V. RAILYARD OPERATIONAL AND PHYSICAL CHANGES

There are opportunities to reduce railyard diesel PM emissions and associated health risks to nearby residents through the design and implementation of railyard specific operational and physical changes. Total railyard diesel PM emissions have a more direct effect on health risks in downwind areas. Other source diesel PM emissions characteristics such as density or strength, allocation, and proximity to residents also play a critical role in the level of public health risks that occur near a railyard. Individual railyard operational and physical changes could potentially reduce both diesel PM emissions and downwind exposure levels.

In this chapter, there is an evaluation of potential options to enhance and accelerate efforts to reduce railyard emissions. Two of these options include the installation of walls and trees to provide a barrier, redirect, or filter railyard diesel PM emissions away from nearby residents. Other options include the installation of ambient air monitoring stations and remote sensing devices to more accurately measure and track railyard diesel PM emissions. Another option is to create an enhanced state and local enforcement task force to ensure air quality levels are preserved and protected. There is also an option to install indoor air filters at nearby schools and homes to potentially reduce indoor exposure to railyard diesel PM emissions. Another key option is to move emissions sources further away from exposed residents to reduce Maximum Individual Cancer Risk (MICR) levels near railyards. All of these options represent potential operational and physical changes to the railyards that would typically be implemented as unique and individual to each railyard.

The evaluations for the railyard operational and physical change options are based on the following criteria: technical feasibility, potential emissions reductions, costs, and cost-effectiveness.

A. Install Railyard Perimeter Walls

1. Background

In this option, staff assessed the potential for concrete walls, built around the perimeter of railyards, to serve as a barrier or to redirect railyard diesel PM emissions away from nearby residents.

Currently, there are no published studies indicating whether walls can impede or reduce diesel PM exposure to residents living near railyards. Unlike air filtration effects from trees or vegetation, walls have a low surface density as compared to the breadth and height of tree branches. The potential for a barricade effect from railyard perimeter walls to impede, reduce, or redirect diesel PM emissions away from nearby residents may be limited, if there are any benefits at all. There may be potential reductions in diesel PM exposure if railyard emission sources, with low exhaust heights, operate relatively close to the walls under certain ambient conditions. However, the effectiveness of walls, even with low exhaust stack emissions sources, is unclear.

Walls can serve other purposes than to reduce or redirect diesel PM emissions away from nearby residents. Walls can provide better visual aesthetics and could potentially lower nearby residents' exposure to railyard operational noises by partially blocking sound waves. Generally, the effectiveness of a noise wall depends on the distance and height of the wall between the listener and the noise source. Typically, the noise reduction from a sound wall will provide the most benefits for listeners located nearest to the wall. Also, walls may be able to potentially block out railyard lights that radiate during night time operations, and which may adversely affect the quality of life of nearby residents.

2. Analysis of Option 32 - Install Railyard Perimeter Walls

Technical Feasibility

Building perimeter walls around a railyard facility is technically feasible. Similar types of walls are built by the California Department of Transportation (CalTrans) next to freeways for visual aethetics and sound reduction. However, when building walls around the perimeter of a railyard there will need to be an analysis of any potential effects on individual railyard operations and safety. At this time, staff has been unable to identify any studies or data to suggest that walls can create a barrier or redirection effect on diesel PM emissions to reduce diesel PM exposure to nearby residents.

Potential Emission Reductions

The potential diesel PM emissions reductions associated with the installation of walls around the perimeter of railyards is uncertain. Staff theorizes that there might be limited potential for walls to serve as a barrier to impede or redirect diesel PM emissions, but only for low exhaust stack emissions sources, such as low-height stationary diesel generators. The low exhaust emissions sources would have to also operate primarily in areas right next to or near the walls to have any potential benefits. However, at this time, staff has no data to support this theory.

Costs

Based on building a Caltrans-style[6] wall (similar to a sound wall built along highways) that is about 16 feet high, staff estimates the costs to on average about $450 per lineal foot or $2.4 million per mile.

Cost-Effectiveness

Staff has been unable to identify studies or data to quantify the potential diesel PM emissions reductions from the installation of walls around the perimeter of railyards. As a result, staff has not calculated cost-effectiveness for this option.

[6] Source: http://www.dot.ca.gov/dist07/resources/soundwalls/

B. Plant Trees Around the Perimeter of Railyards

1. Background

This option assesses the potential for trees, planted around the perimeter of railyards, to possibly filter and capture airborne railyard diesel PM emissions, and thereby reduce diesel PM exposure to nearby residents. The trees would be planted to filter and capture, via particulate dry deposition or falling onto the vegetation surfaces, airborne railyard diesel PM emissions on tree branches and leaves.

Airborne particulate matter (PM) can travel a long distance before falling onto or depositing onto surfaces such as the ground, water, or vegetation (e.g., trees, bushes, etc.). What happens to PM in the air depends on many variables such as: atmospheric conditions, wind speed, wind direction, air mixing, local turbulent eddies, terrain characteristics, and emission stack heights.

A recent study (Cahill et al., 2008[7]) preliminarily concluded that as diesel PM moved through the air some of the particles would fall out of the air and settle (i.e., deposition) onto tree leaves and branches. Also, as airbone diesel PM moved through the air, and passed through tree branches and leaves, the trees could collect particles through filtration. The Cahill study confirmed that airborne particles can be collected on various types of surfaces, and also indicated that the rate of deposition and filtration of airborne particles onto trees can be influenced by a number of factors.

The Cahill study is similar to many other studies that have been conducted on this subject. The Cahill study experiments were conducted in a confined and well-controlled wind tunnel and vegetation chamber. The vegetation chamber was about 8 feet long and 3 feet by 3 feet in width and height with tree branches inside the chamber (see Figure VI-1).

For the Cahill study experiments, a PM emission source was simulated by flare smoke being blown into the wind tunnel and the vegetation chamber. The study indicated that, under the designed configuration, the trees did collect between a range of 30 to 85 percent of the smoke that passed by branches under a low wind speed condition of 1 to 2 meters per second. However, the study also indicated that the location of a tree and its branches and leaves, relative to the emission sources, can substantially affect the rate of PM collection by the tree leaf surfaces.

[7] Cahill, T.A. et al., *Removal Rates of Particulate Matter onto Vegetation as a Function of Particle Size*, Final Report to Breathe California of Sacramento-Emigrant Trail's Health Effects Task Force and Sacramento Metropolitan Air Quality Management District, April 30, 2008.

Figure VI-1
Cahill Study: Wind Chamber

Figure VI-1: Wind chamber with filled redwood tree branches used by Cahill et al. study. Image source: Adapted from *Removal Rates of Particulate Matter onto Vegetation as a Function of Particle Size*, Cahill et al. (2008).

The Cahill study determined that the greatest PM collection rate was found in a configuration where the trees are located very close to the emission sources. Among several tree species tested in the study, redwood trees were found to have higher particulate capturing efficiency due to a large surface ratio per unit biomass. The Cahill test chamber was designed so that PM emissions flowed into tree branches in the chamber at low wind speeds. As may be expected, the spatial differences in pollutant flows played a key role in the deposition and filtering effectiveness provided by the tree branches and leaves.

Based on results from the Cahill study, plants that are located nearest to emissions sources, such as trees and tall bushes planted next to highways, would remove more PM than plants that are located at greater distances from emissions sources. Tree deposition and filtering rates, based on the distances of emission sources from the trees or vegetation planted at the perimeter of railyards, are difficult to quantify. Relative to railyard emissions sources, locomotive emissions can generally be concentrated in the middle of railyard tracks, which can be up to one half mile from the nearest railyard perimeter.

Another important consideration, along with distance of the trees from the emissions sources, is tree height. A typical locomotive engine exhaust height is about 15 feet from ground. Locomotive exhaust temperatures, when operating in railyards can range from 150 to 250 ^{o}C, in the lower locomotive power settings of idle to Notch 3. With these exhaust temperatures, a locomotive exhaust plume quickly elevate high into the ambient air (see Figure VI-2).

Once the diesel PM emissions are mixed in the higher air mass, the plume can be transported to a height that exceeds 100 foot trees, the latter influenced by how far the trees are located from the emissions sources. This is also true for other types of diesel PM emission sources, such as Rubber Tired Gantry (RTG) cranes, that have exhaust stacks with greater heights. The Cahill study may not have taken into account tree deposition and filtration rates when considering: 1) railyard diesel PM emissions that could elevate to levels of 100 feet or higher, and 2) where locomotives may emit up to one half mile away from the where the trees are located (in this case along a railyard perimeter).

Figure VI-2
Example of Locomotive Exhaust Plume Rise

Figure VI-2. An example of locomotive exhaust effluence and plume rise with a 16.4 foot exhaust stack height. **Note: The Image was altered (darkened) to better illustrate exhaust plume rise. Under normal engine operating conditions the exhaust plume is difficult to observe.** The opacity of the locomotive engine exhaust plume shown is not necessarily representative of most locomotives, but the plume rise is typical for general locomotives under low wind speed conditions.

The railyards in California range from large classification and intermodal railyards to small mechanical and servicing facilities. In many cases, locomotive emissions are emitted along the tracks located in the middle of a railyard. Railroad tracks are not generally located in small confined areas and next to railyard boundaries and perimeters, where trees could realize the greatest deposition and filtration rates. One exception may be mechanical shops, where locomotives can aggregate in confined areas, and potentially be located near a railyard perimeter.

One case is the UP Roseville Railyard, a major classification facility located in northern California. Most of UP Roseville's locomotive emissions occur on the tracks located in the center portion of the railyard. Within the UP Roseville Railyard, the distance between the main classification train tracks (located in the middle of the railyard) to the east or west fence lines is about 1,600 feet, or about one-third of a mile. With UP Roseville, taking into account locomotive exhaust stack heights and a one-third mile distance to the railyard perimeter, a significant amount of the locomotive emissions could potentially rise into the upper air mass and travel up and over most trees located on the railyard perimeter.

Trees can potentially provide benefits other than diesel PM emissions reductions. For example, trees planted at railyard perimeters may provide neighbors with a visual barrier from railyard operations. Trees may provide for better neighborhood aesthetics around railyards. Also, trees may dampen noise from railyard operations, and the shade they provide may potentially help to reduce nearby summer temperatures.

2. Analysis of Option 33 - Plant Trees Around the Perimeter of Railyards

<u>Technical Feasibility</u>

Over the past decade, there have been a number of research efforts to study potential tree and vegetation deposition and filtration rates of air pollutants. However, staff has not been able to identify any studies with experiments or modeling of the diesel PM deposition or filtration rates from planting trees near the perimeter of railyards or similar types of facilities. This includes studies that would take into account exhaust stack heights and distances from emissions sources. The prior studies have assessed the efficacy of trees for capturing airborne particulate through particle dry deposition on a regional scale, but with a particular focus on urbanized areas. These studies typically employed air flow models or a wind tunnel (or chamber) for the assessments.

Extrapolating regional or urban modeling studies to actual field conditions can be challenging. The applicability and technical feasibility of these macro-level study findings to an actual local or micro facility (like a railyard) are unclear. As mentioned above, a number of factors would need to be considered at a particular railyard beyond the issues of exhaust stack heights, the distances between the railyard emissions sources, and the distances from trees planted on a railyard perimeter. For example, there would be a need to consider operational (e.g., movement of cargo handling equipment within the railyard, sight lines for engineers operating locomotives) and safety (e.g., visual obstructions that may not meet homeland security requirements) concerns within railyards.

Trees planted on railyard perimeters may potentially be able to filter diesel PM emissions that are generated near-ground (e.g., low exhaust from yard hostlers and trucks) and that operate close to a railyard perimeter. Trees may also provide filtering effects from regional diesel PM and other criteria and toxic air contaminants. However, each individual railyard would need to be evaluated to determine which particular operations may benefit from tree deposition and filtration diesel PM emissions.

Staff is not aware of monitoring devices or techniques available to speciate between regional and localized (facility) diesel PM emissions. Regional and facility diesel PM speciation would be critical in order to estimate the diesel PM emissions reductions derived from tree filtration at a particular facility. Staff believes there would need to be a study at an actual railyard, with measurement systems that could differentiate between regional and facility-specific diesel PM emissions, to determine the technical feasibility and potential emissions reductions from planting trees at railyards. At this time, staff does not have the actual data, from a real case study, to be able to estimate the potential diesel PM emissions reductions from planting trees at the perimeter of a railyard.

Potential Emission Reductions

The potential diesel PM emissions reductions from planting trees and vegetation on the perimeter of a railyard are unclear at this time. A pilot study of an individual railyard may be needed to quantify the potential deposition and filtration rates of diesel PM from planting trees and vegetation at railyard perimeters.

Costs

The Cahill study recommended redwood trees, due to their high density foliage (leaf) surfaces, as potentially the most effective for deposition and filtration of diesel PM. The estimated cost of planting 15 foot tall redwood trees, for a one mile perimeter of a railyard, is about $200,000 to $250,000. The latter assumes about 20 to 25 foot spacing between each tree. Redwood trees are known for rapid growth and could approach heights of 100 feet in a relatively short period of time.

Cost-Effectiveness

Currently, there are no studies that have measured the effectiveness of tree deposition and filtration rates for diesel PM at the perimeter of railyards. Without emissions data, staff is currently unable to calculate the cost-effectiveness for this option.

C. Install Indoor Air Filters in Schools and Homes Nearby Railyards

1. Background

Air cleaning devices are usually sold as filters or cleaners in a central air system or as portable, stand-alone appliances. Portable units can usually help clean the air in a single room, while central air units may improve the air throughout the house.

Central air filters are rated based on their removal efficiency for different particle sizes. Based on test results for ASHRAE (American Society of Heating, Refrigerating, and Air-Conditioning Engineers) Standard 52.2-2007, filters are assigned a Minimum Efficiency

Reporting Value (MERV) rating. Typical filters in homes are made of coarse fiberglass mesh, and cost $2-3. They have very low removal efficiencies, usually below MERV 4, i.e., less than 20% efficiency for 3-10 micron particle sizes (a micron is one millionth of a meter). Most portable air cleaners are rated for their removal of tobacco smoke, road dust, and pollen. Based on a test developed by the Association of Home Appliance Manufacturers, portable air cleaners are assigned a Clean Air Delivery Rate (CADR) and an appropriate room size for operation.

The health benefits of air cleaning devices are not clear, based on the very limited scientific evidence that is currently available. However, air cleaners that deliberately produce ozone (ozone generators) should never be used in occupied spaces. Ozone generators also indirectly produce UFPs and formaldehyde, and do not clean the air. ARB will limit ozone emissions from portable indoor air cleaners, starting in 2010; additional information on air cleaners and the new ARB regulation can be found at ARB's website[8].

2. Analysis of Option 34 - Install Indoor Air Filters in Schools and Homes Nearby Railyards

Technical Feasibility

Central air filters can be upgraded to improve indoor air quality in a home. Medium-efficiency filters typically are made of pleated, woven material, and have a one-inch depth. They have MERV 6-8 ratings with 35-70% efficiency for removing particles of 3 to 10 microns. Their removal efficiencies for particle sizes less than 3 microns are not tested, but results from modeling and a one-home study indicate particle removal efficiency decreases from 3 to 0.1 microns and then increases for sizes below 0.1 micron. These filters are easily installed in place of the typical fiberglass mesh filter, and should have a minimal effect on air flow and energy use by the central air system.

Even higher efficiency filters may be installed on some central air systems. Filters with MERV 9-12 have even better efficiencies: 70-85% for 3-10 microns, and 50-80% for 1-3 microns[9,10]. These filters are two inches deep, so a new holding rack may need to be installed. In addition, these filters have much higher air resistance, so professional inspection is necessary to avoid air flow problems when exceeding the rated pressures for the system. Upgraded filters such as HEPA filters, and electrostatic precipitator (ESP) devices, can be installed in a central air system, but they require professional installation to modify the ductwork and may require a more powerful fan.

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8 ARB, 2008. "Hazardous Ozone-Generating "Air Purifiers." http://www.arb.ca.gov/research/indoor/ozone.htm.

9 Kowalski WJ and Bahnfleth WP, 2002. MERV Filter Models For Aerobiological Applications. Aerosol Media, Summer Issue, 2002. http://www.nafahq.org/LibaryFiles/Articles/Article015.htm.

10 Wallace LA, Emmerich SJ, and Howard-Reed C, 2004. Effect of central fans and in-duct filters on deposition rates of ultrafine and fine particles in an occupied townhouse. Atmospheric Environment Volume 38 (3): 405-413. http://fire.nist.gov/bfrlpubs/build04/PDF/b04008.pdf.

Portable air cleaners can reduce indoor particle levels in small rooms. Models with HEPA filter media or ESP devices can remove 40-60% of particles above 0.050 microns[11]. However, their removal efficiencies can decrease markedly below 0.030 microns, and significant filter by-pass may reduce the HEPA's efficiency. In addition, the energy and maintenance costs of portable air cleaners can be substantial. The expected lifetime of these devices is not known, but under constant use the fan motors may only operate for 10 years or less. Ionizing air cleaners are less effective at reducing UFPs and can also produce ozone, which can increase UFP levels[12].

Finally, the actual removal efficiency of central air filters and portable air cleaners in occupied homes is expected to be less than the rated efficiency for several reasons. Particle buildup (loading) and ionizing wire deposits can quickly reduce the efficiency of the device. Filters usually are not changed very often and have significant air bypass around the edges. In addition, central air filters only remove particles when the central air system is operating, which is usually only intermittently for parts of the year when heating or cooling is needed. To conserve energy, a two-speed or variable speed fan is recommended for central systems that operate continuously, but such systems are not readily available for retrofit applications. For new homes in California, energy standards will require outdoor air ventilation systems that operate throughout the day and year, starting in mid-2009; some types of ventilation systems appear to be more effective in removing outdoor PM[13].

Potential Emission Reductions

Staff believes there are no potential diesel PM emission reductions associated with central air filters or portable air cleaners discussed above, but these devices do generally reduce indoor particle levels when the central air system or portable air cleaner is running. The efficiency of new air filtration cleaners to remove excess air particles (fine particulates typically) can range from about 70% by a HEPA-similar type filter to 99.97% by a true certified HEPA filter. The effectiveness of portable air cleaners, especially for UFPs, is not well known. As mentioned above, both central air filters and portable air cleaners generally require continuous operation to be effective.

Costs

Central air filters with a MERV 6-8 cost about $5 to $20, and both disposable and washable models are available. MERV 9-11 filters cost about $20 to $130, depending on whether they are disposable or washable. Installation of a HEPA or ESP unit in the central air system can cost from about $1,000 to $5,000. Continuous operation of the

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[11] Waring MS, Siegel JA, and Corsi RL, 2008. Ultrafine particle removal and generation by portable air cleaners. Atmospheric Environment 42: 5003–5014. http://www.ce.utexas.edu/prof/siegel/papers/waring_2008_aircleaner_ae.pdf.

[12] Ibid.

[13] Bowser D and Fugler D, 2004. Preventing Particle Penetration. Home Energy: March/April 2004. http://www.homeenergy.org/article_full.php?id=181&article_title=Preventing_Particle_Penetration.

system fan can add $200 or more per year in energy costs[14]. Portable air cleaners range in cost between $50 and $200 for smaller units, and $300 or more for larger or more effective models. The energy and maintenance costs can be substantial for portable air cleaners. At least two portable air cleaners would be needed to filter the air in a bedroom and a living room of a typical home.

Cost Effectiveness

While the central air filters and portable air cleaners can provide benefits to improve indoor air quality, the cost effectiveness in reducing indoor particle levels and health risks over time is unclear due to insufficient data.

D. Install Ambient Diesel PM Monitoring Stations

1. Background

Diesel engines emit a complex mixture of inorganic and organic compounds that exist in gaseous, liquid, and solid phases. The composition of this mixture will vary depending on engine type, engine age and horsepower, operating conditions, fuel, lubricating oil, and whether or not an emission control system is present. The primary gas or vapor phase components of diesel exhaust include typical combustion gases and vapors such as carbon monoxide (CO), carbon dioxide, sulfur dioxide, NOx, reactive organic gases (ROG), water, and excess air (nitrogen and oxygen).

Diesel exhaust contains over 40 substances that have been listed as TACs (toxic air contaminants) by the state of California and as hazardous air pollutants by U.S. EPA. Diesel PM is either directly emitted from diesel powered engines (primary particulate matter) or is formed from the gaseous compounds emitted by a diesel engine (secondary particulate matter). Diesel PM consists of both solid and liquid material and can be divided into three primary constituents: the elemental carbon fraction; the soluble organic fraction, and the sulfate fraction.

Currently, there is no approved specific measurement technique for directly monitoring diesel PM emissions in the ambient air. A PM monitor is designed to collect all types of air particulates on the site, regardless of the differences among the sources. The speciation from the samples can face many technical limitations. More often than not, a monitoring site is also heavily impacted by other surrounding diesel PM sources, such as diesel trucks on the major roadways nearby a facility.

A source apportionment from different diesel PM emissions cannot be done without an approved technique, a surrogate methodology, or a source tagging method. The readings from an upwind-downwind monitoring configuration could be strongly influenced by the high background air diesel PM concentrations in many urban areas.

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[14] Bowser D, 1999. Evaluation of Residential Furnace Filters. Prepared for CMHC. http://www.cmhc-schl.gc.ca/odpub/pdf/61607.pdf.

Air monitor measurements would not necessarily be accurate in singling out the emissions from a local facility. A PM monitor can serve as a tool to track the trend of ambient particulate concentrations, or for relative comparison of one location's readings with another's. However, a PM monitor is not designed to differentiate individual diesel PM emission contributions from various regional and local emissions sources.

Recently, the Roseville Railyard Air Monitoring Project study (RRAMP study) (Campbell et al., 2008[15]) concluded that there was a substantial increase in particulate concentrations at the sites downwind of the railyard relative to the sites upwind of the railyard. However, it is difficult to use this observed increase to quantify the diesel PM emissions specifically from the UP Roseville Railyard and not take into account regional particulate matter emission sources.

The Aethalometer™ is a device that can provide real-time measurements of the concentration of an aerosol component that is specific to combustion emissions, such as traffic emissions and wood burning. The technique was developed in the late 1970s, and manufactured in the late 1980s. It has been used for measuring ambient black carbon, a surrogate for elemental carbon, which is a ubiquitous component of traffic and industrial combustion emissions. This is a tool, through a surrogate, that can potentially assess diesel PM levels at a single area or location. However, the tool is not designed to speciate diesel PM emissions and assign those emissions to a particular facility or emissions source.

2. Analysis of Option 35 - Install Ambient Monitoring Stations to Measure Railyard Diesel PM Emissions

Technical Feasibility

A PM monitoring system has been widely used for measuring and tracking ambient PM levels to evaluate trends on a regional basis. A PM monitoring system is not designed to quantify and speciate individual facility diesel PM emission sources. This applies even with a possible source tagging method, like elemental carbon, which would provide only anecdotal data instead of emission source apportioned measurements. A PM monitor is designed for qualitative emissions monitoring (i.e., measuring and tracking ambient levels) to evaluate emissions trends over a region, with specific measurement levels for a particular area of a region.

Potential Emission Reductions

An ambient PM monitoring station would measure long-term emissions trends for a location within a region. There are no diesel PM emissions reductions associated with the installation of a PM monitoring system.

Costs

[15] Reference: Campbell, D.E.; Fujita, E.M., *Roseville Railyard Air Monitoring Project*, Third Annual Report to Placer County Air Pollution Control District, Auburn, California, July, 2008.

The cost of an Aethalometer™ ranges from $25,000 to $35,000, with all of the options possible. ARB staff estimates the operation, data analysis, and maintenance costs at about $30,000 - $35,000 annually.

Cost-Effectiveness

Staff has not calculated cost-effectiveness for this option. Ambient air monitors are emissions measurement systems and are not designed to provide diesel PM emission reductions.

E. Implement an Enhanced Truck and Locomotive Inspection Program

1. Background

In this option, staff assesses the potential to enhance existing state and locale enforcement programs. This option would provide more frequent state enforcement inspections, and provide more coordination with local air districts and local community law enforcement.

2. Analysis of Option 36 - Implement an Enhanced Truck and Locomotive Inspection Program

Technical Feasibility

This proposed option could apply statewide for all 31 UP and BNSF designated and covered railyards.

ARB staff peform locomotive inspections at the 31 UP and BNSF covered railyards on a semi-annual basis. With increased enforcement staffing and funding, this option would propose to increase the frequency of inspections to quarterly or monthly, depending on the need. ARB staff conduct periodic inspections of diesel trucks operating at intermodal railyards to ensure there are no exceedances of the five minute idling regulations. With increased enforcement staffing and funding, this option would propose to increase the frequency of truck inspections. In addition, all of these efforts could be coordinated with local air pollution control districts to enhance these efforts. Also, local communities have offered to coordinate with ARB inspectors during inspections to issue tickets to truckers parked illegally in and around railyards.

This option is technologically and operationally feasible. The ability to implement this option would largely depend on finding the resources (i.e., staffing and funding) necessary to implement the program.

Potential Emission Reductions

The potential emissions reductions that could be provided by a proposed ARB and local community truck and locomotive enhanced enforcement program are difficult to quantify at this time. Field inspection data over a period of time would be necessary to attempt to quantify emissions reductions from enhanced inspections of railyards.

Costs

Costs are difficult to quantify due to lack of available data and the details of the scope of an enhanced program for individual railyards.

Cost-Effectiveness

Cost-effectiveness cannot be quantified due to the lack of available emissions reductions and costs data.

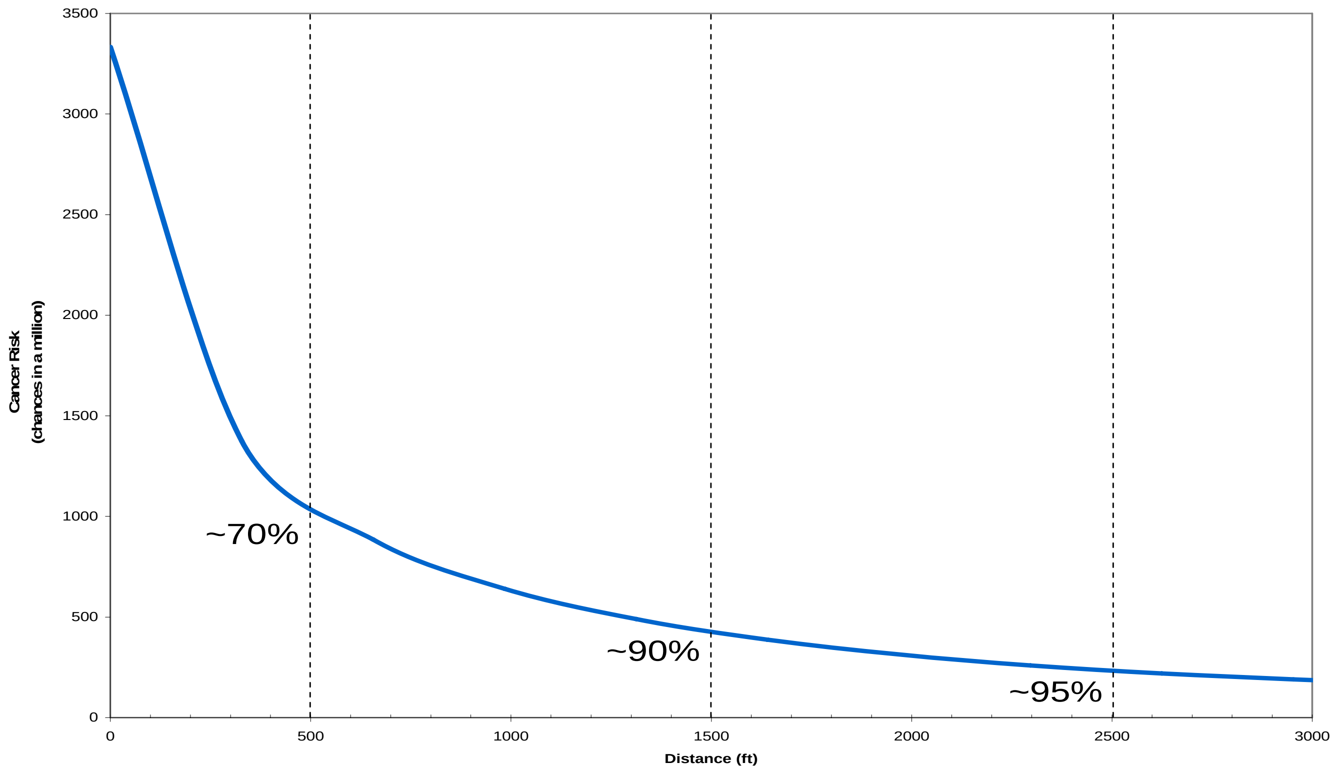
F. Move Railyard Emission Sources Further Away from Nearby Residents

1. Background

In this option, staff assesses the potential public health benefits from moving railyard emissions sources further away from nearby residents. Most health studies indicate that diesel PM cancer risks decrease significantly the further away emissions sources are from the populations exposed. These studies indicate that up to a 90 percent reduction can occur when diesel PM emissions sources are greater distances from populations exposed of more than 1,500 meters. There are also significant benefits are distances less than 1,500 meters. Each railyard has different operational dynamics, and the location and population density of nearby residents can vary widely. Therefore, this option would need to be designed on an individual railyard basis.

The proximity of railyard emission sources to nearby residents can have a significant effect the level of cancer and non-cancer health effects from railyard diesel PM emissions. Health risks increase significantly when railyard diesel PM emissions occur closer to nearby residents.

The figure below presents an example that shows the estimated cancer risks versus the distance from the railyard boundary along north direction at a major emission source for the BNSF San Bernardino railyard. As indicated, the estimated health risks decrease significantly within 500 feet from the yard boundary, about a 70 percent reduction.



2. *Analysis of Option 37 - Move Railyard Emission Sources Further Away from Nearby Residents*

Technical Feasibility

The technical feasibility of the option is only limited by individual railyard operational constraints. This option could provide significant reductions in diesel PM health risks at hot spot areas or locations near a railyard diesel PM emissions sources.

Potential Emission Reductions

The potential diesel PM emissions reductions associated with a change in the proximity of a railyard diesel PM emissions source may range from zero reduction (i.e., increase source-receptor distance) to a certain degree of increase due to operational changes. Potential health benefits would need to be evaluated through a health impact modeling assessment and a sensitivity analyses.

Costs

The costs of reducing the proximity from emission sources to receptors would be railyard and source specific and driven by specific railyard operations. To evaluate the costs of this option would require individual railyard measures and cost estimates.

Cost-Effectiveness

Emissions, costs, and cost-effectiveness would have to be determined based on the specific changes made at individual railyards. The potential benefits and costs would depend on the unique operations and specific operational and physical changes made at each individual railyards.

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