AIR EMISSIONS REPORT

PROPOSED BERTH AND APPROACH CHANNEL
EDGEMOOR, DELAWARE

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Prepared for

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For Submission to:

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Executive Summary

The proposed construction of a new container terminal access channel, berth and wharf at Edgemoor, Delaware, will require the use of commercial marine vessels and land-based equipment that generate air emissions. Because the project requires federal Clean Water Act and Rivers and Harbors Act permits, the project must comply with State of Delaware Implementation Plans for compliance with the Clean Air Act (42 U.S.C. 7401et seq.) NEPA also requires that the project applicant assess temporary construction and transportation related air emissions and the effect of those emissions on air quality.

To comply, the Applicant, Diamond State Port Corporation, has estimated Criteria Air Pollutants (CAPs) emissions from the machinery that might be used for construction and by construction workers (vehicles) commuting to the project site, and compared those emissions to quantities allocated (budgeted) for similar activities in the federally-approved 2014 National Emissions Inventory (NEI) and to threshold values established per 7 DE Admin. Code 1132, paragraph 3.2.1 (rates applicable to marginal ozone nonattainment area). In consultation, DNREC recommended using the 2014 NEI budgets for the comparative purposes of the conformity assessment. CAPs include nitrogen dioxide (NO_2), sulfur dioxide (SO_2) carbon monoxide (CO), ground-level ozone (O_3), particulate matter (PM) and lead. Ground-level ozone concentrations commonly are linked to emissions of nitrogen oxides (NO_x) and volatile organic compounds (VOC), and regulations focus on the emissions of those substances as a means of controlling ozone concentrations.

The construction emission estimates for this project were calculated using the following equipment categories: commercial marine, nonroad construction equipment, and on-road heavy duty and light duty vehicles. The dredging and wharf construction work were included in the commercial marine category and are expected to require three years to complete, due to limitations that will be placed in the federal permit to avoid in-water work (dredging and pile driving) during the annual anadromous fish migration and spawning season (March through July), and the capacity of the dredge storage facility that will be used to contain, decant, and dry the dredge slurry. Dredging during the first year of construction is anticipated to be limited to approximately 90 days. The duration of dredging in the second and third years are anticipated to be 75 days and 60 days, respectively.

The initial, conservative assessment scenario assumed that the commercial marine category equipment used would be powered by Tier 0 (pre-2000) diesel engines, due to the longevity of marine vessels, the perceived availability of marine equipment powered by newer Tier II diesel engines, and the limited use of ancillary equipment when compared to land-based construction equipment. Nonroad construction equipment (land-based) was assumed to be equipped with newer diesel engines designed to meet Tier III exhaust emission standards, reflecting engines built after the mid-2000s. On-road heavy duty vehicles were modeled as using Tier II diesel engines and light duty vehicles were assumed to use gasoline engines. In this scenario NO_x emissions would exceed the *de minimis* marginal ozone nonattainment area threshold of 100 tons per year (TPY). However, when compared to the State of Delaware NO_x emission budget of 2014 NEI, total first year NO_x emissions of commercial marine sources would only represent approximately 3.4 percent of the budget established by the State of Delaware for marine emission sources category of emissions.

Further, the project construction emission in total would comprise 0.72% of the budget established for transportation sources within the State of Delaware. Subsequent year construction related emissions are anticipated to be lower than those of the first year, and would represent smaller portions of the marine and overall transportation budgets.

A second assessment scenario, designed to explore a means of minimizing emissions, was performed and assumed that commercial marine diesel engines meeting Tier II standards (constructed post 2006) would be utilized, while the nonroad construction engines would continue to meet Tier III specifications. Under those circumstances, the analysis indicated that none of the *de minimis* thresholds for CAPs would be exceeded. The use of Tier II and III engines in marine and nonroad construction equipment as estimated is identified as a best practice to minimize emissions. Used in conjunction with an anti-idling provision in contract documents, these practices would help to minimize criteria emissions to air during project construction.

Both analyses suggest that the project conforms to State of Delaware and federal requirements. In the scenario where commercial marine engines are Tier 0, NO_x, emissions represent a very small portion of the State NO_x budget for transportation related NO_x emissions, and are not anticipated to: cause or contribute significantly to ozone concentrations in excess of the National Ambient Air Quality Standards (NAAQS); increase the frequency or severity of ozone concentrations exceeding NAAQS; or delay timely attainment of the ozone NAAQS, interim emission reductions, or other milestones. In the second scenario, where best practices are utilized, NO_x emissions do not exceed *de minimis* thresholds and no further mitigation would be required. Contract bidding documents for the project will encourage the provision and the use of Tier II engines in marine equipment and Tier III engines in land-based construction equipment. Contract specifications will contain an anti-idling provision.

1. Introduction

1.1. Project Background

Diamond State Port Corporation (DSPC) (Applicant) has applied to the United States Army Corps of Engineers (USACE) for a Clean Water Act Section 404 permit, and a Rivers and Harbors Act Section 10 permit for dredging related to the construction of a primary harbor access channel and ship berth development ("proposed project") at the Applicant's Edgemoor property ("Edgemoor Site"). The proposed project supports the redevelopment of the Edgemoor Site into a multi-user containerized cargo port.

The proposed project is located adjacent to and north of the federal navigation channel, in the southern portion of Reach B of the Delaware River, at the intersection of the Cherry Island and Bellevue Ranges and is offshore of the Applicant's property located along Hay Road, in Edgemoor, Delaware. The Applicant proposes to deepen portions of the Delaware River adjacent to the federal navigation channel to create a primary access channel that will serve the proposed berth construction at the Edgemoor Site.

The primary harbor access channel will provide access to an approximately 2,600-foot long wharf structure. Proposed construction of the berth and access channel calls for excavation to a 45-foot mean lower low water (MLLW) project depth. The 45-foot MLLW project depth matches the maintained depth of the federal navigation channel of the Delaware River. The area expected to be dredged is approximately 4,000 feet in length and has a width extending from the boundary of the federal navigation channel to approximately 300 feet offshore of the site at MLLW. The total area is approximately 86.9 acres.

The initial dredging for the berth and access channel is anticipated to require removal of an approximate volume of 3.3 million cubic yards of river sediments and underlying soils. Project planning anticipates that this material will be placed in an existing USACE Confined Disposal Facility (CDF) along the Delaware River proximate to the Edgemoor Site.

The development of infrastructure needed to support the operation of a container port and constructed on the upland portion of the Applicant's property, site of the former Chemours Edge Moor Facility, are considered incidental to the project, since the Edgemoor Site previously was developed for industrial use, including chemical processing with car, truck, and rail access for moving people, raw materials, wastes, and finished products. The former facility was developed for titanium dioxide and ferric chloride manufacturing, which reportedly initiated operations in the early 1930s. Production at the manufacturing facility ceased in 2015 followed by decommissioning and demolition of the process equipment by the former owner. DSPC has since demolished and removed most of the buildings that remained after decommissioning in preparation of redevelopment.

In an effort to expand port operations and serve a portion of the projected increases in future market demand, DSPC purchased the Edgemoor Site in 2016, as identified in the 2016 DSPC Strategic Master Plan. The Edgemoor Site was purchased with the intent of re-developing the property into a multi-user containerized cargo port capable of accepting New Panamax cargo ships. In October 2018, the State of Delaware signed a 50-year concession agreement with Gulftainer USA Wilmington, LLC to operate and expand the Port of Wilmington and to construct a new containerized cargo port at the Edgemoor Site.

The purpose of this project is to:

- Modernize the international waterborne trade capabilities of the State of Delaware;
- Allow for the State of Delaware port to remain competitive within the Delaware River international trade market;
- Meet the rising demand for modern containerized ports; and
- Continue, and strengthen, the importance of waterborne trade to the State of Delaware and regional economy.

International waterborne trade is considered an essential part of the State of Delaware economy. According to the DSPC Strategic Master Plan, the Port of Wilmington supports over 4,000 jobs annually, generates nearly $340 million in business revenue, over $300 million in personal revenue, and $31 million in state and regional taxes.

In response to the increasing size of modern shipping vessels, and to remain competitive with other ports along the eastern seaboard, the USACE embarked on the Delaware Main Channel Deeping Project in 2010. The deepening provides for more efficient transportation of cargo to the Delaware River ports. To capitalize on the economic benefits of the deepening project, Delaware River ports will also need to deepen their harbors. The project is being designed to utilize the deepened Delaware River.

The construction of this project will produce temporary air emissions. Dredging associated with the project is anticipated to last for 90 days during the first year, 75 days during the second year and 60 days during the third year. Other related activities that will produce air emissions from equipment such as cranes, bulldozers, excavators and support vessels will operate during and beyond the expected dredging. Annual air emissions inventories for the anticipated three years of construction were generated for project related activities to assess air emissions in relation to *de minimis* emission standards set by the State of Delaware, Department of Natural Resources and Environmental Control (DNREC) for New Castle County, Delaware under General Conformity requirements of the Clean Air Act and 7 DE Admin. Code 1132, paragraph 3.2.1 (rates applicable to nonattainment areas).

1.2. Project Environment

The banks of the Delaware River support one of the greatest concentrations of heavy industry in the nation, including chemical manufacturing and petroleum refining. Over 90 million tons of cargo move through the marine terminals in the region annually. Goods include containerized cargo, petroleum and petrochemical products, steel, fruit, cocoa beans, forest products, automobiles and construction materials (Maritime

Exchange for the Delaware River). Electricity generating plants as well as municipal and industrial wastewater treatment plants are also located in the vicinity of the Port of Wilmington.

2. Regulatory Application

Each state is responsible for reaching compliance with the NAAQS. Regions that do not meet the air quality standards are said to be in ‘nonattainment’. The purpose of the General Conformity requirement is to assure that consultation occurs among federal, state and local regulatory agencies in order to understand the anticipated impacts from projects subject to a conformity assessment. The assessment is also conducted to allow agencies to assess how project emissions may impact a State Implementation Plan (SIP) or other planning documents intended to improve or maintain compliance with NAAQS.

This project requires a federal permit to authorize construction in navigable waters and dredging in waters of the United States of America. As such, the project is subject to the General Conformity Rule under the Clean Air Act administered by the Environmental Protection Agency (EPA). The General Conformity Rule assures that the Federal Government does not provide financial assistance, license, or permit activities that hinders state efforts to attain National Ambient Air Quality Standards.

The EPA has established a series of steps to determine whether a federal action is subject to General Conformity review. The steps are as follows (EPA 2010b):

1. Determine whether the action will occur in a nonattainment or maintenance area;
2. Determine whether one or more of the specific exemptions apply to the action;
3. Determine whether the federal agency has included the action on its list of “presumed to conform” actions;
4. Determine whether the total emissions are below or above the *de minimis* levels; and
5. Determine whether the emissions from the proposed action are within the emission budget established by the State of Delaware and accepted by EPA.

The proposed project will be occurring in New Castle County, which is located in the Metropolitan Philadelphia Interstate Air Quality Control Region. The Metropolitan Philadelphia Interstate Air Quality Control region is designated as marginal nonattainment for the 2008 ozone standard. None of the specific exemptions apply to the action. The USACE has not included dredging projects on a list of “presumed to conform” actions. The State of Delaware does include emissions from marine sources in the emissions budget that is part of the federally approved SIP.

In a case where the annual air emissions from a project would be below *de minimis* levels, no further action regarding emissions would be required of a federal agency before proceeding with the action before them, such as issuing a permit. However, if emissions would exceed *de minimis* levels, an applicant would need to satisfy one of the following conditions before project permitting could proceed:

1. Demonstrate that the total emissions are specifically identified and accounted for in the applicable SIP or other federally acknowledged, State of Delaware developed emissions budget;
2. Obtain a written statement from the state documenting that the total emissions from the action, along with all other emissions in the area, will not exceed the State of Delaware established emission budget;
3. Obtain a written commitment from the state to revise the SIP or other appropriate emissions budget to include the emissions from the action;
4. Obtain a statement from the metropolitan planning organization (MPO) for the area documenting that any on-road motor vehicle emissions are included in the current regional emission analysis for the area transportation plan or transportation improvement program; or
5. Fully offsetting the total emissions by reducing emissions of the same pollutant or precursor in the same nonattainment.

3. Project Construction Air Emissions Inventory

3.1. Air Emissions Inventory Methodology

An air emissions inventory was prepared for project-related construction activities. This inventory is intended to support the general conformity determination for the project. Air emissions estimates were calculated for criteria pollutants using methods appropriate for the emissions-generating sources. The techniques used closely follow the methodologies used for the federal projects presented in the *Freeport Harbor Channel Improvement Project General Conformity Determination* and the *Delaware River Main Channel Deepening Project General Conformity Analysis and Mitigation Report*.

During the Edgemoor site dredging and wharf construction, emissions sources will consist of both marine and land-based mobile sources. Marine emissions sources are assumed to include a 9,000 horsepower dredge, a barge mounted crane and support vessels such as tugboats, survey vessels, and crew boats. Emissions sources from land-based equipment are anticipated to include bulldozers and excavators for fill placement adjacent to the proposed bulkhead and dredge material management at the confined dredge facility. Emissions associated with transporting workers to and from the site are also included, as well as emissions produced by heavy duty vehicles that will bring fill soil to the site. Both marine, nonroad and heavy duty on-road based emissions sources are assumed to consist of diesel-powered engines, whereas light duty on-road emissions stem from worker vehicles that are assumed to be light trucks with gasoline-powered engines.

3.2. Marine Emissions

The marine air emissions for this project include the engines on a dredge, tugboats, crew boats, and survey vessels. Emissions were calculated in tons per year based on the assumed horsepower, load factor, hours of operation, days of operation, and fuel type.

Operational information for marine equipment was assumed based on the *Delaware River Main Channel Deepening Project General Conformity Analysis and Mitigation Report* as well as the experiences of Duffield Associates, Inc. regarding similar construction activities during other projects. The *Delaware River Main Channel Deepening Project General Conformity Analysis and Mitigation Report* obtained operational information from the Corps of Engineers Dredge Estimating Program, provided by USACE via email.

Emission factors reflect a 0.0015% sulfur concentration in fuel oil, which is the maximum allowable amount of sulfur in nonroad diesel fuel, according to the EPA Office of Transportation and Air Quality. Particulate matter emissions were adjusted using the EPA NONROAD 2008a emission factor model, which assumes that all diesel particulate matter is PM10, and 97% of PM10 is PM2.5. This ratio was used to estimate particulate matter emissions for marine equipment.

Two scenarios were developed to determine whether or not the total construction emissions for the project would be above or below *de minimis* levels applicable to the marginal nonattainment area. In the first scenario, the commercial marine engines were assumed to be old (pre-2000), Tier 0 engines, due to the longevity of marine vessels and the limited use of ancillary equipment when compared to land-based construction equipment. For Tier 0 engines, the emission factors and load factors were based on the EPA report “Analysis of Commercial Marine Vessels Emissions and Fuel Consumption Data”, February 2000. For reference, these factors were used in the *Freeport Harbor Channel Improvement Project General Conformity Determination*. In the second scenario, the marine engines were assumed to comply with newer (mid-2000s) Tier II emission standards. The Tier II engines emission factors were based on the 40 CFR Part 94.8. This regulation details the Tier II standards for a variety of engine power levels and engine displacement. The emission factors were calculated based on the engines operating at running and idling loads.

Marine construction is expected to require three years to complete, due to limitations that will be placed in the federal permit to avoid in-water work (dredging and pile driving) during the annual anadromous fish migration and spawning season (March through July) and the capacity of the dredge storage facility that will be used to contain, decant and dry dredge slurry. Dredging during the first year of construction is anticipated to be limited to approximately 90 days. The duration of dredging in the second and third years are anticipated to be 75 days and 60 days, respectively. As such, annual dredge engine operations were limited to these numbers of days.

3.3. Nonroad Equipment Emissions

The nonroad equipment for this project is assumed to consist of bulldozers and excavators that will be used to support construction activities. Bulldozers are forecast for use at the project site to spread and compact fill placed landward of the proposed bulkhead. A bulldozer and excavator are forecast for use within Wilmington Harbor South dredged material storage area to facilitate drying of dredged material from the project site.

The bulldozers and excavators are assumed to be powered by engines meeting USEPA Tier III standards. Adjusted emission factors were determined based on the 2010 EPA report "Exhaust and Crankcase Emission Factors for nonroad Engine Modeling – Compression-Ignition" NR-00d, which summarizes the EPA NONROAD 2008a emission factor model. Emissions were calculated in tons per year based on the assumed horsepower, hours of operation, days of operation, and fuel type.

Factors that affected the estimated emissions differed between years in the project lifetime. In regards to the construction of the bulkhead, the fill needed behind the bulkhead would most likely be required during the second year of the project, after the sheet piles have been installed. Taking this timing into consideration, one bulldozer and one excavator would be operating in Wilmington Harbor South during the first year following dredging. During the second year, two bulldozers would be operating at the project site, one while one bulldozer and one excavator would continue to operate at Wilmington Harbor South. Filling operations landward of the bulkhead would be completed during the second year. During the third year of the project, one bulldozer and one excavator would be operating in Wilmington Harbor South in response to the third dredging cycle.

3.4. On-Road Equipment Emissions

The on-road emissions included in the construction emission estimates are assumed to be from light duty gasoline passenger vehicles and heavy duty diesel dump trucks (tri-axle trucks). The workers that commute to the work site during the project contribute to the on road emissions. The scenarios assume that 55 workers will travel to the site daily using "light trucks". The emission factors in grams per mile (g/mi) were determined from " Average Annual Emissions and Fuel Consumption for Gasoline-Fueled Passenger Cars and Light Trucks", and using the average commuting distance (15.6 mi) in Wilmington from the March 2015 report titled *The Growing Distance between People and Jobs in Metropolitan America* to calculate the emissions in tons per day. The emission associated with commuting workers are expected to occur during all three years of project construction.

The Tier II heavy duty tri-axle trucks are assumed to only be active during the second year of the project. Year one would consist of the installation of the sheet piles, and year two would involve placement and compaction of fill behind the sheet pile bulkhead. The tri-axle trucks are assumed to travel between sources of borrow material within New Castle County and the project site during the second year of the project. The total volume of fill required for the bulkhead construction is approximately 145,900 cubic yards (CY).

A fleet of 18 trucks, each with a carrying capacity of 14 CY, were assumed to travel 30 miles per round trip to supply fill at a rate that spreading and compaction could accommodate. The emission factors in grams per mile (g/mi) were determined from "Average In-Use Emissions from Heavy-Duty Trucks" published by U.S. EPA.

4. Calculations

The method and equations used to calculate the emissions for marine equipment, based on their respective emission factors is as follows:

(1) $$E = hp \times days \times hours \times LF \times EF \times \frac{1}{453.6}\frac{lb}{g} \times \frac{1}{2000}\frac{ton}{lb}$$

Where:

E = emissions (tons/year)
hp = horsepower (hp)
days = days of operation (days/year)
hours = hours in day of operation (hr/days)
LF = load factor (unit less)
EF = emission factor (g/hp-hr)
1/453.6 = conversion from g to lbs.
1/2000 = conversion from lbs. to tons

The methodology for calculating adjusted emission factors for nonroad equipment is based on the EPA NONROAD 2008a emission factor model that includes the following equations:

(2) $$EF_{adj}(HC, CO, NOx) = EF_{ss} \times TAF \times DF$$

(3) $$EF_{adj}(PM) = EF_{ss} \times TAF \times DF \times SPM_{adj}$$

(4) $$EF_{adj}(BSFC) = EF_{ss} \times TAF$$

(5) $$SPM_{adj} = BSFC \times 453.6 \times SOx_{cny} \times 0.01(SOx_{bas} - SOx_{dsl})$$

(6) $$CO_2 = (BSFC \times 453.6 - HC) \times 0.87 \times \frac{44}{12}$$

(7) $$SO_2 = (BSFC \times 453.6(1 - SOx_{cnv}) - HC) \times 0.01 \times SOx_{dsl} \times 2$$

Where:

EF_{adj} = final emission factor used in model, after adjustments to account for transient operation and deterioration (g/hp-hr)

EF_{ss} = zero-hour, steady-state emission factor (g/hp-hr)

TAF = transient adjustment factor (unit less)

DF = deterioration factor (unit less)

SPM_{adj} = PM sulfur adjustment (g/hp-hr)

BSFC = in-use adjusted brake-specific fuel consumption (lb. fuel/hp-hr)

453.6 = conversion from lb. to grams

7.0 = grams PM sulfate/grams PM sulfur

0.01= conversion from percent to fraction

SOx_{cnv} = grams PM sulfur/grams fuel sulfur consumed

SOx_{bas} = default certification fuel sulfur weight percent (.2%)

SOx_{dsl} = episodic fuel sulfur weight percent (.0015%)

HC = the in-use adjusted hydrocarbon emissions in g/hp-hr

44/12 = the ratio of CO2 mass to carbon mass

The calculated air emission inventory reflects a fleet of Tier III diesel engines as well as a 0.0015% sulfur concentration in fuel oil, which is the current allowable sulfur content for diesel fuel. The modeled default fuel sulfur content in the 2010 EPA report is 0.2% for Tier III diesel engines greater than 175 hp and less than or equal to 750 hp. Therefore, particulate matter and sulfur oxide emission calculations were adjusted to reflect a fuel sulfur content of 0.0015%.

Light Duty On-Road emissions were calculated using the following equations:

(8) $$Commute = D \times 2 \times Days$$

(9) $$E = EF_x \times \frac{Commute}{453.6} \times \frac{1}{2000} \times 55$$

<u>Where:</u>

Commute = The total commute distance traveled (mi/year/worker)

D = The average one way commute distance in Delaware (mi/day-trips/worker)

2 = The number of trips made in a day (trips)

Days = The number of work days in a calendar year (days/year)

E = Final emission result (tons/year)

EF_x = Emission Factor for each CAP, in light trucks (g/mi)

1/453.6 = conversion from g to lbs.

1/2000 = conversion from lbs. to Tons

55 = Number of workers

Heavy Duty On-Road emissions were calculated using the following equations:

(10) $$No.of\ Trucks = \frac{Total\ Fill\ Required}{Average\ Truck\ Capacity}$$

(11) $$Travel\ Distance = D \times No.of\ Trucks$$

(12) $$EF_x \times \frac{1}{456.3} \times \frac{1}{2000} \times Travel\ Distance$$

<u>Where:</u>

Total Fill Required = Estimated volume of fill required for the construction of the bulkhead (CY)

Average truck Capacity = Estimated capacity of a tri axle dump truck (CY)

Travel Distance = Total travel distance required to transport total required fill (mi)

D = The average roundtrip distance travelled by a truck transporting fill to site (mi)
No .of Trucks = The total number of truck trips needed to meet construction requirements
E = Final emission result (tons/year)
EF_x = Emission Factor for each CAP in heavy duty trucks (g/mi)
1/453.6 = conversion from g to lbs.
1/2000 = conversion from lbs. to Tons

5. Comparison of Emissions to Thresholds

5.1. Scenario 1 - Tier 0 Commercial Marine Engines

Marine Emission Results

The marine emission estimates for the first year assuming use of Tier 0 engines are summarized in Table 5.1.1 below. The standard operating time in year one was assumed to be 90 days for the dredge vessels. An additional 28 days (4 weeks) of operation per year was used for estimating emissions from the support vessels (tugboats, crew boat and crew/survey boat). The horsepower, load factors and hours of active and idle operation for each day, as assumed for each machine, can be found in Appendix A Scenario 1 - Project Emissions, Factors and Calculations.

The first year emissions are anticipated to be the largest for marine equipment of the three year construction period. The equipment in use is not expected to change during the three year period, but progressively less dredging is expected to occur in years 2 and 3. Emission estimates for years 2 and 3 are also provided in Appendix A.

Table 5.1.1 - Summary of Marine Emissions during First Year of Construction for Tier 0 Engines

Marine Emissions (tons/year)							
Equipment	**Quantity**	**NO_x**	**CO**	**SO_x**	**VOCs**	**$PM_{2.5}$**	**PM_{10}**
Dredge	1	95	10	0.071	1.1	2.3	2.4
Tugboats (2)	2	6.4	1.23	0.005	0.15	0.15	0.16
Crew boat	1	2.6	0.49	0.002	0.06	0.1	0.06
Crew/Survey Boat (Dredge phase)	2	0.64	0.12	0.001	0.02	0.02	0.02
Crane	1	2.6	0.30	0.002	0.03	0.03	0.06
Diesel Hammer (2)	2	0.51	0.10	0.0004	0.01	0.012	0.013
PowerPack	1	2.1	0.61	0.003	0.05	0.08	0.08
Total Project (tons/yr)		**110**	**13**	**0.08**	**1.4**	**2.7**	**2.7**

Nonroad Emission Results

The nonroad emission results for the first year assume the use of Tier III engines in bulldozers and excavators. The second year would result in the most active nonroad construction equipment emissions, due to placement and compaction of fill landward of the bulkhead occurring in this timeframe. The emissions for the second year are summarized in Table 5.1.2 below. The estimated operating time for use of the equipment during the second year is 251 days. The horsepower, load factors and hours of active and idle operation for each day, as assumed for each machine, can be found in Appendix A. While the second year emission estimates are provided in Table 5.1.2, the first and third year emissions for nonroad emissions are forecast to be lower due to fewer bulldozers operating.

Table 5.1.2-Summary of Nonroad Emissions for Second Year of Construction for Tier III Engines

Nonroad Emissions (tons/year)						
Equipment	**Quantity**	**NO_x**	**CO**	**SO_x**	**VOCs**	**PM_{10}**
Bulldozers	5	0.081	0.46	0.019	0.018	0.022
Excavators	3	0.038	0.36	0.091	0.087	0.010
Total Project		**0.12**	**0.82**	**0.11**	**0.11**	**0.032**

On Road Emission Results

The on-road emission results for the second year of construction are summarized in Table 5.1.3 below. On-road emissions that year are anticipated to be the largest of the construction period. An annual operating time was assumed to be 250 work days for commuters. For the heavy trucks in use during the second year, the emissions were estimated based on Tier II engines, hours of operation and the number of truck trips required to deliver the quantity of fill needed for the project. The horsepower, load factors and hours of active and idle operation for each day, as assumed for each machine, can be found in Appendix A. While the second year emission estimates are provided in Table 5.1.3, the first and third year emissions for on-road emissions are forecast to be lower due to absence of tri axle dump trucks.

Table 5.1.3- Summary of On-Road Emissions for Second Year of Construction

On-Road Emissions (tons/year)							
Equipment	**Quantity**	**NO_x**	**CO**	**SO_x**	**VOCs**	**$PM_{2.5}$**	**PM_{10}**
Light Duty On-Road	55	0.22	2.8	-	0.29	0.001	0.001
Heavy Duty On-Road	18	3.0	0.80	-	-	-	0.075
Total Project		**3.2**	**3.6**	**-**	**0.29**	**0.001**	**0.076**

Comparison to *De Minimis* Levels

The table below compares the total emissions for each criteria pollutant to the de minimis threshold for New Castle County. The total emissions consist of the sum of marine, nonroad and on-road emissions. As discussed, NO_x is the only CAP that exceeds its respective threshold.

Table 5.1.4 - Scenario 1 Total Estimated Project Construction Emissions Compared to De Minimis Levels

Summary of Annual Emissions for Criteria Pollutant (tons/year)						
	NO_x	**CO**	**SO_x**	**VOCs**	**$PM_{2.5}$**	**PM_{10}**
***De minimis* level**	**100**	**100**	**100**	**50**	**100**	**100**
Year 1 Emissions	110	17	0.093	1.7	2.7	2.7
Year 2 Emissions	95	16	0.097	1.7	2.3	2.4
Year 3 Emissions	75	13	0.077	1.3	1.8	1.9

5.2. Scenario 2 - Tier II Commercial Marine Engines

Marine Emission Results

The marine emission results for the first year of construction assuming use of Tier II engines are summarized in Table 5.2.1 below. The standard operating time in year one was assumed to be 90 days for the dredge. As with Scenario 1, an additional 28 days (4 weeks) of operation per year was used for estimating emissions from the support vessels (tugboats, crew boat and crew/survey boat). The horsepower, load factors and hours of active and idle operation for each machine each day can be found in Appendix A-Project Emissions, Factors and Calculations.

As in Scenario 1, the first year emissions are anticipated to be the largest for marine equipment of the three year construction period. The equipment in use is not expected to change during the three year period, but progressively less dredging is expected to occur during the second and the third year of construction. Emission estimates for the second and the third years are also provided in Appendix A.

Table 5.2.1 - Summary of Marine Emissions during First Year of Construction for Tier II Engines

Marine Emissions (tons/year)				
Equipment	**Quantity**	**NOx**	**CO**	**PM**
Dredge	1	87	44	4.4
Tugboats	2	4.6	2.9	0.29
Crew boat	1	1.8	1.2	0.12
Crew/Survey Boat (Dredge phase)	1	0.46	0.29	0.029
Crane	1	2.4	1.2	0.12
Diesel Hammer	2	0.37	0.23	0.023
PowerPack	1	1.5	1.5	0.15
Total Project (tons/yr)		**98**	**51**	**5.1**

Nonroad Emission Results

The nonroad emission results for the first year are summarized in Table 5.1.2 in Section 5.1.2. The methodology and calculation result are not affected by the change in marine engine type.

On-Road Emission Results

The largest on-road emission results will occur during the second year and are summarized in Table 5.1.3 in Section 1.5.3. The methodology and calculation result are not affected by the change in marine engine type.

Comparison to De Minimis Levels

The table below compares the total emissions for each criteria pollutant to the de minimis threshold for New Castle County. The total emissions consist of the sum of marine, nonroad and on-road emissions. The calculations performed were based on the assumption that a Tier II engine was used therefore the results are less conservative and the emissions for each year is less than the de minimis threshold.

Table 5.2.2 - Scenario 2 Total Estimated Project Construction Emissions Compared to De Minimis Levels

Summary of Annual Emissions for Criteria Pollutant (tons/year)			
	NOx	**CO**	**PM**
***De minimis* level**	**100**	**100**	**100**
Year 1 Emissions	97	54	5.1
Year 2 Emissions	85	47	4.4
Year 3 Emissions	66	38	3.5

6. General Conformity Assessment

In the case where the Tier 0 marine engines are used, general conformity can be demonstrated by comparison of the estimated emissions to the allowance for such emissions in budget established by the State of Delaware and accepted by EPA. The current budget established by DNREC was provided in the 2014 National Emissions Inventory (NEI) should be utilized in conducting the general conformity analysis. DNREC indicated that the emissions data from the NEI would be a more appropriate comparison than the 2009 EPA approved State Implementation Plan for Delaware.

Due to estimated NO_x emissions being the only group of substances in excess of the *de minimis* threshold, the percentage of the 2014 NEI that would be affected by the total project emissions for NO_x was assessed to demonstrate general conformity. The 2014 NEI budgets for each respective category: commercial marine, nonroad and on-road emissions are provide in Table 6.1 below. The estimated percentages of the categorical budgets that would be used are 3.4% for marine activities, 0.003% for off-road activities, and 0.003% for on-road mobile sources. These numbers indicate that even though the *de minimis* threshold would be breached the first year of construction, the estimated NO_x emissions comprise small parts of the categorical budgets and the total annual NO_x transportation budget for the State.

Table 6.1 - Comparison of Scenario 1 Project Emissions to 2014 NEI

Project Categories	Inventory Categories	DNREC 2014 NEI NO_x Emissions Budget	Project NO_x Emissions					
			First Year		Second Year		Third Year	
		(tpy)	(tpy)	Portion of Budget	(tpy)	Portion of Budget	(tpy)	Portion of Budget
Commercial Marine Activities	Marine Emission Sources	3,189	110	3.4%	92	2.9%	75	2.4%
Land-side Activities	Nonroad Emission Sources	2,756	0.09	0.003%	0.09	0.003%	0.09	0.003%
On-Road Vehicles	On-Road Mobile Sources	8,044	0.23	0.003%	0.23	0.003%	0.23	0.003%
	Heavy Duty On Road	113.16	-	-	3.0	2.65%	-	-
Totals		**14,102**	**110.32**	**0.78%**	**95.32**	**0.67%**	**75.32**	**0.53%**

7. Best Practices

The general conformity assessment in Section 6 indicates that the estimated project emissions would be within the State of Delaware budget set aside for such emissions and would not lead to a deterioration of air quality. However, the emissions estimated as Scenario 2 suggests that some emissions could be avoided or minimized by using Tier II marine diesel engine equipped vessels on the project. The project marine work (e.g., dredging and pile driving) is expected to be mostly performed outside of the regional ozone season, which extends from May through September, due to restrictions on in water work during the anadromous fish migration period. Additionally, work practices that could be implemented would further reduce engine emissions. Implementation of best practices would be included in contract specifications and bid documents. These measures are expected to be included:

1. Solicitation of commercial marine vessels and equipment to be used in the project that are equipped with controls to meet Tier II emission exhaust standards, by offering a preference in selection of such equipment over older Tier 0 powered equipment.
2. Solicitation of nonroad construction equipment that utilizes Tier III compliant engines and on-road Tier II compliant trucks by offering a preference in selection of such equipment over older Tier 0 powered equipment.
3. Include anti-idling provisions in the contract specifications.

8. Conclusion

On the basis of the analyses described in this report, the construction of the proposed access channel, berth and wharf should not cause a deterioration of air quality or significantly contribute to the continuation of marginal nonattainment of the ozone NAAQS. The general conformity assessment indicates that the estimated construction emissions would be within the State of Delaware NEI budget allowance for transportation related emissions and be minor components of the specific categories for transportation related emissions within the overall NEI budget.

Implementation of the best practices identified in Section 7 have the potential to reduce the project construction emissions to levels below the de minimis thresholds. Project specifications and bid documents will be crafted to encourage or mandate the use of these practices to avoid unnecessary emissions and minimize those that are necessary.

9. References

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APPENDIX A

PROJECT EMISSIONS, FACTORS, AND CALCULATIONS

Table 1. Scenario 1 - Summary of Project Emissions
Air Conformity Analysis
DSCP Edgemoore Facility, DE

Summary of Year 1 Emissions for Criteria Pollutant (tons)								
De minimis level (tons/year)	**Quantity**	**100**	**100**	**100**	**-**	**50**	**100**	**100**
		NOx	**CO**	**SOx**	**CO2**	**VOCs**	**PM2.5**	**PM10**
Dredge Vessel	1	95	10	0.071	6300	1.1	2.3	2.4
Tugboats	2	6.4	1.2	0.0050	450	0.15	0.16	0.16
Crew boat	1	2.6	0.49	0.0020	180	0.062	0.06	0.065
Crew/Survey Boat (Dredge phase)	1	0.64	0.12	0.00050	45	0.015	0.016	0.016
Bulldozers	3	0.049	0.46	0.0052	1300	0.0050	0.013	-
Excavators	3	0.038	0.36	0.0052	990	0.0050	0.010	-
Crane	1	2.6	0.30	0.0019	170	0.033	0.063	0.065
Diesel Hammer	2	0.51	0.10	0.0004	36	0.012	0.013	0.013
PowerPack	1	2.1	0.39	0.0016	140	0.050	0.051	0.052
Light Duty On-Road	55	0.22	2.8	-	120	0.29	0.0011	0.0012
Total Project (Tons/yr)		**110**	**17**	**0.093**	**9700**	**1.7**	**2.7**	**2.7**

Summary of Year 2 Emissions for Criteria Pollutant (tons)								
De minimis level (tons/year)	**Quantity**	**100**	**100**	**100**	**-**	**50**	**100**	**100**
		NOx	**CO**	**SOx**	**CO2**	**VOCs**	**PM2.5**	**PM10**
Dredge Vessel	1	79	8.7	0.059	5300	0.88	1.9	2.0
Tugboats	2	5.6	1.1	0.0044	390	0.13	0.14	0.14
Crew boat	1	2.2	0.43	0.0018	160	0.054	0.055	0.057
Crew/Survey Boat (Dredge phase)	1	0.56	0.11	0.00044	39	0.013	0.014	0.014
Bulldozers	5	0.081	0.76	0.019	2100	0.018	0.022	-
Excavators	3	0.038	0.36	0.0091	990	0.087	0.010	-
Crane	1	2.3	0.26	0.0017	150	0.029	0.055	0.056
Diesel Hammer	2	0.43	0.082	0.00034	30	0.010	0.011	0.011
PowerPack	1	1.7	0.33	0.0013	120	0.041	0.042	0.044
Heavy Duty On-Road	18	3.0	0.80	-	-	0.15	0.070	0.075
Light Duty On-Road	55	0.23	2.8	-	120	0.29	0.0011	0.0012
Total Project (Tons/yr)		**95**	**16**	**0.097**	**9400**	**1.7**	**2.3**	**2.4**

Duffield Associates, Inc.
Project No. 11139.LH

Table 1. Scenario 1 - Summary of Project Emissions
Air Conformity Analysis
DSCP Edgemoore Facility, DE

Summary of Year 3 Emissions for Criteria Pollutant (tons)								
De minimis level (tons/year)	**Quantity**	**100**	**100**	**100**	**-**	**50**	**100**	**100**
		NOx	**CO**	**SOx**	**CO2**	**VOCs**	**PM2.5**	**PM10**
Dredge Vessel	1	63	6.9	0.047	4200	0.71	1.5	1.6
Tugboats	2	4.8	0.92	0.0038	330	0.12	0.12	0.12
Crew boat	1	1.9	0.37	0.0015	130	0.046	0.047	0.049
Crew/Survey Boat (Dredge phase)	1	0.48	0.092	0.00038	33	0.012	0.012	0.012
Bulldozers	3	0.049	0.46	0.011	1300	0.011	0.013	-
Excavators	3	0.038	0.36	0.0090	990	0.087	0.010	-
Crane	1	1.9	0.23	0.0015	130	0.024	0.047	0.048
Diesel Hammer	2	0.43	0.082	0.00034	30	0.010	0.011	0.011
PowerPack	1	1.7	0.33	0.0013	120	0.041	0.042	0.044
Light Duty On-Road	55	0.23	2.8		120	0.29	0.001	0.0012
Total Project (Tons/yr)		**75**	**13**	**0.077**	**7400**	**1.3**	**1.8**	**1.9**

Notes :

1. Scenario 1 analyzed the use of Tier 0 Commercial Marine Engines, Tier III Non-Road Construction Engines, Heavy Duty and Light Duty On-Road Engines
2. Refer to Table 2. for details of load factors and hours of operation for all equipment used
3. Two additional D10 bulldozers required for bulkhead construction in year 2
4. Heavy Duty On Road emissions required for bulkhead construction in year 2

Table 2. Scenario 1 - Summary of Emission Factors, Load Factors and Hours of Operation
Air Conformity Analysis
DSCP Edgemoore Facility, DE

Estimated Emission Factors											
Emissions (g/hp-hr)											
	Dredge		Crane		Tugboat	Crew boat	Crew/Survey Boat	Diesel Hammer	Power Pack	Excavators	Buldozer
Horsepower	**9000**	**3000**	**365**	**100**	**500**	**400**	**100**	**105**	**420**	**472**	**600**
CAP	**Active**	**Idle**	**Active**	**Idle**							
NOx	7.9	8.8	7.9	8.8	8.2	8.2	8.2	8.2	8.2	0.021	0.021
CO	0.78	3.1	0.78	3.1	1.6	1.6	1.6	1.6	1.6	0.19	0.19
SOx	0.0059	0.0073	0.0059	0.0073	0.0064	0.0064	0.0064	0.0064	0.0064	0.0049	0.0049
CO2	520	650	520	650	570	570	570	570	570	540	540
VOCs	0.070	0.56	0.070	0.56	0.20	0.20	0.20	0.20	0.20	0.047	0.0047
PM2.5	0.19	0.23	0.19	0.23	0.20	0.20	0.20	0.20	0.20	-	-
PM10	0.20	0.24	0.20	0.24	0.21	0.21	0.21	0.21	0.21	0.0055	0.0055

Load factors and emission factors for Tier 0 marine engines were determined based on the February, 2000 EPA report "Analysis of Commercial Marine Vessels Emissions and Fuel Consumption Data"
Excavators and Bulldozers (Tier III)engines are engines based on the 2010 EPA report "Exhaust and Crankcase Emission Factors for Non-road Engine Modeling – Compression-Ignition"

Emission Standards for Non-Diesel Vehicles			
Petroleum	**Light Truck**	**Car**	**Heavy Duty Truck**
CAP	**Emissions (g/mi)**		
NOx	0.95	0.69	8.6
CO	12	9.4	2.3
SOx	-	-	-
CO2	510	370	-
VOCs	1.2	1.0	0.45
PM2.5	0.0045	0.0041	0.20
PM10	0.0049	0.0044	0.22

Non Diesel Emission Factors are obtained from 2008 EPA Report ' Average Annual Emissions and Fuel Consumption for Gasoline-Fueled Passenger Cars and Light Trucks'
Diesel Emission Factors are obtained from 2008 EPA Report ' Average In-Use Emissions from Heavy Duty Trucks'

Load Factors and Operation Time (g/hp-hr)											
	Dredge		Crane		Tugboat	Crew boat	Crew/Survey Boat	Diesel Hammer	Power Pack	Excavators	Bulldozer
Horsepower	**9000**	**3000**	**365**	**100**	**500**	**400**	**100**	**105**	**420**	**472**	**600**
Load Factors	**0.8**	**0.2**	**0.8**	**0.2**	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**	**0.59**	**0.59**
Hours/ Day	16	8	8	8	15	15	15	15	15	8	8
Days /Year 1	90		118		118	118	118	90	90	250	250
Days /Year 2	75		103		103	103	103	75	75	251	251
Days /Year 3	60		88		88	88	88	60	60	250	250

Table 3. Scenario 1 - Summary of Commercial Marine Emissions for Tier 0 Engines
Air Conformity Analysis
DSCP Edgemoore Facility, DE

Dredge Vessel Emission Summary

	Year 1					Year 2					Year 3				
Days/Year	90				Annual Total	75				Annual Total	60				Annual Total
	Dredging		Idling			Dredging		Idling			Dredging		Idling		
Pollutants	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)		Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)		Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)	
NOx	1.0	91	0.047	4.2	**95**	1.0	75	0.047	3.5	**79**	1.0	60	0.047	2.8	**63**
CO	0.10	8.9	0.017	1.49	**10**	0.10	7.4	0.017	1.24	**8.7**	0.10	5.9	0.017	0.99	**6.9**
SOx	0.00075	0.067	0.000039	0.0035	**0.071**	0.001	0.056	0.000039	0.0029	**0.06**	0.00075	0.045	0.000039	0.0023	**0.047**
CO_2	67	6,000	3.4	310	**6,300**	67	5,000	3.5	260	**5,300**	67	4,000	3.5	210	**4,200**
VOC	0.0088	0.79	0.0029	0.26	**1.1**	0.009	0.66	0.0029	0.22	**0.88**	0.009	0.53	0.0029	0.18	**0.71**
PM2.5	0.024	2.2	0.0012	0.11	**2.3**	0.024	1.8	0.0012	0.09	**1.9**	0.024	1.5	0.0012	0.074	**1.5**
PM10	0.025	2.2	0.0013	0.11	**2.4**	0.025	1.9	0.0013	0.10	**2.0**	0.025	1.5	0.0013	0.076	**1.6**

Crane Emission Emission Summary

	Year 1					Year 2					Year 3				
Days/Year	118				Annual Total	103				Annual Total	88				Annual Total
	Crane in operation		Idling			Crane in operation		Idling			Dredging		Idling		
Pollutants	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)		Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)		Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)	
NOx	0.020	2.41	0.0016	0.18	**2.6**	0.020	2.10	0.0016	0.16	**2.3**	0.020	1.8	0.0016	0.14	**1.9**
CO	0.0020	0.24	0.00055	0.065	**0.30**	0.0020	0.21	0.00055	0.057	**0.26**	0.0020	0.18	0.00055	0.048	**0.23**
SOx	0.000015	0.0018	0.0000013	0.00015	**0.0019**	0.000015	0.0016	0.0000013	0.00013	**0.0017**	0.000015	0.0013	0.0000013	0.00011	**0.0015**
CO2	1.4	159	0.11	13	**170**	1.4	139	0.11	12	**150**	1.4	119	0.11	10	**130**
VOC	0.00018	0.021	0.00010	0.012	**0.033**	0.00018	0.018	0.00010	0.010	**0.029**	0.00018	0.016	0.00010	0.0086	**0.024**
PM2.5	0.00049	0.058	0.000041	0.0048	**0.063**	0.00049	0.051	0.000041	0.0042	**0.055**	0.00049	0.043	0.000041	0.0036	**0.047**
PM10	0.00051	0.060	0.000042	0.0050	**0.065**	0.00051	0.052	0.000042	0.0043	**0.056**	0.00051	0.045	0.000042	0.0037	**0.048**

Diesel Hammer Emission Summary

	Year 1		Year 2		Year 3	
Days/Year	90		75		60	
Pollutants	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)
NOx	0.0057	**0.51**	0.0057	**0.43**	0.0057	**0.34**
CO	0.0011	**0.10**	0.0011	**0.082**	0.0011	**0.066**
SOx	0.0000045	**0.00040**	0.0000045	**0.00034**	0.0000045	**0.00027**
CO_2	0.40	**35.65**	0.40	**30**	0.40	**24**
VOC	0.00014	**0.012**	0.00014	**0.010**	0.00014	**0.0083**
PM2.5	0.00014	**0.013**	0.00014	**0.011**	0.00014	**0.0085**
PM10	0.00015	**0.013**	0.00015	**0.011**	0.00015	**0.0087**

Table 3. Scenario 1 - Summary of Commercial Marine Emissions for Tier 0 Engines
Air Conformity Analysis
DSCP Edgemoore Facility, DE

2 x Tugboat Emission Summary						
	Year 1		Year 2		Year 3	
Days/Year	90		75		60	
Pollutants	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)
NOx	0.054	**6.4**	0.054	**5.6**	0.054	**4.8**
CO	0.010	**1.2**	0.010	**1.1**	0.010	**0.92**
SOx	0.000043	**0.0050**	0.000043	**0.004**	0.000043	**0.0038**
CO_2	3.8	**450**	3.8	**390**	3.8	**330**
VOC	0.0013	**0.15**	0.0013	**0.135**	0.0013	**0.12**
PM2.5	0.0013	**0.16**	0.0013	**0.138**	0.0013	**0.12**
PM10	0.0014	**0.16**	0.0014	**0.142**	0.0014	**0.12**

Crew Boat Emission Summary						
	Year 1		Year 2		Year 3	
Days/Year	118		103		88	
Pollutants	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)
NOx	0.022	**2.6**	0.022	**2.2**	0.022	**1.9**
CO	0.0042	**0.49**	0.0042	**0.43**	0.0042	**0.37**
SOx	0.000017	**0.0020**	0.000017	**0.002**	0.000017	**0.0015**
CO_2	1.5	**180**	1.5	**160**	1.5	**130**
VOC	0.00052	**0.062**	0.00052	**0.054**	0.00052	**0.046**
PM2.5	0.00054	**0.063**	0.00054	**0.055**	0.000537	**0.047**
PM10	0.00055	**0.065**	0.00055	**0.057**	0.00055	**0.049**

Crew-Survey Boat Emission Summary						
	Year 1		Year 2		Year 3	
Days/Year	118		103		88	
Pollutants	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)
NOx	0.0054	**0.64**	0.0054	**0.56**	0.0054	**0.48**
CO	0.0010	**0.12**	0.0010	**0.11**	0.0010	**0.092**
SOx	0.0000043	**0.00**	0.0000043	**0.00044**	0.0000043	**0.00038**
CO_2	0.38	**45**	0.38	**39**	0.38	**33**
VOC	0.00013	**0.015**	0.00013	**0.013**	0.00013	**0.012**
PM2.5	0.00013	**0.016**	0.00013	**0.014**	0.00013	**0.012**
PM10	0.00014	**0.016**	0.00014	**0.014**	0.00014	**0.012**

Table 3. Scenario 1 - Summary of Commercial Marine Emissions for Tier 0 Engines
Air Conformity Analysis
DSCP Edgemoore Facility, DE

Power Pack Emission Summary						
	Year 1		Year 2		Year 3	
Days/Year	90		75		60	
Pollutants	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)
NOx	0.023	**2.06**	0.023	**1.714**	0.023	**1.4**
CO	0.0068	**0.61**	0.0044	**0.328**	0.0044	**0.26**
SOx	0.000028	**0.0025**	0.000018	**0.0013**	0.000018	**0.0011**
CO_2	2.5	**220**	1.6	**120**	1.6	**95**
VOC	0.00086	**0.077**	0.00055	**0.041**	0.00055	**0.033**
PM2.5	0.00088	**0.079**	0.00056	**0.042**	0.000564	**0.034**
PM10	0.00090	**0.081**	0.00058	**0.044**	0.00058	**0.035**

Notes:

1. Load factors and emission factors were determined based on the February, 2000 EPA report "Analysis of Commercial Marine Vessels Emissions and Fuel Consumption Data"
2. Emissions factors conservatively reflect a fleet of Tier 0 marine engines, lacking NOx emissions control technology
3. Assumes a 0.0015% sulfur concentration in fuel oil, which is the maximum allowable amount of sulfur in non-road diesel fuel according to the EPA Office of Transportation
4. The EPA NONROAD 2008a emission factor model assumes that all diesel particulate matter is PM10 and 97% of diesel PM10 is PM2.5. This ratio was used to estimate
5. 2 Tugboats are required for the project
6. Support Vessels (Crew Boat, Crew - Survey Boat, Tugboat and Crane) Operate for an additional 2 weeks before and after standard project schedule

Table 4. Scenario 2 - Summary of Project Emissions
Air Conformity Analysis
DSCP Edgemoore Facility, DE

Summary of Year 1 Emissions for Criteria Pollutant (tons/year)				
De minimis level (tons/year)	**Quantity**	**100**	**100**	**100**
		NOx	**CO**	**PM**
Dredge Vessel	1	87	44	4.4
Tugboats	2	4.6	2.9	0.29
Crew boat	1	1.8	1.2	0.12
Crew/Survey Boat (Dredge phase)	1	0.46	0.29	0.029
Bulldozers	3	0.049	0.46	0.013
Excavators	3	0.038	0.36	0.010
Crane	1	1.9	1.2	0.12
Diesel Hammer	2	0.37	0.23	0.023
PowerPack	1	1.5	0.93	0.093
Light Duty On-Road	55	0.22	2.8	0.0012
Total Project (Tons/yr)		**97**	**54**	**5.1**

Summary of Year 2 Emissions for Criteria Pollutant (tons/year)				
De minimis level (tons/year)	**Quantity**	**100**	**100**	**100**
		NOx	**CO**	**PM**
Dredge Vessel	1	72	37	3.7
Tugboats	2	4.0	2.5	0.25
Crew boat	1	1.6	1.0	0.10
Crew/Survey Boat (Dredge phase)	1	0.40	0.25	0.025
Bulldozers	5	0.049	0.46	0.000
Excavators	3	0.038	0.36	0.0091
Crane	1	1.6	1.0	0.10
Diesel Hammer	2	0.30	0.19	0.019
PowerPack	1	1.2	0.78	0.078
Heavy Duty -On-Road	18	3.0	0.80	0.075
Light Duty On-Road	55	0.23	2.8	0.0012
Total Project (Tons/yr)		**85**	**47**	**4.3**

Table 4. Scenario 2 - Summary of Project Emissions
Air Conformity Analysis
DSCP Edgemoore Facility, DE

Summary of Year 3 Emissions for Criteria Pollutant (tons/year)				
De minimis level (tons/year)	**Quantity**	**100**	**100**	**100**
		NOx	**CO**	**PM**
Dredge Vessel	1	58	29	2.9
Tugboats	2	3.4	2.2	0.22
Crew boat	1	1.4	0.87	0.087
Crew/Survey Boat (Dredge phase)	1	0.34	0.22	0.022
Bulldozers	3	0.049	0.46	0.0058
Excavators	3	0.04	0.36	0.0057
Crane	1	1.4	0.90	0.090
Diesel Hammer	2	0.30	0.19	0.019
PowerPack	1	1.2	0.78	0.078
Light Duty On-Road	55	0.23	2.8	0.0012
Total Project (Tons/yr)		**66**	**38**	**3.5**

Notes :

1. Scenario 1 analyzed the use of Tier II Commercial Marine Engines, Tier III Non-Road Construction Engines, Heavy Duty and Light Duty On-Road Engines
2. Refer to Table 5. for details of load factors and hours of operation for all equipment used.
3. Two additional D10 bulldozers required for bulkhead construction in year 2
4. Heavy Duty On Road emissions required for bulkhead construction in year 2

Table 5. Scenario 2 - Summary of Emission Factors, Load Factors and Hours of Operation
Air Conformity Analysis
DSCP Edgemoore Facility, DE

Estimated Emission Factors											
Emissions (g/hp-hr)											
	Dredge		Crane		Tugboat	Crew boat	Crew/Survey Boat	Diesel Hammer	Power Pack	Excavators	Bulldozer
Horsepower	**9000**	**3000**	**365**	**100**	**500**	**400**	**100**	**105**	**420**	**472**	**600**
CAP	**Active**	**Idle**	**Active**	**Idle**							
NOx	7.3	6.5	5.8	5.8	5.8	5.8	5.8	5.8	5.8	0.021	0.021
CO	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	0.19	0.19
PM10	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.0055	0.0055

Note:
Tier II Marine emission factors are based on 40 CFR §94.8
Excavators and Bulldozers (Tier III)engines are based on the 2010 EPA report "Exhaust and Crankcase Emission Factors for Non-road Engine Modeling – Compression-Ignition"

Emission Standards for Non-Diesel Vehicles			
Petroleum	**Light Truck**	**Car**	**Heavy Duty Truck**
CAP	**Emissions (g/mi)**		
NOx	0.95	0.69	8.6
CO	12	9.4	2.3
SOx	-	-	-
CO2	510	370	-
VOCs	1.2	1.0	0.45
PM2.5	0.0045	0.0041	0.20
PM10	0.0049	0.0044	0.22

Non Diesel Emission Factors are obtained from 2008 EPA Report ' Average Annual Emissions and Fuel Consumption for Gasoline-Fueled Passenger Cars and Light Trucks'
Diesel Emission Factors are obtained from 2008 EPA Report ' Average In-Use Emissions from Heavy Duty Trucks'

EPA Tier II Engine Emission Standards and Dates											
Category	**Power (kW)**	**Power (hp)**	**Displacement (liters/cylinder)**	**Displacement (in^3/cylinder)**	**Model year**	**Nox+HC (g/KW-hr)**	**Nox+HC (g/hp-hr)**	**CO (g/kW-hr)**	**CO (g/hp-hr)**	**PM (g/kW-hr)**	**PM (g/hp-hr)**
1	>37	>50	< 0.9	< 54.9	2005	7.5	5.6	5	3.7	0.40	0.30
			0.9 - < 1.2	54.9 - < 73.2	2004	7.2	5.4	5	3.7	0.30	0.22
			1.2 - < 2.5	73.2 - < 152.6	2004	7.2	5.4	5	3.7	0.20	0.15
			2.5 - < 5.0	152.6 - < 305	2007	7.2	5.4	5	3.7	0.20	0.15
2	>37	>50	5.0 - < 15	305 - < 915	2007	7.8	5.8	5	3.7	0.27	0.20
	<3,300	<4,425	15 - < 20	915 - < 1,220	2007	8.7	6.5	5	3.7	0.50	0.37
	>3,300	>4,425	15 - < 20	915 - < 1,220	2007	9.8	7.3	5	3.7	0.50	0.37
			20 - < 25	1,220 - < 1,525	2007	9.8	7.3	5	3.7	0.50	0.37
			25 - < 30	1,525 - < 1,830	2007	11	8.2	5	3.7	0.50	0.37

Tabled Referenced from Moffat & Nichol - Delaware River Main Channel Deepening Project, General Conformity Analysis and Mitigation Report, 2004

Load Factors and Operation Time (g/hp-hr)											
	Dredge		Crane		Tugboat	Crew boat	Crew/Survey Boat	Diesel Hammer	Power Pack	Excavators	Bulldozer
Horsepower	**9000**	**3000**	**365**	**100**	**500**	**400**	**100**	**105**	**420**	**472**	**600**
Load Factors	**0.8**	**0.2**	**0.8**	**0.2**	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**	**0.59**	**0.59**
Hours/ Day	16	8	8	8	15	15	15	15	15	8	8
Days /Year 1	90		118		118	118	118	90	90	250	250
Days /Year 2	75		103		103	103	103	75	75	251	251
Days /Year 3	60		88		88	88	88	60	60	250	250

Table 6. Scenario 2 - Summary of Commercial Marine Emissions for Tier II Engines
Air Conformity Analysis
DSCP Edgemoore Facility, DE

Dredge Vessel Emission Summary															
	Year 1				Annual Total	Year 2				Annual Total	Year 3				Annual Total
Days/Year	90					75					60				
	Dredging		Idling			Dredging		Idling			Dredging		Idling		
Pollutants	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)		Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)		Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)	
NOx	0.93	83	0.034	3.1	**87**	0.93	70	0.034	2.58	**72**	0.93	56	0.034	2.1	**58**
CO	0.47	42	0.020	1.8	**44**	0.47	35	0.020	1.47	**37**	0.47	28	0.020	1.2	**29**
PM	0.047	4.2	0.0020	0.18	**4.4**	0.047	3.5	0.0020	0.15	**3.67**	0.047	2.8	0.0020	0.12	**3**

Crane Emission Emission Summary															
	Year 1				Annual Total	Year 2				Annual Total	Year 3				Annual Total
Days/Year	118					103					88				
	Crane in operation		Idling			Crane in operation		Idling			Dredging		Idling		
Pollutants	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)		Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)		Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)	
NOx	0.025	2.2	0.0015	0.14	**2.4**	0.026	1.9	0.0016	0.12	**2.1**	0.028	1.7	0.0017	0.10	**1.8**
CO	0.012	1.1	0.00086	0.077	**1.2**	0.013	0.98	0.00090	0.067	**1.0**	0.014	0.84	0.0010	0.057	**0.9**
PM	0.0012	0.11	0.000086	0.0077	**0.12**	0.0013	0.10	0.000090	0.0067	**0.10**	0.0014	0.084	0.000096	0.0057	**0.090**

Diesel Hammer Emission Summary						
	Year 1		Year 2		Year 3	
Days/Year	90		75		60	
Pollutants	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)
NOx	0.0041	**0.37**	0.0041	**0.30**	0.0041	**0.24**
CO	0.0026	**0.23**	0.0026	**0.19**	0.0026	**0.16**
PM	0.00026	**0.023**	0.00026	**0.019**	0.00026	**0.016**

Table 6. Scenario 2 - Summary of Commercial Marine Emissions for Tier II Engines
Air Conformity Analysis
DSCP Edgemoore Facility, DE

2 x Tugboat Emission Summary						
	Year 1		Year 2		Year 3	
Days/Year	118		103		88	
	Tugboats (2)		Tugboats (2)		Tugboats (2)	
Pollutants	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)
NOx	0.039	**4.6**	0.039	**4.0**	0.039	**3.4**
CO	0.025	**2.9**	0.025	**2.5**	0.025	**2.2**
PM	0.0025	**0.29**	0.0025	**0.25**	0.0025	**0.22**

Crew Boat Emission Summary						
	Year 1		Year 2		Year 3	
Days/Year	118		103		88	
Pollutants	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)
NOx	0.015	**1.8**	0.015	**1.6**	0.015	**1.4**
CO	0.010	**1.2**	0.010	**1.0**	0.010	**0.87**
PM	0.0010	**0.12**	0.0010	**0.10**	0.0010	**0.087**

Crew-Survey Boat Emission Summary						
	Year 1		Year 2		Year 3	
Days/Year	118		103		88	
Pollutants	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)
NOx	0.0039	**0.46**	0.0039	**0.40**	0.0039	**0.34**
CO	0.0025	**0.29**	0.0025	**0.25**	0.0025	**0.22**
PM	0.00025	**0.029**	0.00025	**0.025**	0.00025	**0.022**

Power Pack Emission Summary						
	Year 1		Year 2		Year 3	
Days/Year	90		75		60	
Pollutants	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)
NOx	0.016	**1.5**	0.016	**1.2**	0.016	**0.97**
CO	0.016	**1.5**	0.010	**0.78**	0.010	**0.62**
PM	0.0016	**0.15**	0.0010	**0.078**	0.0010	**0.062**

Notes

1. Emissions factors reflect a fleet of Tier II marine engines, referenced from 40 CFR § 94.8
2. Assumes a 0.0015% sulfur concentration in fuel oil, which is the maximum allowable amount of sulfur in non-road diesel fuel according to the EPA Office of Transportation and Air Quality

3. Support Vessels (Crew Boat, Crew - Survey Boat, Tugboat and Crane) Operate for an additional 2 weeks before and after standard project schedule
4. 2 Tugboats are required for the project

Table 7. Summary of Non Road Emissions
Air Conformity Analysis
DSCP Edgemoore Facility, DE

D10 Bulldozer Emission Summary						
	3 Bulldozers		5 Bulldozers		3 Bulldozers	
	Year 1		Year 2		Year 3	
Days/Year	250		251		250	
Pollutants	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)
NOx	0.000065	**0.049**	0.000065	**0.081**	0.000065	**0.049**
CO	0.00061	**0.46**	0.00061	**0.46**	0.00061	**0.46**
SOx	0.000021	**0.0052**	0.000015	**0.019**	0.000015	**0.011**
CO_2	1.7	**1300**	1.7	**2,100**	1.7	**1300**
VOC	0.000020	**0.0050**	0.000015	**0.018**	0.000015	**0.011**
PM2.5	0.000017	**0.013**	0.000017	**0.022**	0.000017	**0.013**

374 Excavator Emission Summary						
	3 Excavators		3 Excavators		3 Excavators	
	Year 1		Year 2		Year 3	
Days/Year	250		251		250	
Pollutants	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)	Daily Emissions (Tons/Day)	Annual Emissions (Tons/Year)
NOx	0.00015	**0.038**	0.00015	**0.038**	0.00015	**0.038**
CO	0.0014	**0.36**	0.0014	**0.36**	0.0014	**0.36**
SOx	0.000036	**0.0090**	0.000036	**0.0091**	0.000036	**0.0090**
CO_2	4.0	**990**	3.9	**990**	4.0	**990**
VOC	0.000020	**0.0050**	0.00035	**0.087**	0.00035	**0.087**
PM2.5	0.000041	**0.010**	0.000041	**0.010**	0.000041	**0.010**

Table 7. Summary of Non Road Emissions
Air Conformity Analysis
DSCP Edgemoore Facility, DE

Notes:

1. Machines run for 8 hours per day for 250 days during years 1 and 3, and 251 days during year 2
2. 3 bulldozers and 3 excavators required throughout the project, plus 2 additoinal bulldozers required in year 2
3. Emission factors were referenced from the 2010 EPA report "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition" NR-009d, which summarizes the EPA NONROAD 2008a emission inventory model
4. Assuming Tier III diesel engine
5. Assumes a 0.0015% sulfur concentration in fuel oil, which is the maximum allowable amount of sulfur in non-road diesel fuel according to the EPA Office of Transportation and Air Quality. The modeled default fuel sulfur content is 2000 ppm for Tier III diesel engines 175 < hp 750
6. All PM emissions are assumed to be smaller than 10 microns (PM10) and 97% of the PM is assumed to be smaller than 2.5 microns (PM2.5)

7. Load Factor of 0.59 refernced from 2002 EPA Report 'Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling'

Table 8. Summary of On Road Emissions
Air Conformity Analysis
DSCP Edgemoore Facility, DE

55 Commuter On Road Emission Summary						
	Year 1		Year 2		Year 3	
Woring Days/Year	**250**		**251**		**250**	
Pollutants	**Daily Emissions (Tons/Day)**	**Annual Emissions (Tons/Year)**	**Daily Emissions (Tons/Day)**	**Annual Emissions (Tons/Year)**	**Daily Emissions (Tons/Day)**	**Annual Emissions (Tons/Year)**
NOx	0.00090	**0.22**	0.00090	**0.23**	0.00090	**0.22**
CO	0.011	**2.8**	0.011	**2.8**	0.011	**2.8**
SOx	-	-	-	-	-	-
CO_2	0.49	**120**	0.49	**120**	0.49	**120**
VOC	0.0012	**0.29**	0.0012	**0.29**	0.0012	**0.29**
PM2.5	0.0000043	**0.0011**	0.0000043	**0.0011**	0.0000043	**0.0011**
PM10	0.0000046	**0.0012**	0.0012	**0.0012**	0.0012	**0.0012**

Notes:

1. Non Diesel Emission Factors are obtained from 2008 EPA Report ' Average Annual Emissions and Fuel Consumption for Gasoline-Fueled Passenger Cars and Light Trucks'
2. Passengers are assumed to travel in ' Light Trucks'
3. The average commuting distance is 7.8 miles, one way
4. Commuting Distance is referenced from 2015 Brookings Report ' The growing distance between people and jobs in metropolitan America'
5. Duration of work is assumed to be the entire working year

Table 8. Summary of On Road Emissions
Air Conformity Analysis
DSCP Edgemoore Facility, DE

Tier 0 - Heavy Duty Diesel On Road Emission Summary			
Year 2			
Working Days/Year	**251**		
Pollutants	**Daily Emissions per Truck (Tons/Day)**	**Annual Emissions per Truck (Tons/Year)**	**Total Annual Emissions from a fleet of Trucks (Tons/Year)**
NOx	0.012	0.16	**3.0**
CO	0.0032	0.044	**0.80**
PM	0.00030	0.0042	**0.075**

Notes:

1. Diesel Emission Factors are obtained from 2008 EPA Report ' Average In-Use Emissions from Heavy Duty Trucks'
2. Machines run for 8 hours per day for 251 days
3. Assumes a 0.0015% sulfur concentration in fuel oil, which is the maximum allowable amount of sulfur in non-road diesel fuel according to the EPA Office of Transportation and Air Quality. The modeled default fuel sulfur content is 2000 ppm for tier 3 diesel engines 175 <hp 750
4. All PM emissions are assumed to be smaller than 10 microns (PM10) and 97% of the PM is assumed to be smaller than 2.5 microns (PM2.5)
5. Load Factor of 0.59 refernced from 2002 EPA Report 'Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeli
6. The average truck capacity is assumed to be 14 CY
7. The total volume of fill required is estimated to be 145,893 CY, therefore a fleet of 18 trucks provides a realistic representation of the project requirements, based on the assumptions made above