	0.003	0.098	255.965
	175	0.155	1.406	1.137	0.003	0.058	255.965
	250	0.118	0.492	0.965	0.003	0.030	255.965
	500	0.114	0.475	0.861	0.003	0.029	255.965
Water Trucks	175	0.217	1.954	1.183	0.004	0.061	324.222
	250	0.181	0.684	0.982	0.004	0.034	324.222
	500	0.177	0.648	0.891	0.003	0.033	324.222
	750	0.177	0.648	0.907	0.003	0.033	324.222
	1000	0.188	0.670	2.021	0.003	0.047	324.222