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Supplier DI#: NRP-R-SYSW-EI-0002-03

Supplier Rev.: 03

Supplier Date: 05/15/07

Reference #: NVT-CD-00153

NVM Nevada Transportation Manager Gene Allen
NE Nevada Engineering Scott Kelderhause

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BSC	Transportation Data Pedigree Form *Complete only applicable items.*	QA: N/A Page 1 of 2

Subcontractor:	Item Number/Title/Revision:	Submittal Date:	SRCT No.:
Nevada Rail Partners	T13/EIS Interface Support – Air Quality Emission Factors and Socioeconomic Input, Caliente Rail Corridor – NRP-R-SYSW-EI-0002-03, Rev. 03, Exhibit I, item number 8p, RFP Reference Exhibit D-2.13a.2	May 15, 2007	06-00013

Section I. Submittal Information (includes above information)

Submittal Description and Revision Summary for Entire Submittal:

The document included in this submittal is revised from the previous Rev. 02A submittal in January 2007.The redline changes submitted as Rev. 02A of this document have been accepted by BSC. The new changes shown in the PDF file containing the Rev. 03 redlines resulted from the comment resolution process for the Rev. 02A submittal.

In addition, changes to the Beatty Wash and Busted Butte alignments were submitted in 2006 as part of the final plan and profile sheets. These alignment changes resulted in earthwork changes to CS6 and BC3 that are reflected in this Rev. 03 submittal.

Special Instructions:

All files can be printed in their entirety.

Section II. Data File Information (Add lines below if needed for additional files. Indicate "Last item" or "End of list" on last line used.)

Filename	Rev.	File Size	Description (File description and revision summary for file)	Application and Version/ Add-in or Extension and Version
T13_Cover_May2007.ppt	03	699 KB	Report cover for *Air Quality Emission Factors and Socioeconomic Input, Caliente Rail Corridor* - NRP-R-SYSW-EI-0002-03, Rev. 03	Microsoft Powerpoint 2003
T13_CRC_AirQualityEmissions_FINAL_Rev03_15May07.doc	03	4,325 KB	Main text with all graphics and appendices - *Air Quality Emission Factors and Socioeconomic Input, Caliente Rail Corridor* - NRP-R-SYSW-EI-0002-03, Rev. 03	Microsoft Word 2003
T13_CRC_AirQualityEmissions_FINAL_Rev03_15May07.pdf	03	1,325 KB	Scanned final version of the complete document with all imbedded graphics and appendices - *Air Quality Emission Factors and Socioeconomic Input, Caliente Rail Corridor* - NRP-R-SYSW-EI-0002-03, Rev. 03	Adobe Acrobat 7.0 Standard Version
T13_CRC_AirQualityEmissions_FINALReadonly_Rev03_15May07.doc	03	4,321 KB	Main text (Read Only) with all graphics and appendices - *Air Quality Emission Factors and Socioeconomic Input, Caliente Rail Corridor* - NRP-R-SYSW-EI-0002-03, Rev. 03	Microsoft Word 2003
T13_CRC_AirQualityEmissions_FINALredlines_Rev03_15May07.pdf	03	926 KB	Scanned redline version of the complete document with all imbedded graphics and appendices - *Air Quality Emission Factors and Socioeconomic Input, Caliente Rail Corridor* NRP-R-SYSW-EI-0002-03, Rev. 03	Adobe Acrobat 7.0 Standard Version
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Section III. Metadata

☐ **GIS Metadata** All GIS data is preferred in ArcGIS9.1 UTM, NAD1983, Zone11, Feet.	Projection: Datum: Zone: Units:
☐ **CAD Metadata** CAD drawings are preferred in **Bentley MicroStation V8 and/or InRoads** and should adhere to established **CAD standards**.	Level descriptions: Scale: Units of Measurement: Horizontal and Vertical Datum:

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Transportation Data Pedigree Form

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Nevada Rail Partners	T13/EIS Interface Support – Air Quality Emission Factors and Socioeconomic Input, Caliente Rail Corridor – NRP-R-SYSW-EI-0002-03, Rev. 03, Exhibit I, item number 8p, RFP Reference Exhibit D-2.13a.2	May 15, 2007	06-00013

Section IV. Data Screening (Completed by BSC personnel)

Suitable for Review?	Screener Name:	Signature:	Date:
☒ Yes* ☐ No	Cathy Stettler	Cathy Stettler	5/18/07

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Section V. STR Disposition of Submittal

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☒ Yes ☐ No**			
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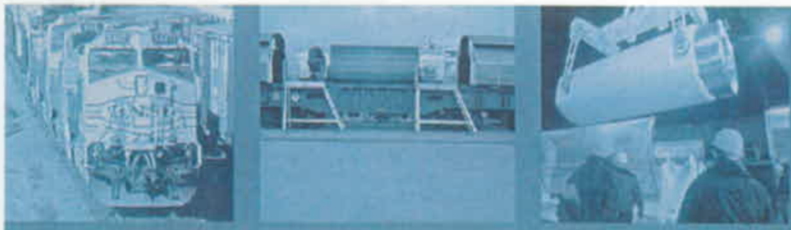
5/18/07



Air Quality Emission Factors and Socioeconomic Input Caliente Rail Corridor

Task 13: EIS Interface Support

Rev. 03

Document No. NRP-R-SYSW-EI-0002-03

prepared by:

NEVADA RAIL PARTNERS

prepared for:

BECHTEL SAIC COMPANY, LLC

Nevada Rail Line Conceptual Design

Subcontract NN-HC4-00239

May 15, 2007

Air Quality Emission Factors and Socioeconomic Input Caliente Rail Corridor

Task 13: EIS Interface Support

Rev. 03

Document No. NRP-R-SYSW-EI-0002-03

Nevada Rail Line Conceptual Design
Subcontract NN-HC4-00239
15 May 2007

Prepared for:
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List of Acronyms

CFR	Code of Federal Regulations
CRC	Caliente Rail Corridor
EOL	End-of-Line
EPA	U.S. Environmental Protection Agency
LB	Pound
MOW	Maintenance-of-Way
NRL	Nevada Rail Line
NRP	Nevada Rail Partners
NTP	Notice to Proceed
PM	Particulate Matter
RA EIS	Rail Alignment Environmental Impact Statement
REMI®	Regional Economic Models, Inc.
ROW	Right-of-Way
UPRR	Union Pacific Railroad
VOC	Volatile Organic Compounds

1.1 PURPOSE

The proposed Caliente Rail Corridor (CRC) alignment of the Nevada Rail Line (NRL) may potentially affect the air quality and socioeconomic resources of the Lincoln, Esmeralda, and Nye County region. These effects will be quantified and evaluated by the rail alignment environmental impact statement (RA EIS) contractor. However, data regarding construction equipment, workers, and methods are required for these evaluations to occur.

The purpose of this report is to:

- Describe the techniques, methods, and equipment used for construction and operation of the CRC in terms that can be used by the RA EIS contractor to estimate the total air emissions and subsequent impacts to the local and regional environment
- Describe the construction and operational data requested by the RA EIS contractor for use in subsequent economic impact modeling

1.2 CONTENT

This report describes three principal elements: (1) the basis of the analysis, (2) air quality emissions during construction and operation, and (3) socioeconomic factors during construction and operation. These elements, defined below, are necessary to determine the magnitude of the potential effects of the CRC on the air quality and socioeconomic resources of the region. Subsequent sections of this report further describe these elements.

Revision 0 of this report (Nevada Rail Partners [NRP] 2005) was based in part upon an alignment developed using aerial mapping and contour data prepared and published by the U.S. Geological Survey. Subsequently, new aerial photography was obtained that provides greater resolution of the contours (5-foot contours) and topographic features within the CRC. These data were then used to refine the horizontal and vertical geometry of the Revision 0 alignment. This new alignment is the engineering basis of this report.

The new alignment resulted in significantly different values for earthwork, including volumes of alluvial materials and rock to be excavated, and embankment fill placement. Further, for purposes of obtaining construction authorization from Federal regulatory agencies, additional evaluations were performed for specific construction features. These analyses also resulted in additional information for the air quality emissions and socioeconomic model inputs. The analyses covered the following topics:

- Access roads
- Construction camp development and operation
- Quarry development and operation
- Water well development

Basis for Analysis: Construction and subsequent operation of the rail line will require the efforts of hundreds of workers, support personnel, vehicles and equipment. These activities may affect the region's air quality and socioeconomic resources, but the construction plan and the operation and maintenance plan are only conceptually defined at this time. Consequently, it is necessary to make several basic assumptions regarding construction and operation that will frame the air quality and socioeconomic analysis. These assumptions are discussed in Section 2.0.

Air Emissions: Section 3.0 of this report describes the methodologies and references used to make air emissions calculations. This report provides estimates of the numbers and types of equipment needed for construction and operation, the duration of operations, and the horsepower associated with the various equipment types. Numeric results of the air quality emissions calculations for construction are presented in Appendix A; numeric results for operational air emissions are shown in Appendix B.

Socioeconomic Factors: Section 4.0 of this report discusses the preparation of input data for the socioeconomic impact analysis. Although this analysis will be conducted by the RA EIS contractor, input data were needed from the engineering team regarding the number of construction personnel, construction camp locations and other factors. Operational data were also needed in terms of the personnel needed to operate the railroad and its facilities.

Appendices: The report narrative documents the assumptions and methodologies used to perform the air emissions calculations and the socioeconomic analysis. These data are presented in appendices:

- Appendix A – Analysis Assumptions
- Appendix B – Air Emissions Analysis for Construction Activities
- Appendix C – Air Emissions Analysis for Operational Activities
- Appendix D – Modeling Inputs Requested for Socioeconomic Modeling

2.1 FRAMEWORK FOR ANALYSIS

Estimating fugitive dust and exhaust emissions from construction and operating equipment requires information about the proposed construction process. For example, the number and operating hours of various types of equipment are dependent on the construction duration. These factors are also dependent on the estimated volumes of cut and fill along the engineered alignment segments. Schedule and construction philosophy (for example, the number of headings in which construction occurs) will influence the size of crews and their location along the alignment.

Although the methods of constructing the CRC are still evolving, several assumptions have been made for the purposes of this report that establish a general framework for construction of the proposed rail line. These assumptions are grouped into three categories:

- Schedule
- Construction
- Alignment

The individual assumptions made for the air quality and socioeconomic modeling inputs analyses are listed on the analysis spreadsheets, which are presented in the appendices, and are summarized in Appendix A. These assumptions are intended to represent a typical construction concept and not necessarily the preferred methods or process for the CRC. Those decisions will be made in later project development phases.

Supporting data for the analyses described in this report have been obtained from other NRP reports. These reports include:

- *Alignment Development Report, Caliente Rail Corridor* (NRP 2007a)
- *Comparative Cost Estimates, Caliente Rail Corridor* (NRP 2007b)
- *Construction Plan, Caliente Rail Corridor* (NRP 2007c)
- *Facilities–Design Analysis Report, Caliente Rail Corridor* (NRP 2007d)
- *Operations and Maintenance Report, Caliente Rail Corridor* (NRP 2007e)

2.2 SCHEDULE ASSUMPTIONS

A construction schedule based on overall Yucca Mountain program plans has not yet been developed. For this analysis, it has been assumed that the project would be constructed over a five-year period beginning in October 2009, and would be completed and operational by June 2014. Schedule elements and assumptions that are critical to the air quality emissions and the socioeconomic analyses are discussed below.

<u>Sequence of Activities</u>: Activities during the 5-year construction period include:

- Mobilization and construction of alignment access roads, construction camps, construction communications, power supply facilities, and utility relocations
- Development of ballast quarries along the CRC alignment
- Construction of water wells and water supply systems
- Mobilization of materials laydown areas near Caliente, at the maintenance-of-way (MOW) facility, and at CRC sidings
- Site grading and drainage
- Track construction

- Supporting facilities construction
- Construction of major bridges and structures
- Signals and remaining communication features
- Commissioning

Duration: Although the overall duration of the schedule is five years, the majority of ground disturbing and emission-producing activities occur over a 36-month period within the construction schedule. Of the activities listed above, only the "signals and communications" and "commissioning" elements occur outside of that period. For purposes of this air emissions analysis, this 36-month period is referred to as the "Project Duration" and is used as the basis for emissions computations for activities occurring within that timeframe. For other activities, the basis for analysis is noted on the individual spreadsheets.

Schedule: An alternative approach to constructing the CRC is the distribution of the work over a longer duration, such as ten years. This approach may be necessary in response to Yucca Mountain programmatic requirements. The effects of this alternative approach on the air quality and socioeconomic model inputs are discussed in the respective sections of this report. When a construction timeframe is refined, the data and related issues of this report should be reconfirmed.

2.3 CONSTRUCTION ASSUMPTIONS

Materials: Construction of the CRC would require substantial quantities of a wide variety of materials and equipment. For purposes of conducting the air quality analysis, the source of major materials required for construction has been assumed to be as follows:

- Generally, subballast would be obtained from crushing materials excavated as part of the site grading activities. In some instances, subballast may be obtained as a byproduct of quarry operations.
- Ballast would be provided to the construction site via ballast trains; no trucking would be required. Ballast would be moved from the mined site to the plant crushers via a conveyor belt.
- Water for construction would be obtained from new wells developed within or near to the proposed right-of-way (ROW). Generally, water would be used for dust control, compaction of embankment fill materials, and for potable use in construction camps.
- Steel rail, ties, and other track materials would be provided from off-site, existing commercial sources. These materials would be delivered to and stockpiled at Caliente and then shipped to the construction site via construction trains.
- Initial estimates of construction equipment types and operating hours were provided by a railroad contractor. These estimates were adjusted to reflect areas of rugged terrain.
- Concrete for structures would be provided from temporary batch plants that would be assembled at the site of the White River bridge, and the site of the Beatty Wash bridge. Cement and aggregate for operating these plants would be provided via trucking operations.

Site Grading: Site grading and drainage construction would occur on multiple headings; track construction would occur on one heading, starting at Caliente. Earthwork quantities and surface areas have been computed based on information provided from *Comparative Cost Estimates, Caliente Rail Corridor* (NRP 2007b).

Access Roads: To the extent possible, the existing roadway system would be used to provide access to quarries and water wells. These roads would be upgraded with a gravel surface to minimize dust (NRP 2007c).

Construction Camps: Construction camps will be established along the alignment to house the labor force necessary to construct the CRC. Conceptual design features of these camps are described in the *Construction Plan, Caliente Rail Corridor* (NRP 2007c). With respect to air quality emissions, critical assumptions include:

- The disturbed area for each camp is approximately 25 acres. Construction of the camp would require approximately four months for site clearing, installation of utilities and services (including water and sewer systems, and a fueling station), and erection of offices, supporting facilities and living quarters. Site grading would be minimal and camps have been located to be within or immediately adjacent to the proposed ROW.
- No new access roads would be required for camp development. The existing road system would be used to provide access from the camps to a paved highway. Roads used for camp access would be upgraded to a gravel surface to minimize fugitive dust.
- After completion of the construction activities, the construction camps would be dismantled and the land reclaimed. Reclamation methods are described in the *Construction Plan, Caliente Rail Corridor* (NRP 2007c).
- For purposes of the air quality analysis, it has been assumed that ten camps would be open concurrently **as a bounding condition** for estimating exhaust emissions. It has also been assumed that 12 sites would be constructed, again **as a bounding condition** for estimating fugitive dust emissions. It has been assumed that over a four-year period, the annual employment would average approximately 2,100 persons. This value suggests that if the contractor opts to use construction camps to house workers, only six would be needed in any one year.

Quarries: Rock quarries would be developed at approved locations within the ROW for production of ballast materials needed for track construction. Locations of these potential quarries are specified in the *Construction Plan, Caliente Rail Corridor* (NRP 2007c). With respect to air quality emissions, critical assumptions include:

- Surface area disturbed for each quarry is approximately 120 acres. Construction of the quarry would require only a few days for minor site grading and erection of plant facilities. Construction of the conveyor would require as much as six months, depending on length and topography of the route. The conveyor would also have a parallel access road to allow maintenance access to the conveyor system.
- Emissions have been calculated based on the total volume of ballast required and are independent of either the number or location of the quarries.
- Analyses include dust generated during conveyor movement.

Wells: Water for construction activities would be provided from approximately 170 new wells installed for this project *Construction Plan, Caliente Rail Corridor* (NRP 2007c). The wells would be spaced along the alignment and, for the most part, within the proposed 1,000-foot ROW. Twenty wells would be outside of the ROW, and would require new access roads to construct and operate the well. With respect to air quality emissions, critical assumptions include:

- Surface area disturbed for each well is approximately 1.4 acres. Construction of the well would require up to four weeks.
- Estimated well depths range from 200 to 2,000 feet. For this analysis, it has been assumed that the average depth is 400 feet, and that the drilling rate is 20 feet per day.

2.4 ALIGNMENT ASSUMPTIONS

The CRC segments comprising the alignment used as the basis for analysis[1] are listed in Table 2-1 and as shown in Figure 1. The fugitive dust and exhaust emission factors for these segments have been evaluated and are presented in Appendix B of this report. This report also includes consideration of alternative alignment segments. Engineering characteristics of these segments are described in the *Alignment Development Report, Caliente Rail Corridor* (NRP 2007a). Air quality emissions for these segments have not been evaluated at this time. However, earthwork volumes for these segments are presented in Appendix B, along with sufficient information for others to calculate the emissions from these segments in the event that it becomes necessary to compare air quality effects of one segment to another.

Table 2-1. CRC Engineered Alignment Segments Used in Air Emissions Analysis

Name	Map Identifier	Length (miles)
Caliente	Caliente	11.32
Bennett Pass	CS1	25.57
Pahroc Summit	CS1	18.61
White River	CS1	26.34
Garden Valley	GV8	22.72
Common Segment 2	CS2	30.64
South Reveille	SR3	12.31
Common Segment 3	CS3	69.97
Goldfield	GF3	31.08
Common Segment 4	CS4	7.15
Bonnie Claire	BC3	12.35
Common Segment 5	CS5	24.85
Oasis Valley	OV1	6.14
Common Segment 6	CS6	31.82
	Total	331

Source: NRP 2007a.

[1] Throughout this and other NRP reports, the phrase "basis for analysis" is used to provide a frame of reference for NRP's evaluations of the alignment's construction engineering and operational characteristics. Except for the *Operations and Maintenance Report, Caliente Rail Corridor* (NRP 2007e), NRP reports provide data for all alignment segments so that consideration of other alternative alignment segment combinations may be accomplished.

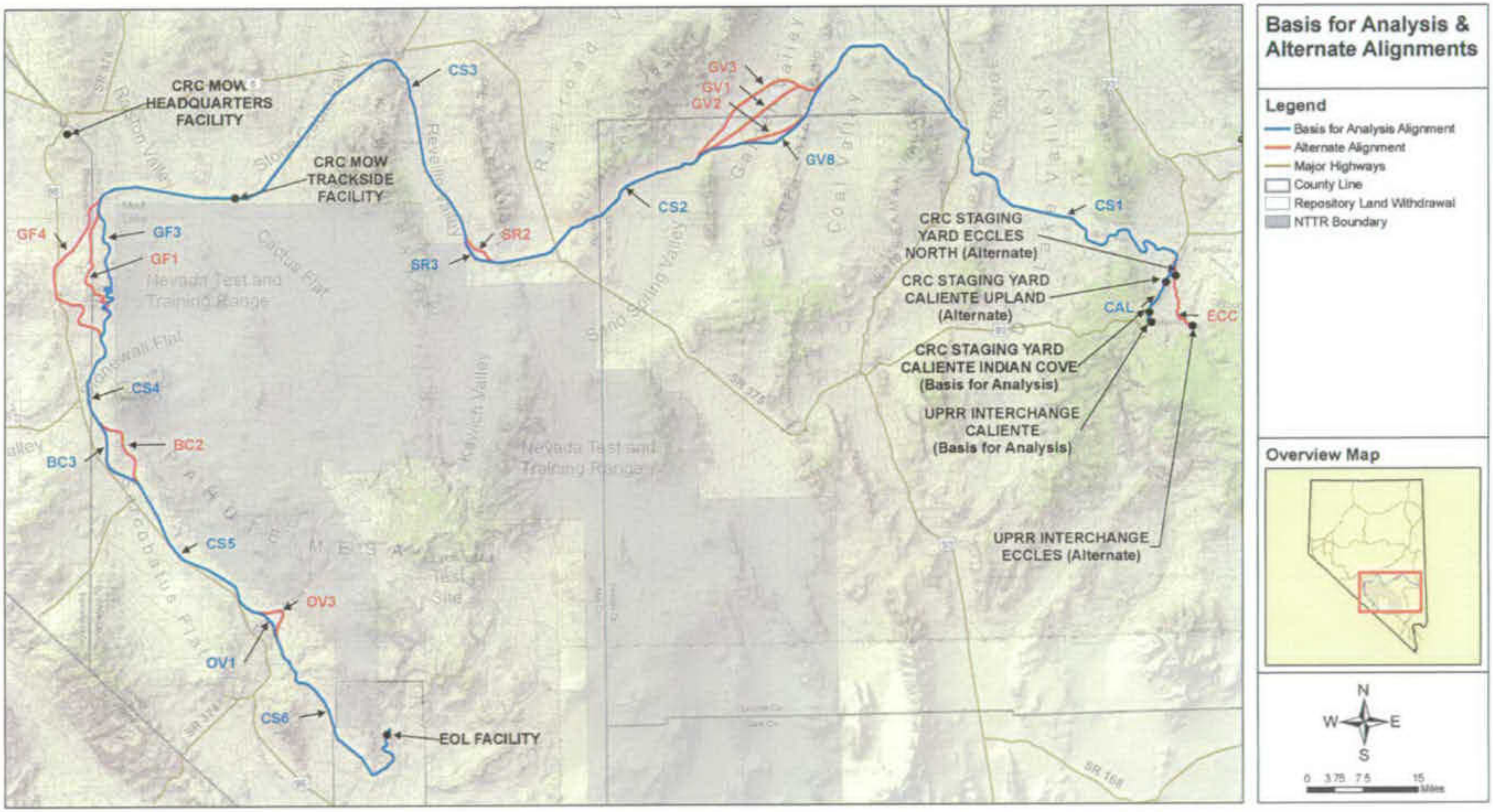

Figure 1. CRC Basis for Analysis

3.1 CONSTRUCTION

Air emissions associated with railroad construction consist of fugitive dust from various construction activities and engine exhaust from operating construction equipment. Examples of fugitive dust sources on this project include the grading and earthwork associated with construction of the rail line, access roads, facilities, bridges, and construction camps, vehicular traffic on unpaved haul roads, quarrying of ballast materials, batching of concrete, rock excavation, and storage piles. Engine exhaust sources include the motorized construction equipment associated with construction of the rail line, access roads, facilities, bridges, and construction camps. Exhaust sources also include haul trucks transporting materials to the alignment and operation of fuel combustion equipment at batch plants, quarries, and well drilling sites. Exhaust emissions from construction workers traveling to the camps from their places of residence have not been tabulated. Anticipated sources of emissions that may affect air quality are listed in Table 3-1 and Table 3-2 for construction and operation, respectively.

The air quality emission considerations included in this report provide estimates of fugitive dust emissions from the sources listed above, and estimates of engine operating parameters necessary for use as inputs to the U.S. Environmental Protection Agency's (EPA) NONROAD Emissions Model for the generation of engine exhaust emission estimates.

Table 3-1. Activities Affecting Air Quality During Construction for Selected Project Features

	Activities Affecting Air Quality During:	
Feature	**Construction**	**Construction Operations**
Embankment	• Excavation • Fill placement • Grading • Construction vehicle exhaust • Drill and blast • Rippable rock removal • Material storage piles	
Track	• Material delivery vehicle exhaust • Track placement vehicle exhaust • Ballast tamping • Welding • Construction train movement	• Freight train exhausts (track and repository construction materials) • Track placement vehicles exhaust
Structures	• Excavation • Fill placement • Grading • Construction vehicle exhaust	
Facilities	• Site grading • Construction vehicle exhaust • Track placement vehicle exhaust • Ballast tamping • Welding	

Table 3-1. Activities Affecting Air Quality During Construction for Selected Project Features

	Activities Affecting Air Quality During:	
Feature	Construction	Construction Operations
Camps	• Site grading • Construction vehicle exhaust	• Crew transport vehicle exhaust • Supply and delivery vehicles exhaust
Quarries	• Site preparation • Vehicle exhaust	• Material excavation • Material handling
Wells	Construction vehicle exhaust	• Diesel engine for pump operations
Signals	• Construction vehicle exhaust	• Maintenance vehicle exhaust
Communications	• Construction vehicle exhaust	• Maintenance vehicle exhaust
Batch Plant	• Material handling • Material delivery vehicle exhaust • Cement mixer vehicle exhaust • Material storage piles • Diesel generator	
Permanent access roads	• Grading • Construction vehicle exhaust	• Maintenance vehicle exhaust

Table 3-2. Activities Affecting Air Quality During Project Operation

Feature	Activities Affecting Air Quality During Operation
Track	• Cask train movements • Freight train movements • Hi-rail maintenance vehicle exhaust
Facilities	• Switch engine exhaust • Fuel delivery and storage • Vehicle exhaust
Permanent access roads	• Vehicle exhaust (employee and maintenance)
Signals	• Vehicle exhaust (maintenance)
Communications	• Vehicle exhaust (maintenance)

3.1.1 Fugitive Dust

Fugitive dust is reported in three forms:

- Particulate matter (PM) with an aerodynamic diameter smaller than 100 microns (PM)
- Particulate matter with an aerodynamic diameter of less than or equal to 10 microns (PM_{10})
- Particulate matter with an aerodynamic diameter of less than 2.5 microns ($PM_{2.5}$)

The emission estimating methodologies for fugitive dust are based on the use of established emission factors for similar activities (Western Regional Air Partnership 2004 and U.S. EPA various updates). Specific references and assumptions used in the development of the emission estimates are shown on the tables included in Appendix A. The analytical basis provides a summary of the assumed numeric values of various parameters used in the emissions analysis, such as total yards of excavation, miles of new access road, duration of construction activities, and so forth. All of the emissions calculations refer to this sheet for assigned project values. Appendix B provides results of fugitive dust calculations.

3.1.2 Exhaust Emissions

The derivation of the engine operating parameters is based on the typical motorized construction equipment utilized on similar construction projects. This information, which is listed in Appendix B, Track and Bridge Construction – Exhaust, (page B-32) was provided by Kanza, Inc., a general contractor specializing in railroad construction. Typical engine sizes (horsepower) for each type of equipment are provided along with the total project and annual operating hours. The operating hours are estimated based on the estimated construction quantities and typical construction rates for similar projects.

Engine exhaust information is provided for:

- Track and bridge construction
- Construction features (camps, quarries, wells)
- Facility construction
- Access road construction
- Batch plants
- Signal and communication construction

3.1.3 Methodologies for Construction Emissions

The computations for fugitive dust and engine exhaust sources during construction are presented in Appendix B. The bases of these computations are presented in Tables 3-3 and 3-4 for fugitive dust and exhaust, respectively, for each table in Appendix B.

Table 3-3. Explanation of Appendix B Data Sheets for Fugitive Dust Emissions

Appendix B Sheet Name	Basis of Computation
Earthwork Basis	• <u>Disturbed Area</u>: Tabulates the disturbed area in each segment. Area calculated from InRoads data, with factors added for alignment access roads (100 feet for the length of segment) and contingency (20 percent). • <u>Earthwork Volumes</u>: Earthwork volumes (NRP 2007a). Includes adjustments for shrinkage (25 percent for alluvial materials) and swell (15 percent for rippable rock and 25 percent for drill and blast rock). • <u>Alignment Access Roads</u>: Earthwork volumes are presented for construction of alignment access roads on each side of the trackbed. These volumes are based on an assumed 24-foot topwidth of each road, with 12-foot shoulder and drainage ditches. • <u>Other Surface Area Disturbances</u>: Tabulates surface areas disturbed by construction camps, access roads (those outside of the ROW), quarries, and water well developments. • <u>Terrain Scaling Factor</u>: This factor is based on surface area disturbance and is used to account for areas of rugged terrain that are expected to result in increased exhaust emissions due to increased construction equipment activity for a given length of segment.

Table 3-3. Explanation of Appendix B Data Sheets for Fugitive Dust Emissions

Appendix B Sheet Name	Basis of Computation
Track and Bridge Construction - Dust	The alignment segments are shown with the corresponding surface areas, effective surface areas, and effective scaling factor. The effective scaling factor provides estimated construction duration for each segment by proportioning the anticipated total construction duration based on the segments' proportion of effective surface area to total project effective surface area. This allows the emission factor for general construction (units of lb/acre/month) to be used in conjunction with effective surface area and construction duration on a segment-by-segment basis to estimate fugitive emissions. The estimated fugitive emissions from on-site and off-site cut and fill operations, based on the estimated quantities of each, are also provided as an additional source of emissions to those estimated from general construction. Bridge Construction was included as a separate sheet in Appendix B (NPR 2005). In this report, fugitive dust created by bridge construction is incorporated into the surface area disturbances reported for the alignment.
Construction Features	The fugitive dust emissions due to construction of the camps, quarries, and wells and the access roads to these features are based on the surface area and duration of earthwork activities associated with construction of the sites. • Camps: Computations present emissions for the bounding condition of ten open camps. The schedule assumes that the camps would be constructed within the first six months following notice to proceed. • Quarries: Two quarries would be developed for the project. Excavated quarry materials would be delivered to a loading facility adjacent to the track via conveyors. • Wells: The majority of the 170 wells needed for the project would be developed within the 1,000-foot ROW. Hence, no calculations for dust are presented for these wells. It is estimated that 20 wells would be developed outside of the ROW; dust emissions are presented for these twenty wells.
Facilities	The fugitive dust emissions due to construction of the facilities are based on the surface area and duration of earthwork activities associated with construction of the each facility. The estimates of surface areas and earthwork disturbance activities are used in conjunction with the emission factor to estimate the fugitive dust emissions. For purposes of estimating annual emissions: • Construction of the Union Pacific Railroad (UPRR) interchange would require about six months to complete. • Construction of the staging yard at Indian Cove or Beaver Dam Road would require 12 months to complete. • Construction of the MOW facilities, including a trackside facility and an off-track facility to serve as the maintenance headquarters, would require 12 months to complete. • Construction of the end-of-line (EOL) facility would require about 20 months to complete the work.
Access Roads	The fugitive dust emissions due to construction of the access roads are based on the surface area and duration of earthwork activities associated with construction of the roads. Emissions are presented for preparation of new and existing access roads to facilities.
Unpaved Roads	The sources of construction-related traffic anticipated on unpaved roads during construction of the CRC are shown. For each vehicle, either the total estimated operating hours or the total estimated volume of material to be hauled served as the basis for the emissions. This information was used with vehicular weights and assumed typical silt content, for unpaved industrial/construction haul roads to estimate emissions.
Batch Plants	Emission factors are applied based on the estimated quantity of concrete to be produced by each plant for the project. Annual emissions are estimated as a linear distribution of total emissions throughout the anticipated total construction duration. Previously two scenarios for batch plant construction and operation were considered (NRP 2005). This report considers only one scenario. The option of constructing a batch plant along the alignment for construction of access roads is no longer considered.

Table 3-3. Explanation of Appendix B Data Sheets for Fugitive Dust Emissions

Appendix B Sheet Name	Basis of Computation
Materials Storage and Stockpiles	Fugitive dust emissions from a material stockpile are generated primarily at the time of each pile disturbance. Stockpiles will be utilized along the alignment for placement of soils removed during grading operations. Stockpiles are also utilized at batch plants for storage of coarse and fine aggregate. This spreadsheet provides the means for estimating the emissions in terms of pounds per disturbance. The user selects the wind speed data from the bottom of the table that corresponds to the anticipated wind speeds at the time of pile disturbances. It is most conservative to assume that all pile disturbances occur during the highest wind speeds.
Quarry	Fugitive dust data are presented for each of two types of quarry operations: subballast and ballast. Emission factors are applied to each operation based on the estimated quantity of material to be produced for the project. Annual emissions are estimated as a linear distribution of total emissions throughout the anticipated total construction duration.
Rock Excavation	The excavation of rock from the alignment is anticipated to utilize either the rippable technique or drill and blast technique. Fugitive emission factors are applied to each technique based on the estimated quantity of rock to be removed for the project. Annual emissions are estimated as a linear distribution of total emissions throughout the anticipated total construction duration.

Table 3-4. Explanation of Appendix B Data Sheets for Construction Exhausts

Appendix B Sheet Name	Basis of Computation
Track and Bridge	The typical motorized construction equipment used for similar construction projects is shown along with horsepower and operating hours. Annual operating hours are estimated as a linear distribution of hours throughout the anticipated total construction duration.
Construction Features	The typical motorized construction equipment used for similar construction projects is shown along with horsepower and operating hours. The construction camps are anticipated to be constructed during the first year of the project and utilized during the total construction duration. Therefore, the annual operating hours for the construction phase are equal to the total hours but the annual operating hours for the utilization phase are estimated as a linear distribution of hours throughout the anticipated total construction duration. The use of mobile generators is no longer planned for the construction camps; power would be provided through connections with the existing utility grid and underground power cables installed as part of this project.
Facilities	The typical motorized construction equipment used for similar construction projects is shown along with horsepower and operating hours. The information is shown separately for each of the three facilities with the corresponding number of hours estimated for each, based on information stated for supporting facilities in the Fugitive Dust Section 3.1.1.
Access Roads	The typical motorized construction equipment used for construction of roads is shown along with horsepower and operating hours. The roads are anticipated to be constructed during the first year of the project. Therefore, the annual operating hours are equal to the total operating hours.
Batch Plants	Estimated operations of motorized equipment necessary for the primary operations of the plants and deliveries of materials are provided. Annual operating hours are estimated as a linear distribution of hours throughout the anticipated total construction duration.
Signals and Communications	The typical motorized construction equipment used for installation of signals and communications equipment along a rail line is shown along with horsepower and operating hours. The information is shown separately for installation of signals and installation of communications equipment. Communications facilities would be installed in the 12 months prior to NTP; signals work would begin in the 2nd year of construction following NTP and would require about 24 months.

3.1.4 Effects of Expanding Construction Schedule

The air emission calculations for construction activities were based on the volumes of material to be moved and the time needed to implement the construction. Expanding the schedule from five years to ten years (or fifteen years) does not change the total volume of material to be moved, or the equipment hours required to move the materials, it just expands the time available to do the work. Therefore, the total amounts of exhaust and dust generated over the life of the construction effort would not change. The average annual amount of emissions in all emission categories during a ten-year construction schedule would be expected to decrease. With a five-year schedule, track grading construction would be expected on multiple headings at multiple locations and require several different construction crews operating construction equipment at different sites. However, with a ten-year schedule, the need for multiple headings, and thus multiple crews, is reduced. Because fewer crews would be involved at any given time, less land would be disturbed, fewer vehicle exhaust emissions would occur, and less fugitive dust would be created.

Based on this analysis, it is concluded that expanding the construction schedule would not increase the total volumes of exhaust emissions or fugitive dust.

3.2 OPERATION

Air emissions associated with operations of the CRC consist primarily of locomotive and vehicular engine exhausts and fugitive emissions associated with fueling operations. The locomotives included in this report are the line-haul trains transporting spent nuclear fuel to the repository and delivering fuel and other materials to the facilities, and switch engines operating at the UPRR interchange and EOL facilities. Vehicular engine exhausts are included for the work trucks (mostly hi-rail vehicles) anticipated to be based at the facilities for use by the locomotive and car maintenance crews, track and maintenance crews, and signals and communications crews.

Fugitive emissions associated with fueling operations are in the form of volatile organic compounds (VOC) and originate from the unloading of diesel fuel from railcars into a storage tank and subsequent loading of the fuel from the storage tank into locomotives. Other sources of these fugitives are the breathing losses of fuel vapors from the storage tank.

The air quality emission considerations related to operation of the CRC provide estimates of annual fuel combustion emissions from the locomotives and engine operating parameters for vehicular traffic necessary for use in the EPA's NONROAD Emissions Model. This report also includes the data inputs necessary for use of EPA estimating methodologies for emissions from storage tanks and from fuel loading and unloading operations.

The engine exhaust and fugitive VOC sources are included in Appendix C and the basis of computation used for emission estimates are provided in Table 3-5. Data are provided for:

- Rail traffic
- Fuel storage for rail operations
- Fuel delivery to facilities
- Equipment exhaust at facilities

Table 3-5. Basis of Computation for Operational-Related Emissions

Parameter	Basis of Computation
Rail Traffic	The rail traffic associated with the operations of the CRC is presented in two categories: line-haul locomotives and switch engines. Line-haul locomotive traffic is based on projected peak year traffic and the anticipated use of two locomotives per train. Switch engine usage is based on the anticipated use of one switch locomotive at the UPRR interchange facility and two switch locomotives at the EOL. Emission factors are based on the current Tier 2 standards located at 40 Code of Federal Regulations (CFR) 92.8 (U.S. EPA 2003). Sulfur dioxide emissions are based on the complete conversion of the fuel-bound sulfur to sulfur dioxide.
Fuel Storage for Rail Operations	The VOC emissions from fuel storage tanks can be estimated using EPA's TANKS 4.9 program. The necessary data inputs for this program are presented on this table for a 200,000 gallon tank located at the EOL, based on current project plans. Annual fuel throughput is estimated based on consumption of 200 gallons per hour per locomotive and the anticipated line-haul and switch engine operations. Space is provided for additional tanks if necessary.

Table 3-5. Basis of Computation for Operational-Related Emissions

Parameter	Basis of Computation
Fuel Delivery to Facilities	The VOC emissions from fuel unloading and loading operations are estimated by using Equation 1 in Section 5.2 of AP-42 (U.S. EPA Various Updates). The necessary data inputs for use of the equation are presented on this table for diesel fuel. The total quantity of fuel unloaded is equal to the total annual fuel throughput of the storage tanks.
Equipment Exhaust at Facilities	The vehicles anticipated to be used for the various operational functions of the CRC are tabulated. They are listed according to the facility that will serve as their base of operations. The corresponding engine horsepower and hours of operation are shown for each type of vehicle. For purposes of providing input data for use in NONROAD, the operating hours are assumed to be eight hours per day, representative of an entire work shift.

4.1 RA EIS TEAM DATA REQUESTS

Construction and operation of the CRC would require a large force of construction personnel that could induce economic or social impacts to the region. The RA EIS contractor will use an economic-demographic forecasting model known as Regional Economic Models, Inc. (REMI®) to provide employment, real disposable income, and gross regional product data for Lincoln, Nye, and Clark Counties. The REMI® model used in these determinations is a four-region model. Three of the regions are Clark, Nye, and Lincoln Counties. The fourth region is an aggregation of the other 14 counties in Nevada.

The REMI® model has been in use since 1980, and is used to generate year-by-year estimates of the total regional effects of any specific policy initiative, such as the CRC. The model has the following features:

- It is calibrated to local conditions using a relatively large amount of local data.
- It combines several different kinds of analytical tools (including economic-base, input-output, and econometric models).
- It allows users to manipulate an unusually large number of input variables and gives forecasts for an unusually large number of output variables.
- It allows the user to generate forecasts for any combination of future years, allowing the user special flexibility in analyzing the timing of economic impacts.
- It accounts for business cycles.

The REMI® model is very data intensive – that is, as noted above, it requires a "relatively large amount of local data" to produce feasible results. As with the air emissions data requests, much of the data requested for REMI® modeling pertained to specific construction activities. Section 2.1 of this report noted that the methods of constructing the CRC are still evolving; therefore, several assumptions have been made for the purposes of this report which establish a general framework for construction of the proposed rail line and serve as a basis for the input data provided to the RA EIS team. These assumptions are outlined in Appendix A. In general, data requirements covered the following topics:

- Size and composition of workforce for construction of track, drainage, and major bridge structures, including construction camps, batch plants, and ballast sites
- Construction of supporting facilities at the UPRR interchange, MOW, and EOL at the geologic repository operations area
- Operation of the rail line, including crew size and support requirements
- Operation of the supporting facilities, including workforce size and composition
- Locomotive fuel consumption for repository construction, operation, and spent nuclear fuel shipments

4.2 RA EIS INPUTS

Data for the REMI® modeling effort were compiled during the March 2005 workshop sessions and are based in part the assumptions outlined with each worksheet as well as professional judgment. At least three workshop sessions were held, all of which included personnel from NRP; Bechtel SAIC Company, LLC; and the RA EIS contractor. Socioeconomic modeling input is summarized in Appendix D.

4.3 EFFECTS OF EXPANDED SCHEDULE

An expanded construction schedule would not result in greater impacts than would occur with a five-year schedule. The reason for this is that the extended schedule would not need the large numbers of construction personnel on-site during the construction period. Fewer labor camps would be needed at any one time, although the total number of camps could remain the same. The construction costs of the facilities would not change significantly (except for inflation and remobilization), thus the dollars spent in any one part of the region would remain more or less the same. The timing of the expenditures would be extended over a timeframe of five to ten additional years.

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____. 2007a. *Alignment Development Report, Caliente Rail Corridor.* Las Vegas, NV: NRP. Rev. 03, 15 May 2007.

____. 2007b. *Comparative Cost Estimates, Caliente Rail Corridor.* Las Vegas, NV: NRP. Rev 03, 15 May 2007.

____. 2007c. *Construction Plan, Caliente Rail Corridor.* Las Vegas, NV: NRP. Rev 02, 15 May 2007.

____. 2007d. *Facilities–Design Analysis Report, Caliente Rail Corridor.* Las Vegas, NV: NRP. Rev. 03, 15 May 2007.

____. 2007e. *Operations and Maintenance Report, Caliente Rail Corridor.* Las Vegas, NV: NRP. Rev. 03, 15 May 2007.

Shannon & Wilson, Inc. 2005. *Ballast Sourcing Cost Analysis, Phase 1, Caliente Rail Corridor, Yucca Mountain Project, Nevada.* Seattle: Shannon & Wilson, Inc. 18 February 2005.

U.S. Environmental Protection Agency. Various Updates. *Compilation of Air Pollutant Emission Factors (AP-42).*

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Western Regional Air Partnership. 2004. *Fugitive Dust Handbook.* 15 November 2004.

Appendix A
Analysis Assumptions

ASSUMPTIONS FOR FUGITIVE DUST AND EXHAUST AIR EMISSIONS DURING CONSTRUCTION	
EARTHWORK BASIS	
(1)	All values are based on output from InRoads analyses of alignment dated January 2006. Alignment segments listed as the Basis for Analysis are defined in the *Alignment Development Report, Caliente Rail Corridor* (NRP 2007a).
(2)	Surface area disturbed data from InRoads were adjusted to account for disturbances resulting from construction of alignment access roads, and to allow for contingencies (20%).
(3)	The Effective Disturbed Surface Area adds a 50% factor to the portion of the segment assumed to be rugged terrain, to account for the expected increase in construction time associated with this type of terrain.
(4)	Volumes of different types of materials based on geologic mapping provided by Shannon & Wilson, Inc.
TRACK AND BRIDGE CONSTRUCTION - FUGITIVE DUST	
(1)	Analysis includes fugitive dust emanating from surface area disturbances and placement of **embankment, track,** and **alignment access roads**. Results are tabulated for alluvial and rock excavations, and for anticipated **borrow** and **waste.**
(2)	PM_{10} emission factor reference taken from WRAP *Fugitive Dust Handbook*, Chapter 3, Construction and Demolition, Table 3-2 Recommended PM_{10} Emission Factors for Construction Operations, Level 1 (November 15, 2004) for "worst-case conditions" due to the "active large-scale earth moving operations." These factors were based on a work schedule of 168 hours per month, and were therefore adjusted to account for a 260 hour per month work schedule.
(3)	AP-42, Section 13.2.3 was utilized for PM General Construction emission factor due to the absence of a similar factor in the WRAP *Fugitive Dust Handbook*.
(4)	For both on-site and off-site cut and fill emissions, WRAP does not provide a PM emission factor. Therefore, the PM emission factor for this project is assumed to be the WRAP PM_{10} factor multiplied by 1.85 to provide a similar PM:PM_{10} ratio as for other construction activities utilizing a general construction PM_{10} factor (i.e., track construction, bridge construction, facilities construction, and access road construction).
(5)	$PM_{2.5}$ is assumed to be 20.8% of PM_{10} per ratio for construction dust published by the California Air Resources Board (CARB, June 30, 1989).
(6)	Assumes disturbed areas associated with **track sidings** and **bridge construction** are included in the surface area of the alignment.
(7)	Assumes that potential wind erosion associated with track construction phase is accounted for by applying the emission factor to the entire time (effective duration) the segment is exposed.
(8)	Emissions of fugitive dust from construction of signals and communication equipment are included herein, as the construction of said equipment is assumed to occur within the ROW.
CONSTRUCTION FEATURES - FUGITIVE DUST	
(1)	Analysis includes fugitive dust emanating from construction of **camps, quarries,** and **wells,** and the **access roads** leading to these features.
(2)	PM_{10} emission factor reference taken from WRAP *Fugitive Dust Handbook*, Chapter 3, Construction and Demolition, Table 3-2 Recommended PM_{10} Emission Factors for Construction Operations, Level 1 (November 15, 2004). These factors were based on a work schedule of 168 hours per month, and were therefore adjusted to account for a 260 hour per month work schedule.
(3)	AP-42, Section 13.2.3 was utilized for PM General Construction emission factor due to the absence of a similar factor in the WRAP *Fugitive Dust Handbook*.

ASSUMPTIONS FOR FUGITIVE DUST AND EXHAUST AIR EMISSIONS DURING CONSTRUCTION	
(4)	$PM_{2.5}$ is assumed to be 20.8% of PM_{10} per ratio for construction dust published by CARB (June 30, 1989).
(5)	Construction camps assumed to be sited on flat terrain. Therefore, general construction emissions are assumed to account for site-grading emissions. Earth-moving activities are assumed to be negligible.
FACILITY CONSTRUCTION - FUGITIVE DUST	
(1)	Analysis includes fugitive dust emanating from construction of **the UPRR interchange yard** and **interchange facility,** the **MOW facility,** and the **EOL** facility.
(2)	PM_{10} emission factor reference taken from WRAP *Fugitive Dust Handbook*, Chapter 3, Construction and Demolition, Table 3-2 Recommended PM_{10} Emission Factors for Construction Operations, Level 1 (November 15, 2004). These factors were based on a work schedule of 168 hours per month, and were therefore adjusted to account for a 260 hour per month work schedule.
(3)	AP-42, Section 13.2.3 was utilized for PM General Construction emission factor due to the absence of a similar factor in the WRAP *Fugitive Dust Handbook*.
(4)	$PM_{2.5}$ is assumed to be 20.8% of PM_{10} per ratio for construction dust published by CARB (June 30, 1989).
(5)	Earthwork quantities for facilities taken from *Comparative Cost Estimates* (NRP 2007b).
ACCESS ROAD CONSTRUCTION - FUGITIVE DUST	
(1)	Analysis includes fugitive dust emanating from construction of permanent access roads to the **UPRR interchange yard** and **interchange facility,** the **MOW facility,** and the **EOL** facility.
(2)	PM_{10} emission factor reference taken from WRAP *Fugitive Dust Handbook*, Chapter 3, Section 3.2.4 (November 15, 2004). These factors were based on a work schedule of 168 hours per month, and were therefore adjusted to account for a 260 hour per month work schedule.
(3)	AP-42, Section 13.2.3 was utilized for PM General Construction emission factor due to the absence of a similar factor in the WRAP *Fugitive Dust Handbook*.
(4)	$PM_{2.5}$ is assumed to be 20.8% of PM_{10} per ratio for construction dust published by CARB (June 30, 1989).
(5)	Assumes all roads meet the criteria of WRAP, Table 3-3, Conversion of Road Miles to Acres Disturbed, Group 4.
CONSTRUCTION TRAFFIC ON UNPAVED ROADS - FUGITIVE DUST	
(1)	Silt content taken from the Industrial Unpaved Roads section of AP-42, Table 13.2.2-1 for a typical surface material.
(2)	Wet days per year is expressed as the mean number of days per year with at least 0.01 inch of precipitation, taken from AP-42, Figure 13.2.2-1 for southwestern Nevada.
(3)	Total operating hours, provided by NRP construction team, were used to estimate total vehicle miles traveled (VMT) by assuming an average vehicle speed.
(4)	Batch plants were assumed at the Beatty Wash Bridge, and the White River Bridge. Haul distances for delivery of raw materials to the batch plant were assumed to be 15 miles for each plant; distance from plant to bridge was assumed to be 1 mile.
(5)	Truck travel for fuel and maintenance trucks are assumed to be included within data listed for grading and track operations within this same tab.
(6)	Assumes that vehicles are traveling on a constructed gravel road.
(7)	Emissions of fugitive dust from paved roads is assumed to be insignificant.

ASSUMPTIONS FOR FUGITIVE DUST AND EXHAUST AIR EMISSIONS DURING CONSTRUCTION	
BATCH PLANT OPERATIONS - FUGITIVE DUST	
(1)	Emission factor reference taken from AP-42, Table 11.12-3 (October 2001).
(2)	$PM_{2.5}$ is assumed to be equal to PM_{10}, because AP-42 does not provide an emission factor for $PM_{2.5}$ for the listed processes.
(3)	Concrete volume of 49,502 cubic meters was taken from the Morrison-Knudsen (M-K) estimate (1997), and converted to cubic yards by multiplying by 1.31.
(4)	Analysis assumes two (2) plants; located at the White River bridge site and at the Beatty Wash bridge site.
(5)	Assumed truck mix concrete for conservative emission factors.
(6)	Wind erosion of storage piles is not included on this tab.
TRACK AND BRIDGE CONSTRUCTION STORAGE PILES - FUGITIVE DUST	
(1)	See notes within tab.
BATCH PLANTS, FINE MATERIALS STORAGE PILES - FUGITIVE DUST	
(1)	See notes within tab.
BATCH PLANTS, COARSE MATERIALS STORAGE PILES - FUGITIVE DUST	
(1)	See notes within tab.
QUARRY OPERATIONS - FUGITIVE DUST	
(1)	Emission factor reference taken from AP-42, Table 11.19.2-2 (August 2004).
(2)	Assumes the total project subballast and ballast is processed at the quarries established for the project. Volumes are adjusted to account for swell factors. Shannon & Wilson, Inc. estimate that approximately 4,600 cubic yards of material would be excavated to produce 3,400 cubic yards of useable material.
(3)	Assumes that all rock excavation is performed by wet drilling. AP-42 does not provide emission factors for rock blasting.
(4)	Assumes AP-42 emission factor for tertiary crushing applies to all crushing operations (primary, secondary, and tertiary) because AP-42 does not provide emission factors for primary and secondary crushing. No emissions for fines crushing are included.
(5)	For sources listed in AP-42 which do not explicitly express PM factors, the PM emission factor for this project is assumed to be the AP-42 PM_{10} factor multiplied by 1.85. This will provide a similar $PM:PM_{10}$ ratio as for other construction activities accounted for in this project where a documented PM factor is not available. $PM_{2.5}$ emissions are assumed to equal PM_{10}.
(6)	Assumes six conveyor transfer points in the process.
(7)	Truck loading emission factor is assumed to equal the truck unloading emission factor from AP-42 because no truck loading factor is provided.

ASSUMPTIONS FOR FUGITIVE DUST AND EXHAUST AIR EMISSIONS DURING CONSTRUCTION	
TRACK AND BRIDGE CONSTRUCTION - EXHAUST	
(1)	Hours of operation are based on an assumed construction equipment consist. Five (5) consists would be used for site grading; one (1) would be used for track construction. Consists are listed within the Analytical Basis sheets.
(2)	Hours of operation are assumed to be those for common terrain, then adjusted by the terrain factor. A factor of 50% was then added to the hours for each equipment type to account for the increase in construction time associated with rugged terrain.
(3)	Hours of operation based on estimated number of pieces of equipment type, over five (5) crews for 3,000 hours per year.
(4)	Duration of construction activities would be 24 months for grading; 32 months for track laying.
(5)	If no specific piece of equipment was referenced, the horsepower represents typical equipment listed by these manufacturers that is similar to the equipment listed for this project, and is identified as such by the word "generally." These references are intended to be representative, not indicative of actual equipment.
CONSTRUCTION FEATURES - EXHAUST	
(1)	Duration of construction specified on Analytical Basis tab.
(2)	If no specific piece of equipment was referenced, the horsepower represents typical equipment listed by these manufacturers that is similar to the equipment listed for this project, and is identified as such by the word "generally." These references are intended to be representative, not indicative of actual equipment.
(3)	Generators pumping water wells were given an estimated horsepower (hp) of 150 hp, assuming a 90% efficiency.
FACILITIES CONSTRUCTION - EXHAUST	
(1)	Duration of construction specified on Analytical Basis tab.
(2)	If no specific piece of equipment was referenced, the horsepower represents typical equipment listed by these manufacturers that is similar to the equipment listed for this project, and is identified as such by the word "generally." These references are intended to be representative, not indicative of actual equipment.
ACCESS ROAD CONSTRUCTION - EXHAUST	
(1)	Analysis covers exhaust emissions for construction of access roads to camps, quarries, and wells, and permanent access roads to facilities.
(2)	If no specific piece of equipment was referenced, the horsepower represents typical equipment listed by these manufacturers that is similar to the equipment listed for this project, and is identified as such by the word "generally." These references are intended to be representative, not indicative of actual equipment.
BATCH PLANT OPERATIONS - EXHAUST	
(1)	If no specific piece of equipment was referenced, the horsepower represents typical equipment listed by these manufacturers that is similar to the equipment listed for this project, and is identified as such by the word "generally." These references are intended to be representative, not indicative of actual equipment.
SIGNALS AND COMMUNICATIONS CONSTRUCTION - EXHAUST	
(1)	Assumes a construction period of 1.5 years, to occur over the final year and a half of the project.
(2)	If no specific piece of equipment was referenced, the horsepower represents typical equipment listed by these manufacturers that is similar to the equipment listed for this project, and is identified as such by the word "generally." These references are intended to be representative, not indicative of actual equipment.

ASSUMED NUMERICAL VALUES FOR GENERAL PARAMETERS AFFECTING AIR QUALITY

Parameter	Value	Notes			
Duration of construction					
Track grading and installation	24	months			
Camp, quarry, well & facility access roads	6	months			
Water Wells					
Total number of wells	170	Assumed to be evenly distributed (1 every 2 miles)			
Number of well sites outside of ROW	15	Information provided by Converse Consultants, Inc.			
Surface area disturbed per well (acres)	1.43	Basis - 250-foot square plot			
Quarry Construction					
Number of quarries	2	Several quarries were studied; 2 will be developed			
Surface area disturbed per quarry (acres)	120	Information provided by Shannon & Wilson, Inc.			
Access Road Lengths	**Existing (miles)**	**New (miles)**	**Contingency**	**Total (miles)**	
Alignment Access Road	0	660	132	792	
Camps	119	0	24	143	
Quarries	24	14	8	46	
Wells	23	2	5	31	
Access Road Disturbed Area & Earthwork	**Surface Area Disturbed (acres)**		**Earthwork (yd^3)**		
Alignment Access Road		6,420		12,818,000	
Camps		730		523,000	
Quarries		650		219,000	
Wells		240		94,000	
Excavation					
Alluvial (cubic yards [yd^3])	22,094,000				
Rippable (yd^3)	2,074,000				
Drill & blast (yd^3)	6,800,000				
Embankment Fill					
Fill (yd^3)	25,135,000				
Borrow (yd^3)	5,534,000				
Track Installation					
Sub-ballast (tons)	2,600,000				
Ballast (tons)	3,469,000				
Trackage (track feet)	1,980,000	Does not include yard tracks			
Track welding	2,648	field welds	41,044	plant welds	
Structures					
Bridge Construction					
Batch Plant	2				
Facilities	**Disturbed Area (acres)**	**Duration of Construction Activity (months)**			
		Grading	**Trackwork**	**Structures**	**Total**
Interchange Yard	15	3	3	0	6
Staging Yard*	50	6	6	6	12
MOW Trackside*	15	6	6	6	12
MOW Headquarters	0	6		6	12
EOL Yard*	100	8	12	12	20
Totals	180				

*Trackwork and structures constructed concurrently.

LENGTH AND DISTURBED AREA FOR ACCESS ROADS TO CONSTRUCTION FEATURES

Access Road Destination	Existing Roads (miles)	New Roads (miles)	Disturbed Area (acres)		
			Site	Road	Total
Alignment Access Road	-	660	0	6,420	6,420
Construction Camp 1	1.49	0.00	25	0	30
Construction Camp 2	16.84	-	25	61	86
Construction Camp 3	14.54	-	25	53	78
Construction Camp 4	28.97	-	25	105	130
Construction Camp 5	0.00	-	25	0	25
Construction Camp 6	15.20	-	25	55	80
Construction Camp 7	10.87	-	25	40	65
Construction Camp 8	9.29	-	25	34	59
Construction Camp 9	5.84	-	25	21	46
Construction Camp 10	1.38	-	25	5	30
Construction Camp 11	2.70	-	25	10	35
Construction Camp 12	12.30	0.25	25	45	70
Caliente Quarry	2.71	3.36	120	31	151
South Reveille Quarries	9.49	4.37	120	58	178
Northeast Goldfield Quarry	8.01	2.24	120	39	159
West Goldfield Quarry	4.10	5.15	120	44	164
Well 1	0.66	0.17	1.43	2	3
Well 2	0.00	0.17	1.43	0	1
Well 3	0.93	-	1.43	2	3
Well 4	0.87	-	1.43	2	3
Well 5	1.23	-	1.43	2	3
Well 6	0.00	0.73	1.43	1	2
Well 7	1.64		1.43	3	4
Well 8	1.89	-	1.43	4	5
Well 9	2.42	0.00	1.43	5	6
Well 10	2.97		1.43	6	7
Well 11	0.31		1.43	1	2
Well 12	1.47		1.43	3	4
Well 13	3.75	0.35	1.43	8	9
Well 14	4.05	1.01	1.43	10	11
Well 15	0.80		1.43	2	3
Well 16	0.00	0.00	0.00	0	0
Well 17	0.00		0.00	0	0
Well 18	0.00		0.00	0	0
Well 19	0.00		0.00	0	0
Well 20			0.00	0	0
SUMMARY Alignment	-	660.00			6,420
Camps	118.99	0.11	← Units in miles		730
Quarries	24.09	13.94	Units in acres →		650
Wells	23.33	2.09			240

ESTIMATED EARTHWORK FOR ACCESS ROADS TO CONSTRUCTION FEATURES

Access Road Destination	Estimated Earthwork (yd^3)	
	Calculated	Rounded
Alignment Access Road		12,818,000
Construction Camp 1	28,873	21,000
Construction Camp 2	71,132	71,000
Construction Camp 3	61,417	62,000
Construction Camp 4	122,369	124,000
Construction Camp 5		0
Construction Camp 6	64,205	65,000
Construction Camp 7	45,912	46,000
Construction Camp 8	39,241	39,000
Construction Camp 9	24,688	26,000
Construction Camp 10	5,829	6,000
Construction Camp 11	11,405	11,000
Construction Camp 12	53,011	52,000
Caliente Quarry	39,832	40,000
South Reveille Quarries	77,004	73,000
Northeast Goldfield Quarry	52,758	48,000
West Goldfield Quarry	60,825	58,000
Well 1	3,068	3,000
Well 2	628	1,000
Well 3	3,437	3,000
Well 4	3,216	3,000
Well 5	4,546	5,000
Well 6	2,698	3,000
Well 7	6,061	6,000
Well 8	6,985	7,000
Well 9	8,944	9,000
Well 10	10,977	11,000
Well 11	1,146	1,000
Well 12	5,433	5,000
Well 13	15,154	15,000
Well 14	18,702	19,000
Well 15	2,957	3,000
Well 16	0	0
Well 17	0	0
Well 18	0	0
Well 19	0	0
Well 20	0	0

	EARTHWORK SUMMARY	Alignment	12,823,000
	(Units in cubic yards)	Camp roads	527,000
		Quarry roads	231,000
		Well roads	94,000

ESTIMATED CONSTRUCTION EQUIPMENT CONSISTS, SITE GRADING

Equipment Type	Number of pieces		Annual Operating Hours	Duration of grading	Total Hours
	Pieces	Crews			
2 Ton Flatbed Truck	2	5	30,000	2	60,000
Tractor/trailer (flatbed, belly dump)	4	5	60,000	2	120,000
Caterpillar D400 Rock Truck	20	5	300,000	2	600,000
Water Truck – 4,000 gal	10	5	150,000	2	300,000
Fuel/service truck	3	5	45,000	2	90,000
Pickup	30	5	450,000	2	900,000
Caterpillar 966 Loader	5	5	75,000	2	150,000
Caterpillar 140 Blade	10	5	150,000	2	300,000
CP 563E Padfoot Drum Compactor – (84")	2	5	30,000	2	60,000
CP 563E Smooth Drum Compactor – (84")	2	5	30,000	2	60,000
Caterpillar 815 Compactor	5	5	75,000	2	150,000
Caterpillar D6 Dozer	10	5	150,000	2	300,000
Caterpillar D9 Dozer	15	5	225,000	2	450,000
Caterpillar D10 Dozer	15	5	225,000	2	450,000
Komatsu PC 300 Excavator	2	5	30,000	2	60,000
Komatsu PC 400 Excavator	5	5	75,000	2	150,000
Caterpillar 615 Scraper	2	5	30,000	2	60,000
Caterpillar 631 Scraper	18	5	270,000	2	540,000
Air compressor (250 cfm)	5	5	75,000	2	150,000
Jumping Jack compactor	10	5	150,000	2	300,000
	175		2,625,000		5,250,000

Notes: 1) Annual hours used in estimating exhaust emissions from Track and Bridge Construction Equipment
2) Annual hours assumes 3,000 hours per year
3) Duration of grading is in years

CONSTRUCTION TRAIN OPERATING HOURS

Train Type	Cars per Train	Trains per Day	Trains per Month	Caliente Speed	Garden Valley Speed	Goldfield Speed	Total Time (months)	Total Trains
Concrete Ties – L*	12	1	20	15			8	160
Concrete Ties – E*	12	1	20	15			8	160
Rail – 80' – L	8	1	8	15			8	64
Rail – 80' – E	8	1	8	15			8	64
Rail – Weld – L	17	1	8	15			8	64
Rail – Weld – E	17	1	8	15			8	64
Ballast – L	20	8	80	15			8	640
Ballast – E	20	8	80	15			8	640
Construction Materials – L	10	1	8	15			8	64
Construction Materials – E	10	1	8	15			8	64
Concrete Ties – L	12	1	20	40	15		9	180
Concrete Ties – E	12	1	20	40	15		9	180
Rail – 80' – L	8	1	8	40	15		9	72
Rail – 80' – E	8	1	8	40	15		9	72
Rail – Weld – L	17	1	8	40	15		9	72
Rail – Weld – E	17	1	8	40	15		9	72
Ballast – Load	20	8	80	40	15		9	720
Ballast – E	20	8	80	40	15		9	720
Construction Materials – L	10	1	8	40	15		9	72
Construction Materials – E	10	1	8	40	15		9	72
Concrete Ties – L	12	1	20	40	40	15	16	320
Concrete Ties – E	12	1	20	40	40	15	16	320
Rail – 80' – L	8	1	8	40	40	15	16	128
Rail – 80' – E	8	1	8	40	40	15	16	128
Rail – Weld – L	17	1	8	40	40	15	16	128
Rail – Weld – E	17	1	8	40	40	15	16	128
Ballast – Load	20	8	80	40	40	15	16	1,280
Ballast – E	20	8	80	40	40	15	16	1,280
Construction Materials – L	10	1	8	40	40	15	16	128
Construction Materials – E	10	1	8	40	40	15	16	128

*L = Loaded; E = Empty

SUMMARY - OPERATING HOURS				Locomotive Operating Hours
Cargo	No. of Locomotives	Months of Operation	Days per month	
Concrete Ties	3	33	21	25,000
Rail	3	33	21	25,000
Rail – Welded	6	33	21	50,000
Ballast	6	33	21	50,000
Construction Materials	6	33	21	50,000
Totals	**24**			**200,000**

Notes
1) Locomotive operating hours assumes 12 hour day
2) Assumes ballast, welded rail, and construction materials train locomotives will be 4,000 hp units
3) Assumes tie and rail trains will be 3,000 hp units

TRACK CONSTRUCTION EQUIPMENT OPERATING HOURS

Equipment Type	Machines per Day	Machine-Months	Caliente Speed	Garden Valley Speed	Goldfield Speed	Total Time (months)	Total Moves
Track Tamper	8	224	15			8	1,320
Ballast Regulator	4	112	15			8	560
Tie Handler	2	56	15			8	280
Rail Clip Applicator	2	56	15			8	280
Ballast Consolidator	4	112	15			8	560
Track Tamper	8	224		15		9	1,792
Ballast Regulator	4	112		15		9	896
Tie Handler	2	56		15		9	448
Rail Clip Applicator	2	56		15		9	448
Ballast Consolidator	4	112		15		9	896
Track Tamper	8	224			15	16	4,256
Ballast Regulator	4	112			15	16	2,128
Tie Handler	2	56			15	16	1,064
Rail Clip Applicator	2	56			15	16	1,064
Ballast Consolidator	4	112			15	16	2,128

Track Equipment	Pieces of Equipment	Months of Operation	Days per month	Operating Hours
Speedswing	4	33	21	33,000
Track Tamper	8	33	21	67,000
Ballast Regulator	4	33	21	33,000
Tie Handler	2	33	21	17,000
Rail Clip Applicator	2	33	21	17,000
Ballast Consolidator	4	33	21	33,000
			Total	167,000

Note: 1) Operating hours assumes 12 hours operation per day

Appendix B
Air Emissions Analysis for Construction Activities

Contents	Page

SUMMARY OF FUGITIVE DUST EMISSIONS BY SOURCE

Source of Emissions	Annual Emissions (tons/year)			Percent of Total
	PM	PM_{10}	$PM_{2.5}$	
Track and bridge construction				
Surface area disturbance	17,000	9,300	1,900	20%
Alluvial excavation	1,900	1,100	200	2%
Rock excavation	0	0	0	0%
Offsite borrow	3,200	1,700	200	4%
Construction features	11,800	6,300	1,300	14%
Facilities construction	2,900	1,700	600	3%
Access roads	400	200	0	0%
Unpaved roads	49,000	14,000	2,000	56%
Track storage piles	500	500	100	1%
Batch plant	0	0	0	0%
Coarse stockpiles	0	0	0	0%
Fines stockpiles	0	0	0	0%
Quarries	200	100	100	0%
Totals	**86,900**	**34,900**	**6,400**	**100%**

Note: All values rounded to nearest 100 tons. Values showing "zero" emissions actually have emissions, but are less than 50 tons per year. See individual sheets for amounts less than 50 tons.

DISTURBED AREAS FOR BASIS FOR ANALYSIS AND ALTERNATIVE SEGMENTS

	Segment	Length		ROW Area (acres)	Disturbed Area (acres)			
		Feet	Miles		InRoads	Additions	Contingency	Total
Basis for Analysis	Caliente	59,755	11.3	1,372	90	220	60	370
	Bennett Pass	135,000	25.6	3,099	340	500	170	1,010
	Pahroc Summit	98,276	18.6	2,256	280	360	130	770
	White River	139,099	26.3	3,193	250	510	150	910
	GV8	119,981	22.7	2,754	230	440	130	800
	CS2	161,762	30.6	3,714	280	590	170	1,040
	SR3	65,000	12.3	1,492	110	240	70	420
	CS3	369,440	70.0	8,481	660	1,360	400	2,420
	GF3	164,085	31.1	3,767	360	600	190	1,150
	CS4	37,728	7.1	866	70	140	40	250
	BC3	65,192	12.3	1,497	140	240	80	460
	CS5	131,224	24.9	3,012	160	480	130	770
	OV1	32,421	6.1	744	80	120	40	240
	CS6	167,997	31.8	3,857	480	620	220	1,320
	Totals	**1,746,960**	**330.7**	**40,104**	**3,530**	**6,420**	**1,980**	**11,930**
Alternate Alignment Segments	Eccles	60,810	11.5	1,396	190	220	60	470
	GV1	114,685	21.7	2,633	180	420	120	720
	GV2	117,299	22.2	2,693	210	430	130	770
	GV3	123,405	23.4	2,833	200	450	130	780
	SR2	61,842	11.7	1,420	60	240	60	360
	GF1	154,725	29.3	3,552	310	570	180	1,060
	GF4	172,345	32.6	3,956	340	630	190	1,160
	BC2	66,224	12.5	1,520	150	240	80	470
	OV3	46,377	8.8	1,065	100	170	50	320

Notes: 1) Source: InRoads output, January 2006
2) InRoads area rounded to nearest 10 acres of value shown on InRoads results
3) ROW area based on 1,000-foot ROW width
4) Additions to disturbed area account for alignment access roads on both sides of alignment (160 feet)
5) Contingency adds 20% to sum of InRoads and Additions columns

	Alignment Road Excavation			Terrain Scaling Factor			
	Segment	Length, feet	Excavation, cubic yards	Common	Rugged	Actual Disturbed Area (acres)	Effective Disturbed Area (acres)
Basis for Analysis	Caliente	59,188	434,000	100%	0%	370	370
	Bennett Pass	135,000	991,000	70%	30%	1,010	1,160
	Pahroc Summit	98,276	721,000	70%	30%	770	890
	White River	139,099	1,021,000	70%	30%	910	1,050
	GV8	119,981	881,000	90%	10%	780	820
	CS2	161,762	1,187,000	70%	30%	1,040	1,200
	SR3	65,000	477,000	70%	30%	420	480
	CS3	369,313	2,711,000	90%	10%	2,420	2,540
	GF3	164,085	1,204,000	70%	30%	1,150	1,320
	CS4	37,917	278,000	100%	0%	250	250
	BC3	65,192	479,000	100%	0%	460	460
	CS5	131,224	963,000	100%	0%	770	770
	OV1	32,421	238,000	100%	0%	240	240
	CS6	167,997	1,233,000	70%	30%	1,320	1,520
		1,746,455	12,818,000			**11,910**	**13,070**
Alternate Alignment Segments	Eccles	58,700	431,000	70%	30%	470	540
	GV1	114,685	842,000	90%	10%	720	760
	GV2	117,299	861,000	90%	10%	770	810
	GV3	123,405	906,000	90%	10%	780	820
	SR2	65,000	477,000	70%	30%	360	410
	GF1	154,725	1,136,000	70%	30%	1,060	1,220
	GF4	172,345	1,265,000	70%	30%	1,160	1,330
	BC2	66,224	486,000	100%	0%	470	470
	OV3	46,377	340,000	100%	0%	320	320

Terrain Scaling Factor (T.S.F.) = **0.100**

$$\text{T.S.F.} = \frac{[\text{Sum of Effective Disturbed Area - Sum of Actual Disturbed Area}]}{\text{Sum of Actual Disturbed Area}}$$

Effective disturbed area = Actual Disturbed area x (% common + (1.5 x % rugged))

CUT AND FILL MATERIALS, WITH BORROW & WASTE COMPUTATIONS

	Segment	INROADS CUT				INROADS FILL	Additional Material Needed	
		Alluvial	Rippable	Drill & Blast	Total	Embankment	Borrow	Waste
Basis for Analysis	Caliente	545,000	89,000	0	634,000	221,000	0	387,000
	Bennett Pass	4,023,000	42,000	1,004,000	5,070,000	2,554,000	0	2,355,000
	Pahroc Summit	4,406,000	0	1,123,000	5,529,000	4,000,000	0	944,000
	White River	1,593,000	0	0	1,593,000	1,150,000	0	60,000
	GV8	1,065,000	39,000	51,000	1,155,000	844,000	0	84,000
	CS2	1,158,000	0	400,000	1,558,000	680,000	23,000	941,000
	SR3	219,000	0	211,000	430,000	190,000	0	293,000
	CS3	2,470,000	520,000	55,000	3,046,000	2,529,000	401,000	389,0000
	GF3	277,000	433,000	2,293,000	3,003,000	5,897,000	3,100,000	0
	CS4	304,000	0	0	304,000	262,000	45,000	0
	BC3	167,000	57,000	82,000	306,000	921,000	837,000	0
	CS5	304,000	282,000	0	586,000	1,320,000	1,024,000	0
	OV1	58,000	8,000	0	66,000	715,000	883,000	0
	CS6	5,505,000	604,000	1,581,000	7,690,000	3,852,000	0	3,724,000
	Totals	**22,094,000**	**2,074,000**	**6,800,000**	**30,968,000**	**25,135,000**	**6,313,000**	**9,177,000**
Alternate Alignment Segments	Eccles	1,020,000	887,000	486,000	2,393,000	1,329,000	0	1,320,000
	GV1	298,000	0	57,000	355,000	1,077,000	1,042,000	0
	GV2	939,000	0	0	939,000	694,000	0	14,000
	GV3	654,000	0	394,000	654,000	689,000	265,000	0
	SR2	267,000	1,168,000	2,275,000	661,000	287,000	0	473,000
	GF1	563,000	200,000	1,682,000	4,006,000	2,537,000	0	2,213,000
	GF4	567,000	0	568,000	2,449,000	4,361,000	2,138,000	0
	BC2	30,000	0	0	598,000	1,235,000	673,000	0
	OV3	156,000	0	0	156,000	1,339,000	1,629,000	0

NOTES: 1)All values in cubic yards, rounded to nearest 1,000

2) Borrow quantities based on 25% shrinkage for alluvial, 25% swell for drill and blast, and 15% swell for rippable

3) Source: InRoads output

4) Borrow = $1.25*[V_E - (.75V_A + 1.15V_R + 1.25V_D)]$

V_E = Embankment fill volume; V_R = Rippable rock cut volume

V_A = Alluvial cut volume; V_D = Drill and blast cut volume

ESTIMATED EMISSIONS RESULTING FROM SURFACE AREA DISTURBANCES

	Segment	Surface Area (acres)	Effective Surface Area (acres)	Scaling Factor (months)	Effective Scaling Factor (months)	Emission Factor (tons/acre/month)			Emissions (tons/segment)			Annual Emissions (tons/segment)		
						PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$
Basis for Analysis	Caliente	370	370	0.74	0.68				302	163	34	151	82	17
	Bennett Pass	1,010	1,160	2.03	2.13				2,582	1,398	291	1,291	699	145
	Pahroc Summit	770	890	1.55	1.63				1,510	818	170	755	409	85
	White River	910	1,050	1.83	1.93				2,105	1,140	237	1,053	570	119
	GV8	800	820	1.61	1.51				1,446	783	163	723	391	81
	CS2	1,040	1,200	2.09	2.20				2,750	1,490	310	1,375	745	155
	SR3	420	480	0.84	0.88	1.2	0.65	0.14	444	241	50	222	120	25
	CS3	2,420	2,540	4.87	4.66				13,545	7,337	1,526	6,772	3,668	763
	GF3	1,150	1,320	2.31	2.42				3,345	1,812	377	1,672	906	188
	CS4	250	250	0.50	0.46				138	75	16	69	37	8
	BC3	460	460	0.93	0.84				466	253	53	233	126	26
	CS5	770	770	1.55	1.41				1,306	708	147	653	354	74
	OV1	240	240	0.48	0.44				127	69	14	63	34	7
	CS6	1,320	1,520	2.66	2.79				4,421	2,395	498	2,211	1,197	249
	Totals	**11,930**	**13,070**	**24.00**	**24.00**	**Emission Totals**			**34,000**	**19,000**	**3,900**	**17,000**	**9,300**	**1,900**
Alternate Alignment Segments	Eccles	470	540	0.95	0.99				559	303	63	280	151	32
	GV1	720	760	1.45	1.40				1,206	653	136	603	327	68
	GV2	770	810	1.55	1.49				1,374	744	155	687	372	77
	GV3	780	820	1.57	1.51				1,409	763	159	705	382	79
	SR2	360	410	0.72	0.75				325	176	37	163	88	18
	GF1	1,060	1,220	2.13	2.24				2,850	1,544	321	1,425	772	161
	GF4	1,160	1,330	2.33	2.44				3,400	1,841	383	1,700	921	192
	BC2	470	470	0.95	0.86				487	264	55	243	132	27
	OV3	320	320	0.64	0.59				226	122	25	113	61	13

ESTIMATED EMISSIONS RESULTING FROM ALLUVIAL EXCAVATION

Segment		Length (feet)	Alignment Road Excavation (yd³)	Track Excavation (yd³)	Total Excavation (yd³)	Emission Factor (ton/1000 yd³)			Emissions (tons/segment)			Annual Emissions (tons/segment)		
						PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$
Basis for Analysis	Caliente	59,755	439,000	545,000	984,000				110	60	10	60	30	10
	Bennett Pass	135,000	991,000	4,023,000	5,014,000				550	300	60	280	150	30
	Pahroc Summit	98,276	721,000	4,406,000	5,127,000				560	300	60	280	150	30
	White River	139,099	1,021,000	1,593,000	2,614,000				280	150	30	140	80	20
	GV8	119,981	881,000	1,065,000	1,946,000				210	110	20	110	60	10
	CS2	161,762	1,187,000	1,158,000	2,345,000	0.109	0.059	0.012	260	140	30	130	70	20
	SR3	65,000	477,000	219,000	696,000				80	40	10	40	20	10
	CS3	369,440	2,712,000	2,470,000	5,182,000				560	310	60	280	160	30
	GF3	164,085	1,204,000	277,000	1,481,000				160	90	20	80	50	10
	CS4	37,728	277,000	304,000	581,000				60	30	10	30	20	10
	BC3	65,192	479,000	167,000	646,000				70	40	10	40	20	10
	CS5	131,224	963,000	304,000	1,267,000				140	70	20	70	40	10
	OV1	32,421	238,000	58,000	296,000				30	20	0	20	10	0
	CS6	167,997	1,233,000	5,505,000	6,738,000				730	400	80	370	200	40
	Excavation Totals		**12,823,000**	**22,094,000**	**34,917,000**	**Emission Totals**			**3,800**	**2,060**	**420**	**1,930**	**1,060**	**240**
Alternate Alignment Segments	Eccles	60,810	446,000	1,020,000	1,466,000				160	90	20	80	50	10
	GV1	114,685	842,000	298,000	1,140,000				120	70	10	60	40	10
	GV2	117,299	861,000	939,000	1,800,000				200	110	20	100	60	10
	GV3	123,405	906,000	654,000	1,560,000				170	90	20	90	50	10
	SR2	61,842	454,000	267,000	721,000				80	40	10	40	20	10
	GF1	154,725	1,136,000	563,000	1,699,000				190	100	20	100	50	10
	GF4	172,345	1,265,000	567,000	1,832,000				200	110	20	100	60	10
	BC2	66,224	486,000	30,000	516,000				60	30	10	30	20	10
	OV3	46,377	340,000	156,000	496,000				50	30	10	30	20	10

NOTES: 1) Excavation rounded to nearest 1,000 cubic yards
2) Emissions rounded to nearest 10 tons

ESTIMATED EMISSIONS RESULTING FROM ROCK EXCAVATION

Rock Excavation	Total Volume Excavated (yd^3)	Conversion Factor ($tons/yd^3$)	Total Mass Excavated (tons)	Emission Factors (lb/ton)			Emissions (tons)			Annual Emissions (tons)		
				PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$
Rippable	2,074,000	1.96	4,065,040	0.00015	0.00008	0.00008	0.3	0.2	0.2	0.2	0.1	0.1
Rippable - Truck Loading				0.00018	0.00010	0.00010	0.4	0.2	0.2	0.2	0.1	0.1
Drill & Blast	6,800,000	1.96	13,328,000	0.00015	0.00008	0.00008	1.0	0.5	0.5	0.49	0.27	0.27
Drill & Blast - Truck Loading				0.00018	0.00010	0.00010	1.2	0.7	0.7	0.62	0.33	0.33
Total Rock Excavation Emissions							**3.00**	**2.00**	**2.00**	**1.00**	**0.78**	**0.78**

NOTES: 1) Emission factor reference taken from AP-42, Table 11.19.2-2 (August 2004)

2) No emission factor is available for rippable excavation. Assumes the emissions from rippable excavation are equal to emissions from drill and blast.

3) Assumes that all rock excavation is performed by wet drilling. AP-42 does not provide emission factors for rippable or drilling excavation techniques.

4) For sources listed in AP-42 which do not explicitly express PM factors, the PM emission factor for this project is assumed to be the AP-42 PM10 factor multiplied by 1.85 to provide a similar PM:PM10 ratio as for other construction activities accounted for in this project where a documented PM factor is not available. PM2.5 emissions are assumed to equal PM10.

5) Truck loading emission factor is assumed to equal the truck unloading emission factor from AP-42 because no truck loading factor is provided.

ESTIMATED EMISSIONS RESULTING FROM BORROW AND WASTE

	Segment	Borrow	Waste	Emission Factor (ton/1000 yd³)			Emissions(tons/segment)			Annual Emissions (tons/segment)		
		(yd³)		PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$
Basis for Analysis	Caliente	0	387,000				100	100	0	50	50	0
	Bennett Pass	0	2,355,000				900	500	100	450	250	50
	Pahroc Summit	0	944,000				400	200	0	200	100	0
	White River	0	60,000				0	0	0	0	0	0
	GV8	0	84,000				30	0	0	15	0	0
	CS2	23,000	941,000				400	200	0	200	100	0
	SR3	0	293,000	0.41	0.22	0.046	100	100	0	50	50	0
	CS3	401,000	389,000				320	200	0	160	100	0
	GF3	3,100,000	0				1,200	600	100	600	300	50
	CS4	45,000	0				0	0	0	0	0	0
	BC3	837,000	0				300	200	0	150	100	0
	CS5	1,024,000	0				400	200	0	200	100	0
	OV1	883,000	0				300	200	0	150	100	0
	CS6	0	3,724,000				1,500	800	200	750	400	100
	Borrow/Waste Total	6,313,000	9,177,000		**Emission Totals**		**6,000**	**3,000**	**400**	**3,000**	**1,700**	**200**
Alternate Alignment Segments	Eccles	0	1,320,000				500	300	100	250	150	50
	GV1	1,042,000	0				400	200	0	200	100	0
	GV2	0	14,000				0	0	0	0	0	0
	GV3	265,000	0				100	100	0	50	50	0
	SR2	0	473,000	0.41	0.22	0.046	200	100	0	100	50	0
	GF1	0	2,213,000				1,100	600	100	550	300	50
	GF4	2,138,000	0				800	400	100	400	200	50
	BC2	673,000	0				300	100	0	150	50	0
	OV3	1,629,000	0				600	300	100	300	150	50

ESTIMATED EMISSIONS RESULTING FROM SURFACE AREA DISTURBANCES

Feature	Total Surface Area (acres)	Construction Duration (months)	Emission Factor (tons/acre/month)			Emissions (tons)		
			PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$
Camps	730	6	1.2	0.65	0.14	5,300	2,800	600
Quarries	650	6	1.2	0.65	0.14	4,700	2,500	500
Wells	240	6	1.2	0.65	0.14	1,700	900	200
Fugitive Dust Emissions from Surface Disturbance						**11,700**	**6,200**	**1,300**

ESTIMATED EMISSIONS RESULTING FROM ALLUVIAL EXCAVATION

	Total Excavation (yd^3)		Emission Factor (ton/1000 yd^3)			Emissions (tons)		
			PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$
Camps	527,000					60	30	10
Quarries	231,000		0.109	0.059	0.012	20	10	0
Wells	94,000					10	10	0
Fugitive Dust Emissions from Earth-Moving Activities						**90**	**50**	**10**
Total Fugitive Dust Emissions from Construction-Related Features						**11,800**	**6,300**	**1,300**

Notes: 1) Surface area includes facility and access roads
2) Excavation rounded to nearest 1,000 cubic yards, and includes excavation for access roads
3) Emissions rounded to nearest 100 tons (surface area disturbances) and 10 tons (alluvial excavation)

ESTIMATED EMISSIONS RESULTING FROM SURFACE AREA DISTURBANCES

Facility	Surface Area (acres)	Earthwork Disturbance Duration (months)	Emission Factor (tons/acre/mo)			Total Emissions (tons)			Annual Emissions (tons)		
			PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$
Interchange	65	12	1.2	0.65	0.14	936	507	105	940	510	110
MOW	15	12	1.2	0.65	0.14	216	117	24	160	120	20
EOL	100	20	1.2	0.65	0.14	2,400	1,300	270	1,440	780	160
Total Facilities Construction Emissions due to Surface Disturbance						**2,400**	**1,300**	**270**	**2,540**	**1,410**	**290**

Notes: 1) Interchange surface area including interchange and staging yards
2) Duration of disturbance includes grading and trackwork
3) Annual emissions rounded to nearest 10 tons

ESTIMATED EMISSIONS RESULTING FROM ALLUVIAL EXCAVATION

Facility	Total Excavation (yd^3)		Emission Factor (ton/1000 yd^3)			Emissions (tons/segment)			Annual Emissions (tons/segment)		
			PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$
Interchange	20,000		0.109	0.059	0.012	0	0	0	0	0	0
Staging Yard	750,000		0.109	0.059	0.012	80	80	80	80	80	80
MOW (trackside)	150,000		0.109	0.059	0.012	20	20	20	20	20	20
MOW (headquarters)	3,500		0.109	0.059	0.012	0	0	0	0	0	0
EOL	3,845,000		0.109	0.059	0.012	420	420	420	210	210	210
Total Facilities Construction Emissions due to Excavation and Earth-moving						**520**	**520**	**520**	**310**	**310**	**310**
Total Estimated Fugitive Dust Emissions resulting from Construction of Facilities						**2,920**	**1,820**	**790**	**2,850**	**1,720**	**600**

BASIS OF EMISSIONS

Facility	Number Constructed	Average Miles Constructed per Facilty	Total Miles Constructed	Miles-to-acres conversion	Total Earthwork Disturbance Duration (months)
UPRR Interchange	1	10	10	12.12	2
MOW	1	2	2	12.12	1
EOL	1	2	2	12.12	2

ESTIMATED EMISSIONS RESULTING FROM CONSTRUCTION OF FACILITY ACCESS ROADS

Facility	Emission Factor (tons/acre/mo)			Emissions (tons)			Annual Emissions (tons)		
	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$
UPRR Interchange	1.2	0.65	0.14	291	158	33	291*	158*	33*
MOW	1.2	0.65	0.14	29	16	3	29*	16*	3*
EOL	1.2	0.65	0.14	58	32	7	58*	32*	7*
Total Access Roads Construction Emissions				**380**	**200**	**43**	**380***	**200***	**43***

*Note - See construction schedule to determine what year emissions would occur.

Notes: 1) Camp access roads constructed at beginning of project
2) UPRR interchange access road constructed at beginning of grading for Caliente alignment segment
3) MOW access road constructed at beginning of grading for Common Segment 3
4) EOL access road constructed at beginning of grading for Common Segment 7

Miles-to-acres conversion:	100	Assumed roadway width (feet)
	5,280	Feet per mile
	43,560	Square feet per acre
	12.12	Conversion rate - Acres disturbed per mile of roadway

ESTIMATED EMISSIONS RESULTING FROM CONSTRUCTION TRAFFIC ON UNPAVED ROADS

Operation	Vehicle Type	Traffic Data		Trip Description	Assumed Average Trip Length (miles)	Total Trip Distance (Hours*MPH)	(W)	(k)			(s)	(P)	E		
		Trips	Hours Plus Contingency				Vehicle Weight (tons)	PM Size Multiplier	PM_{10} Size Multiplier	$PM_{2.5}$ Size Multiplier	Silt Content (%)	Wet Days per Year	PM Emission Factor (lb/VMT)	PM_{10} Emission Factor (lb/VMT)	$PM_{2.5}$ Emission Factor (lb/VMT)
Grading & Track	Water truck	NA	173,000	along alignment	NA	1,730,000	27.0	4.9	1.5	0.23	8.5	30	9.496	2.713	0.416
	Fuel/service truck	NA	52,000	along alignment	NA	520,000	27.0	4.9	1.5	0.23	8.5	30	9.496	2.713	0.416
	Pickup truck	NA	518,000	along alignment	NA	7,770,000	2.5	4.9	1.5	0.23	8.5	30	3.254	0.930	0.143
Access Roads	Water truck	NA	20,600	along access roads	NA	206,000	27.0	4.9	1.5	0.23	8.5	30	9.496	2.713	0.416
	Pickup trucks	NA	71,300	along access roads	NA	1,070,000	2.5	4.9	1.5	0.23	8.5	30	3.254	0.930	0.143
Batch Plants	Mixers-full	9,300	NA	batch plant to bridge	1	NA	30.0	4.9	1.5	0.23	8.5	30	9.957	2.845	0.436
	Mixers-empty	9,300	NA	bridge to batch plant	1	NA	15.0	4.9	1.5	0.23	8.5	30	7.289	2.083	0.319
	Cement Delivery-full	600	NA	highway to batch plant	15	NA	45.0	4.9	1.5	0.23	8.5	30	11.950	3.414	0.524
	Cement Delivery-empty	600	NA	batch plant to highway	15	NA	15.0	4.9	1.5	0.23	8.5	30	7.289	2.083	0.319
	Aggregate Delivery-full	3,600	NA	highway to batch plant	15	NA	42.5	4.9	1.5	0.23	8.5	30	11.646	3.328	0.510
	Aggregate Delivery-empty	3,600	NA	batch plant to highway	15	NA	12.5	4.9	1.5	0.23	8.5	30	6.715	1.919	0.294
Construction Camps	Crew transport bus-full	NA	46,000	camp to alignment	NA	690,000	15.5	4.9	1.5	0.23	8.5	30	7.397	2.113	0.324
	Crew transport bus-empty	NA	46,000	alignment to camp	NA	690,000	13.0	4.9	1.5	0.23	8.5	30	6.834	1.953	0.299
	Water truck	NA	2,600	within camps and to/from well	NA	26,000	27.0	4.9	1.5	0.23	8.5	30	9.496	2.713	0.416
	Fuel/service truck	NA	58,000	within and between camps	NA	580,000	27.0	4.9	1.5	0.23	8.5	30	9.496	2.713	0.416
	Pickup trucks	NA	1,740,000	within and between camps	NA	26,100,000	2.5	4.9	1.5	0.23	8.5	30	3.254	0.930	0.143
Quarries	Trucks	NA	23,000	quarry to alignment	NA	46,000	42.5	4.9	1.5	0.23	8.5	30	11.646	3.328	0.510
	Pickups	NA	70,000	alignment to quarry	NA	1,050,000	12.5	4.9	1.5	0.23	8.5	30	6.715	1.919	0.294
Well Drilling	Pickup trucks	NA	790,000	within and between facilities	NA	11,850,000	2.5	4.9	1.5	0.23	8.5	30	3.254	0.930	0.143
Facilities Construction (MOW)	Water truck	NA	1,600	within and between facilities	NA	16,000	27.0	4.9	1.5	0.23	8.5	30	9.496	2.713	0.416
	Pickups	NA	7,900	within and between facilities	NA	118,500	2.5	4.9	1.5	0.23	8.5	30	3.254	0.930	0.143
Facilities Construction (EOL)	Water truck	NA	4,200	within and between facilities	NA	42,000	27.0	4.9	1.5	0.23	8.5	30	9.496	2.713	0.416
	Pickup trucks	NA	21,100	within and between facilities	NA	316,500	2.5	4.9	1.5	0.23	8.5	30	3.254	0.930	0.143
Facilities Construction (UPRR Interchange)	Water truck	NA	4,800	within and between facilities	NA	48,000	27.0	4.9	1.5	0.23	8.5	30	9.496	2.713	0.416
	Pickup trucks	NA	23,800	within and between facilities	NA	357,000	2.5	4.9	1.5	0.23	8.5	30	3.254	0.930	0.143
Signals and Communications	Supervisor truck-Signals	NA	6,600	along alignment	NA	99,000	2.5	4.9	1.5	0.23	8.5	30	3.254	0.930	0.143
	Foreman truck-Signals	NA	16,500	along alignment	NA	248,000	2.5	4.9	1.5	0.23	8.5	30	3.254	0.930	0.143
	Crew cab trucks-Signals	NA	16,500	along alignment	NA	248,000	3.0	4.9	1.5	0.23	8.5	30	3.533	1.009	0.155
	Utility line trucks-Signals	NA	16,500	along alignment	NA	248,000	7.5	4.9	1.5	0.23	8.5	30	5.336	1.525	0.234
	Tractor-trailer for transport	NA	3,300	along alignment	NA	50,000	16.5	4.9	1.5	0.23	8.5	30	7.608	2.174	0.333
	Pickup-Comm	NA	3,300	along alignment	NA	50,000	2.5	4.9	1.5	0.23	8.5	30	3.254	0.930	0.143
	Supervisor truck-Comm	NA	6,600	along alignment	NA	99,000	2.5	4.9	1.5	0.23	8.5	30	3.254	0.930	0.143
	Utility line trucks-Comm	NA	6,600	along alignment	NA	99,000	7.5	4.9	1.5	0.23	8.5	30	5.336	1.525	0.234
	Crew cab trucks-Comm	NA	3,300	along alignment	NA	50,000	3.0	4.9	1.5	0.23	8.5	30	3.533	1.009	0.155
	Tractor-trailer for transport	NA	3,300	along alignment	NA	50,000	16.5	4.9	1.5	0.23	8.5	30	7.608	2.174	0.333
Totals			**3,756,400**	**hours**		**54,467,000**	**miles**								

Notes: 1) Emission Factor Equations taken from the Industrial Unpaved Roads section of AP-42 (13.2.2, dated December 2003).

2) $E_{PM10}, E_{PM2.5} = k\,(s/12)^{0.9}\,(W/3)^{0.45}\,[365\text{-}P/365]$

$E_{PM} = k\,(s/12)^{0.7}\,(W/3)^{0.45}\,[365\text{-}P/365]$

Where: k = particle size multiplier
s = silt content of road surface material (%)
W = mean vehicle weight (tons)
P = mean number of days in a year with at least 0.01 inch of precipitation; AP-42, Table 13.2.2-1.

3) Signals and communications are installed at staggered levels. Communications are installed at least one year prior to start of grading; signals are installed during final year of construction.

ESTIMATED EMISSIONS RESULTING FROM CONSTRUCTION TRAFFIC ON UNPAVED ROADS

Operation	Vehicle Type	Control Efficiency (%)	Total Emissions (tons)			Annual Emissions (tons)			Assumptions
			PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$	
Grading & Track	Water truck	100%	-	-	-	-	-	-	water truck is self-mitigating; assume 10 miles per hour (mph)
	Fuel/service truck		2,469	705	108	1,234	353	54	assume 10 mph
	Pickup truck		12,644	3,613	554	6,322	1,806	277	assume 15 mph
Access Roads	Water truck	100%	-	-	-	-	-	-	water truck is self-mitigating; assume 10 mph; emissions occur only in Year 1
	Pickup trucks		1,741	497	76	1,741	497	76	assume 15 mph; emissions occur only in Year 1
Batch Plants	Mixers-full		46	13	2	23	7	1	7 yd^3 truck, yd^3 from Batch Plant - Fugitive Dust
	Mixers-empty		34	10	1	17	5	1	
	Cement Delivery-full		54	15	2	27	8	1	550 lb cement/yd^3
	Cement Delivery-empty		33	9	1	16	5	1	
	Aggregate Delivery-full		314	90	14	157	45	7	3300 lb aggregate/yd^3 (coarse+fine)
	Aggregate Delivery-empty		181	52	8	91	26	4	
Construction Camps	Crew transport bus-full		2,552	729	112	1,276	365	56	assume 15 mph; load = 25 men @ 200 lb.
	Crew transport bus-empty		2,358	674	103	1,179	337	52	
	Water truck	100%	-	-	-	-	-	-	water truck is self-mitigating; assume 10 mph; emissions occur only in Year 1
	Fuel/service truck		2,754	787	121	1,377	393	60	assume 10 mph
	Pickup trucks		42,471	12,135	1,861	21,236	6,067	930	assume 15 mph
Quarries	Trucks		268	77	12	134	38	6	assume 2 mph
	Pickups		3,525	1,007	154	1,763	504	77	assume 15 mph
Well Drilling	Pickup trucks		19,283	5,510	845	9,641	2,755	422	assume 15 mph
Facilities Construction (MOW)	Water truck	100%	-	-	-	-	-	-	water truck is self-mitigating; assume 10 mph; emissions occur only in Year 1
	Pickups		193	55	8	193	55	8	assume 15 mph; emissions occur only in Year 1
Facilities Construction (EOL)	Water truck	100%	-	-	-	-	-	-	water truck is self-mitigating; assume 10 mph; emissions occur only in Final Year of project
	Pickup trucks		515	147	23	515	147	23	assume 15 mph; emissions occur only in Final Year of project
Facilities Construction (UPRR Interchange)	Water truck	100%	-	-	-	-	-	-	water truck is self-mitigating; assume 10 mph; emissions occur only in Year 1
	Pickup trucks		581	166	25	581	166	25	assume 15 mph; emissions occur only in Year 1
Signals and Communications	Supervisor truck-Signals		161	46	7	107	31	5	Half-ton pickup at 15 mph
	Foreman truck-Signals		404	115	18	269	77	12	Half-ton pickup at 15 mph
	Crew cab trucks-Signals		438	125	19	292	83	13	One-ton crew cab pickup at 15 mph
	Utility line trucks-Signals		662	189	29	441	126	19	assume 15 mph; 6T chassis and 1.5T boom equipment
	Tractor-trailer for transport		190	54	8	127	36	6	assume 15 mph; 12.5T tractor/trailer, 8T load half-time
	Pickup-Comm		81	23	4	54	15	2	Half-ton pickup at 15 mph
	Supervisor truck-Comm		161	46	7	107	31	5	Half-ton pickup at 15 mph
	Utility line trucks-Comm		264	75	12	176	50	8	assume 15 mph; 6T chassis and 1.5T boom equipment
	Crew cab trucks-Comm		88	25	4	59	17	3	assume 15 mph; 12.5T tractor/trailer, 8T load half-time
	Tractor-trailer for transport		190	54	8	127	36	6	One-ton crew cab pickup at 15 mph
		Total Emissions	**95,000**	**27,000**	**4,000**	**49,000**	**14,000**	**2,000**	

Methodology: The methodology for estimating fugitive dust emissions from stockpiles is taken from AP-42, Section 13.2.5. It assumes that the dust is emitted at the time of each pile disturbance. The $PM/PM_{10}/PM_{2.5}$ emissions for each disturbance are estimated by comparing the friction velocities at different locations on the surface of the pile with the theoretical threshold friction velocities. The calculation of friction velocities utilizes the fastest mile (wind speeds) for each time period between pile disturbances. For each subarea of the pile in which the friction velocity is greater than the threshold velocity, the emissions are estimated based on the calculated erosion potential and surface area of that subarea of the pile.

The methodology has been converted onto this worksheet for use on this project. Actual wind data for Las Vegas are incorporated at the bottom of the sheet. The Storage Pile Contributions section contains one table for each of the wind speed "categories" and calculates the total pounds of PM per disturbance per pile for that wind speed category. The totals from each subarea for each wind speed category are summed at the bottom of the sheet and converted to total tons based on an assumption of number of piles and disturbances, as noted.

DATA FOR CALCULATIONS

Threshold Friction Velocity (meters/second [m/s])	Total Surface Area of Pile (square meters [m^2])	Surface Wind Speed Factor (Pile B3)	Percent of Pile Area
1.02	3,275	0.2a	3%
		0.2b	25%
		0.6a	28%
		0.6b	26%
		0.9	14%
		1.1	4%

Storage Pile Contributions

WIND DATA BETWEEN 6 AM AND 6 PM, CONVERTED TO 10 METERS

Pile Subarea	Range (mph)		Max Speed (mph)	Max Speed (m/s)	% Time at Speed
	1.79 - 7.23		7.23	3.2	9.44%
	Surface Wind Speed (U_s)	Friction Velocity U ($0.1U_s$)	Disturbed Area (m^2)	grams (g)/m^2	Total lb PM/disturbance per pile at Speed
0.2a	0.65	0.065	< threshold	0.00	0.00
0.2b	0.65	0.065	< threshold	0.00	0.00
0.6a	1.94	0.194	< threshold	0.00	0.00
0.6b	1.94	0.194	< threshold	0.00	0.00
0.9	2.91	0.291	< threshold	0.00	0.00
1.1	3.55	0.355	< threshold	0.00	0.00

Pile Subarea	Range (mph)		Max Speed (mph)	Max Speed (m/s)	% Time at Speed
	7.23 - 12.63		12.63	5.6	35.96%
	Surface Wind Speed (U_s)	Friction Velocity U ($0.1U_s$)	Disturbed Area (m^2)	g/m^2	Total lb PM/disturbance per pile at Speed
0.2a	1.13	0.113	< threshold	0.00	0.00
0.2b	1.13	0.113	< threshold	0.00	0.00
0.6a	3.39	0.339	< threshold	0.00	0.00
0.6b	3.39	0.339	< threshold	0.00	0.00
0.9	5.08	0.508	< threshold	0.00	0.00
1.1	6.21	0.621	< threshold	0.00	0.00

Pile Subarea	Range (mph)		Max Speed (mph)	Max Speed (m/s)	% Time at Speed
	12.63 - 19.86		19.86	8.9	22.90%
	Surface Wind Speed (U_s)	Friction Velocity U ($0.1U_s$)	Disturbed Area (m^2)	g/m^2	Total lb PM/disturbance per pile at Speed
0.2a	1.78	0.178	< threshold	0.00	0.00
0.2b	1.78	0.178	< threshold	0.00	0.00
0.6a	5.33	0.533	< threshold	0.00	0.00
0.6b	5.33	0.533	< threshold	0.00	0.00
0.9	7.99	0.799	< threshold	0.00	0.00
1.1	9.77	0.977	< threshold	0.00	0.00

Storage Pile Contributions

WIND DATA BETWEEN 6 AM AND 6 PM, CONVERTED TO 10 METERS

Pile Subarea	Range (mph)		Max Speed (mph)	Max Speed (m/s)	% Time at Speed
	19.86 - 30.70		30.70	13.7	18.26%
	Surface Wind Speed (U_s)	Friction Velocity U ($0.1U_s$)	Disturbed Area (m^2)	g/m^2	Total lb PM/disturbance per pile at Speed
0.2a	2.75	0.275	< threshold	0.00	0.00
0.2b	2.75	0.275	< threshold	0.00	0.00
0.6a	8.24	0.824	< threshold	0.00	0.00
0.6b	8.24	0.824	< threshold	0.00	0.00
0.9	12.35	1.235	459	8.07	8.16
1.1	15.10	1.510	131	26.17	7.56

Pile Subarea	Range (mph)		Max Speed (mph)	Max Speed (m/s)	% Time at Speed
	30.70 - 37.90		37.90	16.9	7.57%
	Surface Wind Speed (U_s)	Friction Velocity U ($0.1U_s$)	Disturbed Area (m^2)	g/m^2	Total lb PM/disturbance per pile at Speed
0.2a	3.39	0.339	< threshold	0.00	0.00
0.2b	3.39	0.339	< threshold	0.00	0.00
0.6a	10.17	1.017	< threshold	0.00	0.00
0.6b	10.17	1.017	< threshold	0.00	0.00
0.9	15.25	1.525	459	27.40	27.69
1.1	18.64	1.864	131	62.37	18.01

Pile Subarea	Range (mph)		Max Speed (mph)	Max Speed (m/s)	% Time at Speed
	> 37.90		44	19.7	0.00%
	Surface Wind Speed (U_s)	Friction Velocity U ($0.1U_s$)	Disturbed Area (m^2)	g/m^2	Total lb PM/disturbance per pile at Speed
0.2a	3.93	0.393	< threshold	0.00	0.00
0.2b	3.93	0.393	< threshold	0.00	0.00
0.6a	11.80	1.180	917	5.49	11.11
0.6b	11.80	1.180	852	5.49	10.31
0.9	17.70	1.770	459	51.41	51.96
1.1	21.64	2.164	131	104.46	30.17

Total lb PM/disturbance per pile	9		
Total ton PM/disturbance per pile	0.0		
Total disturbances per pile	650		
Total piles	400		**Annual tons**
Total tons PM		**1,000**	**500**
Total tons PM_{10}		**1,000**	**500**
Total tons $PM_{2.5}$		**200**	**100**

Notes: 1) Pile Configuration taken from AP-42, Chapter 13.2.5, Pile B3

2) PM_{10} multiplier is 0.5 per AP-42, Chapter 13.2.5. $PM_{2.5}$ multiplier is 0.2 per AP-42, Chapter 13.2.5

3) Threshold Friction Velocity taken from AP-42, Table 13.2.5-2 for overburden

4) Assume 1 pile per mile of mainline (320 mi) and sidings (80 mi), for a total of 400 piles

5) Surface area of pile estimated as 235 feet long x 150 feet wide (for an approximate surface area of 3,275 square meters, or 0.81 acres), and 15 feet high, for an approximate volume of 528,000 cubic feet. The approximate volume is intended to consider scrapers moving dirt across a one mile distance, 100 feet wide and one foot deep.

6) Caterpillar 631 Scraper capacity is approximately 30 cubic yards, per Caterpillar Performance Handbook, Edition 26. Therefore, it would take approximately 650 scraper loads (disturbances) to move 528,000 cubic feet.

7) The Erosion Potential, P, and Emissions, E, are calculated as follows:

$$P = 58(u^{*}-u^{*}_{t})^{2} + 25(u^{*}-u^{*}_{t})$$

$$E = P \text{ g/m}^{2} * \text{subarea m}^{2} * \text{lb}/453.6\text{g}$$

8) Wind speeds for Las Vegas 1988-1992, between 6AM and 6PM break down as follows:

Range of speeds between 6AM & 6PM at 20 feet	0.51 - 2.06	2.06 - 3.60	3.60 - 5.66	5.66 - 8.75	8.75 - 10.80	>10.80	**m/s**
	2.06	3.60	5.66	8.75	10.80	10.80	**m/s**
	6.76	11.81	18.57	28.71	35.43	35.43	**mph**

Las Vegas anemometer height = 20 ft (6.1 meters), must be converted to 10 meters.

$$U_{10} = U_{6.1}((\ln(10/0.005)/\ln(6.1/0.005))$$

10 m wind speed	7.23	12.63	19.86	30.70	37.90	>37.90	**mph**
% Time within Range	9.44%	35.96%	22.90%	18.26%	7.57%	2.81%	96.95 %

9) Wind speed for category ">37.90 mph" was assumed to be 44 mph, taken as an average of the highest monthly 3-minute fastest-mile speeds recorded for Las Vegas, 1961-1990.

ESTIMATED EMISSIONS RESULTING FROM BATCH PLANT OPERATIONS

Batch Plant Equipment	Mixed Concrete (yd^3)	Emission Factors (lb/yd^3)			Emission (tons)			Annual Emission (tons)		
		PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$
Concrete Volume for Structures	65,000									
Aggregate delivery to ground storage		0.0064	0.0031	0.0031	0.21	0.10	0.10	0.10	0.05	0.05
Sand delivery to ground storage		0.0015	0.0007	0.0007	0.05	0.02	0.02	0.02	0.01	0.01
Aggregate transfer to conveyor		0.0064	0.0031	0.0031	0.21	0.10	0.10	0.10	0.05	0.05
Sand transfer to conveyor		0.0015	0.0007	0.0007	0.05	0.02	0.02	0.02	0.01	0.01
Aggregate transfer to elevated storage		0.0064	0.0031	0.0031	0.21	0.10	0.10	0.10	0.05	0.05
Sand transfer to elevated storage		0.0015	0.0007	0.0007	0.05	0.02	0.02	0.02	0.01	0.01
Cement delivery to silo		0.0002	0.0001	0.0001	0.01	0.00	0.00	0.00	0.00	0.00
Cement supplement delivery to silo		0.0003	0.0002	0.0002	0.01	0.01	0.01	0.00	0.00	0.00
Weigh hopper loading		0.0079	0.0038	0.0038	0.26	0.12	0.12	0.13	0.06	0.06
Truck mix loading		0.1700	0.0420	0.0420	5.53	1.37	1.37	2.76	0.68	0.68
Total Emissions		0.2021	0.0575	0.0575	**7.00**	**2.00**	**2.00**	**3.00**	**1.00**	**1.00**

Methodology: The methodology for estimating fugitive dust emissions from stockpiles is taken from AP-42, Section 13.2.5. It assumes that the dust is emitted at the time of each pile disturbance. The $PM/PM_{10}/PM_{2.5}$ emissions for each disturbance are estimated by comparing the friction velocities at different locations on the surface of the pile with the theoretical threshold friction velocities. The calculation of friction velocities utilizes the fastest mile (wind speeds) for each time period between pile disturbances. For each subarea of the pile in which the friction velocity is greater than the threshold velocity, the emissions are estimated based on the calculated erosion potential and surface area of that subarea of the pile.

The methodology has been converted onto this worksheet for use on this project. Actual wind data for Las Vegas are incorporated at the bottom of the sheet. The Storage Pile Contributions section contains one table for each of the wind speed "categories" and calculates the total pounds of PM per disturbance per pile for that wind speed category. The totals from each subarea for each wind speed category are summed at the bottom of the sheet and converted to total tons based on an assumption of number of piles and disturbances, as noted.

DATA FOR CALCULATIONS

Threshold Friction Velocity (m/sec)	Total Surface Area of Pile (m^2)	Surface Wind Speed Factor (Pile A)	Percent of Pile Area
1.33	1,515	0.2a	5%
	16,305	0.2b	35%
	16,305	0.6a	48%
	16,305	NA	0%
	16,305	0.9	12%
	16,305	NA	0%

Storage Pile Contributions

WIND DATA BETWEEN 6 AM AND 6 PM, CONVERTED TO 10 METERS

Pile Subarea	Range (mph)		Max Speed (mph)	Max Speed (m/s)	% Time at Speed
	1.79 - 7.23		7.23	3.2	9.44%
	Surface Wind Speed (U_s)	Friction Velocity U ($0.1U_s$)	Disturbed Area (m^2)	g/m^2	Total lb PM/disturbance per pile at Speed
0.2a	0.65	0.065	< threshold	0.00	0.00
0.2b	0.65	0.065	< threshold	0.00	0.00
0.6a	1.94	0.194	< threshold	0.00	0.00
NA	0.00	0.000	< threshold	0.00	0.00
0.9	2.91	0.291	< threshold	0.00	0.00
NA	0.00	0.000	< threshold	0.00	0.00

Storage Pile Contributions

WIND DATA BETWEEN 6 AM AND 6 PM, CONVERTED TO 10 METERS

Pile Subarea	Range (mph)		Max Speed (mph)	Max Speed (m/s)	% Time at Speed
	7.23 - 12.63		12.63	5.6	35.96%
	Surface Wind Speed (U_s)	Friction Velocity U ($0.1U_s$)	Disturbed Area (m^2)	g/m^2	Total lb PM/disturbance per pile at Speed
0.2a	1.13	0.113	< threshold	0.00	0.00
0.2b	1.13	0.113	< threshold	0.00	0.00
0.6a	3.39	0.339	< threshold	0.00	0.00
NA	0.00	0.000	< threshold	0.00	0.00
0.9	5.08	0.508	< threshold	0.00	0.00
NA	0.00	0.000	< threshold	0.00	0.00

Pile Subarea	Range (mph)		Max Speed (mph)	Max Speed (m/s)	% Time at Speed
	12.63 - 19.86		19.86	8.9	22.90%
	Surface Wind Speed (U_s)	Friction Velocity U ($0.1U_s$)	Disturbed Area (m^2)	g/m^2	Total lb PM/disturbance per pile at Speed
0.2a	1.78	0.178	< threshold	0.00	0.00
0.2b	1.78	0.178	< threshold	0.00	0.00
0.6a	5.33	0.533	< threshold	0.00	0.00
NA	0.00	0.000	< threshold	0.00	0.00
0.9	7.99	0.799	< threshold	0.00	0.00
NA	0.00	0.000	< threshold	0.00	0.00

Pile Subarea	Range (mph)		Max Speed (mph)	Max Speed (m/s)	% Time at Speed
	19.86 - 30.70		30.70	13.7	18.26%
	Surface Wind Speed (U_s)	Friction Velocity U ($0.1U_s$)	Disturbed Area (m^2)	g/m^2	Total lb PM/disturbance per pile at Speed
0.2a	2.75	0.275	< threshold	0.00	0.00
0.2b	2.75	0.275	< threshold	0.00	0.00
0.6a	8.24	0.824	< threshold	0.00	0.00
NA	0.00	0.000	< threshold	0.00	0.00
0.9	12.35	1.235	< threshold	0.00	0.00
NA	0.00	0.000	< threshold	0.00	0.00

Storage Pile Contributions

WIND DATA BETWEEN 6 AM AND 6 PM, CONVERTED TO 10 METERS

Pile Subarea	Range (mph)		Max Speed (mph)	Max Speed (m/s)	% Time at Speed
	30.70 - 37.90		37.90	16.9	7.57%
	Surface Wind Speed (U_s)	Friction Velocity U ($0.1U_s$)	Disturbed Area (m^2)	g/m^2	Total lb PM/disturbance per pile at Speed
0.2a	3.39	0.339	< threshold	0.00	0.00
0.2b	3.39	0.339	< threshold	0.00	0.00
0.6a	10.17	1.017	< threshold	0.00	0.00
NA	0.00	0.000	< threshold	0.00	0.00
0.9	15.25	1.525	181.7708411	7.07	2.83
NA	0.00	0.000	< threshold	0.00	0.00
Pile Subarea	Range (mph)		Max Speed (mph)	Max Speed (m/s)	% Time at Speed
	> 37.90		44	19.7	0.00%
	Surface Wind Speed (U_s)	Friction Velocity U ($0.1U_s$)	Disturbed Area (m^2)	g/m^2	Total lb PM/disturbance per pile at Speed
0.2a	3.93	0.393	< threshold	0.00	0.00
0.2b	3.93	0.393	< threshold	0.00	0.00
0.6a	11.80	1.180	< threshold	0.00	0.00
NA	0.00	0.000	< threshold	0.00	0.00
0.9	17.70	1.770	181.7708411	22.25	8.92
NA	0.00	0.000	< threshold	0.00	0.00

Total lb PM/disturbance per pile	1	
Total ton PM/disturbance per pile	0.0	
Total disturbances per pile	33,600	
Total piles	2	**Annual tons**
Total tons PM	**0**	**0**
Total tons PM_{10}	**0**	**0**
Total tons $PM_{2.5}$	**0**	**0**

Notes: 1) Pile Configuration taken from AP-42, Chapter 13.2.5, Pile A.
2) PM10 multiplier is 0.5 per AP-42, Chapter 13.2.5. PM2.5 multiplier is 0.2 per AP-42, Chapter 13.2.5.
3) Threshold Friction Velocity taken from AP-42 Table 13.2.5-1 for No. 16 Tyler Sieve opening (2 mm), based on a mid-range of typical fine aggregate used in Portland cement concrete.
4) Number of batch plants specified on sheet "Analytical Basis."
5) Surface area of pile estimated as a 100-foot diameter conical pile (20 feet high, for an approximate surface area of 1,515 square meters), based on similar previous projects.
6) Assumes 350 working days per year at eight hours per day of batch plant operation, with a disturbance occurring every 10 minutes over the duration of the project.
7) The Erosion Potential, P, and Emissions, E, are calculated as follows:

$$P = 58(u^* - u^*_t)^2 + 25(u^* - u^*_t)$$

$$E = P\ g/m^2 * \text{subarea}\ m^2 * lb/453.6g$$

8) Wind speeds for Las Vegas 1988-1992, between 6AM and 6PM break down as follows:

Range of speeds between 6AM & 6PM at 20 feet	0.51 - 2.06	2.06 - 3.60	3.60 - 5.66	5.66 - 8.75	8.75 - 10.80	>10.80	**m/s**
	2.06	3.60	5.66	8.75	10.80	10.80	**m/s**
	6.76	11.81	18.57	28.71	35.43	35.43	**mph**

Las Vegas anemometer height = 20 ft (6.1 meters), must be converted to 10 meters.

$$U_{10} = U_{6.1}((\ln(10/0.005)/\ln(6.1/0.005))$$

10 m wind speed	7.23	12.63	19.86	30.70	37.90	>37.90	**mph**
% Time within Range	9.44%	35.96%	22.90%	18.26%	7.57%	2.81%	96.95%

9) Wind speed for category ">37.90 mph" was assumed to be 44 mph, taken as an average of the highest monthly 3-minute fastest-mile speeds recorded for Las Vegas, 1961-1990.

Air Emission Estimates for Batch Plants, Fine Materials Storage Piles - Fugitive Dust

Methodology: The methodology for estimating fugitive dust emissions from stockpiles is taken from AP-42, Section 13.2.5. It assumes that the dust is emitted at the time of each pile disturbance. The $PM/PM_{10}/PM_{2.5}$ emissions for each disturbance are estimated by comparing the friction velocities at different locations on the surface of the pile with the theoretical threshold friction velocities. The calculation of friction velocities utilizes the fastest mile (wind speeds) for each time period between pile disturbances. For each subarea of the pile in which the friction velocity is greater than the threshold velocity, the emissions are estimated based on the calculated erosion potential and surface area of that subarea of the pile.

The methodology has been converted onto this worksheet for use on this project. Actual wind data for Las Vegas are incorporated at the bottom of the sheet. The Storage Pile Contributions section contains one table for each of the wind speed "categories" and calculates the total pounds of PM per disturbance per pile for that wind speed category. The totals from each subarea for each wind speed category are summed at the bottom of the sheet and converted to total tons based on an assumption of number of piles and disturbances, as noted.

DATA FOR CALCULATIONS

Threshold Friction Velocity (m/sec)	Total Surface Area of Pile (m^2)	Surface Wind Speed Factor (Pile A)	Percent of Pile Area
1.00	1,515	0.2a	5%
	16,305	0.2b	35%
	16,305	0.6a	48%
	16,305	NA	0%
	16,305	0.9	12%
	16,305	NA	0%

Storage Pile Contributions

WIND DATA BETWEEN 6 AM AND 6 PM, CONVERTED TO 10 METERS

Pile Subarea	Range (mph)		Max Speed (mph)	Max Speed (m/s)	% Time at Speed
	1.79 - 7.23		7.23	3.2	9.44%
	Surface Wind Speed (U_s)	Friction Velocity U ($0.1U_s$)	Disturbed Area (m^2)	g/m^2	Total lb PM/disturbance per pile at Speed
0.2a	0.65	0.065	< threshold	0.00	0.00
0.2b	0.65	0.065	< threshold	0.00	0.00
0.6a	1.94	0.194	< threshold	0.00	0.00
NA	0.00	0.000	< threshold	0.00	0.00
0.9	2.91	0.291	< threshold	0.00	0.00
NA	0.00	0.000	< threshold	0.00	0.00

Storage Pile Contributions

WIND DATA BETWEEN 6 AM AND 6 PM, CONVERTED TO 10 METERS

Pile Subarea	Range (mph)		Max Speed (mph)	Max Speed (m/s)	% Time at Speed
	7.23 - 12.63		12.63	5.6	35.96%
	Surface Wind Speed (U_s)	Friction Velocity U ($0.1U_s$)	Disturbed Area (m^2)	g/m^2	Total lb PM/disturbance per pile at Speed
0.2a	1.13	0.113	< threshold	0.00	0.00
0.2b	1.13	0.113	< threshold	0.00	0.00
0.6a	3.39	0.339	< threshold	0.00	0.00
NA	0.00	0.000	< threshold	0.00	0.00
0.9	5.08	0.508	< threshold	0.00	0.00
NA	0.00	0.000	< threshold	0.00	0.00
Pile Subarea	Range (mph)		Max Speed (mph)	Max Speed (m/s)	% Time at Speed
	12.63 - 19.86		19.86	8.9	22.90%
	Surface Wind Speed (U_s)	Friction Velocity U ($0.1U_s$)	Disturbed Area (m^2)	g/m^2	Total lb PM/disturbance per pile at Speed
0.2a	1.78	0.178	< threshold	0.00	0.00
0.2b	1.78	0.178	< threshold	0.00	0.00
0.6a	5.33	0.533	< threshold	0.00	0.00
NA	0.00	0.000	< threshold	0.00	0.00
0.9	7.99	0.799	< threshold	0.00	0.00
NA	0.00	0.000	< threshold	0.00	0.00
Pile Subarea	Range (mph)		Max Speed (mph)	Max Speed (m/s)	% Time at Speed
	19.86 - 30.70		30.70	13.7	18.26%
	Surface Wind Speed (U_s)	Friction Velocity U ($0.1U_s$)	Disturbed Area (m^2)	g/m^2	Total lb PM/disturbance per pile at Speed
0.2a	2.75	0.275	< threshold	0.00	0.00
0.2b	2.75	0.275	< threshold	0.00	0.00
0.6a	8.24	0.824	< threshold	0.00	0.00
NA	0.00	0.000	< threshold	0.00	0.00
0.9	12.35	1.235	181.7708411	9.10	3.65
NA	0.00	0.000	< threshold	0.00	0.00

Storage Pile Contributions

WIND DATA BETWEEN 6 AM AND 6 PM, CONVERTED TO 10 METERS

Pile Subarea	Range (mph)		Max Speed (mph)	Max Speed (m/s)	% Time at Speed
	30.70 - 37.90		37.90	16.9	7.57%
	Surface Wind Speed (U_s)	Friction Velocity U ($0.1U_s$)	Disturbed Area (m^2)	g/m^2	Total lb PM/disturbance per pile at Speed
0.2a	3.39	0.339	< threshold	0.00	0.00
0.2b	3.39	0.339	< threshold	0.00	0.00
0.6a	10.17	1.017	727.0833643	0.43	0.69
NA	0.00	0.000	< threshold	0.00	0.00
0.9	15.25	1.525	181.7708411	29.09	11.66
NA	0.00	0.000	< threshold	0.00	0.00

Pile Subarea	Range (mph)		Max Speed (mph)	Max Speed (m/s)	% Time at Speed
	> 37.90		44	19.7	0.00%
	Surface Wind Speed (U_s)	Friction Velocity U ($0.1U_s$)	Disturbed Area (m^2)	g/m^2	Total lb PM/disturbance per pile at Speed
0.2a	3.93	0.393	< threshold	0.00	0.00
0.2b	3.93	0.393	< threshold	0.00	0.00
0.6a	11.80	1.180	727.0833643	6.39	10.24
NA	0.00	0.000	< threshold	0.00	0.00
0.9	17.70	1.770	181.7708411	53.67	21.51
NA	0.00	0.000	< threshold	0.00	0.00

Total lb PM/disturbance per pile	0	
Total ton PM/disturbance per pile	0.0	
Total disturbances per pile, assumed over the life of the project	33,600	
Total piles	2	**Annual tons**
Total tons PM	**0**	**0**
Total tons PM_{10}	**0**	**0**
Total tons $PM_{2.5}$	**0**	**0**

Notes: 1) Pile Configuration taken from AP-42, Chapter 13.2.5, Pile A.
2) PM10 multiplier is 0.5 per AP-42, Chapter 13.2.5. PM2.5 multiplier is 0.2 per AP-42, Chapter 13.2.5.
3) Threshold Friction Velocity taken from AP-42 Table 13.2.5-1 for No. 16 Tyler Sieve opening (2 mm), based on a mid-range of typical fine aggregate used in Portland cement concrete.
4) Number of batch plants specified on sheet "Analytical Basis."
5) Surface area of pile estimated as a 100-foot diameter conical pile (20 feet high, for an approximate surface area of 1,515 square meters), based on similar previous projects.
6) Assumes 350 working days per year at eight hours per day of batch plant operation, with a disturbance occurring every 10 minutes over the duration of the project.
7) The Erosion Potential, P, and Emissions, E, are calculated as follows:

$$P = 58(u^*-u^*_t)^2 + 25(u^*-u^*_t)$$

$$E = P\ g/m^2 * \text{subarea } m^2 * lb/453.6g$$

8) Wind speeds for Las Vegas 1988-1992, between 6AM and 6PM break down as follows:

Range of speeds between 6AM & 6PM at 20 feet	0.51 - 2.06	2.06 - 3.60	3.60 - 5.66	5.66 - 8.75	8.75 - 10.80	>10.80	**m/s**
	2.06	3.60	5.66	8.75	10.80	10.80	**m/s**
	6.76	11.81	18.57	28.71	35.43	35.43	**mph**

Las Vegas anemometer height = 20 ft (6.1 meters), must be converted to 10 meters.

$$U_{10} = U_{6.1}((\ln(10/0.005)/\ln(6.1/0.005))$$

10 m wind speed	7.23	12.63	19.86	30.70	37.90	>37.90	**mph**
% Time within Range	9.44%	35.96%	22.90%	18.26%	7.57%	2.81%	96.95%

9) Wind speed for category ">37.90 mph" was assumed to be 44 mph, taken as an average of the highest monthly 3-minute fastest-mile speeds recorded for Las Vegas, 1961-1990.

ESTIMATED EMISSIONS RESULTING FROM BALLAST PRODUCTION

Quarry Operation	Total (tons)	Emission Factors (lb/ton)			Emissions (tons)			Annual Emissions (tons)		
		PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$
Subballast										
Drilling and Blasting		1.48E-04	8.00E-05	8.00E-05	0.3	0.1	0.1	0.1	0.1	0.1
Truck Loading		0.0002	0.0001	0.0001	0.3	0.2	0.2	0.2	0.1	0.1
Truck Unloading		0.0002	0.0001	0.0001	0.3	0.2	0.2	0.2	0.1	0.1
Primary Crusher		0.0054	0.0024	0.0024	9.5	4.2	4.2	4.7	2.1	2.1
Screening	3,518,000	0.0250	0.0087	0.0087	44.0	15.3	15.3	22.0	7.7	7.7
Secondary Crusher		0.0054	0.0024	0.0024	9.5	4.2	4.2	4.7	2.1	2.1
Screening		0.0250	0.0087	0.0087	44.0	15.3	15.3	22.0	7.7	7.7
Tertiary Crusher		0.0054	0.0024	0.0024	9.5	4.2	4.2	4.7	2.1	2.1
Conveyor Transfer Points (6)		0.0030	0.0011	0.0011	31.7	11.6	11.6	15.8	5.8	5.8
Total Subballast Emissions					**120**	**44**	**44**	**59**	**22**	**22**
Track Ballast										
Drilling and Blasting		1.48E-04	8.00E-05	8.00E-05	0.3	0.2	0.2	0.2	0.1	0.1
Truck Loading		0.0002	0.0001	0.0001	0.4	0.2	0.2	0.2	0.1	0.1
Truck Unloading		0.0002	0.0001	0.0001	0.4	0.2	0.2	0.2	0.1	0.1
Primary Crusher		0.0054	0.0024	0.0024	12.7	5.6	5.6	6.3	2.8	2.8
Screening	4,693,000	0.0250	0.0087	0.0087	58.7	20.4	20.4	29.3	10.2	10.2
Secondary Crusher		0.0054	0.0024	0.0024	12.7	5.6	5.6	6.3	2.8	2.8
Screening		0.0250	0.0087	0.0087	58.7	20.4	20.4	29.3	10.2	10.2
Tertiary Crusher		0.0054	0.0024	0.0024	12.7	5.6	5.6	6.3	2.8	2.8
Conveyor Transfer Point (6)		0.0030	0.0011	0.0011	42.2	15.5	15.5	21.1	7.7	7.7
Total Ballast Emissions					**200**	**74**	**74**	**99**	**37**	**37**

Notes: 1) Subballast emissions occur along the alignment
2) Ballast emissions occur at the quarries

ESTIMATED EQUIPMENT OPERATING HOURS FOR TRACK AND BRIDGE CONSTRUCTION

Track and Bridge Construction Equipment	HP	Original Basis for Hours	Hours Adjusted for Terrain	Notes/Reference/Assumptions
SITE PREPARATION AND GRADING				
2 Ton Flatbed Truck	300	30,000	35,000	Generally www.macktrucks.com
Tractor/trailer (flatbed, belly dump)	300	60,000	69,000	Generally www.macktrucks.com
Caterpillar D400 Rock Truck	405	300,000	345,000	D400E Series II from *Caterpillar Performance Handbook* 33 ed., Chapter 19, Former Models, 2002.
Water Truck – 4,000 gal	300	150,000	173,000	Generally www.macktrucks.com
Fuel/service truck	300	45,000	52,000	Generally www.macktrucks.com
Pickup	250	450,000	518,000	HP values taken from similar equipment on previous projects
Caterpillar 966 Loader	260	75,000	86,000	www.cat.com, 966 Gseries II Loader
Caterpillar 140 Blade	222	150,000	173,000	www.cat.com, 140 H Global Grader
CP 563E Padfoot Drum Compactor – (84")	150	30,000	35,000	www.cat.com
CP 563E Smooth Drum Compactor – (84")	150	30,000	35,000	www.cat.com
Caterpillar 815 Compactor	254	75,000	86,000	www.cat.com, 815F
Caterpillar D6 Dozer	210	150,000	173,000	www.cat.com, D6R Series II Track-Type Tractor
Caterpillar D9 Dozer	464	225,000	259,000	www.cat.com, D9T Track-Type Tractor
Caterpillar D10 Dozer	646	225,000	259,000	www.cat.com, D10T Track Type Tractor
Komatsu PC 300 Excavator	254	30,000	35,000	www.komatsu.com, PC300LC-7
Komatsu PC 400 Excavator	347	75,000	86,000	www.komatsu.com, PC400LC-6 Excel
Caterpillar 615 Scraper	279	30,000	35,000	http://www.cat.com, 615C Series II
Caterpillar 631 Scraper	519	270,000	311,000	www.cat.com, 631G
Rock Drill	161	35,000	40,000	EPA Publication 460/3-91-02 (21A-2001), "Nonroad Engine and Vehicle Emissions Study (NEVES)", November 1991.

ESTIMATED EQUIPMENT OPERATING HOURS FOR TRACK AND BRIDGE CONSTRUCTION

Track and Bridge Construction Equipment	HP	Original Basis for Hours	Hours Adjusted for Terrain	Notes/Reference/Assumptions	
Crawler Crane – 100 ton	350	8,000	9,000	Generally www.manitowoccranegroup.com	
Crawler Crane – 150 ton	500	4,000	5,000	Generally www.manitowoccranegroup.com	
Air Compressor (250 cfm)*	37	75,000	86,000	HP values taken from similar equipment on previous projects; hours of operation includes operation of small air tools	*Air compressor and jumping jack compactor likely powered by gasoline.
Jumping Jack Compactor*	161	150,000	173,000	EPA Publication 460/3-91-02 (21A-2001), "NEVES", November 1991.	
TRACK INSTALLATION					
Pettibone 360 Speed Swing – Hi-Rail	185		33,000	www.pettibone-mi.com/speedswings/ss360m	
Kershaw 26-2 Ballast Regulator	161		33,000	EPA Publication 460/3-91-02 (21A-2001), "NEVES", November 1991.	
Jackson 6700 Tamper	99		67,000	HP values taken from similar equipment on previous projects	
Tie Handler	464		17,000	www.cat.com, D9T Track-Type Tractor	
Rail Clip Applicator	210		17,000	www.cat.com, D6R Series II Track-Type Tractor	
Ballast Consolidator	464		33,000	www.cat.com, D9T Track-Type Tractor	
EMD SD40 Locomotive	3,000		50,000	Build dates 1984 - 1995	
EMD SD70MAC Locomotive	4,000		150,000	Build date 1995	

Notes: 1) Hours shown for site grading are annual. Total hours listed in Analytical Basis
2) Hours shown for track installation are total over life of construction (33 months)
3) Two types of locomotives are listed; larger (SD70) would be used for line haul of materials; smaller unit used for short haul

ESTIMATED EQUIPMENT OPERATING HOURS FOR CAMP, QUARRY AND WELL CONSTRUCTION

Construction Camp Equipment	HP	Original Basis for Hours	Total Hours Plus Contingency	Yearly Average Operation (hours)	Notes/References/Assumptions
BUILD CAMPS					
Caterpillar 140 Blade	222	2,400	2,600	2,600	www.cat.com, 140H Global Grader; emissions occur only in Year 1
Tandem Axle Dump Truck	300	4,800	5,300	5,300	Generally, www.macktrucks.com; emissions occur only in Year 1
Caterpillar 420D Backhoe-loader	93	4,800	5,300	5,300	www.cat.com, 420D IT; emissions occur only in Year 1
Water Truck – 4,000 gal	300	2,400	2,600	2,600	Generally, www.macktrucks.com; emissions occur only in Year 1
Pickup Trucks	250	288,000	317,000	317,000	Similar to previous project
OPERATE CAMPS					
Construction Crew Buses	300	42,000	46,000	23,000	Estimate based on CAT and Cummins
Fuel and Maintenance Trucks	300	52,800	58,000	29,000	Generally, www.macktrucks.com
Pickup Trucks	250	1,584,000	1,740,000	870,000	Similar to previous project
BUILD QUARRIES					
Caterpillar 140 Blade	222	480	500	500	www.cat.com, 140H Global Grader; emissions occur only in Year 1
Tandem Axle Dump Truck	300	1,440	1,600	1,600	Generally, www.macktrucks.com; emissions occur only in Year 1
Caterpillar 420D Backhoe-loader	93	1,440	1,600	1,600	www.cat.com, 420D IT; emissions occur only in Year 1
Water Truck – 4,000 gal	300	480	500	500	Generally, www.macktrucks.com; emissions occur only in Year 1
Pickup Trucks	250	2,400	2,600	2,600	Similar to previous project
OPERATE QUARRIES					
Case CX800 Excavators	486	21,120	23,000	12,000	www.casece.com/products/products
Case 921C Loaders	248	42,240	46,000	23,000	www.casece.com/products/products
Caterpillar D400 Rock Truck	405	21,120	23,000	12,000	D400E Series II from *Caterpillar Performance Handbook* 33 ed., Chapter 19, Former Models, 2002.

ESTIMATED EQUIPMENT OPERATING HOURS FOR CAMP, QUARRY AND WELL CONSTRUCTION

Construction Camp Equipment	HP	Original Basis for Hours	Total Hours Plus Contingency	Yearly Average Operation (hours)	Notes/References/Assumptions
Crushers and Conveyors	210	31,680	35,000	18,000	Equivalent to www.cat.com, D6R Series II Track-Type Tractor
Pickup Trucks	250	63,360	70,000	35,000	Similar to previous project
BUILD WATER WELLS					
Caterpillar 140 Blade	222	0	0	0	www.cat.com, 140H Global Grader; emissions occur only in Year 1
Tandem Axle Dump Truck	300	3,400	3,700	3,700	Generally, www.macktrucks.com; emissions occur only in Year 1
Caterpillar 420D Backhoe-loader	93	3,400	3,700	3,700	www.cat.com, 420D IT; emissions occur only in Year 1
Water Truck – 4,000 gal	300	0	0	0	Generally, www.macktrucks.com; emissions occur only in Year 1
Drill Rig	250	8,160	9,000	9,000	Generally www.cmeco.com; 24 hours per day
Pickup Trucks	250	34,000	37,000	37,000	Similar to previous project
OPERATE WATER WELLS					
Generator	200	2,150,000	2,370,000	1,185,000	Estimate based on CAT and Cummins
Pickup Trucks	250	720,000	790,000	395,000	Similar to previous project

Basis of hours - Camps	
Caterpillar 140 Blade	Calculated as 1 blade per camp x 10 camps x 4 weeks of activity x 60 hours per week
Tandem Axle Dump Truck	Calculated as 2 trucks per camp x 10 camps x 4 weeks of activity x 60 hours per week
Caterpillar 420D Backhoe-loader	Calculated as 2 loaders per camp x 10 camps x 4 weeks of activity x 60 hours per week
Water Truck – 4,000 gal	Calculated as 1 water truck per camp x 10 camps x 4 weeks of activity x 60 hours per week
Pickup Trucks	Calculated as 30 pickups per camp x 10 camps x 16 weeks of activity x 60 hours per week
Operations	
Construction Crew Buses	Calculated as 4 buses per camp x 10 camps x 2 hrs operation per day x 22 days per month x duration of project
Fuel and Maintenance Trucks	Calculated as 1 truck per camp x 10 camps x 10 hrs operation per day x 22 days per month x duration of project
Pickup Trucks	Calculated as 20 trucks per camp x 10 camps x 10 hours per week x 22 days per month x duration of project

Number of Pickup Trucks	1	Camp superintendent	10	Foremen
	3	Staff personnel	5	Construction management personnel
	2	Health and safety	5	Resident field inspectors
	2	Line superintendents	2	DOE resident staff

ESTIMATED EQUIPMENT OPERATING HOURS FOR CAMP, QUARRY AND WELL CONSTRUCTION

Basis of hours - Quarries	
Caterpillar 140 Blade	Calculated as 2 quarries x 1 blade x 4 weeks of activity x 60 hours per week
Tandem Axle Dump Truck	Calculated as 2 quarries x 3 trucks x 4 weeks of activity x 60 hours per week
Caterpillar 420D Backhoe-loader	Calculated as 2 quarries x 3 loaders x 4 weeks of activity x 60 hours per week
Water Truck – 4,000 gal	Calculated as 2 quarries x 1 truck x 4 weeks of activity x 60 hours per week
Pickup Trucks	Calculated as 5 pickups per quarry x 2 quarries x 4 weeks of activity x 60 hours per week
Operations	
Excavators	Calculated as 2 excavators per quarry x 2 quarries x 10 hrs operation per day x 22 days per month x duration of project
Loaders	Calculated as 4 loaders per quarry x 2 quarries x 10 hrs operation per day x 22 days per month x duration of project
Caterpillar D400 Rock Truck	Calculated as 2 trucks per quarry x 2 quarries x 10 hrs operation per day x 22 days per month x duration of project
Crushers and Conveyors	Calculated as 3 crushers per quarry x 2 quarries x 10 hrs operation per day x 22 days per month x duration of project
Pickup Trucks	Calculated as 6 trucks per quarry x 2 quarries x 10 hours per day x 22 days per month x duration of project
Basis of hours - Wells	
Caterpillar 140 Blade	Not required
Tandem Axle Dump Truck	Calculated as 1 truck per 10 wells x 170 wells x 2 days of activity x 10 hours per day
Caterpillar 420D Backhoe-loader	Calculated as 1 loader per 10 wells x 170 wells x 2 days of activity x 10 hours per day
Water Truck – 4,000 gal	Not required
Drill Rig	Calculated as 400 feet per well x 170 wells x 12 hours per day ÷ 100 feet per day
Pickup Trucks	Calculated as 2 pickups per 10 wells x 170 wells x 10 days of activity x 10 hours per day
Operations	17 Number of pickups required
Generators	Calculated as 170 wells x 24 hours per day x 22 days per month x duration of project
Pickup Trucks	Calculated as 1 trucks per 10 wells x 170 wells x 8 hours per day x 22 days per month x duration of project

ESTIMATED EQUIPMENT OPERATING HOURS FOR FACILITY CONSTRUCTION

UPRR Interchange Construction Equipment	HP	No. Req'd	Original Basis for Hours	Hours Plus Contingency	Total Hours of Emissions	Notes/Reference/Assumptions
Grading and site preparation						
Caterpillar 140 Blade	222	2	4,320	4,800	4,800	www.cat.com, 140H Global Grader
Tandem Axle Dump Truck	300	5	10,800	11,900	11,900	Generally www.macktrucks.com
Caterpillar 420D Backhoe-loader	93	4	8,640	9,500	9,500	www.cat.com, 420D IT
CP 563E Smooth Drum Compactor – (84")	150	2	4,320	4,800	4,800	www.cat.com
Caterpillar 615 Scraper	279	3	6,480	7,100	7,100	www.cat.com, 615C
Pickup Truck	250	10	21,600	23,800	23,800	Similar to previous projects
Water Truck – 4,000 gal	300	2	4,320	4,800	4,800	Generally www.macktrucks.com
Trackwork						
Pettibone 441 Speed Swing – Hi-Rail	161	2	4,320	4,800	4,800	EPA Publication 460/3-91-02 (21A-2001), "NEVES", November 1991
Kershaw 26-2 Ballast Regulator	161	2	4,320	4,800	4,800	EPA Publication 460/3-91-02 (21A-2001), "NEVES", November 1991
Jackson 6700 Tamper	99	2	4,320	4,800	4,800	Similar to previous projects
Hi-Rail Dump Truck	400	2	4,320	4,800	4,800	Similar to previous projects
Tractor/trailer (flatbed, belly dump)	300	4	8,640	9,500	9,500	Generally www.macktrucks.com
Structures						
2-Ton Flatbed Truck	300	3	4,320	4,800	4,800	Generally www.macktrucks.com
Tractor/trailer (flatbed)	300	3	4,320	4,800	4,800	Generally www.macktrucks.com
Crane - Burro 45	220	1	1,440	1,600	1,600	Generally www.manitowoccranegroup.com
Air Compressor – Small Air Tools	37	5	7,200	7,900	7,900	Compressor assumed to be similar to that used in track construction
Caterpillar 420D Backhoe-loader	93	5	7,200	7,900	7,900	www.cat.com, 420D IT

ESTIMATED EQUIPMENT OPERATING HOURS FOR FACILITY CONSTRUCTION

MOW Construction Equipment	HP	No. Req'd	Original Basis for Hours	Hours Plus Contingency	Total Hours of Emissions	Notes/Reference/Assumptions
Grading and site preparation						
Caterpillar 140 Blade	222	1	1,440	1,600	1,600	www.cat.com, 140H Global Grader
Tandem Axle Dump Truck	300	3	4,320	4,800	4,800	Generally www.macktrucks.com
Caterpillar 420D Backhoe-loader	93	2	2,880	3,200	3,200	www.cat.com, 420D IT
CP 563E Smooth Drum Compactor – (84")	150	2	2,880	3,200	3,200	www.cat.com
Caterpillar 615 Scraper	279	1	1,440	1,600	1,600	www.cat.com, 615C
Pickup Truck	250	5	7,200	7,900	7,900	Similar to previous projects
Water Truck – 4,000 gal	300	1	1,440	1,600	1,600	Generally www.macktrucks.com
Trackwork						
Pettibone 441 Speed Swing – Hi-Rail	161	2	2,880	3,200	3,200	EPA Publication 460/3-91-02 (21A-2001), "NEVES", November 1991
Kershaw 26-2 Ballast Regulator	161	2	2,880	3,200	3,200	EPA Publication 460/3-91-02 (21A-2001), "NEVES", November 1991
Jackson 6700 Tamper	99	2	2,880	3,200	3,200	Similar to previous projects
Hi-Rail Dump Truck	400	2	2,880	3,200	3,200	Similar to previous projects
Tractor/trailer (flatbed, belly dump)	300	4	5,760	6,300	6,300	Generally www.macktrucks.com
Structures						
2-Ton Flatbed Truck	300	3	4,320	4,800	4,800	Generally www.macktrucks.com
Tractor/trailer (flatbed)	300	3	4,320	4,800	4,800	Generally www.macktrucks.com
Crane - Burro 45	220	1	1,440	1,600	1,600	Generally www.manitowoccranegroup.com
Air Compressor – Small Air Tools	37	5	7,200	7,900	7,900	Compressor assumed to be similar to that used in track construction
Caterpillar 420D Backhoe-loader	93	5	7,200	7,900	7,900	www.cat.com, 420D IT

ESTIMATED EQUIPMENT OPERATING HOURS FOR FACILITY CONSTRUCTION

EOL Construction Equipment	HP	No. Req'd	Original Basis for Hours	Hours Plus Contingency	Total Hours of Emissions	Notes/Reference/Assumptions
Grading and site preparation						
Caterpillar 140 Blade	222	2	3,840	4,200	4,200	www.cat.com, 140H Global Grader
Tandem Axle Dump Truck	300	5	9,600	10,600	10,600	Generally www.macktrucks.com
Caterpillar 420D Backhoe-loader	93	4	7,680	8,400	8,400	www.cat.com, 420D IT
CP 563E Smooth Drum Compactor – (84")	150	2	3,840	4,200	4,200	www.cat.com
Caterpillar 615 Scraper	279	3	5,760	6,300	6,300	www.cat.com, 615C
Pickup Truck	250	10	19,200	21,100	21,100	Similar to previous projects
Water Truck – 4,000 gal	300	2	3,840	4,200	4,200	Generally www.macktrucks.com
Trackwork						
Pettibone 441 Speed Swing – Hi-Rail	161	2	5,760	6,300	6,300	EPA Publication 460/3-91-02 (21A-2001), "NEVES", November 1991
Kershaw 26-2 Ballast Regulator	161	2	5,760	6,300	6,300	EPA Publication 460/3-91-02 (21A-2001), "NEVES", November 1991
Jackson 6700 Tamper	99	2	5,760	6,300	6,300	Similar to previous projects
Hi-Rail Dump Truck	400	2	5,760	6,300	6,300	Similar to previous projects
Tractor/trailer (flatbed, belly dump)	300	4	11,520	12,700	12,700	Generally www.macktrucks.com
Structures						
2-Ton Flatbed Truck	300	3	8,640	9,500	9,500	Generally www.macktrucks.com
Tractor/trailer (flatbed)	300	3	8,640	9,500	9,500	Generally www.macktrucks.com
Crane - Burro 45	220	1	2,880	3,200	3,200	Generally www.manitowoccranegroup.com
Air Compressor – Small Air Tools	37	5	14,400	15,800	15,800	Compressor assumed to be similar to that used in track construction
Caterpillar 420D Backhoe-loader	93	5	14,400	15,800	15,800	www.cat.com, 420D IT

BASIS FOR ANALYSIS

Facility Name	Duration of construction activity (months)			Notes
	Grading	Trackwork	Structures	
UPRR Interchange	9	9	6	Emissions occur in Year 1 of 3-year duration
MOW	6	6	6	Emissions occur in Year 2 of 3-year duration
EOL	8	12	12	Emissions occur in Year 3 of 3-year duration

Note: Original basis of hours calculated as (no. of equipment pieces) x (no. months duration of construction activity) x 240 hours per month

ESTIMATED EQUIPMENT OPERATING HOURS FOR ACCESS ROAD CONSTRUCTION

Access Roads Construction Equipment	HP	Number Required	Original Basis for Hours	Hours Plus Contingency	Yearly Avg Operation	Notes/References/Assumptions
Access Roads - Camps, Quarries & Wells						
Caterpillar 140 Blade	222	9	12,960	14,300	14,300*	www.cat.com, 140H Global Grader
Tandem Axle Dump Truck	300	9	12,960	14,300	14,300*	Generally, www.macktrucks.com
Caterpillar 420D Backhoe-loader	93	9	12,960	14,300	14,300*	www.cat.com, 420D IT
CP 563E Padfoot Drum Compactor – (84")	150	2	2,880	3,200	3,200*	www.cat.com
CP 563E Smooth Drum Compactor – (84")	150	9	12,960	14,300	14,300*	www.cat.com
Caterpillar 615 Scraper	279	3	4,320	4,800	4,800*	www.cat.com, 615C
Pickup Truck	250	20	28,800	31,700	31,700*	Similar to previous project
Water Truck – 4,000 gal	300	8	11,520	12,700	12,700*	Generally, www.macktrucks.com
Access Road - Facilities						
Caterpillar 140 Blade	222	5	7,200	7,900	7,900*	www.cat.com, 140H Global Grader
Tandem Axle Dump Truck	300	12	17,280	19,000	19,000*	Generally, www.macktrucks.com
Caterpillar 420D Backhoe-loader	93	12	17,280	19,000	19,000*	www.cat.com, 420D IT
CP 563E Padfoot Drum Compactor – (84")	150	4	5,760	6,300	6,300*	www.cat.com
CP 563E Smooth Drum Compactor – (84")	150	9	12,960	14,300	14,300*	www.cat.com
Caterpillar 615 Scraper	279	8	11,520	12,700	12,700*	www.cat.com, 615C
Pickup Truck	250	25	36,000	39,600	39,600*	Similar to previous project
Water Truck – 4,000 gal	300	5	7,200	7,900	7,900*	Generally, www.macktrucks.com

* Emissions to occur in Year 1 of construction.

EQUIPMENT REQUIRED FOR CONSTRUCTION

Camps, Quarries & Wells	Camps	Quarries	Wells	Total	Comments
Caterpillar 140 Blade	5	2	2	9	1 consist per 50 miles of road; 2 consists for camps; 1 each for wells and quarries; consist includes blade, truck, loader, compactor
Tandem Axle Dump Truck	5	2	2	9	
Caterpillar 420D Backhoe-loader	5	2	2	9	
CP 563E Padfoot Drum Compactor – (84")	2	0	0	2	
CP 563E Smooth Drum Compactor – (84")	5	2	2	9	
Caterpillar 615 Scraper	2	1	0	3	
Pickup Truck	10	5	5	20	
Water Truck – 4,000 gal	5	2	1	8	
Facilities	**UPRR**	**MOW**	**EOL**	**Total**	**Comments**
Caterpillar 140 Blade	2	1	2	5	Assume one crew; sequence of construction runs from east to west
Tandem Axle Dump Truck	5	2	5	12	
Caterpillar 420D Backhoe-loader	5	2	5	12	
CP 563E Padfoot Drum Compactor – (84")	2	0	2	4	
CP 563E Smooth Drum Compactor – (84")	5	2	2	9	
Caterpillar 615 Scraper	4	0	4	8	
Pickup Truck	10	5	10	25	
Water Truck – 4,000 gal	2	1	2	5	

ESTIMATED EQUIPMENT OPERATING HOURS FOR BATCH PLANT OPERATIONS

Batch Plant Equipment	HP	Original Basis for Hours	Hours Plus Contingency	Yearly Avg Operation	Notes/Reference/Assumptions
Loaders	260	18,000	19,800	9,900	www.cat.com, 966 Gseries II Loader; assumes loaders operate half of the total time the batch plant operates
Cement Mixer	300	1,240	1,400	700	Generally www.macktrucks.com; assumes 15 mph
Cement Delivery	500	1,200	1,300	700	Generally www.macktrucks.com; assumes 15 mph
Aggregate Delivery	500	7,200	7,900	4,000	Generally www.macktrucks.com; assumes 15 mph
Generators (2 located at each plant)	200	36,000	39,600	19,800	Assumes 3,000 hr/year operation each based on a 3-year project

Note: Assumes two plants, one at White River Bridge (Highway 93), the other at Beatty Wash Bridge

ESTIMATED EQUIPMENT OPERATING HOURS FOR SIGNAL AND COMMUNICATIONS CONSTRUCTION

Signals and Communications Construction Equipment	HP	Original Basis for Hours	Hours Plus Contingency	Yearly Avg Operation	Notes/References/Assumptions
Signals					
2 supervisor half-ton pickups	250	6,000	6,600	4,400	Similar to previous projects; emissions occur over the last year and a half of project - emissions shown are Final Year emissions
5 half-ton crew foreman pickups	250	15,000	16,500	11,000	"
5 one-ton crew cab pickups	250	15,000	16,500	11,000	"
5 utility line trucks	300	15,000	16,500	11,000	Generally www.macktrucks.com; emissions occur over the last year and a half of project - emissions shown are Final Year emissions
1 20-ton crane	332	3,000	3,300	2,200	Generally www.manitowoccranegroup.com; emissions occur over the last year and a half of project - emissions shown are Final Year emissions
3 tractor backhoes	93	9,000	9,900	6,600	www.cat.com, 420D IT, assumes backhoe loader; emissions occur over the last year and a half of project - emissions shown are Final Year emissions
Tractor-trailer combo for transport	300	3,000	3,300	2,200	Generally www.macktrucks.com; emissions occur over the last year and a half of project - emissions shown are Final Year emissions
Communications					
1 half-ton pickup	250	3,000	3,300	2,200	Similar to previous projects; emissions occur over a year and a half period prior to first year of grading construction - emissions shown are First Year emissions
2 supervisor half-ton pickups	250	6,000	6,600	4,400	"
2 utility line trucks	250	6,000	6,600	4,400	"
1-ton crew cab pickup	250	3,000	3,300	2,200	"
Backhoe	93	3,000	3,300	2,200	www.cat.com, 420D IT, assumes backhoe loader; emissions occur over a year and a half period prior to first year of grading construction - emissions shown are first Year emissions
Tractor-trailer combo for transport	300	3,000	3,300	2,200	Generally www.macktrucks.com; emissions occur over a year and a half period prior to first year of grading construction - emissions shown are first Year emissions

Original basis of hours calculated as number of pieces required x 1.5 years x 2000 hours per year.

Appendix C
Air Emissions Analysis for Operational Activities

Appendix C – Contents

ASSUMPTIONS MADE FOR AIR EMISSIONS ANALYSIS DURING OPERATIONS

RAIL TRAFFIC

(1) All emission factors other than SO2, based on Emission Standards found at 40 CFR 92.8, Table A8-3 - Tier 2 Standards. All locomotives and locomotive engines manufactured after January 1, 2005 must meet the Tier 2 Standards.

(2) SO2 emission factor estimated using the following: ppmw as (S/1000000) x Fuel Density (lb/gal) x (1 /HHV Diesel) x (1 lb-mol S/32 lb S) x (1 lb mole SO2/1 lb-mole S) x (64 lb SO2/1 lb-mole SO2) x BSFC, where:

ppmw =	15	
Fuel density =	7	
HHV Diesel =	137,000	BTU/gal
BSFC =	6,869	BTU/hp-hr

This yields an SO2 emission factor of:	0.00001	lb/bhp-hr
	0.005	g/bhp-hr

(3) The BSFC was calculated using a factor of 20.24 bhp-hr/gal obtained from Development of Railroad Emission Methodologies, Table 17, prepared for Southeastern Air Resource Managers, Inc., by Sierra Research Inc., June 2004.

(4) The fuel density and HHV were obtained from EPA's Compilation of Air Pollutant Emission Factors (AP-42), Appendix A (September 1985).

(5) Line Haul train traffic assumes peak of about 20 trains per week, including commercial and DOE traffic.

(6) Switch cycle train traffic assumes one switch engine based at the interchange facility, operating 8 hours/day; and two switch engines based at EOL, operating 16 hours/day.

FACILITIES - FUEL TANKS

(1) Assumes Diesel (No. 2) Fuel Oil for all storage.

(2) Net throughput is based on fuel consumption of 200 gal/hr/engine for line haul and switch cycle locomotives. It is assumed that total fuel consumption for locomotives to be distributed from the fuel tank.

(3) A single, 200,000 gallon tank is currently anticipated at the EOL facility. Space is provided on the table for the inclusion of additional tanks, if necessary.

(4) Tank dimensions are representative of a 200,000 gallon tank but not based on engineered dimensions.

ASSUMPTIONS MADE FOR AIR EMISSIONS ANALYSIS DURING OPERATIONS

FACILITIES - FUEL HANDLING

(1) Loading Loss (LL) = 12.46 x [(S x P x M)/T] where,

S = Saturation Factor

P = True Vapor Pressure

M = Molecular Weight of Vapor

T = Tempurature of Bulk Liquid Loaded (F + 460)

Source: EPA's Compilation of Air Pollutant Emission Factors (AP-42), Chapter 5.2, Emission Factors for Transportation and Marketing of Petroleum Liquids (January 1995).

(2) Assumes S factor for splash loading dedicated normal service. AP-42, Table 5.2-1.

(3) Vapor Pressure for Distillate Fuel Oil No. 2 obtained from TANKS 4.0

(4) Vapor Molecular Weight for Distillate Fuel Oil No. 2 obtained from TANKS 4.0

(5) Temperature in F of bulk liquid for Distillate Fuel Oil No. 2 is provided by TANKS 4.0 as a function of the specified meteorological data. By default this cell assumes Las Vegas met data will be utilized, but the appropriate value should be determined based on the location of the fuel unloading.

(6) Fuel is delivered to the site by rail. This rail traffic is included in Line Haul emissions.

(7) Assumes total amount of fuel consumed by line haul and switch cycle locomotives is unloaded from rail car to storage tank.

FACILITIES - EXHAUST

(1) Assumes permanent power supplied to facilities; generators are not required.

(2) Equipment list represents anticipated vehicles to be based at each facility. It is assumed that roughly one-half of the work force will be operating a pick-up.

Air Emissions During Operations – Rail Traffic

Line Haul			
Basis for Analysis	Max bhp-hr per locomotive	4,000	
	Locomotives per train	2	
	Hours Per Roundtrip	24	
	Trips Per Week	20	
	Hours Per Week	960	
	Emission Factors (g/bhp-hr)	Emissions (lb/hr)	Emissions (tons/year)
NO_x	5.5	48.49	1,210
PM/PM_{10}	0.2	1.76	44
CO	1.5	13.22	330
VOC	0.3	2.64	66
SO_x	0.005	0.04	1.1
Switch Cycle			
Basis for Analysis	Max bhp-hr	2,000	
	Locomotives per train	3	
	Hours Per Day	40	
	Days Per Week	5	
	Hours Per Week	600	
	Emission Factors (g/bhp-hr)	Emissions (lb/hr)	Emissions (tons/year)
NO_x	8.100	35.71	557.0
PM/PM_{10}	0.240	1.06	16.5
CO	2.400	10.58	165.0
VOC	0.600	2.64	41.3
SO_x	0.005	0.02	0.3

Number of locomotives assumes 1 switch engine at UPRR interchange operating 8 hours per day, and two switch engines at EOL facility, each operating 10 hours per day.

Air Emissions During Operations – Fuel Tanks

Fuel Storage - TANKS Inputs Meteorological Data used in Emissions Calculations:				
Dimensions/Design	Facility	Interchange	Maintenance of Way	End of Line
	Tank Name/Number	T-0001INT	T-0001MOW	T-0001EOL
	Orientation (horizontal/vertical)	Vertical	Vertical	Vertical
	Shell Height (ft)			38.2
	Diameter (ft)			30
	Maximum Liquid Height (ft)			37
	Avg. Liquid Height (ft)			20
	Net Throughput (gallons/year)			5.0MM
	Tank Heated (y/n)			no
	If yes:			
	Avg. Liquid Surface Temperature (F)			-
	Minimum Liquid Surface Temperature (F)			-
	Maximum Liquid Surface Temperature (F)			-
	Bulk Liquid Temperature (F)			-
Paint Conditions	Shell Color			white
	Shell Condition (Good/Poor)	Good	Good	Good
	Roof Color/Shade			white
Roof Characteristics	Roof Condition (Good/Poor)	Good	Good	Good
	Roof Type (e.g., floating or fixed, external or internal)			external floating
	Roof Height (ft)			38.2
	Radius (ft) (Dome Roof)			NA
Breather Vent Settings	Vacuum Settings (psig)	TANKS Default	TANKS Default	TANKS Default
	Pressure Settings (psig)	TANKS Default	TANKS Default	TANKS Default
Contents		No. 2 Fuel Oil	No. 2 Fuel Oil	No. 2 Fuel Oil

Air Emissions During Operations – Fuel Tanks

Methodology: This methodology for estimating emissions from fuel storage tanks is the use of EPA's TANKS 4.0 program. This program provides emission estimates for standing and working losses based on user supplied information on the tanks and liquid to be stored. The following table reflects the required user supplied information in the order requested by the program. The user must specify meteorological data from a location with a similar climate to that of tank location. The TANKS 4.0 program contains data for Las Vegas and Ely, Nevada. This template assumes one tank per facility. Additional columns can be added to account for additional tanks.

Fuel Unloading Parameter	Value
Saturation Factor (S)	1.45
True Vapor Pressure (psia) (P)	0.0088
Molecular Weight of Vapors (lb/lb-mol)	130
Temperature of bulk liquid (T)	527
Loading Loss (L_L) (lb/1,000 gallons)	0.04
Fuel Unloaded (1,000 gallons per year)	5,000
Total (lb/year)	196

Air Emissions During Operations – Vehicle Exhausts at Facilities

	Equipment Type	Quantity	HP	Annual Hours of Operation
UPRR Interchange (includes interchange and staging yard)				
Trainmaster - East	Pick-up	1	250	500
Assistant Trainmaster/Road Foreman of Engines	Pick-up	2	250	1,000
Yard Master/Station Agent	Pick-up	1	250	500
Conductors		None		
Engineers		None		
Track Inspector	Pick-up	1	250	500
Track and Maintenance Crew	Pick-up	1	400	1,500
Signal Maintainer	Pick-up	1	250	500
Field Maintainer	Pick-up	1	250	500
Maintenance Equipment				
	Boom truck	1	400	4,000
	Utility	3	400	2,000
MOW (includes trackside and headquarters)				
Office Director - Engineering and Maintenance	Pick-up	1	250	500
Track and Structures Maintenance Supervisor	Pick-up	1	250	500
Storekeeper - Track and Structures	Pick-up	1	250	500
Signal and Communications Maintenance Supervisor	Pick-up	1	250	500
Building Maintenace Supervisor	Pick-up	1	250	500
Track and Structures Maintenance Staff/Crew	Pick-up	5	400	7,500
Building and Maintenance Carpenters	Pick-up	2	250	1,000
Signal and Communications Staff	Pick-up	4	250	2,000
Administrative staff	Pick-up	1	250	500
Maintenance Equipment				
	Boom truck	1	400	500
	Utility	4	400	2,000

Air Emissions During Operations – Vehicle Exhausts at Facilities

	Equipment Type	Quantity	HP	Annual Hours of Operation
EOL				
General Manager	Pick-up	1	250	500
Director of Operations or Director of Transportation	Pick-up	1	250	500
Trainmaster - West	Pick-up	1	250	500
Yard Master	Pick-up	1	250	500
Movement Director/Chief Dispatcher	Pick-up	1	250	500
Assistant Movement Director	Pick-up	1	250	500
Assistant Trainmaster/Road Foreman of Engines	Pick-up	2	250	1,000
Chief Crew Dispatcher	Pick-up	1	250	500
Train Dispatchers	Pick-up	2	250	1,000
Crew Dispatchers	Pick-up	2	400	1,000
Conductors		None		
Engineers		None		
Locomotive and Car Maintenance Supervisor	Pick-up	1	250	500
Storekeeper - Rolling Stock Maintenance	Pick-up	1	250	500
Shop Foreman	Pick-up	1	250	500
Shop Mechanics		None	250	
Maintenance Equipment				
	Boom truck	1	400	500
	Utility	3	400	1,500
Total		54		37,000

Appendix D
Modeling Inputs Requested for Socioeconomic Modeling

Table 1. REMI Inputs - Construction of Rail Line

Input Description	Professional	Clerical	Craftsman	Total
CONSTRUCTION CREWS, TOTAL EMPLOYMENT				
Year 1	240	120	1,800	2,160
Year 2	240	120	1,800	2,160
Year 3	240	120	1,800	2,160
Year 4	120	60	900	1,080
Year 5	60	30	450	540
Construction personnel per camp (approximate; actual numbers may vary)	40	20	300	360
Input Description	**Input Value**		**Notes**	
Number of camps operational at any given time	6	camps		
Number of workers not in camps	60	persons		(7)
Lincoln	40	persons		
Nye	15	persons		
Esmeralda	5	persons		
Construction schedule	56	months		
Average wage rate or total wages ($)				(1)
CONSTRUCTION FEATURES				
BATCH PLANTS	2			(5)
Total number batch plants in each county				
Lincoln	1	each		
Nye	1	each		
Schedule for constructing batch plant	2	weeks		
Estimated costs to construct batch plant ($)	$ 500,000			
Estimated number workers needed to *construct* batch plant	10	persons		
Estimated number of workers needed to *operate* batch plant	5	persons		
CONSTRUCTION CAMPS				(2)
Total number of work camps operational at any given time	6	sites		
Total number of potential construction camp sites	12	sites		

Table 1. REMI Inputs - Construction of Rail Line

Total number camp sites in each county		
Lincoln	3 each	
Nye	8 each	
Esmeralda	1 each	
Schedule for constructing workcamp (# weeks)	26 weeks	
Schedule for manning workcamps (e.g. all 6 active at one time)	12 months	
Estimated cost to construct each work camp ($)	$ 6,300,000	
Estimated cost to operate each work camp ($)	$ 300,000 month	
Estimated number of workers to construct work camps	60 per camp	
Estimated number of workers to operate work camps	90 per camp	
Minimum estimated camp population	50 per camp	
QUARRY SITES		(3)
Total number ballast areas in each county		
Lincoln	1	
Nye	0	
Esmeralda	1	
Schedule for establishing ballast sites	6 months	
Estimated pre production costs to ballast sites ($)		
Lincoln	$ 13,000,000	(4)
Nye	$ -	
Esmeralda	$ 13,000,000	(4)
Estimated operation and maintenance costs to ballast sites ($)		
Lincoln	$100,000,000	(4)
Nye	$ -	
Esmeralda	$100,000,000	(4)
Estimated number workers needed to *establish* ballast sites	30	
Estimated number of workers needed to *operate* ballast sites	30	
Estimated number of workers needed to *reclaim* ballast sites	30	

Table 1. REMI Inputs - Construction of Rail Line

WELLS		
Total number of wells in each county		(3)
Lincoln	60 each	
Nye	100 each	
Esmeralda	10 each	
Estimated cost to drill each well, excluding contingency ($)	$ 179,000	(4)
Contingency costs for well construction (as % total costs)	25 percent	
Estimated cost to construct each well ($)	$ 100,000	
Estimated cost to operate each work camp ($)	$ 300,000 month	
Estimated number of workers to construct wells	70 persons	
Estimated number of workers to operate wells	20 persons	
ROAD IMPROVEMENTS		(6)
Estimated length of upgrades (miles)		
Schedule for upgrades (# weeks)		
Estimated length of new road construction (miles)	14 miles	
Schedule for new construction (# months)	12 months	

Notes: 1) Average wage rate to be determined by EIS contractor.
2) Camp details provided in *Construction Plan, Caliente Rail Corridor* (NRP 2007c).
3) Assumes two quarries, one in Caliente and the other near Goldfield. Cost based on info in *Ballast Sourcing Cost Analysis* (Shannon & Wilson 2005).
4) Source: *Comparative Cost Estimates, Caliente Rail Corridor* (NRP 2007b)
5) Assumes one plant at each of two major structure sites; one plant at Goldfield, and one plant at Caliente. Goldfield and Caliente plants will manufacture pre-cast concrete structures for minor drainage works.
6) Road improvements are for construction of new access roads to the interchange and staging yards, and the MOW trackside facility.
7) Assume that the construction personnel who are not in camps are included in the totals shown above; assume that some camps will not be fully occupied.

Table 2. REMI Inputs - Construction of Facilities

Input Description	Input Value		Notes
UPRR INTERCHANGE (Caliente)			
Interchange Yard			
Estimated costs to construct facility, excluding contingency ($)	$ 6,038,000		(1)
Contingency costs for facility construction (as % total costs)	30	percent	
Schedule for constructing (# weeks)	26	weeks	(2)
Estimated number workers need to construct facility	110	person s	(3)
Staging Yard			
Estimated costs to construct facility, excluding contingency ($)	$ 19,470,000		(1)
Contingency costs for facility construction (as % total costs)	30	percent	
Schedule for constructing (# weeks)	52	weeks	(2)
Estimated number workers need to construct facility	110	person s	(3)
MOW (Goldfield or Tonopah)			
Headquarters Facility			
Estimated costs to construct facility, excluding contingency ($)	$ 3,295,000		(1)
Contingency costs for facility construction (as % total costs)	30	percent	
Schedule for constructing (# weeks)	52	weeks	(2)
Estimated number workers need to construct facility	110	person s	(3)
Trackside Facility			
Estimated costs to construct facility, excluding contingency ($)	$9,291,000		(1)
Contingency costs for facility construction (as % total costs)	30	percent	
Schedule for constructing (# weeks)	52	weeks	(2)
Estimated number workers need to construct facility	60	person s	(3)
EOL (with Trackage for Cask Maintenance Facility)			
Estimated costs to construct facility, excluding contingency ($)	$ 51,755,000		(1)
Contingency costs for facility construction (as % total costs)	30	percent	
Schedule for constructing (# weeks)	88	weeks	(2)
Estimated number workers need to construct facility	150	person s	(3)

Notes: 1) Source: *Comparative Cost Estimates, Caliente Rail Corridor* (NRP 2007b)
2) Source: *Facilities–Design Analysis Report, Caliente Rail Corridor* (NRP 2007d)
3) Construction crew size is exclusive of other crew needs for track grading, structures or placement.

Table 3. REMI Inputs - Operation of Rail Line

Input Description	Input Value		Notes
TRAIN CREW			
Average number of trains per week (2014-2037)	20		(1)
Number of rail crews per week	6	each	
Number of employees in each rail crew	2	persons	
Average annual wage for rail crew employee	$ 100,000		
Schedule for number of trains per week	2033		(2)
Peak number of trains per week	20		
Per diem spending by train crew			
Standard meal per diem ($)	$ 30		(3)
Standard lodging per diem ($)	$ 80		(4)
Number of train trips per crew	10	trips	(5)
Number of overnights per week per train rider			
Number of train-riding workers with contingency			
Number of train-riding workers without contingency			
Number of workers per train	8	persons	
Total number of overnights per week	72	overnights	(6)
Total number of meals per week	480	meals	
Weeks per year the trains run	50	weeks	(7)
Costs of operating rail line that are not already included in costs of operating ancillary facility ($)	$ 1,200,000	annual	(8)
Administrative workers	$ 150,000		(9)

Notes: 1) Based on peak year.
2) Assume operation of rail line peaks in the year 2034.
3) Value shown is based on an assumed total cost of meals per week.
4) Value shown is based on an assumed total aggregate room nights per trip.
5) Assumes that one trip does not layover.
6) Assumes 9 layovers of 72 aggregate nights by total of 8 train crew.
7) Assumes no operations during Christmas holiday season.
8) Includes locomotive maintenance, signals and communications maintenance, track renewal, related track and rail line maintenance materials.
9) Includes salary cost for two (2) administrative staff persons who will maintain personnel records and related human resources duties.

Table 4. REMI Inputs - Operation of Facilities

Input Description	Input Value		Notes
UPRR INTERCHANGE			
Total estimated number operations workers (per day)	38		
Trainmaster - East	1		
Assistant Trainmaster/Road Foreman of Engines	2		
Yard Master/Station Agent	1		
Conductors	13		
Engineers	13		
Track Inspector	1		
Track and Maintenance Crew	3		
Signal Maintainer	1		
Field Maintainer	1		
Estimated costs to operate facility ($)	$ 120,000	per year	(1)
Schedule for operations (# weeks)			(2)
MOW			
Total estimated number operations workers (per day)	49		
Office Director - Engineering and Maintenance	1		
Track and Structures Maintenance Supervisor	1		
Storekeeper - Track and Structures	1		
Signal and Communications Maintenance Supervisor	1		
Building Maintenace Supervisor	1		
Track and Structures Maintenance Staff/Crew	21		
Building and Maintenance Carpenters	2		
Signal and Communications Staff	13		
Administrative staff	6		
Estimated costs to operate facility ($)	$ 120,000	per year	
Schedule for operations (# weeks)			

Table 4. REMI Inputs - Operation of Facilities

Input Description	Input Value	Notes
EOL and Transportation Operations Center		
Total estimated number operations workers (per day)	45	
General Manager	1	TCC
Director of Operations or Director of Transportation	1	TCC
Trainmaster - West	1	
Yard Master	1	
Movement Director/Chief Dispatcher	1	TCC
Assistant Movement Director	1	TCC
Assistant Trainmaster/Road Foreman of Engines	2	
Chief Crew Dispatcher	1	TCC
Train Dispatchers	5	TCC
Crew Dispatchers	5	TCC
Conductors	6	
Engineers	6	
Locomotive and Car Maintenance Supervisor	1	
Storekeeper - Rolling Stock Maintenance	1	
Shop Foreman	1	
Shop and Escort Car Mechanics	9	
Estimated costs to operate facility ($)	$ 120,000 per year	
Schedule for operations (# weeks)		

Staffing Summary for Operation of Facilities

Staff Position	Primary Location: Staging Yard	MOW Headquarters	EOL Facility	MOW Trackside Facility	Total
Professional	4	4	11	1	20
Labor	46	2	25	37	110
Clerical	0	4	4	2	10
Total	50	10	40	40	140

Notes: 1) Estimated costs to operate facilities (interchange yard, MOW facility, and EOL facility) include costs for yard utilities (sewer, water, power), building maintenance, solid waste disposal, and administrative costs (copy/fax machines, computers, etc.)
2) Schedule of operations for ancillary facilities will be for life of repository project.

Table 5a. REMI Inputs - Estimated Gallons of Fuel Consumed by Category by Year for the NRL (1)

Year	Waste Shipments					Repository Shipments		Commercial Shared Use (3)	Road Haul Total	Switching	Total Gallons	
	Commercial SNF	Commercial HLW	DOE SNF	Navy	Other (2)	Repository Construction	Fuel Oil				DOE Only	Including Shared Use
1	28,000	57,000	6,000	4,000	93,000	207,000	37,000	875,000	1,307,000	410,000	842,000	1,717,000
2	76,000	110,000	11,000	4,000	102,000	207,000	74,000	1,166,000	1,750,000	410,000	994,000	2,160,000
3	82,000	110,000	25,000	4,000	107,000	207,000	74,000	1,458,000	2,067,000	410,000	1,019,000	2,477,000
4	127,000	110,000	40,000	4,000	116,000	207,000	74,000	1,458,000	2,136,000	410,000	1,088,000	2,546,000
5	150,000	110,000	51,000	7,000	113,000	207,000	74,000	1,458,000	2,170,000	410,000	1,122,000	2,580,000
6	173,000	110,000	34,000	11,000	113,000	207,000	74,000	1,458,000	2,180,000	410,000	1,132,000	2,590,000
7	156,000	110,000	40,000	11,000	113,000	207,000	74,000	1,458,000	2,169,000	410,000	1,121,000	2,579,000
8	156,000	110,000	40,000	11,000	113,000	207,000	74,000	1,458,000	2,169,000	410,000	1,121,000	2,579,000
9	147,000	122,000	40,000	11,000	116,000	207,000	74,000	1,458,000	2,175,000	410,000	1,127,000	2,585,000
10	150,000	124,000	40,000	11,000	122,000	207,000	74,000	1,458,000	2,186,000	410,000	1,138,000	2,596,000
11	150,000	124,000	40,000	11,000	99,000	207,000	74,000	1,458,000	2,163,000	410,000	1,115,000	2,573,000
12	153,000	124,000	40,000	11,000	130,000	0	74,000	1,458,000	1,990,000	410,000	942,000	2,400,000
13	164,000	130,000	40,000	11,000	136,000	0	74,000	1,458,000	2,013,000	410,000	965,000	2,423,000
14	161,000	136,000	42,000	11,000	136,000	0	74,000	1,458,000	2,018,000	410,000	970,000	2,428,000
15	156,000	141,000	48,000	11,000	139,000	0	74,000	1,458,000	2,027,000	410,000	979,000	2,437,000
16	161,000	144,000	40,000	11,000	116,000	0	74,000	1,458,000	2,004,000	410,000	956,000	2,414,000
17	158,000	144,000	45,000	11,000	141,000	0	74,000	1,458,000	2,031,000	410,000	983,000	2,441,000
18	173,000	82,000	45,000	11,000	122,000	0	74,000	1,458,000	1,965,000	410,000	917,000	2,375,000
19	167,000	0	45,000	11,000	113,000	0	74,000	1,458,000	1,868,000	410,000	820,000	2,278,000
20	167,000	0	45,000	11,000	113,000	0	74,000	1,458,000	1,868,000	410,000	820,000	2,278,000
21	158,000	0	45,000	11,000	113,000	0	74,000	1,458,000	1,859,000	410,000	811,000	2,269,000
22	158,000	0	45,000	11,000	99,000	0	74,000	1,458,000	1,845,000	410,000	797,000	2,255,000
23	161,000	0	45,000	0	105,000	0	74,000	1,458,000	1,843,000	410,000	795,000	2,253,000
24	110,000	0	48,000	0	82,000	0	74,000	1,458,000	1,772,000	410,000	724,000	2,182,000
25	20,000	0	0	0	25,000	0	74,000	1,458,000	1,577,000	410,000	529,000	1,987,000
26	0	0	0	0	17,000	0	74,000	1,458,000	1,549,000	410,000	501,000	1,959,000
27	0	0	0	0	14,000	0	74,000	1,458,000	1,546,000	410,000	498,000	1,956,000

Table 5a. REMI Inputs - Estimated Gallons of Fuel Consumed by Category by Year for the NRL (1)

Year	Waste Shipments					Repository Shipments		Commercial Shared Use (3)	Road Haul Total	Switching	Total Gallons	
	Commercial SNF	Commercial HLW	DOE SNF	Navy	Other (2)	Repository Construction	Fuel Oil				DOE Only	Including Shared Use
28	0	0	0	0	14,000	0	74,000	1,458,000	1,546,000	410,000	498,000	1,956,000
29	0	0	0	0	0	0	74,000	1,458,000	1,532,000	205,000	279,000	1,737,000
30	0	0	0	0	0	0	74,000	1,458,000	1,532,000	205,000	279,000	1,737,000
31	0	0	0	0	0	0	74,000	1,458,000	1,532,000	205,000	279,000	1,737,000
32	0	0	0	0	0	0	74,000	1,458,000	1,532,000	205,000	279,000	1,737,000
33	0	0	0	0	0	0	74,000	1,458,000	1,532,000	205,000	279,000	1,737,000
34	0	0	0	0	0	0	74,000	1,458,000	1,532,000	205,000	279,000	1,737,000
35	0	0	0	0	0	0	74,000	1,458,000	1,532,000	205,000	279,000	1,737,000
36	0	0	0	0	0	0	74,000	1,458,000	1,532,000	205,000	279,000	1,737,000
37	0	0	0	0	0	0	74,000	1,458,000	1,532,000	205,000	279,000	1,737,000
38	0	0	0	0	0	0	74,000	1,458,000	1,532,000	205,000	279,000	1,737,000
39	0	0	0	0	0	0	74,000	1,458,000	1,532,000	205,000	279,000	1,737,000
40	0	0	0	0	0	0	74,000	1,458,000	1,532,000	205,000	279,000	1,737,000
41	0	0	0	0	0	0	74,000	1,458,000	1,532,000	205,000	279,000	1,737,000
42	0	0	0	0	0	0	74,000	1,458,000	1,532,000	205,000	279,000	1,737,000
43	0	0	0	0	0	0	74,000	1,458,000	1,532,000	205,000	279,000	1,737,000
44	0	0	0	0	0	0	74,000	1,458,000	1,532,000	205,000	279,000	1,737,000
45	0	0	0	0	0	0	74,000	1,458,000	1,532,000	205,000	279,000	1,737,000
46	0	0	0	0	0	0	74,000	1,458,000	1,532,000	205,000	279,000	1,737,000
47	0	0	0	0	0	0	74,000	1,458,000	1,532,000	205,000	279,000	1,737,000
48	0	0	0	0	0	0	74,000	1,458,000	1,532,000	205,000	279,000	1,737,000
49	0	0	0	0	0	0	74,000	1,458,000	1,532,000	205,000	279,000	1,737,000
50	0	0	0	0	0	0	74,000	1,458,000	1,532,000	205,000	279,000	1,737,000
Total	3,461,000	2,101,000	939,000	213,000	2,822,000	2,282,000	3,640,000	72,003,000	87,462,000	15,990,000	31,448,000	103,487,000

Notes: 1) All values in gallons, rounded to nearest 1,000 gallons
2) Includes site specific cask & waste packages
3) Mid-range Estimate of Commercial Shared Use Traffic

Table 5b. Estimated Fuel Consumption During Construction

Input Description	Note	Input Value
Total Hours During Grading Activities	(1)	2,819,000
Average Diesel Fuel Consumption, gallons per hour	(2)	11.0
Estimated Diesel Fuel Consumption, gallons	(2)	31,009,000
Total Diesel Fuel Consumed in Nevada during 2004, gallons	(3)	478,296,000
NRL Consumption During Construction as a Percentage of Nevada Consumption		6.5%

Notes: 1) Assumes that air compressors and jumping jack compactors use gasoline
2) Source: NRP calculations
3) Source: http://tonto.eia.doe.gov/state/state_energy_profiles.cfm