Chapter 6.11: Construction—Greenhouse Gas Emissions

A. INTRODUCTION

This chapter evaluates the greenhouse gas (GHG) emissions that would be generated by the construction of the proposed project and its consistency with the citywide GHG reduction goals. Note that there would be no substantial energy use associated with operations post construction, and, therefore, the construction emissions represent the total lifetime emissions associated with the proposed project.

As discussed in the Federal National Climate Assessment,[1] the New York State Department of Environmental Conservation (NYSDEC) policy,[2] and the 2014 *City Environmental Quality Review* (*CEQR) Technical Manual*,[3] climate change is projected to have wide-ranging effects on the environment, including rising sea levels, increases in temperature, and changes in precipitation levels. Although this is occurring on a global scale, the environmental effects of climate change are also likely to be felt at the local level. The United States, New York State, and New York City have all established sustainability initiatives and goals for greatly reducing GHG emissions and for adapting to climate change.

Per the three guidance documents cited above, the citywide GHG reduction goal is currently the most appropriate standard by which to analyze a project under CEQR. Accordingly, a GHG consistency assessment is provided, assessing the projected emissions consistent with the requirements of CEQR, State Environmental Quality Review Act (SEQRA), and National Environmental Policy Act (NEPA).

B. PRINCIPAL CONCLUSIONS

The proposed project would not introduce any substantial new buildings or other uses which would require electricity use, fuel consumption, or generate transportation needs. Therefore, consistency with the efficient buildings goal, clean power goal, and transit-oriented development and sustainable transportation goal defined in CEQR as part of the City's GHG reduction goal would not be relevant for the proposed project. Since the proposed project would not result in substantial carbon dioxide equivalent (CO_2e) emissions once in operation, the quantified analysis of CO_2e emissions focuses on construction of the proposed project.

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[1] U.S. Global Change Research Program. Climate Science Special Report: Fourth National Climate Assessment. Volume I. 2017.

[2] NYSDEC. "NYSDEC Policy: Assessing Energy Use and Greenhouse Gas Emissions in Environmental Impact Statements." July 15, 2009.

[3] New York City Mayor's Office of Environmental Coordination. *CEQR Technical Manual*. March 2014.

NO ACTION ALTERNATIVE (ALTERNATIVE 1)

The No Action Alternative assumes that no new comprehensive coastal protection system would be constructed in the proposed project area. Therefore, this alternative is not evaluated further as there will no new construction associated with the proposed project.

PREFERRED ALTERNATIVE (ALTERNATIVE 4): FLOOD PROTECTION SYSTEM WITH A RAISED EAST RIVER PARK

The total fossil fuel use in all forms associated with construction under the Preferred Alternative would result in up to approximately 48,889 metric tons of CO_2e emissions. Potential measures for further reductions of emissions from construction of the Preferred Alternative are under consideration and may include the use of biodiesel, expanded use of recycled steel and aluminum, as well as expanded construction waste reduction.

OTHER ALTERNATIVES

The magnitude of construction activities for The Flood Protection System on the West Side of East River Park – Baseline Alternative (Alternative 2) would be substantially lower than the Preferred Alternative, resulting in fewer on-road trips and on-site use of nonroad engines, requiring less materials, and resulting in the removal of fewer trees. Overall, less GHG would be emitted under Alternative 2 as compared to the Preferred Alternative.

The total fossil fuel use in all forms associated with construction under Alternative 3 would result in up to approximately 48,652 metric tons of CO_2e emissions for the Flood Protection System on the West Side of East River Park – Enhanced Park and Access Alternative (Alternative 3). This estimate is similar to the total fossil fuel use projected for the Preferred Alternative.

The Flood Protection System East of FDR Drive (Alternative 5) aligns the flood protection system on the east side of the FDR Drive between East 13th Street and Avenue C to the north as opposed to the west side of the FDR Drive for the Preferred Alternative and is expected to result in similar GHG emissions as the Preferred Alternative. However, Alternative 5 would require extensive work within the FDR Drive and could require full closure of the FDR Drive northbound lanes for a period of two months, which could result in increased congestion and ensuing GHG emissions as compared to the Preferred Alternative.

C. REGULATORY CONTEXT

POLLUTANTS OF CONCERN

GHGs are those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of infrared radiation emitted by the Earth's surface, the atmosphere, and clouds. This phenomenon causes the general warming of the Earth's atmosphere, or the "greenhouse effect." Water vapor, carbon dioxide (CO_2), nitrous oxide (N_2O), methane, and ozone are the primary greenhouse gases in the Earth's atmosphere.

There are also a number of entirely anthropogenic greenhouse gases in the atmosphere, such as halocarbons and other chlorine- and bromine-containing substances, which also damage the stratospheric ozone layer (and contribute to the "ozone hole"). Since these compounds are being replaced and phased out due to the 1987 Montreal Protocol, there is no need to address them in GHG assessments for most projects. Although ozone itself is also a major greenhouse gas, it does not need to be assessed as such at the project level since it is a rapidly reacting chemical and efforts are ongoing to reduce ozone concentrations as a criteria pollutant (see Chapter 6.10, "Construction—Air Quality"). Similarly, water vapor is of great importance to global climate change, but is not directly of concern as an emitted pollutant since the negligible quantities emitted from anthropogenic sources are inconsequential.

CO_2 is the primary pollutant of concern from anthropogenic sources. Although not the GHG with the strongest effect per molecule, CO_2 is by far the most abundant and, therefore, the most influential GHG. CO_2 is emitted from any combustion process (both natural and anthropogenic); from some industrial processes such as the manufacturing of cement, mineral production, metal production, and the use of petroleum-based products; from volcanic eruptions; and from the decay of organic matter. CO_2 is removed ("sequestered") from the lower atmosphere by natural processes such as photosynthesis and uptake by the oceans. CO_2 is included in any analysis of GHG emissions.

Methane and N_2O also play an important role since the removal processes for these compounds are limited and because they have a relatively high impact on global climate change as compared with an equal quantity of CO_2. Emissions of these compounds, therefore, are included in GHG emissions analyses when the potential for substantial emission of these gases exists.

The *CEQR Technical Manual* lists six GHGs that could potentially be included in the scope of a GHG analysis: CO_2, N_2O, methane, hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). This analysis focuses mostly on CO_2, N_2O, and methane. There are no significant direct or indirect sources of HFCs, PFCs, or SF_6 associated with the proposed project.

To present a complete inventory of all GHGs, component emissions are added together and presented as CO_2e emissions—a unit representing the quantity of each GHG weighted by its effectiveness using CO_2 as a reference. This is achieved by multiplying the quantity of each GHG emitted by a factor called global warming potential (GWP). GWPs account for the lifetime and the radiative forcing of each chemical over a period of 100 years (e.g., CO_2 has a much shorter atmospheric lifetime than SF_6, and therefore has a much lower GWP). The GWPs for the main GHGs discussed here are presented in **Table 6.11-1**.

Table 6.11-1
Global Warming Potential (GWP) for Major GHGs

Greenhouse Gas	100-year Horizon GWP
Carbon Dioxide (CO_2)	1
Methane (CH_4)	21
Nitrous Oxide (N_2O)	310
Hydrofluorocarbons (HFCs)	140 to 11,700
Perfluorocarbons (PFCs)	6,500 to 9,200
Sulfur Hexafluoride (SF_6)	23,900

Note:
The GWPs presented above are based on the Intergovernmental Panel on Climate Change's (IPCC) Second Assessment Report (SAR) to maintain consistency in GHG reporting. The IPCC has since published updated GWP values that reflect new information on atmospheric lifetimes of GHGs and an improved calculation of the radiative forcing of CO_2. In some instances, if combined emission factors were used from updated modeling tools, some slightly different GWP may have been used for this study. Since the emissions of GHGs other than CO_2 represent a very minor component of the emissions, these differences are negligible.
Source: 2014 *CEQR Technical Manual.*

POLICY, REGULATIONS, STANDARDS, AND BENCHMARKS FOR REDUCING GHG EMISSIONS

The regulatory context for the proposed project includes the following requirements and policies for which each of the alternatives have been analyzed to result in a determination of environmental effects with project implementation.

FEDERAL

As a result of the growing consensus that human activity resulting in GHG emissions has the potential to profoundly impact the Earth's climate, countries around the world have undertaken efforts to reduce emissions by implementing both global and local measures addressing energy consumption in production, land use, and other sectors. In December 2015, the U.S. signed the international Paris Agreement[4] that pledges deep cuts in emissions, with a stated goal of reducing emissions to between 26 and 28 percent lower than 2005 levels by 2025[5]. On June 1, 2017, the President announced that "the United States will withdraw from the Paris Climate Accord."[6]

Regardless of the Paris Agreement, the U.S. Environmental Protection Agency (USEPA) is required to regulate greenhouse gases under the Clean Air Act (CAA), and has begun preparing and implementing regulations aimed at limiting emissions from vehicles and stationary sources. In addition, there are various federal policies aimed at reducing GHG emissions. For example, Executive Order 13693 of March 19, 2015 maintains the existing policy of the United States that

[4] Conference of the Parties, 21st Session. *Adoption of The Paris Agreement, decision -/CP.21*. Paris, December 12, 2015.

[5] United States of America. Intended Nationally Determined Contributions (INDCs), as submitted. March 31, 2015.

[6] Under the Agreement, countries are allowed to withdraw four years from the date the agreement entered into force—meaning the United States can officially withdraw on November 4, 2020. However, given the voluntary nature of the agreement, any action in the U.S. may or may not occur regardless of this status.

federal agencies increase energy efficiency; measure, report, and reduce their GHG emissions from direct and indirect activities; conserve and protect water resources through efficiency, reuse, and stormwater management; eliminate waste, recycle, and prevent pollution; leverage agency acquisitions to foster markets for sustainable technologies and environmentally preferable materials, products, and services; design, construct, maintain, and operate high performance sustainable buildings in sustainable locations; strengthen the vitality and livability of the communities in which Federal facilities are located; and prioritize actions based on a full accounting of both economic and social benefits and costs.

NEW YORK STATE

There are also regional and local efforts to reduce GHG emissions. In 2009, Governor Paterson issued Executive Order No. 24, establishing a goal of reducing GHG emissions in New York State by 80 percent, compared with 1990 levels, by 2050, and creating a Climate Action Council tasked with preparing a climate action plan outlining the policies required to attain the GHG reduction goal of which an interim draft plan has been published.[7] The State is now seeking to achieve some of the emission reduction goals via local and regional planning and projects through its Cleaner Greener Communities and Climate Smart Communities programs. The State has also adopted California's GHG vehicle standards (which are at least as strict as the federal standards).

The New York State Energy Plan outlines the State's energy goals and provides strategies and recommendations for meeting those goals. The latest version of the plan was published in June 2015. The 2015 plan also establishes new targets of reducing GHG emissions in New York State by 40 percent, compared with 1990 levels, by 2030, providing 50 percent of electricity generation in the state from renewable sources by 2030 and increasing building energy efficiency gains by 600 trillion British thermal units (Btu) by 2030.

New York State has also developed regulations to cap and reduce CO_2 emissions from power plants to meet its commitment to the Regional Greenhouse Gas Initiative (RGGI). Under the RGGI agreement, the governors of nine northeastern and Mid-Atlantic states have committed to regulate the amount of CO_2 that power plants are allowed to emit, gradually reducing annual emissions to half the 2009 levels by 2020, and reducing an additional 30 percent from 2020 to 2030. The RGGI states and Pennsylvania have also announced plans to reduce GHG emissions from transportation through the use of biofuel, alternative fuel, and efficient vehicles.

NEW YORK CITY

Many local governments worldwide, including New York City, are participating in the Cities for Climate Protection™ (CCP) campaign and have committed to adopting policies and implementing quantifiable measures to reduce local GHG emissions, improve air quality, and enhance urban livability and sustainability. New York City's long-term comprehensive plan for a sustainable and resilient New York City, which began as PlaNYC 2030 in 2007 and continues to evolve today as OneNYC, includes GHG emissions reduction goals, many specific initiatives that can result in emission reductions, and initiatives aimed at adapting to future climate change impacts. The goal to reduce citywide GHG emissions to 30 percent below 2005 levels by 2030 ("30 by 30") was codified by Local Law 22 of 2008, known as the New York City Climate

[7] New York State Climate Action Council. *New York State Climate Action Plan Interim Report*. November 2010.

Protection Act (the "GHG reduction goal").[8] The City has also announced a longer-term goal of reducing emissions to 80 percent below 2005 levels by 2050 ("80 by 50"), which was codified by Local Law 66 of 2014, and has published a study evaluating the potential for achieving that goal. More recently, as part of OneNYC, the City has announced a more aggressive goal for reducing emissions from building energy down to 30 percent below 2005 levels by 2025.

In December 2009, the New York City Council enacted four laws addressing energy efficiency in large new and existing buildings, in accordance with PlaNYC. To achieve the 80 by 50 goals, the City is convening technical working groups to develop action plans to analyze the GHG reduction pathways from the building, power, transportation, and solid waste. The building sector work is currently in progress.

For certain projects subject to CEQR, an analysis of the project's contributions to GHG emissions is required to determine their consistency with the City's reduction goal, which is currently the most appropriate standard by which to analyze a project under CEQR, and is therefore applied in this chapter.

D. METHODOLOGY

Although the contribution of any single project's emissions to climate change is generally infinitesimal, the combined GHG emissions from all human activity have been found to significantly impact global climate. While the increments of criteria pollutants and toxic air emissions are assessed in the context of health-based standards and local impacts, there are no established thresholds for assessing the significance of a project's contribution to climate change. Nonetheless, prudent planning dictates that all sectors address GHG emissions by identifying GHG sources and practicable means to reduce them. Therefore, this chapter presents the total GHG emissions potentially associated with the proposed project and identifies measures that would be implemented and measures that are still under consideration to limit emissions. Note that there would be no substantial energy use associated with operations post construction, and, therefore, the construction emissions represent the total lifetime emissions associated with the proposed project.

The analysis of GHG emissions that would be associated with the proposed project is based on the methodology presented in the *CEQR Technical Manual*. Estimates of emissions of GHGs from the construction activity and materials have been quantified, including on-site emissions from engines, emissions from vehicle use, and emissions associated with materials extraction, production, and transport. Emissions and reduction in carbon sequestration associated with tree removal were evaluated qualitatively. Note that while removal of trees would occur, replacement planting would take place in the process of constructing the proposed project and potentially at other locations throughout the city.

A description of construction activities is provided in Chapter 6.0, "Construction Overview." The analysis is based on the projected activity and materials developed for Alternatives 3 and 4. Under Alternative 3, two options are considered, demonstrating the consequences of optional delivery modes: the delivery of fill and other materials via a combination of trucks and barges, using tugboats, versus all deliveries of such fill via truck. The ultimate mode of transport is not yet decided, and may include a combination of both modes. Under Alternative 4, due to the amount of fill that is required to raise East River Park by approximately eight feet to meet the

[8] Administrative Code of the City of New York, §24-803.

design flood protection criteria, it is anticipated that barges would be the primary mode of delivery of fill and other materials.

CO_2 is the primary pollutant of concern from anthropogenic emission sources and is accounted for in the analysis of emissions from all development projects. GHG emissions for gases other than CO_2 are included where practicable or in cases where they comprise a substantial portion of overall emissions. The various GHG emissions are added together and presented as metric tons of CO_2e emissions per year (see “Pollutants of Concern,” above).

The magnitude of construction activities for Alternative 2 would be lower than Alternatives 3 through 5 since Alternatives 3 through 5 would include higher levels of construction activity and a larger construction workforce, require more materials and deliveries, result in the removal of more trees, and Alternative 2 would therefore result in lower GHG emissions. Alternative 5 aligns the flood protection system on the east side of the FDR Drive between East 13th Street and Captain Patrick J. Brown Walk to the north as opposed to the west side of the FDR Drive for Alternative 4 and is expected to result in similar GHG emissions as Alternative 4. Therefore, the following methodology for quantified analysis is focused on Alternatives 3 and 4.

ON-ROAD EMISSIONS

The total number of construction worker trips was estimated using the construction schedule. The total number of worker-days was multiplied by the vehicle mode share of 48 percent, divided by an average vehicle occupancy of 1.30 (per the project’s transportation study), and multiplied by an average round-trip distance of 25.3 miles (based on the average trip to work distance for the NYMTC area)[9] to obtain a total personal vehicle miles traveled (VMT) of 3.039 million and 2.826 million under Alternatives 3 and 4, respectively. An average combined emission factor of 701 grams CO_2e per mile was applied; this was derived from the “mobile GHG emissions calculator” provided in the *CEQR Technical Manual*[10] for 2020, while applying the distribution by roadway type for Manhattan—22 percent local, 48 percent arterial, and 30 percent freeway.

General deliveries (fuel, potable water, and other miscellaneous materials) were assumed to travel 36 miles round-trip. Concrete was assumed to be delivered from nearby concrete batch plants at a distance of approximately 7.5 miles in each direction (ready-mix concrete needs to be delivered within a short time, and other materials are available locally). It is expected that large volumes of soil (over 100,000 cubic yards) may be required for construction. Imported materials to be used either below or as (a part of) the clean cover layer is conservatively assumed to be delivered from outside the city. Exported debris would travel anywhere from 30 to 200 miles, depending on type of contamination or intended reuse/disposal. An average round-trip distance of 62 miles was estimated for both exported debris and imported soil. The trips, distances, and resulting total VMT for Alternatives 3 and 4 are summarized in **Table 6.11-2**. An average combined emission factor of 1,800 grams CO_2e per mile was applied, derived as described above for personal vehicles but applying a distribution of 10 percent on local roads, 10 percent on arterials, and the remainder on interstate or expressways.

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[9] NYSDOT. *2009 NHTS, New York State Add-On*. Key Tables. “Table 3: Average Travel Day Person-Trip Length By Mode and Purpose,” trip-to work distance for SOV in NYMTC 10-county area. 2011.

[10] The *mobile GHG emissions calculator*, provided in the *CEQR Technical Manual*, is based on emission factors modeled using the EPA’s MOVES model—EPA’s latest approved model for mobile source emissions and the only model capable of providing GHG emissions by speed.

EPA estimates that the well-to-pump GHG emissions of gasoline and diesel are more than 20 percent of the tailpipe emissions.[11] Although upstream emissions (emissions associated with production, processing, and transportation) of all fuels can be substantial and are important to consider when comparing the emissions associated with the consumption of different fuels, fuel alternatives are not being considered for the proposed development, and as per the *CEQR Technical Manual* guidance, the well-to-pump emissions are not considered in the analysis. The assessment of tailpipe emissions only is in accordance with the *CEQR Technical Manual* guidance on assessing GHG emissions and the methodology used in developing the New York City GHG inventory, which is the basis of the GHG reduction goal.

Table 6.11-2
Total Construction Truck Trips and Distances

Type	Trips	Distance (round-trip miles)	Vehicle Miles Traveled
Alternative 3			
Dump truck delivery and removal	40,814	62	2,530,486
General and material delivery	33,168	36	1,194,043
Concrete and pump trucks	13,393	15	200,893
Sub-Total without Fill (Barge and Truck Option)			**3,925,421**
Additional Dump Truck (Truck Only Option)			
Dump truck delivery and removal	10,263	62	636,297
Total (Truck Only Option)			**4,561,719**
Alternative 4			
Dump truck delivery and removal	90,763	62	5,627,297
General and material delivery	35,057	36	1,262,057
Concrete and pump trucks	1,243	15	18,647
Total			**6,908,001**

NON-ROAD EMISSIONS

A detailed schedule for the use of non-road construction engines and, optionally, tug boats to support a partial barging of materials, was developed, as described in Section 6.0, "Construction Overview." The detailed data, including the number, type, power rating, and hours of operation for all construction engines was coupled with fuel consumption rate data from EPA's NONROAD model to estimate total fuel consumption throughout the duration of the construction activities.

Under Alternative 3, non-road construction engines are estimated to require approximately 1.4 million gallons of diesel equivalent throughout the duration of construction, and approximately an additional 0.31 million gallons of diesel would be required for tug boats under the barge option. In addition, on-site idling of ready-mix concrete trucks and other necessary idling is estimated to consume 69.5 thousand gallons of diesel.

Similarly, under Alternative 4, non-road construction engines are estimated to require approximately 1.6 million gallons of diesel equivalent throughout the duration of construction, and approximately an additional 0.14 million gallons of diesel would be required for tug boats under the barge option. In addition, on-site idling of ready-mix concrete trucks and other necessary idling is estimated to consume 20.5 thousand gallons of diesel.

[11] EPA. *MOVES2004 Energy and Emission Inputs*. Draft Report, EPA420-P-05-003. March 2005.

The quantity of fuel was then multiplied by an emission factor of 10.30 and 10.35 kilograms CO_2e per gallon of diesel for trucks and tug boats, respectively.[12]

MATERIAL EMISSIONS

Upstream emissions related to the production of construction materials were estimated based on the expected quantity of iron or steel and cement. Although other materials will be used, cement and metals have the largest embodied energy and direct GHG emissions associated with their production, and substantial quantities would be used for the proposed project.

The construction is estimated to require 17,646 metric tons of cement under Alternative 3. Alternative 4 is estimated to require 13,235 metric tons of cement, three quarters of the amount as required under Alterative 3. An emission factor of 0.928 metric tons of CO_2e per metric ton of cement produced was applied to estimate emissions associated with energy consumption and process emissions for cement production.[13] The precise origin of cement for this project is unknown at this time.

The construction is estimated to require 3,430 metric tons of steel under Alternatives 3 and 4. An emission factor of 0.6 metric tons of CO_2e per metric ton of steel product produced was applied to estimate emissions associated with production energy consumption,[14] and 0.65 metric tons of CO_2e per metric ton of steel product produced for process emissions associated with iron and steel production were applied.[15]

TREE REMOVAL

Tree removal estimates are presented in **Table 6.11-3**. As discussed further in Chapter 5.6, "Natural Resources," the proposed project would require a New York City Department of Parks and Recreation (NYC Parks)-approved tree replacement plan to address the tree clearing that is proposed. These trees would be replanted or replaced in accordance with the pre-approved tree mitigation plan. The newly constructed and planted raised landscapes would be passive structures that are integrated components of East River Park and Stuyvesant Cove Park.

Table 6.11-3
Trees Removed Due to Design

Alternative	Total Trees Removed Due to Design	Total Trees Removed Due to Conditions
Alternative 2	265	62
Alternative 3	776	62
Alternative 4	981	62
Alternative 5	981	62

Since the details of reuse or disposal of the removed trees and the tree replacement plan are not known at this time, the carbon content of the trees to be removed was not estimated, but net emissions associated with tree removal is discussed qualitatively.

[12] EPA. Emission Factors for Greenhouse Gas Inventories. 19 November 2015.

[13] The Portland Cement Association, Life Cycle Inventory of Portland Cement Manufacture, 2006

[14] Arpad Horvath et al., Pavement Life-cycle Assessment Tool for Environmental and Economic Effects, Consortium on Green Design and Manufacturing, UC Berkeley, 2007.

[15] Based on 42.3 teragrams of CO_2e emitted and 65,460 thousand tons produced; EPA, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2009, April 15, 2011.

E. ENVIRONMENTAL EFFECTS

A detailed description of the alternatives analyzed in this chapter is presented in Chapter 2.0, “Project Alternatives.”

NO ACTION ALTERNATIVE (ALTERNATIVE 1)

The No Action Alternative assumes that no new comprehensive coastal protection system would be constructed in the proposed project area. Therefore, this alternative is not evaluated further as there will no new construction associated with the proposed project.

PREFERRED ALTERNATIVE (ALTERNATIVE 4): FLOOD PROTECTION SYSTEM WITH A RAISED EAST RIVER PARK

TRANSPORTATION EMISSIONS

The on-road GHG emissions from the construction of the Preferred Alternative are presented in detail in **Table 6.11-4**. Note that some emissions from trucks, associated with increased congestion, are not included due to the limitations of the above methodology; however, these would not be expected to be greater overall than the difference between barge and truck emissions.

Table 6.11-4
Total Transportation Emissions (metric tons CO_2e)

Vehicle Type	Total
Passenger Vehicle	2,129
Truck	7,007
Tug Boat (Delivery by Barge)	1,458
Total	**10,594**

ON-SITE EMISSIONS

The GHG emissions from construction engines associated with the proposed project are presented in detail in **Table 6.11-5**.

Table 6.11-5
Total On-Site Emissions (metric tons CO_2e)

Vehicle Type	Emissions
Non-Road	16,365
On-Site Truck Idling	212
Total	**16,657**

CONSTRUCTION MATERIAL EMISSIONS

The resulting GHG emissions from construction materials extraction, processing, and transport would be 12,279 metric tons CO_2e from cement and 4,273 metric tons CO_2e from steel.

TREE REMOVAL EMISSIONS

As discussed above, 981 trees of varying size and species would be removed due to design and conditions for the Preferred Alternative. This would result in GHG emissions of stock carbon and reduced carbon sequestration in the future. Some carbon would be also be sequestered annually by transfer to soils if left intact.

Under the tree replacement plan, tree restitution is expected to result in the planting of 1,442 new trees. While the new trees are not equivalent to the removed trees, many of which are large established trees, the methodology for determining equivalent restitution accounts for this by increasing the number of trees substantially. While many trees would be planted on-site once construction is concluded, structural and design limitations would likely result in many of the replacement trees being planted elsewhere by the City. Overall, the replacement plan is expected to result in long-term sequestration that equals or exceeds the current level of sequestration by the trees identified for removal.

To the extent that the wood can be used, the release of the carbon stock back to the atmosphere as CO_2 or methane may be delayed or avoided. Chipped wood would release CO_2 and small amounts of methane, while landfilled wood would release larger amounts of methane but the gas is likely to be captured and burned or used (depending on the landfill). Firewood carbon is mostly released as CO_2 but avoids the use of wood which may be otherwise useful as firewood, and other uses (e.g., structural, furniture) generally preserve the wood extending the sequestration for many years. A small amount of the wood would be used to construct play equipment in East River Park, and the exact disposition of the rest of the wood is unknown at this time.

Overall, a net reduction in long-term carbon sequestration and flux is not expected due to the tree removal and replacement associated with the proposed project.

SUMMARY

A summary of GHG emissions by source type for the Preferred Alternative is presented in **Table 6.11-6**. Note that tree removal is not included, given the uncertainty regarding the changes in long-term sequestration, and since replacement details are unknown at this time and therefore not quantified. As described above, it is expected that in the long term, sequestration and flux of carbon would not substantially change due to the project since trees removed would be replaced by new plantings with a larger potential for sequestration, and since removed wood would be recycled and used to the extent practicable.

Table 6.11-6
Summary of GHG Emissions (metric tons CO_2e)

Use	Total
Transportation	15,770
On-Site	16,567
Materials	16,552
Total	**48,889**

Total GHG emissions associated with the construction, including direct emissions and upstream emissions associated with construction materials (excluding fuel), would be approximately 49 thousand metric tons.

OTHER ALTERNATIVE (ALTERNATIVE 2): FLOOD PROTECTION SYSTEM ON THE WEST SIDE OF EAST RIVER PARK - BASELINE

The magnitude of construction activities for Alternative 2 would be lower than the Preferred Alternative, resulting in fewer on-road trips and on-site use of nonroad engines, requiring less materials, and resulting in the removal of fewer trees. Overall, less GHG would be emitted under this alternative.

OTHER ALTERNATIVE (ALTERNATIVE 3): FLOOD PROTECTION SYSTEM ON THE WEST SIDE OF EAST RIVER PARK – ENHANCED PARK AND ACCESS

TRANSPORTATION EMISSIONS

The on-road GHG emissions from the proposed project are presented in detail in **Table 6.11-7**. The truck-only option would have some additional emissions from trucking materials, but would not include the tug-boat emissions from barge transport of material (see "Non-Road Emissions," below). Overall, the barge and truck option is projected to result in higher GHG emissions, by over 2,000 metric tons. Note that some emissions from trucks, associated with increased congestion, are not included due to the limitations of the above methodology; however, these would not be expected to be greater overall than the difference between barge and truck emissions.

Table 6.11-7
Total Transportation Emissions (metric tons CO_2e)

Vehicle Type	Barge and Truck Option	Truck Only Option
Passenger Vehicle	2,181	
Truck	7,136	8,292
Tug Boat (Delivery by Barge)	3,190	0
Total	**12,506**	**10,473**

The barge and truck option would have some additional emissions from tug-boats used for barge transport, but would have somewhat lower emissions from trucking (see "On-Road Emissions," above).

ON-SITE EMISSIONS

The GHG emissions from construction engines associated with the proposed project are presented in detail in **Table 6.11-8**.

Table 6.11-8
Total On-Site Emissions (metric tons CO_2e)

Vehicle Type	Emissions
Non-Road	14,867
On-Site Truck Idling	633
Total	**15,500**

CONSTRUCTION MATERIAL EMISSIONS

The resulting GHG emissions from construction materials extraction, processing, and transport would be 16,373 metric tons CO_2e from cement and 4,273 metric tons CO_2e from steel.

TREE REMOVAL EMISSIONS

As discussed above, 776 trees of varying size and species would be removed due to design and conditions for Alternative 3. This would result in GHG emissions of stock carbon and reduced carbon sequestration in the future. Some carbon would be also be sequestered annually by transfer to soils if left intact.

Under the tree replacement plan, tree restitution is expected to result in the planting of 1,180 new trees. While the new trees are not equivalent in size to the removed trees, many of which are large established trees, the methodology for determining equivalent restitution accounts for this by increasing the number of trees substantially. While many trees would be planted on-site once construction is concluded, structural and design limitations would likely result in many of the replacement trees being planted elsewhere by the City. Overall, the replacement plan is expected to result in long-term sequestration that equals or exceeds the current level of sequestration by the trees identified for removal.

To the extent that the wood can be used, the release of the carbon stock back to the atmosphere as CO_2 or methane may be delayed or avoided. Chipped wood would release CO_2 and small amounts of methane, while landfilled wood would release larger amounts of methane but the gas is likely to be captured and burned or used (depending on the landfill). Firewood carbon is mostly released as CO_2 but avoids the use of wood, which may be otherwise useful as firewood, and other uses (e.g., structural, furniture) generally preserve the wood extending the sequestration for many years. A small amount of the wood would be used to construct play equipment in East River Park, and the exact disposition of the rest of the wood is unknown at this time.

Overall, a net reduction in long-term carbon sequestration and flux is not expected due to the tree removal and replacement associated with the proposed project.

SUMMARY

A summary of GHG emissions by source type for Alternative 3 is presented in **Table 6.11-9**. Note that tree removal is not included, given the uncertainty regarding the changes in long term sequestration and since replacement details are unknown at this time and therefore not quantified. As described above, it is expected that in the long term, sequestration and flux of carbon would not substantially change due to the project since trees removed would be replaced by new plantings with a larger potential for sequestration, and since removed wood would be recycled and used to the extent practicable.

Table 6.11-9
Summary of GHG Emissions (metric tons CO_2e)

Use	Total Truck and Barge Option	Total Truck Only Option
Transportation	12,506	10,473
On-Site	15,500	15,500
Materials	20,646	20,646
Total	**48,652**	**46,619**

Total GHG emissions associated with the construction, including direct emissions and upstream emissions associated with construction materials (excluding fuel), would be approximately 49 thousand metric tons with the truck-only option and 47 thousand metric tons with the truck and barge option.

ALTERNATIVE 5 – FLOOD PROTECTION SYSTEM EAST OF FDR DRIVE

Alternative 5 aligns the flood protection system on the east side of the FDR Drive between East 13th Street and Avenue C to the north as opposed to the west side of the FDR Drive for the Preferred Alternative and is expected to result in similar GHG emissions as the Preferred Alternative. However, Alternative 5 would require extensive work within the FDR Drive and could require full closure of the FDR Drive northbound lanes for a period of two months, which could result in increased congestion and ensuing GHG emissions (see Chapter 6.9, "Construction—Transportation") as compared to the Preferred Alternative.

F. EVALUATION OF MEASURES FOR REDUCING GHG EMISSIONS AND CONSISTENCY WITH CITY GHG GOALS

The proposed project would not introduce any substantial new buildings or other uses which would require electricity use, fuel consumption, or generate transportation needs. Therefore, consistency with the efficient buildings goal, clean power goal, and transit-oriented development and sustainable transportation goal defined in the *CEQR Technical Manual* as part of the City's GHG reduction goal would not be relevant for the proposed project.

REDUCE CONSTRUCTION OPERATION EMISSIONS

REDUCING TRANSPORTATION EMISSIONS

On-road and/or tugboat emissions would be reduced by selecting sources of clean fill and other construction materials that are nearer to the project areas, therefore reducing transport emissions, if found to be practicable. Note that this would require identifying sources of clean fill not requiring substantial reprocessing which would result in additional expense and emissions. The reuse of excess fill material from other sites would also reduce emissions associated with the transport and disposal of that fill if it were otherwise used. While similar considerations exist for debris disposal, the location for disposal is dictated by the nature of the material and disposal requirements. Within the limitations of those requirements, efforts would be made to identify nearer destinations for disposal. Since cost for both delivery and disposal are associated with distance, this consideration is included in the decision making as a matter of course.

The analysis results indicate that disposal by truck would be more energy efficient and result in lower emissions than by barge. Nonetheless, there are other considerations, including reducing congestion and expediency for the project, which may result in a decision to use barges for transport.

REDUCE NON-ROAD ENGINE EMISSIONS

To reduce construction operations emissions, construction contracts could include a requirement to use biodiesel blends of 20 percent (B20, ASTM D7467-15ce1) in non-road and marine engine fleets operating on-site. B20 can be used with no considerable adjustments necessary for virtually all diesel construction engines[16] and can also reduce cost since average biodiesel prices in the region have been lower than standard diesel on a per-energy unit basis.

While some operations in the past have stated concerns about biodiesel use in cold weather, these have been resolved in B20 blends meeting ASTM quality standards and BQ-9000 supply chain management, with minimal handling and management requirements. Another concern that has been raised in the past was that engine warranties do not cover the use of biodiesel. It should be noted that warranties do not cover any fuel, standard or alternative, and that a warranty would not be voided by using appropriate fuel. Damage caused by fuel not meeting standards would be covered under the fuel supply warranties. Nonetheless, it is recommended to require that contractors use engines from manufacturers that have explicitly approved B20 use.

[16] USDOE. *Biodiesel Blends*. https://www.afdc.energy.gov/fuels/biodiesel_blends.html. Accessed 2/7/2018.

Based on fuel price data for the two years leading up to October 2017, in the NY region, B20 is cheaper than diesel fuel (both per gallon and on an energy content basis).[17] Recent average relative cost of B20 is presented in **Figure 6.11-1**. Note that these are average prices—shopping for a low price provider during procurement could identify lower costs, and implementing a 'locked-in' contract price can potentially provide cost savings throughout the construction period.

Biodiesel does not entirely eliminate GHG emissions, and B20 is a blend of 20 percent biodiesel and 80 percent standard diesel. Accounting for the overall lifecycle of the fuel, the use of B20 could reduce GHG emissions associated with diesel combustion by at least 13 percent (for standard soybean biodiesel, varies by source with higher reductions available from more advanced biofuels).[18] Therefore, if cost and implementation procedures allow, including a requirement to use B20 for all on-site non-road and marine diesel engines in construction contracts would substantially reduce emissions, and would be practicable and financially beneficial. The use of B20 would be further evaluated through the contract bidding process.

Project specifications and contract requirements would include an extensive diesel emissions reduction program, as described in detail in Chapter 6.10, "Construction—Air Quality," including diesel particle filters for large construction engines and other measures. These measures would reduce particulate matter emissions; while particulate matter is not included in the list of standard GHGs ("Kyoto gases"), recent studies have shown that black carbon—a constituent of particulate matter—may play an important role in climate change.

USE BUILDING MATERIALS WITH LOW CARBON INTENSITY

Recycled steel would most likely be used for most structural steel and reinforcing steel (rebar) since the most readily available and specified steel elements required for the project are mostly recycled. Recycled steel reduces most of the emissions associated with extracting materials and processing steel and steel products; and is generally more cost effective than "new" steel. Therefore, including a contract requirement to meet and document a high recycled content target for the total rebar, structural steel, other steel, and aluminum used for the project would likely be practicable, could be easy to implement and achieve, and would ensure that potential reductions are actualized. The specific recycled content target would be evaluated through final design and the contract bidding process.

To reduce the use of high-carbon cement, construction contracts could require the use of supplementary cementitious materials (SCMs) such as fly ash, slag, silica fume, and calcined clay, in addition to up to 5.0 percent interground limestone to the extent practicable, contingent upon meeting the project's concrete performance requirements and specifications. While some SCM content is almost always applied, requiring their use, in addition to interground limestone where practicable, would ensure that benefits are realized, and would reduce costs since the use of SCM and/or interground limestone replaces more expensive cement. The requirements could include cement content optimization, which would identify the appropriate minimum cement content along with SCM and interground limestone so as to meet the structural requirements while minimizing cement content. Note that interground limestone can be used in addition to

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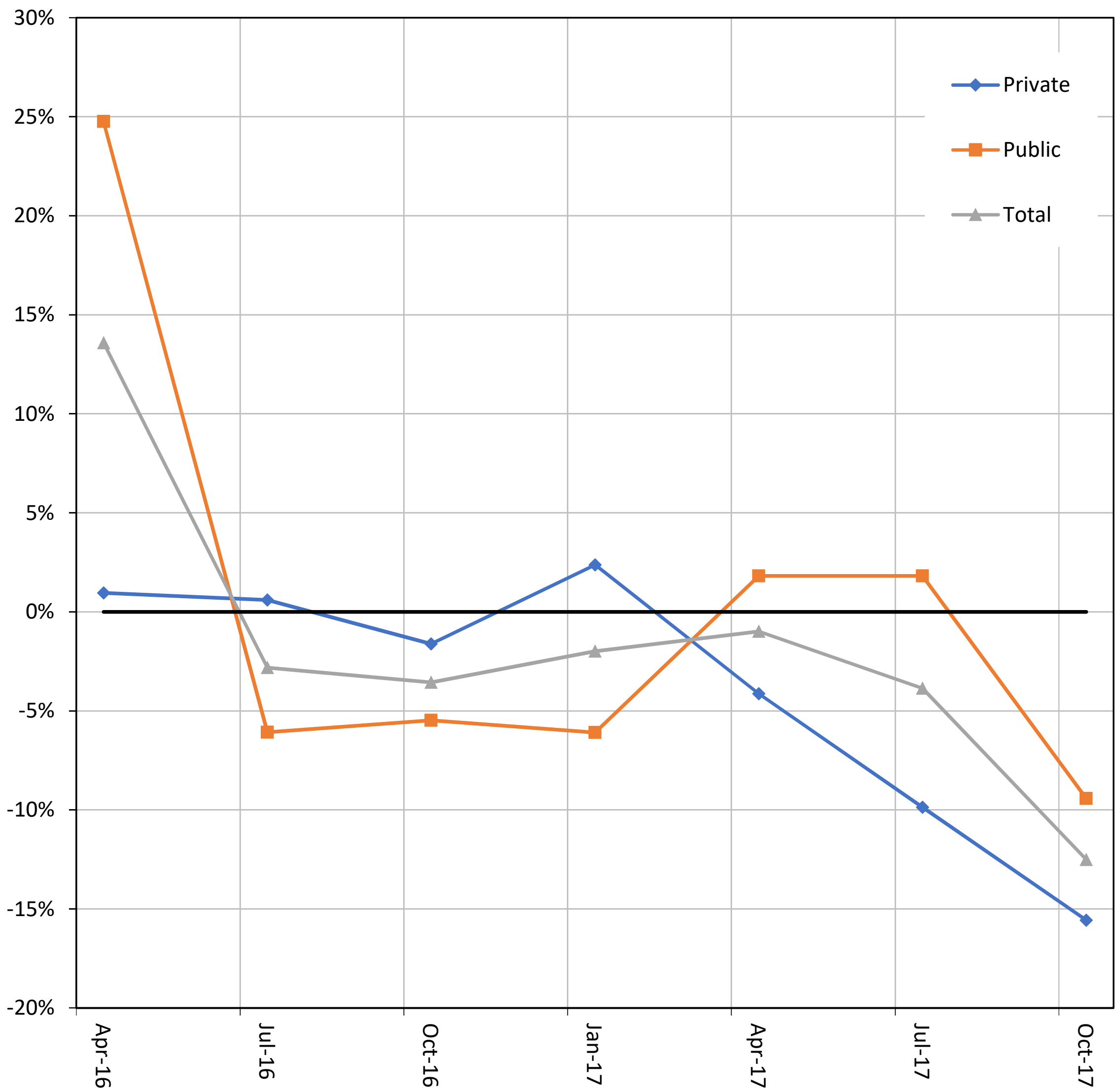
[17] Allegheny Science and Technology for U.S. Department of Energy. Personal communication, 12/11/2017.

[18] Argonne National Laboratory. GREET Well-to-Wheels Calculator and Sample Results from GREET 1 2017. December 5, 2017.



Source: AKRF, 2018.
Data: Allegheny Science and Technology for U.S. Department of Energy, personal communication, 12/11/2017.

Price of B20 v. Regular Diesel per Energy Unit, Central Atlantic PADD

Figure 6.11-1

SCMs and has been approved for standard use up to 5.0 percent by CalTrans for concrete pavements, structure approach slabs, and bridge decks. Other implementations have been undertaken in Colorado. SCMs and interground limestone replace cement in the mix and reduce GHG emissions associated with extracting and producing cement proportionally, with the potential to reduce those emissions by approximately 15 percent.

Construction waste, especially from the demolition of the existing park lighting fixtures and benches, and pedestrian bridges (under Alternatives 3 through 5), could be diverted from landfills to the extent practicable by separating out materials such as steel for reuse and recycling, with a diversion target of minimum 75 percent. Specifying and implementing a recycling target would ensure that the benefits of recycling materials are realized.

BIOGENIC EMISSIONS

While the new trees to be planted for the proposed project are not equivalent to the removed trees and not all new trees planted survive and thrive, the tree replacement plan is expected to result in long-term sequestration that equals or exceeds the current level of sequestration by the trees identified for removal.

CONCLUSIONS

Based on the above evaluation, the following mitigation is recommended and under consideration in order to achieve practicable and cost effective reduction of GHG emissions from construction of the proposed project:

1. *Use of Biodiesel*: Construction bid documents could require bidders to present an option for the use of biodiesel blends of 20 percent (B20, ASTM D7467-15ce1) in non-road and marine engine fleets operating on-site to the extent practicable. SCDPW will select this option if found to be practicable, including cost and other practical considerations. If B20 is adopted in the construction contracts, the contracts will also specify that contractors shall employ diesel engines from manufacturers that have explicitly approved B20 use.
2. *Recycled Steel and Aluminum*: Construction bid documents could require bidders to estimate the total quantity of recycled content in all structural steel, rebar, and aluminum used for the proposed contract. Construction contracts will specify a target for total recycled content based on this estimate, and require documentation submissions demonstrating that the project meets the target to the extent practicable.
3. *Construction Waste Reduction:* Construction waste could be reduced by diverting recyclable materials from the waste stream to the extent practicable. Construction contracts will require that contractors submit documentation demonstrating a minimum of 75 percent of construction waste diverted for recycling.

The proposed project could also include a number of sustainable design features, which would, among other benefits, result in lower GHG emissions. If these features were specified and required under the construction contracts, the project would be consistent with all City, state, and federal policies regarding GHG emissions. Note that if the proposed project were not pursued or completed, the potential long-term reconstruction of structures and infrastructure due to future design storms would likely result in much higher energy consumption, material use, and GHG emissions that might be largely avoided with the proposed project. Note also that regardless of the GHG emissions, the project, by its nature, is a resiliency project necessary for preparation for the impacts of climate change. ✷