APPENDIX W PURPOSE AND NEED AND ALTERNATIVES EVALUATION

Hazen ARCADIS
A JOINT VENTURE

DATE: August 26, 2019

TO: Kenneth Arnold, P.E.

FROM: Peter Glus, P.E.

SUBJECT: Long Beach WPCP Consolidation Project – Purpose and Need and Alternatives Evaluation

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The Long Beach WPCP Consolidation project aims to decommission the Long Beach WPCP and instead pump the wastewater through a force main to the Bay Park STP. For this goal, several alternatives were proposed and summarized in this memorandum.

The memorandum is broken down into the following sections:

1. Purpose and Need
2. Alternatives Evaluation
3. Cost Summary
4. Conclusions/Recommendations

1. Purpose and Need

The Western Bays region is Nassau County's most significant natural resource, and its world-class beaches and waterways create recreational and employment opportunities for millions of people each year. Moreover, in 2012 Super Storm Sandy showed how the Western Bays ecosystem plays a critical role in protecting Southern Nassau County from climate change and extreme weather conditions. Over the past century, the Western Bays region and its complex ecosystem has been gradually degrading in a manner not unlike Jamaica Bay to the west. One of the major causes of that degradation is the presence of nitrogen in the waterways. Excess nitrogen changes the marsh grass growth rate and ultimately destabilizes the marsh edges, making them susceptible to erosional forces from wave energy and currents.

Studies by the U.S. Environmental Protection Agency consultants indicate that the majority of the nitrogen loading to the Western Bays is from the Bay Park Sewage Treatment Plan (STP), as well as the smaller but still significant discharge from the City of Long Beach Water Pollution Control Plant (WPCP). To improve water quality in the Western Bays, Nassau County is committed to reducing nitrogen being discharged into the Western Bays from wastewater treatment plants, and has been active over the past decade pursing this goal with the consolidation of treatment facilities at Cedarhurst, Lawrence, and Jones Beach. In another significant and ongoing project, the County also has committed to convey the Bay Park STP effluent out of the Western Bays and through the Cedar Creek ocean outfall.

The County is now focused on the last remaining point source, the Long Beach WPCP. The County and the City of Long Beach have agreed to implement the Long Beach Consolidation project ("the Project") to

decommission the Long Beach WPCP, and instead pump the wastewater through a force main to the Bay Park STP for advanced treatment and eventual conveyance to the Cedar Creek ocean outfall.

The proposed Project, in combination with the conveyance of treated effluent from the Bay Park STP to the Cedar Creek ocean outfall will significantly reduce nitrogen loading to the Western Bays, resulting in improved water quality in the Western Bays. By reducing nitrogen discharges to the Western Bays and, hence, excess nutrient nitrogen, which is a significant driver of tidal marsh loss, the project will make a major contribution to improving the health of the Western Bay marsh ecosystem.

In addition to the primary purpose of reducing nitrogen loadings to the Western Bays, the Project also intends to restore and enhance low elevation wetlands and/or mudflats that were adversely affected by prior construction of the existing Bay Park STP outfall through the middle of the Pearsalls and North and South Black Bank Hassocks. Since the Western Bays are is in a densely urban area that has significantly reduced natural sediment inputs, the secondary objective of the project is to augment the sediment supply to these low elevation marsh platforms by specifically increasing the elevation of marsh platforms that are most vulnerable to sea level rise. Coastal marshes in this densely urban landscape are highly susceptible to the combined impacts of human activity and sea level rise and can no longer keep up with the changing conditions by trapping sediment and accumulating root biomass to maintain a favorable elevation to support vegetative growth. Vegetated marshes that cannot keep up with the rising sea levels will be flooded too frequently, which will stress and eventually kill the plants, and ultimately convert these habitats to unvegetated mudflats. This process is already happening within the Western Bays, and most notably for this project at the southern end of the South Black Banks Hassock.

This sediment enhancement approach has been used successfully across the country but most notably within the Gateway National Recreation Area in Jamaica Bay. The approach incorporated into this project augments sediment inputs within the Western Bays to strategically increase the elevation of threatened vegetated marsh platforms that were previously disturbed by past anthropogenic disturbance. By raising the marsh elevation, the project will increase primary productivity of native vegetation and, in turn, increase ecological functioning and long-term resilience of these wetlands within the Western Bays. The cumulative effect of this project is intended to reverse historical trends of wetland loss within the Western Bays and provide needed sediment to these native habitats to better help them adapt to anticipated future changes in sea levels, sediment inputs and nutrients.

2. Alternatives Evaluation

The sections below summarize the constructability, community impact, and ecological impact evaluation of the following eight (8) alternatives:

- Alternative A (Previously Alternative 3A) – Hassocks In-Water Route (HDD)
- Alternative B (Previously Alternative 1B) – Austin Boulevard (HDD)
- Alternative C – Harbor Isle & Hassocks (HDD)
- Alternative D (Previously Alternative 1) – Austin Boulevard (Open Cut)
- Alternative E (Previously Alternative 2A) – Long Beach Road (Open Cut)
- Alternative F (Previously Alternative 2B) – Long Beach Road (Hybrid Route)

- Alternative G (Previously Alternative 3B) – Harbor Isle & Hassocks (Hybrid Route)
- Alternative H – Rehabilitation of Existing Plant to Meet DFE

Images of conceptual routing for all alternatives are included in Appendix A. A detailed analysis of these alternatives as they relate to all screening criteria is included in Appendix B.

3. Cost Summary

The PM-JV performed a conceptual level cost estimate for each of these routes, shown in Table 1 below, to aid in order to determining the most cost-effective alternative.

Table 1. Cost Summary of Design Alternatives

Design Alternatives	Route Description	Total Construction Costs	Total Project Costs
Alternative A	Force Main through Hassock Islands (HDD)	$64,000,000	$76,000,000
Alternative B	Force Main through Austin Blvd & Mainland (HDD)	$70,000,000	$83,000,000
Alternative C	Force Main through Harbor Isle & Hassocks (HDD)	**Not constructible**	
Alternative D	Force Main through Austin Blvd & Mainland (Open Cut)	$82,000,000	$96,000,000
Alternative E	Force Main through Long Beach Rd & Mainland (Open cut)	$97,000,000	$113,000,000
Alternative F	Force Main through Long Beach Rd & Hassocks Islands (Hybrid)	$84,000,000	$99,000,000
Alternative G	Force Main through Harbor Isle & Hassocks Islands (Hybrid)	**Not Constructible**	
Alternative H	Upgrades to the Existing Plant	$152,500,000	$177,325,000

The estimates show that Alternative A – "Force Main through Hassock Islands (HDD Method)" has the lowest total project cost. This can be attributed to several factors including, but not limited to, the following:

- Minimizing the length of installation by open cut which reduces the amount of dewatering and active shoring.
- Minimizing the quantity of existing infrastructure relocations.
- Minimizing the quantity of traffic management considerations.

As stated previously, these estimates are conceptual in nature. The level of project definition at the time of this memo dictates that the estimates be crafted to meet the requirements of a Class 5 estimate as established by the Association for the Advancement of Cost Engineering (AACE) which indicates an accuracy range of -20% to +100%. Considering this accuracy range, in conjunction with foundational project knowledge, the following contingencies were applied:

- Segments Constructed by Horizontal Directional Drilling: 30%
- Segments Constructed by Open cut or Microtunneling: 40%
- Pump Station Construction and Long Beach WPCP: 40%

4. Conclusions/Recommendation

Constructability, community impacts, ecological impacts, and cost were evaluated for all identified alternatives as critical screening criteria to arrive at a recommendation for a preferred route.
After analysis, Alternative A (formerly Alternative 3A) was confirmed to be the recommended alternative for this project. In addition to being the lowest cost alternative, this alternative limits community impacts and has minimal constructability concerns (refer to Appendix C for construction staging figures). While permitting is anticipated to be more complex, and temporary environmental impacts are higher than for the alternatives that route down Austin Boulevard or Long Beach Road, this alternative provides an opportunity to restore the wetlands as part of the project (refer to Appendix D for marshland restoration plans).

Pearsalls Hassock and North and South Black Hassocks were adversely impact by prior construction of the existing Bay Park STP outfall. Alternative A provides an opportunity to restore Hassock wetlands and stabilize shorelines to preserve the existing marsh footprint. Additionally, the Project can evaluate the potential for restoring eroded shorelines and provided a stepwise habitat adaptation to Sea Level Rise (SLR), another contributing factor to the loss of marshland in the Western bays. Such an adaptive approach would allow the Hassocks to adapt to increasing SLR as the high marsh zone transitions to low marsh and upland to high marsh.

APPENDIX A

Conceptual Routing of Alternatives

Legend

- FORCE MAIN (HDD)
- FORCE MAIN (OPEN-CUT)
- LONG BEACH WPCP AND BAY PARK STP

NASSAU COUNTY DEPARTMENT OF PUBLIC WORKS
CITY OF LONG BEACH
LONG BEACH WPCP CONSOLIDATION PROJECT

ALTERNATIVE A

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A JOINT VENTURE

FIGURE
1

DIV/GROUP: ENV/IMDV DB: sbell LD: PIC: PM: TM:
PROJECT: JBMDL PATH: \\corpstorage.arcadis-us.com\Data\ArcGisData\GISProjects_ENV\Nassau County DPW\MXDs\Alternatives\Fig1_AltA.mxd DATE: 8/20/2019 9:21:32 AM

Legend

- FORCE MAIN (HDD)
- FORCE MAIN (OPEN-CUT)
- FORCE MAIN (MICROTUNNELING)
- FORCE MAIN (AERIAL BRIDGE ATTACHMENT)
- LONG BEACH WPCP AND BAY PARK STP

NASSAU COUNTY DEPARTMENT OF PUBLIC WORKS
CITY OF LONG BEACH
LONG BEACH WPCP CONSOLIDATION PROJECT

ALTERNATIVE B

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A JOINT VENTURE

FIGURE
2

DIV/GROUP: ENV/IMDV DB: sbell LD: PIC: PM: TM:
PROJECT: JBMDL PATH: \\corpstorage.arcadis-us.com\Data\ArcGisData\GISProjects_ENV\Nassau County DPW\MXDs\Alternatives\Fig2_AltB.mxd DATE: 8/20/2019 2:43:08 PM

Legend

- FORCE MAIN (HDD)
- FORCE MAIN (OPEN-CUT)
- LONG BEACH WPCP AND BAY PARK STP

NASSAU COUNTY DEPARTMENT OF PUBLIC WORKS
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LONG BEACH WPCP CONSOLIDATION PROJECT

ALTERNATIVE C

Hazen ARCADIS A JOINT VENTURE

FIGURE 3

DIV/GROUP: ENV/IMDV DB: sbell LD: PIC: PM: TM:
PROJECT: JBMDL PATH: \\corpstorage.arcadis-us.com\Data\ArcGisData\GISProjects_ENV\Nassau County DPW\MXDs\Alternatives\Fig3_AltC.mxd DATE: 8/20/2019 10:27:31 AM

Legend

- FORCE MAIN (HDD)
- FORCE MAIN (OPEN-CUT)
- FORCE MAIN (MICROTUNNELING)
- FORCE MAIN (AERIAL BRIDGE ATTACHMENT)
- LONG BEACH WPCP AND BAY PARK STP

NASSAU COUNTY DEPARTMENT OF PUBLIC WORKS
CITY OF LONG BEACH
LONG BEACH WPCP CONSOLIDATION PROJECT

ALTERNATIVE D

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FIGURE
4

DIV/GROUP: ENV/IMDV DB: sbell LD: PIC: PM: TM:
PROJECT: JBMDL PATH: \\corpstorage.arcadis-us.com\Data\ArcGisData\GISProjects_ENV\Nassau County DPW\MXDs\Alternatives\Fig4_AltD.mxd DATE: 8/20/2019 11:08:36 AM

Legend

- FORCE MAIN (HDD)
- FORCE MAIN (OPEN-CUT)
- FORCE MAIN (MICROTUNNELING)
- FORCE MAIN (AERIAL BRIDGE ATTACHMENT)
- LONG BEACH WPCP AND BAY PARK STP

NASSAU COUNTY DEPARTMENT OF PUBLIC WORKS
CITY OF LONG BEACH
LONG BEACH WPCP CONSOLIDATION PROJECT

ALTERNATIVE E

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FIGURE
5

DIV/GROUP: ENV/IMDV DB: sbell LD: PIC: PM: TM:
PROJECT: JBMDL PATH: \\corpstorage.arcadis-us.com\Data\ArcGisData\GISProjects_ENV\Nassau County DPW\MXDs\Alternatives\Fig5_AltE.mxd DATE: 8/20/2019 11:15:12 AM

Legend

- FORCE MAIN (HDD)
- FORCE MAIN (OPEN-CUT)
- FORCE MAIN (MICROTUNNELING)
- LONG BEACH WPCP AND BAY PARK STP

NASSAU COUNTY DEPARTMENT OF PUBLIC WORKS
CITY OF LONG BEACH
LONG BEACH WPCP CONSOLIDATION PROJECT

ALTERNATIVE F

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FIGURE
6

DIV/GROUP: ENV/IMDV DB: sbell LD: PIC: PM: TM:
PROJECT: JBMDL PATH: \\corpstorage.arcadis-us.com\Data\ArcGisData\GISProjects_ENV\Nassau County DPW\MXDs\Alternatives\Fig6_AltF.mxd DATE: 8/20/2019 11:17:42 AM

Legend

- FORCE MAIN (HDD)
- FORCE MAIN (OPEN-CUT)
- LONG BEACH WPCP AND BAY PARK STP

NASSAU COUNTY DEPARTMENT OF PUBLIC WORKS
CITY OF LONG BEACH
LONG BEACH WPCP CONSOLIDATION PROJECT

ALTERNATIVE G

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FIGURE 7

DIV/GROUP: ENV/IMDV DB: sbell LD: PIC: PM: TM:
PROJECT: JBMDL PATH: \\corpstorage.arcadis-us.com\Data\ArcGisData\GISProjects_ENV\Nassau County DPW\MXDs\Alternatives\Fig7_AltG.mxd DATE: 8/20/2019 10:24:02 AM

APPENDIX B

Screening Matrix

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Client: Nassau County Department of Public Works
Project: Long Beach WPCP Consolidation Project
Purpose: Screening Matrix of Various Design Alternatives

Long Beach WPCP Consolidation Project Alternatives Screening Matrix

SCREENING CRITERIA	Alternative A: Alternative 3A Hassocks - In-Water Route	Alternative B: Alternative 1B (new) Austin Blvd - All HDD	Alternative C: Harbor Isle Marina - HDD	Alternative D: Austin Boulevard - Upland Route	Alternative E: Alternative 2A - Long Beach Road & tie to 54-inch trunk sewer line	Alternative F: Alternative 2B - Island Park/Hassocks - Hybrid Route	Alternative G: Alternative 3B - Harbor Isle/Hassocks - Hybrid Route	Action Alternative H: Rehabilitation & DFE for the existing plant
Image of Route (yellow is HDD, orange is open cut)								
Total Construction Cost	$64,000,000	$70,000,000	na	$82,000,000	$97,000,000	$84,000,000	na	$152,500,000
Total Project Cost	$76,000,000	$83,000,000	na	$96,000,000	$113,000,000	$99,000,000	na	$177,000,000
Construction Duration	30 months	30 months	na	42 months	40 months	30 months	na	42 months
Length of Alignment by Construction Method	Open Cut: 2,750 ft HDD: 12,250 ft Suspension: 0 ft Micro tunnel: 0 ft	Open Cut: 900 ft HDD: 15,863 ft Suspension: 430 ft Micro tunnel: 200 ft	na	Open Cut: 15,163 ft HDD: 1,500 ft Suspension: 430 ft Micro tunnel: 200 ft	Open Cut: 14,675 ft HDD: 1,500 ft Suspension: 430 ft Micro tunnel: 600 ft	Open Cut: 9,230 ft HDD: 7,100 ft Suspension: 0 ft Micro tunnel: 400 ft	na	Not Applicable. (Plant to be expanded to meet nitrogen limits.)
Primary Construction Method	Horizontal Directional Drilling (HDD)	Horizontal Directional Drilling (HDD) and/or Direct Pipe	Horizontal Directional Drilling (HDD)	Open Trench	Open Trench	Hybrid: Horizontal Directional Drilling (HDD) and Open Trench	Hybrid: Horizontal Directional Drilling (HDD) and Open Trench	Conventional Construction Methods and Open Trench Technology
Constructible (Yes/No)	Yes	Yes	No	Yes	Yes	Yes	No (See Attachment "Feasibility of G/3B")	Yes
Land Acquisition	There are a total of 9 impacted parcels based on this layout due to HDD staging requirements. These 9 properties are owned by a mix of public, private, and currently unknown owners.	There are a total of 13 impacted parcels based on this layout due to HDD staging requirements. Of these 13 properties, 4 are private owned, 3 are public owned, and 6 are unknown.	There are a total of at least 7 impacted parcels based on this layout due to HDD staging requirements. These 7 properties are owned by a mix of public, private, and currently unknown owners, one of them being the marina on Harbor Isle.	There are a total of 6 impacted parcels based on this layout due to HDD staging requirements. Of these 6 properties, 2 are private, and 4 are public owned.	There are a total of 3 impacted parcels based on this layout due to HDD staging requirements. Of these 3 properties, 2 are public owned, and 1 is unknown.	There are a total of 14 impacted parcels based on this layout due to HDD staging requirements. Of these 14 properties, 7 are private, and 7 are public owned.	There are a total of 46 impacted parcels based on this layout due to HDD staging requirements. Of these 46 properties, 38 are private while the rest are public owned.	There are a total of 2 impacted parcels based on the proposed upgrades to the Long Beach WPCP. Of these 2 properties, 1 is private, and one publicly owned.
Utility Conflicts	Minor utility conflicts and/or relocation expected during construction on the Hassocks. Minimal utility coordination expected during open trench construction from HDD termination on Bay Park to the connection point at the sanitary sewer tying point west of the Bay Park STP.	There are localized utility relocations and service disruptions at HDD entry and exit points.	na	There are extensive utility relocations and service disruptions with this option, both buried (water, sewer, gas) and overhead (power/phone/traffic lights) along entire route, with potential for bypass pumping.	There are extensive utility relocations and service disruptions with this option, both buried (water, sewer, gas) and overhead (power/phone/traffic lights) along entire route, with potential for bypass pumping.	There are extensive utility relocations and service disruptions, both buried (water, sewer, gas) and overhead (power/phone/ traffic lights) along Park Ave and Long Beach Road and at HDD entry and exit. Potential for bypass pumping.	na	No utility conflicts and/or relocation expected during construction of the treatment plant upgrades.
Community Disruption/ Local Business Impacts	Low Adverse Impact. There are no direct impacts to homes and businesses during construction. Expect impacts to Bay Park STP and to dog park and boat ramp near Long Beach Plant. Expect increased noise from construction activities in these areas.	Moderate Adverse Impact. There is a moderate adverse impact to certain businesses at HDD entry and exit locations. Long term impacts will occur at the HDD entry (4-5 months) and exit locations (2 months) separated by 1,500 to 4,000 feet. HDD drill rig location footprints are 200' x 30' and pullback location footprints are 150' x 30' for staging. Short term impacts will occur during pipe string up and pullback at a footprint 30' x HDD length (1-2 weeks). Expect increased noise from construction activities. Minimal road restoration required.	Significant Adverse Impacts. Potential significant adverse impacts to residences along west end of Harbor Isle and the Harbor Isle Marina during construction from potential loss of on-street parking, elevated noise during construction, impaired access to driveways, and utility service disruption.	Significant Adverse Impact. There will be significant adverse impacts to dozens of local businesses along the route from utility service disruptions, loss of on-street parking, impaired access, traffic detours, and extended closure to vehicular access to property. Work area expected to be 100-300 feet long, which is greater than the spacing between driveways/businesses along Austin Boulevard. Expect increased noise from construction activities. Road restoration required along all segments.	Significant Adverse Impact. There will be significant adverse impacts to dozens of local businesses along the route from utility service disruptions, loss of on-street parking, impaired access, traffic detours, and extended closure to vehicular access to property. Work area expected to be 100-300 feet long, which is greater than the spacing between driveways along Long Beach Road. Potential adverse impacts on emergency services (Island Park Fire Dept. on Long Beach Rd. across from Freemans Square). Potential issues with access to Island Park Public Library and Village Hall on Long Beach Rd. Expect increased noise from construction activities. Road restoration required along entire route.	Significant Adverse Impact. There will be significant adverse impacts to dozens of local businesses along the route from utility service disruptions, loss of on-street parking, impaired access, traffic detours, and extended closure to vehicular access to property. Work area expected to be 100-300 feet long, which is greater than the spacing between driveways along Long Beach Road. Significant adverse impact on Mason Beach for HDD construction: Loss of parking at beach with limited available on-street parking on adjacent streets, impact on recreational activities at beach from construction noise, longer walk to beach/dock from beach access/parking to the south. Road restoration required along all open cut segments.	Significant Impacts. Potential significant adverse impacts to residences along Harrison Avenue during construction from potential loss of on-street parking, elevated noise during construction, impaired access to driveways, utility service disruption	Moderate Adverse Impact. The acquisition of new land, specifically the skate park and the boat launching pad may have negative repercussions with the community of Long Beach.

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Community Disruption: Traffic Impacts	Low Adverse Impact. None or limited lane closures. - Relatively minor increase in traffic to Long Beach plant site and Bay Park from deliveries of equipment/supplies and worker access during construction.	Significant Adverse Impact. A road closure will likely be required on Park Place to complete the micro tunneling operation beneath the railroad. Single lane traffic is expected along Park Place during open cut construction. Multi-lane closures with two-way traffic at HDD entry/exit locations. HDD drill rig location footprints are 200' x 30'. HDD pullback location footprints are 150' x 30' for staging and 30' x HDD length for pipe string up and pullback. In locations where detours are set up on parallel streets, there is a potential for significant adverse impacts on local roads, adjacent residents, and public safety.	na	Significant Adverse Impact. A road closure will likely be required on Park Place to complete the micro tunneling operation beneath the railroad. Single lane traffic is expected along Park Place during open cut construction. Significant adverse traffic impacts anticipated along Austin Blvd. and Long Beach Rd. No detour route available for Long Beach Rd between Barnum Bridge and Daly Blvd. In locations where detours are set up on parallel streets, there is a potential for significant adverse impacts on local roads, adjacent residents, and public safety (Lincoln Owens Middle School between Audubon & Trafalgar Blvd.). Multi-lane closures with two-way traffic along entire open cut route, with impaired access to businesses when the construction is crossing. Significant adverse impacts for emergency evacuation of Long Beach Island (Austin Blvd is major artery) (Source: Cameron Engineering report)	Significant Adverse Impact. A road closure will likely be required on Park Place to complete the micro tunneling operation beneath the railroad. Single lane traffic is expected along Park Place during open cut construction. Significant adverse traffic impacts anticipated along Long Beach Rd. Additional micro tunneling to cross the railroad twice on Long Beach Rd. will require extended lane closures. No detour route available for Long Beach Rd between Barnum Bridge and Daly Blvd. In locations where detours are set up on parallel streets, there is a potential for significant adverse impacts on local roads, adjacent residents, and public safety. Single direction or flagged two-way traffic on Long Beach Road, with impaired access to homes and businesses when construction is passing.	Significant Adverse Impact. A road closure will likely be required on Park Place to complete the micro tunneling operation beneath the railroad. Single lane traffic is expected along Park Place during open cut construction. Significant adverse traffic impacts anticipated along Long Beach Rd segment. Additional micro tunneling to cross the railroad on Long Beach Rd will required extended lane closure in that area. In locations where detours are set up on parallel streets, there is a potential for significant adverse impacts on local roads, adjacent residents, and public safety. Single direction or flagged two-way traffic on Long Beach Road, with impaired access to homes and businesses and loss of on-street parking when construction is passing.	na	Although a traffic impact has not been performed for this work, the town implications are expected to be minimal as all activities are anticipated to occur within the treatment plant's footprint. Construction trucks will be circulating back and forth the construction site and a proper traffic evaluation should be undertaken to determine the impact of these vehicles to the community.
Structural Damage (due to surface settlement)	Low Adverse Impact. No structures within zone of influence of construction.	Significant Adverse Impact. Roads, railroads, homes, and businesses within zone of influence of construction. Structural damage possible due to surface settlement from tunneling/drilling, vibration from vibratory hammers for sheet pile installation, or dewatering activities.	na	Significant Adverse Impact. Roads, railroads, homes, and businesses within zone of influence of construction. Structural damage possible due to surface settlement from tunneling/drilling, vibration from vibratory hammers for sheet pile installation, or dewatering activities.	Significant Adverse Impact. Roads, railroads, homes, and businesses within zone of influence of construction. Structural damage possible due to surface settlement from tunneling/drilling, vibration from vibratory hammers for sheet pile installation, or dewatering activities.	Significant Adverse Impact. Roads, railroads, homes, and businesses within zone of influence of construction. Structural damage possible due to surface settlement from tunneling/drilling, vibration from vibratory hammers for sheet pile installation, or dewatering activities.	na	None expected as construction will occur in the footprint of the Plant.
Clean Water Act Open Waters & NYS Tidal Wetlands	Moderate Adverse Impact -Route runs under open waters and two hassocks including intertidal wetlands. -HDD launching/receiving pits situated in wetland area which will cause temporary impacts to waters and wetlands of a maximum of 5.5 acres. Temporary impacts to be addressed through comprehensive restoration plan. -Possible minor permanent impacts from air vents or manholes will be mitigated at a 3:1 ratio.	Minimal to No Adverse Impact -Route primarily runs through heavily urbanized uplands. - Route will cross over Barnums Channel and adjacent to adjacent freshwater wetlands. - Route will cross under open waters within Hempstead Bay utilizing HDD . Associated pits and construction areas are expected to occur in previously developed upland areas.	Moderate Adverse Impact -Route runs under open waters and two hassocks including intertidal wetlands. -HDD launching/receiving pits situated in residential and wetlands area, which will cause permanent impacts to the community and temporary impacts to wetlands. Temporary impacts to be addressed through comprehensive restoration. -Possible minor permanent impacts from air vents or manholes will be mitigated at a 3:1 ratio.	Minimal to No Adverse Impact -Route primarily runs through heavily urbanized uplands. - Route will cross over Barnums Channel and adjacent to adjacent freshwater wetlands. - Route will cross under open waters within Hempstead Bay utilizing HDD . Associated pits and construction areas are expected to occur in previously developed upland areas.	Minimal to No Adverse Impact -Route primarily runs through heavily urbanized uplands. - Route will cross over Barnums Channel and adjacent to adjacent freshwater wetlands. - Route will cross under open waters within Hempstead Bay utilizing HDD . Associated pits and construction areas are expected to occur in previously developed upland areas.	Moderate Adverse Impact -Route runs under open waters and two hassocks including intertidal wetlands. -HDD launching/receiving pits situated in wetland area which will cause temporary impacts to waters and wetlands of a maximum of 5.5 acres. Temporary impacts to be addressed through comprehensive restoration plan detailed in Row 18. -Possible minor permanent impacts from air vents or manholes will be mitigated at a 3:1 ratio as described in Row 18	Moderate Adverse Impact -Route runs under open waters and two hassocks including intertidal wetlands. -HDD launching/receiving pits situated in wetland area which will cause temporary impacts to waters and wetlands of a maximum of 5.5 acres. Temporary impacts to be addressed through comprehensive restoration plan detailed in Row 18. -Possible minor permanent impacts from air vents or manholes will be mitigated at a 3:1 ratio as described in Row 18	The project will have positive and negative impacts. Even though nitrification and denitrification will limit nitrogen levels in Reynolds Channel, nitrogen will still be discharged to the channel. The best alternative is to discharge nitrogen in another location less sensitive to nutrients and provides higher dilution.
Adjacent Areas Impacts	Low Adverse Impact: - The majority of the route occurring below the Hassocks adjacent areas impacts will be limited to previously developed areas near Long Beach WPCP and Bay Park STP. - Expected minimal impacts to previously disturbed dredge deposal areas to support HDD construction. - Temporary impacts to natural habitats will be addressed with full restoration of native habitats providing ecological benefits to Hempstead Bay.	No Adverse Impact: - This route occurs in adjacent area in highly urbanized areas that were previously developed for residential and commercial uses. - No impacts to native habitats expected	Low Adverse Impact -The majority of route occurring below the Hassocks adjacent areas impacts will be limited to previously developed areas near LBWPCP and Bay Park WTP. - Expected minimal impacts to previously disturbed dredge deposal areas to support HDD construction. - Temporary impacts to natural habitats will be addressed with full restoration of native habitats providing ecological benefits to Hempstead Bay.	No Adverse Impact: - This route occurs in adjacent area in highly urbanized areas that were previously developed for residential and commercial uses. - No impacts to native habitats expected	No Adverse Impact: - This route occurs in adjacent area in highly urbanized areas that were previously developed for residential and commercial uses. - No impacts to native habitats expected	Low Adverse Impact -The majority of route occurring below the Hassocks adjacent areas impacts will be limited to previously developed areas near LBWPCP and Bay Park WTP. - Expected minimal impacts to previously disturbed dredge deposal areas to support HDD construction. - Temporary impacts to natural habitats will be addressed with full restoration of native habitats providing ecological benefits to Hempstead Bay.	Low Adverse Impact -The majority of route occurring below the Hassocks adjacent areas impacts will be limited to previously developed areas near LBWPCP and Bay Park WTP. - Expected minimal impacts to previously disturbed dredge deposal areas to support HDD construction. - Temporary impacts to natural habitats will be addressed with full restoration of native habitats providing ecological benefits to Hempstead Bay.	Construction of the Flood Wall, particularly along the North Side of the property will require disruption of the coastline and protection against runoff. Soil would have to be tested for contamination. 1. Loss of one (1) of the trickling filters for maintenance or repairs could mean loss of nitrification and exceedance of effluent limitation for ammonia and assessment of fines and penalties – this would result in violations and enforcement actions. 2. Conversion of ammonia-nitrogen to nitrate-nitrogen and the subsequent reduction of nitrate-nitrogen would reduce overall total nitrogen loading to Reynolds Channel – the improvement to the receiving water would be significant. 3. Improvement to marine waters by the reduction of oxygen demand due to oxidation of ammonia to nitrate.

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Project: Long Beach WPCP Consolidation Project
Purpose: Screening Matrix of Various Design Alternatives

Long Beach WPCP Consolidation Project Alternatives Screening Matrix								
SCREENING CRITERIA	Alternative A: Alternative 3A Hassocks - In-Water Route	Alternative B: Alternative 1B (new) Austin Blvd - All HDD	Alternative C: Harbor Isle Marina - HDD	Alternative D: Austin Boulevard - Upland Route	Alternative E: Alternative 2A - Long Beach Road & tie to 54-inch trunk sewer line	Alternative F: Alternative 2B - Island Park/Hassocks - Hybrid Route	Alternative G: Alternative 3B - Harbor Isle/Hassocks - Hybrid Route	Action Alternative H: Rehabilitation & DFE for the existing plant
Threatened & Endangered Species Impacts *Conservatively assumed the same for all routes due to proximity	Low Adverse Impact to Species: Federal Terrestrial Species - 1 mammals - 3 birds - 2 plants - 53 migratory bird species Federal Aquatics Species -26 EFH species in project vicinity State Species - 2 T&E bird species - 8 protected bird species BMPs, including project scheduling, are expected to be required to minimize impacts to federal and state species. Potential work restrictions may be required around bird breeding season within hassocks. Tree clearing only allowed during winter months.	No Adverse Impact to Species: Federal Terrestrial Species - 1 mammals - 3 birds - 2 plants - 53 migratory bird species Federal Aquatics Species -26 EFH species in project vicinity State Species - 2 T&E bird species - 8 protected bird species BMPs, including project scheduling, may be required as it relates to migratory birds. Expected to avoid essential fish habitat.	Low Adverse Impact to Species: Federal Terrestrial Species - 1 mammals - 3 birds - 2 plants - 53 migratory bird species Federal Aquatics Species -26 EFH species in project vicinity State Species - 2 T&E bird species - 8 protected bird species BMPs, including project scheduling, are expected to be required to minimize impacts to federal and state species. Potential work restrictions may be required around bird breeding season within hassocks. Tree clearing only allowed during winter months.	No Adverse Impact to Species: Federal Terrestrial Species - 1 mammals - 3 birds - 2 plants - 53 migratory bird species Federal Aquatics Species -26 EFH species in project vicinity State Species - 2 T&E bird species - 8 protected bird species BMPs, including project scheduling, may be required as it relates to migratory birds. Expected to avoid essential fish habitat.	No Adverse Impact to Species: Federal Terrestrial Species - 1 mammals - 3 birds - 2 plants - 53 migratory bird species Federal Aquatics Species -26 EFH species in project vicinity State Species - 2 T&E bird species - 8 protected bird species BMPs, including project scheduling, may be required as it relates to migratory birds. Expected to avoid essential fish habitat.	Low Adverse Impact to Species: Federal Terrestrial Species - 1 mammals - 3 birds - 2 plants - 53 migratory bird species Federal Aquatics Species -26 EFH species in project vicinity State Species - 2 T&E bird species - 8 protected bird species BMPs, including project scheduling, are expected to be required to minimize impacts to federal and state species. Potential work restrictions may be required around bird breeding season within hassocks. Tree clearing only allowed during winter months.	Moderate Adverse Impact to Species: Federal Terrestrial Species - 1 mammals - 3 birds - 2 plants - 53 migratory bird species Federal Aquatics Species -26 EFH species in project vicinity State Species - 2 T&E bird species - 8 protected bird species BMPs, including project scheduling, are expected to be required to minimize impacts to federal and state species. Potential work restrictions may be required around bird breeding season within hassocks. Tree clearing only allowed during winter months.	Low Adverse Impact to Species: Even though Nitrification/Denitrification will limit nitrogen levels in Reynolds Channel, nitrogen will still be discharging into the channel. The best alternative is to discharge nitrogen in another location less sensitive to nutrients and provides higher dilution.
Ecological Benefits	Expected Benefits: - Improved water quality in Hempstead Bay and associated natural improvement of aquatic habitat - Restoration of temporarily impacted wetlands area in-kind at 1:1 ratio with native vegetation of greater quality than existing cover - Restoration of minimal permanent impacts (i.e. air vents or manholes) at 3:1 ratio in adjacent degraded wetland area with native vegetation similar to existing community - Impact limited to low marsh and high marsh habitats that are highly restorable with appropriate planning and monitoring	Expected Benefits: - Improved water quality in Hempstead Bay and associated natural improvement of aquatic habitat	Expected Benefits: - Improved water quality in Hempstead Bay and associated natural improvement of aquatic habitat - Restoration of temporarily impacted wetlands area in-kind at 1:1 ratio with native vegetation of greater quality than existing cover - Restoration of minimal permanent impacts (i.e. air vents or manholes) at 3:1 ratio in adjacent degraded wetland area with native vegetation similar to existing community - Impact limited to low marsh and high marsh habitats that are highly restorable with appropriate planning and monitoring	Expected Benefits: - Improved water quality in Hempstead Bay and associated natural improvement of aquatic habitat	Expected Benefits: - Improved water quality in Hempstead Bay and associated natural improvement of aquatic habitat	Expected Benefits: - Improved water quality in Hempstead Bay and associated natural improvement of aquatic habitat - Restoration of temporarily impacted wetland area in-kind at 1:1 ratio with native vegetation of greater quality than existing cover - Restoration of minimal permanent impacts (i.e. air vents or manholes) at 3:1 ratio in adjacent degraded wetland area with native vegetation similar to existing community -Impact limited to low marsh and high marsh habitats that are highly restorable with appropriate planning and monitoring	Expected Benefits: - Improved water quality in Hempstead Bay and associated natural improvement of aquatic habitat - Restoration of temporarily impacted wetland area in-kind at 1:1 ratio with native vegetation of greater quality than existing cover - Restoration of minimal permanent impacts (i.e. air vents or manholes) at 3:1 ratio in adjacent degraded wetland area with native vegetation similar to existing community -Impact limited to low marsh and high marsh habitats that are highly restorable with appropriate planning and monitoring	Expected Benefits: 1. Loss of one (1) of the trickling filters for maintenance or repairs could mean loss of nitrification and exceedance of effluent limitation for ammonia and assessment of fines and penalties – this would result in violations and enforcement actions. 2. Conversion of ammonia-nitrogen to nitrate-nitrogen and the subsequent reduction of nitrate-nitrogen would reduce overall total nitrogen loading to Reynolds Channel – the improvement to the receiving water would be significant. 3. Improvement to marine waters by the reduction of oxygen demand due to oxidation of ammonia to nitrate
Archeological sites/Cultural heritage	Low Adverse Impact: A portion of the project area is within a NYSHPO designated archaeologically sensitive area; Phase IA survey will be likely with potential for a Phase IB survey.	Low Adverse Impact: A portion of the project area is within a NYSHPO designated archaeologically sensitive area; Phase IA survey will be likely with potential for a Phase IB survey.	Low Adverse Impact: A portion of the project area is within a NYSHPO designated archaeologically sensitive area; Phase IA survey will be likely with potential for a Phase IB survey.	Low Adverse Impact: A portion of the project area is within a NYSHPO designated archaeologically sensitive area; Phase IA survey will be likely with potential for a Phase IB survey.	Low Adverse Impact: A portion of the project area is within a NYSHPO designated archaeologically sensitive area; Phase IA survey will be likely with potential for a Phase IB survey.	Low Adverse Impact: A portion of the project area is within a NYSHPO designated archaeologically sensitive area; Phase IA survey will be likely with potential for a Phase IB survey.	Low Adverse Impact: A portion of the project area is within a NYSHPO designated archaeologically sensitive area; Phase IA survey will be likely with potential for a Phase IB survey.	No impact.
Permitting	The following are a list of permit requirements for this route: -NOAA NMFS Essential Fish Habitat Assessment and Endangered Species Act Consultation -USCG Notice to Mariners -USACE Department of the Army Permit -USFWS Consultation (Section 7 of the Endangered Species Act) -Funding Compliance for NEPA -Executive Order 11990, "Protection of Wetlands" -USEPA Funding Compliance with Section 1424(e) of the Safe Drinking Water Act (Sole Source Aquifer) USFWS- Biological Assessment and Incidental Take Permit (potential) -NYSDEC Article 15 Protection of Waters Permit -NYSDEC SPDES Permit (Dewatering/Hydrostatic Test) -NYSDEC SPDES General Permit for Stormwater Discharges from Construction Activity -NYSDEC Article 25 Tidal Wetlands Permit -NYSOPRHP Consultation - Section 106 of the National Historic Preservation Act of 1966	The following are a list of permit requirements for this route: -NOAA NMFS Essential Fish Habitat Assessment and Endangered Species Act Consultation -USCG Notice to Mariners -USACE Department of the Army Permit -USFWS Consultation (Section 7 of the Endangered Species Act) -Funding Compliance for NEPA - Executive Order 11990, "Protection of Wetlands" -Funding Compliance with Section 1424(e) of the Safe Drinking Water Act (Sole Source Aquifer) -NYSDEC Article 15 Protection of Waters Permit -NYSDEC SPDES Permit (Dewatering/Hydrostatic Test) -NYSDEC SPDES General Permit for Stormwater Discharges from Construction Activity -NYSDEC Article 25 Tidal Wetlands Permit -NYSOPRHP Consultation - Section 106 of the National Historic Preservation Act of 1966 There are 4 private owners and 6 that are currently unknown. Due to this limitation, not all permit requirements can be identified.	The following are a list of permit requirements for this route: -NOAA NMFS Essential Fish Habitat Assessment and Endangered Species Act Consultation -USCG Notice to Mariners -USACE Department of the Army Permit -USFWS Consultation (Section 7 of the Endangered Species Act) -Funding Compliance for NEPA - Executive Order 11990, "Protection of Wetlands" -Funding Compliance with Section 1424(e) of the Safe Drinking Water Act (Sole Source Aquifer) -NYSDEC Article 15 Protection of Waters Permit -NYSDEC SPDES Permit (Dewatering/Hydrostatic Test) -NYSDEC SPDES General Permit for Stormwater Discharges from Construction Activity -NYSDEC Article 25 Tidal Wetlands Permit -NYSOPRHP Consultation - Section 106 of the National Historic Preservation Act of 1966 There are 4 private owners and 6 that are currently unknown. Due to this limitation, not all permit requirements can be identified.	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Land acquisition and any associated permits. 2. Loss of one (1) of the trickling filters for maintenance or repairs could mean loss of nitrification and exceedance of effluent limitation for ammonia and assessment of fines and penalties – this would result in violations and enforcement actions. 3. Interim SPDES effluent limitations would need to be requested to cover loss of plant efficiency during the construction period

APPENDIX C

HDD-Construction Staging

N
W E
S

Hazen ARCADIS
A JOINT VENTURE

Long Beach WPCP Consolidation Project
Alternative A - Hassocks In-Water Route

0 500 1,000 2,000 3,000
US Feet

DATE: August 2019

FIGURE: Construction Overview

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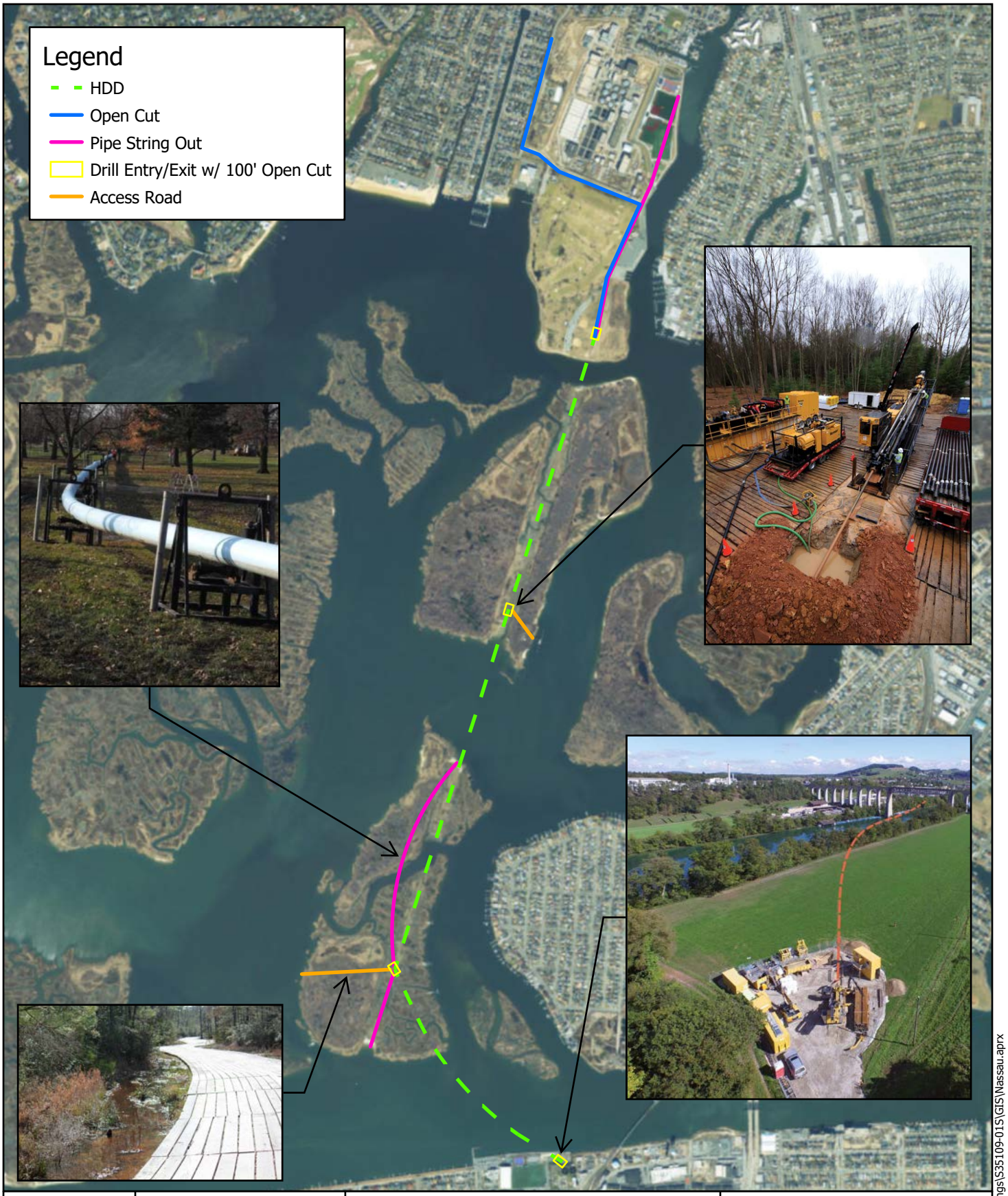

N
W E
S

Hazen ARCADIS
A JOINT VENTURE

Long Beach WPCP Consolidation Project
Alternative A - Hassocks In-Water Route

0 5001,000 2,000 3,000
US Feet

DATE: August 2019

FIGURE: Construction Layout

O:\90500-000-NYC\Drawings\S35109-01S\GIS\Nassau.aprx

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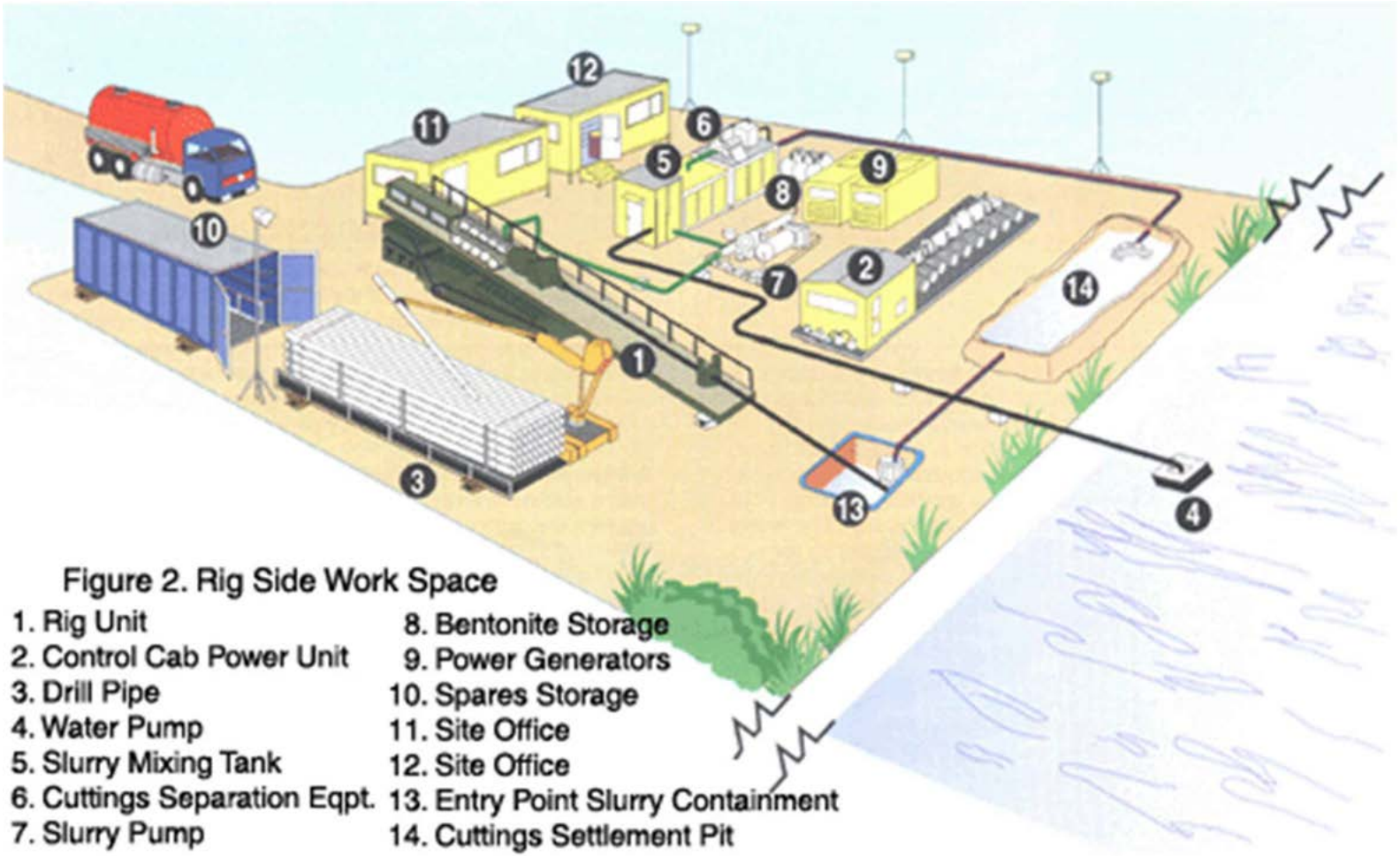


Figure 2. Rig Side Work Space

1. Rig Unit
2. Control Cab Power Unit
3. Drill Pipe
4. Water Pump
5. Slurry Mixing Tank
6. Cuttings Separation Eqpt.
7. Slurry Pump
8. Bentonite Storage
9. Power Generators
10. Spares Storage
11. Site Office
12. Site Office
13. Entry Point Slurry Containment
14. Cuttings Settlement Pit

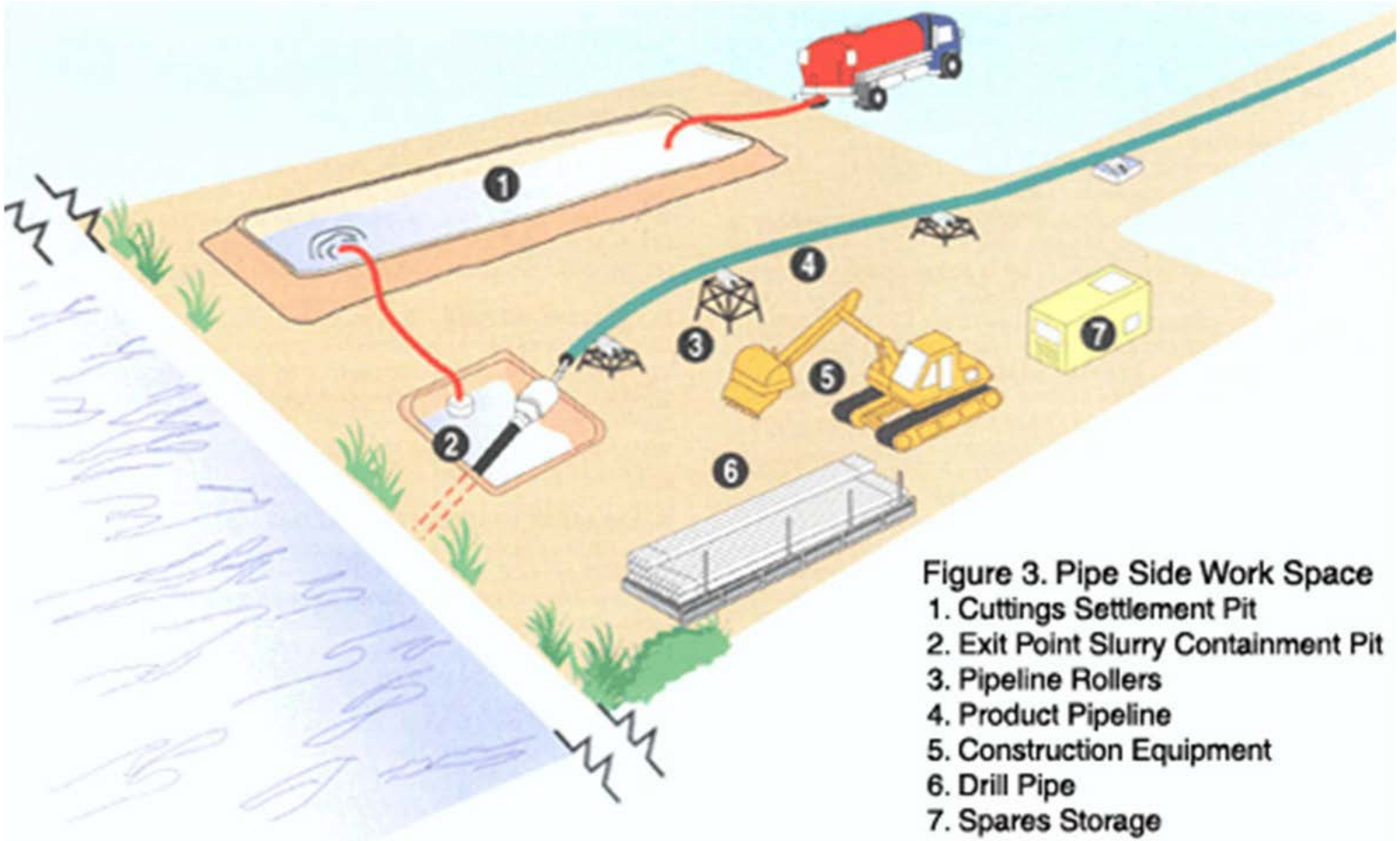


Figure 3. Pipe Side Work Space

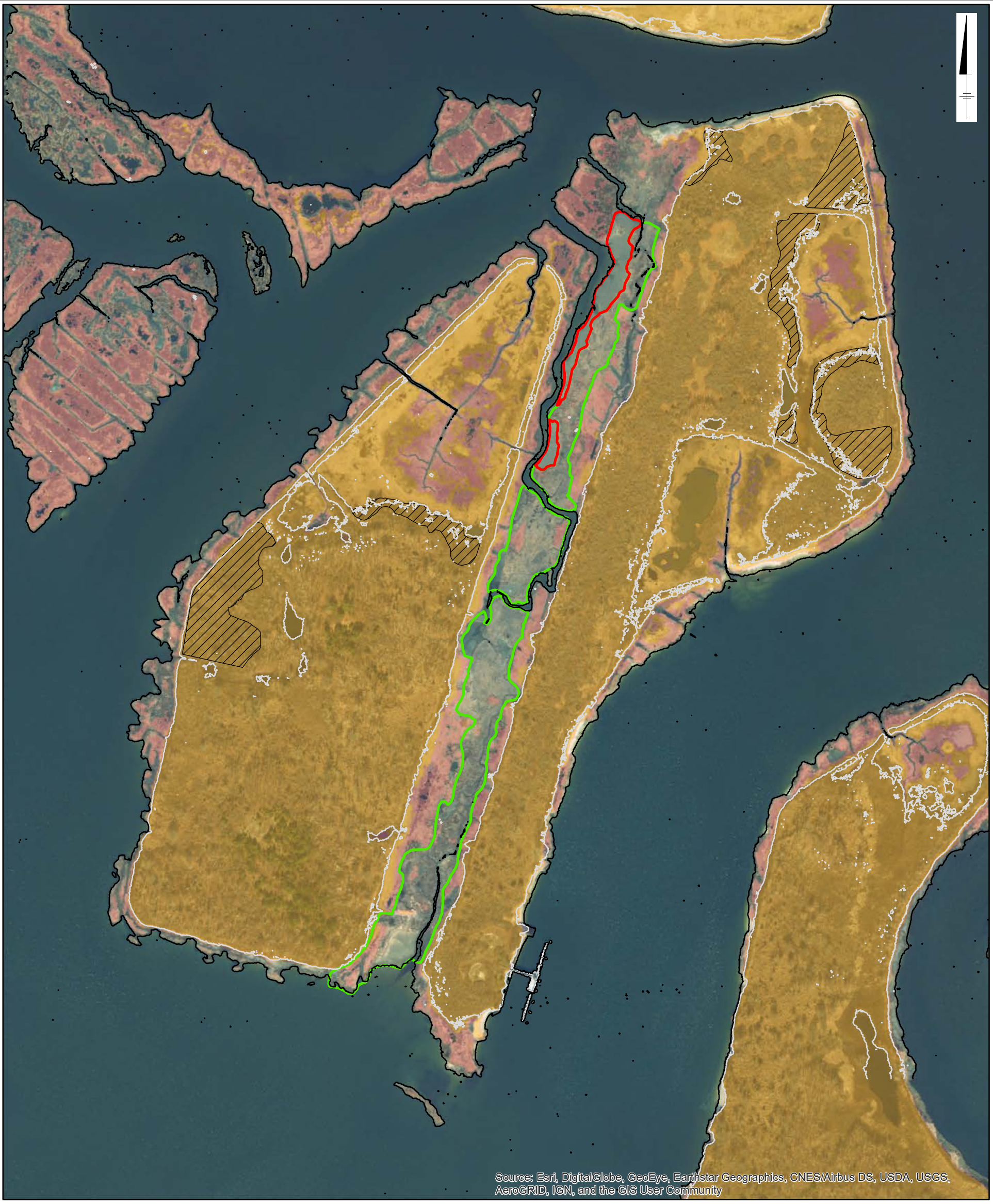
1. Cuttings Settlement Pit
2. Exit Point Slurry Containment Pit
3. Pipeline Rollers
4. Product Pipeline
5. Construction Equipment
6. Drill Pipe
7. Spares Storage

DD1100RS

APPENDIX D

Marshlands Restoration Plan

City: CITRIX Div/Group: IMDV Created By: K.Ives Last Saved By: WWollman
\\arcadis-us.com\officedata\LongIslandCity-NY\Projects\00726790.0001_LBWPCP Consolidation\2.0_References\GIS Data for Restoration Approach\MXD\Version2\New\Figure1_RestorationLocationsAerial.mxd 8/26/2019 1:04:43 PM



LEGEND

- Mean Low Water
- Mean High Water
- Fill Source
- Restoration Zone
- Enhancement Zone
- High Marsh and Upland Habitat Zone
- Low Marsh Habitat Zone

NOTES:
1. ALL DATA PROJECTED IN NAD 1983 STATE PLANE NEW YORK LONG ISLAND COORDINATE SYSTEM

2. 2016 BASEMAP IMAGE ACCESSED VIA ESRI ONLINE MAPPING

3. "ENHANCEMENT" ZONE REPRESENTS ADDITION OF SEDIMENT TO A VEGETATED MARSH PLATFORM TO AUGMENT NATURAL SEDIMENT INPUTS AND PROVIDE GREATER RESILIENCE TO ADAPT TO ANTICIPATED SEA LEVEL RISE.

4. "RESTORATION" ZONE REPRESENTS ADDITION OF SEDIMENT TO EXISTING MUDFLATS TO A SUITABLE ELEVATION TO SUPPORT NATIVE LOW MARSH VEGETATION. AREAS TARGETED BY THIS PLAN ARE HISTORIC LOW MARSH HABITATS THAT HAVE BEEN LOST DUE TO SHORELINE EROSION OR SUBSIDENCE.

5. LOW MARSH HABITAT ZONE ARE NATIVE MARSH HABITATS ON HIGHER END OF THE SUITABLE ELEVATION RANGE TO SUPPORT NATIVE VEGETATION. THESE ARE THE HABITATS AT "LOWER" RISK OF SUBSIDENCE AND CONVERSION TO MUDFLATS.

6. HIGH MARSH AND UPLAND HABITAT ZONE. ON THE HASSOCKS OF CONCERN, THIS HABITAT ZONE TYPICALLY REPRESENTS PREVIOUS SEDIMENT DISPOSAL AREAS THAT MAY PROVIDE A SUITABLE BORROW AREA FOR SEDIMENT. IT IS ALSO ASSUMED THAT HIGH MARSH HABITATS WITHIN THIS ZONE HAVE BEEN INVADED BY MONOCULTURES OF PHRAGMITES AUSTRALIS.

0 500 1,000 Feet

GRAPHIC SCALE

NASSAU COUNTY DEPARTMENT OF PUBLIC WORKS
CITY OF LONG BEACH

LONG BEACH WPCP CONSOLIDATION PROJECT CONCEPTUAL RESTORATION APPROACH

Hazen ARCADIS
A JOINT VENTURE

FIGURE
1

LEGEND

- Mean Low Water
- Mean High Water
- Fill Source
- Restoration Zone
- Enhancement Zone
- Low Marsh Habitat Zone
- High Marsh and Upland Habitat Zone

NOTES:
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0 500 1,000 Feet

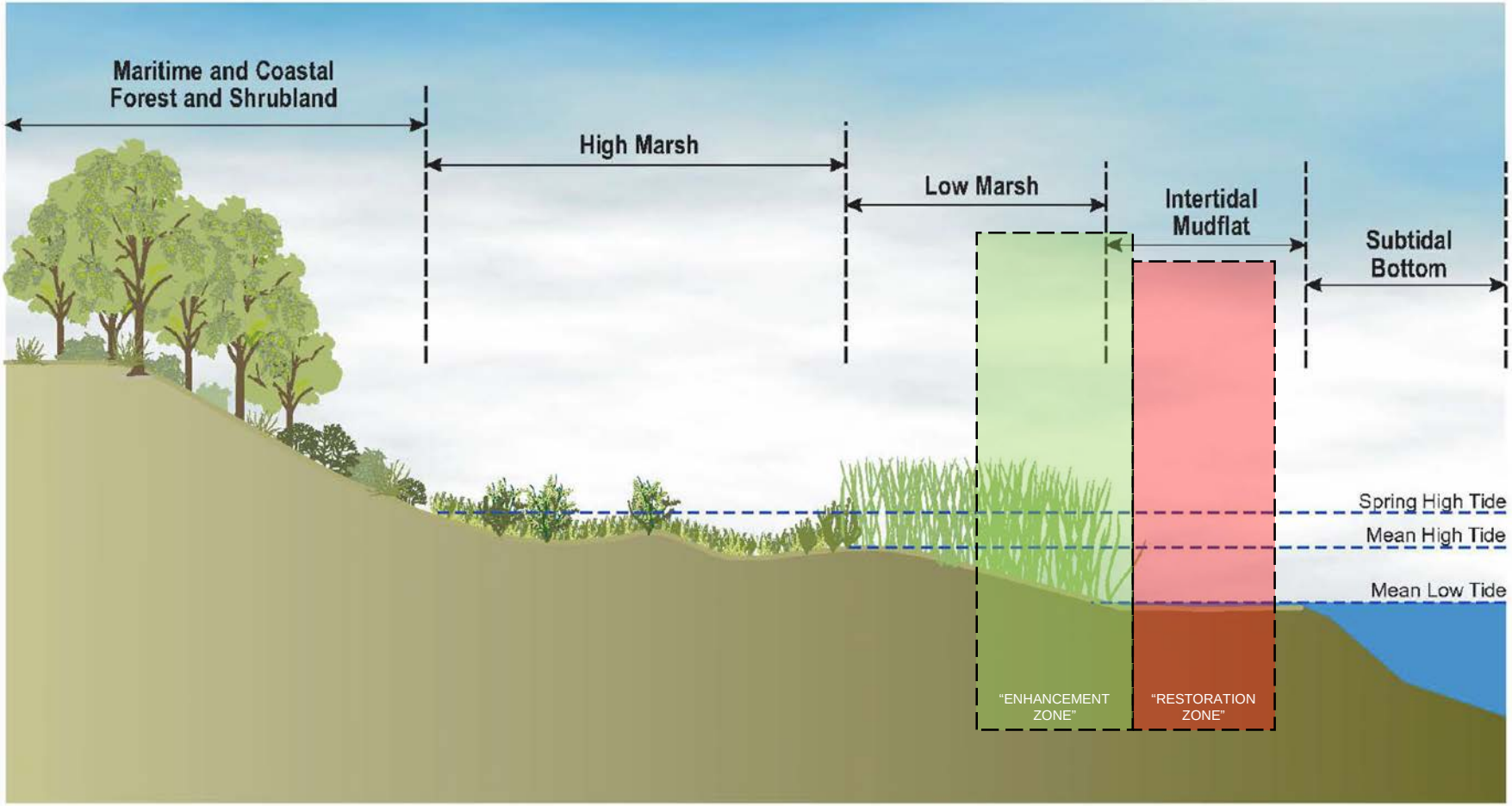
GRAPHIC SCALE

NASSAU COUNTY DEPARTMENT OF PUBLIC WORKS
CITY OF LONG BEACH

LONG BEACH WPCP CONSOLIDATION PROJECT CONCEPTUAL RESTORATION APPROACH

Hazen ARCADIS A JOINT VENTURE

FIGURE
2



NOTES:

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2. "RESTORATION" ZONE REPRESENTS ADDITION OF SEDIMENT TO EXISTING MUD FLATS TO A SUITABLE ELEVATION TO SUPPORT NATIVE LOW MARSH VEGETATION. AREAS TARGETED BY THIS PLAN ARE HISTORIC LOW MARSH HABITATS THAT HAVE BEEN LOST DUE TO SHORELINE EROSION OR SUBSIDENCE.

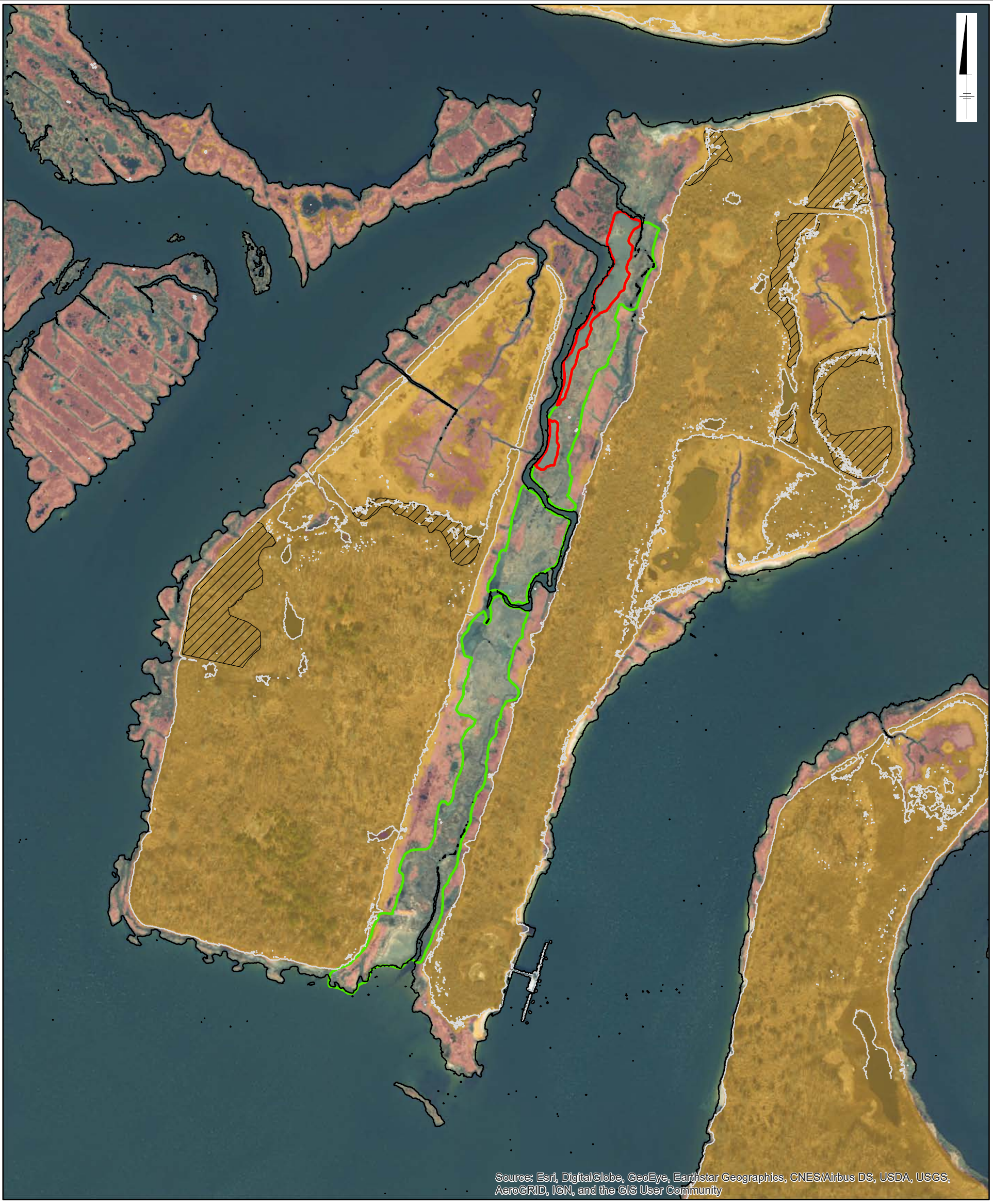
NASSAU COUNTY DEPARTMENT OF PUBLIC WORKS
CITY OF LONG BEACH

CONCEPTUAL RESTORATION APPROACH

Hazen ARCADIS
A JOINT VENTURE

FIGURE 11

City: CITRIX Div/Group: IMDV Created By: K.Ives Last Saved By: WWollman
\\arcadis-us.com\officedata\LongIslandCity-NY\Projects\00726790.0001_LBWPCP Consolidation\2.0_References\GIS Data for Restoration Approach\MXD\Version2\New\Figure1_RestorationLocationsAerial.mxd 8/26/2019 1:04:43 PM



LEGEND

- Mean Low Water
- Mean High Water
- Fill Source
- Restoration Zone
- Enhancement Zone
- High Marsh and Upland Habitat Zone
- Low Marsh Habitat Zone

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6. HIGH MARSH AND UPLAND HABITAT ZONE. ON THE HASSOCKS OF CONCERN, THIS HABITAT ZONE TYPICALLY REPRESENTS PREVIOUS SEDIMENT DISPOSAL AREAS THAT MAY PROVIDE A SUITABLE BORROW AREA FOR SEDIMENT. IT IS ALSO ASSUMED THAT HIGH MARSH HABITATS WITHIN THIS ZONE HAVE BEEN INVADED BY MONOCULTURES OF PHRAGMITES AUSTRALIS.

0 500 1,000 Feet

GRAPHIC SCALE

NASSAU COUNTY DEPARTMENT OF PUBLIC WORKS
CITY OF LONG BEACH

LONG BEACH WPCP CONSOLIDATION PROJECT CONCEPTUAL RESTORATION APPROACH

Hazen ARCADIS
A JOINT VENTURE

FIGURE
1

LEGEND

- Mean Low Water
- Mean High Water
- Fill Source
- Restoration Zone
- Enhancement Zone
- Low Marsh Habitat Zone
- High Marsh and Upland Habitat Zone

NOTES:
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0 500 1,000 Feet

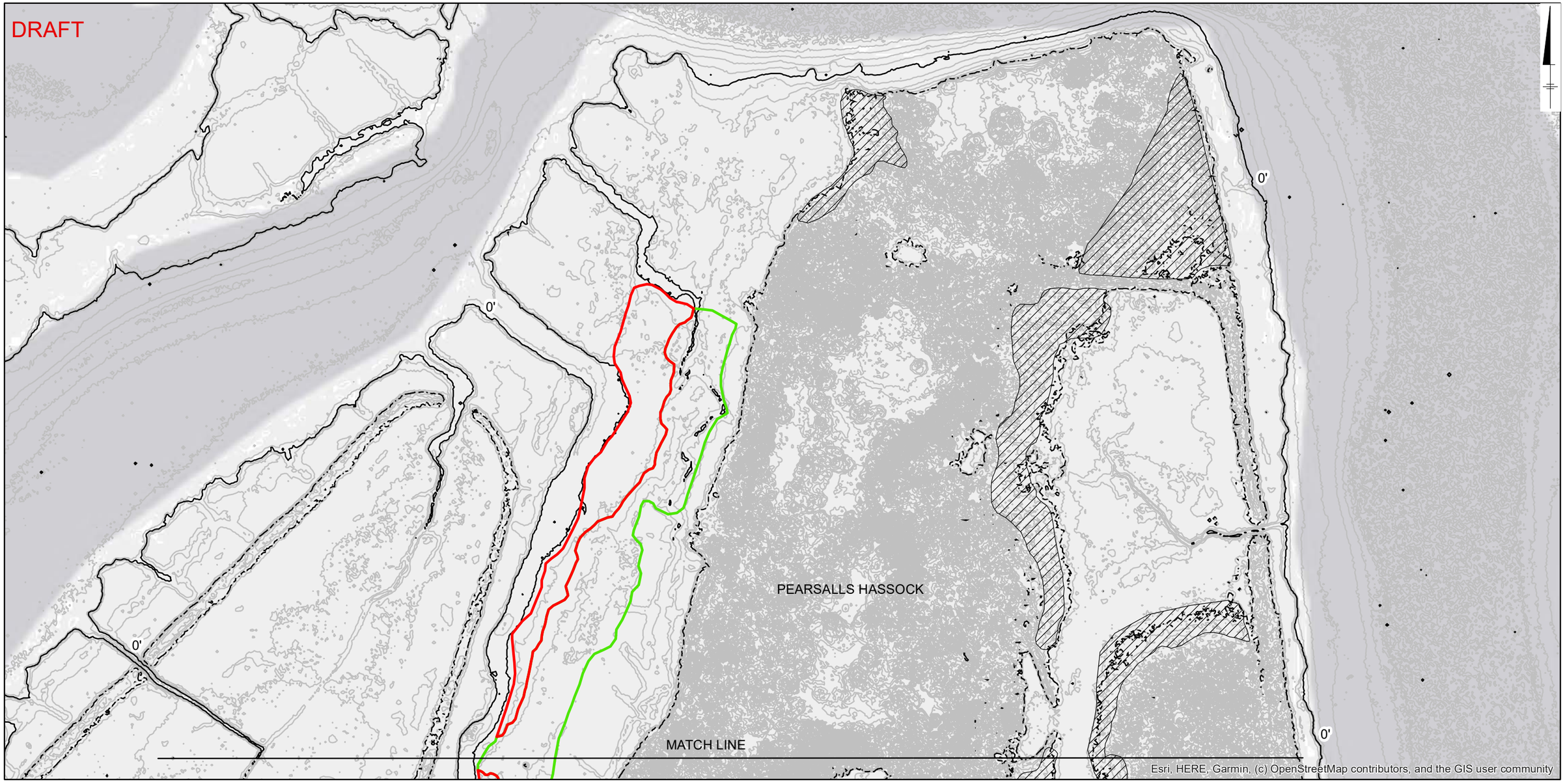
GRAPHIC SCALE

NASSAU COUNTY DEPARTMENT OF PUBLIC WORKS
CITY OF LONG BEACH

LONG BEACH WPCP CONSOLIDATION PROJECT CONCEPTUAL RESTORATION APPROACH

Hazen ARCADIS A JOINT VENTURE

FIGURE
2



LEGEND

- MEAN HIGH WATER
- MEAN LOW WATER
- EXISTING TOPO/BATHY
- PROPOSED FILL SOURCE
- PROPOSED RESTORATION
- PROPOSED ENHANCEMENT

0 200 400 Feet

GRAPHIC SCALE

NOTES:
1. ALL DATA PROJECTED IN NAD 1983 STATE PLANE NEW YORK LONG ISLAND COORDINATE SYSTEM

2. FILL SOURCE WILL COME FROM HISTORICALLY PLACED DREDGE MATERIAL NOW INHABITED BY COMMON REED (PHRAGMITES AUSTRALIS) MONOCULTURE. FILL MATERIAL SOURCING WILL INVOLVE REMOVAL OF COMMON REED COMMUNITIES AND SOILS TO DEPTH BELOW RHIZOPHERES. AREAS DISTURBED IN FILL MATERIAL SOURCING WILL BE RESTORED WITH NATIVE VEGETATION.

3. AREAS PROPOSED FOR RESTORATION SHOW MARSH RETREAT OR SEDIMENT REDUCTION RESULTING IN COMPLETE LOSS OF VEGETATIVE HABITAT. RESTORATION WILL PLACE FILL TO MATCH ELEVATION OF HISTORIC LOW MARSH HABITAT.

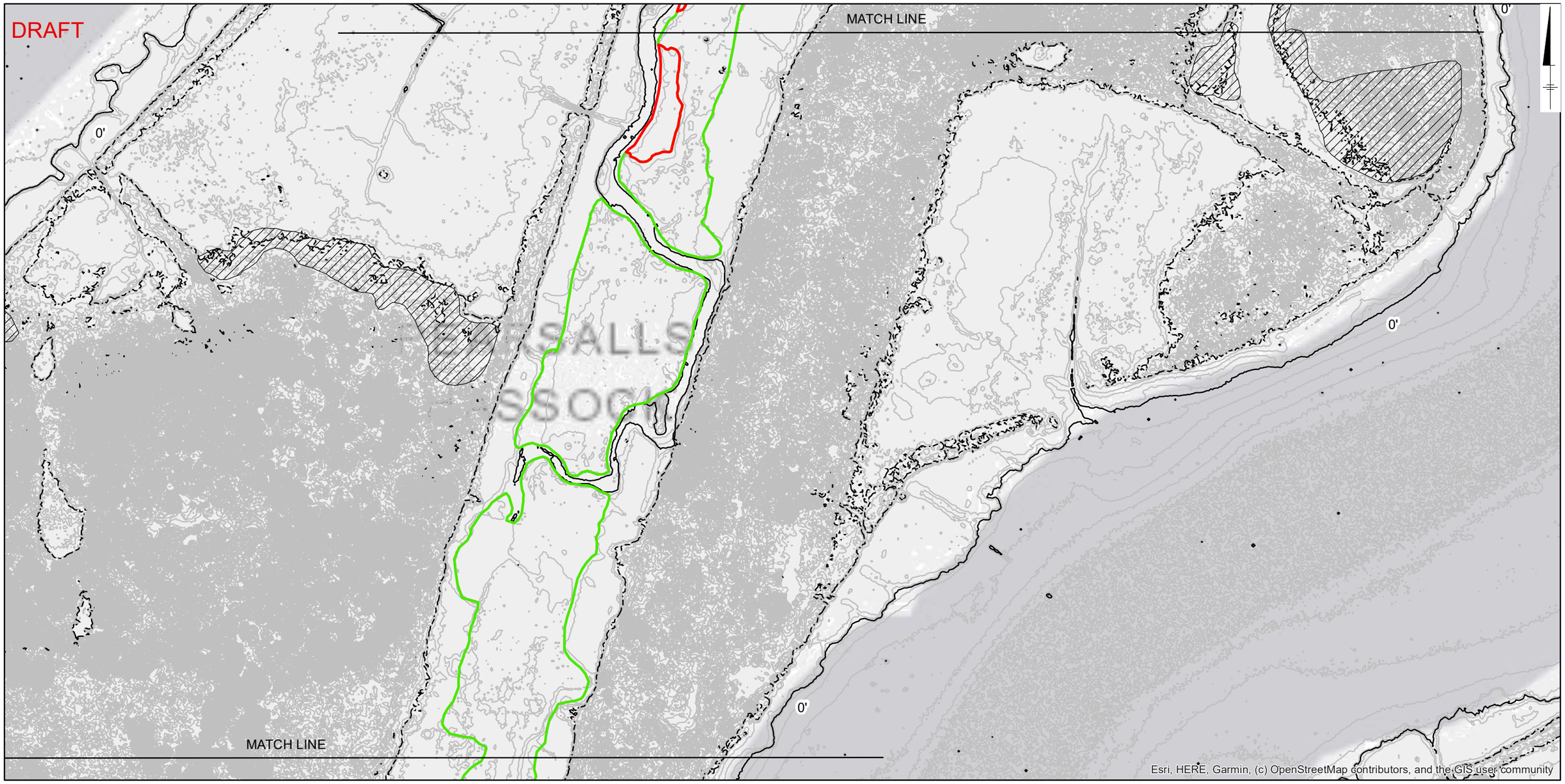
4. AREAS PROPOSED FOR ENHANCEMENT SHOW MARSH RETREAT OR SEDIMENT REDUCTION RESULTING IN PARTIAL LOSS OF VEGETATIVE HABITAT. ENHANCEMENT EFFORTS WILL PLACE FILL TO MATCH ELEVATION OF HISTORIC LOW MARSH HABITAT.

NASSAU COUNTY DEPARTMENT OF PUBLIC WORKS
CITY OF LONG BEACH

LONG BEACH WPCP CONSOLIDATION PROJECT CONCEPTUAL RESTORATION APPROACH - TOPOGRAPHY

Hazen ARCADIS
A JOINT VENTURE

FIGURE
3



LEGEND

- MEAN HIGH WATER
- MEAN LOW WATER
- EXISTING TOPO/BATHY
- PROPOSED FILL SOURCE
- PROPOSED RESTORATION
- PROPOSED ENHANCEMENT

0 200 400 Feet

GRAPHIC SCALE

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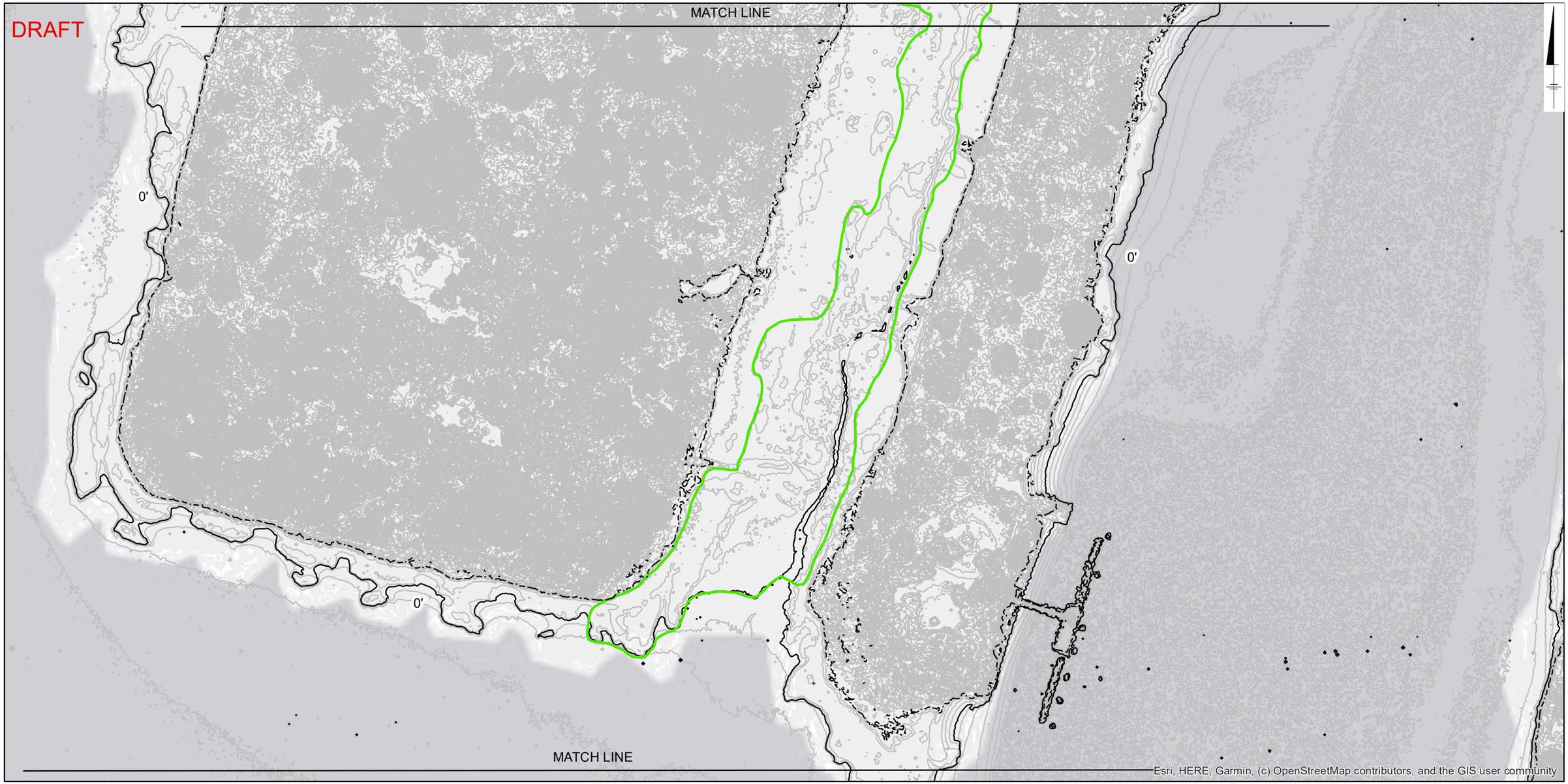
4. AREAS PROPOSED FOR ENHANCEMENT SHOW MARSH RETREAT OR SEDIMENT REDUCTION RESULTING IN PARTIAL LOSS OF VEGETATIVE HABITAT. ENHANCEMENT EFFORTS WILL PLACE FILL TO MATCH ELEVATION OF HISTORIC LOW MARSH HABITAT.

NASSAU COUNTY DEPARTMENT OF PUBLIC WORKS
CITY OF LONG BEACH

LONG BEACH WPCP CONSOLIDATION PROJECT CONCEPTUAL RESTORATION APPROACH - TOPOGRAPHY

Hazen ARCADIS A JOINT VENTURE

FIGURE 4



LEGEND

- MEAN HIGH WATER
- MEAN LOW WATER
- EXISTING TOPO/BATHY
- PROPOSED FILL SOURCE
- PROPOSED RESTORATION
- PROPOSED ENHANCEMENT

0 200 400 Feet

GRAPHIC SCALE

NOTES:
1. ALL DATA PROJECTED IN NAD 1983 STATE PLANE NEW YORK LONG ISLAND COORDINATE SYSTEM

2. FILL SOURCE WILL COME FROM HISTORICALLY PLACED DREDGE MATERIAL NOW INHABITED BY COMMON REED (PHRAGMITES AUSTRALIS) MONOCULTURE. FILL MATERIAL SOURCING WILL INVOLVE REMOVAL OF COMMON REED COMMUNITIES AND SOILS TO DEPTH BELOW RHIZOPHERES. AREAS DISTURBED IN FILL MATERIAL SOURCING WILL BE RESTORED WITH NATIVE VEGETATION.

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Hazen ARCADIS A JOINT VENTURE

FIGURE 5

LEGEND

- MEAN HIGH WATER
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- PROPOSED RESTORATION
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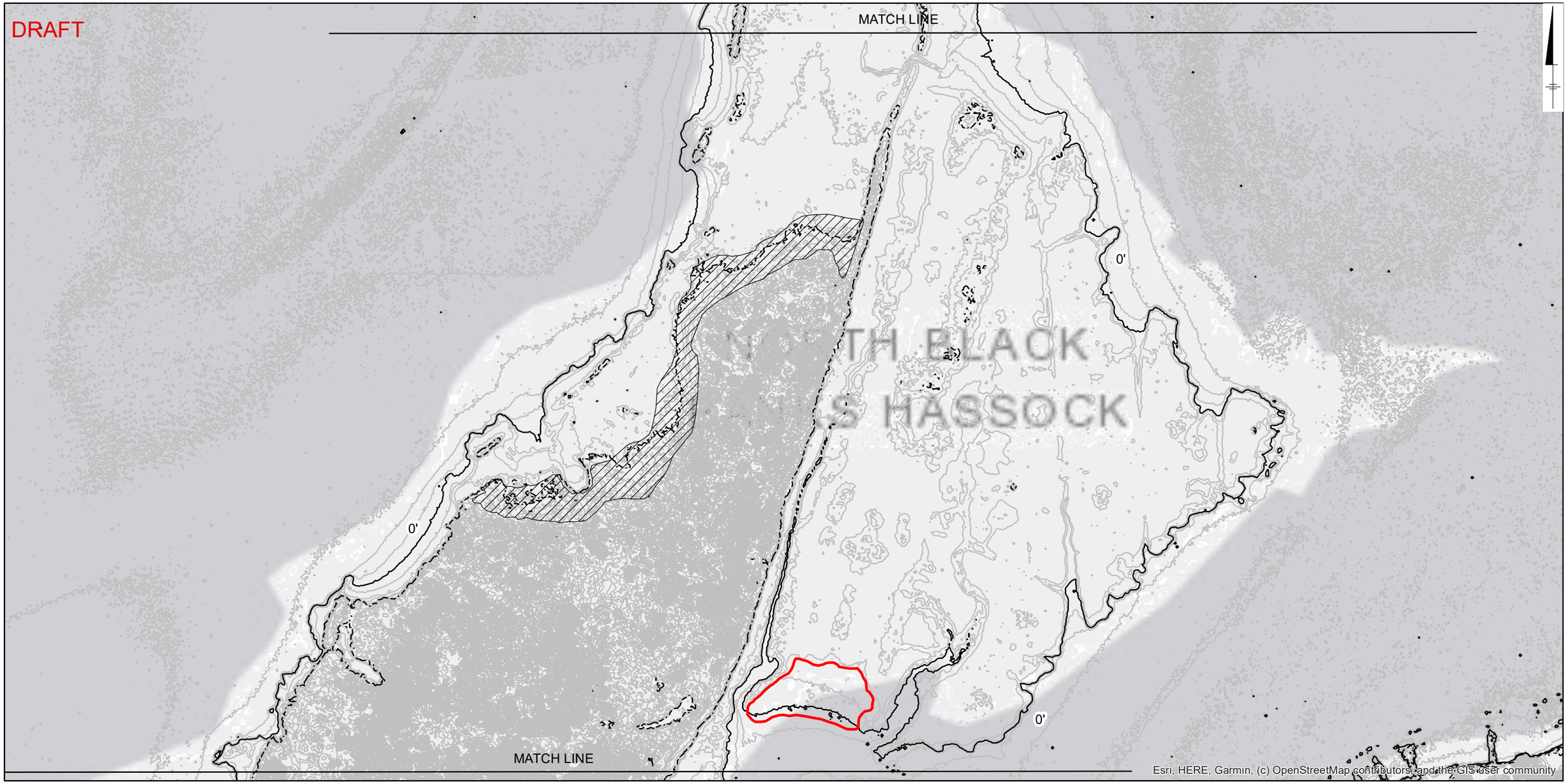
Hazen ARCADIS A JOINT VENTURE

FIGURE
6



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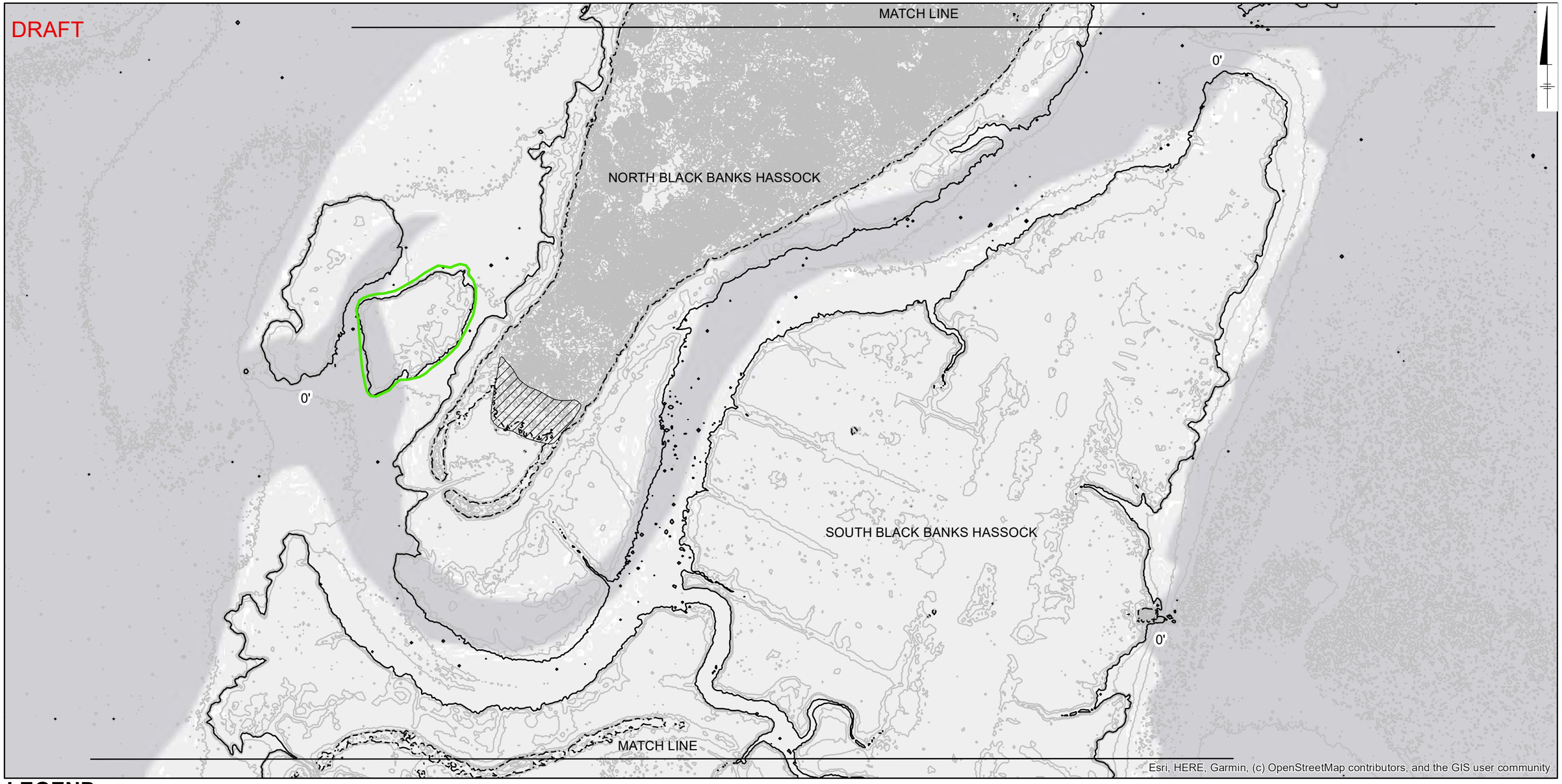
Hazen ARCADIS
A JOINT VENTURE

FIGURE
7



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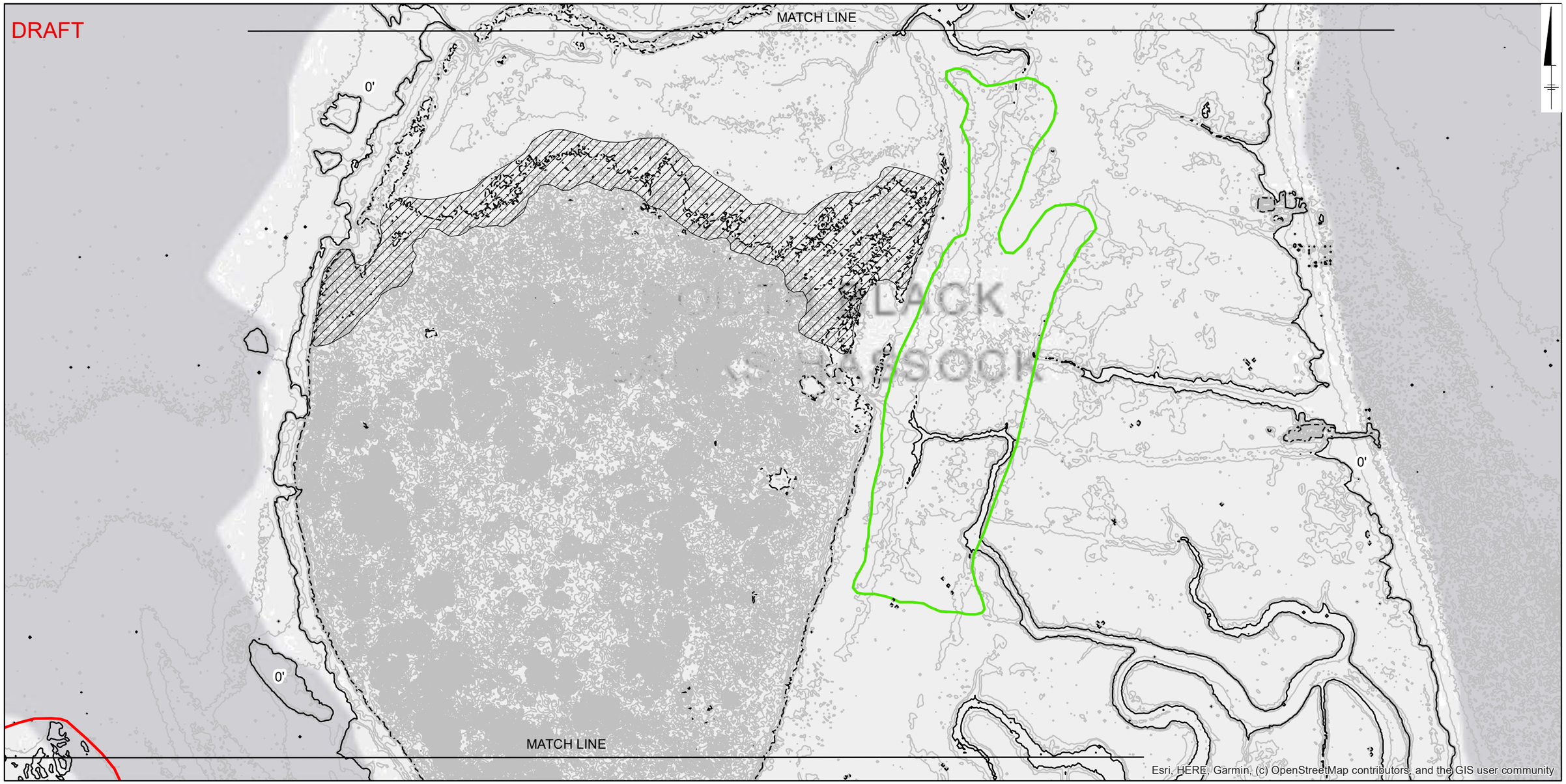
Hazen ARCADIS A JOINT VENTURE

FIGURE
8



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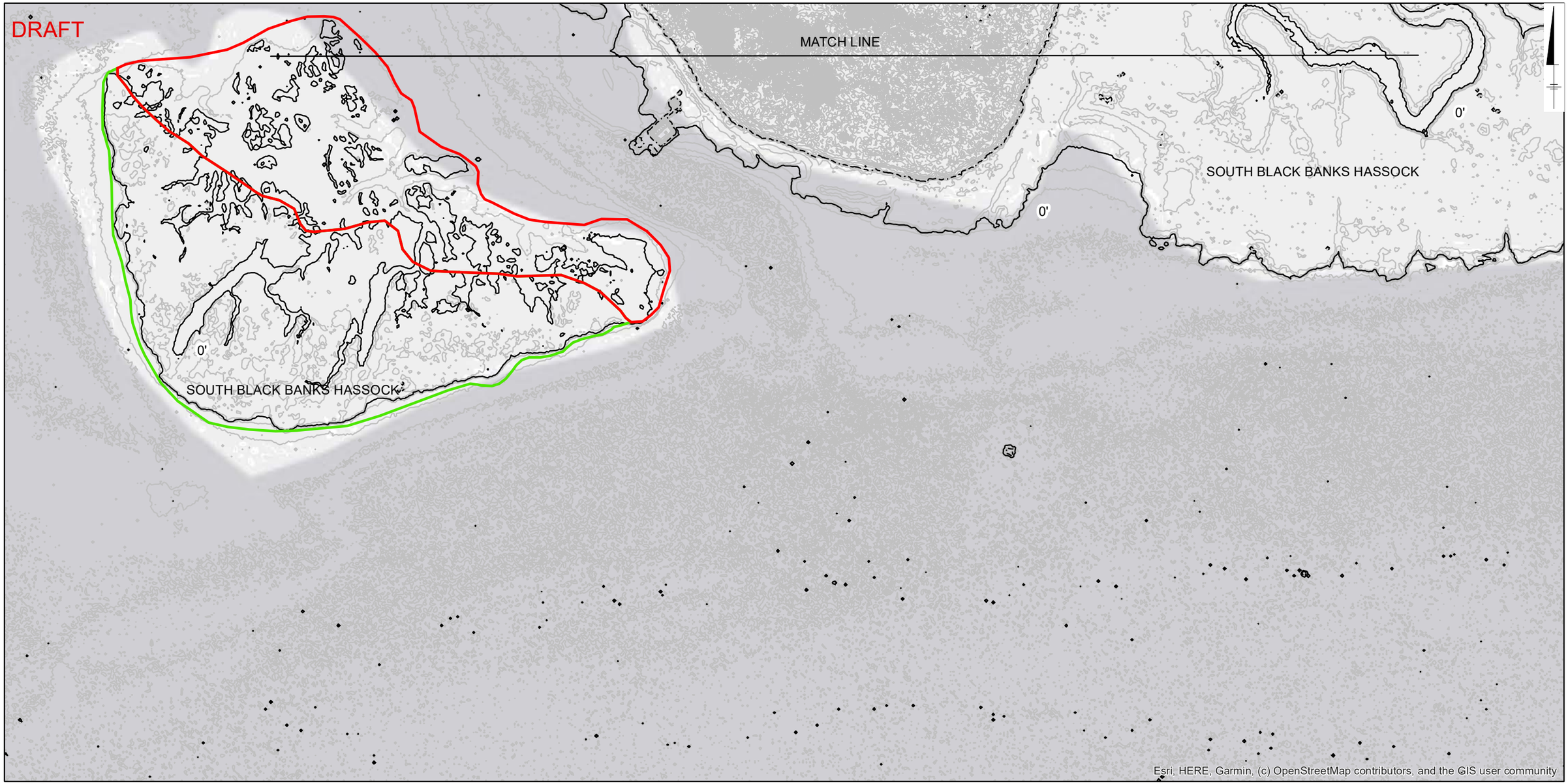
Hazen ARCADIS A JOINT VENTURE

FIGURE
9



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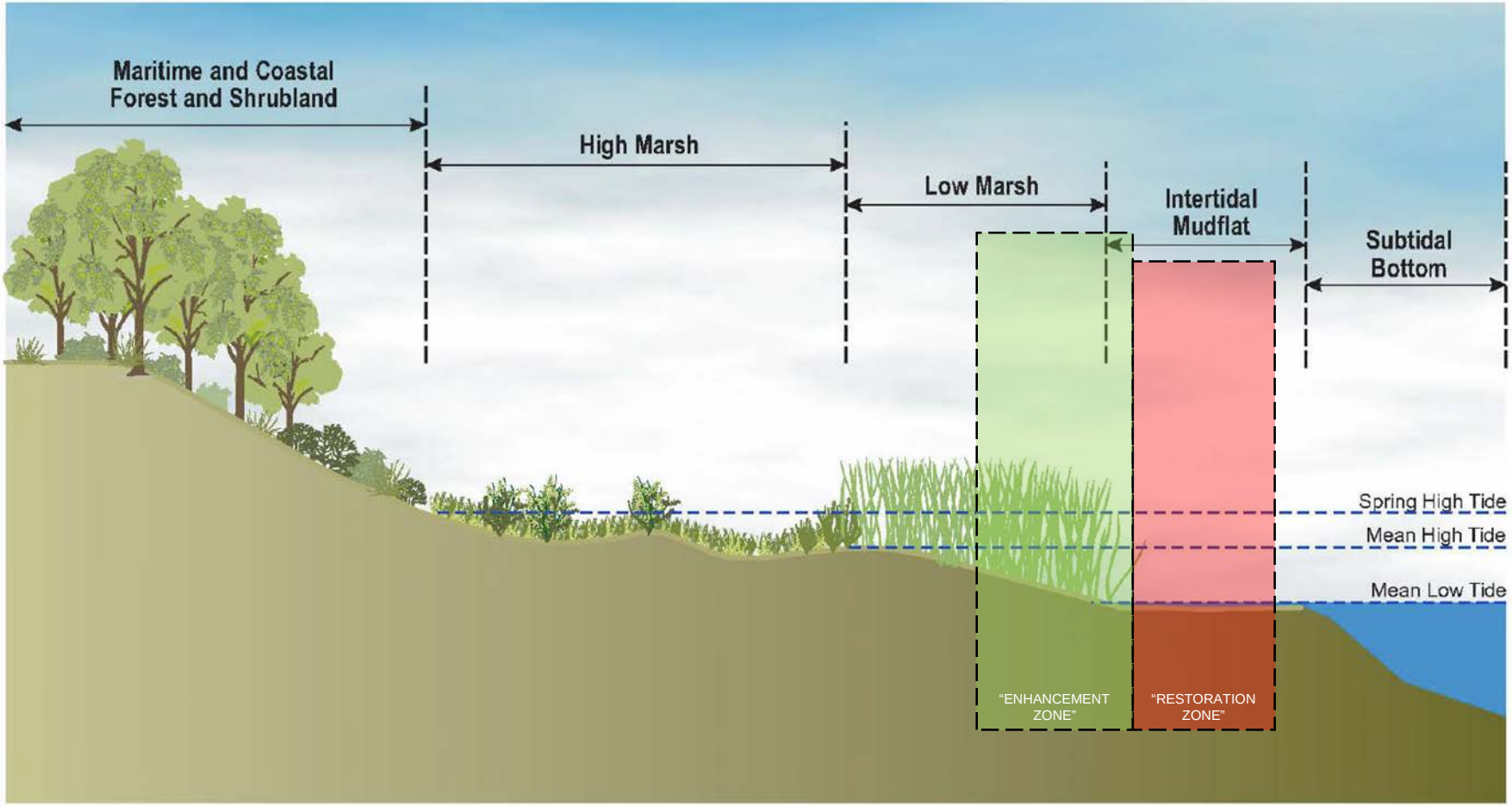
Hazen ARCADIS A JOINT VENTURE

FIGURE
10



NOTES:

1. "ENHANCEMENT" ZONE REPRESENTS ADDITION OF SEDIMENT TO A VEGETATED MARSH PLATFORM TO AUGMENT NATURAL SEDIMENT INPUTS AND PROVIDE GREATER RESILIENCE TO ADAPT TO ANTICIPATED SEA LEVEL RISE.
2. "RESTORATION" ZONE REPRESENTS ADDITION OF SEDIMENT TO EXISTING MUD FLATS TO A SUITABLE ELEVATION TO SUPPORT NATIVE LOW MARSH VEGETATION. AREAS TARGETED BY THIS PLAN ARE HISTORIC LOW MARSH HABITATS THAT HAVE BEEN LOST DUE TO SHORELINE EROSION OR SUBSIDENCE.

NASSAU COUNTY DEPARTMENT OF PUBLIC WORKS
CITY OF LONG BEACH

CONCEPTUAL RESTORATION APPROACH

Hazen ARCADIS
A JOINT VENTURE

FIGURE 11