Draft Report

DIESEL PARTICULATE MATTER MITIGATION PLAN FOR THE BNSF RAILROAD WATSON RAIL YARD

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TABLE OF CONTENTS

Page

TABLES

FIGURES

DIESEL PARTICULATE MATTER MITIGATION PLAN FOR THE BNSF RAILROAD WATSON RAIL YARD

1. INTRODUCTION

In accordance with the 2005 California Air Resources Board (CARB)/Railroad Statewide Agreement (MOU), BNSF has prepared this Mitigation Plan for the Wilmington – Watson Rail Yard. The purpose of this Plan is to outline the potential mitigation measures that can be used reduce Diesel particulate matter (DPM) emissions from the Wilmington – Watson Rail Yard. The Plan also contains sections detailing how the baseline and projected emissions were calculated and mechanisms that will be used to track progress. The baseline emissions were described in great detail in a series of reports that are publicly available (http://www.arb.ca.gov/railyard/hra/hra.htm).

As discussed below, the proposed Mitigation Measures, when fully implemented, will reduce the DPM emissions from the Wilmington – Watson Yard by 64 from 2005 baseline. These emission reductions will concurrently lower any existing predicted health risk associated with the facility operations. Other federal, state, local, and Port of Los Angeles/Port of Long Beach (Ports) related air pollution control measures and plans, and existing railroad voluntary agreement measures will supplement the current and future emission reduction discussed in this Plan.

2. SUMMARY OF RAIL YARD OPERATIONS

The BNSF Wilmington – Watson yard is situated in a generally north-south direction near, but not adjacent, to west-north-south crossroad of the BNSF system with the Alameda Corridor. Trains primarily approach from the east (Alameda Corridor) or from the west and leave in those directions. A single and infrequently used track leads from the south end of the yard toward the Port. The operations at Wilmington – Watson exclusively consist of train arrival and departures. Support for that activity includes refueling of line-haul locomotives and switching engines for making up trains.

No intermodal activity occurs at this yard, so on-road and off-road sources are limited to a small number of fleet vehicles and equipment. Fuel delivery trucks are the only other predictable and recurring mobile source emissions activity. No stationary sources exist at this yard.

3. EMISSIONS SUMMARY

Table 3-1 below, shows the DPM emissions from the Wilmington – Watson Yard, by equipment category, for the 2005 baseline year, and for future years as the mitigation measures proposed in this Plan are implemented over time. As shown in Table 3-1, when the proposed mitigation measures are implemented DPM emissions will be reduced by approximately 69 percent without considering activity growth. These emission reductions will concurrently lower any existing predicted health risk related to facility operations. A detailed discussion of each mitigation measure is provided in Section 6.

The projected emission reduction calculations shown in Tables 3-1 and 3-2 assume a gradual increase in freight handled at the Wilmington – Watson Yard, though recent activity trends in Section 5 do not show growth. The assumptions and methodologies used to predict the rate of growth are discussed in Section 5. In addition, the analysis takes into account certain other future regulatory measures and voluntary agreements, which will be implemented and effective by 2020.

In summary the emission totals for all rail yards were compiled using the adjustments to the emission inventory projecting fleet turnover and future year emission rates. The totals, by source category, are provided in Tables 3-1 and 3-2 for Watson.

Table 3-1. Estimated total annual DPM emissions associated with the operations at the Wilmington – Watson facility with 2005 activity levels. (metric tonnes)

Wilmington – Watson	**PM Emissions (metric tonnes)**			
Facility Operations	**2005**	**2010**	**2015**	**2020**
Basic Services	0.05	0.01	0.00	0.00
Switching	0.39	0.34	0.23	0.21
Arriving and Departing Trains	1.26	0.72	0.52	0.32
On-Road Fleet Vehicle	0.00	0.00	0.00	0.00
Other Off-Road TRU	0.03	0.01	0.01	0.00
Other Off-Road Track Maintenance	0.01	0.01	0.01	0.01
Total	**1.74**	**1.09**	**0.77**	**0.54**

Table 3-2. Estimated total annual DPM emissions associated with the operations at the Wilmington – Watson facility with 2005 activity levels. (short tons)

Wilmington – Watson	**PM Emissions (short tons)**			
Facility Operations	**2005**	**2010**	**2015**	**2020**
Basic Services	0.06	0.01	0.00	0.00
Switching	0.43	0.37	0.25	0.23
Arriving and Departing Trains	1.39	0.79	0.57	0.35
On-Road Fleet Vehicle	0.00	0.00	0.00	0.00
Other Off-Road TRU	0.03	0.01	0.01	0.00
Other Off-Road Track Maintenance	0.01	0.01	0.01	0.01
Total	**1.92**	**1.20**	**0.85**	**0.60**

4. EMISSION INVENTORY METHODOLOGY

In forecasting emissions at rail yards, ENVIRON projected the impact of several rulemakings and voluntary initiatives. These rulemakings and initiatives include emission reductions expected to result from Federal, State, and voluntary emission reduction strategies from all sources. The emission reductions will primarily result from normal and accelerated fleet turnover to engines meeting more stringent new engine emission standards. Normal fleet turnover is the fleet replacement expected due to retirement of older equipment for mechanical or other business reasons. Accelerated turnover of equipment is the centerpiece of many California rulemakings and some voluntary initiatives and is expected to result in emission reductions in years immediately after a change in the new engine emission standards. Retrofit of older equipment is often available as an alternative element to comply with accelerated turnover.

The emission sources affected include the following source categories:

- Locomotives (Line-Haul & Switching)
- Heavy Equipment (truck and off-road equipment)
- Transport Refrigeration Units (TRU) and Refrigerated Railcars
- Other Miscellaneous Diesel-Fueled Equipment

The emissions consider a constant 2005 level of activity and apply activity changes after the fact. Overall ENVIRON expects emissions from rail yards to have significant reductions in the years 2005 through 2020 as a result of Federal, State, and local initiatives affecting new engines and of replacement or retrofit of older equipment with engines and equipment using low emission technology. The projected emission reductions without considering growth range from 37% in 2010 to 69% in 2020, and adding the expected growth results in emission reductions from 34% in 2010 to 64% in 2020. A no growth scenario was run to determine the emission reduction due to fleet turnover or other measures prior to applying any growth estimate. The growth estimates for this yard were estimated at 1% per year. The no growth and growth scenarios are shown in Table 4-1 and in Figures 4-1 and 4-2 for Watson rail yard.

Table 4-1. DPM emission (short tons per year) forecast summary for BNSF Watson.

Yard (condition)	2005	2010	2015	2020
No growth	**1.92**	**1.20**	**0.85**	**0.60**
With growth	**1.92**	**1.26**	**0.94**	**0.69**

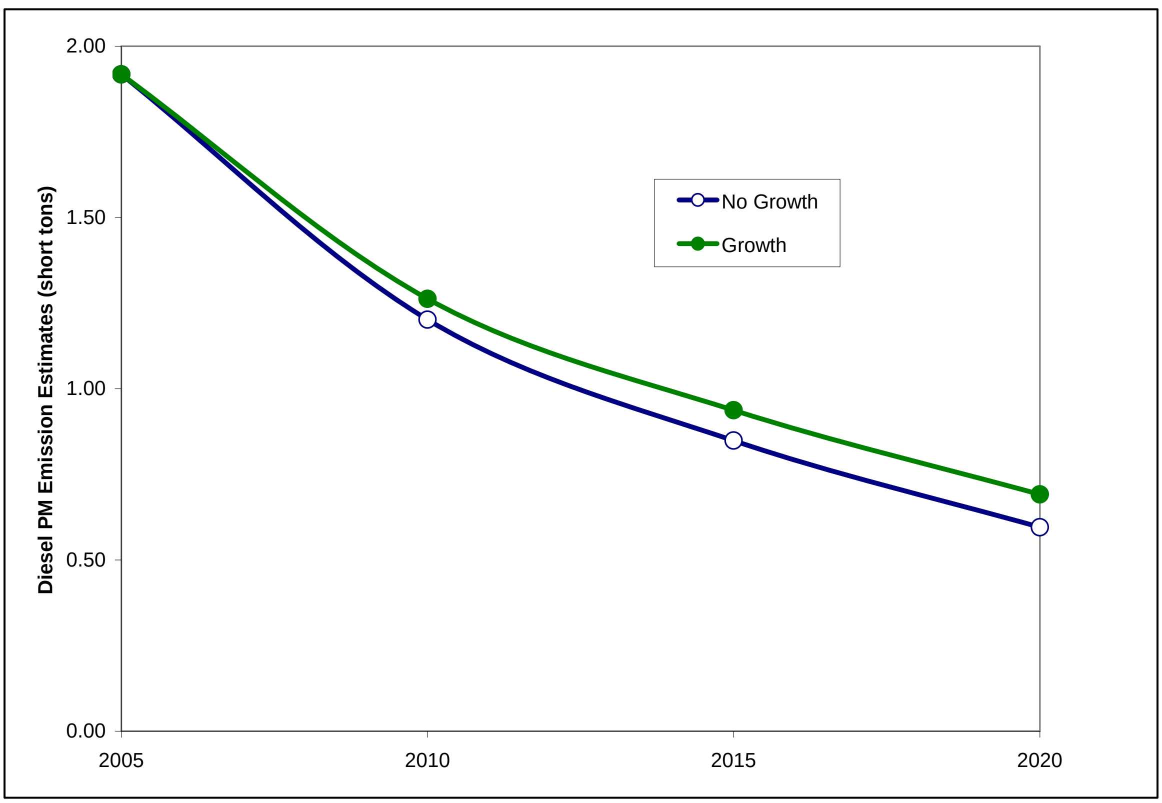

Figure 4-1. BNSF Wilmington – Watson emission summary (with and without growth) in short tons.

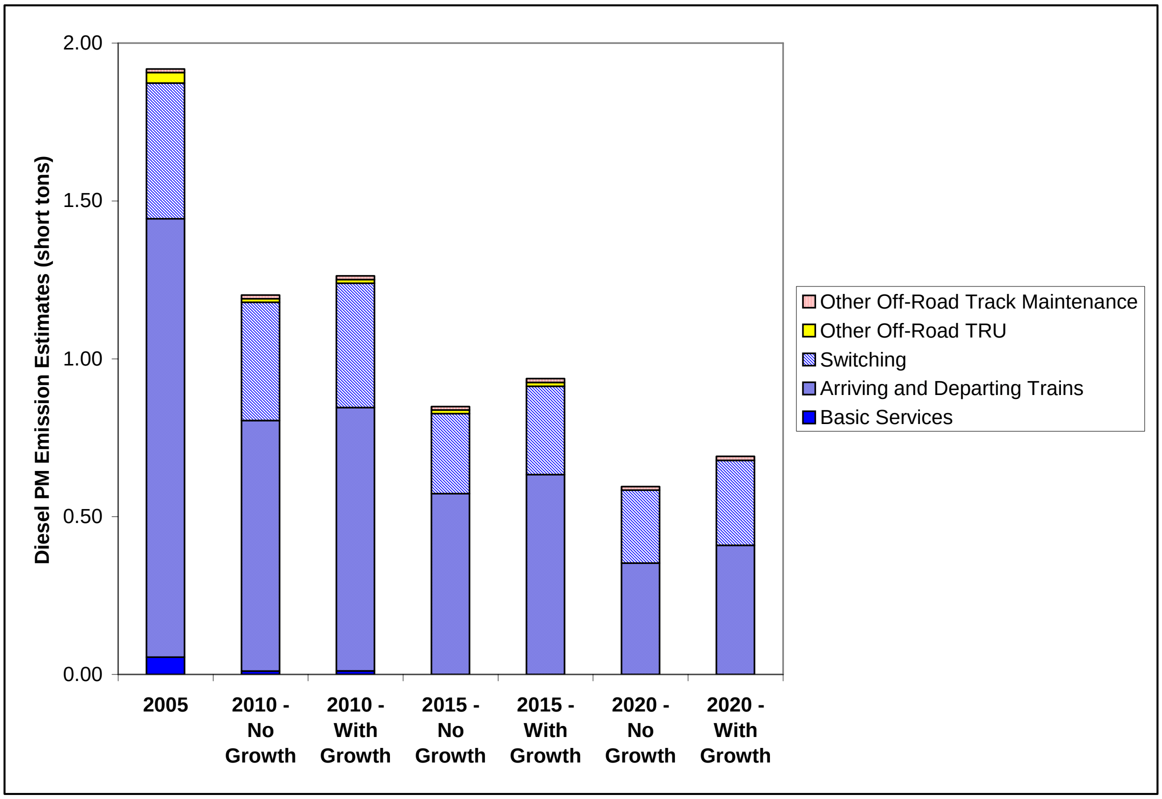

Figure 4-2. BNSF Wilmington – Watson emission summary (with and without growth) by source category in short tons.

A general discussion of the analytical methodology and assumptions used to calculate the 2005 baseline emissions and to forecast emissions for calendar years 2010 through 2020, for each equipment category is provided below. Detailed emission calculations for the 2005 baseline year can be found in the Wilmington – Watson Toxic Air Contaminants Emissions Inventory with modifications for the revised emission inventory methods described in this report.

4.1 Locomotives

BNSF has agreed ("Memorandum of Mutual Understandings and Agreements," July 2, 1998) to meet Tier 2 fleet average emissions for all locomotives operating in the South Coast. This agreement may be met in variety of ways through averaging very low emitters with engines not meeting Tier 2 levels.

In addition, BNSF has agreed in the MOU (ARB/Railroad Statewide Agreement, "Particulate Emission Reduction Program at California Rail Yards," June 2005) to reduce idling and to use lower sulfur fuels for locomotives based and refueled in California.

The reduced idling agreement calls for engines based in California to be refit with idle shut-off devices, limiting each idle event to no more than 15 minutes. This will affect all switching engines at California yards and likely most line-haul engines operating in the South Coast where many line-haul engines may be dedicated to that area. ENVIRON assumed that all BNSF new engines are fitted with idle shutoff; so at least all Tier 2 engines were expected to use these devices.

BNSF agreed to accelerate the use of low sulfur fuel in California ahead of the Federal standard for 15 ppm sulfur starting in 2012. By agreement, BNSF will use 15 ppm sulfur in 80% of the California refueling gallons with the remaining assumed to be at the 2007 Federal standard of 500 ppm. Based on an assessment of the in-bound engines using Federal fuel and out-bound engines using California fuel along with refueling rates at locations inside and outside of California, ENVIRON calculated the average sulfur level to be no higher than 0.034% in 2007-2011 time frame compared with 0.105% in 2005 due to the agreement.

EPA announced final emission standards (EPA, 2008) that include an analysis of the expected benefit of normal fleet turnover and the additional benefit of the EPA rule. The emission standards include a retrofit of existing equipment as well as new engine emission standards. Existing Tier 0, 1, and 2 engines will be subject to retrofit at the time of rebuild; so the engines will be rebuilt gradually throughout their remaining useful life.

The emissions standards and projected EPA emission factors are shown in Tables 4-2 and 4-3, depending on the duty cycle chosen to certify the engines - either line-haul or switching engine duty cycles. The duty cycle for line-haul engines typically leads to lower emission on a gram per horsepower-hour (hp-hr) basis because the switching engine duty cycle has a considerable idling time (no hp-hr generated). In some cases the uncontrolled emissions are much lower than some of the emission standards, so no emission reduction would be expected from those standards especially for HC and CO emissions. The relative emission factors provided by EPA were used to adjust the locomotive emission rates. For instance, for the Tier 2 remanufactured engines the PM emissions were reduced by 55.6% that reflect the expected emission reduction from 0.08 g/hp-hr for remanufactured locomotives compared to 0.18 g/hp-hr for the baseline Tier 2 locomotives in Table 4-2b.

Table 4-2a. Locomotive – Emission standards (g/hp-hr) for line-haul (duty cycle) engines.

Emission Standard	Applicable Year	HC (g/hp-hr)	CO (g/hp-hr)	NOx (g/hp-hr)	PM (g/hp-hr)
Uncontrolled Emissions	**Pre-1973**	**0.48**	**1.28**	**13.0**	**0.32**
Tier 0 – original	1973 – 2001	1.00	5.0	9.5	0.60
Tier 0 – final[1]	2008 / 2010	1.00	5.0	8.0	0.22
Tier 1 – original	2002 – 2004	0.55	2.2	7.4	0.45
Tier 1 – final[1]	2008 / 2010	0.55	5.0	7.4	0.22
Tier 2 – original	2005	0.30	1.5	5.5	0.20
Tier 2 – final[1]	2013	0.30	1.5	5.5	0.10
Tier 3	2012 – 2014	0.30	1.5	5.5	0.10
Tier 4 [2]	2015	0.14	1.5	1.3	0.03

[1] These are retrofit standards at the time of rebuild and phased in as retrofit kit availability.
[2] The Tier 4 NOx standard can be a 1.4 NOx + HC standard.

Table 4-2b. Locomotive – EPA projected emissions factors (g/hp-hr) for line-haul engines.

Engine Type	Applicable Year	HC (g/hp-hr)	CO (g/hp-hr)	NOx (g/hp-hr)	PM (g/hp-hr)
Uncontrolled Emissions	**Pre-1973**	**0.48**	**1.28**	**13.0**	**0.32**
Tier 0 – original	1973 – 2001	0.48	1.28	8.60	0.32
Tier 0 – final[1]	2008 / 2010	0.30	1.28	7.20	0.20
Tier 1 – original	2002 – 2004	0.47	1.28	6.70	0.32
Tier 1 – final[1]	2008 / 2010	0.29	1.28	6.70	0.20
Tier 2 – original	2005	0.26	1.28	4.95	0.18
Tier 2 – final[1]	2008 / 2013	0.13	1.28	4.95	0.08
Tier 3	2012 – 2014	0.13	1.28	4.95	0.08
Tier 4 [2]	2015	0.04	1.28	1.00	0.015

[1] These are estimated emissions with retrofit with some exceptions for older Tier 0 engines.
[2] The Tier 4 NOx standard would not apply until 2017, while the other standards would apply starting in 2015. The Tier 4 NOx standard would apply, however, at remanufacture for model year 2015 and 2016 locomotives.

Table 4-3a. Locomotive – Emission standards for switching (duty cycle) engines.

Emission Standard	Applicable Year	HC (g/hp-hr)	CO (g/hp-hr)	NOx (g/hp-hr)	PM (g/hp-hr)
Uncontrolled Emissions	**Pre-1973**	**1.01**	**1.83**	**17.4**	**0.44**
Tier 0 – original	1973 – 2001	2.10	8.0	14.00	0.72
Tier 0 – final[1]	2008 / 2010	2.10	8.0	11.80	0.26
Tier 1 – original	2002 – 2004	1.20	2.5	11.00	0.54
Tier 1 – final[1]	2008 / 2010	1.20	2.5	11.00	0.26
Tier 2 – original	2005	0.60	2.4	8.10	0.24
Tier 2 – final[1]	2008 / 2013	0.60	2.4	8.10	0.13
Tier 3	2011 - 2015	0.60	2.4	5.00	0.10
Tier 4 [2]	2015	0.14	2.4	1.30	0.03

1 These are retrofit standards at the time of rebuild and phased in as retrofit kit availability allows.
2 The Tier 4 NOx standard can be a 1.3 NOx + HC standard.

Table 4-3b. Locomotive – EPA projected emission factors for switching (duty cycle) engines.

Engine Type	Applicable Year	HC (g/hp-hr)	CO (g/hp-hr)	NOx (g/hp-hr)	PM (g/hp-hr)
Uncontrolled Emissions	**Pre-1973**	**1.01**	**1.83**	**17.4**	**0.44**
Tier 0 – original	1973 – 2001	1.01	1.83	14.0	0.44
Tier 0 – final[1]	2008 / 2010	0.57	1.83	10.62	0.23
Tier 1 – original	2002 – 2004	1.01	1.83	9.9	0.43
Tier 1 – final[1]	2008 / 2010	0.57	1.83	9.9	0.23
Tier 2 – original	2005	0.51	1.83	7.3	0.19
Tier 2 – final[1]	2008 / 2013	0.26	1.83	7.3	0.11
Tier 3	2011 - 2015	0.26	1.83	5.4	0.08
Tier 4 [2]	2015	0.08	1.83	1.00	0.015

1 These are estimated emissions with retrofit with some exceptions for older Tier 0 engines.
2 The Tier 4 NOx standard would not apply until 2017, while the other standards would apply starting in 2015. The Tier 4 NOx standard would apply, however, at remanufacture for model year 2015 and 2016 locomotives.

4.1.1 Line-haul Locomotives

Line-haul locomotives are responsible for long-haul trips that pass rail yards on the mainline tracks and also enter classification and intermodal yard pulling arriving and departing trains (TA/TD). The two types of activities, passing and TA/TD, were treated uniquely in the assessment of the rail yards because the spatial allocation of the activity and the engine duty cycles are unique to each type of train.

Because the South Coast agreement is an averaging standard, the exact fleet composition may change from day to day. For the purposes of this work, ENVIRON assumed a fleet mix of locomotives such that 75% of the fleet were GE ES44DC engines that meet NOx and other pollutant emission levels below the Tier 2 standard, and 15% were GE Dash 9 engines meeting the Tier 1 standard. The remaining 10% of line-haul locomotives were Tier 0 GE Dash 9. This assumption of the fleet make-up somewhat overstates future year emissions because Dash 9 and the Tier 2 engines have higher rated power than some of the engines used in 2005. Therefore either fewer engines or lower power notch settings would be used to perform the same work.

For 2015 and 2020, ENVIRON estimated the fleet turnover to Tier 3 and Tier 4 engines to be 3% per year with the equivalent fleet replacement of Tier 0, Tier 1, and Tier 2 engines by the Tier 3 and Tier 4 engines. ENVIRON assumed that the Tier 3 and 4 engines percentage emissions reductions would occur equivalently for all modes (idle and notches) from the Tier 2 engines. The Tier 3 PM emission standard is essentially the same as the rebuilt Tier 2, but the engines meeting Tier 4 standards have a lower PM emission standard.

BNSF estimated that the remaining Tier 0 and Tier 1 engines would undergo engine rebuilds every 6 years or 17% of the fleet per year. Likewise because Tier 2 engines would be rebuilt every 8 years, 12.5% of the Tier 2 fleet would be rebuilt per year. The final rebuild kits would be available for all engines starting in 2010 for Tier 0 and Tier 1, and 2013 for Tier 2. Some emission reductions could occur earlier, but ENVIRON chose to ignore the phase-in period for rebuild kits. The emission reduction was calculated to be 37.5% for Tier 0 and 1 rebuilds (0.20 g/hp-hr compared to the baseline PM emission rate of 0.32 g/hp-hr) and 50% for Tier 2 rebuilds from Tier 2 base emissions (0.20 to 0.10 g/hp-hr PM emission rate reduction).

Table 4-4 provides expected fleet composition with introduction of the Tier 3 and Tier 4 engines replacing the South Coast fleet. ENVIRON assumes that the introduction of Tier 3 and 4 engines could replace the fleet of Tier 0 / 1 / 2 engines in equal proportion and so the fleet fraction of remaining Tier 0, 1, and 2 engines were proportionally reduced.

Table 4-4. Fleet composition estimate in the South Coast in future years.

Engine Model	2010	2015	2020
Tier 0	10%	1.3%	0.0%
Tier 0 rebuild	0%	7.5%	7.3%
Tier 1	15%	2.0%	0.0%
Tier 1 rebuild	0%	11.2%	11.0%
Tier 2	75%	49.5%	6.8%
Tier 2 rebuild	0%	16.5%	47.9%
Tier 3	0%	9.0%	9.0%
Tier 4	0%	3.0%	18.0%
Overall	100%	100%	100%

Idle emission reductions are difficult to predict. Past locomotive idle times were found to be short and result from main line congestion and speed limits forcing engineers to back off power, but no idle emission reductions are expected for this activity category. The TA/TD engines however do spend more time in the yard where engines can idle a significant amount of time. ENVIRON assumed that the idle shut-off devices would reduce TA/TD engines idle time to 1 hour (15 minutes for each event; arrival and train cut out, move to refueling area, arrival at ready track awaiting assignment, and prior to leaving with a new train) per arrival of new Tier 2 engines with factory installed idle limiting timers.

4.1.2 Switching Locomotives

Based on conversation with BNSF, the switching engines will continue to be Tier 0 compliant and remanufactured according to the schedule that EPA has finalized. The emissions for switching engines will be affected by the MOU idle reduction measure in addition to the remanufacturing emissions reductions. It will take a study to determine the idle reduction due to idle shut off devices installed on these engines. Because some emission reduction will be realized with these devices, ENVIRON assumed 30% reduction of the time in idle mode.

4.1.3 Locomotive Service

Some locomotives (primarily line-haul) arriving at Watson are refueled on site from fuel delivery trucks. In 2005 roughly 200 trucks serviced about 1,000 locomotives of the approximately 5,000 arriving at Watson. ENVIRON assumed the service activity to be affected by the idle reduction devices on Tier 2 and later locomotives reducing the idle time from 1.5 hours to 0.5 hours accounting for up to two moves of the locomotive at the service site.

4.2 On-road Vehicles

Locomotives are refueled on site from tanker trucks driving into the yard. These trucks by and large are a minor source category accounting for about 200 truck trips in 2005 of about 1 mile driving distance each resulting in an insignificant portion of the yard emissions. The tanker trucks will be largely controlled through fleet turnover though the emissions were small in 2005.

Other on-road vehicle fleets based at the site are used by BNSF and contractor staff for crew changes, errands, and other general uses. The vehicle types are nearly all gasoline-fueled vehicles. The vehicle mileage on site for these vehicles is a very small portion of the vehicle's annual mileage and therefore results in little emissions in 2005. To estimate the emission reduction in future years, the EMFAC model was run to determine the expected emission reduction percentage using the default age distribution and fleet turnover in the county. For light-heavy duty diesel trucks, the minimum emission reduction that occurs from normal fleet turnover is 11% for 2005 to 2010, about 21% to 2015, and 24% to 2020.

4.3 Transport Refrigeration Units (TRUs) and Refrigerated Railcars (Reefers)

Transport refrigeration units (TRU) use small diesel generators to run refrigeration compressors on containers and refrigerated boxcars. By far more emissions are derived from containers than from boxcars in general. BNSF submitted emission estimates for its sites using the time on site of loaded containers and boxcar, however later it was realized that the engines running the refrigeration compressors only run 60% of the time on average. BNSF and ENVIRON conducted a survey of several dozen TRU units and compared the hours the TRU was working to the engine hours, both read from individual hour meters on each unit. Because ENVIRON overestimated the on-site TRU diesel generator engine emissions, the total emissions were adjusted downward for this analysis prior to assessing future year emissions.

ARB has written a rulemaking to address TRU emissions (2003). From this rulemaking, ARB estimated TRU emission reductions. 2005 BNSF TRU PM emission estimates were projected to 2010, 2015, 2020 based on emission factor reduction estimates that were drawn from the 2003 TRU ATCM ISOR, Figure VII-2 (ARB, ATCM ISOR, Figure VII-2, October 2003 http://www.arb.ca.gov/regact/trude03/trude03.htm). The emission reduction control factors are shown in Table 4-5.

Table 4-5. ENVIRON estimated ARB PM emission reductions for TRU.

Year	<25 HP	25-50HP	Combined
2000 to 2010	-18%	-70%	-66%
2010 to 2020	-28%	-91%	-79%

For each site, future year activity and population were assumed to be equivalent to 2005 activity and population. ENVIRON estimated the emission reduction for TRU for the years 2010, 2015 (through interpolation), and 2020.

4.4 Other Miscellaneous Diesel-Fueled Equipment

Other offroad equipment primarily consists of track maintenance equipment with portable engines occasionally used for general industrial purposes. Track maintenance equipment is comprised of any number of various equipment types from small pumps and generators to larger, specially designed equipment for rail line maintenance. However, equipment based at each site is used over the entire rail network, so a low fraction of this equipment activity and emissions occur on site.

To estimate emission reductions from this equipment, an OFFROAD model run using construction and industrial equipment was made to determine the relative emission reduction. The emission reduction equipment with rated power of 50 – 500 hp (the breadth of the equipment found at rail yards) are typically similar even though the standards and phase-in schedules for new emission standards vary by engine power. ENVIRON estimated the average emission reduction for 2010 at 14%, 2015 at 36%, and 2020 at 59%.

5. PROJECTED GROWTH RATES

Historic activity data from calendar years 1999 through 2008 were reviewed to determine the expected activity growth rate for the Watson Yard. Table 5-1 summarized the historic activity data for the Watson Yard. The activity estimates for the 2005 base year assessment resulted from data collect from May 2005 through April 2006.

Table 5-1. Historic Activity Data for Diesel-Fueled Equipment Watson Rail Yard.

Activity	Historic Data			Growth Rate (%)
	2005/2006	2007	2008	
Locomotive Arrivals	4,943	N/A	4,148	Limited Trend Data Available

As shown in Table 5-1, based on the recent trend shows less activity at the Watson Yard in 2008 than estimated for 2005. So a 1% per year growth rate was assumed for this analysis.

6. MITIGATION MEASURES

6.1 Current Mitigation Measures

BNSF has implemented all measures in the MOU with the state and works to comply with all rules as quickly as possible.

6.2 Proposed Future Mitigation Measures

BNSF will work with local and state authorities to investigate additional mitigation measures.

7. EVALUATION OF ADDITIONAL MITIGATION MEASURES

The evaluation of the current and proposed mitigation measures will be conducted once the mitigation measures have been specifically defined.

8. MECHANISMS FOR TRACKING PROGRESS

BNSF will work with state officials to determine a method for tracking the emissions reductions achieved through the implementation of the Mitigation Measures.

9. CONCLUSIONS

The emissions at the Wilmington – Watson yard will be reduced by at least 60% by 2020 without considering any additional mitigation measures.