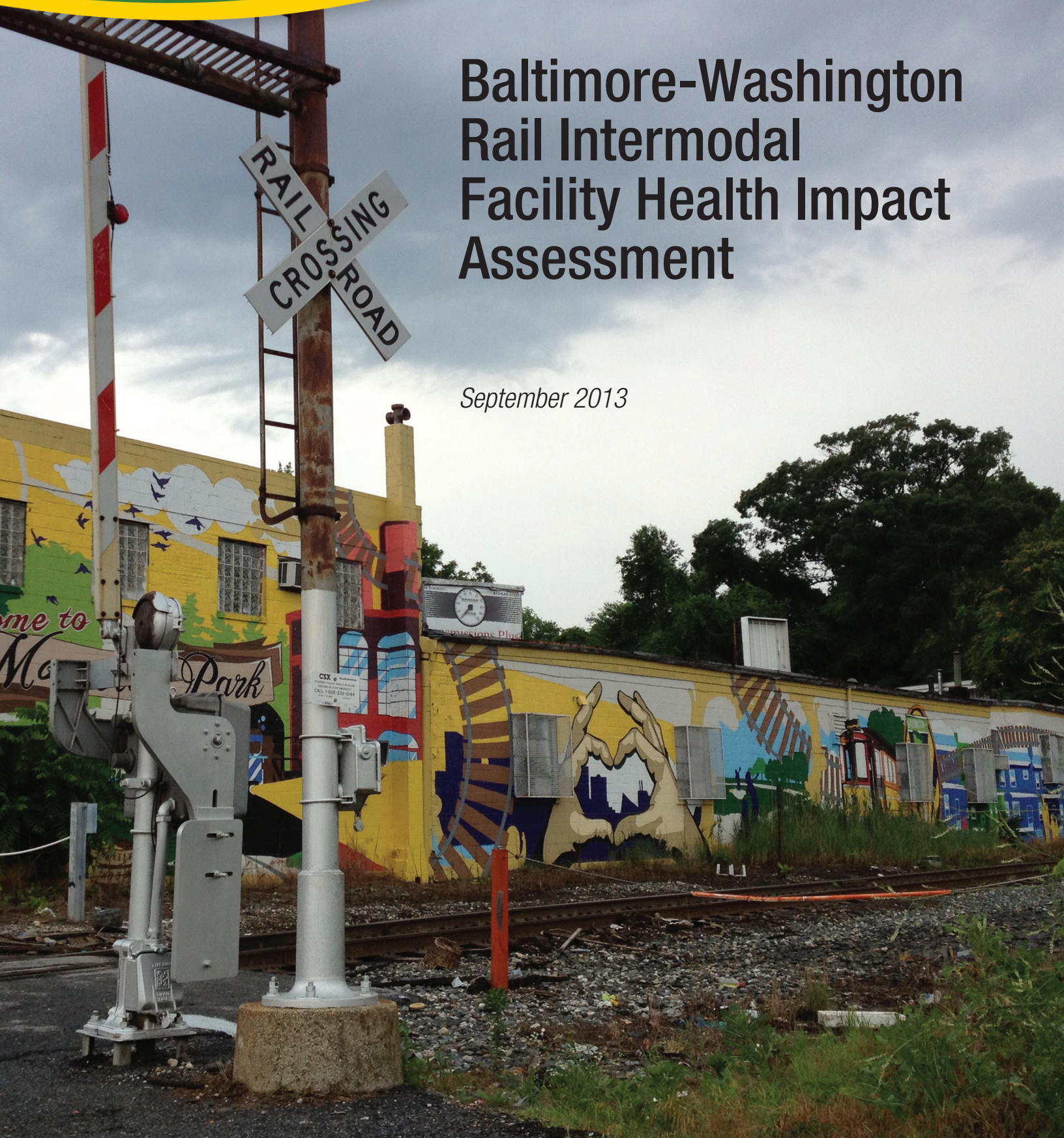
National Center for Healthy Housing

Baltimore-Washington Rail Intermodal Facility Health Impact Assessment

September 2013



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Members of the Morrell Park Community Association and the Morrell Park and St. Paul's Improvement Association helped scope this HIA and refine its recommendations.

Cover Photo: Mural on Washington Boulevard.

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List of Acronyms Used

AQ – Air quality
BRFSS – Behavioral Risk Factor Surveillance System
CO – Carbon monoxide
CSA – Community Statistical Area
DHMH – Maryland Department of Health and Mental Hygiene
EPA – Environmental Protection Agency
FHWA – Federal Highway Administration
HIA – Health Impact Assessment
MDOT – Maryland Department of Transportation
MDSHA – Maryland State Highway Administration
MEPA – Maryland Environmental Policy Act
µg – Microgram
µm – Micrometer
NCHH – National Center for Healthy Housing
NEJAC – National Environmental Justice Advisory Council
NEPA – National Environmental Policy Act
NO_x – Nitrogen oxides
PM_{10} – Particulate matter less than 10 micrometers
$PM_{2.5}$ – Particulate matter less than 2.5 micrometers
SO_x – Sulfur oxides
VOC – Volatile organic compound
WHO – World Health Organization

Executive Summary

Background

Decision-makers at the state and local levels are evaluating a proposed Baltimore-Washington Rail Intermodal Facility at the existing Mount Clare Yard in southwest Baltimore. The purpose of the facility is to transfer goods "between trucks and trains for either 'long-haul' rail service to markets outside of the region or 'short-haul' truck delivery to local warehouses, retailers, and other businesses within the region" in response to the growing demand for consumer goods movement (Maryland Department of Transportation, n.d.). The intermodal facility at the Mount Clare Yard will allow CSX Transportation, Inc. (CSX) and its affiliates to double-stack freight containers arriving into the Seagirt Marine Terminal after they have passed through the Howard Street Tunnel, before shipping to markets outside of Baltimore.

The National Center for Healthy Housing (NCHH), a national nonprofit organization based in Columbia, Maryland, received funding from the Health Impact Project in December 2011 to conduct a health impact assessment (HIA) of the potential health effects of the proposed Baltimore-Washington Rail Intermodal Facility. HIA brings together scientific data, health expertise, and public input to identify the potential – and often overlooked – health effects of proposed projects, policies, and programs.

NCHH used a combination of qualitative and quantitative methods, including literature review, quantitative forecasting, focus groups, and stakeholder interviews to assess the potential positive and negative impacts of the development on the health of the community.

Health determinants are economic, social, and environmental conditions that influence the health of people and communities. Based on input from community residents and agency stakeholders, NCHH identified six health determinants for study:

- Air Quality;
- Employment;
- Neighborhood Resources (e.g., property values, tax revenue, and community resources such as schools, emergency services, and parks and recreational spaces);
- Noise;
- Traffic Safety; and
- Light

Findings

The findings from the HIA include:

Community Demographics and Health

- The Morrell Park/Violetville Community Statistical Area[1] (CSA), where the proposed intermodal facility would be located, has a greater population of white residents and

[1] Community Statistical Areas are clusters of neighborhoods developed by the Baltimore City Planning Department.

residents age 65 or older than that of the city, Baltimore County, and the state as a whole. The median household income for the area is $39,931—slightly higher than the city as a whole, but substantially lower than Baltimore County ($65,411) and the state ($72,419).

- The residents living in the CSA have higher rates of age-adjusted mortality and heart disease, all cancer and lung cancer deaths, and deaths linked to chronic diseases of the lower respiratory system (e.g., chronic obstructive pulmonary disease, emphysema, bronchitis, and asthma) compared with Baltimore City and Maryland residents as a whole.

Air Quality

- The introduction of the intermodal facility at the Mount Clare site will increase the frequency of freight transport moving through the surrounding residential areas, resulting in emissions of numerous hazardous chemicals. These include particulate matter (PM), nitrogen oxides (NO_x), sulfur oxides (SO_x), volatile organic compounds (VOCs), and carbon monoxide (CO).

- Our air quality analysis examined the baseline levels of particulate matter less than 2.5 micrometers in diameter ($PM_{2.5}$). We found that the area surrounding the proposed site is currently in attainment with the U.S. Environmental Protection Agency's (EPA's) National Ambient Air Quality (NAAQ) standard for $PM_{2.5,}$ but is already level with the more health protective World Health Organization (WHO) air quality threshold for the pollutant. Measuring from the nearest air quality monitoring station (four miles away), the present conditions in the community for $PM_{2.5}$ annually average 10 micrograms per cubic meter ($\mu g/m^3$), which compares with EPA's annual NAAQ standard of 12 $\mu g/m^3$ and the WHO annual guideline of 10 ug/m^3 (World Health Organization, 2000).

- Using conservative models,[2] we found that air quality near the proposed site will worsen due to increased truck traffic. If trucks were concentrated in two peak hour periods (morning and evening), the maximum additional exposure of residents to $PM_{2.5}$ would be an estimated 0.8 $\mu g/m^3$ during a peak period on any given day.

- Using data from the census block groups surrounding the proposed site location for 3,933 individuals over age 30, we calculated the excess annual mortality rate attributable to $PM_{2.5}$ exposure that could result from the facility. The maximum modeled changes in air quality emissions due to increased truck traffic could result in an excess annual mortality risk of 10 deaths per 100,000 individuals attributable to $PM_{2.5}$ exposure if the Desoto Road[3] access option is selected. The Bernard Drive[4] access option could result in an

[2] The air quality models assume 300 truck trips per day and do not project any growth in truck trips. They also exclude emissions from rail and equipment at the facility, and do not include emissions from idling vehicles at or around the site. The models also do not include the contribution of additional emissions that could result from new industries associated with the facility, such as warehousing or truck repair businesses, siting in the neighborhood.
[3] In the Desoto Road access option, trucks would travel to and from the site via I-95, South Caton Avenue., Wilkens Avenue, and Desoto Road.

excess annual mortality risk of four deaths per 100,000 individuals attributable to $PM_{2.5}$ exposure. Over 50 years, $PM_{2.5}$ exposure would be expected to result in 14 excess deaths in the Desoto Road option, and eight excess deaths in the Bernard Drive option.

Employment

- Income is one of the most important and consistently documented predictors of health status, including premature death, low birth weight, chronic disease, suffering from injuries or violence, heart disease, and depression, among many other health outcomes (Yen & Syme, 1999; Yarnell et al., 2005; Berube & Katz, 2005).

- The current unemployment rates in two of the census tracts surrounding the proposed facility are substantially higher than those of the city of Baltimore and the state of Maryland when comparing demographically similar populations. For example, unemployment rates of white residents in Morrell Park/Violetville census tracts 2502.06 and 2503.03 (9.3 percent and 15.7 percent, respectively) are significantly higher than those in both the city of Baltimore and Maryland (6.5 percent and 5.5 percent, respectively). Similarly, 31.5 percent of African-Americans in census tract 2503.03 are unemployed, compared with 16.4 percent of African-Americans in the city and 11.0 percent in the state.

- A study by Towson University predicted that the intermodal facility will create 45 jobs onsite, which will be transferred directly from existing jobs at the Seagirt Marine Terminal. The study estimated that the facility will produce 192 direct jobs for contractors who transport goods, 490 jobs during the construction phase, and 84 jobs induced from spending in local economies (Irani et al., 2012). Focus group findings revealed concerns that those who are unemployed or underemployed in the community may not be eligible for the jobs that are created by the facility due to a misalignment in skills and training.

Neighborhood Resources

- Neighborhood resources, including police and fire services, parks and open space, and schools, have an impact on public health and quality of life by impacting individual exposure to injuries and violence, educational outcomes and associated health outcomes, physical activity, and mental health. Park facilities provide opportunities for recreation and facilitate physically active lifestyles (Transportation Research Board & Institute of Medicine of National Academies, 2005).

- A vibrant neighborhood environment is one type of setting for social interaction, which can lead to an increased sense of community and less crime. Social networks and interaction have been linked to improvements in physical and mental health through multiple mechanisms (Sullivan et al., 2004).

[4] In the Bernard Drive access option, trucks would travel to and from the site via I-95, South Caton Avenue, Wilkens Avenue, South Dukeland Street, Wilmarco Avenue, and Bernard Drive.

- Property values are indicative of community wealth, which has potential health implications. Significant changes in property values, as demonstrated through the recent literature generated on housing foreclosures, can enact economic hardships on homeowners through loss of home equity and impacts on housing stability (Immergluck & Smith, 2005).

- Based on the literature, we predict the facility could decrease residential property values for homes adjacent to the proposed site. Studies show a correlation between increased roadway traffic and diminished residential property values. Parts of the CSA are already rated as stressed housing markets by the City of Baltimore. Decrements in housing value could further exacerbate the market conditions in certain parts of the CSA.

- Increased traffic on truck transit routes to the Mount Clare site is a potential threat to the use of park spaces, including a small memorial garden on Washington Boulevard. In addition, Gibbons Commons, which is expected to be a significant community asset with its recreational facilities and a baseball field, is slated for construction on Wilkens Avenue, one of the roads that will be used as a thoroughfare for facility truck traffic.

Noise

- According to the World Health Organization, industries, construction, and road, rail, and air traffic are main sources of community noise (Berglund et al., 1999).

- Focus group participants describe the current neighborhood conditions as quiet and peaceful. CSX is completing a noise study to predict changes in noise levels caused by operation of the facility, but these data were not available at the time of publication.

- A causal effect of noise on annoyance[5] has been well established at 50-55 dBA (Berglund et al., 1999), and sleep disturbance begins at 55-60 dBA. For comparison, a truck with more than three axles going 37 mph creates 83 dBA of noise (Annecke et al., 2008). Facility operations are expected to produce an average of 300 additional truck trips through the Morrell Park/Violetville neighborhoods daily.

- Sensitive receptors[6] that line Wilkens Avenue – a high school, a hospital, and senior care facilities – will not have any barrier to the increased noise emissions of trucks moving to and from the facility. The new facilities of Gibbons Commons, which are expected to include green spaces, recreational facilities, and grand housing (housing for grandparents raising their grandchildren), will also sit along the intended truck access route for the facility.

[5] Noise annoyance is defined as a feeling of resentment, displeasure, discomfort, dissatisfaction, or offense when noise interferes with someone's thoughts, feelings, or actual activities (Passchier-Vermeer, 2000).
[6] Sensitive receptors are places where populations that may be particularly vulnerable to the impacts of a particular project reside or spend significant amounts of time, including schools, hospitals, residences, parks, and other areas.

- The children in the seven schools located within a mile of the Mount Clare site may be exposed to higher noise levels both in school and, for those also living near operations, at home. As a result, many school-age children could be at increased risk of deficits in attention span, concentration and memory, and reading ability (Evans & Lepore, 1993).

Traffic Safety

- The Baltimore City Department of Transportation's Traffic Impact Study of the proposed facility indicates that the baseline conditions of traffic already push the threshold of acceptable quality; the Level of Service rating[7] at the intersection of Caton Avenue and Wilkens Avenue is currently a *D*, which is the considered the lowest acceptable rating of quality of service for Baltimore City intersections.

- Focus group participants predicted that the addition of trucks that will accompany the operation of the new intermodal facility will exacerbate their current traffic problems with congestion. Safety was a concern, as drivers were worried about sharing roadways with more tractor trailers. Efforts to obtain baseline vehicular crash data from the City of Baltimore for the Morrell Park/Violetville area were unsuccessful and therefore quantitative predictions of the impact of the increased truck traffic on injuries and fatalities are not provided in this report.

Light

- Study of the health effects of light exposure is relatively new. Although the relationships between exposure to Light at Night (LAN) and the onset of a number of negative health outcomes are not yet entirely clear, there is sufficient evidence of associations between LAN and negative health effects to warrant concern over the potential impacts of the intermodal facility's lighting system on the health of nearby residents.

- Recent studies indicate that humans react to artificial light at both low and high intensities; the light intensity used for illuminating house interiors and worksites is sufficient to alter circadian rhythms, which can influence sleep-wake cycles, hormone release, and other important bodily functions (Navara & Nelson, 2007).

- Experimental studies with rodents suggest that even small amounts of LAN may have major impacts on physical and psychological well-being, including irritability, anxiety-like and depressive-like behaviors, learning and memory deficits, inhibition of melatonin secretion, accelerated tumor growth, propensity to obesity, and cardiovascular disease (Salgado-Delgado et al., 2011).

- Lighting was raised by several focus group participants as an issue of concern. Homeowners with properties directly adjacent to the Mount Clare Yard described

[7] Level of Service (LOS) reflects the quality of service by assigning a letter grade based on the average delay experienced by motorists at an intersection and ranges from *LOS A* (minimal delay) to *LOS F* (significant delay). *LOS D* is typically used to represent the acceptable LOS threshold in Baltimore City (Baltimore City Department of Transportation, 2013).

concerns about light from the facility site flooding their properties at night. Residents also described negative impacts on privacy and safety attributable to the lighting and hours of facility operation.

Priority Recommendations

The HIA predicted potential health effects of the proposed facility and identified strategies for mitigating those effects. Section 8 provides a complete list of these recommendations. Based on feedback from agency officials and community leaders, NCHH has prioritized the following recommendations:

Design/Planning Phase:

1. CSX should pay the City of Baltimore a facility regulatory and site infrastructure fee to at least partially offset any potential negative impacts on access to neighborhood resources. For example, the fees could be used to provide local jurisdictions with block grants for improvements to neighborhood resources (e.g., libraries, schools, parks, community centers) that could be impacted by the project. The fees would be used to mitigate costs borne by the City to mitigate the impact of the trucks on the roads, the potential loss of tax revenue resulting from decreased property assessments, and to pay for pedestrian and bicycle safety programs. The fees would provide a sustainable stream of funding to mitigate unforeseen impacts of the facility in the future. These amounts should increase by five percent each year and would automatically increase by 20 percent if the State or City takes any enforcement action related to the construction or operation of the facility.

2. CSX and the Maryland Department of the Environment should complete the air quality models begun in this HIA to more fully assess the existing air quality in the community (including existing train emissions) and project the added impacts of the facility (including idling, train emissions, machinery, congestion, etc.) on air quality and excess mortality.

3. The community should be involved in decisions and priority setting for the community improvements CSX plans to make with project funds. Improvements related to the construction and operations of the facility and mitigations related to the facility should be included in CSX's construction budget rather than as part of the community improvement budget.

4. The City of Baltimore should develop a plan to monitor and enforce the truck routes to ensure trucks traveling to and from the facility do not use prohibited, local roads. All truck routes should be well defined and marked with clear signs indicating approved routes. The City of Baltimore should also make provisions for enforcement of truck idling regulations in the planning process.

5. Once noise models from CSX are available, the Baltimore Health Department or the Maryland Department of Health and Mental Hygiene should analyze the magnitude of impacts on annoyance and sleep disturbance. NCHH provides protocols in appendices G and H that the agencies could use to conduct this analysis. If excessive noise levels are noted,

CSX should install sound-proofing/noise-reducing windows for homes and schools in close proximity to the facility and along the routes servicing the facility.

6. CSX should provide a site lighting plan that accounts for impacts on residents' privacy and is subject to a third-party review. To the extent possible while ensuring occupational safety, CSX should reduce the facility's lighting at night to minimize disturbance to nearby residents. If possible, the color spectrum of lighting sources should also be adjusted towards low-level red lighting and away from high-energy blue lighting, which has been found to be highly disruptive to human biological cycles (Navara & Nelson, 2007).

Construction Phase:

7. The City of Baltimore should assess the current pedestrian infrastructure and coordinate with CSX to provide a complete network of sidewalks to any roads where truck traffic will increase as a result of the facility. Signalized, stop controlled, or otherwise protected crosswalks should be included in the plans for upgrading the pedestrian infrastructure.

8. The City of Baltimore should work with CSX to establish a rodent control program during the excavation, construction, and operations phases.

Operations Phase:

9. CSX should make all efforts to reduce air pollution resulting from on- and off -site equipment and vehicles. For example, the City and CSX should pursue opportunities to require and encourage that all trucks entering the facility be 2008 or newer.[8] CSX should pursue opportunities to ensure that all diesel trains associated with the intermodal facility are low emitting or retrofitted to provide the lowest possible emissions. Wherever possible, container cranes, loaders, and forklifts should be either electrically powered or equipped with low-emitting engines. CSX should ensure that no unnecessary truck or train idling occurs.

10. CSX should restrict activities that are likely to produce noise and light pollution before 7:00 a.m. and after 7:00 p.m. and on weekends.

Communications:

11. CSX, the City of Baltimore, and the Maryland Department of Transportation should develop clear and transparent procedures through which residents may raise and address issues regarding noise, lighting, air quality, or other concerns once the project is operational.

12. CSX, the City of Baltimore, and the Maryland Department of Transportation should improve the transparency and timeliness of information during the design, planning, and construction phases by maintaining an up-to-date public website, providing Town Hall-style forums to respond to community questions, and providing timely responses to emails received through the address provided on the project website (intermodal@mdot.maryland.gov).

[8] Note: The Port Authority operates a program to assist fleets with upgrading their trucks to reduce emissions and improve air quality.

Monitoring:

13. CSX should provide funding to the Maryland Department of the Environment to install and operate air quality monitors at several locations, including: near residences directly adjacent to the project site and associated truck routes; at locations ¼ mile and ½ mile from the site and associated truck routes; and at sensitive receptor sites, such as schools, community centers, libraries, senior facilities, parks, and playgrounds. These data should be monitored at least annually following the opening of the site, should be made public, and should be provided directly to residents of the Morrell Park/Violetville CSA.

14. If indoor or outdoor pollutant levels at sites such as schools, libraries, and community and senior centers rise above standards published by the World Health Organization (World Health Organization, 2000),[9] CSX should seek to reduce emissions through pollution control technology and by improving the building performance (e.g., through reduced air leakage and improved ventilation), reducing emissions through pollution control technologies, and installing additional natural buffers and barriers.

Policy Recommendations:

15. As part of the City's consolidated planning process, the City should create a neighborhood revitalization plan for the Morrell Park/Violetville CSA. The plan should improve the community's infrastructure and services and encourage businesses to remain in the intermodal corridor communities through financial incentives. Such investment would help maintain property values, promote social cohesion, and mitigate the potential stigma of the facility on the surrounding neighborhood. The City should preferentially consider strategies to divert increasing tax revenue resulting from the Baltimore-Washington Rail Intermodal Facility into infrastructure and services for the Morrell Park/Violetville CSA.

[9] Note that the WHO standards are for outdoor pollutants. No established standards exist for indoor air pollutants. However, if pollutant levels are at or above outside thresholds in indoor spaces, mitigations would be prudent.

1. Introduction

Decision-makers at the state and local levels are evaluating a proposed Baltimore-Washington Rail Intermodal Facility at the existing Mount Clare Yard in southwest Baltimore. The purpose of the facility is to transfer goods "between trucks and trains for either 'long-haul' rail service to markets outside of the region or 'short-haul' truck delivery to local warehouses, retailers, and other businesses within the region" in response to the growing demand for consumer goods movement (Maryland Department of Transportation). Key decision-makers in this project include the Maryland Department of Transportation (MDOT), the CSX Corporation (CSX), and the City of Baltimore.

The proposed facility is part of a global response to the expansion of the Panama Canal, which will allow large container ships to deliver goods to and from Asia and the east coast of the United States (Irani, Steward, Ebersole, Radchenko, & Asala, 2012). The Port of Baltimore is working to improve its current infrastructure and rail capacity to remain competitive relative to other eastern ports once the Panama Canal expansion is complete. The construction of the proposed intermodal facility is seen as a critical component of this competitive advantage. According to a report prepared by Towson University's Regional Economic Studies Institute for the Economic Alliance of Greater Baltimore, without the intermodal facility, "the larger vessels will make fewer stops along the Eastern Seaboard, which could potentially benefit the port in Norfolk, Virginia, to the disadvantage of Maryland. The Port of Baltimore could possibly lose up to 50 percent of containerized cargo to Norfolk if there is no proper infrastructure to accommodate the projected increase in containerized cargo" (Irani et al., 2012).

In December 2011, the Health Impact Project provided funding to the National Center for Healthy Housing (NCHH) to conduct a *health impact assessment* (HIA) of the proposed facility. An HIA is a "systematic process that uses an array of data sources and analytic methods and considers input from stakeholders to determine the potential effects of a proposed policy, plan, program, or project on the health of a population and the distribution of those effects within the population. HIA provides recommendations on monitoring and managing those effects" (National Research Council of the National Academies, 2011). Table 1 depicts the HIA process, which involves six systematic steps (Health Impact Project, 2011).

Table 1: Six Steps of Health Impact Assessment

HIA Step	Purpose
Screening	Determines the need and value of a HIA
Scoping	Determines which health impacts to evaluate, methods for analysis, and a work plan
Assessment	Provides (1) a profile of existing health conditions and (2) an evaluation of potential health impacts

HIA Step	Purpose
Recommendations	Provide strategies to manage identified adverse health impacts and maximize benefits to health
Reporting	Includes (1) development of the HIA report and (2) communication of findings and recommendations
Monitoring	Tracks (1) impacts on decision-making processes and the decision and (2) impacts of the decision on health determinants

When NCHH began working on the HIA in January 2012, MDOT and CSX were considering four site alternatives. NCHH designed the HIA to inform the site selection and design and operation of the facility, with the ultimate goal of protecting and promoting the health of individuals living, working, attending school, and recreating near the proposed site location. The federal funding for the intermodal project also meant that MDOT and CSX would have to comply with the National Environmental Policy Act (NEPA). NCHH was attracted to the idea of integrating the HIA with the NEPA process because of the potential for scaling up the use of HIA as part of the NEPA process.

In the fall of 2012, MDOT and CSX announced that the facility would be constructed at a location not previously included on the list of alternatives—CSX's existing Mount Clare Yard in southwest Baltimore City (Maryland Department of Transportation, 2012). In addition, the State announced that federal funds would no longer be used for the project, which in turn meant that the federal environmental review process (required by NEPA) would no longer be required (Maryland Department of Transportation, 2013). NCHH shifted its focus to the new location and revised the scope of the HIA to reflect the health concerns expressed by residents living in the community surrounding the Mount Clare Yard. NCHH completed the HIA report in August 2013 and continued to work throughout the summer of 2013 to disseminate findings and begin monitoring the impacts of the HIA.

This HIA will inform decisions regarding the final design and site plans for the facility, including decisions regarding truck access routes. Moving forward, the HIA will also inform city and state agency decisions regarding zoning changes, as well as permits and other approvals that CSX will need to secure to construct and operate the facility. Finally, this HIA can inform decisions of the Maryland Department of Planning in overseeing the intermodal facility project's compliance with the Maryland Environmental Policy Act (MEPA).

2. Project Background

The proposed intermodal facility at the Mount Clare Yard in southwest Baltimore is located within the Morrell Park/Violetville Community Statistical Area[10] (Figure 1), and is an existing, underused rail yard owned by CSX. There is frequent commuter, freight, and intermodal train activity along the main rail lines that run through the neighborhoods near the proposed site; however, no trains currently pass through the rail line that services the Mount Clare Yard. Because the site is not currently used to load or unload freight cargo (i.e., there are no container lifts happening at the site), there are currently no trucks traveling to and from the site.

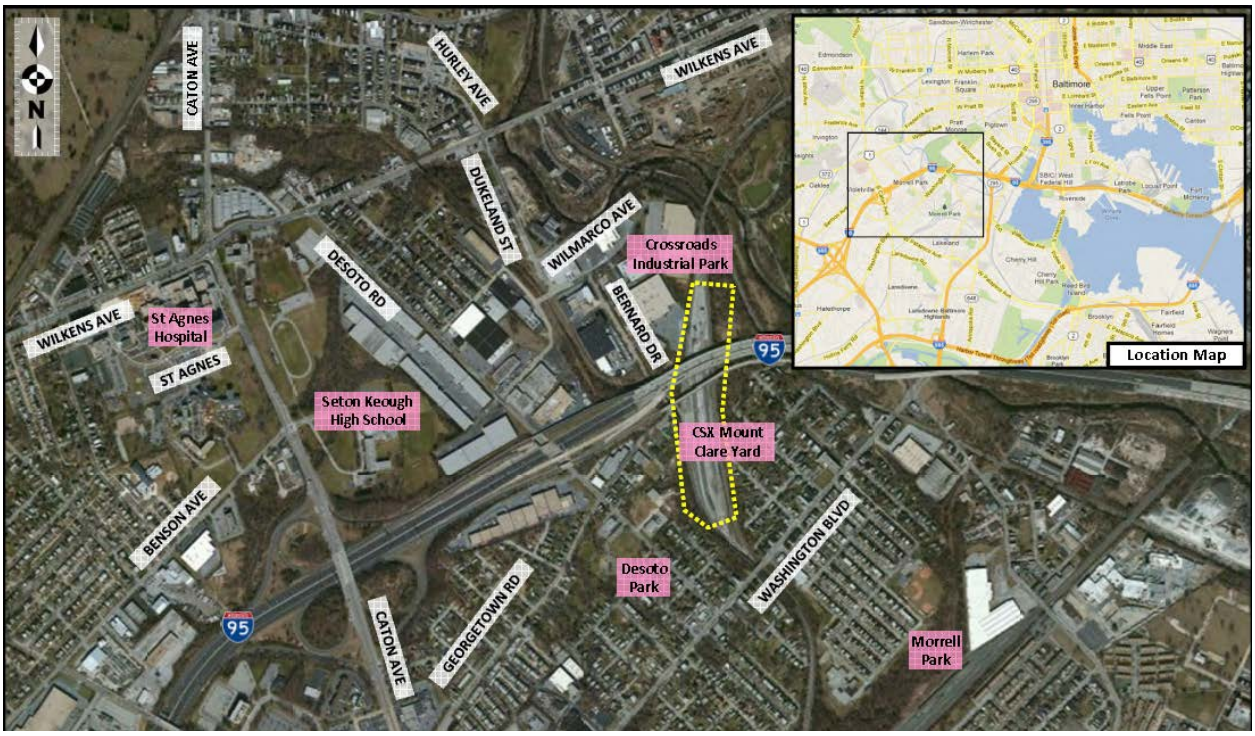

Figure 1: Mount Clare Yard Site Location
(Map Source: CSX Intermodal Transfer Facility Traffic Impact Study, April 5, 2013)

The CSX site plan for the 65 acres of land at the Mount Clare Yard includes:

- Rail tracks for trains entering and exiting the facility; space for storage tracks, and working tracks for loading and unloading freight containers;
- Paved areas that would accommodate approximately 180 wheeled parking units and 360 stacked containers;
- Areas for employee parking, operations and maintenance buildings, lighting, and security; and
- Areas for storm water management *(CSX Corporation).*

[10] Community Statistical Areas are clusters of neighborhoods developed by the Baltimore City Planning Department based on recognizable city neighborhoods (Baltimore City Health Department, n.d.).

Once renovations are completed in 2015, the intermodal facility is expected to generate approximately 300 truck trips daily, with a maximum of 350 truck trips at full capacity (CSX Corporation, 2013). Most of these would be tractor-trailer trucks with up to and including 53-foot trailers (Figure 2) (Baltimore City Department of Transportation, 2013). Once in operation, a maximum of 5 intermodal trains would use the 65-acre site per day. These trains span approximately a mile to a mile and a half in length, and are currently running along the main rail line en route to the Seagirt Marine Terminal. CSX does not expect an increase in the number of intermodal trains because they will be using double-stack technology to carry more cargo on the same amount of trains (CSX Corporation, 2013). It is estimated that the renovation of the Mount Clare Yard facility would result in 85,000 annual container lifts and would cost $90 million (Maryland Department of Transportation, 2012). Although the volume of freight moving through Maryland is expected to grow by 75 percent by 2030 due to the Panama Canal and port expansion, MDOT does not expect facility operations to increase beyond the maximum truck, train, and container lift capacities stated above.

Figure 2: Truck with 53-Foot Trailer

Decision-makers are considering two access points, and consequently two distinct truck routes, to the proposed facility. In both scenarios, trucks traveling to and from the facility will use South Caton Avenue and Wilkens Avenue as the access route to and from Interstate 95 (I-95).

1. In Option 1 (Desoto Road Access) trucks would travel to and from Wilkens Avenue and the site via Desoto Road. This option would require trucks to travel through residential areas along Desoto Road to access the site (Figure 3).

2. In Option 2 (Bernard Drive Access), trucks would travel to and from Wilkens Avenue and the site via South Dukeland Street/Bernard Drive. Employees would access the site via Desoto Road. This option would also require closure of the section of Georgetown Road that lies to the northeast of Desoto Road, as well as re-routing of the Maryland Transit Administration's Route 35 bus. This option would require trucks to travel past fewer residences compared to the Desoto Road option (Figure 4).

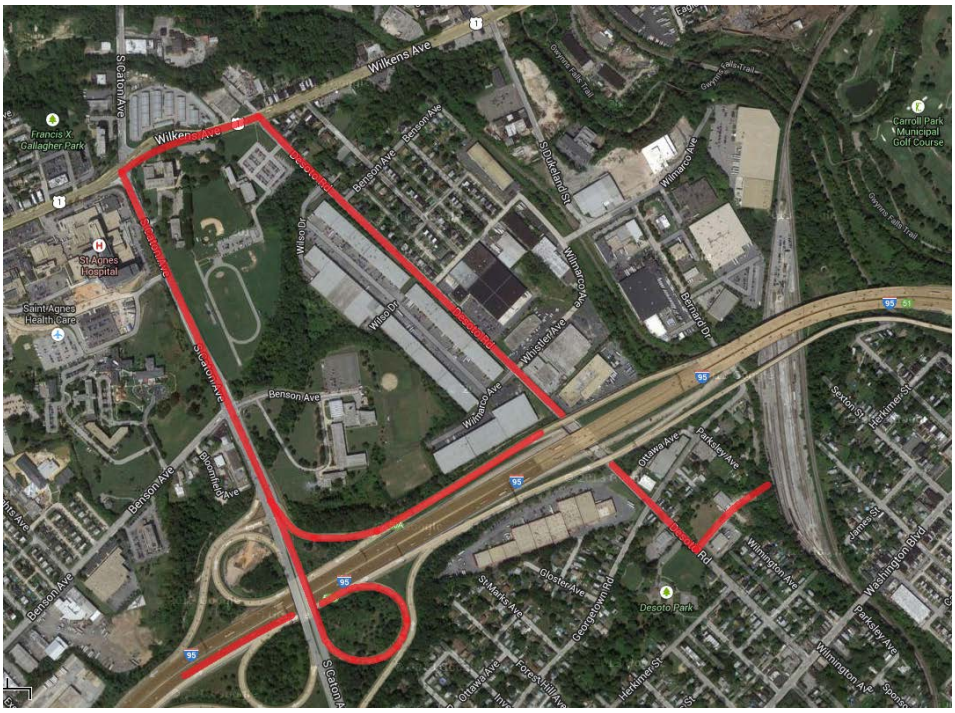

Figure 3: Desoto Road Access Route Option - I-95 to/from Mount Clare Yard via South Caton Avenue, Wilkens Avenue, and Desoto Road

Figure 4: Bernard Drive Access Route - I-95 to/from Mount Clare Yard via South Caton Avenue, Wilkens Avenue, South Dukeland Street, Wilmarco Avenue, and Bernard Drive.

3. HIA Screening

The HIA screening process determines whether an HIA is necessary and whether it will add value to the decision-making process. NCHH followed a checklist of screening criteria to assess the value of and need for the HIA (see Appendix A for the checklist). During the screening process, which included a series of meetings with key decision-makers, potentially impacted residents, and other stakeholders, NCHH determined that:

- **The proposed facility has the potential to affect health, and those impacts are not likely to be considered without the HIA.** Although CSX, MDOT, and the City of Baltimore considered the facility's impact on noise and traffic as part of their reviews, they did not plan to extend these environmental impacts to health outcomes. For example, the City's traffic study examined the impacts of the proposed facility on the street level of service[11] but does not examine the impacts of potential increased traffic and congestion on emissions changes or impacts on asthma and other health issues in the community. Additionally, the screening process revealed a lack of clarity among residents regarding the decision-making process and the process for resolving their concerns. The HIA offered a tool for documenting the community's concerns and for bringing them into the decision-making process.

- **The HIA could potentially inform the development and construction of the proposed facility.** The permitting and zoning processes that the facility must undergo provide an opportunity for implementing the recommendations of the HIA. This HIA provides information that stakeholders may use to engage meaningfully in the planning process.

- **The HIA could help lead to institutional and/or systemic changes that promote better health outcomes for all.** NCHH anticipated that this HIA could further spur the use of HIAs in Maryland. By developing relationships with agencies and organizations involved in land use and transportation decisions and building their capacity to conduct HIAs, NCHH hopes to see that health is more directly and more broadly considered in future land use and transportation planning decisions in the state.

- **Sufficient time, resources, and partnerships existed to conduct the HIA in advance of key project decisions.** NCHH secured funding through the Health Impact Project and had sufficient internal capacity to support the HIA. In addition, NCHH had established partnerships with key agencies and community groups to facilitate successful involvement and stakeholders throughout the HIA process. We included input from the following agencies in the development of the HIA: the Maryland Department of Health and Mental Hygiene, the Maryland Department of Transportation, the Baltimore City Health Department, and the Baltimore City Planning Department. Additionally, NCHH developed strong relationships with community residents and leaders near the four original proposed site locations and the Mount Clare Yard site.

[11] Level of Service reflects the quality of service by assigning a letter grade based on the average delay experienced by motorists at an intersection. (Baltimore City Department of Transportation, 2013)

A key motivation for pursuing a health impact assessment of the proposed project was NCHH's desire to bring greater clarity and transparency to the decisions that were being made by CSX and MDOT and their impacts on the community.

Focus groups and stakeholder interviews conducted as part of the HIA revealed concern and confusion regarding the decision-making process and timeline for the intermodal facility project. Homeowners living near the four original proposed site locations noted that the proposed project resulted in stress because residents were unsure when decisions would be made, and if the sites near their homes would be selected.

"We've all been dealing with this stress since the day we heard about it. It comes and goes, I mean, and nothing's been accomplished, really, and put off the list. So, I mean, you kind of forget about it for a while, and then all of a sudden it pops up…And it's been since April of last year."

– Focus Group Participant

"So you're in this constant state of not knowing which way to go, what to do, and it is extremely stressful! And it's extremely stressful like wondering, 'Are they going to be here, are they not? Should we sell our house now? Should we try to do this?' I want to stay. I love my neighborhood, but I got to think of my health. And I don't know which way to go…And that's been stressful from day one that they started talking about this."

- Focus Group Participant

In selecting the Mount Clare Yard site, CSX and MDOT also decided not to accept federal funding for the project. This decision had the important implication of releasing the project from coverage by the National Environmental Policy Act (NEPA). NEPA's fairly extensive and prescribed public participation process afforded the residents of the original four potential sites specific opportunities for input and involvement. Without NEPA's protection, NCHH was concerned that there would be fewer opportunities for community involvement and engagement in decisions that could significantly impact their health.

4. HIA Scope and Methods

The HIA scope determines which health impacts to evaluate, the methods for analysis, and lays out the work plan for the HIA. During the scoping process, researchers collected input from the community and other stakeholders to shape the research questions and prioritize the health effects assessed. NCHH's process for creating the HIA scope included creating a large list of potential health effects based on the scientific literature, generating research questions that the HIA would attempt to answer, and presenting the health effects and proposed research questions to community members for feedback. We further refined the scope through qualitative research (namely focus groups and stakeholder interviews).

Health Effects Considered

NCHH used the guidance provided in *Improving Health in the United States: The Role of Health Impact Assessment* (National Research Council of the National Academies, 2011) and *Health Impact Assessment: A Guide for Practice* (Bhatia, 2011) to identify possible health effects of the proposed facility. We selected health effects that were plausible, logical, and supported by sound evidence, while acknowledging any data limitations and uncertainties. NCHH considered the following five characteristics of the health effects:

- Direction—indicating whether the health effect is adverse, beneficial, or unclear;
- Magnitude—indicating how much a health effect might change as a result of a decision;
- Intensity—indicating a health effect's severity;
- Likelihood—indicating the degree of certainty that the health effect will occur; and
- Distribution—indicating whether the health effects are shared equally among the exposed populations.

Vulnerable Populations

The HIA sought to consider how the facility might impact particularly vulnerable or susceptible sub-populations. In addition to individuals living, working, attending school, and recreating near the planned site location, NCHH used available data from peer-reviewed literature (Aday, 2001) and input from community residents and agency stakeholders to identify the following vulnerable populations:

- Children (young children ages 0-5 and school-aged children ages 6-17);
- Elderly (adults ages 65 and older);
- Pregnant women;
- Low-income individuals (those living below 200 percent of federal poverty level);
- People of color (e.g., African American; Hispanic); and
- Populations with existing health conditions that make them more susceptible to air quality and other impacts (e.g., asthma, diabetes, cardiovascular disease).

Development of Pathway Diagrams and Research Questions

Pathway diagrams are used to show the relationships between health determinants (e.g., air quality) and health outcomes (e.g., asthma). In April 2012, NCHH hosted a training to build its own capacity, as well as that of stakeholders and decision-makers, including state agencies, organizations, and community residents, for carrying out an HIA.

During this training, NCHH and participants prepared pathway diagrams for each health determinant to depict potential health outcomes resulting from the development and operation of an intermodal facility. For each health determinant, NCHH also prepared two sets of research questions, one set concerning determinant-related existing conditions at the proposed site location and the second set concerning the future impact of the facility on each health determinant and its associated health outcomes. The research questions were used to further define the scope of the HIA and identify methods to answer the questions.

NCHH generated 70 research questions and key indicators for these research questions and corresponding data sources (Appendix B includes the research questions and Appendix C summarizes, for each health determinant, the key indicators and data sources used to answer research questions). For example, we used annual average daily traffic data to answer four research questions about air quality: (1) what are the existing traffic and truck counts on roadways surrounding the proposed facility; (2) what are the possible changes once the facility becomes operational; (3) what are the existing levels of traffic- and truck-attributable air pollution emissions/exposures on roadways surrounding the location; and (4) what is the effect of the changes in traffic and truck counts on air quality on these surrounding roadways? Pathway diagrams for each determinant are included in the sections that follow.

Community and Stakeholder Input into HIA Scope

Based on input from community residents and agency stakeholders, NCHH narrowed the list of health determinants for study to the following six: air quality, employment, neighborhood resources (e.g., property values, tax revenue, and community resources such as schools, emergency services, and parks and recreational spaces), noise, traffic safety, and light.

In June 2012, NCHH issued a draft scope for the HIA of the Baltimore-Washington Rail Intermodal Facility to outline a clear plan and timeline for conducting the HIA and to define the priority health issues to be examined, research questions and methods for answering those questions, and the roles of stakeholders in the HIA. The scope reflected the input and feedback generated through community forums, meetings, trainings, and interviews with stakeholders.

As noted in the Introduction, NCHH originally planned to compare the impacts of the proposed facility at four potential sites in the Baltimore-Washington region; however, after decision-makers announced the existing Mount Clare Yard as the selected facility location, NCHH shifted the focus of the HIA to this new site location.

Figure 5 includes a timeline of community and stakeholder engagement activities conducted by NCHH.

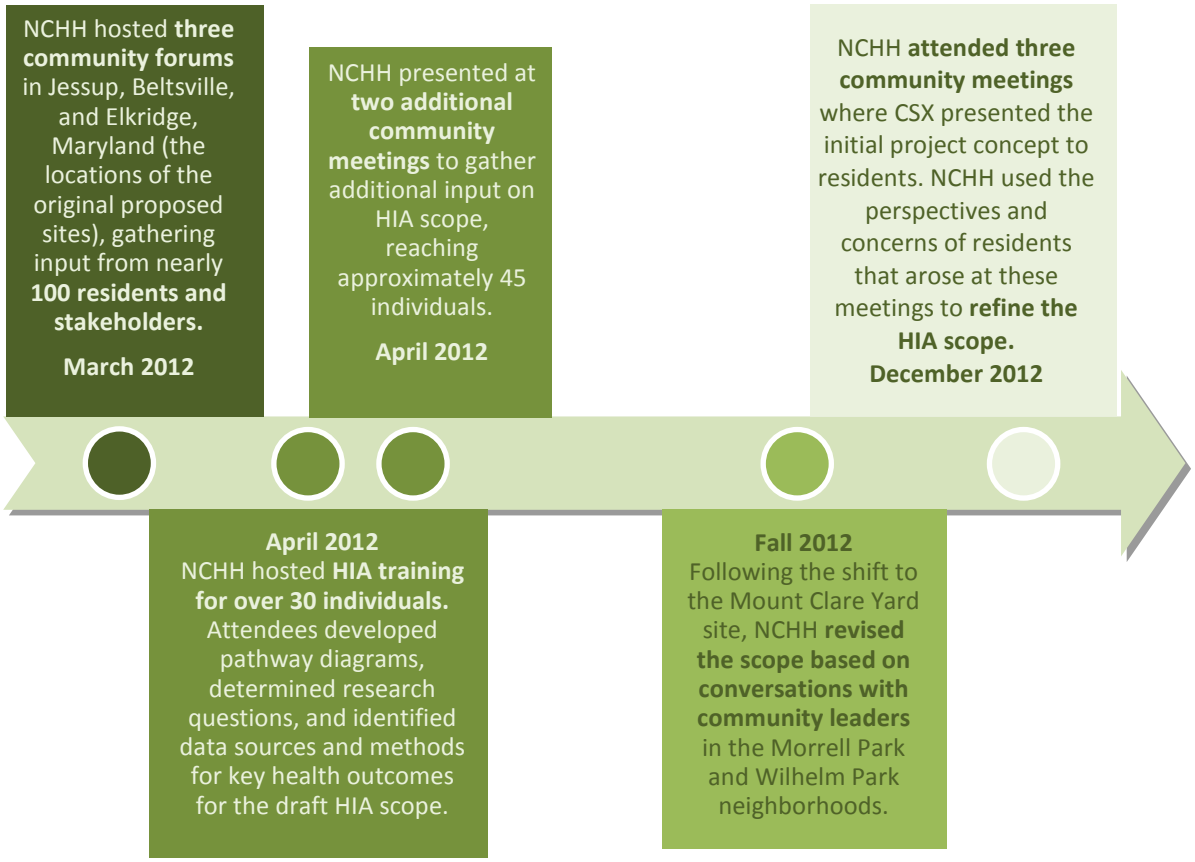

Figure 5: Timeline of Engagement and Scoping Process

Throughout the HIA process, NCHH focused on clear communication and transparency, community engagement, equity, methodological and scientific integrity, and protection and promotion of public health.

Health Determinants Considered but Not Addressed

Water Quality: Residents in the original four sites ranked water quality as a priority health concern. However, residents from the Mount Clare site did not identify water quality as a high priority.

Rodent Control: Residents near the Mount Clare site did cite the current significant rodent control problem, and raised concerns that the facility's construction would worsen the rodent problem in the neighborhood by dispersing rodents currently living near the underutilized rail yard. Ultimately, NCHH did not analyze the impact of the facility on the rodent problems in the community due to the unavailability of baseline data and the lack of literature on the effects of similar projects on rodent populations. NCHH did, however, include in its recommendations opportunities to prevent surges in rodent populations as a result of the construction and

operations of the facility based on technical advice from the Baltimore City rodent control program.

Occupational Hazards: Although NCHH examined the impacts of employment related to the facility on health, NCHH did not consider occupational hazards as part of this HIA. Individuals employed in goods movement may face occupational hazards related to the trucking and rail industries. Long-haul truck drivers experience challenges in accessing healthcare services, particularly preventive care (Solomon et al., 2004). Surveys of both male and female truck drivers have demonstrated common health problems reported among drivers, including back pain, hypertension, headaches, and arthritis (Layne et al., 2009). NCHH determined that these occupational health concerns were beyond the scope and capacity of analysis given the relatively limited information regarding the number and types of jobs that might be available to residents living near the Mount Clare Yard as a result of the facility.

Methods

Table 2 includes the health determinants considered, the methods used to evaluate their impact on human health, and their geographic scale. Evaluation methods generally consisted of a literature review, a summary of available data on the existing conditions at the proposed site location, and an evaluation (quantitative and/or qualitative) of the potential impact of the operation of the future facility. Generally, for the purposes of establishing the baseline conditions of the community, NCHH used the smallest available unit of data (e.g., block group, census tract, CSA). When such data were unavailable, NCHH relied on a larger-scale unit (e.g., city). When possible, NCHH compared baseline community statistics to the City of Baltimore, Baltimore County, and state of Maryland statistics.

Table 2: Health Determinant Evaluation Methods

Health Determinant	Methods
Air Quality	• Traffic and air emissions modeling • GIS analysis • Application of exposure-response functions • Literature review and review of available and projected statistics • Stakeholder Interviews • Focus Groups
Employment	• GIS analysis • Review of Towson University Economic Impact Study • Review of available and projected statistics • Stakeholder Interviews • Focus Groups
Neighborhood Resources	• GIS analysis • Baltimore City market typology • Literature review and review of available statistics • Stakeholder interviews • Focus groups

Health Determinant	Methods
Noise	• GIS analysis • Review of available and projected statistics • Analysis of current and projected traffic levels by the Baltimore City Department of Transportation • Stakeholder interviews • Focus groups
Traffic Safety	• GIS analysis • Review of available statistics • Review of study prepared for Baltimore City Department of Transportation projecting traffic impacts • Stakeholder interviews • Focus groups
Light	• Literature Review • Focus groups • Stakeholder interviews

Geospatial Analysis

NCHH conducted the geospatial analysis presented in this document using ArcGIS, a software package produced by Environmental Systems Research Institute. NCHH downloaded 2010 Census data and 2010 American Community Survey (ACS) one-year estimates from the U.S. Census Bureau's American FactFinder website (http://factfinder2.census.gov). NCHH joined these data with census tract shapefiles from the 2010 Census Topologically Integrated Geographic Encoding and Referencing (TIGER) database. Additional Maryland-specific geographic information system (GIS) data, such as roads, train routes, and water bodies were gathered from open source Maryland GIS mapping resources offered by the Maryland State Highway Administration, the City of Baltimore, and the *Maryland Mapping Resource Guide*. As part of the scoping process, NCHH determined its geographic focus on impacts to populations residing within one mile of the proposed facility location and within 300 meters of major roadways that will be used by the facility. Therefore, the majority of the maps presented in this document examine the distribution of demographic, social, and economic indicators within a one-mile radius from the proposed facility location or within smaller geographic scales, such as within 300 meters of major roadways and the site location, or within one-quarter or one-half mile of the site location.

Demographic, Social, and Health Outcome Data Analysis

NCHH gathered additional demographic, social, and health data presented in this document from the Baltimore City Department of Health's 2011 Neighborhood Health Profiles, the U.S. Census Bureau's American FactFinder, and the Maryland Department of Health and Mental Hygiene's State Health Improvement Process County Health Profiles.

Focus Groups

As part of the assessment phase of the HIA, NCHH conducted five focus groups, three in August 2012 with residents living near the four original proposed site locations in Elkridge, Jessup, and Beltsville; and two in April and May 2013 with residents living near the Mount Clare Yard site. The focus groups documented resident experiences and how the development and operation of the facility could impact their health and their communities.

All of the focus groups were conducted in English. NCHH recruited focus group participants at local community association meetings. Community leaders also circulated information about the focus groups through their networks and hung fliers at local shops in the neighborhoods. A total of 24 individuals participated in the 5 focus groups; 17 from the four original site locations and 7 from the Mount Clare Yard site.

Participation in the focus groups was completely voluntary, and NCHH informed participants that although their quotes would be used in the report, their names would never be linked to any statements made during the focus groups. Given limited funding, NCHH was not able to provide all participants with compensation for their participation. However, at the close of each focus group, one participant was selected through a "raffle" process to choose a $25 gift card to one of three locations: Home Depot, iTunes, or the Cheesecake Factory.

At the start of each focus group meeting, NCHH asked for permission to audio record the conversation to ensure an accurate description of the discussion. NCHH used Production Transcripts to transcribe the audio recordings. Given the shift in focus to the Mount Clare Yard Site, the majority of the focus group data presented in this HIA report are from the two focus groups with residents near this site. For these focus groups, three NCHH staff members independently reviewed each of the focus group transcripts and identified key themes that arose during the discussions. The staff then convened to develop a common codebook, with key themes and associated definitions. Staff then re-reviewed and coded the transcripts in alignment with the key themes. NCHH has included in this report quotes from the focus groups conducted with residents near the original proposed site locations to elucidate themes regarding the decision-making process or communication between agencies, CSX, and residents.

Stakeholder Interviews

NCHH identified stakeholders in the construction and operation of the proposed facility through correspondence with community residents and contact with involved government agencies. Identified stakeholders included community leaders, business owners, local healthcare providers, environmental groups, and government departments involved in planning and regulation processes for the facility. NCHH conducted interviews with stakeholders over the telephone following a structured interview format (Appendix D lists the questions used for the stakeholder interviews). Interview questions sought the individual's perspective on the potential impacts of the construction and operation of the intermodal facility, including, but not limited to, the six key health determinants identified by NCHH. Potential impacts and recommendations recognized by stakeholders were incorporated into the Assessment and Recommendations sections of the HIA.

NCHH interviewed the following stakeholders:

- Marjorie Owens, President of the Wilhelm Park Neighborhood Association
- Bonnie Phipps, CEO and President of Saint Agnes Healthcare
- Andrew Fellows, Vice-Chair of the Commission on Environmental Justice and Sustainable Communities
- Keith Haynes, Maryland State Delegate, District 44, Baltimore City
- Jill Lemke, Economic Development Planner, Baltimore City Department of Planning
- Keith Davis, former HIA Planning Coordinator, Baltimore City Health Department
- Rebecca Ruggles, Coordinator of The Maryland Environmental Health Network
- Kathryn Holmes, President of the Crossroads Business Park Association

CSX did not respond to requests to participate in an interview, and the Baltimore City Chamber of Commerce declined to participate in an interview for the HIA.

Air Quality Modeling

NCHH conducted air quality modeling using an EPA-approved traffic model, CAL3QHCR. NCHH used the Lakes Environmental Calroad interface to input traffic volume, emissions, meteorology, and street characteristics into the CAL3QHCR model. Traffic volumes and truck percentages were extracted from the Maryland State Highway Administration GIS traffic counts for the Baltimore area. NCHH used surface meteorological data from the Baltimore-Washington International Airport (BWI), Station number 93721, and upper air data from the Sterling Airport, Sterling, Virginia (Station number 93734). NCHH used historical hourly data for the full year of 1990 in both surface and upper air meteorological inputs. NCHH estimated $PM_{2.5}$ emissions data for automobiles using California Air Resources Model, EMFAC 2007. NCHH estimated truck $PM_{2.5}$ emissions at 0.4 grams per mile as the age, speed, and load characteristics of the fleet were not defined and similar emissions have been found for trucks in other intermodal facilities. Exposure data are displayed and illustrated as an annual average.

Study Limitations

The scoping process enabled NCHH to focus its assessment on those factors that were of greatest concern to the community and ripe for mitigation. However, for some of the selected health determinants, data gaps limited our ability to conduct quantitative assessments. For example, data from the CSX noise study predicting changes in noise levels caused by operation of the facility were unavailable. This precluded NCHH from modeling the health effects of any increase in noise. Data on existing rates of pedestrian-vehicle and vehicle-vehicle collisions at intersections of interest along the proposed truck routes were also unavailable. Without these data, NCHH was unable to examine baseline conditions fully and the potential impact of the facility on pedestrian, cyclist, and vehicular injuries. Finally, the views of focus group and stakeholder interview participants may not fully represent all the residents surrounding the Mount Clare Yard or all stakeholder groups with a vested interested in the impacts of the facility. However, NCHH made significant efforts to secure participants with a diverse range of viewpoints.

5. Baseline Conditions

Profile of the Communities Surrounding the Mount Clare Yard Site

The Mount Clare Yard is located within the Morrell Park/Violetville CSA within southwest Baltimore City (See Figure 6). The Morrell Park/Violetville CSA is comprised of the Morrell Park, Violetville, Wilhelm Park, Saint Paul, and Oaklee neighborhoods.

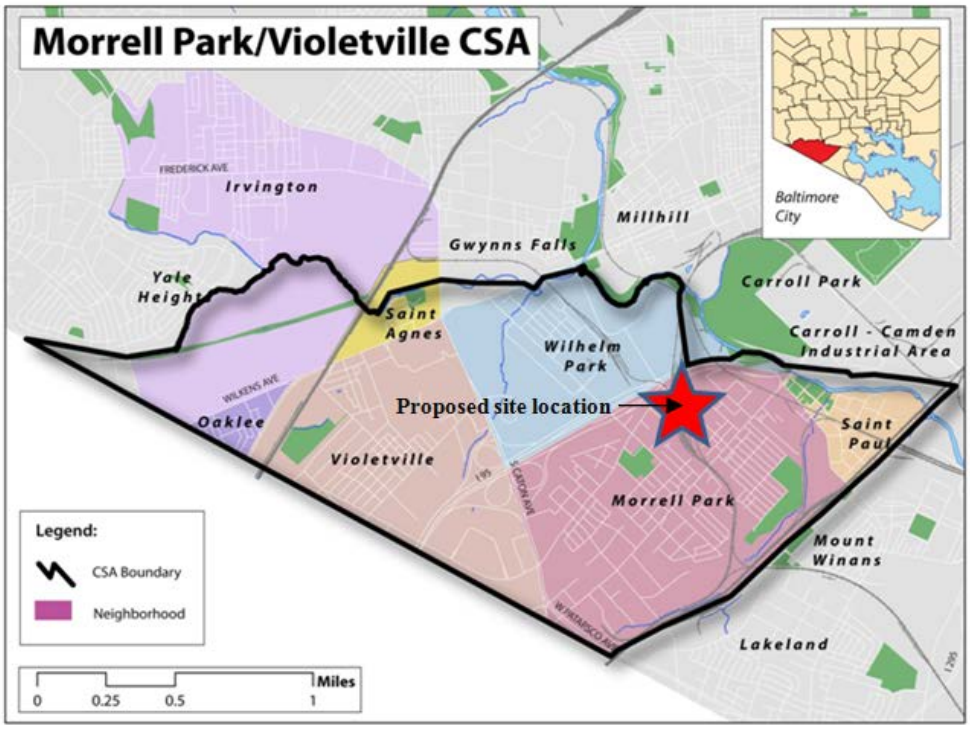

Figure 6: Mount Clare Rail Yard Site

Map Source: Modified from Baltimore Neighborhood Indicators Alliance, Vital Signs 11 Community Statistical Area (CSA) Profiles, Morrell Park/Violetville

Table 3 provides an overview of selected demographic data to describe the population residing within the Morrell Park/Violetville CSA compared with Baltimore City, Baltimore County, and the State of Maryland. The Morrell Park/Violetville CSA has a greater population of residents age 65 or older (17.6 percent of the population) than that of the city (11.8 percent of the population), Baltimore County (14.6 percent), and the state as a whole (12.5 percent). It has a higher proportion of white residents (73.3 percent) compared to the city (29.7 percent), Baltimore County (65.4 percent), and state (61.1 percent). Residents in the Morrell Park/Violetville CSA have a slightly higher median household income ($39,931) than that of the city as a whole ($37,395), but have substantially lower median incomes compared to households in Baltimore County ($65,411) and state as a whole ($72,419). More than 11 percent of families

in the Morrell Park/Violetville CSA are living in poverty,[12] compared to 15.2 percent of families in Baltimore City, 5.3 percent of families in Baltimore County, and 6.1 percent of families in Maryland.

Table 3: Comparison of Morrell Park/Violetville CSA Data with City, County, and State-Level Data

	Morrell Park/ Violetville CSA	Baltimore City	Baltimore County	State of Maryland
Demographics				
Total Population	9,095	616,802	809,941	5,828,289
Age Distribution				
0-17 years	19.6%	21.6%	22.0%	23.4%
18-24 years	8.7%	12.5%	10.1%	9.6%
25-44 years	28.4%	28.8%	25.6%	26.9%
45-64 years	25.8%	25.2%	27.7%	27.6%
65+ years	**17.6%**	11.8%	14.6%	12.5%
Race/Ethnicity				
Black or African American	18.8%	63.6%	26.8%	30.0%
White	73.3%	29.7%	65.4%	61.1%
Asian	2.4%	2.4%	5.2%	5.8%
Some Other Race	2.6%	2.2%	0.5%	0.6%
Two or More Races	2.8%	2.1%	2.1%	2.5%
Hispanic or Latino	4.3%	4.2%	4.4%	8.4%
Income and Education				
Median Household Income	$39,931	$37,395	$65,411	$72,419
Less than $25,000	**29.9%**	33.3%	15.6%	15.1%
$75,000 and over	19.4%	22.5%	42.1%	48.3%
Percent Unemployed	5.8%	11.1%	6.0%	7.3%
Percent of Families in Poverty	**11.4%**	15.2%	5.3%	6.1%
Percent of Kindergartners "Fully Ready" to Learn	**63.2%**	65.0%	85.0%	81.0%
Note: Items in bold indicate indicators that are high relative to other comparative geographic areas.				

[12] The U.S. Census Bureau uses a set of money income thresholds that vary by family size and composition to determine who is in poverty. If a family's total income is less than the threshold for that family size, then that family and every individual in it is considered in poverty. For example, for a family of four in 2013, the federal poverty threshold is $23,550.

Table 4 presents selected health outcomes related to mortality and life expectancy among Morrell Park/Violetville CSA residents. Morrell Park/Violetville residents have a lower life expectancy compared to the city as a whole (72.2 years vs. 73.5 years), higher age-adjusted mortality rates (118.6 per 10,000 vs. 110.4 per 10,000), and higher mortality rates compared to the city among the 15-24, 45-65, and 65-84 age groups.

Table 4: Comparison of Selected Health Outcomes - Morrell Park/Violetville CSA and Baltimore City

	Morrell Park/ Violetville	Baltimore City
Life Expectancy at Birth (in years)	72.2	73.5
Age-Adjusted Mortality (Deaths per 10,000)	**118.6**	110.4
Avertable Deaths[2]	26.1%	36.1%
Mortality by Age (per 10,000)[3]		
Less than 1 year	11.3	11.7
1-14 years	2.8	2.8
15-24 years	**21.4**	13.5
25-44 years	25.6	27.3
45-64 years	**135.8**	117.9
65-84 years	**458.3**	393.7
85 and older	907.8	1315.0

[1]Rates are annual averages for 2005-2009 and are age-adjusted.

[2]As defined by the Baltimore City Health Department, "Avertable deaths are deaths that could have been avoided if all Baltimore communities had the same opportunity at health. Data presented here are based on the assumption that the death rates achieved in the five communities with the highest incomes should be achievable in every community, regardless of income. A positive percentage indicates the percentage of deaths that could have been avoided if a particular neighborhood had the same death rates as the five highest-income neighborhoods."

[3]The number of deaths of persons by age per 10,000 persons within the area in a five year period. Data Source: Baltimore City Health Department, 2011. www.bniajfi.org/uploaded_files/VSChapters/Vital%20Signs%2011.pdf

The Morrell Park/Violetville CSA has a number of sensitive receptors near the proposed site location and major roadways that would be used to access the facility. Sensitive receptors are places where populations that may be particularly vulnerable to the impacts of a particular project reside or spend significant amounts of time, including schools, hospitals, residences, parks and other areas. Vulnerable populations include children, the elderly, and those with pre-existing health conditions. Figure 7 shows the locations of key sensitive receptors in proximity to the proposed site location. There are six public schools within a one-mile radius of the proposed site location, as well as a private high school and hospital that are both located near the intersection of South Caton Avenue and Wilkens Avenue. This intersection is along the truck route that would be used to access the site location. A number of parks are located in close proximity to the site, including Desoto Park, Morrell Park, Carroll Park, and Gwynns Falls Park. In April 2013, site plans were announced for Gibbons Commons, a 32-acre area on Wilkens Avenue, to include a baseball field, green spaces, recreational facilities, community services, and grand housing, providing accessible housing to grandparents raising their grandchildren. These

new facilities, which are intended to benefit vulnerable populations, will sit along the intended truck access route for the facility. In addition to the sensitive receptors shown on Figure 7, 483 residences are located within a quarter mile of the proposed site location, and 1,780 residences within a half mile of the proposed site location (Baltimore City Department of Planning, 2013).[13]

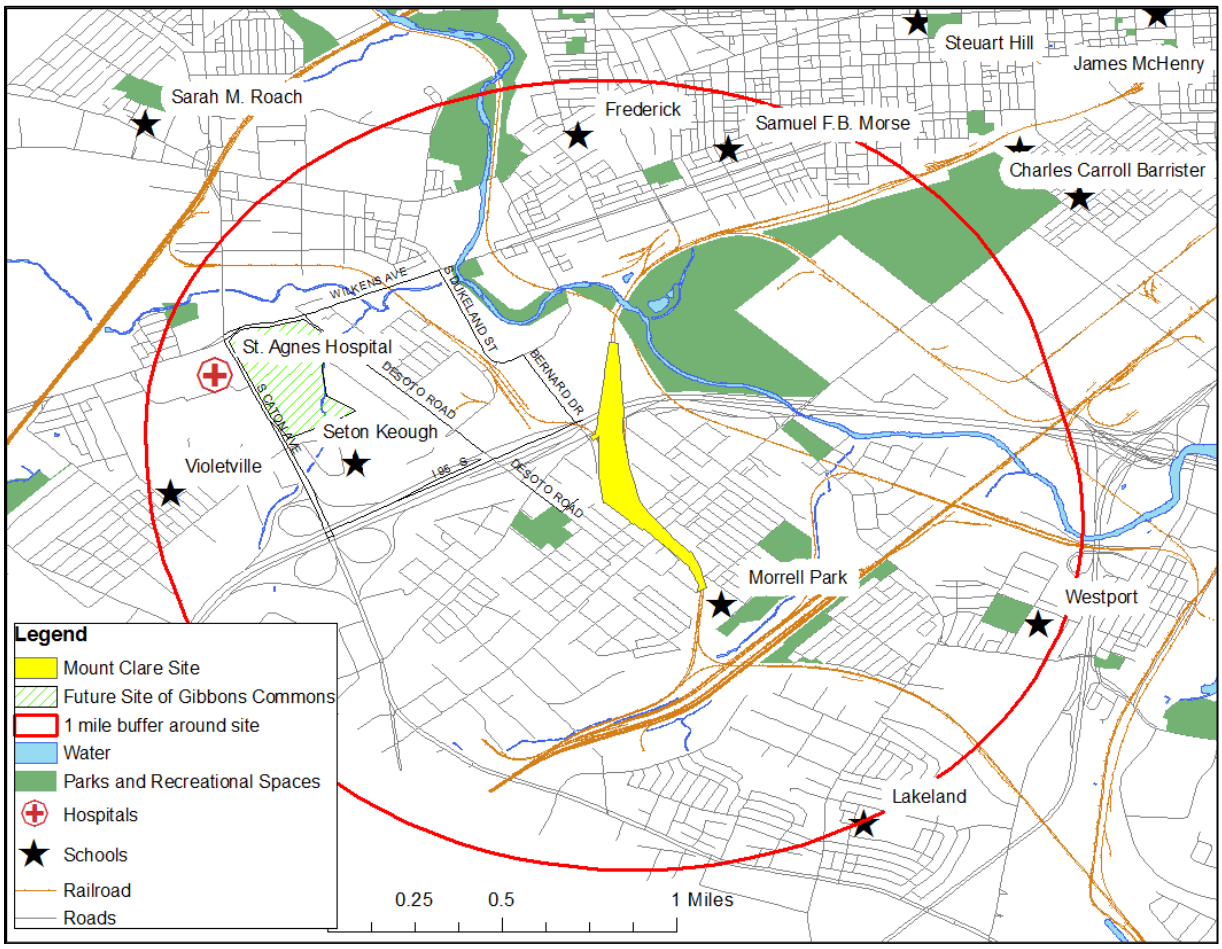

Figure 7: Schools, Hospitals, and Parks Near the Proposed Site Location

[13] The Mount Clare Yard site has a greater number of residences within a quarter mile and half mile of the site compared to the four original proposed site locations: Beltsville – 132 within a quarter mile and 352 within a half mile; Hanover – 343 within a quarter mile and 451 within a half mile; Jessup – 0 within a quarter mile (excludes correctional facility) and 50 within a half mile (excludes correctional facility); and Montevideo – 114 within a quarter mile and 296 within a half mile (CSX and Maryland Department of Transportation, 2011).

6. HIA Assessment Findings

6.1 Air Quality

The introduction of the intermodal facility to the Mount Clare site will increase the frequency of freight transport moving through the surrounding residential areas. Freight transport relies on locomotives, trucks, cargo equipment, and other vehicles with engines that typically burn diesel fuel, resulting in emissions of numerous hazardous chemicals (National Environmental Justice Advisory Council, 2009). These include particulate matter (PM), nitrogen oxides (NO_x), sulfur oxides (SO_x), volatile organic compounds (VOC), and carbon monoxide (CO). Individuals living and working near diesel emission sources, including major roadways, rail yards, and ports, face greater health risks resulting from higher levels of emissions exposure (National Environmental Justice Advisory Council, 2009; Brugge, Durant, & Rioux, 2007; California Air Resources Board, 2006; California Air Resources Board, 2004).

One of the principal worries expressed by focus group participants was that the intermodal facility operations would worsen the air quality around their homes. Members of the community expressed sympathy with the regional and statewide economic benefits that could result from the facility's operation, but also communicated that health is already a local concern. As one focus group participant said, "I want to see the economic development in this community grow, but I also want to see the safety of the area, because this area has, I think, one of the highest rates of cancer in the city, and also one of the worst air qualities."

6.1.1 The Evidence: Air Quality and Health

Health effects from these emissions include increased risk of asthma and other respiratory diseases, cardiovascular disease, cardiac mortality, and lung cancer (Holguin, Tellez-Rojo, M, & et, 2003; Brugge, Durant, & Rioux, 2007; HEI Panel on the Health Effects of Traffic-Related Air Pollution, 2010).

Numerous studies within the United States and internationally have documented the impacts of traffic-related air pollution on respiratory health. A recent analysis by the Health Effects Institute "concluded that the evidence is sufficient to support a causal relationship between exposure to traffic-related air pollution and exacerbation of asthma. It also found suggestive evidence of a causal relationship with onset of childhood asthma, non-asthma respiratory symptoms, impaired lung function, total and cardiovascular mortality, and cardiovascular morbidity, although the data are not sufficient to fully support causality" (HEI Panel on the Health Effects of Traffic-Related Air Pollution, 2010).

A study of children in six different areas in the Netherlands demonstrated negative associations between lung function and truck traffic density, particularly among children living within 300 meters of a major roadway (Brunekreef et al., 1997). A case-control study of white children in Erie County, New York found that children who were admitted to a hospital for asthma were 1.93 times more likely to live within 200 meters of heavily trafficked roads, and were more likely to have trucks and trailers traveling within 200 meters of their homes compared to children

admitted to the hospital during the same period for nonrespiratory diseases (Lin et al., 2002). These results held after controlling for age and poverty level. A cross-sectional study of school-aged children in the United Kingdom demonstrated that living within 90 meters of a main road was associated with increased risk of wheezing (Venn et al., 2001). A southern California study of traffic-related pollution and childhood asthma demonstrated that lifetime history of doctor-diagnosed asthma, wheezing, and use of asthma medication were associated with outdoor levels of nitrogen dioxide (NO_2) and proximity to freeways (Gauderman, et al., 2005). Another study of California school children demonstrated that children living within 75 meters of a highway or arterial road were 1.5 times more likely to suffer from asthma (McConnell et al., 2006).

Evidence also supports a causal relationship between air pollution and non-respiratory health outcomes, including cardiovascular morbidity and mortality (EPA, 2009). Data from a population-based study in Germany suggest that long-term residence within 150 meters of major roads may be a risk factor for coronary heart disease, even after controlling for background air pollution levels and individual risk factors (Hoffmann et al., 2006). Short-term exposure to $PM_{2.5}$ is associated with non-fatal heart attacks and premature death in people with heart and lung diseases, among other health outcomes (EPA, 2001).

The strong relationships between air pollution and human health have resulted in actions by the federal government to set standards for, control, and monitor air pollutants, such as the inclusion of PM, CO, NO_2, and ozone in the National Ambient Air Quality standards (NAAQs) under the Federal Clean Air Act. A recent EPA analysis estimated that 2005 levels of $PM_{2.5}$ and ozone were responsible for between 130,000 and 320,000 $PM_{2.5}$-related and 4,700 ozone-related premature deaths, or about 6.1% of total deaths (based on the lower end of the avoided mortality range) from all causes in the continental U.S. Almost 200,000 non-fatal heart attacks, 90,000 hospital admissions due to respiratory or cardiovascular illness, and 2.5 million cases of aggravated asthma among children were also attributed to $PM_{2.5}$ and ozone air pollution (Fann N, 2012).

However, the air quality standards under the Federal Clean Air Act were not established to eliminate risk to human health from air pollution completely, and pollution levels below federal regulatory standards should not be interpreted as safe for human health; individuals may be adversely affected by air pollution even when EPA regulatory requirements are met (Schwartz, 2002).

Furthermore, studies have found evidence that incremental changes in levels of air pollutants within the threshold dictated by the NAAQS may impact health significantly. Epidemiological studies show an increase in cardiorespiratory morbidity and mortality with incremental increases in ambient $PM_{2.5}$ and PM_{10} levels (Sarnat et al., 2001) (Samet et al., 2000). Vulnerable populations, including children, the elderly, and those with pre-existing conditions, are more susceptible to the adverse health effects of air pollutants (Bell et al., 2006).

Figure 8 shows the relationships between air quality and health outcomes potentially occurring as a result of developing and operating the Baltimore-Washington Rail Intermodal Facility. The

pathway diagram shows that the changes in trucks, cars, train trips, tree coverage,[14] and equipment at the facility will impact emissions of key air pollutants including PM, CO, VOCs, NO_x, and SO_x. These changes could affect a wide range of health outcomes including cancer, respiratory disease, heart disease, and premature mortality.

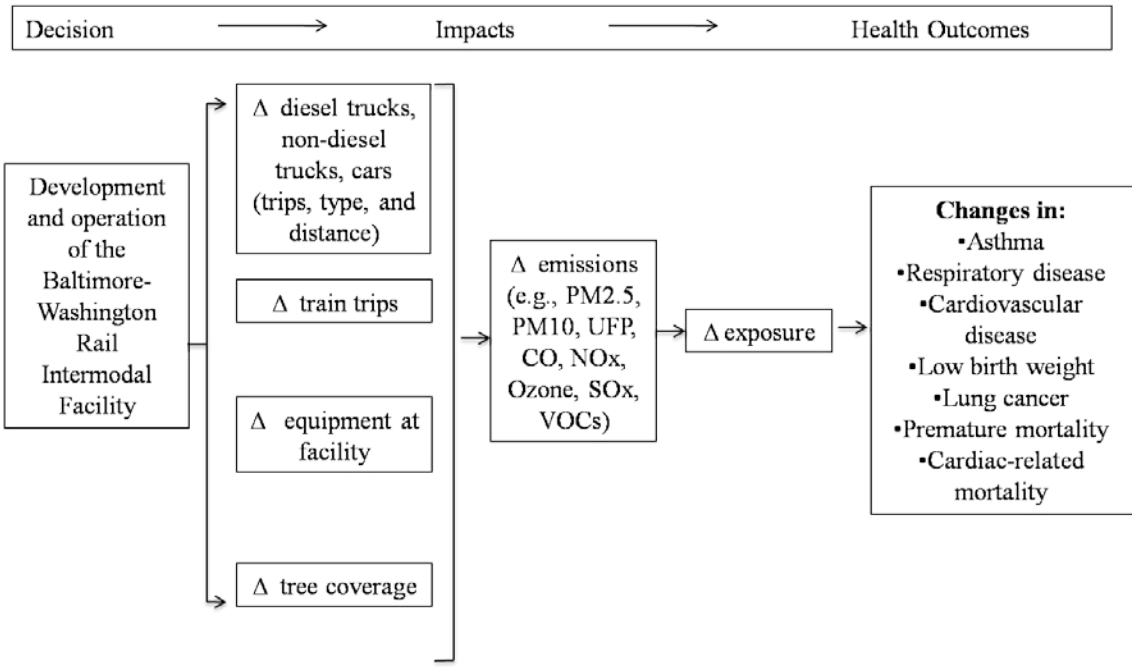

Figure 8: Air Quality Pathway
Legend: Δ = "change in"

6.1.2 Existing Conditions: Air Quality

Stakeholder interviews indicated that air pollution is already an issue of concern in the neighborhoods in the Morrell Park/Violetville CSA. Delegate Keith Haynes, who represents the residents of District 44 in the Maryland House of Delegates, noted that air quality in the Morrell Park community is threatened by a number of sources of air pollution, including an incinerator, which is a point-source of mercury and other toxic metal emissions, such as chromium.

Bonnie Phipps, President and CEO of Saint Agnes Healthcare, also attested to the poor health outcomes already present in the neighborhood. Phipps said, "We already have pretty significant issues particularly in southwest Baltimore where we're located. Things like incidence of cancer, smoking prevalence, different diseases that are lifestyle related, emphysema, things like that, diabetes that can be impacted by lifestyle. We do a lot of work in the community around cardiac disease, also very prevalent in southwest Baltimore due to a lot of different things, the environment… there are a lot of things that are already pointing to [the area] not being a healthy environment."

[14]Trees can help absorb pollutants from the air (Nowak, 2002).

NCHH analysis of air quality focused on motor vehicle traffic as a current producer of air emissions and also focused on the health impact of $PM_{2.5}$ emissions from current motor vehicle traffic. NCHH focused on $PM_{2.5}$ because (1) their emissions are not well controlled by automobile and truck emission standards (compared to pollutants such as CO), and are expected to be a continuous problem well into the future; (2) $PM_{2.5}$ is associated with a variety of well-defined health outcomes as described above, including asthma and mortality; (3) $PM_{2.5}$ is not heavily influenced by atmospheric chemical transformations (compared to pollutants such as NOx), so it is easier to model and predict exposures. For these reasons, $PM_{2.5}$ generally represents an efficient worst-case proxy for roadway air pollution exposures.

Using data on existing traffic volumes, NCHH estimated existing emissions of $PM_{2.5}$ near the Mount Clare site. Figure 9 depicts the annual average weekday daily traffic volume on roadways surrounding the Mount Clare site (i.e., the number of vehicles that pass through a particular road segment on an average weekday). Interstate 95 runs through the center of the Morrell Park/Violetville CSA, presenting an existing vehicle-related air pollution source to the community. On an average weekday, over 18,000 vehicles pass through the Morrell Park/Violetville CSA on I-95 (Maryland State Highway Administration, 2011). Of these, approximately seven percent are single-unit trucks (vehicles on a single frame) and seven percent are combination unit trucks (tractor trailers or semi-tractor trailers) (Maryland State Highway Administration, 2011).

Particular matter less than 2.5 micrometers in diameter ($PM_{2.5}$), also known as fine particulate matter, pose significant risks to health due to their small size (U.S. Environmental Protection Agency, 2013). Figure 10 depicts the existing modeled emissions of $PM_{2.5}$ resulting from current vehicle volumes on major roadways surrounding the Mount Clare Yard site. This model shows that along I-95, existing vehicle volumes contribute a maximum $PM_{2.5}$ concentration of 0.5 micrograms per cubic meter of air ($\mu g/m^3$) to regional air quality background levels on an average day. As you move further away from the freeway and along local roadways, these exposure levels decline. The closest regional air monitoring station is located approximately four miles from the proposed site location, and has an annual mean $PM_{2.5}$ level of 10 $\mu g/m^3$ (U.S. Environmental Protection Agency, 2012). Adding the background levels to the maximum modeled concentration, the estimated average annual exposure to $PM_{2.5}$ for residents in the Morrell Park/Violetville CSA is 10.5 $\mu g/m^3$. This level is below the NAAQS for $PM_{2.5}$ of 12 $\mu g/m^3$ (U.S. Environmental Protection Agency, 2012), but is level with the more health-protective World Health Organization (WHO) air quality threshold of 10 ug/m3 (World Health Organization, 2000).

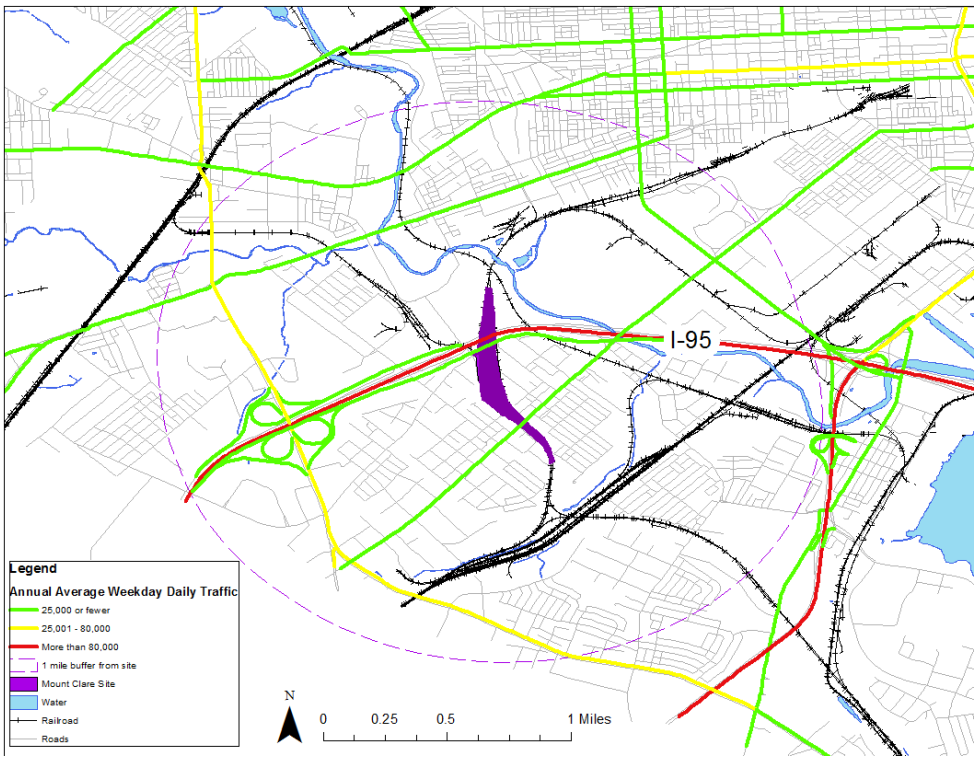

Figure 9: Existing Traffic Volumes by Street Segment, 2011

Figure 10: $PM_{2.5}$ Emissions from Existing Vehicle Volumes

Data on existing health outcomes among residents of the Morrell Park/Violetville CSA suggest that residents may have unique risks from demographic factors or existing health conditions. These unique risks need to be considered carefully when examining the potential impacts of the proposed facility on air-quality-related health issues (See Table 5). These include:

- A high death rate from chronic lower respiratory diseases, including COPD, emphysema, bronchitis, and asthma (8.6 per 10,000 residents) compared to the city (3.9 per 10,000).
- A high percentage of elementary school students missing 20 or more school days (14.3 percent) compared to the city as a whole (10.1 percent).

These health outcomes could potentially be indicative of existing air pollution-related respiratory health issues worsened air quality. In addition, the Morrell Park/Violetville CSA has a larger proportion of residents age 65 and older compared to the city. Older adults may be particularly susceptible to changes in air quality and its associated impacts.

Table 5: Comparison of Health Outcomes Potentially Related to Existing Air Quality–Morrell Park/Violetville CSA and Baltimore City

	Morrell Park/ Violetville	Baltimore City
Percent of Elementary School Students Missing 20+ Days	**14.3%**	10.1%
Age-Adjusted Mortality (Deaths per 10,000 residents)[1]	**118.6**	110.4
Heart Disease Death Rate per 10,000[1]	**28.9**	28.4
Cancer Death Rate per 10,000[1]	**24.8**	23.1
Lung Cancer Death Rate per 10,000[1]	**7.1**	6.9
Chronic Lower Respiratory Disease Death Rate per 10,000 (includes COPD, emphysema, bronchitis, and asthma)[1]	**8.6**	3.9

[1]Rates are annual averages for 2005-2009 and are age-adjusted.
Data Source: Baltimore City Health Department, 2011 Neighborhood Health Profiles
Note: Items in bold indicate indicators that are high relative to the city as a whole.

Although other factors beyond air quality, such as smoking, may contribute to the higher rates of chronic lower respiratory deaths among Morrell Park/Violetville CSA residents, the geographic alignment of elevated chronic lower respiratory death rates with proximity to freeways and railways is striking (See Figure 11), with the only exception to this alignment being in the area surrounding the freeway running north through the city. These data suggest that residents living in the Morrell Park/Violetville CSA, in addition to other communities along major freeways and rail lines, may already be disproportionately burdened by transportation-related air pollution. Figure 12 depicts the proportion of elementary school children missing 20 or more days of school. Asthma is a leading cause of missed school days among children (Akinbami, 2006), and although these data are not stratified based on the cause of missed school days, they may serve as a proxy for the impacts of asthma on school attendance for the community. Over 14 percent of

elementary school children in the CSA missed 20 or more days of school during the 2008-2009 school year.

Focus group and stakeholder interview participants corroborated these data and related personal experiences with health problems they believe were caused by the existing poor air quality in their neighborhood.

"Every one of them [on my street] died of cancer. They're gone, all the way to the top."
– Focus Group Participant

"I mean there is a lot of asthma. All of my grandchildren have asthma. The youngest one is seven months old. He just had a really bad bout with it for like two months. I had asthma. I think maybe the trains aren't all to blame but I think they do make an impact." – Focus Group Participant

The local health care system also noted the high rates of disease among the population neighboring the facility. According to Bonnie Phipps, President and CEO of Saint Agnes Healthcare, "We have a high incidence of lung cancer, we have a high incidence of emphysema; we have a high incidence of cardiac-related issues. None of those people do well in a heavily polluted area."

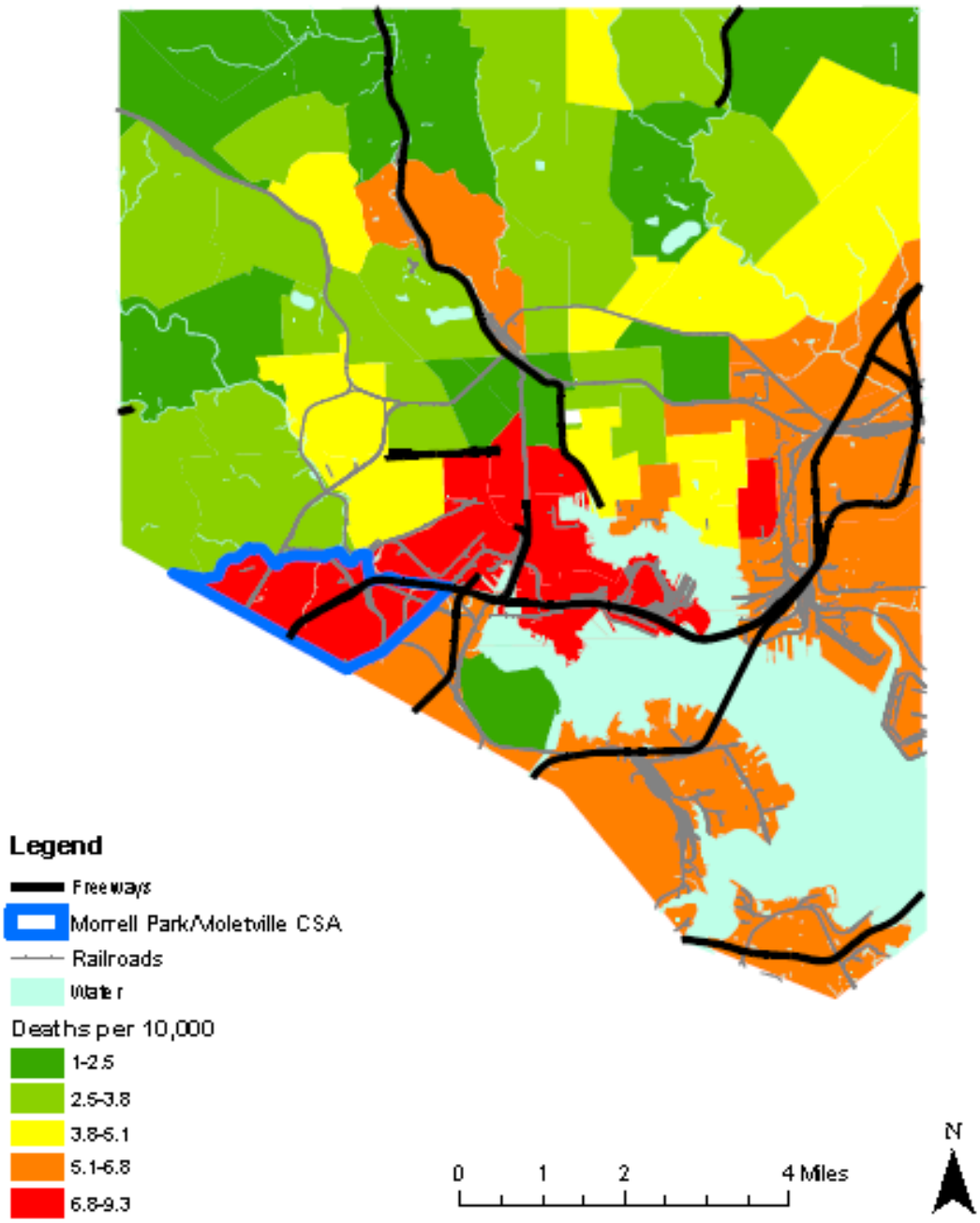

Figure 11: Chronic Lower Respiratory Deaths per 10,000 by Community Statistical Area
Data Source: Baltimore City Neighborhood Health Profiles, Baltimore City Health Department, 2011

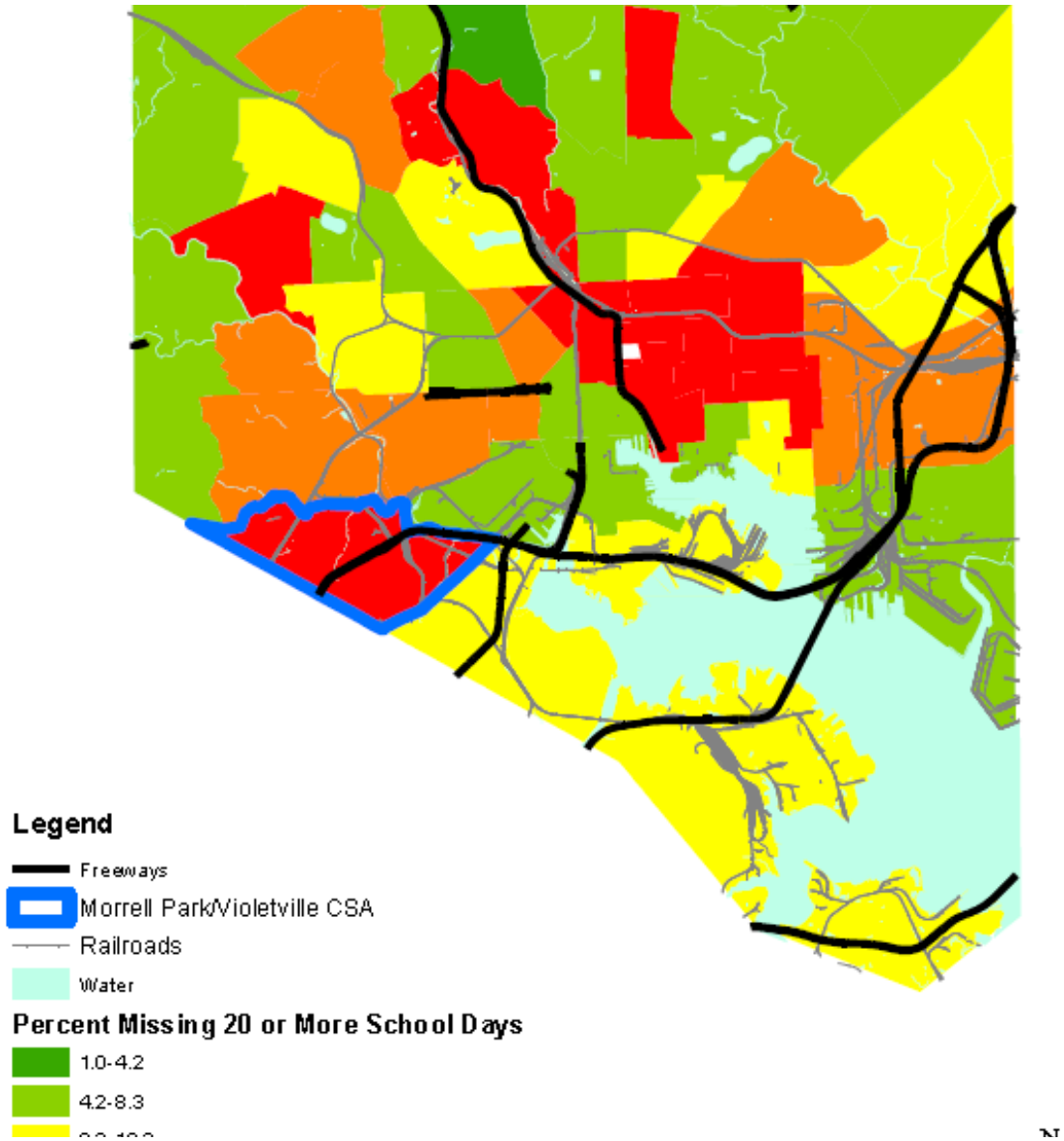

Figure 12: Percent of Elementary School Students Missing 20 or More School Days by Community Statistical Area
Data Source: Baltimore City Neighborhood Health Profiles, Baltimore City Health Department, 2011

6.1.3 Projected Impacts of the Intermodal Facility on Air Quality

Operation of the intermodal facility is expected to result in 150 trucks per day entering and exiting the site, or 300 truck trips per day, with a maximum of 350 truck trips at full capacity (CSX Corporation, 2013). According to the Baltimore City Department of Transportation's Traffic Impact Study of the proposed facility, morning peak hours would see heavier volumes of tractor-trailer truck traffic compared to afternoon peak hours, with 80 percent of the trucks in the morning peak hour exiting the site (See Table 6).

Table 6: Trucks Entering Intermodal Facility during Peak Hours

	Entering Site	Exiting Site
Peak A.M. Hour		
Tractor-trailer trucks, up to and including 53-foot trailers	25	98
Employee vehicles and tractors without containers	5	20
A.M. Total	30	118
Peak P.M. Hour		
Tractor-trailer trucks, up to and including 53-foot trailers	27	31
Employee vehicles and tractors without containers	5	6
P.M. Total	32	37
Data Source: Baltimore City Department of Transportation, CSX Intermodal Transfer Facility Traffic Impact Study		

The Baltimore City Department of Transportation's Traffic Impact Study of the proposed facility indicates that facility operations will increase congestion, and, significantly, determined an increase in the overall intersection delay at the intersection of Caton Avenue and Wilkens Avenue under either access option under consideration (Desoto Road and Bernard Drive) (McCormick Taylor, 2013). This intersection already has a Level of Service[15] rating *D*, which is the considered the lowest acceptable rating of quality of service for Baltimore City intersections. Further, it is the site of a hospital and a school, and plans are underway for recreation facilities, a baseball field, and apartments designated for grand-housing (housing for individuals who are the primary caregivers of their grandchildren) to be constructed on the corner of this intersection. Children, the elderly, and those with preexisting conditions are more sensitive to the negative health effects of emissions, so the potential increase of emissions caused by congestion at this intersection is significant.

Figures 13-16 demonstrate the modeled cumulative impacts of 150 trucks entering and exiting the intermodal facility on $PM_{2.5}$ emissions. These models include both the baseline vehicle $PM_{2.5}$ emissions as well as the emissions from the projected additional vehicles. Figures 13 and 14 demonstrate the projected $PM_{2.5}$ emissions levels if the 300 new truck trips are spread evenly across a 24-hour period (approximately 13 truck trips per hour) along the two different route options (Desoto Road access and Bernard Drive access). Figures 15 and 16 demonstrate the projected emissions levels if the 300 new truck trips were concentrated in two-hour periods in the morning and evening (75 truck trips per hour over four hours in the day) along the two different route options.

[15] Level of Service (LOS) reflects the quality of service by assigning a letter grade based on the average delay experienced by motorists at an intersection and ranges from *LOS A* (minimal delay) to *LOS F* (significant delay).

As shown in the model, because the Desoto Road access option has a greater number of residences along its route than the other access option it would result in greater $PM_{2.5}$ emissions exposures to local residents. Along the Desoto Road route, the maximum additional exposure to $PM_{2.5}$ resulting from a concentration of trucks in two two-hour periods is 0.8µg/m^3. Adding to the annual regional background and existing vehicle-related $PM_{2.5}$ levels, the maximum exposure to $PM_{2.5}$ for residents in the Morrell Park/Violetville CSA would be 11.3 µg/m^3 during a peak period on any given day. The standard set by EPA for $PM_{2.5}$ levels over a 24-hour period is 35ug/m_3.

Importantly, there is no evidence of a safe level of $PM_{2.5}$. Researchers have found a linear relationship between $PM_{2.5}$ at levels of zero to 35 µg/m^3 and increases in deaths (Schwartz, 2002). In other words, pollution levels below federal regulatory standards cannot be considered completely safe for human health; individuals – and vulnerable populations in particular – may be adversely affected by air pollution even when EPA NAAQS are met.

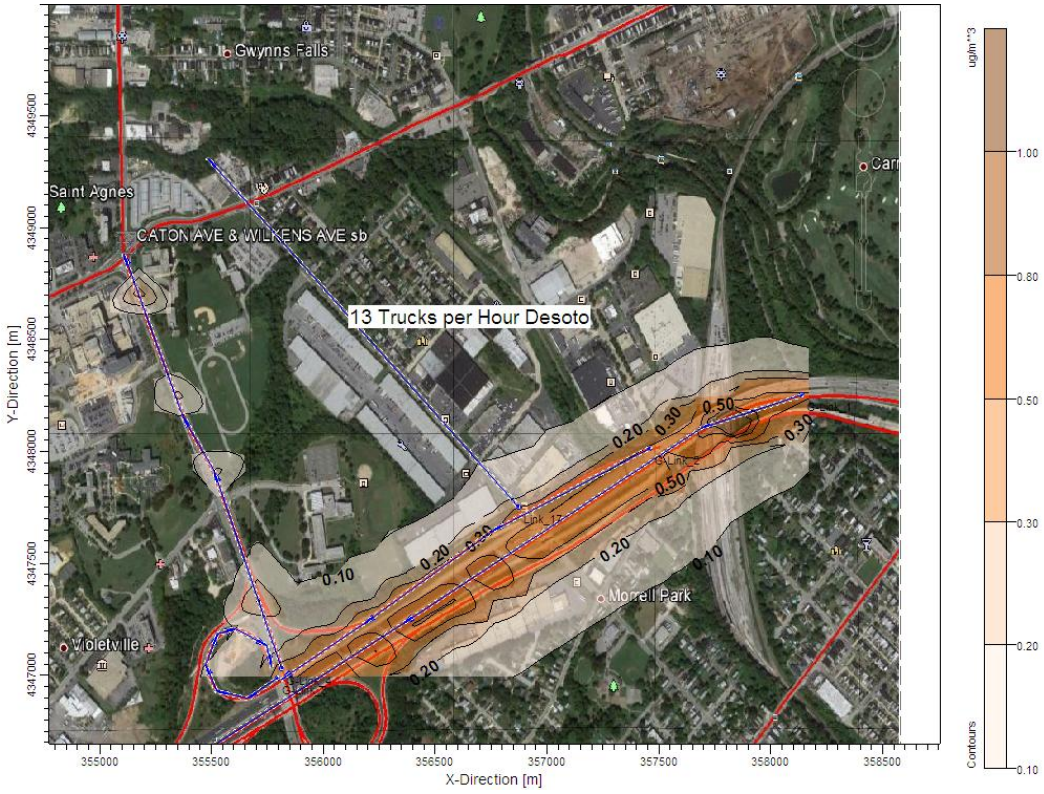

Figure 13: Impact of Truck Traffic Increases on $PM_{2.5}$ Emissions along Desoto Road Route (assuming the trips are evenly spread)

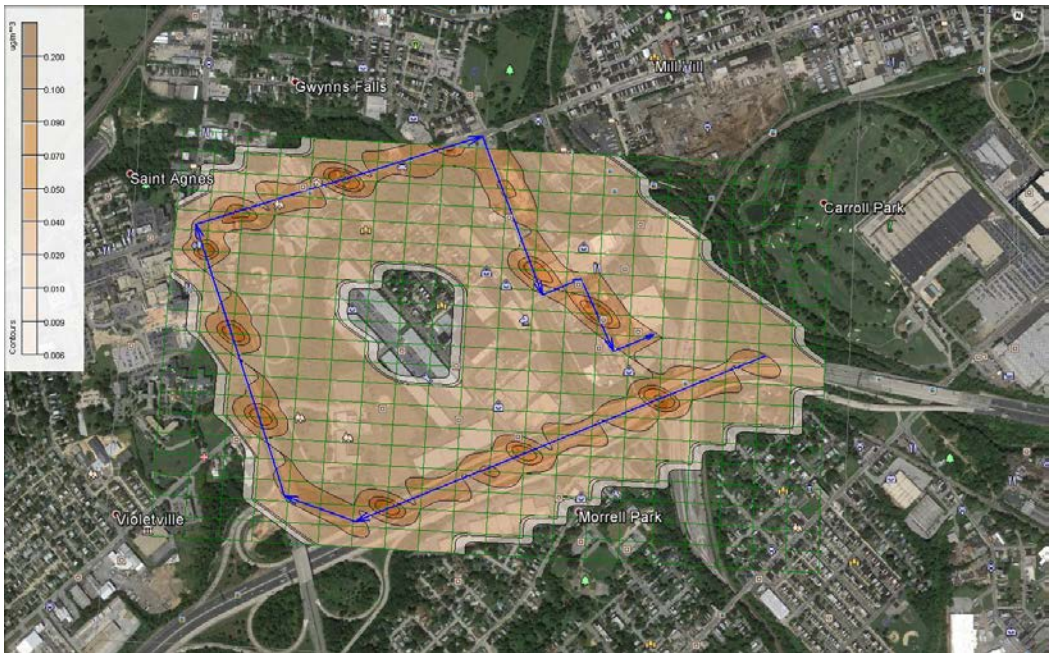

Figure 14: Impact of Truck Traffic Increases on $PM_{2.5}$ Emissions along Bernard Drive Route (assuming the trips are evenly spread)

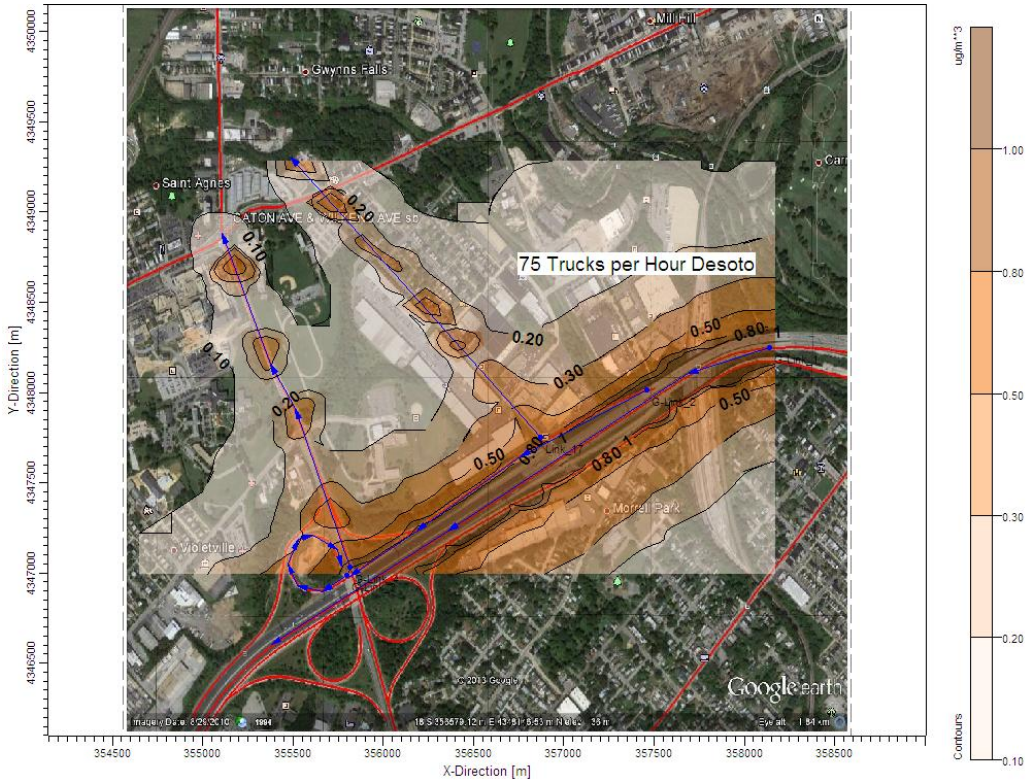

Figure 15: Impact of Truck Traffic Increases on $PM_{2.5}$ Emissions along Desoto Road Route (assuming trips occur during peak hours)

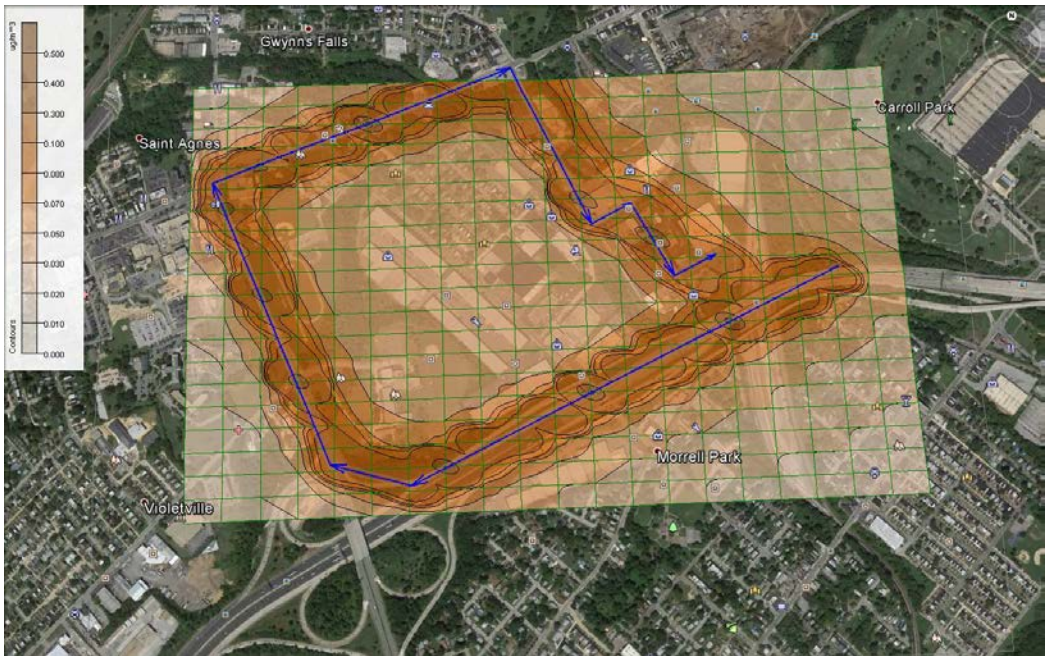

Figure 16: Impact of Truck Traffic Increases on $PM_{2.5}$ Emissions along Bernard Drive Route (assuming trips occur during peak hours)

Using population data from the census block groups surrounding the proposed site location for the population of 3,933 individuals over age 30, we calculated the excess annual mortality rate attributable to $PM_{2.5}$ exposure that could result from the facility using the methods described in Appendix E. The maximum modeled changes in air quality emissions could result in an excess annual mortality risk of 10 deaths per 100,000 individuals attributable to $PM_{2.5}$ exposure if the Desoto Road access option were selected. The Bernard Drive access option could result in an excess annual mortality risk of four deaths per 100,000 individuals attributable to $PM_{2.5}$ exposure. Over 50 years, $PM_{2.5}$ exposure would be expected to result in 14 excess deaths in the Desoto Road option, and eight excess deaths in the Bernard Drive option.

Public health professionals often reference mortality as a rate (e.g., "per 100,000" or "per one million") to compare rates or risks of injuries, diseases, and other measurable health outcomes among populations. This technique allows comparison of health outcomes among populations of different sizes by normalizing the rate in the actual population to a comparable rate in a standard population size. To put into context the risk of 10 or four "excess deaths" from the two potential truck routes for the intermodal facility, consider that the Department of Health and Human Services in its *Healthy People 2010* report found the death rate among women during childbirth was unacceptably high at a rate of 12.1 deaths per 100,000 live births. The agency has set of goal of reducing that rate through programs and services to 3.3 deaths per 100,000. Put another way, the Federal government makes financial investments and enacts regulations for excess mortality levels that are below the excess annual mortality risk that Morrell Park/Violetville residents may face due to operations of the proposed intermodal facility.

6.1.4 Resident Perspectives on Potential Air Quality Impacts

Focus group participants believed that even as their neighborhood sits adjacent to I-95 and has been the site of train operations for decades, the additional traffic and operations will make the intermodal facility a significant source of air pollution in Morrell Park. Residents noted the nature of the facility as a permanent fixture, and indicated that it would be the heaviest industrial operation in the area.

"If you have 150 tractor trailers coming through every day sitting idle and waiting to be unloaded in addition to whatever other machinery is going to be over there, I don't think you have to be an expert to know that [air quality is] going to get worse." –Focus Group Participant

The children of one focus group participant were already planning on moving away from the neighborhood due to fears of the project worsening air quality. She said, "My kids are moving and actually this project has a lot to do with that…they already have asthma and their just scared to death about the impact on the air quality."

Residents also highlighted the need for appropriate monitoring of baseline and future air quality conditions. As one focus group participant stated, "You're never going to know [how the facility impacts air quality] for sure unless you do some kind of an air quality study on those areas directly adjacent to the property now. And then if the facility goes through, another air quality study later and have to…hold some people accountable for it, if this is our air quality study now, and we do it again six months after the facility is open, and we have an issue...But surely, I think you could have something drawn up and agreed to, in writing, that if this were the situation, that, you know, there would be something done."

6.1.5 Limitations and Data Gaps

The air quality models likely underestimate the total air quality impacts of the facility due to limitations in the modeling and data gaps. With regard to the baseline conditions, which are critical to making accurate health predictions, the location of the air monitoring station 4 miles from the site location may underestimate the pollutant levels to which Morrell Park/Violetville residents are currently exposed. Nitrogen dioxide concentrations on roadways are, on average, 80 percent higher than concentrations measured at central site monitors (EPA, 2008).

In addition, the air quality models use average meteorological conditions, rather than using peak hour meteorological pollutant concentrations. This is important for analysis of intermodal operations as, according to the Traffic Impact Study of the proposed facility, morning peak hours would see heavier volumes of tractor-trailer truck traffic compared to afternoon peak hours, with 80 percent of the trucks in the morning peak hour exiting the site.

The analysis does not account for congestion-related impacts. These impacts include a decrease in the average speeds of traffic, a potential impact of increased truck traffic. Lower average speeds increase travel time, increasing produced emissions, and they also result in vehicle-induced air turbulence on roadways, reducing dispersion of vehicle-related pollutants and

resulting in an increase in pollutant concentrations from roadway sources. Increased truck traffic to and from the facility site may also alter driving patterns along truck routes, including increasing frequency of speed-ups, slow-downs, stops, and starts. These actions produce greater volumes of emissions than vehicles operating in cruise conditions, and the difference is particularly significant for vehicles with high-powered accelerations, like tractor trailers (Zhang & Batterman, 2013).

The analysis does not account for several other potential sources of pollution, including: existing train emissions in the neighborhood, potential emissions from onsite machinery *and* from trucks idling at the facility, and the impacts of vehicle incidents (collisions) on emissions. The increase in truck traffic on roadways may result in a greater number of collisions and breakdowns on roadways. Incident congestion may be associated with acute health outcomes, such as asthma exacerbation (Zhang & Batterman, 2013).

Additionally, based on statements from CSX and MDOT that train traffic would remain constant and truck traffic would not increase beyond stated maximum capacities, NCHH did not model any incremental increases in truck trips, trains, or other machinery.

Finally, the conclusions of the analysis are based primarily around the EPA NAAQS, which have been shown to exceed levels that may yield negative health outcomes, particularly for vulnerable populations (EPA, 2008). The models also only looked at one ($PM_{2.5)}$ of many harmful pollutants from vehicles for reasons previously described. PM_{10}, ultrafine particulates, CO, NO_x, Ozone, SO_x, and VOCs are other chemicals that are known health hazards.

6.1.6 Air Quality: Conclusions and Recommendations

The impact of the facility on the air quality in the community is not a trivial matter given the disproportionate existing air quality-related health burden in the Morrell Park/Violetville neighborhoods. NCHH offers the following recommendations on air quality based on the findings presented above:

- CSX and the Maryland Department of the Environment should complete the air quality models begun in this HIA to more fully assess the existing air quality in the community(including existing train emissions) and project the added impacts of the facility (including idling, trains emissions, machinery, congestion, et cetera.) on air quality and excess mortality.

- The City of Baltimore should enforce the maximum number of daily truck and train trips associated with the intermodal facility to ensure that the facility's capacity and usage does not grow beyond the identified maximum capacities.

- CSX should make all efforts to reduce air pollution resulting from on- and offsite equipment and vehicles. For example, the City and CSX should pursue opportunities to require and

encourage that all trucks entering the facility be 2008 or newer.[16] CSX should pursue opportunities to ensure that all diesel trains associated with the intermodal facility are low emitting or retrofitted to provide the lowest possible emissions. Wherever possible, container cranes, loaders, and forklifts should be either electrically powered or equipped with low emitting engines. CSX should ensure that no unnecessary truck or train idling occurs.

- CSX should provide funding to the Maryland Department of the Environment to install and operate air quality monitors at several locations, including: near residences directly adjacent to the project site and associated truck routes; at locations one-quarter mile and one-half mile from the site and associated truck routes; and at sensitive receptor sites such as schools, community centers, libraries, senior facilities, parks, and playgrounds. These data should be monitored at least annually following the opening of the site, should be made public, and should be provided directly to residents of the Morrell Park/Violetville CSA.

- If pollutant levels indoors or outdoors sites such as schools, libraries, and community and senior centers rise above standards published by the World Health Organization (World Health Organization, 2000),[17] CSX should seek to reduce emissions through pollution control technology and by improving the building performance (e.g., through reduced air leakage and improved ventilation), reducing emissions through pollution control technologies, and installing additional natural buffers and barriers.

- The Maryland Department of the Environment should work with agency and academic partners to conduct additional air quality modeling to assess the existing air pollution burden in the region and city from freeways, trucks, and train emissions. This information should be used to inform the future planning of infrastructure projects.

- The Baltimore City Health Department should continue to monitor the health outcomes among residents in the Morrell Park/Violetville CSA that could be directly impacted by the facility, such as asthma and respiratory disease, cardiovascular disease, mortality, and traffic collisions on an annual basis.

[16] Note: The Port Authority operates a program to assist fleets with upgrading their trucks to reduce emissions and improve air quality.

[17] Note that the WHO standards are for outdoor pollutants. No established standards exist for indoor air pollutants. However, if pollutant levels are at or above outside thresholds in indoor spaces, mitigations would be prudent.

6.2 Employment

Income is one of the most important and consistently documented predictors of health status. A good-paying job makes it easier for workers to live in healthier neighborhoods, provide quality education for their children, secure child care services, buy more nutritious food, and meet other basic needs—all of which affect health. Good jobs also tend to provide health insurance and other benefits such as paid sick leave through their employment. Higher earning also translates to a longer lifespan. By contrast, unemployed and low-income Americans face numerous health challenges.

6.2.1 The Evidence: Employment and Health

Having a very low income or living in poverty is associated with higher likelihood of premature death, low birth weight, chronic disease, suffering from injuries or violence, heart disease, and depression, among many other health outcomes (Yen & Syme, 1999; Yarnell, et al., 2005; Berube & Katz, 2005). In addition, benefits received as part of employment, such as health insurance, can impact health outcomes by providing access to preventive care (Faulkner & Schauffler, 1997). Economic resources can influence health through a number of different pathways, including providing access to health-promoting goods and services such as health care and healthy foods; impacting one's psychosocial experience through work, home, and neighborhood environments as well as through chronic stress associated with economic hardship; and through cumulative effects of economic advantage or disadvantage that occur over one's lifetime (Robert Wood Johnson Foundation, 2011).

The impacts of income on health begin at early stages of life. Research has demonstrated that babies born to low-income mothers are more likely to have a low birth weight, which is linked to child development and chronic health conditions later in life (Blumenshine et al., 2010; Braverman & Barclay, 2009). Children below the federal poverty level are seven times more likely to be in poor or fair health than children in families with incomes at or above 400 percent of the federal poverty level (Braveman et al., 2010). These relationships between income and health hold true throughout one's life. Adults living below the federal poverty level are nearly five times more likely to report being in poor or fair health than adults who have family incomes at or above 400 percent of the federal poverty level (Braveman & Egerter, 2008). In addition, a large body of research demonstrates strong associations between coronary heart disease (CHD) and poor socioeconomic status (Skodova, et al., 2008).

Epidemiologic evidence demonstrates a strong association between unemployment and many adverse health outcomes, including rates of overall mortality, mortality due to cardiovascular disease, and suicide (Jin, Shah, & Svoboda, 1995). Income fluctuations (for example, due to decreasing job security) are also associated with adverse health outcomes. A longitudinal study of nearly 5,000 individuals demonstrated that frequency of income loss was associated with increased depression (Prause, Dooley, & Huh, 2009).

Employment can also have a positive impact on health by providing access to employee benefits such as health insurance and paid sick days. An analysis of the Centers for Disease Control and

Prevention's (CDC's) Behavioral Risk Factor Surveillance System (BRFSS) data on over 50,000 adults ages 18 to 64 demonstrated that health insurance coverage is one of the most important determinants in whether or not adults receive recommended preventive care (Faulkner & Schauffler, 1997). Other studies have replicated these findings, confirming that individuals with health insurance are more likely to receive preventive care services (Culica et al., 2002).

Figure 17 demonstrates the relationships between employment and potential health outcomes from developing and operating the Baltimore-Washington Rail Intermodal Facility. Although tax revenues and associated impacts on health are included in the pathway below, information on tax revenues will be addressed through the neighborhood resources section.

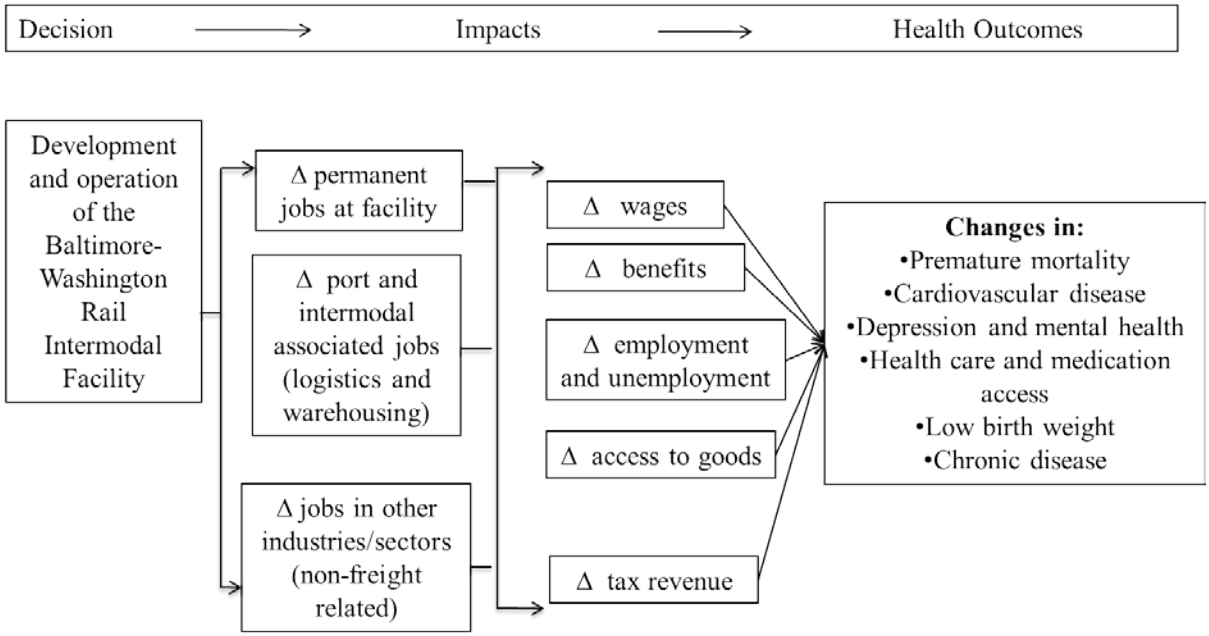

Figure 17: Employment Pathway
Legend: Δ = *"change in"*

6.2.2 Existing Conditions: Employment

The major businesses and potential employers within a one-mile radius of the Mount Clare site include St. Agnes Hospital and the businesses of the Crossroads Desoto Industrial Park. A small number of restaurants are located along Washington Boulevard, south of the proposed site.

Focus group participants and stakeholders perceived the communities surrounding the Mount Clare site as predominantly blue-collar, with some white-collar workers. Focus group participants reported that employed community residents typically either travel to downtown Baltimore for work or work in home improvement trades. Participants felt that the employment profile has changed recently, with higher unemployment (and its consequences) becoming a growing concern for the community.

"This is an area and a community [that] used to be basically middle class blue collar workers, with some white collar in there. Now it's predominantly unemployed blue collar…." –Focus Group Participant.

Table 7 displays unemployment rates of the Morrell Park/Violetville CSA, Baltimore City, and Maryland. Although unemployment rates for the Morrell Park/Violetville CSA as a whole are lower than those in Baltimore City and the state of Maryland (5.8 percent vs. 12.6 percent and 7.3 percent), disaggregation of the data by census tract reveal a higher prevalence of unemployment in census tracts located within a quarter mile of the facility site[18] (see Figure 18), particularly in comparison to demographically similar populations. For example, unemployment rates of white residents in census tracts 2502.06 and 2503.03 (9.3 percent and 15.7 percent, respectively) are significantly higher than those in both Baltimore City and Maryland (6.5 percent and 5.5 percent, respectively). Similarly, 31.5 percent of African-Americans in census tract 2503.03 are unemployed, compared with 16.4 percent of African-Americans in the city and 11.0 percent in the state. The close proximity of these census tracts to the Mount Clare site also puts them at risk of bearing the greatest burden of the impacts of facility operations. More than 11 percent of families in the Morrell Park/Violetville CSA are living in poverty,[19] compared to 15.2 percent in the city, 5.3 percent in Baltimore County, and 6.1 percent in the state.

[18] A portion of Census Tract 2102 sits within a quarter mile of the site; however, NCHH excluded this census tract from this analysis due to the fact that the portion of the census tract within the quarter mile buffer is part of the Carroll Park Golf Course.

[19] The U.S. Census Bureau uses a set of money income thresholds that vary by family size and composition to determine who is in poverty. If a family's total income is less than the threshold for that family size, then that family and every individual in it is considered in poverty. For example, for a family of four in 2013, the federal poverty threshold is $23,550.

Table 7: Employment Status, 2007-2011 American Community Survey Five-Year Estimates

	Census Tract 2502.06[1]		Census Tract 2503.03[1]		CSA (aggregate)		Baltimore City		Maryland	
	#[2]	%	#[2]	%	#[2]	%	#[2]	%	#[2]	%
Total unemployment[3] (all races)	103	8.3%	194	18.4%	380	5.8%	39,347	12.6%	231,047	7.3%
Unemployment, by race and ethnicity:										
One race:										
White	96	9.3%	131	15.7%			7,021	6.5%	104,545	5.5%
Black or African-American	X	X	63	31.5%			30,354	16.4%	100,758	11.0%
American Indian and Alaska Native	X	X	X	X			193	15.4%	950	10.4%
Asian	X	X	X	X			472	5.9%	8,296	4.7%
Native Hawaiian and Other Pacific Islander	X	X	X	X			X	X	X	X
Other	X	X	X	X			473	10.8%	9,685	8.9%
Two or more races:	X	X	X	X			902	17.0%	5,577	10.4%
Hispanic or Latino (of any race)	X	X	X	X			1,242	9.0%	20,900	8.2%
White only, not Hispanic or Latino	96	9.4%	131	19.8%			6,432	6.4%	95,666	5.4%

[1] Large confidence intervals for some census tract-level estimates.
[2] Counts derived by first multiplying the estimated percent of population in the civilian labor force and the estimated population, then multiplying the result by the estimated percent unemployed. Therefore counts should be taken as rough estimates only.
[3] The American Community Survey defines the unemployment rate as "the number of unemployed people as a percentage of the civilian labor force."
X Values suppressed for counts less than 25 due to concerns about the reliability of estimates for smaller sample sizes.

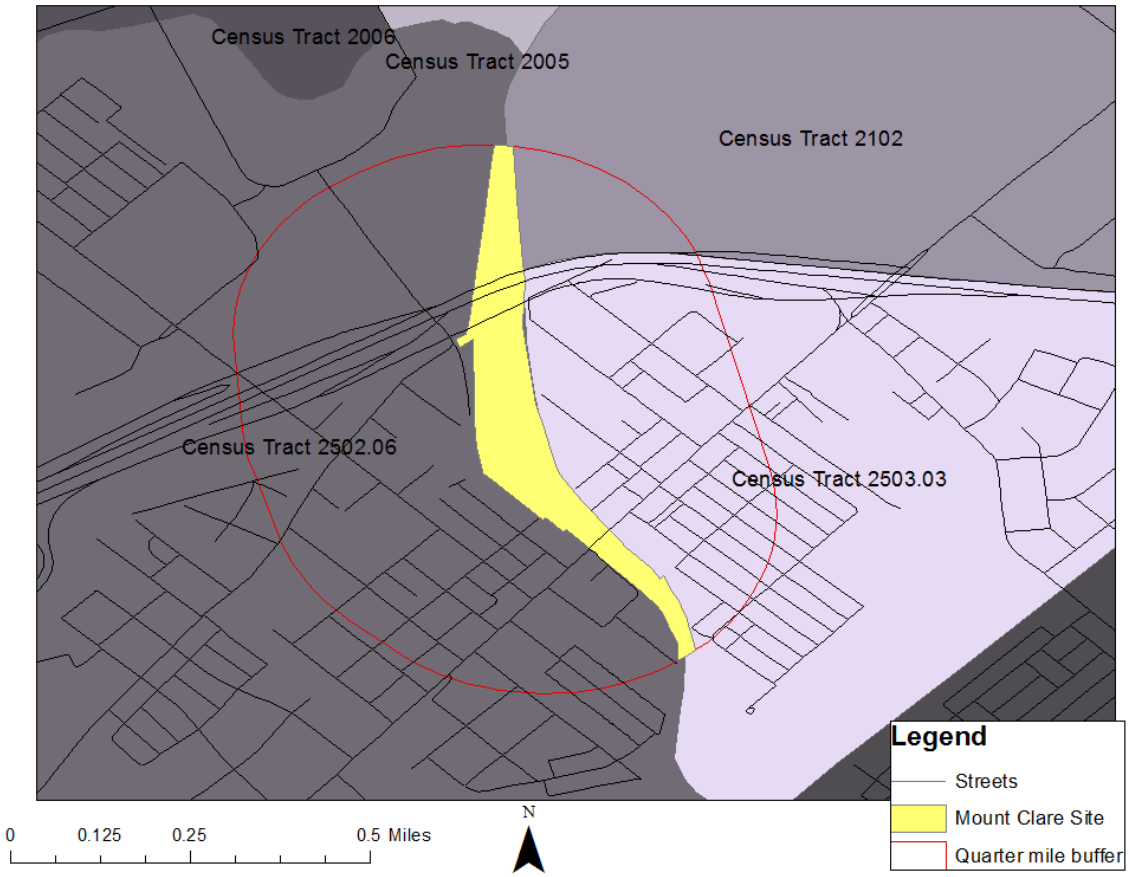

Figure 18: Census Tracts Surrounding the Mount Clare Yard

Residents also noted a perceived decline in the number and variety of businesses in the community over time, with a subsequent negative impact on neighborhood vitality and reduced potential for economic growth and access to vital services.

"We need a pharmacy. We need a dollar store, a real dollar store." – Focus Group Participant

The absence of local economy has negative implications for neighborhood resources, social cohesion, and may also indicate a likelihood that without intervention, the prevalence of unemployment in these neighborhoods will persevere or even increase.

As previously mentioned, the proposed intermodal facility is part of a broader effort to increase the competitive advantage and capacity of the Port of Baltimore following the completed expansion of the Panama Canal. The Maryland Port Administration (MPA) estimates that the port currently accounts for $3 billion in wages and salaries, and that businesses operating at the port provide 14,630 jobs (Maryland Port Administration, 2012). Across the state, MPA estimates that 108,000 jobs are linked to activities at the port. In 2011, CSX employed 1,770 workers in Maryland who received $120 million in compensation (CSX, 2012). However, while these impacts may be felt throughout the Maryland economy, the focus group participants did not identify CSX or the port as current employers of local residents.

6.2.3 Projected Impacts of the Intermodal Facility on Employment and Associated Health Outcomes

The proposed intermodal facility poses a potential source of employment opportunities for the Baltimore area. According to a report prepared by Towson University's Regional Economic Studies Institute for the Economic Alliance of Greater Baltimore, once completed, the intermodal facility will support (See Table 8):

- 45 jobs onsite, which will be transferred directly from existing jobs at the Seagirt Marine Terminal, and 192 contractors who transport goods (Irani et al., 2012).
- About 490 jobs during the construction phase.
- 84 induced jobs from spending in local economies. These induced jobs may be the most likely to be available to residents living near the Mount Clare Yard.

Table 8: Estimated Economic Impacts from the Intermodal Facility

Impact on Employment	Direct	Indirect	Induced	Total
Construction Phase	490.1	134.1	167.6	791.8
Operation Phase – Intermodal Facility	45.0	24.0	15.9	84.9
Operation Phase – Contractors	192.0	53.8	68.0	313.8

Source: (Irani et al., 2012)

Further, the Towson University study estimates that, without the intermodal facility to sustain the needed competitive advantage at the Port of Baltimore, the state could lose up to 746 jobs, 387 of which would be direct jobs at the Port of Baltimore (Irani et al., 2012).

However, it is unclear what, if any, impact this could have on Morrell Park/Violetville residents. State and local officials confirmed that, rather than new jobs being created at the intermodal facility, the 45 direct positions at the facility will be transferred from the Seagirt Marine Terminal. Under these conditions, the new facility may not provide direct employment opportunities by CSX for local residents. Focus group participants see indirect or induced jobs resulting from the facility as the only potential employment opportunity resulting from the new facility. Further, some focus group participants reflected that even if CSX operations made jobs available, local residents may not have the skill sets required for jobs at the facility:

"You can't just pick up and get a job working for CSX. You got to know a little bit of something, I'm sure, I mean unless maybe you're security. You can't be an engineer or you can't be a crane operator." – Focus Group Participant

"I mean, unless for some other reason some of the warehouses around here get more business because of the deliveries, that's about the only opportunity we would have." – Focus Group Participant

However, Kathryn Holmes, President of the Crossroads Business Park Association, indicated that CSX operations may have the opposite effect. Holmes stated that, unless the infrastructure of

traffic routes to the Mount Clare site is improved to accommodate the additional truck traffic, the congestion and accidents induced by increases in truck traffic could be detrimental to the small businesses in Crossroads Business Park, potentially leading to a decrease in employment.

Residents participating in the focus groups expressed cautious optimism that the project represents a real opportunity to revitalize the community through the infusion of some new jobs and by attracting new businesses, but only if CSX takes an active role to help broaden the community's economic base.

"We would hope that, with this facility, we could attract other small businesses, maybe commercial, maybe, what's the word I'm looking for, main businesses, brand businesses, to this community." – Focus Group Participant

"We're not going to get better residents and taxpaying people until we have a good economic base, and I'm hoping that CSX will help us develop that economic base." – Focus Group Participant

6.2.4 Limitations and Data Gaps

Beyond the focus group findings, information regarding the employment background and skills of the unemployed and underemployed residents of the Morrell Park/Violetville CSA were unavailable for this report. This limited our predictions regarding the alignment of the jobs being produced at the facility and the ability for those jobs to help reduce unemployment in the CSA.

6.2.5 Employment: Conclusions and Recommendations

Employment has been one of the key benefits to the community discussed by CSX. If an appropriate number of quality job opportunities are provided to local residents, the facility could have a beneficial impact on the community, increasing their income, decreasing poverty, and therefore directly and indirectly improving community health. In addition, as noted in the Neighborhood Resources Section below, drugs and neighborhood crime are a significant concern among residents. Increasing the training, education, and employment of youth who may otherwise be participating in criminal activities would have a significant impact on the community.

The high prevalence of unemployment in the census tracts closest to the Mount Clare site provides an opportunity for the intermodal facility to impact the nearby residential areas positively. If the facility serves as a source of employment for these residents, it will move economic resources into the community, potentially granting numerous benefits, including reductions in poverty, improved neighborhood resources, and increases in social capital. Moreover, increased employment in these areas will positively impact health outcomes as discussed above, potentially counteracting some of the negative health outcomes of residing in close proximity to facility operations.

Focus group participants suggested that CSX could bring job training programs and apprenticeships to help to bridge the gap in skill sets of local residents when compared to skill sets required for employment in CSX operations. This training could contribute to neighborhood economic development and prepare community members for jobs that should be preferentially offered to the community.

Andrew Fellows, Vice-Chair of the Maryland Commission on Environmental Justice and Sustainable Communities, perceives the introduction of employment opportunities as the only possible mitigator for the disproportionate negative outcomes of the intermodal facility on local residents. According to Fellows, "I think that within a facility, especially one that has a negative impact on the community, that one of the mitigating factors would be to take a look if possible at the jobs that could be created by the facility and then actually put it as part of the guidelines or framework or regulatory framework that they actually have to offer jobs to local residents as a first priority."

Delegate Haynes also emphasized the need to move forward with facility operation plans with an eye on economic benefit for the local community, including consideration of local businesses as potential beneficiaries of the influx of workers and economic activity in the area: "What is the footprint going to look like? Is it going to affect access to the existing level of businesses in such a way that it drives customers away because of access or lack of access or increase their businesses because of bringing more people into the area? So, I think that when you look at the final product, the final footprint, and I think that's one of the things that as this project moves forward and trying to engage with the stakeholders in the area is how do we accommodate residents? How do we accommodate existing businesses? And how do we make room for businesses to grow from the anticipated increase of people coming into an area to work, so to speak...?"

NCHH offers the following recommendations on employment based on the findings presented above:

- CSX should work with the Baltimore City Office of Employment Development to set aside living wage positions at the site for residents in the surrounding neighborhoods during construction and operations phases.

- CSX should initiate and maintain an apprenticeship program for at-risk youth from neighborhoods surrounding the Mount Clare Yard to enable access to goods movement-related employment opportunities as the amount of freight moving through Maryland continues to increase.

6.3 Neighborhood Resources

Neighborhood resources, including police and fire services, parks and open space, and schools, impact public health and quality of life by impacting individual exposure to injuries and violence, educational outcomes and associated health outcomes, and physical activity and mental health.

6.3.1 The Evidence: Neighborhood Resources and Health

Neighborhoods can provide access to parks, open space, and healthy foods, all of which can impact physical activity, nutrition, and mental health. Park facilities provide opportunities for recreation and facilitate physically active lifestyles (Transportation Research Board & Institute of Medicine of National Academies, 2005). A prospective analysis of over 2,000 adults ages 45-84 demonstrated that individuals with better neighborhood resources, as defined by access to opportunities for physical activity and healthy foods, had a 38 percent lower incidence of type 2 diabetes, even after controlling for individual diet, physical activity level, and body mass index (Auchincloss et al., 2009). Studies have found that increases in traffic noise at local parks may lead to a more negative perception of those parks (Szeremeta & Zannin, 2009).

Various studies of residents living in Chicago's public housing developments have provided evidence that trees and other vegetation may positively affect residents' activity and mental health. The researchers demonstrated that trees in public spaces resulted in higher use of the space by both children and adults and that children's level of play and supervision by adults was twice that observed in barren public spaces without trees and grass (Taylor et al., 1998; Coley, Kuo, & Sullivan, 1997). Another study of 145 women living in Chicago public housing revealed that residents living in barren buildings surrounded by little or no vegetation reported higher levels of aggression and violence than residents in buildings surrounded by more vegetation, even after controlling for confounding factors (Kuo & Sullivan, 2001). Further, trees and other vegetation can serve as valuable mitigators of air and noise emissions (Nowak, 2002; Bolund & Hunhammar, 1999), potentially reducing the health impacts of air and noise pollution produced by industrial activity.

Given that the funding of public education is controlled by local government, community economic resources are important in determining the quality of neighborhood schools, including the quality of the curricula, the qualifications of teachers, and access to academic counseling (Williams & Collins, 2001). Quality of school systems is important because education is a significant predictor of health status. Lack of high school education is a powerful predictor of the variation of mortality rates among states in the U.S. (Muller, 2002). Independent of income, higher education levels are associated with increased life expectancy (Lleras-Muney, 2005).

Social cohesion is also a potential product of adequate neighborhood resources, including access to goods, fire and police services, parks, and open spaces, as well as perceptions of safety and connections to the community. A vibrant neighborhood environment is one type of setting for social interaction that can lead to an increased sense of community and less crime. Conversely,

streets with high-volume traffic and a high concentration of non-residential land use are associated with higher crime (Appleyard, 1981; Brantingham, 1981).

Social networks and interaction have been linked to improvements in physical and mental health through multiple mechanisms (Sullivan, Kuo, & DePooter, 2004). Social support, perceived or provided, can buffer stressful situations, prevent feelings of isolation, and contribute to high self-esteem (Cohen, Underwood, & Gottlieb, 2000). Group membership within a community and participation in social activities have been shown to decrease mortality rates and cognitive impairment (Kreuter & Lezin, 2002; Hsu, 2007).

Property values are an important part of neighborhood resources, as they are an indicator of community wealth, which has potential health implications. Significant changes in property values, as demonstrated through the recent literature generated on housing foreclosures, can enact economic hardships on homeowners through loss of home equity and impacts on housing stability (Immergluck & Smith, 2005). Using data on foreclosures in the city of Chicago, researchers estimated that every foreclosure within a city block results in at least a 0.9 percent decline in property values per single-family home (Immergluck & Smith, 2005). This research also demonstrated that nearby foreclosures had an even larger effect on single-family property values within low- and moderate-income census tracts. Foreclosures also impact tax revenues for cities, counties, and local school districts (Immergluck & Smith, 2005). The direct impacts of foreclosure on homeowners include: the damaging of credit rates, affecting one's ability to move to a new home and lessening one's ability to get loans; the loss of the home as an asset along with accumulated equity and tax advantages of homeownership; and high levels of stress, which in turn can impact health (Kingsley, Smith, & Price, 2009).

The specific impacts of freight intermodal facilities on surrounding property values have not yet been evaluated in the published literature. However, studies on the effects of truck and freight traffic on property values have been conducted and provide insight on the potential impact that operation of the new intermodal facility at the Mount Clare site may have on housing values in the adjacent communities. There is evidence of a correlation between increased roadway traffic and diminished residential property values. A study conducted in Baton Rouge, Louisiana determined a significant 0.5 percent negative change for each 1,000 annual average daily traffic (AADT)[20] in suburban areas, and a one percent negative change per 1,000 AADT in city areas (Hughes & Sirmans, 1992).

Increases in railway traffic have also been associated with diminished residential property values for nearby houses. In 1997, CSX and Norfolk Southern combined operations in Cleveland, acquiring Conrail and consolidating track utilization. One study analyzed residential housing values in the area surrounding the train operations from 1996, before announcement of the project, and again in 1999, when operation of the new system had been fully implemented (Simons & Jaouhari, 2004). With 95 percent confidence, Simons and Jaouhari researchers calculated a loss in residential housing value of $194 per average daily freight trip for smaller

[20] Annual Average Daily Traffic is the average daily traffic on a roadway for all days of the week during a period of one year and is expressed in vehicles per day.

housing units within 250 feet of the railway. Sales prices of units located between 251-500 feet and between 501-750 feet also saw losses of $85 and $94, respectively. These smaller units were largely located in central city or inner-ring working-class suburbs. Medium-sized units within 250 feet of tracks were found to drop $262 in property value per average daily freight trip, again with 95 percent confidence. All other findings were significant at 85 percent confidence.

Another study found a correlation between the frequency of train horns and property value; value depreciation was greater for houses located near crossings where train horns were used more frequently (Clark, 2005). This may indicate that the negative association between railway traffic and residential property values will be magnified in the case of an intermodal facility, as trains need to signal movement at the site and when traversing the neighborhood at on-grade crossings.

The proposed intermodal facility may be appealing to business that use rail to ship their commodities, potentially increasing the value of surrounding properties for industrial use. Realtors in Chambersburg, PA, the site of a new CSX intermodal facility, indicated that proximity to the intermodal will likely make surrounding properties attractive for commercial and industrial applications, increasing the property value for these land uses. However, these real estate agents approximated that less than a dozen homes were affected by the construction of the facility, and that CSX redirected facility traffic so that it was not using residential roads. It was noted that a more populated site location may have had a negative impact on residential properties; “If [facility access roads] were to be close to any of our residential areas, yes, there would have been a loss of value and additional inventory in those areas,” said Michael Cordell of Cordell Real Estate LLC.

As discussed in the Employment section, potential reductions in employment and property values could reduce revenue for public resources (e.g., police and fire). Taxes are the most common source of funding for fire and emergency service departments, and local property taxes are a primary component of this funding. If local property values decrease, revenue from these taxes will also decrease, reducing funding for essential emergency services in the area. Revenue from real estate transfer taxes, which tax at the time of sales, will also decrease if properties near the facility site are perceived as less desirable (United States Fire Administration, 2012). Reductions in these services may yield an increase in crime, violence, and fire hazards.

One question is whether the facility will also bring new sources of tax revenue to the city of Baltimore, which would offset the potential reduction in property values. The Towson University study of the economic impacts of the Panama Canal expansion on the Port of Baltimore determined that the construction phase of the proposed intermodal facility would generate approximately $4.2 million in state and local tax revenues. Operation of the proposed intermodal facility is expected to generate approximately $0.3 million in annual state and local tax revenues, and $2.1 million of state and local taxes will be generated by the contractors (Irani et al., 2012). The study concludes that the proposed intermodal facility project would generate considerable tax revenues for Maryland. However, this tax revenue will be dispersed across the state, while residents in the communities surrounding the Mount Clare Yard will bear a disproportionate share of the burden of the potential negative impacts of the facility’s construction and operation.

Figure 19 demonstrates the relationships between neighborhood resources and health outcomes potentially impacted by developing and operating the intermodal facility at the Mount Clare Yard.

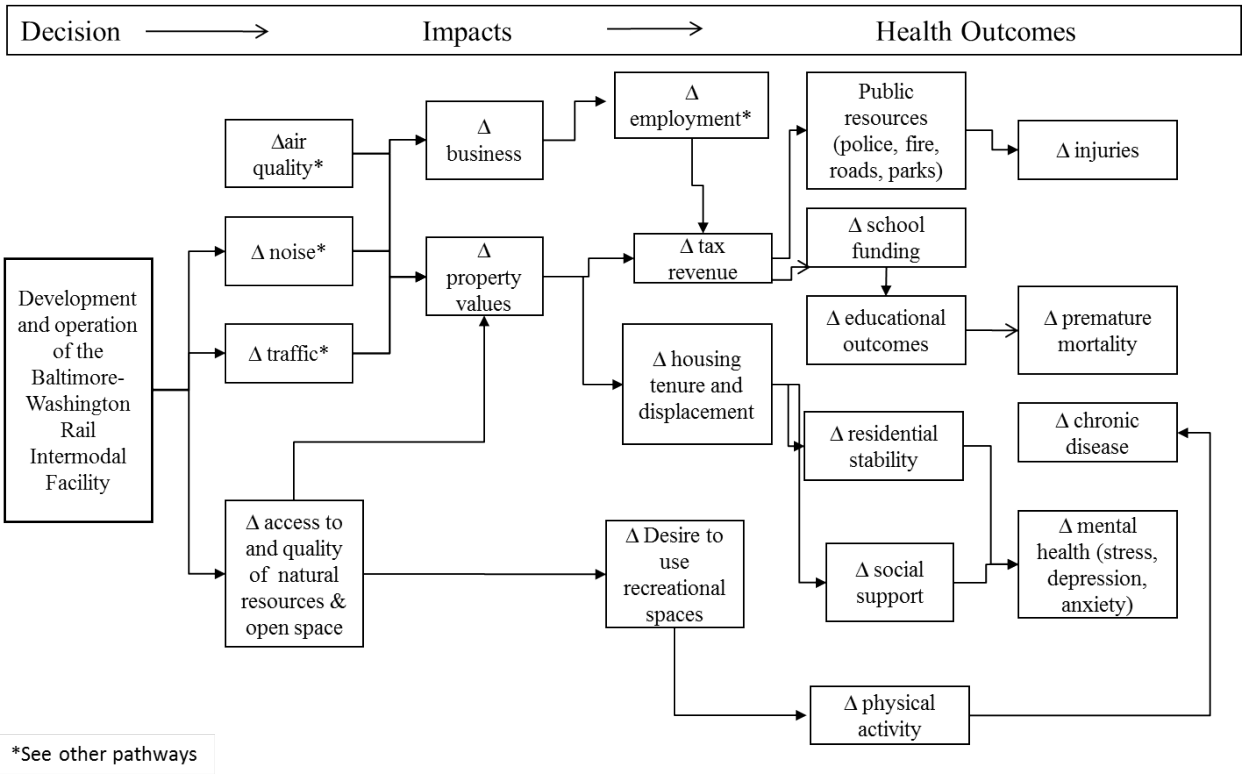

Figure 19: Neighborhood Resources Pathway
Legend: Δ = *"change in"*

6.3.2 Existing Conditions: Neighborhood Resources

When asked what they love about their homes and their neighborhood, one focus group participant responded, "It's sort of like being in the city but also being in the country. We have deer and fox and raccoons and all kinds of wildlife and we have a beautiful wooded lot and just love it…" However, participants also expressed considerable concern with decline in neighborhood quality in recent years. As one participant said, "This was like being in the country, but you were in the city. And it was a wonderful place. We've lost a lot of it, and it's – we've not lost it all, but we've lost a lot of it, and I think this project is just going to make it worse." Residents recalled neighborhood activities aimed at bringing local families together that had long since stopped, and expressed that they missed these social opportunities to get together with other residents in the neighborhood. Drugs and drug-related crime were seen as a major driver in neighborhood decline, and a pervasive problem in the neighborhood.

Of particular concern to residents is the lack of an accessible public high school in the neighborhood, to which some participants attributed the high dropout rate in the neighborhood: "We really don't have an option for high school. A lot of the kids just drop out after elementary. I mean, where are you going to go?" Participants noted that although the official Baltimore City policy is that students can go to any school in the city, but the schools that are close by are "not up to par" and that youth risk experiencing violence if they attend those schools. Participants saw this lack of education as connected with a low sense of self-worth and hopelessness among youth in the neighborhood. As one focus group participant said, "You have a lot of kids that are dropping out of school, so they have no education behind them, so they feel they can't do anything, because there is no self-worth…."

Residents in focus groups expressed concern about the general lack of resources for youth in the neighborhood. One participant said, "We don't really have too much out here for the kids. We've got the rec center, we've got the playground, and they got the park at Desoto Road. We don't even have a library. We had a library, they took it out."

Participants emphasized the value of existing, local parks to the community in focus group discussions, particularly Desoto Park. The truck entrance to the intermodal facility had originally been proposed next to the park, but was strongly objected to by residents to avoid truck traffic on a residential road next to a large green space. Delegate Haynes reiterated the importance of parks and green spaces to the community. Haynes said, "Carroll Park, great park… And we have the Carroll Park Golf Course… that open space is invaluable. Along with the Little League ball field, which is nestled within the community, these are some great green spaces which are being used. I think it is tremendously important to move forward while protecting some of our most precious gems—the green spaces that we have in the city."

The Mount Clare Yard also sits near a portion of the Gwynns Falls Trail, which travels through an environmentally valuable urban greenway park in west and southwest Baltimore City along the Gwynns Falls stream valley, a historically and culturally significant area. Residents are concerned that the increase in operations at the site may produce noise emissions, runoff, and crime that would negatively impact the trail.

Participants felt that the Morrell Park community had experienced a neglect of investment compared to other communities in Baltimore. As one focus group participant said, "In the past, this community has been neglected when you look at other communities."

Many participants enjoyed living in Morrell Park because of its proximity to downtown Baltimore: "It's really nice and it's convenient. You get off the highway; you get to the Inner Harbor in a couple of minutes or wherever you need to go right off of I-95, so the access is really nice. It's a really nice, niche community." However, participants noted that the neighborhood is very dependent on automobiles. Due to the lack of a "main street" area, residents do not really walk other than to access the parks or to just take a walk around the neighborhood. Residents also discussed the impacts of changing bus lines on neighborhood accessibility. "[The Route 36 bus line] was more convenient….before they switched the routes…the city came through and said 'Oh, well, we're changing your route.' The impacts of former bus route changes are

particularly important to consider given that one of the truck route options would require re-routing the MTA Route 35 bus line, which runs from the neighborhood of Franklin Square in northwest Baltimore to the community of Arbutus, which is located in Baltimore County. The bus currently runs from 4:30 a.m. to 12:30 a.m. daily, and services both Johns Hopkins Hospital and St. Agnes Hospital and provides access to downtown Baltimore.

Property Values: Table 9 includes the baseline property values for the community. The City of Baltimore uses five categories to characterize the housing market typology within a neighborhood: regional choice, middle market choice, middle market, middle market stressed, and distressed. The census block group in which the facility would be located is currently characterized as middle market stressed. The markets within other census block groups in close proximity to the site range from middle market stressed to middle market choice.

Table 9: Baseline Property Values

Census block group[21]	Market category	Sales 2009/ 2010	Commercial/ residential land ratio	Units per square mile	Vacant lots	Vacant house notices	Foreclosure filings	Median sales price 2009/ 2010	Owner occupied
2502 061	Middle market stressed	18	0.5	652	13%	1%	6%	$62,251	70.5%
2502 063	Middle market choice	21	6.28	1,540	14%	1%	4%	$112,500	75.4%
2503 032	Middle market	12	19.6	8,200	1%	1%	6%	$88,603	76%
2503 033	Middle market stressed	17	9.9	3,188.89	31%	2%	4%	$55,000	45.1%

Market Category Definitions[1]

Middle Market Choice: Neighborhoods in the Middle Market Choice category have housing prices above the city's average with strong ownership rates, and low vacancies. However, these neighborhoods show slightly increased foreclosure rates. Modest incentives and strong neighborhood marketing should be used to keep these communities healthy, with the potential for growth.

Middle Market: Neighborhoods in the Middle Market category have median sale values of $91,000 (above the City's average of $65,000) as well as high homeownership rates. These markets experienced higher foreclosure rates when compared to more competitive markets, with slight population loss. Neighborhood stabilization and aggressive marketing of vacant houses should be considered in this category. Diligent housing code enforcement is also essential to maintain the existing housing stock.

Middle Market Stressed: Neighborhoods in the Middle Market Stressed category have slightly lower home sale values than the City's average, and have not shown significant sale price appreciation. Vacancies and foreclosure rates are high, and the rate of population loss has increased in this market type, according to the 2010 Census data. Based on these market conditions, intervention strategies should support homeowners who may be facing economic hardships due to adverse changes in the national economy.

[21] Baltimore City 2011 Housing Market Typology: https://data.baltimorecity.gov/Community/2011-Housing-Market-Typology/782b-zpd7.

Emergency Response Services: The Southwest District Police Station is responsible for emergency response services for the Morrell Park/Violetville area, and is located north of Wilkens Avenue on Font Hill Avenue, approximately one mile from the site location. Fire services are provided by Squad 47 of the Baltimore City Fire Department, which is based on Washington Boulevard just south of Mount Clare Yard.

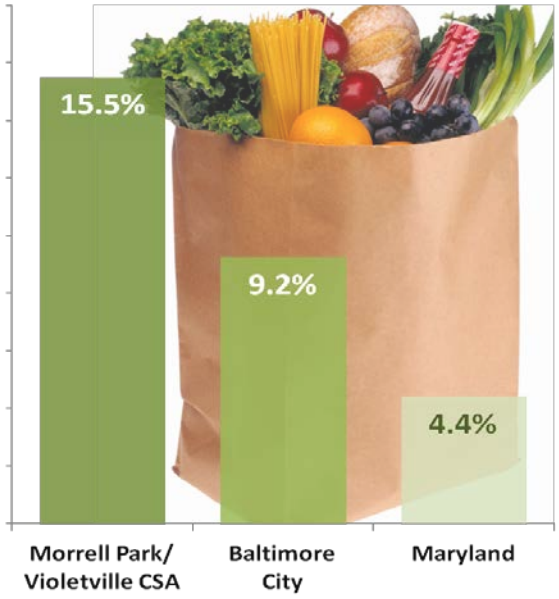

Figure 20: Proportion of Housing Units without Vehicle Access that are Also Located a Half Mile or More from the Nearest Supermarket[1]

6.3.3 Projected Impacts of the Intermodal Facility on Neighborhood Resources and Associated Health Outcomes

Neighborhood Fabric and Social Cohesion: Focus group participants expressed concern over the changing land use mixture in the neighborhood and that the facility may result in many residents moving. Residents expect the facility to make the neighborhood much more industrial. Other participants expressed concern that the facility would exacerbate many of the existing problems in the neighborhood.

"I really don't know what's going to happen but in my mind I see it becoming more of an industrial neighborhood. I don't really like the vision that I have of it."

"Our neighborhood is definitely going down. And what I think, and I hate to say it, I think this is going to make it worse."

"I don't know how it's going to change the things that are alarming right now. I mean we have a problem with drugs in the neighborhood right now. We have a problem with rodents, a terrible problem. I think that's going to get a lot worse."

Bonnie Phipps, President and CEO of Saint Agnes Healthcare, reflected that the movement of industry into the Morrell Park/Violetville neighborhoods is contradictory to the efforts of the community in the past years to make the area more resident-friendly. Stakeholders felt that the introduction of the facility would discourage use of certain neighborhood resources, such as a memorial garden set up by the community on CSX property. Focus group discussions indicated that homeowners with sufficient resources may move away from the neighborhood to avoid intermodal operations, further straining or decreasing the strength of existing social networks and weakening social cohesion.

As noted in the Employment Section, focus group participants expressed significant concern over the neighborhood's declining economic base and the lack of access to essential goods and services in the neighborhood, such as pharmacies and grocery stores. One measure of a healthy community is the extent to which communities have easy access to a grocery store with affordable fresh foods. Compared to Baltimore City and the State of Maryland, the Morrell Park/Violetville CSA has a higher proportion of households without vehicle access that are more than a half mile from a supermarket. Within the CSA, 21.6 percent of the households in Census Tract 2503.03 and 9.7 percent of the households in Census Tract 2502.06 do not have access to vehicles and are located more than a half mile from a supermarket (see Figure 20 and Appendix F for additional detail).

Property Values and Mobility: Focus group participants expressed concern with the manner in which CSX had been working to acquire residential properties near the proposed site location. Participants felt that the offers made by CSX to homeowners were too low, and that homeowners were given the sense that they were fortunate to be compensated. As one homeowner said, "They threatened me a little bit with eminent domain, and I figure if they're going to try something like that, they at least have got to go to my price." He continued, "They lowballed me on an offer. It's only three houses now. The two women are in their seventies, and they pretty much buffaloed them into it. The one son stepped up and is going to take his mother. The other woman, I have no idea where she's going. But they've got a roll back in front of her house right now. The other house is mine, and I've even got one guy down at the bottom and I don't think they've offered him anything. I think he's just going to be stuck down there with all—well, with the mess."

Additionally, residents felt concerned about which properties received offers from CSX. Although these determinations were made based on property that needed to be acquired to build and operate the facility, residents felt CSX should make a good faith effort to purchase a number of properties in close proximity to the site so that residents can relocate if they choose. One resident described the mismatch between the number of properties receiving purchase offers and the number that are in close proximity to the site and the railroad tracks. She said, "The track is here, and our houses are here—we're touching. I think those six people ought to be relocated. I mean, six houses—maybe they don't want to, but at least approach them and say, 'This is what's going to happen here in your neighborhood, it's going to be in your back yard 24-7, do you want to live here or would you like us to relocate you?'"

As previously discussed, there are 483 residences located within a quarter mile of the proposed site location. Figure 21 shows the proximity of residential parcels to the proposed site location.

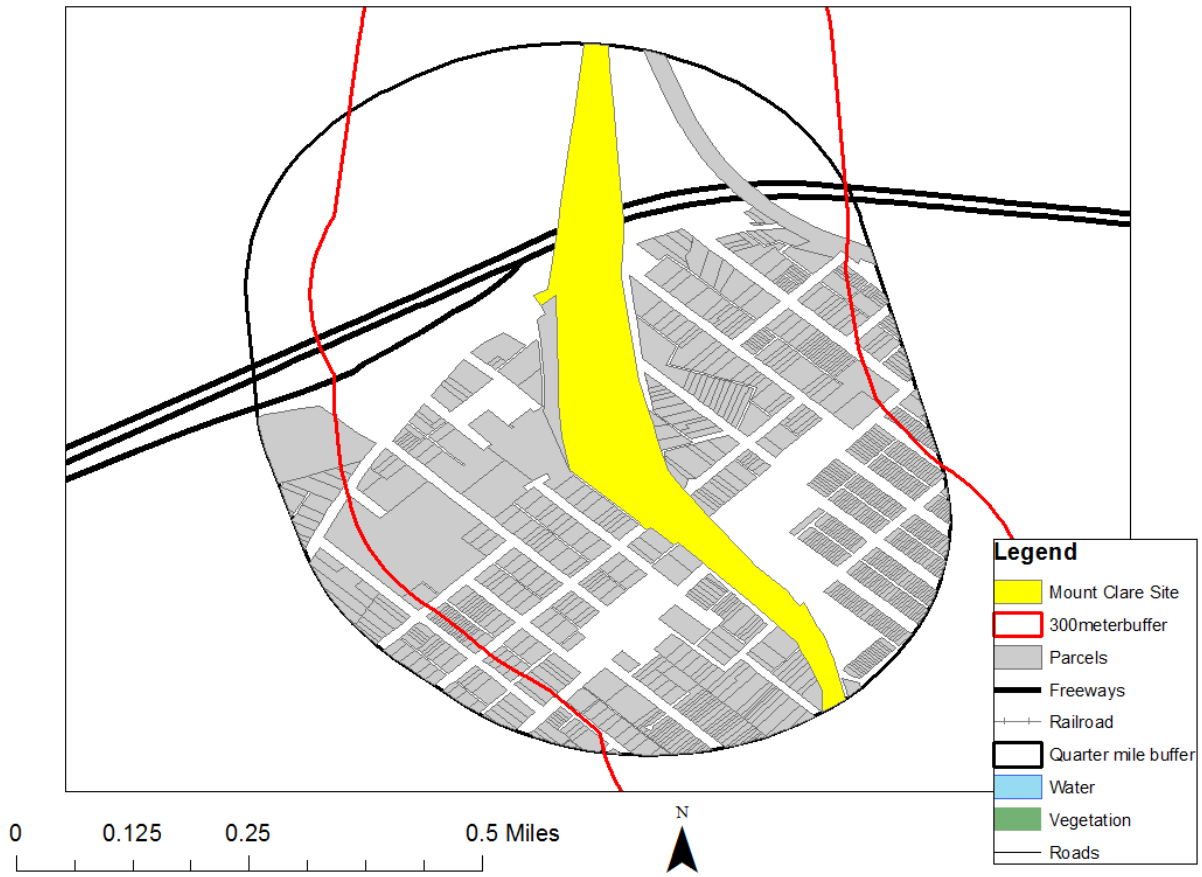

Figure 21: Parcels within a Quarter Mile of the Proposed Site with Residential Land Uses

Residents also noted that the facility could result in a damaging "filtering" situation where those with means are able to leave the neighborhood, and those without remain. As one resident said, "The majority of the people that live in this community are either middle or low income. They're not going to be able to get anywhere. I mean they're going to have to put up with whatever they get and so I think it's very important that somebody care to look into what's going to happen…." Participants discussed that a number of people in the neighborhood are already planning or attempting to move and expressed concerns over the impacts this could have on the neighborhood: "A lot of people are not just talking about moving. They're moving. They're trying to get what they can get for their place now before it happens. So it's definitely going to change the structure of the neighborhood." Other residents would like to move but are financially unable. Some hoped that CSX would make an offer on their properties so that they had the option of moving. As one resident said, "I just want to get out…. Not trying to get rich." Another resident stated, "I think it's bad news for people to be living right on top of this kind of, you know— [It] belongs somewhere where it's commercial, or if it's going to be there, get rid of us."

The Federal Uniform Relocation Act (URA) provides one model for addressing displacement during development projects. The law applies to projects receiving federal funds or federal financial assistance where property is acquired or persons are displaced as a result of acquisition, demolition, or rehabilitation.

The URA requires that the agency conducting the project appraise the property before negotiations, inviting the property owner to accompany the appraiser during the property inspection; provide the owner with a written offer of just compensation and a summary of what is being acquired; pay for the property before possession; and reimburse expenses resulting from the transfer of title such as recording fees, prepaid real estate taxes, or other expenses. If the properties are residential, the agency is required to provide relocation advisory services to displaced tenants and owner occupants; provide a minimum 90 days written notice to vacate prior to requiring possession; reimburse the resident for moving expenses; and to provide payments for the added cost of renting or purchasing comparable replacement housing (U.S. Department of Housing and Urban Development, n.d.).

Participants also noted that many houses in the neighborhood have gone on the market, but owners have had limited success in selling their properties: "We have four houses on our street that are for sale and nothing is moving." Businesses located in the Crossroads Business Park are also concerned about their commercial property values declining if the CSX operations increase traffic congestion in the area.

These potential impacts on property values and residential mobility, and the subsequent effects on social cohesion, stress, and household economic resources, could have significant implications for health.

Access to Parks and Green Space: Focus Group participants noted that the neighborhood currently has a number of parks, as well as the memorial garden near the firehouse. Participants noted that CSX donated the land to help create the memorial garden. However, residents were concerned that no one would continue using the memorial garden once the intermodal facility was built: "There's a piece of property on Washington Boulevard on the side of the tracks and it used to be wooded really. It's next to the firehouse. So I approached CSX a couple years ago and asked them 'Can we use that piece of ground, do something with it if we clean it up?' And they said yeah. So we did, we cleaned it up. And there is a memorial garden up there. Yeah, and it's a nice spot and whenever you ride by there, usually you see somebody just sitting and meditating or whatever. It's a beautiful spot. But I don't think people are going to be sitting there anymore. We just put a grill there, a permanent grill. There's benches. This year we're going to try to put a little play set there for the kids. If [the intermodal facility] is going in, I don't think that's going to be a good spot anymore."

Increased traffic on truck transit routes to the Mount Clare site is a potential threat to the use of the community's parks due to increased traffic noise and road crossings that may be perceived as dangerous (see Figure 24 in the Traffic Safety section). Gibbons Commons, which is in the planning stages, is expected to be a strong community asset, with recreational facilities and a baseball field. However, the park is set to be constructed on Wilkens Avenue, the intended thoroughfare for Mount Clare trucks. As Bonnie Phipps, President and CEO of Saint Agnes Healthcare stated, "[Gibbons Commons], it's going to be a community asset, Cal Ripken's Foundation is going to build a baseball field. We're going to have some housing over there, some workforce housing. We've got interest from a couple people to build some retail over there. I

hope that all those trucks on the street don't kill that project because I'm afraid the people that we had thought would take advantage of the workforce housing are now going to think twice about that, particularly if they have small children."

Noise and threats to pedestrian safety created by truck traffic may dissuade people from taking advantage of the new park, which could in turn lead to reduced physical activity for both adults and children. Reduced physical activity could lead to many negative health impacts, including increased diabetes, cardiovascular disease, and depression.

Emergency Services: Focus group participants viewed the fire and police department as critical resources in the neighborhood. Residents expressed extreme concern with the potential for the railroad to block police and fire response services in the event of an emergency. As one resident said, "In this community we have one fire house. If this railroad down here is blocked, let's say there's a derailment, and there's, just say an emergency up here, and several people were injured.... There is no access to get help to this area, and you're stuck." In addition, the potential for declining property values also portends reduced tax revenue, which could impact funding for police and fire services.

Bonnie Phipps, President and CEO of Saint Agnes Healthcare, also expressed concern about truck traffic as an impediment to emergency response by ambulances from the hospital. At the very least, she said, ambulance sirens would need to be used more frequently, further contributing to noise emissions around sensitive receptors.

6.3.4 Limitations and Data Gaps

Conducting a formal property valuation study was beyond the scope of this assessment. NCHH interviewed a real estate agent who represents the Morrell Park/Violetville CSA and an agent from another CSX intermodal location (Chambersburg, PA). However, the Chambersburg location is not in a residential setting and therefore was not applicable, and the Baltimore agent felt it was too soon to predict precise changes in home values in the surrounding neighborhoods.

6.3.5 Neighborhood Resources: Conclusions and Recommendations

Focus group participants felt strongly that CSX, the city, and the state need to make an ongoing financial commitment to support neighborhood resources in the communities surrounding the Mount Clare Site. As one resident said, "I mean this neighborhood is going to be facing the brunt of this project that's going to benefit the state. Allocate a certain percentage. Going forward each year. Our firehouse, our school, the community, our major needs, our roads to be repaved. I don't think it's too much to ask."

NCHH offers the following recommendations on neighborhood resources based on the findings presented above:

- CSX should pay the City of Baltimore a facility regulatory and site infrastructure fee to at least offset partially any potential negative impacts on access to neighborhood resources. For

example, the fees could be used to provide local jurisdictions with block grants for improvements to neighborhood resources (e.g., libraries, schools, parks, community centers) that could be impacted by the project. The fees would be used to mitigate costs borne by the City to mitigate the impact of the trucks on the roads, the potential loss of tax revenue resulting from decreased property assessments, and to pay for pedestrian and bicycle safety programs. The fees would provide a sustainable stream of funding to mitigate unforeseen impacts of the facility in the future. These amounts should increase by five percent each year and would automatically increase by 20 percent if the State or City takes any enforcement action related to the construction or operation of the facility.

- The community should be involved in decisions and priority setting for the community improvements CSX plans to make with project funds. Improvements related to the construction and operations of the facility and mitigations related to the facility should be included in CSX's construction budget rather than as part of the community improvement budget.

- The City of Baltimore and CSX should partner to increase the police and security presence at and around the facility. The partnership should leverage the facility's security resources to reduce existing crime levels in the neighborhood and to mitigate any potential increases in crime from the more intense industrial use.

- CSX should work with the City of Baltimore to provide fair and consistent property purchasing offers to all households within close proximity of the site perimeter. Offers should include replacement costs for the housing structure and compensation for relocation.

- As part of the rezoning process for the City of Baltimore, the City should ensure harmony between residential and industrial uses in the CSA and seek to reduce future conflicts.

- As part of the City's consolidated planning process, the City should create a neighborhood revitalization plan for the CSA. The plan should improve the community's infrastructure and services, and encourage businesses to remain in the intermodal corridor communities through financial incentives. Such investment would help maintain property values, promote social cohesion, and mitigate the potential stigma of the facility on the surrounding neighborhood. The city should consider strategies to divert preferentially increasing tax revenue resulting from the Baltimore-Washington Rail Intermodal Facility into infrastructure and services for the Morrell Park/Violetville CSA.

- The City of Baltimore should explore alternatives to the closure of Georgetown Road at Bernard Drive. If such a closure is necessary, the City should examine and mitigate the impact on the community and businesses of changes to service of MTA Bus Route 35.

- CSX should minimize the impact of the facility's construction and operations on parks and green spaces adjacent to facility operations and truck routes, particularly Carroll Park and the Gwynns Falls Trail, Desoto Park, and Gibbons Commons. Natural buffers and pedestrian walkways should be installed to protect those walking or recreating in the community from

injuries and other potential health hazards (e.g., crosswalks, fences, trees).

- CSX should work with the City to identify appropriate mechanisms, using greening and aesthetic principles, to block sound and light between the site and adjacent houses. These same principles should be followed to add a buffer of vegetation around site and truck routes, particularly near sensitive receptors including parks and schools. These mitigations should be funded as part of CSX's construction budget.

- CSX should retain all mature, specimen, and significant trees and vegetation around the site to reduce storm runoff and assist with reducing air pollutants.

6.4 Noise

The World Health Organization (WHO) defines *community noise* (also known as *environmental noise*) as "noise emitted from all sources except noise at the industrial workplace" and cites road, rail, and air traffic and construction as main sources of community noise (Berglund, Lindvall, & Schwela, 1999). Traffic, locomotives, and cargo equipment are important sources of environmental noise in communities. The health effects of noise pollution "are numerous, pervasive, persistent, and medically and socially significant" (Hagler, 1999).

6.4.1 The Evidence: Noise and Health

A single truck passing on a street at intermediate speeds typically results in 80 to 90 dBA of noise (Ellebjerg, 2007). The more vehicles there are on the road, and the greater the proportion of trucks, the louder the traffic will be (Federal Highway Administration, 2006).

WHO has identified and documented seven categories of adverse health effects of noise pollution on humans (Hagler, 1999; Berglund, Lindvall, & Schwela, 1999):

Noise-induced hearing impairment: Hearing impairment is defined as a decrease in the threshold of hearing, and is caused by irreversible damage to hair cells, the sensory receptors in the inner ear that convert sound energy into electrical signals that travel to the brain (National Institute on Deafness and Other Communication Disorders, 2008; Berglund, Lindvall, & Schwela, 1999). In the United States, approximately 15 percent of the population between the ages of 20 and 69—or 26 million people—has high-frequency hearing loss that may have been caused by exposure to noise at work or in leisure activities (National Institute on Deafness and Other Communication Disorders, 2008). As both an intense sound presented to the ear for a short period of time and a less intense sound that is presented for a longer time period will produce equal damage to the inner ear, decibel level of the sound, distance from the source of the sound, and duration of exposure to the sound are equally important in determining risk of chronic hearing impairment (Rosen & Vrabec, 2001). Long or repeated exposure to noise at or above 85 decibels has been associated with irreversible hearing loss (National Institute on Deafness and Other Communication Disorders, 2008).

Speech intelligibility: Speech interference occurs when environmental noise levels interfere with the ability to comprehend normal speech. Noise-induced hearing impairment is another pathway in which noise may interfere with spoken communication; the American Hearing Research Foundation reports that one in 10 Americans has irreversible hearing loss that affects his or her ability to understand normal speech (American Hearing Research Foundation, 2012). Reduced speech intelligibility may lead to a number of personal disabilities and behavioral changes, including uncertainty, irritation, misunderstandings, decreased working capacity, problems with concentration, stress reactions, disturbed interpersonal relationships, and fatigue. Some of these effects may lead to increased accidents, disruption of communication in the classroom, and impaired academic performance (Goines & Hagler, 2007).

Sleep disturbance: Sleep disturbance has a substantial impact on physiological and mental functioning. The WHO's *Guidelines for Community Noise* recommend that continuous background noise should not exceed 30 A-weighted decibels (dBA),[22] and individual noise events above 45 dBA should be avoided to prevent noise-related sleep disturbance (Berglund, Lindvall, & Schwela, Guidelines for Community Noise, 1999). Sleep disturbances are associated with a variety of health problems, including fatigue, depressed mood, and decreased performance (Berglund, Lindvall, & Schwela, Guidelines for Community Noise, 1999).

Cardiovascular disturbances: Prolonged noise exposure may result in negative cardiovascular effects, including hypertension and ischemic heart disease. A meta-analysis of 43 studies found significant associations between occupational noise exposure and hypertension (van Kempen et al., 2002). This meta-analysis also found that road traffic noise exposures increases the risk of myocardial infarction and ischemic heart disease. In areas with high levels of noise (95-125 dbA), elevated blood pressure levels among school-aged children are associated with residing or attending school near a major noise source, such as an airport, traffic, or trains (Evans & Lepore, 1993).

Disturbances in mental health: WHO's review of the literature related to environmental noise demonstrated that environmental noise is not believed to directly cause mental illness, but that it can intensify or accelerate the development of mental health issues (Berglund, Lindvall, & Schwela, 1999).

Impaired task performance: Noise can negatively impact the performance of cognitive tasks such as reading, attention, problem solving, and memorization, particularly among children and workers (Evans & Lepore, 1993). Among children, noise has been linked to decreased reading comprehension, decreased memory, lower standardized test performance, and learning delays (Stansfeld et al., 2005; Evans, 2006).

Negative social behavior and annoyance reactions: Noise annoyance is defined as a feeling of resentment, displeasure, discomfort, dissatisfaction, or offense when noise interferes with someone's thoughts, feelings, or actual activities (Passchier-Vermeer, 2000). Noise can result in annoyance as well as changes in social (e.g., aggressiveness or disengagement) and everyday behaviors (Berglund, Lindvall, & Schwela, 1999). A causal effect of noise on annoyance has been well established at 50-55 dBA, (Berglund, Lindvall, & Schwela, 1999) and sleep disturbance begins at 55-60 dBA.

Annoyance is a well-established metric for evaluating the significance of community noise. Annoyance due to noise is determined by loudness, temporal patterns (e.g., the time of day the noise is louder), source and predictability (e.g., traffic or gunshots), and the association of the noise with other environmental factors such as vibration, light pollution, or air pollution.

[22] A-weighted decibels, abbreviated dBA, are an expression of the relative loudness of sounds in air as perceived by the human ear.

Miedema synthesized results from 18 studies of road traffic noise to estimate noise exposure and annoyance response measures and to derive an exposure response curve estimating the percentage of highly annoyed persons (Miedema, 2001). Appendix G includes this exposure response curve and can be used to estimate the percentage of the population reporting being highly annoyed if exposed to certain noise due to road traffic noise.

Research has indicated associations between self-reported disruptions in sleep due to nighttime noise from aircraft, road traffic, and railways (Griefahn, 2006; Jakovljević, 2006). Miedema et al. pooled findings from 14 studies of outdoor noise exposure and sleep disturbance to develop an exposure-response function at the population level for road traffic noise exposure and self-reported sleep disturbance as the response. The meta-analysis included 24 studies and estimated exposure-response curves for aircraft, road traffic, and railway noise. For each noise source, sound levels were plotted against degree of sleep disturbance. Appendix H includes the exposure response curve for road traffic noise and can be used to estimate the percentage of the population that would be highly sleep disturbed if exposed to certain noise levels from road traffic.

Table 10 from the World Health Organization (WHO) provides some general guidelines regarding noise levels found in particular environments, and the health effects that may be relevant should these levels be exceeded (Berglund, Lindvall, & Schwela, 1999). For comparison, a truck with more than three axles going 37 mph creates 83dBA of noise (Ellebjerg, et al., 2008). Facility operations are expected to produce an average of 300 additional truck trips through the Morrell Park/Violetville neighborhoods daily.

Table 10: Typical Sound Levels Found in Different Environments and Some Relevant Health Effects if Sound Levels Are Exceeded.

Environment	Health effect	Sound level (dBA)	Time (hours)
Outdoor living areas	Annoyance	40-55	16
Indoor dwellings	Speech intelligibility	35	16
Bedrooms	Sleep disturbance	30-60	8
School classrooms	Disturbance of communication	35	During class
Industrial, commercial, and traffic areas	Hearing impairment, school performance, ischemic heart disease	70	24

The negative health impacts of noise are related to the total noise exposure experienced from all noise sources in the environment and can lead to a combination of these different negative impacts (Hagler, 1999). Additionally, noise exposure disproportionately impacts certain segments of the population. Infants, children, those with mental or physical illnesses, and the elderly are particularly vulnerable to noise pollution.

In addition to the impacts described above, increased noise at local parks that border the truck transit routes may lead to a more negative perception of those parks (Szeremeta & Zannin, 2009), which in turn could result in reduced physical activity for both adults and children.

Figure 22 depicts the relationships between noise exposure and health outcomes that may be impacted by developing and operating the Baltimore-Washington Rail Intermodal Facility at Mount Clare Yard. Changes in noise levels from the construction of the facility and its ongoing operations may yield a wide range of health outcomes, including sleep disturbance, hearing impairment, impaired task performance, and adverse cardiovascular effects.

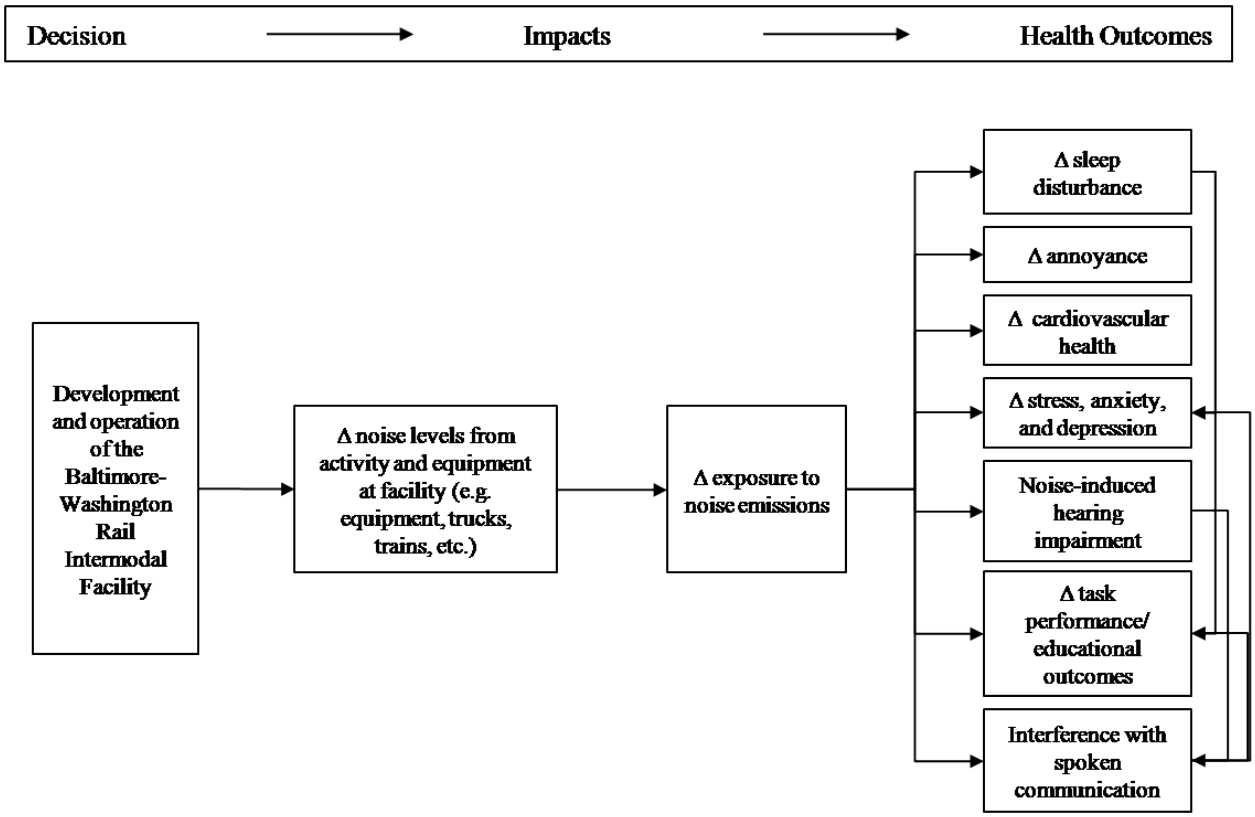

Figure 22: Noise Pathway

Legend: Δ = *"change in"*

6.4.2 Existing Conditions: Noise

Although the community of interest is proximate to both Interstate 95 and existing CSX rail lines, some residents note that the neighborhood is quiet and peaceful. One resident said, "We're not that far from 95, but I don't even remember hearing the cars and stuff. I mean you just don't. It's very quiet and peaceful." Other focus group participants characterize the noise from highway traffic as a constant drone, to which they have largely become accustomed. In contrast, residents identified a problem with the noises associated with the use of air brakes as trucks exit the interstate, in spite of perceived prohibitions against use. Similarly, participants indicated concerns about the current prevalence of truck restriction violations that particularly affect the community because of its location near highways and downtown Baltimore. As one resident said, "With where we are, we hear the drone of traffic from 95. The worst part about that is the tractor trailer air brakes. When they're coming off or going off the exit and I would assume that air brakes are like illegal in the city, but tell that to the truckers. That's bad."

Residents reported that they hear the trains whistle as they move through the neighborhood but again appear to have become used to these noises, which they describe as intermittent and even comforting. In the past, residents reported hearing trains "clanging" together as they coupled/de-coupled, but this issue was not viewed as currently problematic. As one focus group participant said, "Well, believe it or not, it's pretty quiet. Like the trains never used to—they used to run and you could hear them bang together through the night, but you get used to that. You don't hear it anymore. But they haven't run mostly for a long time. Once in a great while they run. So what you hear is crickets or whatever. Like she said, it's like being in the country—it is. Down there I mean it's woods at the bottom of the hill and that's it. We were the last house down at the bottom of the hill and you never hear anything."

6.4.3 Projected Impacts of the Intermodal Facility on Noise and Associated Health Outcomes

Noise models predicting changes in noise levels caused by operation of the Baltimore-Washington Intermodal Rail Facility are being developed by CSX, but were not available at the time of this report's publication. The transition of the Mount Clare Yard to operation at full capacity is expected to cause an increase in noise emissions, primarily from increased truck traffic. Based on this basic knowledge of noise emissions from trucks and the expected increase in traffic from the facility, we expect that noise emissions from the Mount Clare site and truck transit routes will increase. Operations at the intermodal facility will use electric cranes, which will help to reduce noise emissions from the site.

Without the more precise models being developed by CSX, predictions of the magnitude of health impacts resulting from noise emissions from facility operations are not currently possible. However, qualitative predictions can be made regarding changes in annoyance, sleep disturbance, cardiovascular disease, and other health outcomes.

Noise levels in ranges that affect health can be created by a single truck, suggesting that annoyance and sleep disturbance could be outcomes of facility operation, particularly during nighttime hours. Distance between residences and truck routes will mitigate the impact of these noise emissions. However, the sensitive receptors that line Wilkens Avenue—a hospital, senior care facilities, and (future) grand-housing—will not have any barrier to the increased noise emissions of trucks moving to and from the facility.

The children in the seven schools located within a mile of the Mount Clare site may be exposed to higher noise levels both in school and, for those also living near operations, at home, putting them at increased risk of reduced attention span, concentration and remembering problems, and reading ability deficits. These outcomes may impact lifespan, earning potential, and the associated impacts on health.

Increased noise at local parks that border the truck transit route may reduce their use and lead to negative health impacts, including increased diabetes, cardiovascular disease, and depression. For example, the use of Gibbons Commons as a new community asset, including a safe play area for children, may be threatened by noise emissions from the intermodal facility operations.

Residents expressed concern that the facility would likely have a negative impact on noise levels in the community as a result of increased truck traffic and increased train traffic. Additionally, residents perceive that the 24-7 nature of the facility operation would create increased stress because the noise would be constant (e.g., a train being loaded at regular intervals during the day and night) as opposed to intermittent. The increased noise attributable to the facility is perceived as disruptive. As one focus group participant said, "You know, I mean, and it's got to be noisy. I mean, how many people do you have working all night long, and literally 10 steps away from me, and other neighbors." Another participant perceived the lack of sound barriers between the facility and nearby residences as a major concern: "It's a dead-end street. That's going to completely change. It's going to be like a circus down there. It's all open. There's nothing blocking you from their property, the track, so unless they plan on putting up walls or sound barriers. I don't know what their intentions are but I think it's going to have great impact, negative."

6.4.4 Limitations and Data Gaps

The absence of the CSX noise study significantly restricted our ability to analyze the potential noise-related health effects of the proposed facility. As discussed above and in our recommendations, models exist for predicting sleep disturbance and noise annoyance, but those models rely on the inputs from the noise study.

6.4.5 Noise: Conclusions and Recommendations

NCHH offers the following recommendations on noise based on the findings presented above:

- Once noise models from CSX are available, the Baltimore Health Department or the Maryland Department of Health and Mental Hygiene should analyze the magnitude of impacts on annoyance and sleep disturbance. NCHH provides protocols in Appendices G and H that the agencies could use to conduct this analysis. If excessive noise levels are noted, CSX should install sound-proofing/noise-reducing windows for homes and schools in close proximity to the facility and along the routes servicing the facility.

- The City of Baltimore should monitor noise emissions from intermodal operations at one year intervals following the opening of the site. Results should be compared to baseline levels. The Baltimore City Health Department or the Maryland Department of Health and Mental Hygiene should analyze the magnitude of impacts on annoyance and sleep disturbance. CSX should fund additional noise mitigation programs accordingly. NCHH provides protocols in Appendices G and H that the agencies could use to conduct these analyses.

- The Baltimore City Department of Transportation should monitor and enforce existing truck restrictions and prohibitions against the use of air brakes through "stings" or other mechanisms.

6.5 Traffic Safety

The influx of new truck traffic in and around the intermodal facility and the impact on safety was one of the top concerns for the community. The present design of the community, the lack of enforcement of traffic regulations, and the sheer increase in the number of truck trips makes the Morrell Park/Violetville CSA a particularly vulnerable site for traffic safety issues. The current route choices for trucks to access the facility could put residents or those employed in the area at increased risk of traffic collisions—whether in cars, walking, or, less likely, biking.

6.5.1 The Evidence: Traffic Safety and Health

There is a demonstrated and statistically significant association between increased traffic volume and increased frequency of collisions between vehicles and pedestrians (Roberts, 1995; World Health Organization, 2004). Traffic volume has been demonstrated to be a particularly important risk factor for injuries and death rates among child pedestrians, with reductions in traffic volumes associated with reductions in child pedestrian death rates (Roberts, 1995; World Health Organization, 2004). Additionally, traffic collisions involving trucks are associated with a higher risk of severe injuries in both collisions with pedestrians and collisions with other motor vehicles (Chang & Mannering, 1999; Roudsari et al., 2004).

Over 4,000 pedestrians were killed and an estimated 59,000 pedestrians were injured in traffic collisions in the United States in 2009 (National Highway Traffic Safety Administration, 2009). Pedestrians ages 65 and older accounted for 19 percent of these fatalities, and children ages 15 and younger accounted for seven percent of these fatalities. Pedestrians, cyclists, and two-wheel motorized vehicle users are disproportionately impacted by traffic collisions (World Health Organization, 2004). Traffic safety is impacted by a number of factors, including changing vehicle and truck volumes, speed, and changes in road or pedestrian infrastructure.

Speed is a major risk factor influencing both the risk of a collision and the outcomes or consequences of a collision. This relationship has been demonstrated in the empirical evidence, which has shown that every kilometer per hour increase in mean traffic speed will typically result in a 4-5 percent increase in the incidence of fatal crashes (World Health Organization, 2004). The design of roads and road networks also play an important role in collision risk, with increased risk occurring where road networks fail to route heavy traffic around populated areas or separate pedestrians from traffic (World Health Organization, 2004).

Traffic safety and infrastructure can also impact health by promoting or discouraging physical activity. Perceived and actual risk of injury may discourage walking and cycling, which can directly impact health by decreasing physical activity levels (Centers for Disease Control and Prevention, 2002). Adults living in walkable neighborhoods—defined as neighborhoods where residents can walk to essential services such as grocery stores and other common destinations—are more likely to meet national physical activity guidelines than those adults living in the least walkable neighborhoods (Frank et al., 2005). Research has demonstrated that individuals living in mixed-use neighborhoods with easy walking access to shops and other services have a 35 percent lower risk of obesity, and that children are more likely to be physically active when

sidewalks are present and destinations are easily accessible (Frank, Andresen, & Schmid, 2004; Davidson & Lawson, 2006). A cross sectional survey of 56 neighborhoods in Portland, Oregon demonstrated a positive association between employment density, household density, the number of spaces for recreation, and the number of street intersections and walking activity (Li et al., 2005). This study also demonstrated connections between perceptions of safety for walking and levels of walking activity.

Figure 23 demonstrates the relationships between traffic safety and health outcomes that may be impacted by developing and operating the Baltimore-Washington Rail Intermodal Facility at the Mount Clare Yard. Changes in truck volumes and speeds and road infrastructure could cause increased traffic collisions, pedestrian or cyclist injuries, and could reduce the likelihood that residents will walk or bike in the neighborhood, or easily reach goods and services without a vehicle.

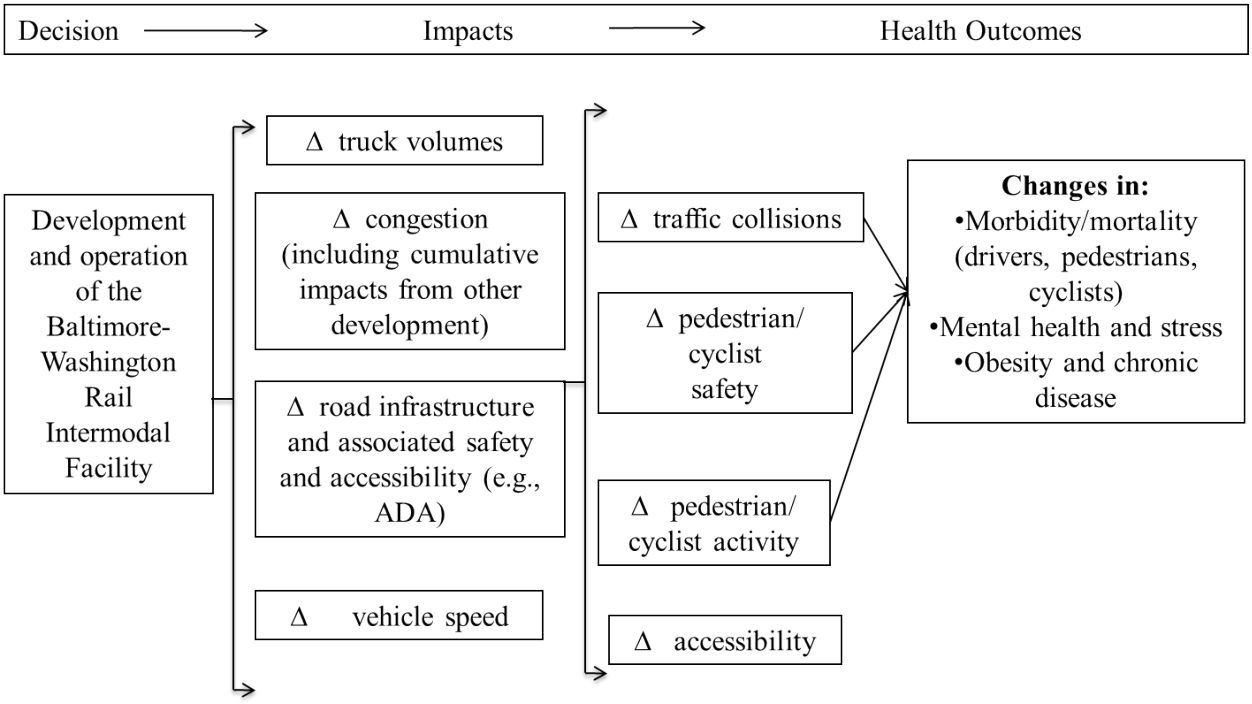

Figure 23: Traffic Safety Pathway
Legend: Δ = "change in"

6.5.2 Existing Conditions: Traffic Safety

The air quality section of this report discusses the current traffic levels in the community surrounding the proposed facility and therefore the data regarding the increases in truck traffic are not repeated here. As discussed previously, increased truck traffic is a concern for air quality, while it also presents concerns and challenges for traffic safety. Focus group participants and stakeholders indicated that the Morrell Park/Violetville area already suffers from traffic congestion. The Baltimore City Department of Transportation's Traffic Impact Study of the proposed facility indicates that the baseline conditions of traffic are already pushing the

threshold of acceptable quality; the Level of Service[23] rating at the intersection of Caton Avenue and Wilkens Avenue is currently a *D,* which is the considered the lowest acceptable rating of quality of service for Baltimore City intersections.

At-grade train crossings also reportedly cause interruptions to traffic flow, contributing to congestion. As one focus group participant stated, "I drive a car and I work downtown, and so I have to cross that track every day. And periodically I have got caught at that track and when they stop, when they backup and they link, whatever they call it, and then they come forward, they stop…. So if you get caught there now, you're sitting there for about 20, 25 minutes. That's pretty bad." Another resident related that they had experienced delays of up to an hour as a result of train traffic along the existing CSX rail lines. As many of the residents in the neighborhoods surrounding the Mount Clare site work downtown, roadway traffic is of great concern to the community.

Traffic problems are not only an inconvenience, they also pose safety concerns. Focus group participants and stakeholders indicated that current infrastructure is insufficient to ensure safe pedestrian travel in the areas surrounding the project site. Focus group participants described how children cross the train tracks on their way to school because it is the most efficient route due to a lack of crosswalks and pedestrian infrastructure:

"The kids use it [the train tracks] as a crosswalk. Because we have asked for years, not putting the city down at all, but we don't have buses for all the kids, so they come down Washington Boulevard, some of them come from the other side. And instead of coming down to Whistler and crossing, because there's no crosswalk there…it's easier for the kids to go up and go down the dead end street and cut across the track than it is to come down the right way and come up."
- Focus Group Participant

Similarly, Bonnie Phipps, President and CEO of Saint Agnes Healthcare stated, "There's no crossing now at the hospital entrance. The city is supposed to be placing a crossing light there and they're also supposed to be redoing the corner of Caton and Wilkens…They've got signs up now that say that they're going to be doing it, but it's not complete.... And there's nothing by the school, I mean there's a light but there's no real [what] I would call safe crossing."

Kathryn Holmes, President of the Crossroads Business Park Association, noted the business park as another hazardous zone for pedestrians. Holmes related that the absence of sidewalks and poor visibility in the heavily-trafficked park have caused employees to be injured in traffic incidents. Focus group participants reported that current truck routes are not particularly well-enforced. This is consistent with findings from other communities in Baltimore. In the Dundalk Area Truck Impact Study, residents reported a high level of illegal truck activity in their neighborhoods and that police enforcement of regulations, either speeding or route restrictions, is infrequent and inconsistent. According to the report, "While southeast District Police are aware of residents' desire for greater enforcement of truck restrictions, they are often diverted to

[23] Level of Service (LOS) reflects the quality of service by assigning a letter grade based on the average delay experienced by motorists at an intersection and ranges from *LOS A* (minimal delay) to *LOS F* (significant delay).

criminal cases elsewhere." The report also noted outdated truck route maps that drivers use and inconsistently understood definitions (such as what is "local") that result in violations.

Generally, the pedestrian infrastructure is not presently designed in a manner to promote physical activity. The increase in truck traffic may exacerbate the community design shortcomings, necessitating intervention.

6.5.3 Projected Impacts of the Intermodal Facility on Traffic Safety and Associated Health Outcomes

Focus group participants predicted that the addition of trucks that will accompany the operation of the new intermodal facility will exacerbate their current traffic problems with congestion. Safety was a concern, as drivers were worried about sharing roadways with more tractor trailers. Efforts to obtain baseline vehicular crash data from the City of Baltimore for the Morrell Park/Violetville CSA were unsuccessful; therefore, quantitative predictions of the impact of the increased truck traffic on injuries and fatalities are not provided in this report.

However, qualitative findings from the focus groups and stakeholder interviews suggests that increased truck traffic from the facility would pose an increased risk to pedestrian safety and exacerbate existing pedestrian safety concerns, particularly on Wilkens Avenue. That crossing is used by many children to get to school, and it is likely that the baseball field and recreational facilities of Gibbons Commons will attract more children to the area. Saint Agnes Hospital, which sits on the corner of South Caton Avenue and Wilkens Avenue, is also without a safe crossing. Bonnie Phipps, President and CEO of Saint Agnes Healthcare, indicated that her primary concern for the project was traffic safety for hospital employees and particularly for the children in the neighborhood: "There [are] going to be 300 additional trucks every day coming right down Caton Avenue right in front of a [private] high school and an elementary school and our property, which really concerns us for a lot of reasons: for the safety of our employees, for the environment which we already know is challenged, for the little kids that are in the elementary school from a safety perspective...."

Participants predicted that the addition of trucks that will accompany the operation of the new intermodal facility will exacerbate their current traffic problems. Again, safety was a concern, as drivers were worried about sharing roadways with tractor trailers. The intersection of Dukeland Street and Wilmarco Avenue and the interchange to I-95 were highlighted by focus groups as places where additional truck traffic may induce incidents. Bonnie Phipps also expressed concern about truck traffic as an impediment to emergency response by ambulances from the hospital. At the very least, she said, ambulance sirens would need to be used more frequently, further contributing to noise emissions around sensitive receptors.

The expected increase in blocked traffic resulting from trains halting at at-grade crossings also raised safety concerns; focus group participants indicated that, in the case of an emergency, a train stopped on the crossing would prevent effective evacuation: "If there was an accident here, and we were not able to get out this way because the tracks are here, and there was a train down here at the tracks, we would all be caught here. We would be trapped." In particular, residents

want assurance that Route 1 would not be blocked by trains on the track from the Mount Clare site. Blocking Route 1 is perceived as a safety issue, as this is the access route between Morrell Park residents and the fire station: “If you have to stop that train to switch, you need to design this so that stop does not block Route 1. You can stop and back up, as long as you’re moving, and you can go forward, but you cannot stop and block Route 1, period.”

Some new infrastructure will need to be put in place on the designated routes to handle the increase in truck traffic. Delegate Keith Haynes indicated that roads in the area would need to be reconditioned, and new traffic signaling systems considered: “If you’re going to have larger vehicular traffic come into the area then you have to have the infrastructure to accommodate that and accommodate in such a way that it doesn’t impact the traffic flow of the normal business traffic and residential traffic that you have coming through that area already.” These infrastructure improvements could offer an opportunity to provide safer pedestrian routes throughout the neighborhood to address existing safety concerns and assist in mitigating some of the increased pedestrian safety risks that could result from the facility.

Focus group responses indicated that pedestrian safety should also be considered in plans for the facility. Children in the neighborhood currently use the train tracks as a crossing to get home from school because of an absence of convenient crosswalks, putting their safety at risk. Increased truck and train thoroughfare will heighten this risk. Participants recommended the addition of barriers to prevent crossing at the tracks. Andrew Fellows, Vice-Chair of the Maryland Commission on Environmental Justice and Sustainable Communities said, “To the extent that there is a walkable urban place that’s sort of being developed in Morrell Park… there’s some possibilities of creating a really walkable urban place that’s not car-dependent. I think this intermodal facility with truck traffic coming through, continuing and maybe increased freight traffic will make it less walkable. And so, to the extent possible, that should be addressed.”

Figure 24 highlights a number of intersections identified by residents and stakeholders as areas of concern for traffic safety.

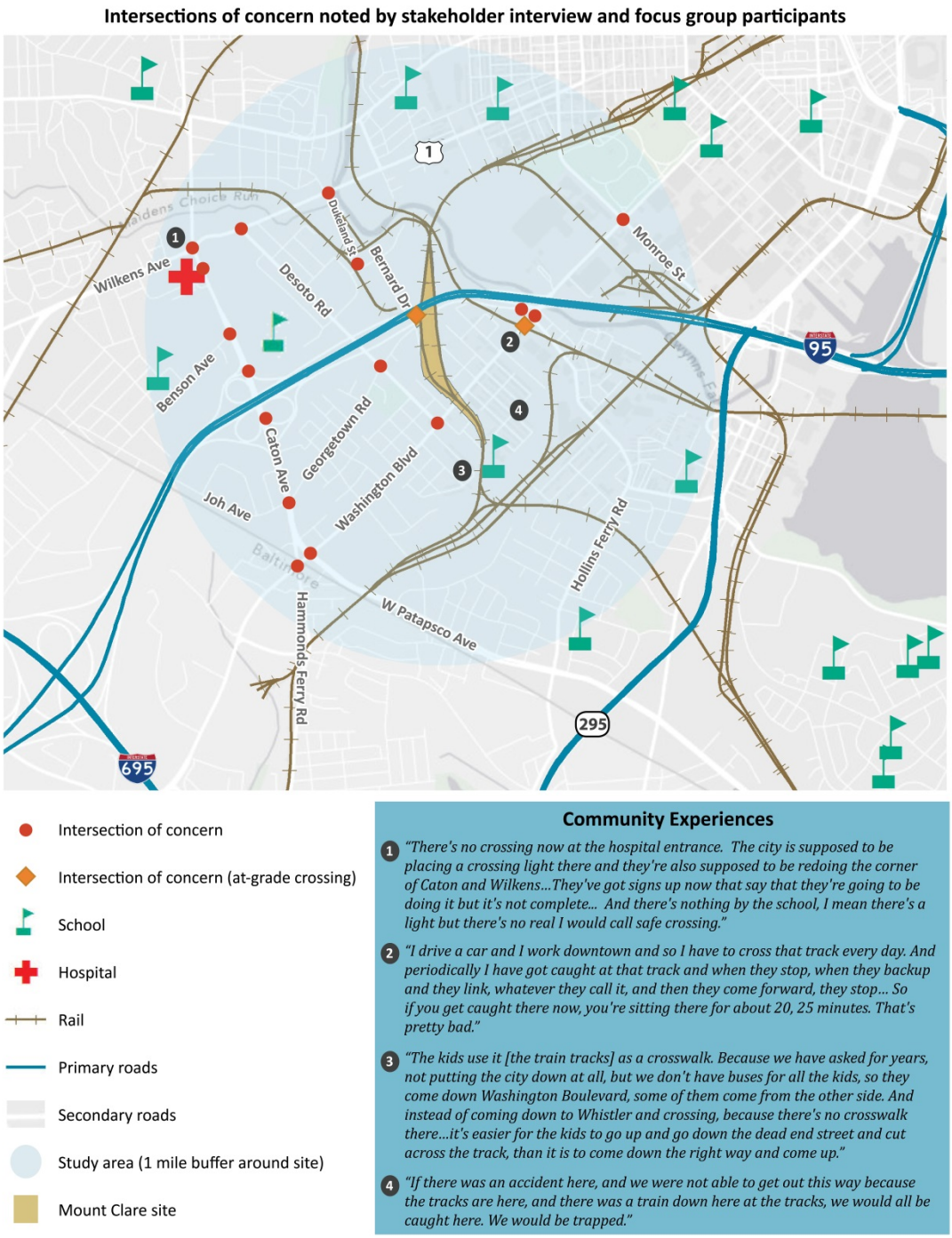

Figure 24: Intersections of Concern Surrounding the Proposed Facility Site

6.5.4 Limitations and Data Gaps

NCHH made several attempts to obtain collision data from the City of Baltimore for the area surrounding the facility. We have noted the intersections of concern that emerged through our qualitative findings in Figure 24 above. Every jurisdiction has access to collision data to help with traffic planning activities including, for example, traffic calming at problematic intersections. Without these data, NCHH was unable to make quantitative predictions about the impact of the increase in truck traffic on pedestrian, vehicle, and bicycle collisions.

6.5.5 Traffic Safety: Conclusions and Recommendations

Designated routes for truck traffic are already part of negotiations between CSX and residents in the plans for the new facility. Focus group participants were enthusiastic about the potential of these negotiations to alleviate some traffic and safety concerns, but wanted assurance that agreed-upon routes will be enforced.

Other models exist around the country for regulating truck transportation into and out of industrial areas. For example, in Oakland, the City and the Port Authority committed to jointly funding and working together to create a truck management plan with the goal of reducing port-related truck traffic on local streets. This resulted in the Maritime Comprehensive Truck Management Program, adopted in June 16, 2009, which aims to address a number of truck issues, including supporting the State's emissions reduction regulations and improving safety, traffic, congestion, and operations. At its core are a truck registry program, enforcement of the new truck emissions regulations, participation in truck traffic and parking studies, improving operations at the gates (reducing idling, providing restrooms, and treating drivers with respect), improving stakeholder involvement and education, and providing business and workforce assistance. The plan also acknowledges that there is still much work to do, including participation in studies of truck traffic management to improve safety, minimize wait times, and address illegal truck parking. Increasing parking penalties, reinvesting money from citations into truck-related facilities, improving signage, identifying enforcement trouble hotspots, finding new enforcement mechanisms, better coordination between the Port and the City on enforcement issues, and education are all included in the plan (UC Berkeley Health Impact Group, 2010).

NCHH offers the following recommendations on traffic safety based on the findings presented above:

- The City of Baltimore should develop a plan to monitor and enforce the truck routes to ensure trucks traveling to and from the facility do not use prohibited, local roads. All truck routes should be well defined and marked with clear signs indicating approved routes. The City of Baltimore should also make provisions for enforcement of truck idling regulations in the planning process.

- CSX and the City of Baltimore should explore additional truck route and access options that do not put residents or employees of the Crossroad Business Park at risk.

- CSX should improve the road infrastructure along the designated truck route, with consideration paid to intersections with high crash incident rates (e.g., at Wilmarco and Dukeland) and taking into account the Crossroads business park traffic.

- The City of Baltimore should assess the current pedestrian infrastructure and coordinate with CSX to provide a complete network of sidewalks to any roads where truck traffic will increase as a result of the facility. Signalized, stop-controlled, or otherwise protected crosswalks should be included in the plans for upgrading the pedestrian infrastructure.

- CSX should erect barriers to prevent children from crossing the train tracks on their way to school. Children in the neighborhood currently use the train tracks as a crossing to get to and from school because of an absence of convenient crosswalks, putting their safety at risk.

- CSX should work with the City of Baltimore to ensure that Route 1 is not blocked by halted trains traveling along the CSX rail network, which would pose a problem for emergency vehicle egress and commuter travel.

6.6 Light

Sensory responses to light exert extensive control upon multiple body systems creating numerous targets on which light-induced disruptions can act, resulting in a wide range of physiological changes and potentially serious medical implications (Navara & Nelson, 2007). Study of the health effects of light exposure is relatively new, and the complex, multi-tiered nature of associations between light and health outcomes are not completely understood. However, though the relationship between exposure to Light at Night (LAN) and the onset of a number of health outcomes are not yet clear, there is sufficient evidence of associations between LAN and negative health outcomes to warrant concern over the potential impacts of the new intermodal facility's lighting system on the health of the local community.

6.6.1 The Evidence: Light and Health

Light at Night (LAN) has two recognized major physiological effects: It disrupts circadian rhythms and suppresses the production of melatonin by the pineal gland (Reiter, et al., 2007). Circadian rhythms are physical, mental, and behavioral changes that follow a roughly 24-hour cycle, responding primarily to light and darkness in an organism's environment. Circadian rhythms can influence sleep-wake cycles, hormone release, and other important bodily functions (National Institute of General Medical Sciences, 2012). Alteration of circadian rhythms has been associated with performance, alertness, sleep, and metabolic disorders; and has also been demonstrated to predispose individuals to a wide range of mood disorders, including impulsivity, mania, and depression (Falchi et al., 2011; Salgado-Delgado et al., 2011). Melatonin plays a significant role in the regulation of metabolism, immune function, and endocrine balances. The suppression of the production and release of melatonin pose several potential health effects (Navara & Nelson, 2007). Inhibiting the production of melatonin can result in accelerated tumor growth and incidence of coronary heart disease (Chepesiuk, 2009; Falchi et al., 2011). The downstream consequences resulting from these effects, such as sleeplessness, make the web of physiological changes resulting from irregular light exposure even wider, as sleep disorders and deprivation are associated with several disorders, such as diabetes and obesity (Falchi et al., 2011).

Recent studies indicate that humans react to artificial light at both low and high intensities; the light intensity used for illuminating house interiors and worksites are sufficient to alter the biological clock and circadian rhythms (Navara & Nelson, 2007). Moreover, both disruptions to circadian rhythms and melatonin production have been found to be light intensity and wavelength dependent. These findings suggest that even minor additions to external light glow can have extensive physiological repercussions on individuals (Reiter, et al., 2007).

Effects of LAN on the health of rodents have been more extensively researched, and studies indicate that even small amounts of LAN can have major impacts on physical and psychological well-being. Experimental studies with rats clearly demonstrated that repetitive exposure to dim light during the night for a relatively short time (five hours average) had similar effects on circadian rhythms as bright light. This exposure to artificial light, which has an intensity similar

to that generated by a 60-watt bulb, for short periods of time during the night induces an important shift in the biological clock advance. Exposure of rodents to constant light leads to irritability, anxiety-like and depressive-like behaviors, learning and memory deficits, inhibition of melatonin secretion, aging and accelerated tumor growth, visceral adiposity increase, propensity to obesity, and cardiovascular malfunction (Salgado-Delgado et al., 2011). These findings, though not directly translatable to human subjects, reinforce conclusions that the effects of exposure to LAN are potentially extensive and severe.

Figure 25 demonstrates the relationships between light exposure and health outcomes that may be impacted by developing and operating the Baltimore-Washington Rail Intermodal Facility at the Mount Clare Yard.

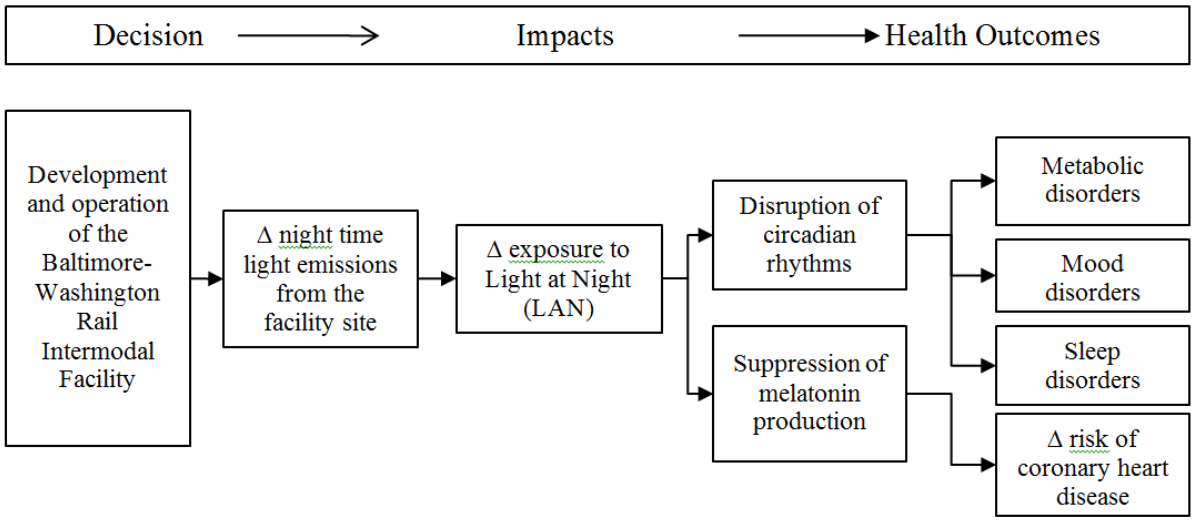

Figure 25: Light Pathway
Legend: Δ = "change in"

6.6.2 Projected Impacts of the Intermodal Facility on Light and Associated Health Outcomes

Lighting was raised by several focus group participants as an issue of concern. Specifically, participants expressed concerns with the negative impact of the amount of lighting they believe will be required to support a 24-7 operation in the midst of residential neighborhoods. Homeowners with properties directly adjacent to the Mount Clare Yard were particularly concerned about light from the facility site flooding their properties at night. Residents also described negative impacts on privacy and safety attributable to the lighting and hours of operation. Finally, residents mentioned their beliefs that CSX was not forthcoming in responding to questions about how site lighting would be managed or provide specific strategies for how lighting issues would be addressed once the site was operational. As one resident said, "Oh, they didn't appreciate any lighting questions at all. Just that…if there was an issue that a resident had that they would be open to adjusting the lighting so it wouldn't be on their property or

whatever." Another resident stated, "I think they're playing down the lighting thing. They have specific lighting that is just in a targeted area. I'm sorry. If you're right there on the tracks and you have lighting, it's going to light up the neighborhood."

6.6.3 Light: Conclusions and Recommendations

CSX has agreed to use targeted lighting methods to limit light emissions from the facility site. Scientists, however, believe reflections from the lit surfaces and atmospheric scatter cause some upward light emissions to remain, even after the best control of the light distribution is reached and when the proper quantity of light is used (Falchi et al., 2011). NCHH offers the following recommendations on light based on the findings presented above:

- CSX should provide a site lighting plan that accounts for impacts on residents' privacy and is subject to a third-party review. To the extent possible while ensuring occupational safety, CSX should reduce the facility's lighting at night to minimize disturbance to nearby residents.

- To the extent possible while ensuring occupational safety, CSX should reduce the facility's lighting at night to minimize disturbance to nearby residents. If possible, the color spectrum of lighting sources should also be adjusted towards low-level red lighting and away from high-energy blue lighting, which has been found to be highly disruptive to human biological cycles (Navara & Nelson, 2007).

- CSX should restrict activities that are likely to produce noise and light pollution before 7:00 a.m. and after 7:00 p.m. and on weekends.

6.7 Other

Several concerns emerged from the focus groups and stakeholder interviews that were not addressed in the HIA scope. In this section, we provide an overview of those issues, including a summary of the associated recommendations. Specifically, the issues include rodent control and transparency/communication in decision-making. Because these issues were excluded from the scope of the HIA, we have not summarized the limitations and data gaps for them separately. Instead, we have noted below where data gaps may have hindered predictions and recommendations.

6.7.1 Rodents

According to the head of the City of Baltimore's Rat Rubout Program, construction of the intermodal facility will disturb rat burrows and the rats will disperse. The city program recommends CSX hire a private rodent control contractor to bait the site repeatedly before, during, and after the site construction. City staff members are available to perform this service in alleys, streets, tree wells, and properties. However, the site where the construction will take place must be treated by CSX and be part of the original construction contract. According to the City of Baltimore, "[T]his would be more than we can handle alone." NCHH offers the following recommendations regarding rodent control:

- The City of Baltimore should work with CSX to establish a rodent control program during the excavation, construction, and operations phases.

- CSX should establish controls over rodents, mosquitoes, and potential drowning related to any storm water retention ponds, and consider using a more modern underground drainage system in the site plan.

6.7.2 Community Engagement, Communication, and Transparency in Decision-Making

Residents near the Mount Clare Yard site expressed concern over the decision-making process that led to the selection of the Mount Clare site. Residents felt the other site locations had been discarded from the list due to political and community power to "say no" to the project.

"And all they really [care] about is Panama Canal and how wonderful it's going to be for Maryland and blah blah blah. It's like well, this is probably the most populated area or community out of all the area sites, wherever it was, 15 or so, where everyone else said no way. They're going to drop it right in the middle of our neighborhood."

Residents also expressed concerns and confusion over the roles and responsibilities of the various agencies and companies involved in the project. Participants questioned who the appropriate contacts were to approach with their concerns, and questioned what opportunities there were to get involved with city and state agencies. Additionally, residents expressed that currently, when they have concerns over a CSX train blocking an at-grade crossing, they face

tremendous challenges contacting the appropriate people because the contact is in Jacksonville, Florida, not Baltimore: "They tell you to call, and its Jacksonville...."

Residents near the Mount Clare Yard and the various original proposed site locations noted that ongoing communication from CSX and state agencies could have helped address some of these communication challenges. For example, although CSX and MDOT decided to pursue the Mount Clare Yard site in September 2012, the public website set up to assist with ongoing communication and transparency with regard to the project was not updated to reflect this decision until April 2013, causing confusion and uncertainty. Similarly, focus group participants living near the Mount Clare Yard noted a need for improved responsiveness through existing communication methods. For example, the project website provides an email through which residents can request information about public meetings; however, participants stated that they never received a response to requests for information they sent to this address. Similarly, representatives from St. Agnes Hospital and the Crossroads Business Park also reported challenges in communication with CSX and key agencies with regard to the project. For example, despite being a critical resource for the neighborhood and being located along the proposed truck access route, St. Agnes Hospital was unaware that the Mount Clare Site was even being considered for the facility until after the site choice had been finalized.

Residents near the Mount Clare Yard site also expressed a desire for a more coordinated outreach effort among the various community groups and want a general meeting where the plan for the facility is presented to the entire community.

"This is one of the issues that I've had with this project all along was that they have fractured – they go to community meetings, but at these other four settings they sent out mailers to the entire neighborhoods with specific meeting dates. This is a more fractured approach that they're taking. So you don't know what's going on at these meetings." – Focus Group Participant

The concerns and confusion related to the project's decision-making process reflect a clear need for continuous improvement with regard to community engagement, communication, and transparency as the project proceeds. Additionally, the challenges highlighted in this section provide an opportunity for reflection and improvement for all future land use decisions in Maryland. NCHH offers the following recommendations regarding community engagement, communication, and transparency in decision-making:

- CSX, the City of Baltimore, and the Maryland Department of Transportation should improve the transparency and timeliness of information during the design, planning, and construction phases by maintaining an up-to-date public website, providing Town Hall-style forums to field community questions, and providing timely responses to emails received through the address provided on the project website (intermodal@mdot.maryland.gov).

- CSX, the City of Baltimore, and the Maryland Department of Transportation should develop clear and transparent procedures through which residents may raise and address issues regarding noise, lighting, air quality, or other concerns once the project is operational.

- CSX should hire one or two residents from within the community to serve in an official capacity as liaison(s) between CSX and the community.

- CSX should respond to and address the concerns raised by community leaders in their letter of July 9, 2013 before it finalizes plans for the facility.

- CSX should offer community-wide opportunities for residents to gather and learn about CSX's plans for the project so that residents from various community groups can collectively learn about the project. The City of Baltimore should work with residents to identify a clear process for communication with CSX and MDOT including a local contact and a timeline and process through which the person is required to respond.

- The Maryland Department of Transportation should provide the community associations near the proposed facility with a clear description of Maryland Environmental Policy Act (MEPA) requirements and the role of citizens in the MEPA process.[24]

- The Maryland State Legislature should work to strengthen the Maryland Environmental Policy Act (MEPA) to ensure that projects funded or permitted solely by state or local funds are still required to consider fully any significant environmental and health impacts, as they would be considered under the National Environmental Policy Act (NEPA). New York's State Environmental Quality Review Act (SEQRA) may serve as a model for these revisions to MEPA.

[24] The White House Council on Environmental Quality has produced a community guide for the National Environmental Policy Act that could serve as a useful model: http://ceq.hss.doe.gov/nepa/citizens_guide_Dec07.pdf.

7. Summary of Impacts

Table 11 summarizes the predictions of how the development and operation of the Baltimore-Washington Rail Intermodal Facility at the Mount Clare Yard may impact the health of individuals living, working, attending school, and recreating near the proposed site location. These predictions are based primarily on the evidence gathered from the literature base, air quality modeling, and focus group and stakeholder interview findings.

The following are definitions of the key terms in the table.

Impact: Indicates whether the health effect is adverse, beneficial, or unclear

- Positive = Changes that may improve health
- Negative = Changes that may detract from health
- Uncertain = Unknown how health will be impacted
- No effect = No effect on health

Magnitude of Impact: Indicates how much a health effect might change as a result of a decision (Note that this is relative to population size)

- Low = Causes impacts to no or very few people
- Medium = Causes impacts to wider number of people
- High = Causes impacts across large sections of the impacted community or across the entire impacted community

Intensity of Impact: Indicates a health effect's severity

- Low = Causes impacts that can be quickly and easily managed or do not require treatment
- Medium = Causes impacts that necessitate treatment or medical management and are reversible
- High = Causes impacts that are chronic, irreversible, or fatal

Likelihood of Impact: Indicates the degree of certainty that the health effect will occur

- Likely = It is likely that impacts will occur as a result of the project
- Possible = It is possible that impacts will occur as a result of the project
- Unlikely = It is unlikely that impacts will occur as a result of the project
- Uncertain = It is unclear if impacts will occur as a result of the project

Distribution of Impact - Indicates whether the health effects are shared equally among the affected populations

Quality of Evidence:

- *** = Many consistent sources of evidence
- ** = A few good sources of evidence
- * = No clear sources of evidence, but generally consistent with principles of public health

Table 11: Summary of Impacts

Health Determinant or Outcome	Impact	Magnitude	Intensity	Likelihood	Distribution	Quality of Evidence
Air Quality						
Asthma and respiratory disease	Negative	High	High	Likely	Children; Elderly; Residents within close proximity to roadways and the site location; Individuals with pre-existing conditions	***
Cardiovascular disease	Negative	High	High	Likely	Elderly; Residents within close proximity to roadways and the site location; Individuals with pre-existing conditions	***
Low birth weight	Negative	High	Medium	Possible	Women of child-bearing age living in close proximity to roadways and the site location; Women of child-bearing age with pre-existing conditions	**
Lung cancer	Negative	High	High	Possible	Elderly; Residents within close proximity to roadways and the site location; Individuals with pre-existing conditions	***
Premature mortality	Negative	High	High	Likely	Elderly; Residents within close proximity to roadways and the site location; Individuals with pre-existing conditions	***
Employment						
Premature mortality	Uncertain	Low	High	Uncertain	Unemployed population in Morrell Park CSA; Employees of Crossroads Industrial Business Park; Individuals newly employed as a result of facility	***

Health Determinant or Outcome	Impact	Magnitude	Intensity	Likelihood	Distribution	Quality of Evidence
Cardiovascular disease	Uncertain	Low	High	Uncertain	Unemployed population in Morrell Park CSA; Employees of Crossroads Industrial Business Park; Individuals newly employed as a result of facility	***
Depression and mental health	Uncertain	Low	Medium	Uncertain	Unemployed population in Morrell Park CSA; Employees of Crossroads Industrial Business Park; Individuals newly employed as a result of facility	***
Healthcare and medication access	Uncertain	Low	Medium	Uncertain	Unemployed population in Morrell Park CSA; Employees of Crossroads Industrial Business Park; Individuals newly employed as a result of facility	***
Low birth weight	Uncertain	Low	Medium	Uncertain	Unemployed population in Morrell Park CSA; Employees of Crossroads Industrial Business Park; Individuals newly employed as a result of facility	**
Chronic disease	Uncertain	Low	High	Uncertain	Unemployed population in Morrell Park CSA; Employees of Crossroads Industrial Business Park; Individuals newly employed as a result of facility	***
Neighborhood Resources						
Injuries	Negative	Low	High	Uncertain	All	*
Premature mortality	Negative	Low	High	Unlikely	All	**
Chronic disease	Negative	Medium	High	Possible	All	***
Mental health (stress, anxiety, depression)	Negative	High	Medium	Likely	All	***
Noise						
Sleep disturbance	Negative	Medium	Medium	Likely	Residents closest to site and site routes, particularly infants and elderly	***
Annoyance	Negative	High	Low	Likely	All	***

Health Determinant or Outcome	Impact	Magnitude	Intensity	Likelihood	Distribution	Quality of Evidence
Cardiovascular health	Negative	Medium	High	Likely	Residents closest to site and site routes, particularly the elderly	***
Stress, anxiety, and depression	Negative	Medium	Medium	Likely	Residents closest to site and site routes	**
Noise-induced hearing loss	Negative	Medium	High	Likely	Residents closest to site and site routes	***
Impaired task performance/ educational outcomes	Negative	Medium	Medium	Likely	Residents closest to site and site routes, children attending schools near site routes	**
Interference with spoken communication	Negative	Medium	Low	Likely	Residents closest to site, particularly children and the elderly	***
Traffic Safety						
Morbidity and mortality	Negative	Low	High	Likely	Individuals living, working, or attending school in proximity to roadways	***
Mental health and stress	Negative	High	Medium	Likely	Individuals living, working, or attending school in proximity to roadways	**
Obesity and chronic disease	Negative	Medium	High	Possible	Commuters; All	**
Light						
Metabolic disorders	Negative	Low	High	Uncertain	Residents closest to site	**
Mood disorders	Negative	Low	Medium	Uncertain	Residents closest to site	**
Sleep disorders	Negative	Low	Medium	Possible	Residents closest to site	***
Risk of coronary heart disease	Negative	Low	High	Uncertain	Residents closest to site, particularly the elderly	**

8. Recommendations

Based on the assessment findings, NCHH developed a draft set of recommended mitigations to reduce the probability and magnitude of adverse health outcomes due to the planned facility. In July, 2013, NCHH shared these recommendations with community residents and key agency stakeholders for assistance with refinement and prioritization.

Design/Planning:

1. CSX should pay the City of Baltimore a facility regulatory and site infrastructure fee to offset, at least partially, any potential negative impacts on access to neighborhood resources. For example, the fees could be used to provide local jurisdictions with block grants for improvements to neighborhood resources (e.g., libraries, schools, parks, community centers) that could be impacted by the project. The fees would be used to mitigate costs borne by the City to mitigate the impact of the trucks on the roads, the potential loss of tax revenue resulting from decreased property assessments, and to pay for pedestrian and bicycle safety programs. The fees would provide a sustainable stream of funding to mitigate unforeseen impacts of the facility in the future. These amounts should increase by five percent each year and would automatically increase by 20 percent if the State or City takes any enforcement action related to the construction or operation of the facility.

2. CSX and the Maryland Department of the Environment should complete the air quality models begun in this HIA to more fully assess the existing air quality in the community (including existing train emissions) and project the added impacts of the facility (including idling, trains emissions, machinery, congestion, etc.) on air quality and excess mortality.

3. The community should be involved in decisions and priority setting for the community improvements CSX plans to make with project funds. Improvements related to the construction and operations of the facility and mitigations related to the facility should be included in CSX's construction budget rather than as part of the community improvement budget.

4. The City of Baltimore should develop a plan to monitor and enforce the truck routes to ensure trucks traveling to and from the facility do not use prohibited local roads. All truck routes should be well defined and marked with clear signs indicating approved routes. The City of Baltimore should also make provisions for enforcement of truck idling regulations in the planning process.

5. CSX and the City of Baltimore should explore additional truck route and access options that do not put residents or employees of the Crossroad Business Park at risk.

6. CSX should work with the Baltimore City Office of Employment Development to set aside living wage positions at the site for residents in the surrounding neighborhoods

during construction and operations phases.

7. CSX should initiate and maintain an apprenticeship program for at-risk youth from neighborhoods surrounding the Mount Clare Yard to enable access to goods movement-related employment opportunities as the amount of freight moving through Maryland continues to increase.

8. CSX should work with the City of Baltimore to provide fair and consistent property purchasing offers to all households within close proximity of the site perimeter. Offers should include replacement costs for the housing structure and compensation for relocation.

9. Once noise models from CSX are available, the Baltimore Health Department or the Maryland Department of Health and Mental Hygiene should analyze the magnitude of impacts on annoyance and sleep disturbance. NCHH provides protocols in appendices G and H that the agencies could use to conduct this analysis. If excessive noise levels are noted, CSX should install soundproofing/noise-reducing windows for homes and schools in close proximity to the facility and along the routes servicing the facility.

10. CSX should provide a site lighting plan that accounts for impacts on residents' privacy and is subject to a third-party review. To the extent possible while ensuring occupational safety, CSX should reduce the facility's lighting at night to minimize disturbance to nearby residents.

11. The City of Baltimore should work with CSX to establish a rodent control program during the excavation, construction, and operations phases.

12. The City of Baltimore should explore alternatives to the closure of Georgetown Road at Bernard Drive. If such a closure is necessary, the City should examine and mitigate the impact on the community and businesses of changes to service of MTA Bus Route 35.

13. CSX should respond to and address the concerns raised by community leaders in their letter of July 9, 2013 before it finalizes plans for the facility.

<u>Construction:</u>

14. CSX should improve the road infrastructure along the designated truck route, with consideration paid to intersections with high crash incident rates (e.g., at Wilmarco and Dukeland) and taking into account the Crossroads business park traffic.

15. The City of Baltimore should assess the current pedestrian infrastructure and coordinate with CSX to provide a complete network of sidewalks to any roads where truck traffic will increase as a result of the facility. Signalized, stop controlled, or otherwise protected crosswalks should be included in the plans for upgrading the pedestrian infrastructure.

16. CSX should minimize the impact of the facility's construction and operations on parks and green spaces adjacent to facility operations and truck routes, particularly Carroll Park and the Gwynns Falls Trail, Desoto Park, and Gibbons Commons. Natural buffers and pedestrian walkways should be installed to protect those walking or recreating in the community from injuries and other potential health hazards (e.g., crosswalks, fences, trees).

17. CSX should work with the City to identify appropriate mechanisms, using greening and aesthetic principles, to block sound and light between the site and adjacent houses. These same principles should be followed to add a buffer of vegetation around site and truck routes, particularly near sensitive receptors, including parks and schools. These mitigations should be funded as part of CSX's construction budget.

18. CSX should retain all mature, specimen, and significant trees and vegetation around the site to reduce storm runoff and assist with reducing air pollutants.

19. CSX should erect barriers to prevent children from crossing the train tracks on their way to school. Children in the neighborhood currently use the train tracks as a crossing to get to and from school because of an absence of convenient crosswalks, putting their safety at risk.

20. CSX should establish controls over rodents, mosquitoes, and potential drowning related to any storm water retention ponds, and consider using a more modern underground drainage system in the site plan.

Operations:

21. The City of Baltimore should enforce the maximum number of daily truck and train trips associated with the intermodal facility to ensure that the facility's capacity and usage does not grow beyond the identified maximum capacities.

22. CSX should make all efforts to reduce air pollution resulting from on- and offsite equipment and vehicles. For example, the City and CSX should pursue opportunities to require and encourage that all trucks entering the facility be 2008 or newer.[25] CSX should pursue opportunities to ensure that all diesel trains associated with the intermodal facility are low emitting or retrofitted to provide the lowest possible emissions. Wherever possible, container cranes, loaders, and forklifts should be either electrically powered or equipped with low emitting engines. CSX should ensure that no unnecessary truck or train idling occurs.

[25]Note: The Port Authority operates a program to assist fleets with upgrading their trucks to reduce emissions and improve air quality.

23. To the extent possible while ensuring occupational safety, CSX should reduce the facility's lighting at night to minimize disturbance to nearby residents. If possible, the color spectrum of lighting sources should also be adjusted towards low-level red lighting and away from high-energy blue lighting, which has been found to be highly disruptive to human biological cycles (Navara & Nelson, 2007).

24. CSX should restrict activities that are likely to produce noise and light pollution before 7:00 a.m. and after 7:00 p.m. and on weekends.

25. CSX should work with the City of Baltimore to ensure that Route 1 is not blocked by halted trains traveling along the CSX rail network, which would pose a problem for emergency vehicle egress and commuter travel.

Communications:

26. CSX, the City of Baltimore, and the Maryland Department of Transportation should develop clear and transparent procedures through which residents may raise and address issues regarding noise, lighting, air quality, or other concerns once the project is operational.

27. CSX, the City of Baltimore, and the Maryland Department of Transportation should improve the transparency and timeliness of information during the design, planning, and construction phases by maintaining an up-to-date public website, providing Town Hall style forums to field community questions, and providing timely responses to emails received through the address provided on the project website (intermodal@mdot.maryland.gov).

28. CSX should hire one or two residents from within the community to serve in an official capacity as liaison(s) between CSX and the community.

29. CSX should offer community-wide opportunities for residents to gather and learn about CSX's plans for the project so that residents from various community groups can collectively learn about the project. The City of Baltimore should work with residents to identify a clear process for communication with CSX and MDOT including a local contact and a timeline and process through which the person is required to respond.

Monitoring:

30. CSX should provide funding to the Maryland Department of the Environment to install and operate air quality monitors at several locations, including near residences directly adjacent to the project site and associated truck routes, at locations one-quarter mile and one-half mile from the site and associated truck routes, and at sensitive receptor sites such as schools, community centers, libraries, senior facilities, parks, and playgrounds. These data should be monitored at least annually following the opening of the site, should be made public, and should be provided directly to residents of the Morrell

Park/Violetville CSA.

31. If pollutant levels indoors or at outdoors sites, such as schools, libraries, and community and senior centers, rise above standards published by the World Health Organization (World Health Organization, 2000),[26] CSX should seek to reduce emissions through pollution control technology and by improving the building performance (e.g., through reduced air leakage and improved ventilation), reducing emissions through pollution control technologies, and installing additional natural buffers and barriers.

32. The Baltimore City Department of Transportation should monitor and enforce existing truck restrictions and prohibitions against the use of air brakes through "stings" or other mechanisms.

33. The City of Baltimore and CSX should partner to increase the police and security presence at and around the facility. The partnership should leverage the facility's security resources to reduce existing crime levels in the neighborhood and to mitigate any potential increases in crime from the more intense industrial use.

34. The City of Baltimore should monitor noise emissions from intermodal operations at one year intervals following the opening of the site. Results should be compared to baseline levels. The Baltimore City Health Department or the Maryland Department of Health and Mental Hygiene should analyze the magnitude of impacts on annoyance and sleep disturbance. CSX should fund additional noise mitigation programs accordingly. NCHH provides protocols in Appendices G and H that the agencies could use to conduct these analyses.

35. The Baltimore City Health Department should continue to monitor the health outcomes among residents in the Morrell Park/Violetville CSA that could be directly impacted by the facility, such as asthma and respiratory disease, cardiovascular disease, mortality, and traffic collisions on an annual basis.

<u>Policy Recommendations:</u>

36. As part of the rezoning process for the City of Baltimore, the City should ensure harmony between residential and industrial uses of the CSA and seek to reduce future conflicts.

37. As part of the City's consolidated planning process, the City should create a neighborhood revitalization plan for the CSA. The plan should improve the community's infrastructure and services and encourage businesses to remain in the intermodal corridor communities through financial incentives. Such investment would help maintain property values, promote social cohesion, and mitigate the potential stigma of the facility on the surrounding neighborhood. The city should consider strategies to divert preferentially

[26] Note that the WHO standards are for outdoor pollutants. No established standards exist for indoor air pollutants. However, if pollutant levels are at or above outside thresholds in indoor spaces, mitigations would be prudent.

increasing tax revenue resulting from the Baltimore-Washington Rail Intermodal Facility into infrastructure and services for the Morrell Park/Violetville CSA.

38. The Maryland Department of Transportation should provide the community associations near the proposed facility with a clear description of Maryland Environmental Policy Act (MEPA) requirements and the role of citizens in the MEPA process.[27]

39. The Maryland Department of the Environment should work with agency and academic partners to conduct additional air quality modeling to assess the existing air pollution burden in the region and city from freeways, trucks, and train emissions. This information should be used to inform the future planning of infrastructure projects.

40. The Maryland State Legislature should work to strengthen the Maryland Environmental Policy Act (MEPA) to ensure that projects funded or permitted solely by state or local funds consider significant environmental and health impacts, as they would be considered under the National Environmental Policy Act (NEPA). New York's State Environmental Quality Review Act (SEQRA) may serve as a model for these revisions to MEPA.

[27] The White House Council on Environmental Quality has produced a community guide for the National Environmental Policy Act that could serve as a useful model: http://ceq.hss.doe.gov/nepa/citizens_guide_Dec07.pdf.

9. Monitoring

As part of CSX's ongoing relationship with the City of Baltimore and the residents near the Mount Clare Yard, CSX should set aside funding to track and document the impacts of the facility on health and the incorporation of priority recommendations from this HIA into decisions related to the intermodal facility. This monitoring plan seeks to determine the following:

- Which recommendations provided in this HIA have been enacted to protect and improve health?
- What evidence is there for changes in health determinants as a result of the facility's development and operation?
- What evidence is there for changes in health determinants as a result of the HIA recommended actions?

Table 12: Indicators to Be Monitored

Indicator	Agency Responsible for Monitoring	Timing
Levels of $PM_{2.5}$ and other pollutant exposures among residents surrounding the site	Maryland Department of the Environment with funding support from CSX	Annually
Rates of asthma-related emergency department visits within census tracts surrounding the site	Baltimore City Health Department	Annually
Increase in enforcement of truck route restrictions	Baltimore City Department of Transportation	Ongoing
Completion of additional air quality modeling to assess the existing burden from train-related air pollution and project the added impacts of the facility (including idling, trains and machinery, et cetera) on air quality, excess mortality, and asthma prior to the completion of the site design	Maryland Department of the Environment with funding support from CSX and in partnerships with other agencies and academic institutions, as needed	Prior to completion of site design and permitting
Number of living wage positions held by residents in the Morrell Park/Violetville CSA at the Mount Clare intermodal facility	Baltimore City Office of Employment Development	Annually
Establishment and continuation of an apprenticeship program for at-risk youth to enable access to goods movement-related employment opportunities	Baltimore City Office of Employment Development	Prior to completion of site design and permitting

Indicator	Agency Responsible for Monitoring	Timing
Completion of noise-related annoyance and sleep disturbance calculations following the completion of the CSX noise study	Baltimore City Health Department	Prior to completion of site design and permitting
Completion of an assessment of pedestrian infrastructure and development of improved pedestrian networks (sidewalks and crosswalks) along any roads where truck traffic will increase as a result of the facility	Baltimore Department of Transportation and CSX	Prior to the facility's opening in 2015
Enforcement of the maximum number of daily truck and train trips	City of Baltimore	Assess annually
Establishment of a regulatory and site infrastructure fee paid by CSX to offset any potential negative impacts on access to neighborhood resources	City of Baltimore	Prior to the facility's opening in 2015
Fair and consistent property purchasing offers provided to all households within close proximity to the site perimeter	City of Baltimore	Prior to completion of site design and permitting
Increase in the City's direct investment in the community's infrastructure and services	City of Baltimore Planning Office	Ongoing
Completion of site lighting plan accounting for impacts on residents' privacy completed	City of Baltimore Planning Office	Prior to completion of site design and permitting
Rodent control program during the excavation, construction, and operations phases established and followed	City of Baltimore Rodent Control Program	Prior to the completion of site design and permitting, and ongoing during construction
Alternatives to the closure of Georgetown Road at Bernard Drive examined and impacts mitigated	Baltimore City Department of Transportation	Prior to completion of site design and permitting
CSX provides responses to documented community concerns	City of Baltimore Planning Office and the Maryland Department of Transportation	Prior to completion of site design and permitting
Businesses encouraged to remain in the intermodal corridor communities through tax breaks or credits	Crossroads Business Park and the City of Baltimore	Annually
Road infrastructure along the designated truck route improved and maintained	Baltimore City Department of Transportation	Ongoing
Impact of the facility's construction and	Maryland Department	Ongoing

Indicator	Agency Responsible for Monitoring	Timing
operations on parks and green spaces minimized	of the Environment	
Appropriate mechanisms, using greening and aesthetic principles, are installed to block sound and light	City of Baltimore Planning Office	Prior to the facility's opening in 2015
Soundproofing/noise-reducing windows for homes and schools in close proximity to the facility and along routes servicing the facility	City of Baltimore Planning Office	Prior to the facility's opening in 2015
Mature, specimen, and significant trees and vegetation retained around the site to reduce storm runoff and reduce air pollutants	Maryland Department of the Environment	Prior to completion of site design and permitting
Buffer of vegetation added around site and truck routes, particularly near sensitive receptors, including parks and schools	Maryland Department of the Environment	Prior to the facility's opening in 2015
Barriers erected to prevent children from crossing the train tracks on their way to school	Baltimore City Department of Transportation	Prior to the facility's opening in 2015
Storm water retention ponds safety plan designed and implemented	City of Baltimore Planning Office	Prior to completion of site design and permitting
All trucks entering the facility have the best emissions control technology installed	Maryland Department of the Environment	Ongoing
Onsite machinery meets EPA emissions standards	Maryland Department of the Environment	Ongoing
Facility's lighting reduced at night to minimize disturbance to nearby residents	City of Baltimore Planning Office	Ongoing following the facility's opening
Procedures established so that residents may raise and have addressed their concerns once the project is operational	Maryland Department of Transportation and the City of Baltimore	Prior to completion of site design and permitting
Police and security presence increased at and around the facility	City of Baltimore Planning Office	Ongoing

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11. Appendices

Appendix A: Screening Criteria

NCHH considered the following criteria during the screening process.

Screening Criteria
1. The project, plan, or policy has been proposed, a final decision about whether to adopt the proposal has not been made, and there is sufficient time to conduct an analysis before the decision is made.
2. The decision has the potential to affect, positively or negatively, environmental or social determinants of health that impact health outcomes of a population—and those health impacts are not being or not likely to be considered without the HIA.
3. Evidence, expertise, and/or research methods exist to analyze health impacts associated with the decision being considered.
4. The proposal being considered could potentially impact health inequities.
5. The proposal's impact on health outcomes is potentially significant. This can be measured in terms of the number of people affected, the magnitude of impacts, and the breadth of the impacts.
6. The connections between the proposal and health outcomes are neither too obvious nor too indirect.
7. Decision-makers and/or those stakeholders who have the capacity to influence decision-makers are likely to use HIA findings and recommendations to inform or influence the decision–making process, whether through regulatory requirements or voluntarily.
8. The HIA could help lead to institutional and/or systemic changes that promote better health outcomes for all.
9. Partners are available to participate in the HIA process and use HIA findings and recommendations.
10. Resources (including funding, personnel, technical capacity, and leadership) are available to conduct the HIA.

Appendix B: Research Questions

Table A.1: Air Quality (AQ) Research Questions

Existing Conditions Research Questions	Impact Research Questions
AQ1E. What are the existing traffic and truck counts on roadways surrounding the proposed site location?	AQ1I. How are traffic and truck counts on roadways surrounding the proposed site location expected to change due to the proposed facility?
AQ2E. What are the existing levels of traffic and truck-attributable air pollution emissions/exposures on roadways surrounding the proposed site location?	AQ2I. How will the projected changes in traffic and truck counts due to the proposed facility affect air quality on roadways surrounding the proposed site location?
AQ3E. What are other sources of air pollution near the proposed site location, including both stationary sources (e.g., refineries) and mobile sources (e.g., freeways)?	AQ3I. What will be the cumulative impact of the proposed facility and all existing air pollution sources on air quality?
AQ4E. What are current rates of asthma in the proposed site location? What are current rates of emergency department visits for asthma in the proposed site location?	AQ4I. How will changes in air quality resulting from the proposed facility potentially impact aggravation of asthma? How will changes in air quality resulting from the facility potentially impact vehicle/truck/train-attributable asthma emergency department visit rates?
AQ5E. What are existing mortality rates (all-cause, cardiac-related, and cancer-related) in the proposed site location?	AQ5I. How will changes in air quality resulting from the facility potentially impact mortality risk?
AQ6E. How do demographic characteristics of populations living in proximity to the proposed site location compare with those of people living in the remainder of the city and the state as a whole?	AQ6I. Will projected changes in air quality resulting from the facility disproportionately impact people with social or economic vulnerabilities?
AQ7E. How many sensitive receptor sites are located in proximity to the proposed site location (e.g., schools, parks, senior housing, and hospitals)?	AQ7I. How will changes in air quality resulting from the facility be expected to impact these sensitive receptor sites?
AQ8E. What are current perceptions of air quality in the proposed site location?	AQ8I. What are the perceived impacts of the proposed facility on air quality in the proposed site location?

Table A.2: Employment (E) Research Questions

Existing Conditions Research Questions	Impact Research Questions
E1E. How many and what types of jobs (including wages, benefits, skill sets necessary) currently exist in the area surrounding the Mount Clare Yard?	E1I. How will the proposed facility impact the number and types of permanent jobs available at the Seagirt Marine Terminal and at the proposed facility? How will the proposed facility impact the number and types of jobs offered to residents in proximity to the proposed site location?
E2E. What non-freight related employers and businesses are currently located near the proposed site location?	E2I. How will the operation of the proposed facility potentially impact non-freight related employers and businesses?
E3E. What is the current level of unemployment among residents near the proposed site location?	E3I. How will the operation of the proposed facility impact employment near the proposed site location?
E4E. What are current perceptions of unemployment and future economic growth in the proposed site location?	E4I. What are the perceived impacts of the proposed facility on unemployment and future economic growth?

Table A.3: Neighborhood Resources (NR) Research Questions

Existing Conditions Research Questions	Impact Research Questions
NR1E. What are the current property values near the proposed site location?	NR1I. How will the proposed facility impact property values near the proposed site location?
NR2E. What level of community services (e.g., police, schools) are currently available near the proposed site location?	NR2I. How will the proposed facility impact tax revenues and associated community services near the proposed site location?
NR3E. What is the residential stability of the current population near the proposed site location?	NR3I. How will the proposed facility impact residential stability near the proposed site location?
NR4E. What neighborhood resources are important to residents near the proposed site location? To what extent are residents near the proposed site location using neighborhood resources?	NR4I. What neighborhood resources do residents near the proposed site location perceive will be impacted by the proposed facility? How do residents near the proposed site location perceive the proposed facility will impact their use of neighborhood resources?

Table A.4: Noise (N) Research Questions

Existing Conditions Research Questions	Impact Research Questions
N1E. What are the existing traffic, truck, and train counts on roadways and railways surrounding the proposed site location?	N1I. How are traffic, truck, and train counts on roadways and railways surrounding the proposed site location expected to change due to the proposed facility?
N2E. What are the current levels of traffic-related noise in the proposed site location?	N2I. How will the projected changes in traffic-related noise potentially impact sleep disturbance and perceived high annoyance?
N3E. What are the current levels of train-related noise in the proposed site location?	N3I. How will the projected changes in train-related noise potentially impact sleep disturbance and perceived high annoyance?
N4E. What are other sources of noise in the proposed site location?	N4I. How will the proposed facility cumulatively impact noise levels in the proposed site location?
N5E. How do demographic characteristics of populations living in proximity to the proposed site location compare to characteristics of people living in the remainder of the city and the state as a whole?	N5I. Will projected changes in noise resulting from the proposed facility disproportionately impact people with social or economic vulnerabilities?
N6E. How many sensitive receptors are located in proximity to the proposed site location (e.g., schools, parks, senior housing, and hospitals)?	N6I. How will changes in noise resulting from the proposed facility potentially impact these sensitive receptors?
N7E. What are current perceptions of noise in the proposed site location?	N7I. What are the perceived impacts of the proposed facility on noise in the proposed site location?

Table A.5: Traffic Safety (T) Research Questions

Existing Conditions Research Questions	Impact Research Questions
T1E. What are the existing vehicle and truck volumes near the proposed site location?	T1I. What are the projected changes in future volumes near the proposed site location?
T2E. What are the existing pedestrian/cyclist volumes near the proposed site location?	T2I. How will the proposed facility potentially impact pedestrian/cyclist volumes near the proposed site location?
T3E. What is the current rate of pedestrian/vehicle and cyclist/vehicle collisions near the proposed site location?	T3I. How will the proposed facility potentially impact pedestrian/vehicle and cyclist/vehicle collisions and associated morbidity and mortality near the proposed site location?
T4E. What pedestrian and cyclist infrastructure currently exists (e.g., crossing signals, bike lanes, etc.) in the proposed site location?	T4I. How will the proposed facility potentially impact pedestrian and cyclist infrastructure in the proposed site location?
T5E. How many sensitive receptors are located in proximity to the proposed site location (e.g., schools, parks, senior housing, and hospitals)?	T5I. How will changes in traffic safety resulting from the proposed facility potentially impact these sensitive receptors?
T6E. What are current injury and fatality rates related to traffic collisions?	T6I. How will traffic collision injury and fatality rates potentially change following the development of the proposed facility?
T7E. What are current rates of physical activity and associated health outcomes among residents in the proposed site location?	T7I. How will changes in traffic safety resulting from the proposed facility potentially impact physical activity rates and associated health outcomes?
T8E. What are current perceptions of vehicle, bicycle, and pedestrian infrastructure in the alternative site areas?	T8I. What are the perceived impacts of the proposed facility on vehicle, bicycle, and pedestrian infrastructure in the proposed site location?

Table A.6: Light (L) Research Questions

Existing Conditions Research Questions	Impact Research Questions
L1E. What are other sources of light at night in the proposed site location?	L1I. How will the proposed facility cumulatively impact levels of light at night in the proposed site location?
L2E. How do demographic characteristics of populations living in proximity to the proposed site location compare to characteristics of people living in the remainder of the city and the state as a whole?	L2I. Will projected changes in light at night resulting from the proposed facility disproportionately impact people with social or economic vulnerabilities?
L3E. How many sensitive receptors are located in proximity to the proposed site location (e.g., schools, parks, senior housing, and hospitals)?	L3I. How will changes in light at night resulting from the proposed facility potentially impact these sensitive receptors?
L4E. What are current perceptions of light at night in the proposed site location?	L4I. What are the perceived impacts of the proposed facility on light at night in the proposed site location?

Appendix C: Health Determinant Indicators and Data Sources

KEY INDICATOR	DATA SOURCE
AIR QUALITY:	
Annual Average Daily Traffic	MDSHA Traffic Count Data
Annual Average Daily Train Traffic	Maryland Department of Transportation
Annual Average Daily Weekday Traffic	MDSHA Traffic Count Data
Percentage single-unit & combination trucks	MDSHA Traffic Count Data
Ambient level of air toxics (e.g., $PM_{2.5}$)	Maryland Department of the Environment; Air Quality Modeling Data
Percent of elementary school students missing 20+ days	Baltimore City Health Department
Age-adjusted mortality rate per 10,000; rate of heart disease deaths per 10,000 population; rate of cancer deaths per 10,000 population; rate of chronic lower respiratory disease deaths per 10,000; rate of lung cancer deaths per 10,000	Baltimore City Health Department
Demographic characteristics: • median household income • race/ethnicity • age distribution • % population in poverty • % unemployed	U.S. Census
Perceptions of air quality	Focus groups and stakeholder interviews
EMPLOYMENT:	
Projected number of jobs created (direct, indirect, and induced)	Economic and Fiscal Impacts of the Panama Canal Expansion on the Port of Baltimore, Towson University
Unemployment rates by race	American Community Survey 5-Year Estimates
Rates of diseases related to income and employment, for example: • life expectancy at birth • age-adjusted mortality • avertable deaths • mortality by age	Baltimore City Health Department
Perceptions of unemployment and future economic growth	Focus groups and stakeholder interviews
NEIGHBORHOOD RESOURCES:	
Property values • # annual sales	Baltimore City Department of Planning Housing Market Typology

KEY INDICATOR	DATA SOURCE
• median sales price • vacant lots	
Zoning and land use data	Maryland Department of Planning GIS data
Perceptions of potential impacts on residential property values	Focus groups and stakeholder interviews
Perceptions of neighborhood resources	Focus groups and stakeholder interviews
NOISE:	
Annual average daily traffic	MDSHA Traffic Count Data
Annual average daily train traffic	Maryland Department of Transportation
Annual average daily weekday traffic	MDSHA Traffic Count Data
Zoning and land use data	Maryland Department of Planning GIS data
Perceptions of noise	Focus groups and stakeholder interviews
TRAFFIC SAFETY:	
Vehicle and truck counts	MDSHA Traffic Count Data
Perceptions of vehicle and pedestrian infrastructure	Focus groups and stakeholder interviews
LIGHT:	
Perceptions of light	Focus group and stakeholder interviews

Appendix D: Sample Stakeholder Interview Questions

Background

1. How familiar would you say you are with plans for the Baltimore-Washington Intermodal Rail Facility?

Employment

2. What types of jobs or entrepreneurship opportunities do you hope that the intermodal facility might bring to this community?

3. How do you think your business/businesses in the area would change (positively or negatively) if this area were chosen for the intermodal facility?

4. What challenges do you see or hear about in today's economy? How might the intermodal facility help with these challenges? How might it create additional challenges for your business/businesses in the area? What geographic areas do you think would be impacted (e.g., neighborhood, city, county)? Are there specific locations or areas that would be particularly affected?

Neighborhood Resources

5. Think about the resources that are available in this neighborhood—to you/your customers/constituents. Resources might include schools, gathering places, police and fire services. Which resources are most important to you? The people you serve/work with? Your business? Your customers? Your constituents?

6. How many of your customers come from nearby? Do you think this might change with the facility?

7. How do you think the intermodal facility might change the ways people in this neighborhood interact with each other? What geographic areas do you think would be impacted (e.g., neighborhood, city, county)? Are there specific locations or areas that would be particularly affected?

8. What parks and open spaces are available to residents in this neighborhood? How do you think the intermodal facility might impact accessibility to parks and open spaces in this neighborhood? What geographic areas do you think would be impacted (e.g., neighborhood, city, county)? Are there specific locations or areas that would be particularly affected?

9. In your opinion, what is the main reason people move to this neighborhood? What is the main reason people move away? How do you think the facility might impact people's desire to move to, or away from, this neighborhood? What geographic areas do you think would be impacted (e.g., neighborhood, city, county)? Are there specific locations or areas that would be particularly affected?

Air Quality

10. How is the current air quality in this neighborhood? What are current sources of air pollution in this neighborhood? How do you think air quality might change with the intermodal facility? What geographic areas do you think would be impacted (e.g., neighborhood, city, county)? Are there specific locations or areas that would be particularly affected?

Noise

11. What are current sources of noise in this neighborhood? How do you think the noise levels in your neighborhood might change with the intermodal facility? What geographic areas do you think would be impacted (e.g., neighborhood, city, county)? Are there specific locations or areas that would be particularly affected?

Traffic Safety

12. What is your perception of current traffic volumes in this neighborhood? What is your perception of current traffic safety in this neighborhood? What do you think would make people in this neighborhood feel safer while they're getting from place to place? How do you think the intermodal facility might affect transportation safety? What geographic areas do you think would be impacted (e.g., neighborhood, city, county)? Are there specific locations or areas that would be particularly affected?

Appendix E: Estimating Attributable Excess Mortality from $PM_{2.5}$ Exposure

Epidemiological studies along with data on pollutant exposure, population size, and mortality rates provide data to construct exposure-response functions relating exposure to ambient $PM_{2.5}$ and premature mortality. We estimated the impact of increased truck traffic related to the intermodal facility on changes in $PM_{2.5}$ exposure and associated related premature mortality using a standard exposure response function (ERF) (equation 1).

(1) Δ Incidence = $-[y_0 * (\exp(-\beta \Delta C \text{ exposure}) - 1)] * \text{population}$

Where:
- β = coefficient of $PM_{2.5}$ parameter in regression model
- y_0 = crude mortality incidence rate
- population = size of the population experiencing a change in exposure

Several well-designed, peer-reviewed prospective cohort studies conducted in the U.S. general population provide data for the effect of long-term community-level $PM_{2.5}$ exposures on community-level annual mortality rates (see table below). The EPA uses these studies for regulatory impact assessments because of their geographic scope and their extensive reexamination.[28] Lower risk estimates in the American Cancer Society (ACS) cohort relative to the Harvard Six Cities study may be due to higher population socioeconomic status or exposure misclassification from retrospective exposure assessments. A re-analysis by Jerrett et al. (2005) of an ACS subpopulation in Los Angeles, using more spatially refined intra-regional exposure data to reduce exposure misclassification, found a higher central relative risk estimate of 1.17 in the same cohort.

Long-term Prospective Cohort Studies of Chronic Exposure to $PM_{2.5}$ and Mortality

Cohort/Publication	Population	RR per 10 µg/m3 $PM_{2.5}$ (95% Confidence Interval)	B: coefficient
American Cancer Society Pope (Pope et al., 2002)[29]	USA, 51 cities Adults, Age >30 years	1.06 (1.02-1.11)	0.0058 (0.002-0.010)
Harvard Six Cities (Lepeule et al., 2012)[30]	USA, Multiple Cities General Population	1.14 (1.07-1.22)	0.013 (0.007-0.020)
American Cancer Society (Jerrett and Burnett, 2005)[31]	USA, Los Angeles General Population	1.17 (1.05-1.30)	0.0157 (0.005-0.026)

[28] Industrial Economics. (2010). Health and welfare benefits analyses to support the second section 812 benefit-cost analysis of the Clean Air Act. Washington, DC: U.S. Environmental Protection Agency; Industrial Economics. (2006.). Expanded expert judgment assessment of the concentration-response relationship between PM2.5 exposure and mortality: Final report. Washington, DC: U.S. Environmental Protection Agency. Available at: www.epa.gov/ttn/ecas/regdata/Uncertainty/pm_ee_report.pdf.

[29] Pope, C. A., III, Burnett, R. T., Thun, M. J., Calle, E. E., Krewski, D., Ito, K., & Thurston, G. D. (2002.). Lung cancer, cardiopulmonary mortality, and long-term exposure to fine particulate air pollution. JAMA 287:1132–1141.

[30] Lepeule, J., Laden, F., Dockery, D., & Schwartz, J. (2012.). Chronic exposure to fine particles and mortality: An extended follow-up of the Harvard Six Cities Study from 1974 to 2009. *Environmental Health Perspectives 120*(7), 965-970.

Our assessment utilized the ERF from the recent extended re-analysis of the Harvard Six Cities study (RR=1.14 per 10 μg/m3 $PM_{2.5}$) for predicting $PM_{2.5}$ attributable health impacts in the Morrell Park/Violetville CSA. This represented a middle estimate based on the three above studies. The Baltimore City Health Department provided all-cause crude mortality incidence data at the CSA level.

[31] Jerrett, M., Burnett, R., Ma, R., Pope, C. A. III, Krewski, D., Newbold, B., et al. 2005. Spatial analysis of air pollution and mortality in Los Angeles. *Epidemiology*, 16: 727-736.

Appendix F: Proportion of Housing Units without Vehicle Access Located a Half Mile or More from the Nearest Supermarket[32]

	Housing Units	Housing units without vehicle access that are located a half mile or more from a supermarket	
	Number[33]	**Number**[34]	**Proportion**[35]
24510**2502.06**	1,008	97	9.7%
24510**2503.03**	962	208	21.6%
Morrell Park/Violetville CSA[36]	**1,970**	**305**	**15.5%**
Baltimore City	249,903	23,099	9.2%
Maryland	2,156,411	94,918	4.4%

[32] Source: USDA, Food Access Research Atlas (www.ers.usda.gov/data-products/food-access-research-atlas.aspx).
[33] Total number of housing units (variable "OHU2010" in USDA datafile)
[34] Number of housing units without vehicle access and low access to supermarkets at a half mile (variable "lahunvhalf" in USDA datafile)
[35] Proportion of housing units without vehicle access and low access to supermarkets at a half mile (variable "lahunvhalfshare" in USDA datafile and calculated as "lahunvhalf"/"OHU2010")
[36] Information about the Morrell Park/Violetville CSA was based on data from Census Tracts 24510250303 and 24510250206.

Appendix G: Estimating the Population at Risk for Being Highly Annoyed from Roadway Noise

Source: Human Impact Partners (2011). I-710 Corridor Project Health Impact Assessment. Oakland, CA.

Annoyance is a well-established metric for evaluating the significance of community noise. Annoyance due to noise is determined by loudness, temporal patterns (e.g., the time of day the noise is louder), source and predictability (e.g., traffic or gunshots), and the association of the noise with other environmental factors such as vibration or light or air pollution.

Miedema and Oudshoorn[37] synthesized results from 18 studies of road traffic noise to estimate noise exposure and annoyance response measures (Day-night level and percentage of respondents considered to be highly annoyed from noise, respectively) and to derive an exposure response curve estimating the percentage of highly annoyed persons as a function of Day Night Average Sound Level (L_{dn}). The following formula represents this exposure response curve and can be used to estimate the percentage of the population reporting being highly annoyed (%HA) if exposed to certain Ldn due to road traffic noise:

$$\%HA = 9.994 \times 10^{-4}(L_{dn}-42)^3 - 1.523 \times 10^{-2}(L_{dn}-42)^2 + 0.538\,(L_{dn}-42)$$

Where L_{dn} (the "average" A-weighted long-term LA_{eq} noise measure with a nighttime penalty of 10 dB) = $10 \log[(15/24) \times 10^{LD/10} + (9/24) \times 10^{(LN+10)/10]}$

LD and LN are the A-weighted long-term LA_{eq} defined by the International Standards Organization[38] for the day (7 a.m. to 10 p.m.) and the night (10 p.m. to 7 a.m.), respectively.

Given estimates of the population living within a certain distance of roadways and monitored or modeled noise (using the Federal Highway Administration's Traffic Noise Model 2.5[39]) based on the number of vehicles of various types and speeds passing specific locations per hour), it is possible to estimate, using this formula, the number of people expected to be highly annoyed based on their exposure to noise from roadway traffic.

This estimation requires the following data:
1. Noise contours—Location-specific LAeq readings during the day (7 a.m. to 10 p.m.) and night (10 p.m. to 7 a.m.)
2. Location-specific and precise Census population estimates—specify the Census data year, geographies (tract, block group, block, or aggregation of one of these to an area specified), and source.

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[37] Miedema, H. M. E., & Oudshoorn, C.G.M.. (2001.). "Annoyance from transportation noise: Relationships with exposure metrics DNL and DENL and their confidence intervals." *Environmental Health Perspectives, 109*(4): 409-416.
[38] International Standards Organization. (1987.). "Acoustics—description and measurement of environmental noise." ISO 1996-2. Geneva, Switzerland.
[39] FHWA (Federal Highway Administration). (2004.). "TNM look-up tables:" 2.5th edition. Washington, DC.

This estimation requires the following activities with the data described above:

1. To quantify the population exposed to various noise levels and that is at risk for being highly annoyed, use noise interval buffer areas calculated through modeling or based on measurements. Using a geographic information system (GIS), overlay buffers on Census tracts, measure the proportion of the Census tracts that falls within the buffer area, use that to weight the tracts' population in the buffer, and calculate the population of each buffer area.

2. Apply L_{dn}-associated %HA values to population figures to estimate the population at risk for high annoyance.

Appendix H: Estimating the Population at Risk for Sleep Disturbance from Roadway Noise

Source: Human Impact Partners (2011). I-710 Corridor Project Health Impact Assessment. Oakland, CA.

Research has indicated associations between self-reported disruptions in sleep due to nighttime noise from aircraft, road traffic, and railways.[40, 41] The WHO Community noise guidelines recommend 30 dB LA_{eq} (eight hours) indoor and 45 dB LA_{eq} (eight hours) outdoor as the threshold value for sleep disturbance. Miedema et al. pooled findings from 14 studies of outdoor noise exposure and sleep disturbance to develop an exposure-response function at the population level for road traffic noise exposure and self-reported sleep disturbance as the response. The meta-analysis included 24 studies and estimated exposure-response curves for aircraft, road traffic, and railway noise. For each noise source, sound levels were plotted against degree of sleep disturbance.

The following formula represents the exposure response curve for road traffic noise and can be used to estimate the percentage of the population that would be highly sleep disturbed (%HSD) if exposed to certain noise levels from road traffic.[42]

$$\%HSD = 20.8 – 1.05L_n + 0.01486L_n^2$$

Where L_n is the "average" nighttime A-weighted long-term LAeq defined by the International Standards Organization[43] for the nighttime (10 p.m. to 7 a.m.) measured at the outside façade of the dwelling.

Given estimates of the population living within a certain distance of roadways and monitored or modeled noise (using the Federal Highway Administration's Traffic Noise Model 2.5[44] based on the number of vehicles of various types and speeds passing specific locations per hour), it is possible to estimate, using this formula, the number of people that would be expected to be highly sleep disturbed based on their predicted exposure to nighttime noise from roadway traffic.

This estimation requires the following data:
1. Noise contours—receptor distance specific LA_{eq} readings during the night (11 p.m. to 7 a.m.).
2. Location-specific and precise Census population estimates—specify the Census data year, geographies (tract, block group, block or aggregation of one of these to an area we specify), and source.

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[40] Griefahn, B., Marks, A.. & Robens, S. (2006.). "Noise emitted from road, rail and air traffic and their effects on sleep." *Journal of Sound and Vibration, 295*: 129-140.
[41] Jakovljević, B., Belojević, G., Paunović, K. & Stojanov, V. (2006.). "Road traffic noise and sleep disturbances in an urban population: Cross-sectional study." *Croatian Medical Journal, 47*: 125–133.
[42] Miedema, H.M.E., Passchier-Vermeer, W., & Vos, H. (2002.). "Elements for a position paper on night-time transportation noise and sleep disturbance." TNO Intro report, 2002-59. Available at: http://www.ocs.polito.it/biblioteca/mobilita/SleepDisturbance.pdf.
[43] International Standards Organization. (1987.). "Acoustics—Description and measurement of environmental noise." ISO 1996-2. Geneva.
[44] FHWA (Federal Highway Administration). (2004.). "TNM look-up tables": 2.5th edition. Washington, DC.

This estimation requires the following activities with the data described above:

1. To quantify the population exposed to various noise levels and that is at risk for being highly sleep disturbed use noise interval buffer areas provided. Using a geographic information system (GIS), overlay buffers on Census tracts, measure the proportion of the Census tracts that falls within the buffer area, use that to weight the tracts' population in the buffer, and to calculate the population of each buffer area.

2. Apply L_n-associated %HSD values to population figures to estimate the population at risk for high annoyance.