Fairfax County, Virginia

Alternatives Analysis Report

Lake Accotink Dredging Project

Project # SD-000041-001

July 12, 2021

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Acronyms and Abbreviations

AA Report	Alternatives Analysis Report
ADT	average daily traffic
Arcadis	Arcadis U.S., Inc.
CCT	Cross County Trail
cy	cubic yards
cy/day	cubic yards per day
cy/hr	cubic yards per hour
DI	ductile iron
DMU	dredge management unit
Dominion	Dominion Energy
DPWES	Fairfax County's Department of Public Works and Environmental Services
FCDOT	Fairfax County Department of Transportation
FCPA	Fairfax County Park Authority
HDPE	high-density-polyethylene
I-495	Interstate-495
LOD	limits of disturbance
mg/kg	milligrams per kilogram
ROW	right-of-way
RPA	Resource Protection Area
TPH-GRO	total petroleum hydrocarbon gasoline range organics
USACE	United States Army Corps of Engineers
VDOT	Virginia Department of Transportation
WOTUS	Water of the United States
WSSI	Wetland Studies and Solutions, Inc.
%	percent

1 Introduction

On behalf of Fairfax County, Arcadis U.S., Inc. (Arcadis) prepared this Alternatives Analysis Report (AA Report) on the development and evaluation of alternatives for the Lake Accotink Dredging Project. The project consists of dredging sediment from Lake Accotink, transporting the dredge material in a pipeline to the dewatering location, dewatering the dredge material, and disposing of the dredge material. The alternatives analysis includes evaluating dredging methods applicable to Lake Accotink, transporting dredge material to the dewatering location, selecting the dewatering location, dewatering the dredge material, and disposing of the dredge material. This AA Report was prepared in accordance with the approved scope of work under Contract #SD-000041-001.

The project has the following guiding considerations that were determined by Fairfax County and provide boundaries for the project:

- Lake Accotink will be dredged.
- The dredge material will be pumped in a pipeline to the dewatering location unless alternatives are identified that will not require pumping of sediments.
- The dewatered dredge material will be transported by truck to the disposal location.

These considerations guided the alternatives analysis.

1.1 Objective and Scope

Lake Accotink is located in Fairfax County, Virginia (Figure 1-1) and the project is led by Fairfax County's Department of Public Works and Environmental Services (DPWES) Stormwater Planning Division with support from the Fairfax County Park Authority (FCPA). The objective of the Lake Accotink Dredging Project is to remove sediment to increase lake depth and overall volume for the benefit of recreational users and the County's Lake Accotink Park Master Plan (FCPA 2019). The dredging project may also help the County meet its stormwater permit requirements. In addition, the project will facilitate retention of the aesthetic and recreational value of the lake and will provide a dredging maintenance plan that allows the lake to remain a valuable asset to the community. Dredging is tentatively scheduled to start in early 2023 and anticipated to be completed in late 2025. Much of the alternatives analysis focuses on this base (2023 to 2025) dredging event. Future dredging (post-2025 dredging) is anticipated to maintain the water depth in the lake.

1.2 Site Background

Lake Accotink is located within Lake Accotink Park, which is owned and managed by the FCPA. Lake Accotink was created after a dam was constructed first in 1918 and then rebuilt in 1943 to provide a source of drinking water for Camp Henderson (now Fort Belvoir). The Lake Accotink Park area was acquired by the FCPA in 1967 (FCPA 1992). Lake Accotink itself is no longer used as a drinking water source. Lake Accotink Park now serves as a recreation area and nature park for Fairfax County and the surrounding community (Wetland Studies and Solutions, Inc. [WSSI] 2017).

The Lake Accotink watershed encompasses approximately 19,600 acres and the lake covers approximately 55 acres. An average of 23,000 cubic yards (cy) of sediment is deposited in Lake Accotink each year, reducing the depth of water and storage volume across the lake (WSSI 2017). Storage volume has decreased from an estimated 800 acre-feet in the late 1940s to less than 200 acre-feet in 2015 (WSSI 2017). Lake Accotink was previously dredged three times:

- During the 1960s when an unspecified volume of sediment was removed;
- In 1985, when 211,000 cy of sediment were removed via hydraulic dredging and deposited in sedimentation basins near the park; and
- Most recently in 2008, when 193,000 cy of sediment were removed via hydraulic dredging. Some of the sediment was placed at the island in the lake to expand the island, create wetland, and create beneficial habitat. The remaining sediment was deposited in an off-site facility (Vulcan Concrete Plant).

Concurrent with previous dredging activities, sedimentation and sediment management studies were completed to develop a long-term management strategy for the lake (HDR 2002; WSSI 2017). The design life of the 1985 dredging event was projected to last for 30 to 40 years; however, due to increased sedimentation the need for additional dredging was identified at least 13 years ahead of schedule by 2002. The shorter-than-anticipated lifespan achieved by the previous dredging events also spurred interest in developing a long-term sediment management solution (HDR 2002). The dredging plan for 2008 included enhancement near the island at the mouth of Accotink Creek in the northwest portion of Lake Accotink to focus sedimentation in this area of the lake.

1.3 Site Characteristics

Lake Accotink is located in Fairfax County within the Springfield area of the County. The areas surrounding the park are primarily residential and light industrial. The area has been highly developed since the 1970s (HDR 2002), and limited continued development is anticipated (WSSI 2017). The majority of the park comprises wooded areas accessible by trail, with developed areas at the eastern edge of the lake including parking areas and recreational facilities for park visitors.

Utilities and infrastructure are generally limited to the developed recreation area. The only known utility in the dredging area is an existing 54-inch sanitary gravity sewer, which crosses the lake as shown on Figure 1-2 and ultimately connects to Keene Mill Pump Station. Structures that may impact dredging design include the dam and pier in the marina.

The area around the lake is primarily Piedmont / Mountain Floodplain Forests, with portions classified as marsh woodlands containing marshes and ephemeral wetlands. Mesic Mixed Hardwood forests are found along slopes. The woodlands range from steeply sloped in the southern portion of the park to more gentle slopes in the floodplain portions of Accotink Creek to the north (FCPA 2017). The lake and surrounding area provide habitat for multiple species of animals including a large and varied bird population, mammals, as well as fish and benthic invertebrate communities within the lake itself. No known threatened or endangered species are located within the park (FCPA 2017). In addition to natural resources, the area around Lake Accotink park has cultural resources. Native American, Civil War, and other early historical sites are located within the Lake Accotink Park footprint. More details regarding the natural and cultural resources and potential impacts of the proposed alternatives are presented in Section 5.

2 Summary of Existing Data

A field assessment was performed between November 2020 and March 2021 to provide data to support the alternatives analysis and design of the Lake Accotink Dredging Project. The field activities are presented in more detail in the Field Assessment Report (Arcadis 2021) and include topographic and bathymetric surveys, sediment sampling and analysis, treatability testing, geotechnical investigation at support areas, and wetland delineation and vegetative community mapping.

Topographic data were collected via aerial survey as part of the field assessment. However, existing topographic data available from Fairfax County were deemed acceptable for the purpose of this AA Report. The data collected during the field assessment will be used in design once the final work area has been selected.

A hydrographic survey of Lake Accotink was completed to map bathymetry and identify the presence of large debris, utilities, and other potential obstacles to dredging. The hydrographic survey identified the location of the 54-inch gravity sanitary sewer, as well as several magnetic anomalies that may indicate large debris (Figure 1-2). The location of the sanitary sewer and anomalies will be used to set appropriate offsets and structure protections during dredging.

The bathymetry was compared to the 2015 bathymetry survey to evaluate the degree and extent of sedimentation in the time period between surveys. The survey showed that approximately 51,000 additional cy of sediment have been deposited in the lake in the 5 years between surveys. Sedimentation generally occurred across the entire lake, particularly in the western portion near the mouth of Accotink Creek and around the island. The 51,000 cy estimate does not include additional sedimentation in the area to the northwest of the island that was inaccessible to the survey boat due to insufficient water depth. Bathymetry and deposition data will be used to define the dredge management units and sedimentation monitoring for future dredging events. Additional information on sedimentation in Lake Accotink is provided in Appendix A.

Sediment sampling, logging, and laboratory analyses were performed as part of the field assessment to determine key physical properties of sediment; sediment thicknesses; the limits, extents, and depths to be achieved during dredging; estimate sediment dewatering rates; and evaluate disposal requirements. One hundred sediment cores were collected from transects spread across the lake to capture the range of potential sediment conditions that may be encountered during dredging. Sediment core logs as well as grain size analysis illustrate the variation in sediment across the site. Coarser grain sediment is encountered at the western end near the mouth of Accotink Creek and in isolated locations near the banks, and finer grain sediment is encountered more frequently at the eastern end of the lake near the dam. Most cores were relatively homogenous, and little stratification was observed. Organic matter was noted in cores from across the lake. Based on grain size analysis performed on a subset of cores, the lake sediments are primarily comprised of silts, clays, or fine sand.

Based on the results of waste characterization sampling, most analytes were either not detected or detected below the Virginia Department of Environmental Quality Voluntary Remediation Program sediment criteria. Petroleum hydrocarbons were detected and must be considered as part of the disposal evaluation (see Section 4.3).

Select sediment samples were also submitted for treatability testing. Treatability tests included evaluating sediment dewatering additives applicable to multiple dewatering methods. Treatability tests also evaluated passive dewatering with geotextile tubes, including dewatering time and effluent water quality. Treatability results indicate that regardless of dewatering method, an additive such as an anionic polymer will likely be required to improve dewatering of fine-grained materials through a coagulation/flocculation processes (referred to generally as flocculation in this document). Geotextile tubes were shown to be an effective dewatering technology that produces an effluent with low solids content. Dewatering tests also illustrated the difference in dewatering time for the various grain sizes of sediment encountered in the lake. The treatability test data will be used to design the dewatering method, including evaluation of whether water generated from dewatering will require treatment prior to discharge to the watershed.

Geotechnical borings were advanced to investigate soils in-and-around potential support areas and pipeline alignments, to provide the design basis for earthwork and structural components, slope stability, and bearing capacity of soils in these areas. Based on this analysis, above and below ground pipe support is feasible at areas where the borings were performed. Above-grade pipelines will likely require pipe supports due to very loose, very soft, and high plastic soils. Soil characteristics for below grade pipeline construction are compatible with open-cut construction and/or jack-and-bore. For open-cut excavation below the water table, sheeting and shoring is recommended. If a land bridge is required, additional subsurface preparation such as laying of geogrid and stone placement, or removal and replacement of soft materials would likely be necessary. Jack and bore and open cut pipeline construction methods are also acceptable in suitable locations.

A wetland identification and vegetative community mapping desktop evaluation was completed as part of the field assessment. The wetland desktop evaluation indicated that wetlands and streams are present within the project area. The vegetative assessment identified the primary vegetation classifications in the project area. Further evaluation of potential wetland and vegetative community impacts are presented in Section 5 and associated appendices.

3 Evaluation Criteria

Criteria for the evaluation of the alternatives were developed based on input from Fairfax County staff (including DPWES and FCPA) and other project stakeholders. The evaluation criteria were organized under four categories – Park Management, Community Considerations, Environmental Considerations, and Construction and Dredging Program Operation. Within each category, there is at least one criterion. Table 3-1 presents the broader evaluation categories and associated criteria.

Table 3-1. Evaluation Categories and Criteria

Category	Criteria
Park Management	Consistency With Long-Term Park Vision
Community	Recreational Use Restrictions During Construction
	Community Considerations During Construction
Environment	Environmental Considerations
	Floodplain Impacts
	Sustainability
Construction and Dredging Program Operation	Available Area and Accessibility
	Site Preparation Requirements
	Flexibility/Compatibility with Various Equipment
	Efficient Water Return
	Constructability
	Long-Term Operation and Maintenance
	Schedule
	Costs

The evaluation criteria were developed for the five components of the project – dredging methods, dewatering methods, disposal methods, dewatering locations, and slurry transport pipeline alignment routes. Within each category and criterion, sub-criteria were developed to customize the evaluation to each project component. Tables 3-2 through 3-6 show the customized sub-criteria for the project components. Detailed evaluation for each of the project components are discussed in the subsequent report sections.

Each component was rated qualitatively for each sub-criterion and given a compatibility ranking as either high, medium, or low. Criteria were worded to indicate meeting the criteria was beneficial:

- High: the alternative met the criteria.
- Medium: the alternative met some of the criteria.
- Low: the alternative did not meet the criteria.

Note for costs the evaluation is based on relative costs between specific alternatives and high, medium, and low do not refer to cost values. Alternatives with the lowest relative cost best meet the cost objective of a cost-effective alternative and thus are ranked high. Conversely, alternatives with the highest relative cost do not meet the cost objective of a cost-effective alternative and thus are ranked low.

4 Development and Screening of Methods

This section describes the alternatives analysis for methods that will be selected by the contractor. These methods include dredging, dewatering, and the disposal location. To maximize flexibility during construction, which will reduce project costs for Fairfax County, the selected contractor will have the ability to propose the dredging method, dewatering method, and disposal location from a range of feasible options identified during the design phase. Fairfax County will review and approve the contractor's proposed approach. An analysis of these methods was performed as proof of concept that there are feasible alternatives for each method. In addition, this section provides ranking of alternatives to facilitate screening and evaluation during future phases of the project.

4.1 Dredging Methods

Prior to evaluating dredging methods, data collected as part of the field assessment were evaluated to determine the volume of sediment requiring removal to restore the average water depth in Lake Accotink to 8 feet for the benefit of recreational users and restore the lake's sediment capture efficiency to meet stormwater permit requirements. The sediment thickness in targeted dredge areas ranges from 0.5 to 8 feet. Evaluating removal across the lake, if sediment is removed to provide a water depth of 8 feet within Lake Accotink, the total volume of dredge material would be approximately 500,000 cy. This volume includes additional sediment accumulation that is anticipated to happen between the field assessment and the end of construction. The lake would be split into separate dredge management units (DMUs) to facilitate sediment removal and closing of portions of the lake during removal. Approximate DMU boundaries are shown on Figure 4-1.

Three dredging methods were evaluated, including:

- Hydraulic dredging;
- Mechanical dredging; and
- Amphibious dredging.

For the alternatives analysis, a proof-of-concept evaluation was performed to confirm whether the three dredging methods identified are viable options and are compatible with proposed dewatering methods. The evaluation confirmed that all three dredging methods are viable and are compatible with the dewatering methods.

The evaluation of the dredging methods is presented in Exhibit 1 and summarized in the following sections.

4.1.1 Hydraulic Dredging

Hydraulic dredging utilizes a pump system that draws in sediment and water through a hydraulic head, creating a slurry that is approximately 10 to 15 percent (%) solids by weight. There are several different types of hydraulic dredges, including horizontal auger, cutter suction, and eddy pump dredges; however, for purposes of this evaluation, it is assumed a cutter suction head will be used. Hydraulic dredging can transport the material through a pipeline a significant distance, making it compatible with all of the dewatering locations evaluated as part of this alternatives analysis. The diameter of the discharge pipeline is the typical descriptor of hydraulic dredge size (e.g., 8-inch).

Hydraulic dredging ranks high or medium for all evaluation categories with the exception of production rate for a smaller sized dredge and debris removal (see Exhibit 1). Hydraulic dredging ranks highest for community considerations of the three methods considered due to its likelihood to generate less dust, odor, and noise during operations. This is due to the fact that a hydraulic dredge system is fully enclosed, and the sediment would not be exposed until it reaches the dewatering location. Hydraulic dredging will require temporary closures of park facilities during mobilization efforts and dredging near the marina and boat launch; however, these closures are expected to be limited in both frequency and duration. As a result, these closures are not anticipated to severely impact recreational use of the park and lake.

Production rates for hydraulic dredges can range from 45 cubic yards per hour (cy/hr) to 200 cy/hr, depending on the dredge size. A separate debris removal step will be required during hydraulic dredging to remove large debris within the lake (e.g., large woody debris), as hydraulic dredges cannot remove debris larger than the pipeline size, and debris that enters the dredge can obstruct the pipeline. Costs associated with hydraulic dredging are moderate and can vary based on selected dredge size.

4.1.2 Mechanical Dredging

Mechanical dredging utilizes conventional excavation equipment (e.g., excavator bucket/clamshell) to remove sediments. The excavation equipment would be mounted on a barge for excavation purposes with the removed sediment placed in a separate barge/scow. The sediment would pass through a debris screen when placed in the separate barge and then be slurried and pumped to the final dewatering location. Mechanical dredging can also be completed in the dry, meaning the excavation area is dewatered during construction. Dredging in the dry was deemed infeasible.

Mechanical dredging ranks high in terms of constructability, including the fact that dredging and debris removal can be completed in one step (see Exhibit 1). Dredge production can also be ranked medium to high depending on the size of the excavator bucket used for dredging activities and can range from 70 cy/hr to 170 cy/hr. Mechanical dredging will require temporary closures of park facilities during mobilization efforts and dredging near the marina and boat launch; however, these closures are expected to be limited in both frequency and duration. As a result, these closures are not anticipated to severely impact recreational use of the park and lake.

Mechanical dredging ranks low in terms of community impacts, largely due to its likelihood to produce more dust, odor, and noise than the other dredging methods evaluated. This is due to the need to continually lower and raise the bucket through the water column, expose the sediment to air during the initial debris screening process, and process the sediment in the additional slurry barge. Costs are ranked low for mechanical dredging (meaning the cost for mechanical dredging is high compared to other dredging methods) due to the need for additional equipment to produce the slurry prior to pumping to the dewatering location.

4.1.3 Amphibious Dredging

Amphibious dredging uses specialized equipment to remove sediment. The amphibious dredge mainly operates as a hydraulic dredge; however, it is also possible to operate in a mechanical dredging mode.

Amphibious dredging ranks high or medium for all categories with the exception of production rate, greenhouse emissions, and availability (see Exhibit 1). Amphibious dredging ranks moderate for community considerations. While the dredge would mainly operate hydraulically, due to production rate limitations, several dredges would be required to meet the anticipated project schedule. Amphibious dredging will require temporary closures of park facilities during mobilization efforts and dredging near the marina and boat launch; however, these closures are expected to be limited in both frequency and duration. As a result, these closures are not anticipated to severely impact recreational use of the park and lake.

Production rates for an amphibious dredge average approximately 30 cy/hr; however, there are certain dredges that can remove at rates of up to 100 cy/hr. As previously mentioned, this will require multiple barges in order to meet project schedule requirements. This is also the reason that amphibious dredging ranks low for greenhouse gas emissions. The dredge is specialized equipment and is not as widely available as the other dredging methods evaluated, which could lead to increased costs associated with procuring the equipment. Costs associated with amphibious dredging are moderate; however, they can increase based on the number of dredges required to meet anticipated project schedules.

4.2 Dewatering Methods

Sediment dewatering is performed to reduce the water content of dredged material prior to reuse or disposal. Sediment dewatering is particularly necessary when hydraulic dredging or hydraulic transport of sediment is used due to the high water content of the sediment slurry created with these methods. The offsite transportation and disposal costs of dredged material are usually a significant portion of dredging project costs. The offsite transportation and disposal costs are typically based on the weight of the material. By dewatering the dredged material, the weight of the material is reduced. Dewatering the dredged material can provide significant savings to the County in transportation and disposal costs and thus the overall project cost.

Based on the results of the sediment testing completed during the field assessment and potential dredging methods anticipated, the sediment dewatering options identified for this alternatives analysis include:

- Passive dewatering via geotextile tubes;
- Passive dewatering via geotextile tubes with desanding;
- Mechanical dewatering via filter presses; and
- Gravity dewatering with the addition of a drying agent.

A dewatering option not considered was use of a confined disposal facility, an onsite containment facility for sediment. Use of a confined disposal facility was deemed impractical due to size constraints. For the alternatives analysis, a proof-of-concept evaluation was performed to confirm the dewatering methods identified are viable options based on the evaluation criteria identified in Section 3. As part of the dewatering method evaluation, the anticipated footprint required for each of the above dewatering methods was evaluated assuming a range of dredging and slurry conditions. Based on dredging of 500,000 cy over 2 years (22 dredging days per month), a minimum average dredging rate of 950 cubic yards per day (cy/day) is needed. To evaluate effect of a higher dredging rate on dewatering footprint requirements, an average dredging rate of 1,250 cy/day was also assumed. Sediment slurry was assumed to vary between 7% and 15% solids. A summary of the mass balance and area calculations, including assumptions, for the dewatering methods is provided as Appendix B.

The results of the dewatering methods evaluation are presented in Exhibit 2 and summarized in the following sections. All dewatering methods are compatible with the disposal options proposed; however, some dewatering methods are not compatible with individual dewatering areas (discussed in Section 6.1) or dredging methods. For example, the use of gravity dewatering with a drying agent is incompatible as the primary dewatering method when using hydraulic dredging or hydraulic transport.

4.2.1 Passive Dewatering (Geotextile Tubes)

A simplified process schematic for passive dewatering with geotextile tubes is provided on Figure 4-2. The dredged material would be slurried (either as part of hydraulic dredging, or subsequent to mechanical dredging), and the slurry would be pumped into the geotextile tubes, which are made of a permeable geotextile fabric that allows water to pass through the fabric while retaining the solids. Polymers are often added to enhance dewatering by flocculating fine-grained materials. Based on the results of the treatability testing conducted during the field assessment, the sediments in Lake Accotink will likely require a polymer to aid in dewatering. Filling of geotextile tubes is alternated with draining time until the geotextile tube is filled to capacity with sediment. Once the geotextile tube is filled to capacity, the sediment is allowed to dewater within the geotextile tubes over a period of time, generally on the order of weeks but can vary depending on sediment properties and disposal requirements. Once dewatered, the material remaining in the geotextile tubes can be loaded into trucks and transported to the final disposal site. The geotextile tubes can be opened for material offloading, or smaller geotextile tubes can be used and direct loaded onto trucks. In beneficial reuse applications, geotextile tubes can be filled in-place and the sediment left in the geotextile tubes for bank stabilization and other land creation beneficial reuse applications.

During sediment dewatering at a centralized dewatering area, decant water leaving the geotextile tubes is captured in a containment area and either directly discharged or is sent to an onsite water treatment plant prior to discharge. The need for water treatment would be determined during the design based on anticipated water quality of the effluent from the geotextile tubes and project-specific permit requirements for water discharge.

Based on the proof-of-concept footprint evaluation, the anticipated dewatering area for passive dewatering with geotextile tubes is estimated to be between 3.5 and 4.9 acres, based on the dredging production rate and the slurry percent solids. The dewatering area typically includes three dewatering cells: one cell with geotextile tubes being actively filled, one cell with geotextile tubes dewatering, and the final cell with the dewatered sediment being loaded for transport to an offsite facility for disposal or beneficial use. Each cell would consist of geotextile tubes stacked in multiple layers to minimize the footprint of the dewatering area. The dewatering area would also contain a polymer support area and a wastewater treatment plant (if needed) to treat the collected water before discharge. Additional details and assumptions are provided in Appendix B.

Geotextile tube dewatering ranks high for relatively low cost compared to other dewatering alternatives, relative ease of operations, and relatively low noise compared to other dewatering methods (see Exhibit 2). Geotextile tube dewatering also ranks high for low energy input (sustainability) and the quality of the effluent water (potential reduction in water treatment requirements). Site preparation would require the area to be cleared of all trees or shrubs, graded to a relatively flat slope, and a gravel pad installed; the gravel pad may be repurposed between dredging events with some effort. Site access requirements are less burdensome than mechanical dewatering, with equipment able to be delivered and maneuvered by standard equipment.

The primary challenge associated with geotextile tube dewatering is the large area required for operations. Passive dewatering with geotextile tubes is compatible with hydraulic and amphibious dredging technology but would require mechanically dredged material to be slurried, adding a significant volume of water after sediment removal from the lake bottom.

4.2.2 Passive Dewatering with Desanding

Passive dewatering with desanding would involve the same process as described in Section 4.2.1, with the addition of a desanding step prior to the geotextile tubes. A simplified process schematic is provided on Figure 4-3. The sediment slurry would be hydraulically pumped into a desanding unit, such as a hydrocyclone, which separates fine and coarse materials. Coarser materials, such as sands and gravels, would be removed in the underflow of the hydrocyclone, while the finer materials would be pumped to the geotextile tubes for dewatering. Separated sands could be more readily used for beneficial reuse applications, as described in Section 4.3. Polymer would be added to the fine materials to enhance dewatering. The sediment would be dewatered and loaded out in the same manner as the sediments in Section 4.2.1. Similarly, water would either be direct discharged or sent to an onsite water treatment plant depending on project-specific permit requirements.

Based on the proof-of-concept evaluation, the anticipated dewatering area is estimated to be between 5.2 and 7.4 acres, based on the dredging production rate and the slurry percent solids. The dewatering area includes a hydrocyclone and three separate dewatering cells similar to the set up discussed in Section 4.2.1, except that a longer dewatering time is assumed due to removal of the sand fraction from the sediment slurry dewatered by the geotextile tubes. Additional details and assumptions are provided in Appendix B.

Geotextile tube dewatering with desanding ranks high for beneficial reuse potential and ability to minimize polymer use (see Exhibit 2). The separated sand material can be more readily used in beneficial reuse applications, such as beach replenishment or bank restoration. Site preparation would be as described in Section 4.2.1 but would require a larger area for the geotextile tube layout, including vegetation clearing and grading.

Passive dewatering with desanding is compatible with hydraulic and amphibious dredging technology but would require mechanically dredged material to be slurried, adding a significant volume of water after removal.

4.2.3 Mechanical Dewatering

Mechanical dewatering consists of using equipment to mechanically separate water from the dredged material and can include a number of different processes. An example of a mechanical dewatering process is the use of presses that apply pressure to thickened sediment slurry to separate water from the sediment, resulting in a filter cake and filtrate water. A simplified process schematic of an assumed mechanical dewatering system is provided on Figure 4-4. The sediment slurry would be hydraulically pumped through a debris screen to remove oversized material and then into holding tanks to provide storage and equalize the flowrate of sediment into the rest of the treatment train. A hydrocyclone is then used to remove coarse grained materials. The remaining fine materials are pumped to gravity thickeners to increase the overall solids content. Thickened sediment is then pumped to another series of holding tanks and then to a filter or belt press. Multiple mobile presses would be required based on the assumed dredging production rate. The filter presses produce a dewatered material referred to as "filter cake" with relatively high solids content, which would be stockpiled along with the coarse-grained material from the hydrocyclone prior to loading and disposal offsite. Polymers are often added to enhance dewatering by flocculating fine-grained materials. Based on the results of the treatability testing conducted during the field assessment, the sediments in Lake Accotink will likely require a polymer to aid dewatering. Decant water separated from the sediments, including from the gravity thickeners and the filter presses, would be treated at an on-site water treatment plant, if needed, prior to discharge.

Based on the proof-of-concept evaluation, the anticipated dewatering area footprint for mechanical dewatering is estimated to be between 3.2 and 5.8 acres, based on the dredging production rate and the slurry percent solids.

The dewatering area would include the equipment described above and associated support facilities, piping, and other infrastructure. The dewatering area would also contain a material staging area, a polymer support area, and a water treatment plant to provide polishing of the collected water before discharge. Additional details and assumptions are provided in Appendix B.

Mechanical dewatering ranks high for sustainability because the process can be designed to produce a relatively drier material decreasing the potential transport and disposal costs based on the decreased weight and volume and coarse material can be separated out to be more readily incorporated into beneficial reuse scenarios (see Exhibit 2). The system also has a high throughput, allowing it to match the production rate of a range of dredging scenarios. Mechanical dewatering ranks low for the high cost, the high energy input required to run the multiple components in the mechanical dewatering treatment train, and associate noise of equipment operations. It also ranks low for constructability and operations due to the number of system components and general complexity of operation. Complex operations may increase the potential for downtime and delays and may require multiple trained operators onsite to operate the system. Site preparations would be more significant to support the large tanks and equipment required. Although clearing and grading would be needed to provide level pads for the individual tanks and dewatering equipment, the configuration of individual components provides more flexibility in overall site grading. Mechanical dewatering is compatible with all dredging and disposal options.

4.2.4 Gravity Dewatering with Drying Agent

Use of a drying agent for dewatering would include gravity dewatering of dredged material on a mixing pad with an impermeable liner and sump for water collection, followed by mixing of a drying agent into the dredged material. Gravity dewatering allows water to freely drain from the sediment, and the amount of water that is separated depends on the sediments, duration, and weather. The drying agent then decreases the water content of the dredged material by solidifying, absorbing, or reacting with the water. The objective of the drying agent is to decrease the water content and improve the dredged material characteristics as needed to meet transportation and/or disposal requirements A simplified process schematic is provided on Figure 4-5. This method is only applicable as a primary dewatering option for mechanically dredged material. Decant water that drains from the sediment would be treated using an onsite water treatment plant to remove solids prior to discharge.

Based on the proof-of-concept evaluation, the anticipated dewatering area for dewatering using a drying agent assuming capacity for a minimum of three days of dredging is approximately 1.7 to 2.2 acres, based on the dredging production rate. However, the dewatering area needed and configuration are more flexible and would be designed to meet space constraints. The dewatering area would include the mixing pad, drying agent staging area, and the onsite water treatment plant. Additional details and assumptions are provided in Appendix B.

Use of a drying agent would have a relatively low cost, due to simplified operation and maintenance (see Exhibit 2). The site would require minimal preparation and straightforward access requirements. Clearing and grubbing of the area would still be required to create the necessary dewatering pad(s). The costs for disposal would increase due to the weight added by the drying agent and the lower weight of water removed during dewatering. This option also has the potential to generate nuisance dust that must be controlled to minimize community impacts. Discharge water from this option would also be of lower quality and require treatment in an onsite water treatment plant prior to discharge.

4.3 Disposal Location

Beneficial reuse and placing dredge material in a landfill are the two disposal options assumed to be available to Fairfax County for the project. Beneficial reuse is "productive and positive uses of dredged material, which cover broad use categories ranging from fish and wildlife habitat development, to human recreation, to industrial/commercial uses" (United States Army Corps of Engineers [USACE] 1987). Beneficial reuse could occur within Lake Accotink Park or offsite. Landfill disposal would occur offsite at a permitted landfill. From these options, the following disposal methods were identified:

- Island expansion;
- Bank restoration;
- County reuse;
- Offsite reuse; and
- Offsite Landfill.

The onsite beneficial reuse options would use a volume of material that is smaller than the dredge material volume that will be removed from the lake. If an onsite beneficial reuse method is proposed, due to the volume and chemistry results discussed below, onsite beneficial reuse would be paired with another disposal method for the remaining dredge material.

The chemistry results from the field assessment (Arcadis 2021) indicate some of the dredge material will require landfill disposal. The total petroleum hydrocarbon gasoline range organics (TPH-GRO) concentration in the sample collected from Transect 4 during the field assessment was 75 milligrams per kilogram (mg/kg). The concentration of TPH-GRO was above the 50 mg/kg screening level in the Virginia Waste Management Board, Solid Waste Management Regulations, disposal criteria - 9VAC20-81-660-D(2). Based on these results, it is assumed that some dredged material may require disposal at a permitted landfill equipped with liners and leachate collection systems to comply with 9VAC20-81-660. The remaining sediment samples had constituent concentrations below the screening levels, indicating all five disposal methods are viable for this sediment.

For the island expansion and bank restoration disposal methods, the dredge material would be pumped directly from the lake to the disposal location. For the remaining three disposal methods, transportation of dewatered dredge material to the disposal location will be by truck. The transportation route will depend on the disposal method selected. The transportation route will be developed by the contractor in coordination with Fairfax County and in consideration of stakeholder input.

For the alternatives analysis, a proof-of-concept evaluation was performed to confirm whether the five disposal methods identified are viable options. It was confirmed that all five methods are viable and that all five methods are compatible with the dredging and dewatering methods.

The evaluation of the disposal methods is presented in Exhibit 3 and summarized in the following sections.

4.3.1 Island Expansion (Onsite Beneficial Reuse)

Island expansion is an onsite beneficial reuse disposal method. Dredge material would be placed between the northwest side of the island and the shore of the lake, creating a connection of the island with the shore of the lake. The rationale for the island expansion is described in Section 6.1.6. Dredge material would be pumped directly from the dredge to the island. The volume of sediment that could be reused in the island expansion disposal method is less than the volume of sediment that will be dredged from the lake. Therefore, island expansion, if selected as a disposal method, would be paired with another disposal method as the island expansion would not use all the dredge material.

The island expansion ranks high for sustainability and cost (meaning the cost is low compared to other disposal methods; see Exhibit 3). The island expansion does not have truck transport of dredge material to the disposal location, which eliminates vehicle miles for the disposal method. The island expansion beneficially reuses dredge material. These aspects give the disposal method a high sustainability ranking. The beneficial reuse of dredge material onsite eliminates the cost of paying a third party to accept disposal of the dredge material, which results in a high ranking for cost (i.e., a low cost).

The island expansion ranks low for park management and community categories. The island expansion would result in limiting access to the area of expansion during dredge material placement and dewatering. The island expansion would convert a portion of the lake to land, eliminating the possibility of aquatic recreation in this area.

4.3.2 Bank Restoration (Onsite Beneficial Reuse)

Bank restoration is an onsite beneficial reuse disposal method. There are creek banks in Lake Accotink Park that are eroding. Fairfax County has identified these creek banks for restoration by filling the eroded area with soil and planting vegetation in the filled area as part of stream restoration projects. The bank restoration disposal method would use dredge material to perform the restoration. Geotextile tubes would be placed along the creek bank. Dredge material would be pumped directly from the dredge to the geotextile tube. Once the dredge material is dewatered, the geotextile tube would be covered with soil and planted with vegetation. The volume of sediment that could be reused for bank restoration is less than the volume of sediment that will be dredged from the lake. Therefore, bank restoration, if selected as a disposal method, would be paired with another disposal method as the bank restoration would not use all the dredge material.

The bank restoration disposal method ranks high for sustainability and cost (meaning the cost is low compared to other disposal methods; see Exhibit 3). The bank restoration does not have truck transport of dredge material to the disposal location, which eliminates vehicle miles for the disposal method. The bank restoration beneficially reuses dredge material. These aspects give the disposal method high sustainability ranking. The beneficial reuse of dredge material onsite eliminates the cost of paying a third party to accept disposal of the dredge material which results in a high ranking for cost (i.e., a low cost).

The bank restoration disposal method ranks medium for park management and community categories. This alternative meets the Fairfax County goal to promote natural resource protection by reusing material and restoring stream banks but limits park use of the bank restoration area during restoration.

4.3.3 County Reuse (Onsite Beneficial Reuse)

County use is an onsite beneficial reuse disposal method. Dewatered dredge material would be used by the County for fill. The dredge material would be transported by truck from the dewatering location to the fill area. The volume of sediment that could be reused for the County reuse is less than the volume of sediment that will be dredged from the lake. The County reuse, if selected as a disposal method, would be paired with another disposal method as the County reuse would not use all the dredge material.

County use ranks high for sustainability and cost (meaning the cost is low compared to other disposal methods, see Exhibit 3). The County use has a short distance of truck transport of dredge material from the dewatering location to the disposal location, which minimizes vehicle miles for the disposal method. County use beneficially reuses dredge material. These aspects give the disposal method a high sustainability ranking. The beneficial reuse of dredge material onsite eliminates the cost of paying a third party to accept disposal of the dredge material, which results in a high ranking for cost (i.e., a low cost).

County use ranks medium for park management and community categories. County use meets the Fairfax County goal to promote natural resource protection by reusing dredge material but limits park use of the fill area during placement of the dredge material.

4.3.4 Offsite Reuse

Offsite reuse is an offsite beneficial reuse disposal method. Dewatered dredge material would be used for third party fill, daily cover in a landfill, or in industrial manufacturing. The dredge material would be transported by truck from the dewatering location to the reuse location. The transportation route would depend on the reuse site selected. The transportation route would be developed by the contractor in coordination with the Fairfax County and in consideration of community input.

Offsite reuse ranks high for park management and community categories (see Exhibit 3). Offsite reuse beneficially reuses dredge material, which meets the Fairfax County goal to promote natural resource protection by reusing material. Offsite reuse does not limit park use as no disposal of dredge material within the park occurs.

Offsite reuse ranks low for sustainability and cost (meaning the cost is high compared to other disposal methods). Offsite reuse has long distance truck transport of dredge material to the disposal location, which results in higher vehicle miles compared to the onsite disposal methods. This results in a lower sustainability ranking. It is assumed there will be a transportation and disposal cost for offsite reuse, which results in a low ranking for cost (i.e., a high cost).

4.3.5 Offsite Landfill

The offsite landfill alternative consists of disposal in an offsite permitted landfill. Dewatered dredge material would be transported by truck to a landfill for disposal. The transportation route would depend on the landfill selected. The transportation route would be developed by the contractor in coordination with Fairfax County and in consideration of community input.

Offsite landfill ranks medium for park management and high for community categories (see Exhibit 3). Offsite landfill does not meet the Fairfax County goal to promote natural resource protection by reusing material or restoring stream banks. Offsite landfill does not limit park use as no disposal of dredge material within the park occurs. This meets the Fairfax County and community objective of unlimited recreational use of the park.

Offsite landfill ranks low for sustainability and cost (meaning the cost is high compared to other disposal methods). Offsite reuse has long distance truck transport of dredge material to the disposal location, which results in higher vehicle miles compared to the onsite disposal methods. Offsite landfill does not reuse the dredge material. There will be a transportation and disposal cost for offsite landfill which results in a low ranking for cost (i.e., a high cost).

5 Environmental and Cultural Resource Evaluation

One of the important factors in assessing the pros and cons of the various sediment transport (e.g., pipeline) and dewatering areas is the impact these activities would have on natural and cultural resources within the limits of disturbance (LOD). To provide a high-level estimate of this potential for each of the various alternatives under consideration, as described in this AA Report, WSSI performed a desktop review. Details regarding the procedures for the desktop review are provided in the previously submitted Field Assessment Report and are thus not presented here.

It is important to note that the potential "impacts" described below represent a worst-case scenario and should not be taken as the level of impact that can be expected by any particular alternative at this point in the evaluation process. The rationale for the computed impacts representing a worst-case scenario is provided below and in Appendix C.

5.1 Assessment Methodology

To determine the potential for impacts to natural resources within the proposed LODs for each alternative, WSSI overlayed each such LOD on the natural resource constraints maps developed during the field assessment. Wherever the proposed LOD intersected either a Water of the United States (WOTUS, to include streams and/or wetlands) or an area designated as "Forest", the area was computed.

To assess the potential for impacts to cultural resources, each of the proposed LODs was also reviewed in relation to known archeological sites gleaned from a state database. More detailed information regarding the methodology employed for this review, as well as more specifics on the specific cultural resource features in the vicinity of the various LODs, is provided in Appendix D.

5.2 Results

Based on the above methodology, the potential impacts to natural and cultural resources resulting from the various pipeline and dewatering areas is summarized in Table 5-1. As mentioned above, the numbers in Table 5-1 represent a worst-case scenario and should therefore be used not as a definitive measure of the potential impacts, but rather as a relative indication of the amount/presence of resources within the LOD for each alternative.

The reason the numbers provided in Table 5-1 represent a worst-case scenario is related to the procedures that will have to be followed during the design process to meet state and federal regulatory requirements. While more details are provided in Appendix C, these requirements include, in part, demonstration that the WOTUS features have been avoided to the maximum extent practicable, and further that any impacts have been minimized and represent the Least Environmentally Damaging Practicable Alternative. Final impacts cannot be determined until the extent of the actual WOTUS areas has been accurately delineated in the field and the detailed design of the selected pipeline and dewatering area are underway. Likewise, impacts represented in Table 5-1 for "Forest" and the potential for cultural resources located in close proximity to the LODs (denoted as a "Yes" or "No" in the table) will also be refined as the design process continues.

Lastly, should mitigation be required, note that purchasing credits from a mitigation bank is preferred by the regulatory agencies. However, any viable onsite mitigation alternatives will also be explored and discussed with the regulatory agencies. Additional information on mitigation requirements is provided in Appendix C.

6 Development and Screening of Alternatives

Each alternative described in this AA Report is a combination of a dewatering location and a pipeline alignment to transport sediment from Lake Accotink to the dewatering location. This section describes each of the alternative components.

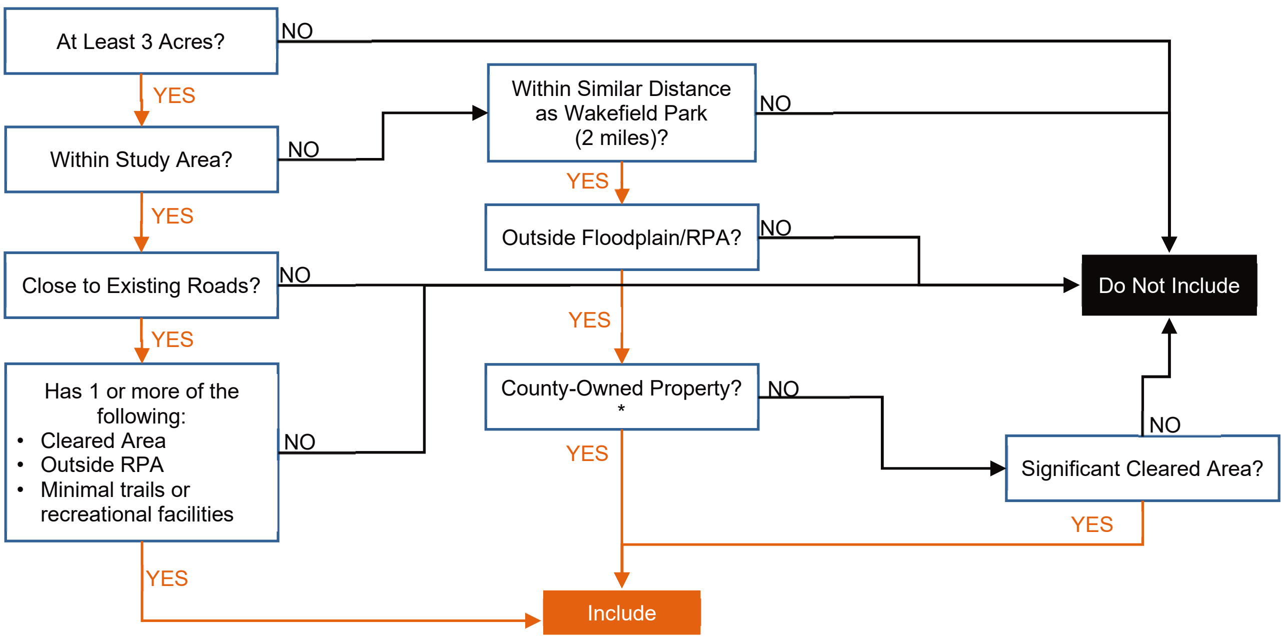
6.1 Dewatering Locations

A preliminary list of potential dewatering locations was identified to include technically feasible options based on the following considerations and generally using the flow chart shown below:

- **Available Area/Footprint**
  - A minimum footprint of at least 3 acres was used for the initial screening.
- **Location Relative to Study Area**
  - Most locations were identified within the Study Area (defined as Howrey Field and portions of Wakefield Park and Lake Accotink Park) based on the original scope of work. However, locations outside of these areas were proposed for consideration.
- **Access to Existing Roads**
  - Locations with access to existing roads and access points were preferred to limit clearing needed for truck access and/or need to install new road access points.
- **Proximity to Lake Accotink**
  - For locations outside of the Study Area, the distance from the potential dewatering location to Lake Accotink was considered. Wakefield Park, about 2 miles from the lake, was set as the farthest location from the lake. Most of the remaining locations were within 2 miles of the lake.
  - The intent was to maintain a similar maximum distance to potential areas within Wakefield Park.
- **County Owned Property**
  - Preference was placed on locations on Fairfax County owned properties, including FCPA parks. Properties owned by others were considered if the proposed area was already cleared and aerial photographs indicated minimal use of the area. Property owners were not contacted as part of the preliminary identification of dewatering locations.
- **Presence of Cleared Areas**
  - Locations with existing cleared area were preferred to limit the extent of clearing that would be required to prepare the dewatering site. Existing forested areas were still considered if the location had minimal trail and recreational impacts or had minimal impacts to floodplains, Resource Protection Areas (RPAs), or wetlands.
- **Presence of Floodplains/RPAs/Wetlands**
  - Locations outside of floodplains, RPAs, or wetlands were preferred to minimize environmental impacts associated with work in these areas. Locations within these areas were still considered if the location had existing cleared areas and/or minimal trail and recreational impacts.
- **Presence of Trails and Recreational Facilities**

- Locations outside of trails and recreational facilities were preferred to minimize community and environmental impacts associated with work in these areas. Locations within these areas were still considered if the location had existing cleared areas and/or minimal floodplains, RPAs, or wetlands impacts.

Chart 6-1 – Dewatering Location Identification Flow Chart



Based on discussions with Fairfax County and key stakeholder groups, the following potential dewatering locations (Figure 6-1) were identified for evaluation as part of this alternatives analysis:

1. Howrey Field
2. Wakefield Park Maintenance Facility
3. Wakefield Ball Fields
4. Dominion Energy (Dominion) Right-of-Way (ROW)
5. Lake Accotink Upper Settling Basin
6. Lake Accotink Island – Current Footprint
7. Lake Accotink Island – Expanded Footprint
8. Concrete Plant

Information on each of the above identified dewatering locations is summarized in the following sections and was used in analyzing each location against the evaluation and screening criteria described in Section 3. Results of the dewatering location evaluation are provided in Exhibit 4.

6.1.1 Howrey Field

Howrey Field (Figure 6-2) is an approximately 7.5-acre park that is owned by the County and is surrounded to the north and west by residential properties and to the east and south by additional parks (FCPA properties). Howrey Field includes three youth baseball/softball fields and one soccer/football field within the main portion of the site and wooded areas to the north and southwest of the fields. Howrey Field also includes a county-maintained trail and a memorial to community members who were killed in an accident during the construction of the fields.

Based on the assumptions discussed in Section 4.2, it is anticipated that Howrey Field may be able to accommodate either passive or mechanical dewatering at the lower dredging rate of 950 cy/day if the dewatering area is expanded outside of the existing fields, as shown on Figure 6-2. It is assumed that there will be tree clearing (approximately 2.5 acres) and grading required to prepare this location for dewatering operations. Howrey Field would be closed to public use for the duration of dredging and dewatering operations. Design of the dewatering operations will have to address work within the floodplain (approximately 4.5 acres of site) and the RPA (approximately 3.7 acres of site). Additionally, the design would have to factor in changes to Braddock Road being planned by Virginia Department of Transportation (VDOT) and Fairfax County Department of Transportation (FCDOT) as part of the Braddock Road Multimodal Improvements, which includes an expansion of Braddock Road south of Howrey Field (FCDOT 2021).

Use of Howrey Field for sediment dewatering would require removal of the existing field infrastructure (e.g., backstop, dugouts, fences) prior to construction of the dewatering facilities. It is assumed based on existing site use and available information, the existing surface would be able to support placement of equipment with minimal improvements other than the grading and clearing mentioned above. Following completion of the main dredging event, the fields within Howrey Field would be restored to match the existing construction. Any use of this location for future maintenance dredging events would require a similar removal and restoration effort to facilitate dewatering activities during maintenance dredging events and returning the fields to service between maintenance dredging events.

Dewatered material would be transported offsite by trucks. Based on the available area, it is assumed that the location would accommodate the lower end of the dredge rates discussed in Section 4. Assuming an average production rate of 950 cy/day and an estimate 10 cy per truck, approximately 95 truckloads (round-trip) would be leaving Howrey Field each day during dredging and dewatering operations. Assuming no public access to Howrey Field and limited distance on the Glen Park Road, it is assumed that traffic controls (e.g., signage, flaggers) would not be required. Trucks would likely use the route identified below and shown on Figure 6-2 to access an existing state route (traffic volume information from VDOT [VDOT 2021] is provided, where available):

- Glen Park Road (Average Daily Traffic [ADT] – 720); and
- SR-620/Braddock Road (ADT – 71,000; 0.85% trucks).

Water generated from the dewatering efforts is anticipated to be returned to Accotink Creek or Lake Accotink. Given the distance from Accotink Creek and necessary road crossings (i.e., Glen Park Road), a permanent return pipeline following a similar alignment as the slurry pipeline may be required. Water would be discharged in a manner that limits erosion of existing soil/sediment or generation of turbidity and in accordance with permit requirements.

6.1.2 Wakefield Park Maintenance Facility

The Wakefield Park Maintenance Facility dewatering location (Figure 6-3) is an approximately 7.7-acre forested area located in Wakefield Park (County-owned) west of the Maintenance Facility. This location is located entirely within Wakefield Park, which is bounded to the north by Little River Turnpike, to the east by Interstate-495 (I-495), to the south by Braddock Road, and to the west by residential properties. Changes to the section of Braddock Road south of the Wakefield Park Maintenance Facility are anticipated as part of the Braddock Road Multimodal Improvements project planned by VDOT and FCDOT and a portion of the Wakefield Park Maintenance Facility site may be utilized as part of that project as a potential stormwater management location (FCDOT 2021).

Based on the assumptions discussed in Section 4.2, it is anticipated that the Wakefield Park Maintenance Facility will be able to accommodate either passive or mechanical dewatering at the lower dredging rate of 950 cy/day. Figure 6-3 shows a potential layout assuming passive dewatering with geotextile tubes. Tree clearing (approximately 6.8 acres) and grading will be required to prepare this location for dewatering operations as shown on Figure 6-3. Design of the dewatering operations would have to address work within the floodplain (approximately 2.6 acres of site) and the RPA (approximately 4.0 acres of site).

Use of the Wakefield Park Maintenance Facility for sediment dewatering would require rerouting of a section of trail around the proposed work area prior to construction; no other impacts to recreational facilities are anticipated. It is assumed based on available information that the existing surface would be able to support placement of equipment with minimal improvements other than the clearing and grading noted above. Following completion of the main dredging event, the dewatering equipment and containment pads would be removed from the site, but the constructed surface would be left in place for future maintenance dredging events. It is anticipated that the constructed surface would consist of a gravel pad that may be utilized by Fairfax County for alternate purposes between maintenance dredging events.

Dewatered material would be transported offsite by trucks. Based on the available area, it is assumed that the location would be able to accommodate the lower end of the dredge rates discussed in Section 4. Assuming an average production rate of 950 cy/day and an estimate 10 cy per truck, approximately 95 truckloads (round-trip) would be leaving the Wakefield Park Maintenance Facility each day of construction during dredging and dewatering operations. Trucks would likely access this location from the maintenance facility parking lot. Assuming limited public access, it is assumed that traffic controls (e.g., signage, flaggers) would not be required. Trucks would likely use the route identified below and shown on Figure 6-3 to access an existing state route (traffic volume information from VDOT [VDOT 2021] is provided, where available):

- Wakefield Park Road; and
- SR-620/Braddock Road (ADT – 71,000; 0.85% trucks).

Water generated from the dewatering efforts is anticipated to be returned to Accotink Creek located east of the proposed Wakefield Park Maintenance Facility. It is assumed that water would be transferred by temporary pipeline and discharged in a manner that limits erosion of existing soil/sediment or generation of turbidity and in accordance with permit requirements.

6.1.3 Wakefield Ball Fields

The Wakefield Ball Fields dewatering location (Figure 6-4) is an approximately 3.5-acre site located in Wakefield Park (County-owned) comprising two adjacent softball fields that would be removed from recreational use for the duration of construction. This location is located entirely within Wakefield Park, which is bounded to the north by

Little River Turnpike, to the east by I-495, to the south by Braddock Road, and to the west by residential properties.

The proposed dewatering location limits would be located on the existing ball fields to utilize the existing cleared land and relatively flat surface. It is assumed that the limits would be located outside of the adjacent floodplain and RPA. Given the limited available area and based on the assumptions discussed in Section 4.2, it is anticipated that this location would require use of mechanical dewatering of the dredged material.

Use of the Wakefield Ball Fields for sediment dewatering would require removal of the existing field infrastructure (e.g., backstop, dugouts) prior to construction of the dewatering facilities. It is assumed based on existing site use and available information the existing surface would be able to support placement of equipment with minimal improvements. Following completion of the main dredging event, the Wakefield Ball Fields would be restored to match the existing construction. Any use of this location for future maintenance dredging events would require a similar removal and restoration effort to facilitate dewatering activities during maintenance dredging events and returning the ball fields to service between maintenance dredging events.

Dewatered material would be transported offsite by trucks. Based on the available area, it is assumed that the location would be able to accommodate the lower end of the dredge rates discussed in Section 4. Assuming an average production rate of 950 cy/day and an estimate 10 cy per truck, approximately 75 truckloads (round-trip) would be leaving the Wakefield Ball Fields each day during dredging and dewatering operations. Trucks would likely access this location from the area behind the Audrey Moore RECenter. Traffic controls (e.g., signage, flaggers) would be required to direct truck and park traffic during construction; secondary truck staging area(s) are likely to be required due to limited area available for staging of trucks waiting to be filled. Trucks would likely use the route identified below and shown on Figure 6-4 to access an existing state route (traffic volume information from VDOT [VDOT 2021] is provided, where available):

- Wakefield Park Road; and
- SR-620/Braddock Road (ADT – 71,000; 0.85% trucks).

Water generated from the dewatering efforts is anticipated to be returned to Accotink Creek located east of the proposed Wakefield Ball Fields. It is assumed that water would be transferred by temporary pipeline and discharged in a manner that limits erosion of existing soil/sediment or generation of turbidity and in accordance with permit requirements.

6.1.4 Dominion ROW

The Dominion ROW dewatering location (Figure 6-5) is an approximately 10-acre area located within the Dominion ROW in Wakefield Park (County-owned). Use of this location would require coordination and approval from Dominion Energy and FCPA. The area being considered within the ROW is located immediately north and south of the Dominion substation. The proposed location is adjacent to the Dominion substation and entirely within Wakefield Park, which is bounded to the north by Little River Turnpike, to the east by I-495, to the south by Braddock Road, and to the west by residential properties.

Based on the assumptions discussed in Section 4.2, it is anticipated that the Dominion ROW may be able to accommodate either passive or mechanical dewatering at the lower dredging rate of 950 cy/day depending on any potential restrictions required by Dominion. Extent of restrictions (e.g., limiting stacking height of geotextile tubes, offsets from Dominion structures) will need to be determined as part of the design and may increase overall area needed and/or limit production rates (increasing dredge schedule). Figure 6-5 shows a potential layout assuming passive dewatering with geotextile tubes (assumed stacked three tubes high). No tree clearing is anticipated with the provided layout, but grading is likely. Design of the dewatering operations would have to address work within the floodplain (approximately 6.2 acres of site) and the RPA (approximately 9.7 acres of site). Impacts to WOTUS (approximately 0.2 acre of site) would be avoided to the extent possible. Design and permitting of the dewatering operations would also have to address potential archeological and cultural resources (e.g., Civil War-era earthworks/trench) within the Dominion ROW site.

Use of the Dominion ROW for sediment dewatering would require rerouting trails around the proposed work area prior to construction; no other impacts to recreational facilities are anticipated. It is anticipated that trail traffic would be redirected to other trails within the adjacent areas. It is assumed based on available information that the existing surface would be able to support placement of equipment with minimal improvements other than the grading noted above. Following completion of the main dredging event, the dewatering equipment and containment pads would be removed from the site, but it is assumed that the constructed surface would be left in place for future maintenance dredging events (subject to acceptance by Dominion). It is anticipated that the constructed surface would consist of a gravel pad that may be utilized for alternate purposes between maintenance dredging events.

Dewatered material would be transported offsite by trucks. Based on the available area, it is assumed that the location would be able to accommodate the lower end of the dredge rates discussed in Section 4. Assuming an average production rate of 950 cy/day and an estimate 10 cy per truck, approximately 95 truckloads (round-trip) would be leaving the Dominion ROW location each day of construction during dredging and dewatering operations. Trucks would likely access this location from access road servicing the Dominion substation. Traffic controls (e.g., signage, flaggers) would be required to direct truck traffic during construction and secondary truck staging area(s) may be required depending on the layout of the dewatering site and any requirements by Dominion to maintain access for their vehicles. Trucks would likely use the route identified below and shown on Figure 6-5 to access an existing state route (traffic volume information from VDOT [VDOT 2021] is provided, where available):

- Wakefield Park Road; and
- SR-620/Braddock Road (ADT – 71,000; 0.85% trucks).

Water generated from the dewatering efforts is anticipated to be returned to Accotink Creek located west of the proposed Dominion ROW. It is assumed that water would be transferred by temporary pipeline and discharged in a manner that limits erosion of existing soil/sediment or generation of turbidity and in accordance with permit requirements.

6.1.5 Lake Accotink Upper Settling Basin

The Lake Accotink Upper Settling Basin dewatering location (Figure 6-6) is an approximately 6.7-acre area located in Lake Accotink Park (County-owned) to the west of the lake. The proposed location is located entirely within Lake Accotink Park and is located in proximity to the Danbury Forest neighborhood to the north; the Lake Accotink trail, embankment, and Accotink Creek to the east; railroad tracks to the south, and the Washington Gas property to the west. The area being considered is located northwest of the lake off of the former railroad embankment that forms part of the loop trail for the park.

Use of the Lake Accotink Upper Settling Basin for sediment dewatering would require either re-routing (if possible) or closure of the Lake Accotink Trail located on the western side of the lake, including trail access points to the Danbury Forest neighborhood, for the duration of the dredging and dewatering construction.

The Lake Accotink Upper Settling Basin was previously used as a disposal site for dredged material during the 1985 dredging event. This location (identified as Basin 1 in previous reports) is the largest of the three sediment disposal basins created and is located furthest upgradient from the lake. The Lake Accotink Upper Settling Basin predominately consists of wetlands formed after the 1985 dredging event and trees are present in a portion of the basin. This basin was identified as the preferred basin for consideration by Fairfax County based on preference to limit truck access to lower basins; presence of historical culverts further down the embankment/trial; and habitat quality associated with the other basins. The existing infrastructure at the Lake Accotink Upper Settling Basin was also identified as in need of repair, which could be incorporated into the scope of the dredging project and would need to be further evaluated during the design.

Based on the presence of dredged material from the previous dredging event, it is assumed that the current surface of the Lake Accotink Upper Settling Basin dewatering area would require improvement prior to construction of dewatering pads and mobilization of equipment, especially if mechanical dewatering processes are used. The extent of improvement required would require additional geotechnical investigations to evaluate existing conditions. Additional geotechnical evaluation of the existing embankment would also be required to evaluate necessary improvements to support truck traffic; concerns with stability of the embankment in the vicinity of the Lake Accotink Upper Settling Basin have been previously noted due to the steep slope of the embankment in that area (WSSI 2018).

Based on the assumptions discussed in Section 4.2, it is anticipated that the Lake Accotink Upper Settling Basin may not be able to accommodate the lower dredging rate within the existing basin limits from the 1985 dredging event but may be able to accommodate that rate if the area can be expanded and grading can be completed. Alternatively, if the dewatering must be performed within the existing basin limits a lower production (longer schedule) may be necessary. Figure 6-6 shows a potential layout assuming passive dewatering with geotextile tubes. This location may also support mechanical dewatering provided access roads along the embankment and soil conditions with the basin are improved. Preparation of the Lake Accotink Upper Settling Basin for dewatering system construction is anticipated to include clearing (approximately 3.4 acres), grading, soil condition improvement, and channel relocation. Design and permitting of the dewatering operations would have to address work within the RPA (approximately 6.7 acres of site) and permanent impacts to WOTUS (approximately 4.1 acres) would require mitigation. Design and permitting of the dewatering operations would also have to address known archeological and cultural resources (e.g., the former railroad embankment, Civil War-era sites) located in the vicinity of the Lake Accotink Upper Settling Basin and associated access routes.

Following completion of the main dredging event, the dewatering equipment and containment pads would be removed from the site, but the constructed surface would be left in place for future maintenance dredging events. It is anticipated that the constructed surface would consist of a gravel pad that may be utilized by Fairfax County for alternate purposes between maintenance dredging events.

Dewatered material would be transported offsite by trucks. Based on the available area, it is assumed that the location would be able to accommodate the lower end of the dredge rates discussed in Section 4. Assuming an average production rate of 950 cy/day and an estimate 10 cy per truck, approximately 95 truckloads (round-trip) would be leaving the Lake Accotink Upper Settling Basin location each day during dredging and dewatering operations. Trucks would likely access this location from the access road/driveway off of Rolling Road. As previously mentioned, the stability of the embankment/trail access to the Lake Accotink Upper Settling Basin would be evaluated to identify any necessary improvements to support the anticipated type and frequency of trucks accessing the site. Traffic controls (e.g., signage, flaggers) would be required to direct truck traffic during construction and secondary truck staging area(s) may be required depending on the layout of the dewatering site and available area for truck parking while waiting to be loaded. Trucks would likely use the route identified below and shown on Figure 6-6 to access an existing state route (traffic volume information from VDOT [VDOT 2021] is provided, where available):

- Lake Accotink Park trail;
- Driveway/Access Road to Dominion and Washington Gas properties; and
- SR-638/Rolling Road (ADT – 22,000 to 29,000; 0.86% trucks).

Although the Lake Accotink Park trail and Driveway/Access Road do not directly service residential traffic, an estimated 101 non-County owned parcels, a majority of which are assumed to be residential, are located adjacent to this route based on information obtained from the Fairfax County GIS system (Jade; Fairfax County 2021). Therefore, there are likely to be noise impacts to the residences due to truck traffic along this route.

Water generated from the dewatering efforts is anticipated to be returned to Accotink Creek or Lake Accotink located east of the proposed Lake Accotink Upper Settling Basin dewatering location. It is assumed that water would be transferred by temporary pipeline and discharged in a manner that limits erosion of existing soil/sediment or generation of turbidity and in accordance with permit requirements.

6.1.6 Lake Accotink Island – Current Footprint

The Lake Accotink Island – Current Footprint dewatering location (Figure 6-7) is an approximately 3.3-acre island located within the limits of Lake Accotink in Lake Accotink Park (County-owned), that was identified based on potential to avoid installation of a pipeline alignment for sediment transport and the potential to mechanically dredge material at a higher solids content, which reduces the quantity of water to be managed. A portion of the island was created, and the island habitat improved as part of mitigation efforts associated with the 2008 dredging event. This location would utilize the extent of the existing footprint of the island for constructing a dewatering area, including this former mitigation area. Lake Accotink Island is located in proximity to residential areas to the north and east and the railroad to the south and west.

Use of the Lake Accotink Island – Current Footprint for sediment dewatering may require closure or modification of operations at the marina area for the duration of construction to facilitate transferring of trucked materials and equipment to/from barges for transport to the island. Trails are expected to remain open for the duration of construction. Use of the island for dewatering activities would require all materials and equipment to be transported by barge or similar marine equipment to the island. Depending on the draft of the barges, pre-dredging of a path between the island and marina may be required to allow the barges to pass.

Based on the assumptions discussed in Section 4.2, the Lake Accotink Island – Current Footprint dewatering location is not able to support passive dewatering of sediment by geotextile tubes (Figure 6-7) and it is assumed that material would be mechanically dredged, transported by barge to the island, and the material gravity dewatered with a drying agent. At the dewatering area, the material would be allowed to gravity dewater and then mixed with drying agent to meet requirements for offsite transportation and disposal. Preparation of the Lake Accotink Island – Current Footprint location for dewatering system construction is anticipated to include clearing (approximately 3 acres), grading, and soil condition improvement. Installation of temporary and/or permanent utilities would also be required; it is currently assumed that no such utilities exist on the island. Design and permitting of the dewatering operations would have to address work within the RPA (approximately 3 acres of site) and permanent impacts to WOTUS (approximately 3 acres) would require mitigation. The Lake Accotink Island – Current Footprint location is located entirely within the floodplain and is generally within a few feet of the water surface and would likely flood if water levels rise in the lake. Therefore, design and permitting of the dewatering operations would need to address work within the floodplain.

Following completion of the main dredging event, the dewatering equipment and containment pads would be removed from the site, but the constructed surface would be left in place for future maintenance dredging events. It is anticipated that the constructed surface would consist of a gravel pad that may be utilized by Fairfax County for alternate purposes between maintenance dredging events; although, access would be limited to water access only. Timing of future maintenance dredging events would need to consider minimum draft requirements of vessels if pre-dredging of a channel between the marina and island is to be avoided.

Dewatered material would be transported from the Lake Accotink Island – Current Footprint location by barge to the marina where it would be loaded onto trucks for offsite transportation and disposal. Based on the available area, it is assumed that the location would be able to accommodate mechanical dredging and dewatering by drying agent. Assuming an average production rate of 950 cy/day, 10% by volume of stabilization agent, and an estimate 10 cy per truck, approximately 107 truckloads (round-trip) would be leaving the marina each day during dredging and dewatering operations. Traffic controls (e.g., signage, flaggers) would be required to direct truck and park traffic during construction and secondary truck staging area(s) would be required for truck parking while waiting to be loaded. From the marina, there are three potential routes described below and shown in Figure 6-7 that may be used to access an existing state route (traffic volume information from VDOT [VDOT 2021] is provided, where available):

- Heming Avenue Route:
  - Unnamed access road from marina to the Heming Avenue parking lot
  - Heming Avenue (ADT – 990 to 4,600; 1.1% trucks)
  - SR-620/Braddock Avenue (ADT – 30,000 to 42,000; 1.5% trucks)
- Leesville Boulevard Route:
  - Unnamed access road from marina to the Heming Avenue parking lot
  - Heming Avenue (ADT – 990 to 4,100; 1.1% trucks)
  - Leesville Boulevard (ADT- 5,100; 0.90% trucks)
  - SR-617/Backlick Road (ADT – 33,000 to 35,000; 1.5% trucks)
- Highland Street Route:
  - Accotink Park Road to park entrance
- An existing historical culvert located within this stretch of road will require evaluation and monitoring to confirm no impacts from truck traffic:
  - Accotink Park Road (ADT – 2,600)
  - Highland Street (ADT – 4,000 to 5,600; 4.4% trucks)
  - SR-617/Backlick Road (ADT – 35,000; 1.5% trucks)

Based on information obtained from the Fairfax County GIS system (Jade; Fairfax County 2021), an estimated 83 non-County owned parcels are located along the Highland Street route; an estimated 115 non-County owned parcels are located along the Heming Avenue route; and an estimated 163 non-County owned parcels are along the Leesville Boulevard route. Most of these parcels are residential properties. To minimize the frequency of trucks through a specific neighborhood, truck routes may be rotated on a routine basis.

Water generated during mechanical dredging, barge transport, and gravity dewatering is expected to be significantly less than methods that require hydraulic transport of sediment by pipeline. Water that is generated from the dewatering efforts would be treated prior to being returned to Lake Accotink. Water discharge would be performed in a manner that limits erosion of existing soil/sediment or generation of turbidity and in accordance with permit requirements.

6.1.7 Lake Accotink Island – Expanded Footprint

The Lake Accotink Island – Expanded Footprint dewatering location would expand the footprint of the existing island (discussed in Section 6.1.5) to create more area for dewatering and create a land bridge to improve access to the island for construction efforts and offsite transportation of dewatered sediments. A conceptual layout for the Lake Accotink Island – Expanded Footprint dewatering site that covers approximately 10 acres is shown on Figure 6-8. Use of this location would avoid installation of a pipeline alignment for sediment transport and allow for dredging at a higher solids content via mechanical dredging similar to the Lake Accotink Island – Current Footprint. It is anticipated that the expansion would take advantage of existing sedimentation to the area north of the island, reduce the required dredging volume, and/or provide an option for reuse of dredged material in the island expansion. This option would reduce the overall surface area of Lake Accotink.

Prior to construction of the land bridge, all required materials and equipment would need to be transported from the marina area by barge or similar to the island. Depending on the draft of the barges, pre-dredging of a path between the island and marina may be required to allow the barges to pass. Marina impacts are anticipated to be similar to those described in Section 6.1.5 if barge transport is used. The duration of marina impacts may be reduced if the constructed land bridge is utilized for truck transport. If trucks and associated construction vehicles access the Lake Accotink Island – Expanded Footprint dewatering location via the land bridge, trail closure or interruptions to the Cross-County Trail (CCT) would be expected for the duration of such transport to allow trucks to access existing roadways (e.g., Hatteras/Queensberry or Accotink Park Road if existing Flag Run bridge can support traffic).

Based on the assumptions discussed in Section 4.2, the Lake Accotink Island – Expanded Footprint could be designed to accommodate a range of dewatering technologies, dredging methods, and dredge production rates. Because of the available area, the example layout for passive dewatering with geotextile tubes is shown for the 1,250 cy/day dredge rate on Figure 6-8. Preparation of the Lake Accotink Island – Expanded Footprint for dewatering system construction is anticipated to include clearing (approximately 5.5 acres), grading, and soil condition improvement of the existing island, and construction of the land bridge to create the expanded island. Additional geotechnical investigation would be required to support design of a land bridge that is able to accommodate the anticipated traffic for the project and protect the sewer crossing beneath Lake Accotink in this area. In addition to considerations for constructing within the floodplain discussed in Section 6.1.5, filling in of a portion of Lake Accotink for creation of the land bridge would require special design and permitting considerations associated with filling in WOTUS. Additionally, design and permitting of the dewatering construction and operations will have to address work within the RPA (approximately 10 acres of site) and permanent impacts to WOTUS (approximately 4.4 acres) would require mitigation.

Once constructed, it is assumed that the land bridge would be maintained for future maintenance dredging events. Following completion of the base dredging event, the dewatering equipment and containment pads would be removed from the site but the constructed surface would be left in place for future maintenance dredging events. It is anticipated that the constructed surface would consist of a gravel pad that may be utilized by Fairfax County for alternate purposes between maintenance dredging events.

Dewatered material would be transported from the Lake Accotink Island – Expanded Footprint using a similar method/route as described in Section 6.1.5 or by truck directly from the expanded island. Assuming an average production rate of 950 cy/day to 1,250 cy/day and an estimate 10 cy per truck, up to approximately 95 to 125 truckloads (round-trip) could be transported offsite each day during dredging and dewatering operations. Traffic controls (e.g., signage, flaggers) would be required to direct truck and park traffic during construction and secondary truck staging area(s) would be required for staging of trucks waiting to be loaded if insufficient suitable space is available within the expanded island footprint. Potential truck routes from the Lake Accotink Island – Expanded Footprint are shown in Figure 6-8. In addition to the routes identified in Section 6.1.5, which can be used for trucks either loaded at the marina or driving from the land bridge to the marina via the CCT (provided the Flag Run bridge can support intended traffic), there is one additional potential route described below that may be used to access an existing state route from the land bridge (traffic volume information from VDOT [VDOT 2021] is provided, where available):

- Queensberry Avenue:
  - CCT;
  - Hatteras Lane (ADT – 530);
  - Queensberry Avenue (ADT – 3,900; 1.4% trucks); and
  - SR-620/Braddock Avenue (ADT – 71,000; 0.85% trucks).

Based on information obtained from the Fairfax County GIS system (Jade; Fairfax County 2021), an estimated 99 non-County owned parcels are located along the Queensberry Avenue route and most of these parcels are residential properties.

Water generated during mechanical dredging would be managed as described in Section 6.1.5. If hydraulic dredging is performed and water quality from passive or mechanical dewatering meets discharge criteria, water may be returned to Lake Accotink either via overland flow or discharged via a temporary pipe. Water will be discharged in a manner that limits erosion of existing soil/sediment or generation of turbidity and in accordance with permit requirements.

6.1.8 Concrete Plant

The Concrete Plant dewatering location (Figure 6-9) is an approximately 18-acre site located adjacent to a residential area to the north and industrial/commercial areas to the south, east, and west. The Concrete Plant was previously used during the 2008 dredging event as the final disposal location for dredged material. The property is not owned by Fairfax County; therefore, an access agreement would be required in order to utilize this site for dewatering for both the base dredging event and future maintenance dredging events.

Based on review of aerial survey and available Fairfax County data, the existing surface is relatively flat, currently grass covered with no trees within the potential dewatering site limits. The area available would be able to accommodate a range of dewatering technologies and dredge production rates based on assumptions discussed in Section 4.2. Because of the available area, the example layout for passive dewatering with geotextile tubes is shown for the 1,250 cy/day dredge rate is shown on Figure 6-9. The Concrete Plant is located outside of floodplains and there are no known wetlands within the limits. An RPA is located along the southwest boundary of the proposed limits (approximately 1 acre); however, disturbance of the RPA could be avoided given the available area at this location.

Based on the presence of dredged material from the previous dredging event and anecdotal information from the property owner that drill rigs have become stuck in this area, it is assumed that the current surface of the Concrete Plant dewatering area would require improvement prior to construction of dewatering pad and mobilization of equipment, especially if mechanical dewatering processes are used.

Dewatered material would be transported offsite by trucks. Based on the available area, it is assumed that a wide range of dredge productions could be accommodated. Using the 950 cy/day to 1,250 cy/day discussed in Section 4, an estimated 95 to 125 truckloads (round-trip) would be leaving the Concrete Plant each day during the dredging and dewatering operations. Trucks would likely use the route identified below and shown on Figure 6-9 to access an existing state route (traffic volume information from VDOT [VDOT 2021] is provided, where available):

- Industrial Drive (ADT – 7,700; 13.6% trucks); and
- SR-648/Edsall Road (ADT – 20,000 to 42,000; 2.2% trucks.

Water generated from the dewatering efforts would either need to be pumped back to Lake Accotink following a similar pipeline alignment as the sediment slurry pipeline or discharged into the local watershed if no adverse effects from water drawdown are anticipated at Lake Accotink. Water would be discharged in a manner that limits erosion of existing soil/sediment or generation of turbidity and in accordance with permit requirements.

6.2 Sediment Transport Pipeline Alignments

This section describes the development of pipeline alignment options for transporting slurried sediment from Lake Accotink to the alternative sediment dewatering locations discussed in Section 6.1. The various pipeline alignments were developed and coordinated with input from County staff and other project stakeholders.

Multiple pipeline alignments were considered for the four dewatering locations north of Braddock Road, which include Howrey Field, the Wakefield Park Maintenance Facility, the Wakefield Ball Fields, and the Dominion ROW. The associated pipeline alignments that were considered include the CCT, Queensberry Avenue, Flag Run/Port Royal, Flag Run/I-495. Additionally, two alignments were considered for the Concrete Plant (residential alignment and Amtrak ROW) and one alignment to the Upper Settling Basin dewatering locations.

A brief description of each alignment and primary reasons for considering each alignment are provided in this section.

All pipeline alignments were developed based on the following assumptions:

1. **Permanent or Temporary Pipeline**: The County's plan is to provide infrastructure for the dredging project that will allow not only the initial dredge but the subsequent maintenance dredging events. Therefore, the team evaluated all alignment alternatives based on the assumption that the slurry transport pipeline will be a permanent County-owned pipeline, except in a few alternatives where a permanent pipeline is not feasible or needed.
2. **Pipe Material**: All alternatives are evaluated based on the pipe material being ductile iron (DI). DI pipe has a life expectancy of 50+ years when installed correctly and protected from corrosion, loads, or

pressures beyond its recommended capabilities. Although high-density-polyethylene (HDPE) pipe was used in previous temporary dredging operations, HDPE pipe is not identified as a permanently installed buried pipeline material option for this analysis due to considerations of long-term loading performance and potential for internal scour causing reduced wall thickness.

3. **Trenchless Technology Adopted**: Pipeline alignments conveying sediment slurry from the dredge site to dewatering locations north of Braddock Road would need to cross underneath Braddock Road. To minimize traffic and community impacts, all Braddock Road sub-surface crossings would require a trenchless installation option. This AA Report assumes a jack-and-bore crossing for each alignment, as jack-and-bore can be constructed using DI pipe and it is the optimal trenchless method for the length, depth, and diameter of the anticipated slurry pipelines.
4. **Buried or Above-ground Pipeline**: Alternatives initially considered included both buried and above-ground options. However, the alignments are evaluated assuming a buried pipeline, except in a few alternatives where burying the pipeline is not feasible. A direct-buried pipeline has several benefits compared to the above-ground alternative – (a) be able to utilize a DI pipe installation that is robust, reliable, and long-lasting; (b) buried pipes are less prone to vandalism or other safety risks; and (c) buried DI pipe has the benefit of not requiring repeated installation and teardown as would be required for an above-ground temporary pipeline.
5. **Booster Pumping**: Initial pumping operations at Lake Accotink have a limitation of how far dredge slurry material can be pumped due to the inherent limitation in the pump technology. Therefore, booster pumps at intermediate locations along the alignment, are considered to help maintain system pressure and material velocity. The location and number of booster pumps are primarily based on the total length of the pipe and required total dynamic system head.

6.2.1 Cross-County Trail

The CCT alignment included in the alternatives analysis runs from the west side of Lake Accotink to Wakefield Park and the Dominion ROW easement and is approximately 2 miles long. The CCT is a combination of asphalt, stone dust, and natural surface surrounded by a variety of vegetation and forest. It is in an RPA and within floodplains.

Each alignment for the CCT is within Fairfax County or FCPA property except for one parcel prior to the Braddock Road Crossing. All four alignments follow the western side of Lake Accotink and extend approximately 1.1 miles to Braddock Road.

The differences between the alignments after the Braddock Road crossing are explained below.

Howrey Field

As shown on Figure 6-10A, after the CCT alignment crosses Braddock Road it turns west for the remaining 0.2 mile and follows a trail that parallels Braddock Road until it crosses Glen Park Road to enter Howrey Field.

Wakefield Park Maintenance Facility

As shown on Figure 6-10B, after the CCT alignment crosses Braddock Road it continues north along the paved trail for 0.15 mile. The alignment then runs parallel with the trail to enter the maintenance facility.

Wakefield Ball Fields

As shown on Figure 6-10C, after the CCT alignment crosses Braddock Road it continues north along the paved trail for 0.4 mile until it reaches the first baseball field to the left of Wakefield Road. It then continues for another 0.1 mile in a heavily vegetated area until it reaches the northern-most baseball field next to the Wakefield Recreation Center.

Dominion ROW

As shown on Figure 6-10D, after the CCT alignment crosses Braddock Road it continues north for another mile paralleling the existing trail to enter the Dominion ROW area.

6.2.2 Queensberry Avenue

All Queensberry Avenue alignments start north of Lake Accotink and follow the Lake Accotink trail (between Inverchapel road and Ravenel Lane) to Hatteras Lane, then turn east towards Queensberry Avenue and follow Queensberry Avenue for approximately 0.8 mile to Braddock Road. Queensberry Avenue is a VDOT-owned two lane road with a bike lane on either side and additional parking lanes.

The differences between the Queensberry Avenue alignments after the Braddock Road crossing are explained below:

Howrey Field

As shown on Figure 6-11A, after the Queensberry Avenue alignment crosses Braddock Road it continues west and parallels Braddock Road, crossing Wakefield Park, Accotink Creek, and Glen Park Road for an additional 0.3 mile to enter Howrey Field.

Wakefield Park Maintenance Facility

As shown on Figure 6-11B, after the Queensberry Avenue alignment crosses Braddock Road it continues north along Wakefield Park until it reaches the Maintenance Facility.

Wakefield Ball Fields

As shown on Figure 6-11C, after the Queensberry Avenue alignment crosses Braddock Road it continues north for approximately 0.3 mile along Wakefield Park until it reaches the service entrance near the Audrey Moore Recreation Center. It then continues west for approximately 0.2 mile until it reaches the northern-most baseball field.

Dominion ROW

As shown on Figure 6-11D, after crossing Braddock Road the Queensberry Avenue alignment traverses through Wakefield Park for 0.7 mile until it reaches the Dominion ROW.

6.2.3 Flag Run/Port Royal Road

Flag Run is 3.1-acre riverine habitat that joins Lake Accotink next to the Lake Accotink Marina and extends into North Springfield by Elgar Street. At the mouth of Flag Run and Lake Accotink, there is approximately 300 feet of slack water. The Flag Run/Port Royal Road pipeline alignment begins by Lake Accotink Marina and extends northeast, parallel to Flag Run, until it is perpendicular with Port Royal Road where it runs northwest through a commercial property parking lot. The alignment continues for approximately 1.5 miles within the VDOT ROW along Port Royal Road until it intersects with Braddock Road.

The differences between the Flag Run/Port Royal Road alignments after the Braddock Road crossing are explained below:

Howrey Field

As shown on Figure 6-12A, after crossing Braddock Road the Flag Run/Port Royal Road pipeline alignment turns west and parallels Braddock Road for 0.35 mile, including crossing of Accotink Creek and through a heavily vegetated/wooded area on the Wakefield Park property, until it reaches Howrey Field Park.

Wakefield Park Maintenance Facility

As shown on Figure 6-12B, after crossing Braddock Road the Flag Run/Port Royal Road pipeline alignment turns west along Wakefield Park property, through a heavily vegetated and wooded area, for 0.05 mile until it reaches the Wakefield Park Maintenance Facility.

Wakefield Ball Fields

As shown on Figure 6-12C, after crossing Braddock Road the Flag Run/Port Royal Road pipeline alignment turns west along Wakefield Park property then traverses through a heavily vegetated and wooded area and crosses over Wakefield Park Road. Subsequently, the alignment follows Wakefield Park Road until the service entrance for the Audrey Moore Recreation Center where it turns west towards the northern-most baseball field.

Dominion ROW

As shown on Figure 6-12D, after crossing Braddock Road the Flag Run/Port Royal Road pipeline alignment turns east towards an existing trail. It then continues north for approximately 0.7 mile paralleling I-495 until it reaches the Dominion ROW dewatering location.

6.2.4 Flag Run/Interstate 495

This alignment follows the same path along Flag Run as described in Section 6.2.3; however, this alignment continues past the commercial/industrial area to the boundary strip between the industrial area parking lots and the I-495 sound barriers. The alignment then turns northwest along the boundary strip to the I-495 south bound ramp to cross Braddock Road. Total distance from the Lake Accotink Marina to Braddock Road is approximately 1.5 miles.

The differences between the alignments after the Braddock Road crossing are explained below:

Howrey Field

As shown on Figure 6-13A, after crossing Braddock Road the Flag Run/I-495 pipeline alignment turns west and parallels Braddock Road. The alignment then runs for approximately 0.7 mile across the heavily vegetated and forested area along Wakefield Park, Accotink Creek, and Glen Park Road.

Wakefield Park Maintenance Facility

As shown on Figure 6-13B, after crossing Braddock Road the Flag Run/I-495 pipeline alignment turns west and parallels Braddock Road for approximately 0.2 mile until it reaches the maintenance facility.

Wakefield Ball Fields

As shown on Figure 6-13C, following the trenchless crossing at Braddock Road the Flag Run/I-495 pipeline alignment turns west along Wakefield Park property then traverses through a heavily vegetated and wooded area and crosses over Wakefield Park Road. Subsequently, the alignment follows Wakefield Park Road until the service entrance for the Audrey Moore Recreation Center where it turns west towards the northern-most baseball field.

Dominion ROW

As shown on Figure 6-13D, after crossing Braddock Road the Flag Run/I-495 pipeline alignment continues for approximately 0.7 mile north following a trail that parallels I-495 until it reaches the Dominion ROW.

6.2.5 Lake Accotink Upper Settling Basin

The 1985 dredging project ran a 0.7-mile temporary above-ground dewatering pipeline from the southwest side of Lake Accotink trail, near the existing dam, to an onsite dewatering location along the northwest trail. Evaluation of the same alignment is considered for the dredging project. The pipeline alignment is within FCPA property and will not require any property easements or coordination with other stakeholders such as VDOT. However, it will run parallel to the historic wooden trestle of the Civil War railroad as shown on Figure 6-14.

6.2.6 Amtrak ROW to the Concrete Plant

The 2015 dredging project ran a temporary above ground pipeline from the lower-level parking lot of Lake Accotink along the Amtrak ROW to the Concrete Plant. As shown on Figure 6-16, the pipeline route for the alternatives analysis follows the same alignment, with a crossing under Robinson Terminal, then continues along the railway ROW until it intersects with Industrial Way and continues along Industrial Way to the Concrete Plant site. The total alignment length is approximately 3.3 miles.

6.2.7 Residential Route to the Concrete Plant

This alignment is an alternative route option for the Concrete Plant dewatering location. As shown on Figure 6-15, it begins near the Lake Accotink dam and follows the existing trail to the northeast through a heavily wooded and vegetated area until it reaches a residential complex. To minimize access and parking disturbances to the residential complex, the alignment will be routed through backyards for 0.73 mile, then cross under I-495 and traverse along the west side of the Robinson Terminal Warehouse until it reaches Leesville Boulevard. Continuing east on Leesville Boulevard, the alignment then turns south along Backlick Road and turns east again along Industrial Road until Industrial Drive, where after approximately 0.38 mile it reaches the Concrete Plant on Industrial Road. The Residential Route Alignment comprises approximately 2.0 miles within VDOT ROW and approximately 0.4 mile within County Park property. The total alignment length is approximately 3.1 miles.

6.3 Initial Screening

Following discussion with Fairfax County and FCPA staff and other project stakeholders, the following alternatives were eliminated from further consideration:

- Dewatering Locations:
  - The Wakefield Ball Fields dewatering location was removed from consideration due to legal considerations and the inability to replace a facility that meets Title IX obligations.

  - The Concrete Plant dewatering location was removed from consideration at the property owner's request because the proposed dewatering operation is not compatible with planned uses for the property.
- Sediment Transport Pipeline Alignments:
  - All Queensberry Avenue pipeline alignments were removed from consideration due to concerns associated with constructability and associated community impacts and cost.

The remaining combination of dewatering locations and pipeline alignments that define the alternatives retained and discussed in Section 7 include:

- Howrey Field via CCT;
- Howrey Field via Flag Run/Port Royal Road;
- Howrey Field via Flag Run/I-495;
- Wakefield Park Maintenance Facility via CCT;
- Wakefield Park Maintenance Facility via Flag Run/Port Royal Road;
- Wakefield Park Maintenance Facility via Flag Run/I-495;
- Dominion ROW via CCT;
- Dominion ROW via Flag Run/Port Royal Road;
- Dominion ROW via Flag Run/I-495;
- Lake Accotink Upper Settling Basin;
- Lake Accotink Island - Current Footprint; and
- Lake Accotink Island - Expanded Footprint.

7 Analysis of Retained Alternatives

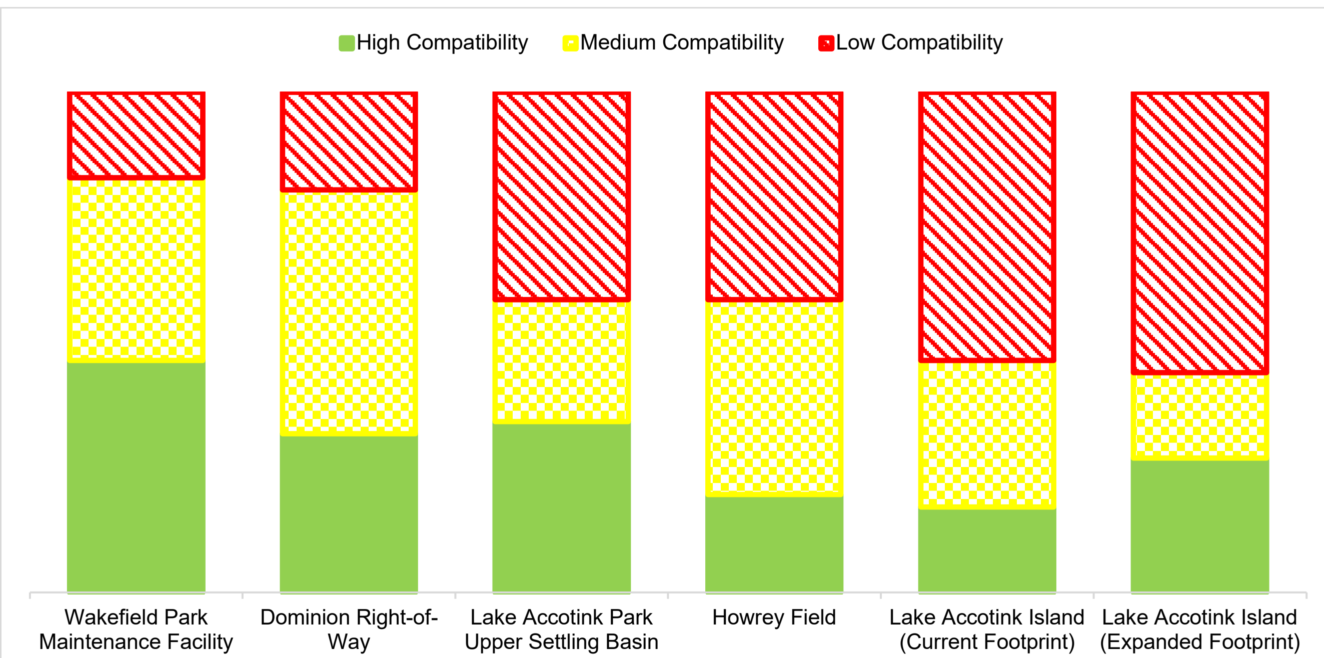
This section details the evaluations completed for each of the alternative components, i.e., combinations of dewatering location and pipeline alignment, that were retained for consideration. The section describes the key advantages and disadvantages, as well as the potential unknowns for each alternative.

7.1 Dewatering Locations

Results of the dewatering location analysis are presented in Exhibit 4. Each dewatering location was evaluated against criteria identified in Section 3 and associated sub-criteria developed for evaluating the potential dewatering locations. A compatibility rating of low, medium, or high was assigned to each of the sub-criterion based on the descriptions indicated in Exhibit 4.

The chart below summarizes distribution of high compatibility, medium compatibility, and low compatibility ratings for each of the retained dewatering locations with the location with the lowest number of low compatibility ratings shown on the left and increasing to the right. No weighting of any criteria or sub-criteria was performed and the key advantages, challenges, and unknowns associated with each dewatering location are summarized below.

Chart 7-1 – Dewatering Location Analysis Summary



7.1.1 Wakefield Park Maintenance Facility

<u>Key Advantages</u>

- Avoids closure of park facilities and limits park use impacts to potential trail rerouting, which can be performed in the same general vicinity to connect existing trails.

- Minimizes potential residential impacts (e.g., noise or truck traffic) due to the distance between the dewatering location and closest residential areas.
- Constructed surface can be maintained for long-term use to support future maintenance dredging.

Key Challenges

- Extent of clearing necessary to develop site for dewatering operations. Loss of tree cover would be a permanent impact as the location would need to be maintained as a clearing for future dredging events.

Unknowns

- The extent that the Braddock Road Multimodal Improvements Project would reduce the available footprint for constructing the dewatering area.

7.1.2 Dominion ROW

Key Advantages

- Avoids trees and WOTUS impacts by using the existing cleared area maintained as part of the ROW.
- Constructed surface can be maintained for long-term use to support future maintenance dredging.

Key Challenges

- Construction within the floodplain, which would require special handling during design, permitting, and construction. However, based on the relative location and elevation of the area the identified section of the ROW is anticipated to flood less frequently than ROW areas closer to Lake Accotink.
- Accessibility and truck access for mobilization of equipment and materials as well as offsite transport of dewatered sediment. Location would require construction traffic to traverse the full length of the Wakefield Park access road which would potentially impact park traffic for the duration of the construction. Additionally, within the dewatering location, existing trails would be used as main access point and may require widening to allow for larger trucks to access the site (if necessary for equipment mobilization); these trails would be closed to public access for the duration of the construction effort.

Unknowns

- Use of this location would require coordination and approval from Dominion. The work would have to conform to Dominion’s requirements for work within the utility easement. Dominion’s requirements may change over time as standards change and/or utility structures are constructed or modified. Actual restrictions would be directed by Dominion but may include:
  - Minimum offsets from existing utility structures that would limit the area and locations available for construction of the dewatering area.
  - Minimum clearances required that would limit either the stacking height of geotextile tubes, size of stockpiles, and/or size of equipment that can be placed within the utility easement.

7.1.3 Lake Accotink Upper Settling Basin

Key Advantages

- Proximity to lake allows for ease of returning separated water to Lake Accotink and minimizes length of piping necessary to hydraulically transport sediment from the dredge to the dewatering area.

- Constructed surface can be maintained for long-term use to support future maintenance dredging.
- Located outside the floodplain resulting in lower likelihood of flood-related impacts to operations or site access.

Key Challenges

- Ability to expand footprint outside of previous limits of disturbance to accommodate production rates while maintaining slope stability and/or potential for longer construction time due to lower production rates.
- Truck access along existing trail, which would likely:
  - Result in closure or significant public use restrictions for the duration to construction to maintain public safety while allowing for construction access.
  - Result in noise related traffic impacts to residential properties that back to the trail.
  - Require additional investigations, improvements, and/or monitoring of the embankment stability to confirm ability to support anticipated truck traffic.
- Permanent WOTUS impacts and mitigation requirements associated with developing the site and need to reroute and existing channel.

Unknowns

- Surface and subsurface conditions within the basin, specifically as it relates to the extent of require surface preparation to create a stable surface to support the selected dewatering method.
- Stability of the embankment in the vicinity of the proposed limits of disturbance.
- Condition of infrastructure installed during the 1985 dredging event and extent of repairs needed create a serviceable dewatering area.
- Potential impacts to known cultural resources (e.g., former railroad embankment) and extent of other cultural resources within the area that may be disturbed. Efforts would be made to limit work to within the limits of work associated with 1985 dredging event to avoid any cultural resources outside this area.

7.1.4 Howrey Field

Key Advantages

- Accessibility of site from Braddock Road and Glen Park Road anticipated to minimize potential truck traffic impacts on surrounding community.

Key Challenges

- The existing memorial would require protection and/or restoration as part of the base dredging event and subsequent maintenance dredging event if maintained in the same location. Alternatively, a new memorial agreeable to the community would need to be constructed in a location that supports future dredging events.
- Park would be closed to public use for the duration of construction.
- Restoration and remobilization efforts anticipated to be more complex as the fields would have to be restored between dredging events.

Unknowns

- The extent that the Braddock Road Multimodal Improvements Project would reduce the available footprint for constructing the dewatering area.

7.1.5 Lake Accotink Island – Current Footprint

Key Advantages

- No permanent pipeline required for transport of dredged material to dewatering area.
- Ability to dredge material at higher solids content and reduce quantity of water requiring management at the dewatering area.
- Ease of returning water generated during dewatering event based on proximity to lake.

Key Challenges

- Limited footprint for dewatering area restricts feasible options available to contractor for dredging and dewatering.
- Offsite transportation of dewatered sediment requires travel through residential areas which would be impacted due to increased truck traffic and noise.
- Construction of permanent dewatering location would result in loss of existing WOTUS (including wetlands installed as part of the 2008 mitigation efforts).
- Located fully within floodplain and existing elevation is within a few feet of the existing water surface indicating area will be prone to flooding. The design and construction would need to account for constructing within the floodplain, controls to minimize impacts of flooding, and potential downtime associated with lost days of work due to flooding.
- All access to the dewatering area would be by barge. Pre-dredging may be required to provide sufficient water depth to allow for transport of materials and equipment by barge. Multiple barges may be necessary for transporting material within the lake. Depending on activity level anticipated, closure of the lake to public use may be required as a safety measure.

Unknowns

- Surface and subsurface conditions on the island, specifically as it relates to the extent of required surface preparation necessary to create a stable surface to support the selected dewatering method.

7.1.6 Lake Accotink Island – Expanded Footprint

Key Advantages

- No permanent pipeline required for transport of dredged material to dewatering area.
- Ability to dredge material at higher solids content and reduce quantity of water requiring management at the dewatering area.
- Ease of returning water generated during dewatering event based on proximity to lake.
- Ability to design and construct necessary area to support multiple dewatering methods and/or production rates.

Key Challenges

- Reduces overall surface area of Lake Accotink, which may impact recreational use of the lake in that area.
- Offsite transportation of dewatered sediment requires travel through residential areas, which would be impacted due to increased truck traffic and noise.

- Closure or significant public use restrictions on portions of the CCT for the duration to construction to maintain public safety while accommodating truck access along the existing trail.
- Construction of permanent dewatering location would result in loss of existing WOTUS (including wetlands installed as part of the 2008 mitigation efforts).
- Located fully within floodplain and existing elevation is within a few feet of the existing water surface indicating area will be prone to flooding. The design and construction would need to account for constructing within the floodplain, controls to minimize impacts of flooding, and potential downtime associated with lost days of work due to flooding.
- Initial access to the dewatering area would be by barge. Pre-dredging may be required to provide sufficient water depth to allow for transport of materials and equipment by barge. This challenge is anticipated to occur for the base dredging event only as maintenance dredging Access is assumed to be via the constructed land bridge.

Unknowns

- Surface and subsurface conditions of the island and proposed land bridge area, specifically as it relates to the extent of required surface preparation necessary to create a stable surface to support the selected dewatering method and protect the existing sewer located within the proposed land bridge area.

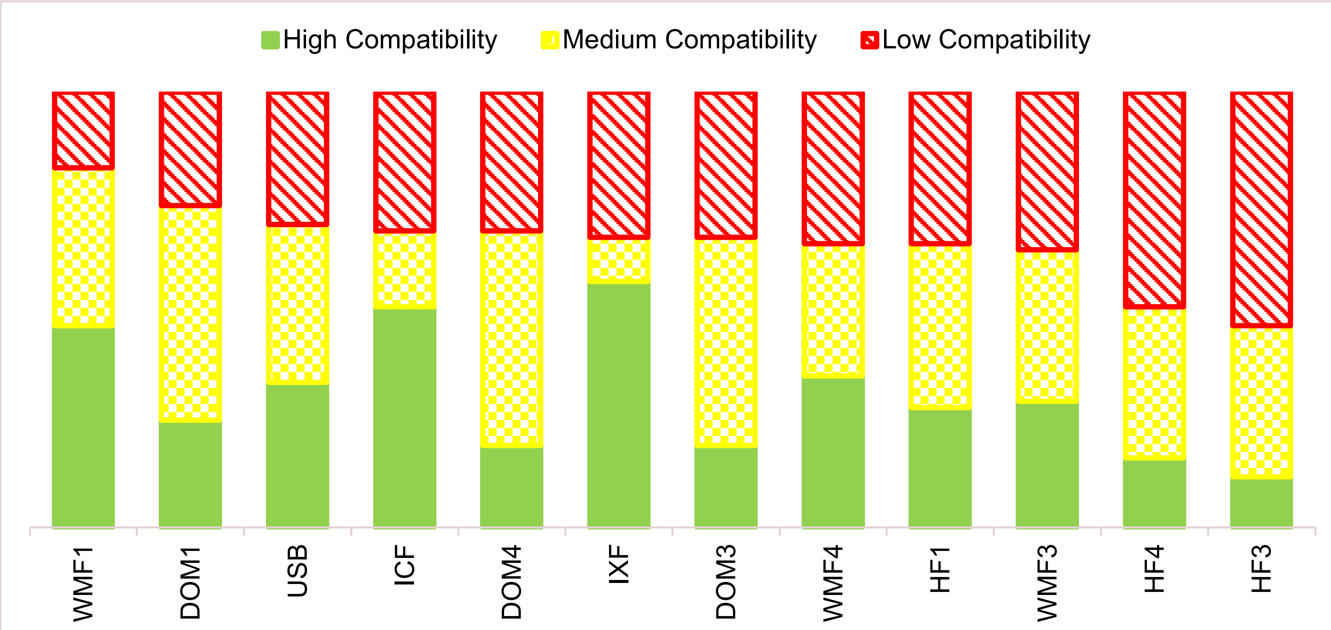
7.2 Combined Dewatering Locations and Pipeline Alternatives

Results of the pipeline alternative screening evaluation are presented in Exhibit 5. Each pipeline alternative was evaluated against screening criteria identified in Section 3 and associated sub-criteria developed for evaluating the potential pipeline alignments. A compatibility rating of low, medium, or high was assigned to each of the sub-criteria based on the descriptions indicated in Exhibit 5.

The chart below summarizes the distribution of high compatibility, medium compatibility, and low compatibility ratings for each of the retained pipeline alternatives when combined with the results of the dewatering location evaluation (discussed in Section 7.1). The combined dewatering location/pipeline alternatives are presented with the lowest number of low compatibility ratings shown on the left and increasing to the right; where alternatives have a similar number of low compatibility ratings, the alternative with the greatest number of high compatibility ratings is shown first. No weighting of any criteria or sub-criteria was performed and the key advantages, challenges and unknowns associated with each alternative are summarized below[1].

[1] WMF2, DOM2, and HF2 were removed due to Queensberry Avenue, as described in Section 6.3, and are not discussed in this section.

Chart 7-2 – Combined Dewatering Location and Pipeline Alignment Analysis Summary



7.2.1 WMF1 – Wakefield Park Maintenance Facility Via Cross-County Trail

Key advantages, challenges, and unknowns associated with the Wakefield Park Maintenance Facility are presented in Section 7.1.1. Below are the key advantages, challenges, and unknowns associated with the CCT pipeline alignment to the Wakefield Park Maintenance Facility.

Key Advantages

- Potential for improvement to trails post-construction.
- Majority of alignment is on County-owned property. Easement negotiation is required for the Ravensworth Homeowners Association parcel adjacent to the Braddock Road crossing.
- Temporary impacts to the CCT as the impacts are only during construction of the pipeline. Once the pipeline is installed, below grade, the trail will be open to the public.
- Minimal traffic impact. Temporary lane closure around construction access sites- Inverchapel Road or Ellet Road.
- Minimal utility crossings of water mains, sanitary sewers, and large power and electric lines.
- Booster pumping is not anticipated to be required based on low total dynamic head for pipeline alignment.

Key Challenges

- Proximity to residential neighborhood. Recreational use of the trail will be closed to nearby neighborhoods during construction of the pipeline. However, depending on the contractor's means and methods, work can be performed where only smaller sections of the trails are closed keeping certain sections open to the public.

- High water table. Construction may require dewatering and support of the below grade pipeline depending on soil and water table.
- Majority of alignment is within floodplain and RPA, which can lead to extensive permitting and mitigation efforts.
- Crossing Dominion ROW will require coordination with Dominion to avoid structures.

Unknowns

- Subsurface conditions between Lake Accotink and Braddock Road – soil conditions unsuitable for a buried DI pipe installation and high water table close to the Accotink Creek may impact installation schedule and costs. This unknown can be minimized by performing adequate soil borings along the proposed alignment.
- Subsurface conditions under Braddock Road – presence of rock at the depth required for jack-and-bore has the potential to increase trenchless installation schedule and costs. This unknown can be minimized by performing adequate soil borings on either side of Braddock Road.

7.2.2 DOM1 – Dominion ROW via Cross-County Trail

Key advantages, challenges, and unknowns associated with the Dominion ROW dewatering location are presented in Section 7.1.2. Below are the key advantages, challenges, and unknowns associated with the CCT pipeline alignment to the Dominion ROW.

Key Advantages

- Potential for improvement to trails post-construction.
- Majority of alignment is on County-owned property. Easement negotiation is required for the parcel just south of the Braddock Road crossing.
- Temporary impacts to the CCT. Impacts are associated during construction of the pipeline. Once the pipeline is installed, below grade, the trail will be open to the public.
- Minimal traffic impact. Temporary lane closure around construction access sites; Inver Chapel Road or Ellet Road. Impacts to Glen Park Avenue for perpendicular pipe crossing will have short-term detour.
- Minimal utility crossings of water mains, sanitary sewers, and large power and electric lines.

Key Challenges

- Proximity to residential neighborhood. Recreational use of the trail will be closed to nearby neighborhoods during construction of the pipeline. However, depending on the contractor's means and methods, work can be performed where only smaller sections of the trails are closed keeping certain sections open to the public.
- Long pipeline length at approximately 2.0 miles. This increases the construction costs, schedule and will require at least one intermediate booster pump system.
- High water table along the trail. Construction may require dewatering and support of the below grade pipeline depending on soil and water table.
- Majority of alignment is within floodplain and RPA, which can lead to extensive permitting and mitigation efforts.
- Crossing Dominion ROW will require coordination with Dominion to avoid structures.

Unknowns

- Subsurface conditions between Lake Accotink and Braddock Road – soil conditions unsuitable for a buried DI pipe installation and high water table close to the Accotink Creek may impact installation schedule and costs. This unknown can be minimized by performing adequate soil borings along the proposed alignment.
- Subsurface conditions under Braddock Road – presence of rock at the depth required for jack-and-bore has the potential to increase trenchless installation schedule and costs. This unknown can be minimized by performing adequate soil borings on either side of Braddock Road.

7.2.3 USB – Lake Accotink Upper Settling Basin

Key advantages, challenges, and unknowns associated with the Lake Accotink Upper Settling Basin are presented in Section 7.1.3. Below are the key advantages, disadvantages, and unknowns associated with the trail pipeline alignment.

Key Advantages

- Short pipeline length (0.7 mile) –shortest excavation length and therefore, shorter anticipated construction schedule compared to other alignments.
- Minimal impact to businesses and residents. Alignment is along Lake Accotink Park property and the trail surrounded by woods. At the end of the alignment is a nearby residential neighborhood but is not anticipated to be impacted by noise, dust, or other pipeline construction activities.

Key Challenges

- Elevation difference between the start of the alignment (surface of the lake) to the settling basin is 70 feet – this will likely require one or two intermediate booster pumping system(s) along the alignment to be able to pump the slurry to the settling basin.
- Recreational impacts during pipeline construction. The northwest trail alignment will be closed to allow for construction vehicles and pipeline installation. Southern parking lot will have impacts for site access with construction vehicles and potential staging area.
- Impacts to historic wooden trestle, Civil War railroad. Large construction vehicles will be driving along the path with the wooden trestles throughout duration of construction.
- High water table and limited space. There is limited space on either side of the trail in certain areas.

Unknowns

- Subsurface conditions along the northwest trail – soil borings along the alignment will be needed to better understand the soil conditions and determine suitability for excavation and pipe installation.

7.2.4 ICF – Lake Accotink Island - Current Footprint

Key advantages, challenges, and unknowns associated with the Lake Accotink Island - Current Footprint dewatering location are presented in Section 7.1.5. With this dewatering location, no permanent pipeline is anticipated; therefore, all pipeline criteria are assumed to have high compatibility with all selection criteria.

7.2.5 DOM4 – Dominion ROW via Flag Run/I-495

Key advantages, challenges, and unknowns associated with the Dominion ROW dewatering location are presented in Section 7.1.2. Below are the key advantages, challenges, and unknowns associated with the Flag Run/I-495 pipeline alignment to the Dominion ROW.

Key Advantages

- Short-term recreational impact around Lake Accotink Park. Construction noise and disturbance to Lake Accotink Marina is limited to initial mobilization and the first few segments of pipeline installation; therefore, impacts are short-term.
- Less traffic impacts. Pipeline alignment is behind commercial properties. Impact to traffic is with construction vehicles accessing sites.
- Minimal residential impacts. Area is surrounded by parkland and forested area. Majority of pipeline alignment is behind commercial/industrial properties.

Key Challenges

- Potential impacts to bridge and trail access near Flag Run during construction, main, and maintenance dredging due to above-ground temporary pipe along Flag Run.
- Easement agreements with commercial properties. To construct the pipeline easement negotiations are required from the various commercial properties, due to limited space between edge of commercial properties and I-495 barriers.
- Prevalence of high water table near Lake Accotink Park and along Flag Run and many steep slopes and valleys pose constructability challenges for pipeline construction. Additionally, this area is an undisturbed forested area and pipeline construction will likely require clearing of approximately 2 acres.
- Long pipe length (2.5 miles) and high difference in elevation (105 feet) will increase cost, construction schedule, and require booster pumping.

Unknowns

- Subsurface conditions between Lake Accotink and Braddock Road and on far east side of Wakefield Park property (near I-495) – soil conditions unsuitable for a buried DI pipe installation and high water table close to the Accotink Creek may impact installation schedule and costs. This unknown can be minimized by performing adequate soil borings along the proposed alignment.

7.2.6 IXF – Lake Accotink Island - Expanded Footprint

Key advantages, challenges, and unknowns associated with the Lake Accotink Island - Expanded Footprint dewatering location are presented in Section 7.1.6. With this dewatering location, no permanent pipeline is anticipated; therefore, all pipeline criteria are assumed to have high compatibility with all selection criteria.

7.2.7 DOM3 – Dominion ROW via Flag Run/Port Royal Road

Key advantages, challenges, and unknowns associated with the Dominion ROW dewatering location are presented in Section 7.1.2. Below are the key advantages, challenges, and unknowns associated with the Flag Run/Port Royal Road pipeline alignment to the Dominion ROW.

Key Advantages

- Short-term recreational impact around Lake Accotink Park. Construction noise and disturbance to Lake Accotink Marina is limited to initial mobilization and the first few segments of pipeline installation.
- Minimal residential impacts. Area is surrounded by parkland and forested area. Majority of pipeline alignment is along Port Royal Road which is surrounded by commercial properties.

Key Challenges

- Potential impacts to bridge and trail access near Flag Run during construction, main, and maintenance dredging due to above-ground temporary pipe along Flag Run.
- Prevalence of high water table near Lake Accotink Park and along Flag Run and many steep slopes and valleys pose constructability challenges for pipeline construction. Additionally, this area is an undisturbed forested area and pipeline construction will likely require clearing of approximately 2 acres.
- Long pipe length (2.5 miles) will result in increased construction cost and schedule. The high difference in elevation (105 feet) will require at least one or two intermediate booster pumping systems, result in higher construction and energy costs.
- Significant traffic control and impacts. Lane closures or full road closures are anticipated to construct the pipeline along Port Royal Road.

Unknowns

- Subsurface conditions along Port Royal Road and along the far east side of Wakefield Park property – soil conditions unsuitable for a buried DI pipe installation may impact installation schedule and costs. This unknown can be minimized by performing adequate soil borings along the proposed alignment.
- Subsurface conditions under Braddock Road – presence of rock at the depth required for jack-and-bore has the potential to increase trenchless installation schedule and costs. This unknown can be minimized by performing adequate soil borings on either side of Braddock Road.

7.2.8 WMF4 – Wakefield Park Maintenance Facility Via Flag Run/I-495

Key advantages, challenges and unknowns associated with the Wakefield Park Maintenance Facility are presented in Section 7.1.1. Below are the key advantages, challenges, and unknowns associated with the Flag Run/I-495 pipeline alignment to the Wakefield Park Maintenance Facility.

Key Advantages

- Short-term recreational impact around Lake Accotink Park. Construction noise and disturbance to Lake Accotink Marina is limited to initial mobilization and the first few segments of pipeline installation; therefore, impacts are short-term.
- Less traffic impacts. Pipeline alignment is behind commercial properties. Impact to traffic is with construction vehicles accessing sites.
- Minimal residential impacts. Area is surrounded by parkland and forested area. Majority of pipeline alignment is along Port Royal Road which is surrounded by commercial properties.

Key Challenges

- Prevalence of high water table near Lake Accotink Park and along Flag Run and many steep slopes and valleys pose constructability challenges for pipeline construction. Additionally, this area is an undisturbed forested area and pipeline construction will likely require clearing of approximately 2 acres.
- Easement agreements with commercial properties. To construct the pipeline easement, negotiations are required from the various commercial properties, due to limited space between edge of commercial properties and I-495 barriers.
- Potential impacts to bridge and trail access near Flag Run during construction, main, and maintenance dredging due to above-ground temporary pipe along Flag Run.
- Temp lane closure at entrance to Wakefield Park may hinder park access temporarily.

Unknowns

- Subsurface conditions under Braddock Road – presence of rock at the depth required for jack-and-bore has the potential to increase trenchless installation schedule and costs. This unknown can be minimized by performing adequate soil borings on either side of Braddock Road.

7.2.9 HF1 – Howrey Field via Cross-County Trail

Key advantages, challenges, and unknowns associated with the Howrey Field dewatering location are presented in Section 7.1.4. Below are the key advantages, challenges, and unknowns associated with the Cross-County trail pipeline alignment to Howrey Field.

Key Advantages

- Potential for improvement to trails post-construction.
- Majority of alignment is on County-owned property. Easement negotiation is required for the Ravensworth Homeowners Association parcel adjacent to the Braddock Road crossing.
- Minimal traffic impact. Temporary lane closure around construction access sites; Inver Chapel Road or Ellet Road. Impacts to Glen Park Avenue for perpendicular pipe crossing will have short-term detour.
- Minimal utility crossings of water mains, sanitary sewers, and large power and electric lines.
- Shorter pipeline length (1.2 miles) – shorter excavation length and therefore, shorter anticipated construction duration. With the elevation difference of only 12 feet, an intermediate booster pumping system may not be required, which further reduces the construction cost and schedule.

Key Challenges

- High water table along the trail. Construction may require dewatering and support of the below grade pipeline depending on soil and water table.
- Potential impact for cultural resources; pre-historic lithic scatter recorded near northern portion of the alignment.
- Crossing Dominion ROW will require coordination with Dominion to avoid structures.
- Majority of alignment is within floodplain and RPA, which can lead to extensive permitting and mitigation efforts.

Unknowns

- Subsurface conditions between Lake Accotink and Braddock Road – soil conditions unsuitable for a buried DI pipe installation and high water table close to the Accotink Creek may impact installation schedule and costs. This unknown can be minimized by performing adequate soil borings along the proposed alignment.
- Subsurface conditions under Braddock Road – presence of rock at the depth required for jack-and-bore has the potential to increase trenchless installation schedule and costs. This unknown can be minimized by performing adequate soil borings on either side of Braddock Road.

7.2.10 WMF3 – Wakefield Park Maintenance Facility Via Flag Run/Port Royal Road

Key advantages and challenges associated with the Wakefield Park Maintenance Facility are presented in Section 7.1.1. Below are the key advantages, challenges, and unknowns associated with the Flag Run/Port Royal Road pipeline alignment to the Wakefield Park Maintenance Facility.

Key Advantages

- Short-term recreational impact around Lake Accotink Park. Construction noise and disturbance to Lake Accotink Marina is limited to initial mobilization and the first few segments of pipeline installation.
- Minimal residential impacts. Area is surrounded by parkland and forested area. Majority of pipeline alignment is along Port Royal Road which is surrounded by commercial properties.

Key Challenges

- Potential impacts to bridge and trail access near Flag Run during construction, main, and maintenance dredging due to above-ground temporary pipe along Flag Run.
- Prevalence of high water table near Lake Accotink Park and along Flag Run and many steep slopes and valleys pose constructability challenges for pipeline construction. Additionally, this area is an undisturbed forested area and pipeline construction will likely require clearing of approximately 2 acres.
- Temporary lane closure at entrance to Wakefield Park may hinder park access temporarily.
- Significant traffic control and impacts. Lane closures or full road closures are anticipated to construct the pipeline along Port Royal Road.

Unknowns

- Subsurface conditions under Braddock Road – presence of rock at the depth required for jack-and-bore has the potential to increase trenchless installation schedule and costs. This unknown can be minimized by performing adequate soil borings on either side of Braddock Road.

7.2.11 HF4 – Howrey Field via Flag Run/ I-495

Key advantages, challenges, and unknowns associated with the Howrey Field dewatering location are presented in Section 7.1.4. Below are the key advantages, challenges, and unknowns associated with the Flag Run/I-495 pipeline alignment to Howrey Field.

Key Advantages

- Short-term recreational impact around Lake Accotink Park. Construction noise and disturbance to Lake Accotink Marina is limited to initial mobilization and the first few segments of pipeline installation; therefore, impacts are short-term.
- Less traffic impacts. Pipeline alignment is behind commercial properties. Impact to traffic is with construction vehicles accessing sites.
- Minimal residential impacts. Area is surrounded by parkland and forested area. Majority of pipeline alignment is behind commercial/industrial properties.

Key Challenges

- Potential impacts to bridge and trail access near Flag Run during construction, main, and maintenance dredging due to above-ground temporary pipe along Flag Run.
- Long pipe length (2.2 miles) will result in increased construction cost and schedule. The high difference in elevation (110 feet) will require at least one or two intermediate booster pumping systems and result in higher construction and energy costs.
- Multiple utility crossings. Crossing includes water mains, sanitary sewer, large communication, and large electrical power lines.
- Easement agreements with commercial properties. To construct the pipeline, easement negotiations are required from the various commercial properties, due to limited space between edge of commercial properties and I-495 barriers.
- Prevalence of high water table near Lake Accotink Park and along Flag Run and many steep slopes and valleys pose constructability challenges for pipeline construction. Additionally, this area is an undisturbed forested area and pipeline construction will likely require clearing of approximately 2 acres.

Unknowns

- Subsurface conditions between at Accotink Creek Crossing – soil conditions unsuitable for a buried DI pipe installation and high water table close to the Accotink Creek may impact installation schedule and costs. This unknown can be minimized by performing adequate soil borings along the proposed alignment.
- Subsurface conditions under Braddock Road – presence of rock at the depth required for jack-and-bore has the potential to increase trenchless installation schedule and costs. This unknown can be minimized by performing adequate soil borings on either side of Braddock Road.

7.2.12 HF3 – Howrey Field via Flag Run/Port Royal Road

Key advantages, challenges, and unknowns associated with the Howrey Field dewatering location are presented in Section 7.1.4. Below are the key advantages, disadvantages, and unknowns associated with the Flag Run/Port Royal Road pipeline alignment to Howrey Field.

Key Advantages

- Minimal residential impacts. Area is surrounded by parkland and forested area. Majority of pipeline alignment is along Port Royal Road, which is surrounded by commercial properties.
- Temporary noise impacts to commercial properties. Noise impacts anticipated during construction and operations from booster pumps. No noise impacts anticipated for residential areas.

- Short-term recreational impact around Lake Accotink Park. Construction noise and disturbance to Lake Accotink Marina is limited to initial mobilization and the first few segments of pipeline installation

Key Challenges

- Potential impacts to bridge and trail access near Flag Run during construction, main, and maintenance dredging due to above-ground temporary pipe along Flag Run.
- Significant traffic control and impacts. Lane closures or full road closures are anticipated to construct the pipeline along Port Royal Road.
- Long pipe length (2.2 miles) will result in increased construction cost and schedule. The high difference in elevation (105 feet) will require at least one or two intermediate booster pumping systems and result in higher construction and energy costs.
- Multiple utility crossings - crossing include water mains, sanitary sewer, large communication, and large electrical power lines.
- Significant traffic control and impacts. Lane closures or full road closures are anticipated to construct the pipeline along Port Royal Road.

Unknowns

- Subsurface conditions between at Accotink Creek Crossing – soil conditions unsuitable for a buried DI pipe installation and high water table close to the Accotink Creek may impact installation schedule and costs. This unknown can be minimized by performing adequate soil borings along the proposed alignment.
- Subsurface conditions under Braddock Road – presence of rock at the depth required for jack-and-bore has the potential to increase trenchless installation schedule and costs. This unknown can be minimized by performing adequate soil borings on either side of Braddock Road.

8 References

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Tables

Table 3-2
Evaluation Criteria – Dredging Methods
Alternatives Analysis Report
Lake Accotink Dredging Project
Fairfax County, Virginia

Category	Criteria	Sub-criteria
Park Management	Consistency with Long-Term Park Vision	Lost Use Days
		Reduced Use
		Existing Infrastructure Impacts
Community	Minimizes Recreational Use Restrictions During Construction	Lake Use
		Facilities Availability
	Community Considerations During Construction	Minimizes Noise
		Minimizes Odors/Dust
Environment	Environmental Considerations	Impacts to Aquatic Wildlife
		Wetland Impacts
		Impacts to Terrestrial Wildlife
	Minimizes Floodplain Impacts	Minimize Floodplain Impacts
	Compatibility with Water Quality Requirements	Minimizes Sediment Resuspension
	Sustainability	Greenhouse Emissions
		Preserving wetlands
Construction and Dredging Program Operation	Accessibility to Work Areas	Minimizes Clearing/Grading
		Requires Updated Infrastructure
	Constructability	Sediment Processing Considerations
		Maneuverability Around Dock/Dam
		Dredge Equipment Accuracy
		Debris Compatibility
		Availability
	Schedule	Seasonal Restrictions
		Production
	Cost	Relative Costs

Table 3-3
Evaluation Criteria – Dewatering Methods
Alternatives Analysis Report
Lake Accotink Dredging Project
Fairfax County, Virginia

Category	Criteria	Sub-Criteria
Park Management	Consistency With Long-Term Park Vision	--
Community	Recreational Use Restrictions	--
	Community Considerations	Noise
		Odors/Dust
Environment	Environmental Considerations	--
	Floodplain Impacts	--
	Sustainability	Beneficial Reuse Potential
		Waste Reduction
		Energy Use
Construction and Dredging Program Operation	Available Area and Accessibility	Area Required
		Available Access
	Site Preparation Requirements	Clearing
		Grading
		Utilities
		Surface Preparation
	Flexibility / Compatibility with Various Equipment	Hydraulic Dredging
		Mechanical Dredging with Hydraulic Transport
		Mechanical Dredging with Barge Transport
		Overall
	Efficient Water Return	Effluent Quality
	Constructability	Equipment Availability
		Chemical Usage
		Dredge Production
		Operation
		Permitting
	Long-Term Operation and Maintenance Dredging	Maintenance Needs Between Events
		Ability to Meet Future Dredge Event Needs
	Schedule	--
	Costs	--

Table 3-4
Evaluation Criteria – Disposal Methods
Alternatives Analysis Report
Lake Accotink Dredging Project
Fairfax County, Virginia

Category	Criteria	Sub-criteria
Park Management	Consistency With Long-Term Park Vision	Future improvements. Compatible with planned long-term improvements
		Lost and reduced use. Minimizes reduced and lost use of park for recreational purposes
Community	Recreational Use Restrictions During Construction	Minimizes Park recreational use restrictions
	Community Considerations During Disposal of Dredge Material	Minimizes Noise in the Park During Disposal
		Minimizes Odors/Dust in the Park During Disposal
Environment	Environmental Considerations	Reduces Creek Bank Erosion
		No Clearing for Access
	Minimizes Floodplain Impacts	--
	Sustainability	Beneficial Reuse of Material
		Minimizes Energy Use by Reducing Transportation Distance
		Restores Streambank or Urban Forest
Construction	Accessibility	Available Access for Vehicles
	Site Preparation Requirements	Minimizes Clearing
	Constructability	Constructable
		Minimizes Additional Equipment and Handling of Material to Unload Haul Truck and Place Material
		Can Accept Full Volume of Dredge Material
	Long-Term Operation and Maintenance Dredging	Ability to Meet Future Dredge Event Needs
		Disposal Facility Acceptance Rate of Material Matches Dewatering Production Rate
	Costs	Relative Costs

Table 3-5
Evaluation Criteria – Dewatering Locations
Alternatives Analysis Report
Lake Accotink Dredging Project
Fairfax County, Virginia

Category	Criteria	Sub-Criteria
Park Management	Consistency With Long-Term Park Vision	Existing Infrastructure Impacts
		Future Improvements
		Lost & Reduced Use
		Cultural Resources
Community	Recreational Use Restrictions During Construction	Trail Availability
		Facilities Availability
		Lake Use
	Community Considerations During Construction	Noise
		Odors/Dust
		Truck Traffic
Environment	Environmental Considerations	Wetland Impacts
		Resource Protection Area Impacts
		Clearing Impacts
	Floodplain Impacts	--
	Sustainability	Bank & Meadows
		Native Landscaping
Construction and Dredging Program Operation	Available Area and Accessibility	Available Area
		County-Controlled
		Use Restrictions
		Construction Accessibility
		Utility Availability
	Site Preparation Requirements	Soil Condition
		Grading
	Flexibility / Compatibility with Various Equipment	Passive Dewatering
		Passive with Desanding
		Mechanical Dewatering
		Drying Agent
	Efficient Water Return	--
	Constructability	Offsite Transport
		Geotechnical Considerations
		Ease of Permitting
		Restoration
	Long-Term Operation and Maintenance Dredging	Compatibility with Maintenance Dredging
		Future Availability
		Remobilization Site Preparation
	Schedule	Main Dredging
		Maintenance Dredging
	Cost	Main Dredging Construction
		Maintenance Dredging

Table 3-6
Evaluation Criteria – Slurry Transport Pipeline Alignment
Alternatives Analysis Report
Lake Accotink Dredging Project
Fairfax County, Virginia

Category	Criteria	Sub-Criteria
Park Management	Consistency With Long-Term Park Vision	Compatibility with Existing LAP Infrastructure
		Compatibility with Future Improvements
		Lost & Reduced Use
		Cultural Resources
Community	Recreational Use Restrictions During Construction	Compatibility with the Recreational use of the Trail System
		Compatibility with Use of Other Park Facilities
		Compatibility with LAP and other Park's Parking Facilities
	Community Considerations During Construction	Compatibility with Noise Ordinance and Community/Recreational/ Residential Requirements
		Odors/Dust
		Road Closure
		Truck Traffic
Environment	Environmental Considerations	Wetland Impacts
		Resource Protection Area Impacts
		Stream Impacts
		Forested Land Cover Impact
	Floodplain Impacts	Floodplains Impact
	Sustainability	Energy Usage
Construction, Dredging Operations & Long-Term O&M	Constructability	Geotechnical Impacts
		Construction Access
		Utility Conflicts
		Permitting Requirements
		Easement acquisition
	Long-Term Operation and Maintenance	Infrastructure Security/ Public Risk
		Pipeline & associated infrastructure O&M
		Booster PS & associated infrastructure O&M
	Schedule	Main Dredging
		Maintenance Dredging
	Costs	Main Dredging Construction
		Maintenance Dredging

Table 5-1
Summary of Estimated Impacts to Alternative Pipeline and Dewatering Locations
Alternatives Analysis Report
Lake Accotink Dredging Project
Fairfax County, Virginia

ALTERNATIVES (PIPELINE AND PROCESSING AREAS)	POTENTIAL WETLAND IMPACT (AC)	POTENTAL STREAM IMPACT (LF)	POTENTIAL WETLAND MITIGATION REQUIREMENT* (CREDIT)	POTENTIAL STREAM MITIGATION REQUIREMENT* (CC)	PRIMARY LAND COVER	FORESTED LAND COVER IMPACT (AC)	PRESENCE OF CULTURAL RESOURCES	PERMIT TYPE**
PIPELINE ROUTES								
I-495 / BASEBALL FIELD	0.65	1,023	1.30	1,023	MAINTAINED / FORESTED	0.67	NO	IP
I-495 / MAINTENANCE FACILITY	0.65	1,003	1.30	1,003	MAINTAINED / FORESTED	0.90	NO	IP
I-495 / DOMINION	0.65	1,013	1.30	1,013	MAINTAINED / FORESTED	0.66	NO	IP
I-495 / HOWREY FIELD	0.65	993	1.30	993	MAINTAINED / FORESTED	0.90	YES	IP
FLAG RUN / BASEBALL FIELD	0.60	1,023	1.20	1,023	MAINTAINED / FORESTED	0.98	NO	IP
FLAG RUN / MAINTENANCE FACILITY	0.60	1,003	1.20	1,003	MAINTAINED / FORESTED	0.88	NO	IP
FLAG RUN / DOMINION	0.60	1,013	1.20	1,013	MAINTAINED / FORESTED	0.96	YES	IP
FLAG RUN / HOWREY FIELD	0.60	1,013	1.20	1,013	MAINTAINED / FORESTED	1.04	YES	IP
QUEENSBERRY / BASEBALL FIELD	0.01	50	0.02	50	MAINTAINED / FORESTED	0.42	YES	IP
QUEENSBERRY / MAINTENANCE FACILITY	0.01	30	0.02	30	MAINTAINED / FORESTED	0.32	YES	IP
QUEENSBERRY / DOMINION	0.01	60	0.02	60	MAINTAINED / FORESTED	0.47	YES	IP
QUEENSBERRY / HOWREY FIELD	0.01	10	0.02	10	MAINTAINED / FORESTED	0.65	YES	IP
TRAIL / BASEBALL FIELD	0.63	104	1.26	104	FORESTED	2.02	YES	IP
TRAIL / MAINTENANCE FACILITY	0.63	60	1.26	60	FORESTED	1.69	YES	IP
TRAIL / DOMINION	0.67	295	1.34	295	FORESTED	2.05	YES	IP
TRAIL / HOWREY FIELD	0.63	104	1.26	104	FORESTED	1.66	YES	IP
CONCRETE PLANT / BEHIND HOMES	--	20	--	20	FORESTED/ MAINTAINED	0.44	YES	IP
AMTRAK ROW / CONCRETE PLANT	--	455	--	455	FORESTED / MAINTAINED	0.52	YES	IP
SETTLING BASIN PIPELINE ROUTE	--	20	--	20	FORESTED	0.76	YES	IP

Table 5-1
Summary of Estimated Impacts to Alternative Pipeline and Dewatering Locations
Alternatives Analysis Report
Lake Accotink Dredging Project
Fairfax County, Virginia

ALTERNATIVES (PIPELINE AND PROCESSING AREAS)	POTENTIAL WETLAND IMPACT (AC)	POTENTAL STREAM IMPACT (LF)	POTENTIAL WETLAND MITIGATION REQUIREMENT* (CREDIT)	POTENTIAL STREAM MITIGATION REQUIREMENT* (CC)	PRIMARY LAND COVER	FORESTED LAND COVER IMPACT (AC)	PRESENCE OF CULTURAL RESOURCES	PERMIT TYPE**
DEWATERING LOCATIONS								
BASEBALL FIELD	--	--	--	--	MAINTAINED	--	NO	IP
DOMINION	--	411	--	441	MAINTAINED/ FORESTED	0.45	YES	IP
MAINTENANCE AREA	--	--	--	--	FORESTED	7.94	YES	IP
HOWREY FIELD	--	--	--	--	MAINTAINED	2.23	YES	IP
CONCRETE PLANT	--	--	--	--	MAINTAINED	--	NO	IP
LAKE ACCOTINK ISLAND - CURRENT FOOTPRINT	2.91	--	5.82	--	FORESTED	2.94	NO	IP
LAKE ACCOTINK ISLAND - EXPANDED FOOTPRINT	4.29	--	8.58	--	FORESTED	4.32	NO	IP
SETTLING BASIN	4.11	1,413	8.22	1,413	FORESTED	6.21	YES	IP

* WETLAND AND STREAM MITIGATION CREDIT COSTS

Wetland credits which can service this project area currently cost approximately $345K - $500K. It is assumed that all wetland impact is to palustrine forested (PFO) wetland, which is mitigated at a 2:1 ratio.
Stream credits (CC's) which can service this project area currently cost approximately $450 - $550 per credit. It is assumed that 1 linear foot of permanent impact requires the purchase of 1 CC.

** WETLAND PERMIT IMPACT THRESHOLD

Below are the state and federal wetland and stream impact thresholds which determine the permit requirement. It is assumed this project will require an Individual Permit from each agency due to the cumulative impact, specifically including the impact to Lake Accotink as a result of the dredging activities.

Exhibits

Exhibit 1
Dredging Method Evaluation
Alternatives Analysis Report
Lake Accotink Dredging Project
Fairfax County, Virginia

ARCADIS

Criteria No.	Category	Criteria	Sub-Criteria	Sub-Criteria Desription	Mechanical		Hydraulic		Amphibious
					8-cubic-yard bucket	16-cubic-yard bucket	8-inch dredge	14-inch dredge	
1	Park Management	Consistency with Long-Term Park Vision	Lost Use Days	Minimizes days lost	Medium. Minimal use days lost. Expected loss of use during initial mobilization and dredging near marina.		Medium. Minimal use days lost. Expected loss of use during initial mobilization and dredging near marina.		Medium. Minimal use days lost. Expected loss of use during initial mobilization and dredging near marina.
2			Reduced Use	Minimizes reduced use of lake	Medium. Temporary impacts to use of the lake (including fishing and boating). Increased impacts likely due to need for slurry barge/slurry plant.		High. Temporary impacts to use of the lake (including fishing and boating).		Medium. Temporary impacts to use of the lake (including fishing and boating). Increased impacts likely due to need for multiple dredges to meet project schedule.
3			Existing Infrastructure Impacts	Minimizes impacts to existing infrastructure	Medium. Temporary impacts to existing infrastructure; however, it is anticipated that certain infrastructure upgrades would be performed to accommodate activities.		Medium. Temporary impacts to existing infrastructure; however, it is anticipated that certain infrastructure upgrades would be performed to accommodate activities.		Medium. Temporary impacts to existing infrastructure; however, it is anticipated that certain infrastructure upgrades would be performed to accommodate activities.
4	Community	Minimizes Recreational Use Restrictions During Construction	Lake Use	Minimizes impacts to lake use due to dredging activities (including aesthetic considerations)	Medium. Temporary impacts to recreational use of the lake (including fishing and boating). Increased impacts likely due to need for slurry barge/slurry plant.		High. Temporary impacts to recreational use of the lake (including fishing and boating). Impacts anticipated due to floating pipeline in lake.		Medium. Temporary impacts to recreational use of the lake (including fishing and boating). Impacts anticipated due to floating pipeline in lake. Increased impacts likely due to need for multiple dredges to meet project schedule.
5			Facilities Availability	Avoids closures of park facilities (e.g., marina, parking)	Medium. Temporary closure of park facilities anticipated during mobilization. Larger upland staging may be required due to additional equipment required for mechanical dredging and reduce parking capacity. Provisions will be put in place to maintain access to park facilities during a majority of construction activities.		Medium. Temporary closure of park facilities anticipated during mobilization. Larger disruptions anticipated during debris removal due to additional required equipment. Provisions will be put in place to maintain access to park facilities during a majority of construction activities.		Medium. Temporary closure of park facilities anticipated during mobilization. Larger upland staging may be required due to additional vessels required to meet project schedule and reduce parking capacity. Provisions will be put in place to maintain access to park facilities during a majority of construction activities.
6		Community Considerations During Construction	Minimizes Noise	Comparison of relative proximity of potential receptors	Low. Greater potential for noise due to the need to continuously bring the dredge bucket to the surface during sediment removal. Additional noise expected from the additional equipment/vessels required for sediment transport/slurrying.		High. Potential for noise impact from booster pumps for sediment transport.		Medium. Potential for noise impact from booster pumps for sediment transport. Additional vessels required to meet production related to project schedule.
7			Minimizes Odors/Dust	Comparison of relative proximity of potential receptors	Low. Greater potential for emissions of odor/dust because materials are brought to the surface and placed in dredge scows for transport. Materials are exposed to air during offloading and slurrying. Additional vessels required for sediment offloading and transport/slurrying, resulting in higher air emissions associated with equipment exhaust.		High. Involves a pipeline to transport sediment to dewatering facility, minimizing sediment exposure to air. Utilizes fewer vessels, minimizing emissions associated with equipment exhaust.		Medium. Involves a pipeline to transport sediment to dewatering facility, minimizing sediment exposure to air. Utilizes fewer vessels, minimizing emissions associated with equipment exhaust. Additional vessels required to meet production related to project schedule.
8	Environment	Environmental Considerations	Impacts to Aquatic Wildlife	Minimizes impacts to aquatic wildlife	High. Direct short-term impacts to underwater habitat. Long-term improvements to sustainability and availability of habitat associated with deeper water.				
9			Wetland Impacts	Minimizes impacts to wetlands	High. Little to no wetlands present in proposed dredge footprint. Mitigation would be required for any disturbed wetlands.				
10			Impacts to Terrestrial Wildlife	Minimizes impacts to terrestrial wildlife	High. Minimal short-term impacts to terrestrial wildlife.				
11		Minimizes Floodplain Impacts	Minimize Floodplain Impacts	--	Low. General floodplain impacts associated with upland staging required to support construction. Additional floodplain impacts expected associated with additional support required for slurry barge/transport.		Medium. General floodplain impacts associated with upland staging required to support construction.		Medium. General floodplain impacts associated with upland staging required to support construction.
12		Compatibility with Water Quality Requirements	Minimizes Sediment Resuspension	--	Low. Resuspension anticipated associated with lifting the filled bucket through the water column as well as associated with propeller wash from tugboat moving dredge scow.		High. Resuspension anticipated to be lower in the water column and less visible at the surface.		Medium. Resuspension during mechanical use anticipated with raising the filled bucket through the water column. Resuspension during hydraulic use anticipated to be lower in the water column.
13		Sustainability	Greenhouse Emissions	Minimizes greenhouse gas emissions	Low. Emissions expected due to use of dredge equipment and booster pumps. Increased emissions due to use of additional vessels (e.g., slurry barge) required for removal.		Medium. Emissions expected due to use of dredge equipment and booster pumps.		Low. Increased emissions due to use of additional vessels required to meet project schedule.
14			Preserving wetlands	Minimizes impacts to wetlands	High. Little to no wetlands present in proposed dredge footprint. Mitigation would be required for any disturbed wetlands.				
15	Construction and Dredging Program Operation	Accessibility to Work Areas	Minimizes Clearing/Grading	--	Low. General clearing/grading associated with upland staging required to support construction. Additional impacts expected associated with additional support required for slurry barge/transport.		Medium. General clearing/grading impacts associated with upland staging required to support construction.		Medium. General clearing/grading expected due to use of dredge equipment and booster pumps. General clearing/grading impacts associated with upland staging required to support construction.
16			Requires Updated Infrastructure	Minimizes required updates to existing infrastructure	Medium. Temporary impacts to existing infrastructure; however, it is anticipated that certain infrastructure upgrades would be performed to accommodate activities.		Medium. Temporary impacts to existing infrastructure; however, it is anticipated that certain infrastructure upgrades would be performed to accommodate activities.		Medium. Temporary impacts to existing infrastructure; however, it is anticipated that certain infrastructure upgrades would be performed to accommodate activities.
17		Constructability	Sediment Processing Considerations	Adaptability to pipeline transport	Medium. Additional equipment required to slurry material prior to pipeline transport (typically a slurry barge).		High. Slurry pipeline will connect directly to the transport pipeline at a single location.		High. Slurry pipeline will connect directly to the transport pipeline at a single location.
18			Maneuverability Around Dock/Dam	--	High. Greater flexibility removing sediment adjacent to the dam and marina area due to greater control of the dredge head.		Medium. Slightly less control of dredge head due to the swinging motion of the dredge head.		High. Greater flexibility removing sediment adjacent to the dam and marina area due to greater control of the dredge head.
19			Dredge Equipment Accuracy	--	High. Approximately a 6-inch vertical accuracy and 4-inch horizontal accuracy.		High. Approximately a 4-inch vertical accuracy and 4-inch horizontal accuracy.		High. Approximately a 4-inch vertical accuracy and 4-inch horizontal accuracy.
20			Debris Compatibility	Separate debris removal step required	High. Debris can be removed during the sediment removal process with limited impact to productivity.		Low. Separate debris removal step required.		Medium. Equipment can be used for debris removal with modification of dredge. Separate equipment may be needed if heavy/large debris is encountered.
21				Convertible for debris removal	High. Equipment can be used for debris removal without modification.		Low. Additional equipment required for debris removal.		Medium. Equipment can be used for debris removal with modification of dredge.
22			Availability	--	High. Equipment widely available.		Medium. Equipment generally available; however, may not be available in immediate area.		Low. Specialized equipment with limited availability.
23		Schedule	Seasonal Restrictions	Seasonal impacts on dredge use	Medium. Potential for slurry freezing over winter.		Medium. Potential for slurry freezing over winter.		Medium. Potential for slurry freezing over winter.
24			Production	Average sustained production rate	Medium. 70 cubic yards/hour	High. 170 cubic yards/hour	Low. 45 cubic yards/hour	High. 200 cubic yards/hour	Low. 30 cubic yards/hour
25		Cost	Relative Costs	--	Low. $$$		Medium. $$		Medium. $$
				Alternative Summary	Green - 9 Yellow - 9 Red - 7	Green - 10 Yellow - 8 Red - 7	Green - 11 Yellow - 11 Red - 3	Green - 12 Yellow - 11 Red - 2	Green - 7 Yellow - 15 Red - 3

KEY

High	High means an alternative meets the criteria. Criteria are worded to indicate meeting the criteria is beneficial. Alternatives with the lowest cost best meet the cost objective of a cost effective alternative and thus are ranked high.
Medium	Medium means an alternative meets some of the criteria.
Low	Low means an alternative does not meet the criteria. Criteria are worded to indicate meeting the criteria is beneficial. Alternatives with the highest cost do not meet the cost objective of a cost effective alternative and thus are ranked low.

Exhibit 2
Dewatering Method Evaluation
Alternatives Analysis Report
Lake Accotink Dredging Project
Fairfax County, Virginia

ARCADIS

Criteria No.	Category	Criteria	Sub-Criteria	Sub-Criteria Description	Passive Dewatering (Geotextile Tubes)	Passive Dewatering with Desanding	Mechanical Dewatering	Gravity Dewatering with Drying Agent
1	Park Management	Consistency With Long-Term Park Vision	Future Improvements	Compatible for planned long-term improvements to Park Authority property.	High. Depending on location and final surface (assumed gravel pad), area may be able to be repurposed between dredging events for alternative uses with minimal to some effort.	High. Depending on location and final surface (assumed gravel pad), area may be able to be repurposed between dredging events for alternative uses with minimal to some effort.	Medium. Depending on final design, some infrastructure/improvements may limit options for repurposing area between dredging events.	High. Depending on location and final surface (assumed gravel pad), area may be able to be repurposed between dredging events for alternative uses with minimal to some effort.
2		Community Considerations	Noise	Minimize noise generation (relative between options) from equipment, trucks, and construction equipment.	High. Lowest anticipated noise of options evaluated. Noise associated with pumping and polymer mixing operations plus heavy equipment and trucks associated with material loadout.	Medium. In addition to noise discussed under Passive Dewatering, additional noise associated with the desanding equipment is anticipated.	Low. Highest anticipated noise of options evaluated based on number of processes and equipment required for mechanical dewatering. Similar noise for material loadout anticipated.	Medium. Would require use of equipment (e.g., excavator, pug mill) to mix in solidification agent.
3			Odors/Dust	Minimize nuisance odor/dust (relative between options) generation that may result in public complaint.	Medium. Sediment contained within tubes during dewatering minimizes dust. Minimal effect on odor is anticipated. Typical dust generation during material loadout.	Medium. Material from desanding may require double handling depending on operations and may generate dust when exposed to wind. Sediment contained within tubes during dewatering minimizes potential odor and dust. Typical dust generation during material loadout.	Low. Material open to air may generate dust and/or odors that will require control. Depending on operations, may have multiple handling of solids from different dewatering processes before loadout.	Low. Requires mixing of solidification agent in with dredge material. Typically performed in open air and has a high potential for generating dust that would require control
4		Sustainability	Beneficial Reuse Potential	Flexibility of method to provide material gradations suitable for beneficial reuse.	Medium. Material would be as dredged from lake and contain high silt and clay, which may limit potential reuse options.	High. Desanding process can be designed to separate out specific material size for beneficial reuse (e.g., sand vs silt/clay)	High. Processes can be selected to separate out specific material for beneficial reuse (e.g., sand vs silt/clay)	Medium. No separation of preferred material would be performed. Depending on solidification agent used, material properties (e.g., pH) may change.
5			Waste Reduction	Reduces the amount of material requiring offsite deposal.	Medium. Able reduce water content of slurry and generate material that can be transported for offsite disposal. Amount of water able to be removed depends on slurry quality and duration able to dewater material. Requires disposal of geotextile material (single use).	Medium. Able reduce water content of slurry and generate material that can be transported for offsite disposal. Amount of water able to be removed depends on slurry quality and duration able to dewater material. Requires disposal of geotextile material (single use).	High. Depending on processes selected, able to produce relatively drier material, which reduces weight of that must be disposed offsite.	Low. Typically requires addition of stabilization agent which increases the weight of material requiring offsite disposal.
6			Energy Use	Minimize energy usage during operation of dewatering system.	High. Uses least energy of options evaluated. Energy inputs required for pumping material and polymer mixing/addition.	Medium. Energy inputs required for pumping material, operation of desanding processes, and polymer mixing/addition.	Low. Uses most energy of options evaluated. Energy inputs required for pumping material and operation of multiple pieces of equipment, depending on processes selected.	Medium. Energy inputs associated with fueling of equipment used for mixing.
7	Construction and Dredging Program Operation	Available Area and Accessibility	Area Required	Lower area requirements to allow for most flexibility and/or minimizing extent of disturbance.	Medium. Estimated area similar to mechanical dewatering - required area dependant on production and dewatering times. Presence of sand improves dewatering time with geotextile tubes. Additional treatability testing recommended to refine polymer dosing requirements and dewatering duration.	Low. Highest area estimated for options evaluated. Removal of sand increases dewatering time which increases area required. Additional treatability testing recommended to refine polymer dosing requirements and dewatering duration.	Medium. Based on assumed processes, similar area to passive dewatering - required area dependant on production, selected processes, assumed redundencies, and assumed storage required to minimize dredge downtime. Additional treatability testing recommended determine mechanical dewatering processes and efficiencies.	Low. Method not appropriate for dewatering hydraulic dredged or transported material so would be additional area to that needed for other dewatering methods unless material is not hydraulically transported.
8			Available Access	Relative level of access needed (truck access) to mobilize, install, and operate system.	High. Standard equipment typically required that may be unloaded in secondary location and driven to staging area. Geotextile tubes and other ancillary supplies can be staged and maneuvered easily.	Medium. Depending on desanding process, may require mobilization of large equipment requiring more area for maneuverability. Passive dewatering components generally more maneuverable.	Low. Depending on processes selected, large equipment anticipated to be mobilized to the site on tractor trailers that require more area for access (e.g., larger turn radius). Access needed to individual components for maintenance/operation.	High. Standard equipment and materials that may be unloaded in secondary location and transported to staging area.
9		Site Preparation Requirements	Clearing	Relative level of clearing needed for installation and operation of dewatering system.	Low. Area must be cleared of all trees and shrubs for construction of dewatering pad.	Low. Area must be cleared of all trees and shrubs for construction of dewatering pad.	Medium. Generally area must be cleared of trees for access and equipment placement. Equipment may be located around trees or sensitive areas if necessary and adequate space allows.	Low. Area must be cleared of all trees and shrubs for construction of dewatering pad.
10			Grading	Relative flexibility of method to minimize extent of grading (e.g., ability to accommodate varying elevation across area).	Low. Area must have relatively flat but with a uniform slope to minimize potential for tubes to roll and allow for collection of water.	Low. Area must have relatively flat but with a uniform slope to minimize potential for tubes to roll and allow for collection of water. Relatively level space needed for desanding unit but does not need to be within same leveled area for tubes.	Medium. Area must be provide relatively flat areas within footprint of dewatering equipment but equipment not as sensitive to elevation difference provided there is sufficient access for placing equipment.	Low. Area must have relatively flat but with a uniform slope to allow for collection of water.
11			Utilities	Type and relative availability of utilities needed for operation.	High. Some electrical anticipated for operation of pumps, polymer unit, and water treatment equipment. Water required for polymer make down and cleaning.	Medium. Some electrical anticipated for operation of pumps, desanding unit, polymer unit, and water treatment equipment. Water required for polymer make down and cleaning of desanding unit..	Low. Electiriccal service required to support high electrical load anticipated for multiple dewatering processes. Access to water required for system cleaning, operation (depending on processes), and polymer make down.	High. Minimal electrical anticipated for operation of water treatment equipment and pumps. Some water ant Water required for polymer make down.
12			Surface Preparation	Relative simplicity of surface required to prepare prior to installing dewatering system.	High. Typically requires installation of a lined pad for geotextile tubes. Surface needs to support weight of sediment.	Medium. Typically requires installation of a lined pad for geotextile tubes. Surface needs to support weight of sediment. Desanding equipment pad varies based on equipment and needs to support weight of equipment and sediment.	Low. Depending on processes used, may require installation of concrete footings/pads to support equipment. Surface needs to support weight of dewatering equipment and sediment.	High. Typically requires installation of a lined pad for surface. Surface needs to support weight of sediment.
13		Flexibility / Compatibility with Various Equipment	Hydraulic Dredging	Ability of dewatering method to accommodate hydraulic dredged material.	High. Typical method used for dewatering hydraulically dredged material.	High. Typical method used for dewatering hydraulically dredged material.	High. Typical method used for dewatering hydraulically dredged material.	Low. Not compatible with hydraulically dredged material due to quantity of water in incoming material. May be used to supplement other dewatering methods.
14			Mechanical Dredging with Hydraulic Transport	Ability of dewatering method to accommodate hydraulic transported material from mechanical dredging.	High. Typical method used for dewatering hydraulically dredged material.	High. Typical method used for dewatering hydraulically dredged material.	High. Typical method used for dewatering hydraulically dredged material.	Low. Not compatible with hydraulically transported material due to quantity of water in incoming material. May be used to supplement other dewatering methods.
15			Mechanical Dredging with Barge Transport	Ability of dewatering method to accommodate mechanically dredged material transported by barge.	Low. Input (slurry) must be able to be pumped into geotextile tubes so water would need to be added into the system. Percent solids of input material dependent on pumping system capabilities.	Low. Input (slurry) must be able to be pumped into geotextile tubes so water would need to be added into the system. Percent solids of input material dependent on pumping system capabilities.	Medium. Processes may be designed around various transport methods and solids inputs.	High. Typical method used for dewatering mechanically dredged material.
16			Overall	Overall compatibility with various dredging method and material transport.	Medium. Method most suitable for hydraulicly dredged or transported materials.	Medium. Method most suitable for hydraulicly dredged or transported materials.	High. Processes may be designed around various transport methods and solids inputs.	Low. Not compatible with hydraulically dredged or transported material. May be appropriate for island dewatering locations only.

Criteria No.	Category	Criteria	Sub-Criteria	Sub-Criteria Description	Passive Dewatering (Geotextile Tubes)	Passive Dewatering with Desanding	Mechanical Dewatering	Gravity Dewatering with Drying Agent
17	Construction and Dredging Program Operation (continued)	Efficient Water Return	Effluent Quality	Relative quality of the water component generated during dewatering and need for additional water treatment.	High. Based on treatability testing, water from geotextile tubes were low in turbidity with appropriate polymer dosing. Depending on discharge requirements, may be able discharge directly or with minimal polishing if needed to remove dissolved nutrients.	Medium. Depending on processes used, may be able to generate water that requires minimal treatment prior to discharge. Based on treatability testing, turbidity was higher for finer material treated by geotextile tubes so water treatment would be anticipated.	Medium. Depending on processes used, may be able to generate water that requires minimal treatment prior to discharge.	Low. No mechanisms in place for filtering of water within the dewatering process. Use of water treatment system required to remove particulates.
18		Constructability	Equipment Availability	Relative availability of equipment.	High. Geotextile tubes and polymer dosing systems are available from multiple vendors.	Medium. Passive dewatering readily available from multiple vendors. Desanding unit availability depends on processes selected but overall availability anticipated to be more readily available than mechanical only dewatering.	Medium. Availability highly dependent on processes selected for use. Equipment may be available for rental or require use of Contractor with available equipment.	High. Uses standard heavy equipment (e.g., excavator) plus solidification agent that is readily available.
19			Chemical Usage	Relative usage of chemical additives during dewatering operations; preference for less additives.	Medium. Will require testing by Contractor to determine appropriate polymer dosing requirements and determine that polymer is not impacting quality of discharge water.	High. May require less polymer usage due to less sediment requirement treatment after removal of coarser material. Will require testing by Contractor to determine appropriate polymer dosing requirements and determine that polymer is not impacting quality of discharge water.	High. May require less polymer usage due to less sediment requirement treatment after removal of coarser material. Will require testing by Contractor to determine appropriate polymer dosing requirements and determine that polymer is not impacting quality of discharge water.	Medium. Will require testing by Contractor to determine appropriate solidification agent dosing requirements and determine that solidification agent is not impacting quality of discharge water.
20			Dredge Production	Ability of processes to accommodate a range of dredge production rates.	Medium. Able to accommodate a range of flows, including start/stops. Overall production is limited based on available area and time required to dewater so may not be able to accommodate large increases in production.	Medium. Able to accommodate a range of flows, including start/stops. Overall production is limited based on available area and time required to dewater so may not be able to accommodate large increases in production.	High. Assumes holding tanks would be constructed to even out flow from dredging process. Throughput is similar to dredging so could increase production by increasing work day or number of days per week.	Medium. Able to accommodate a range of flows, including start/stops. Overall production may be limited based on available area and time required to dewater.
21			Operation & Maintenance	Relative ease of operation considering overall complexity of system and potential downtime of system processes.	High. Relatively straightforward processes but requires Contractor experienced with managing filing of tubes and dredging operations.	Medium. Relatively straightforward processes but requires Contractor experienced with desanding operation and managing filing of tubes.	Low. Increase number of processes increases overall complexity of operations and potential downtime if a process goes offline. Requires more specialized experience.	High. Straight forward operations that involve processes Contractor's.
22			Permitting	Relative permitting requirements for operation of the dewatering system, including final water treatment discharge.	Medium. Discharge of water would likely need to be performed under a discharge permit to confirm quality of water returned to the lake. Depending on pad construction may require addressing stormwater impacts due to change in impervious surface.	Medium. Discharge of water would likely need to be performed under a discharge permit to confirm quality of water returned to the lake. Depending on pad construction may require addressing stormwater impacts due to change in impervious surface.	Medium. Discharge of water would likely need to be performed under a discharge permit to confirm quality of water returned to the lake. Depending on pad construction may require addressing stormwater impacts due to change in impervious surface.	Medium. Discharge of water would likely need to be performed under a discharge permit to confirm quality of water returned to the lake. Depending on pad construction may require addressing stormwater impacts due to change in impervious surface.
23		Long-Term Operation and Maintenance Dredging	Maintenance Needs Between Events	Relative extent of installed infrastructure that would require maintenance between dredging events.	High. Anticipates that equipment would be rentals mobilized for each dredge event requiring no maintenance between events. Assumes minimum utility infrastructure (e.g., electrical) may require maintenance between dredging events. Pad may require some improvement or modification prior to maintenance dredging events depending on use between events.	Medium. Anticipates that equipment would be rentals mobilized for each dredge event requiring no maintenance between events. Assumes some utility infrastructure (e.g., electrical) would require maintenance between dredging events. Pad may require some improvement or modification prior to maintenance dredging events depending on use between events.	Low. Anticipates that equipment would be rentals mobilized for each dredge event requiring no maintenance between events. Alternatively would require purchase of equipment that would require storage between dredging events. Assumes utility infrastructure (e.g., electrical) would require maintenance between dredging events. More robust pad assumes minimal maintenance between events.	High. Anticipates that equipment would be rentals mobilized for each dredge event requiring no maintenance between events. Assumes no utilities are installed and required to be maintained. Pad may require some improvement or modification prior to maintenance dredging events depending on use between events.
24			Ability to Meet Future Dredge Event Needs	Relative ability of area to allow for flexible dredging and/or dewatering methods to be used during maintenance dredging.	Medium. Area used would meet future dewatering area needs for multiple methods assuming smaller volume dredged during maintenance dredging events. Surface preparation may not meet requirements if more robust surface needed for mechanical dewatering equipment.	Medium. Area used would meet future dewatering area needs for all dewatering methods. Surface preparation may not meet requirements if more robust surface needed for mechanical dewatering equipment.	Low. Surface preparation likely to meet future dewatering area needs for multiple dewatering methods. Area may or may not meet needs for multiple dewatering methods depending on quantity of dredging required and anticipated production rates. Additionally availability of same type of mechanical dewatering equipment not guaranteed.	Low. Not compatible with hydraulically dredged or transported material so would limit future dredging methods. Would have limited support facilities (e.g., utilities) installed to support alternate dewatering methods. May be appropriate for island dewatering locations only.
25		Schedule	Relative Schedule	Relative schedule efficiency for installation and operation of system (not including site preparation or restoration)	High. Relatively simple setup up including construction of dewatering pad and deployment of geotextile tubes. Water treatment plant complexity would be based on discharge requirements.	Medium. Similar to passive only but additional effort for preparing location and setting up of settling tank. Water treatment plant complexity would be based on discharge requirements.	Low. Depending on processes used, can be extensive effort for site preparation, installing tanks and equipment, and setting up process controls. Water treatment plant complexity would be based on discharge requirements.	High. Requires construction of lined containment pad. Water treatment plant complexity would be based on discharge requirements.
26		Costs	Relative Costs	Relative construction costs for installation and operation of system (does not include transportation and disposal or preparation of the dewatering location).	High. $ - $$. Relatively cost effective. Cost effectiveness decreases with increasing disposal costs.	Medium. $$ - $$$. Relative cost anticipated between passive and mechanical dewatering.	Low. $$$$. Cost effectiveness varies greatly depending on the processes selected. Cost effectiveness may increase with increasing disposal costs.	High. $-$$. Relatively cost effective depending on drying agent used and amount needed. Cost effectiveness decreases with increasing disposal costs.
				Alternative Summary	Green - 14 Yellow - 9 Red - 3	Green - 5 Yellow - 17 Red - 4	Green - 7 Yellow - 8 Red - 11	Green - 10 Yellow - 6 Red - 10

KEY

High	High means an alternative readily meets the criteria. Criteria are worded to indicate meeting the criteria is beneficial. Alternatives with the lowest cost best meet the cost objective of a cost effective alternative and thus are ranked high.
Medium	Medium means an alternative meets some of the criteria or may be able to meet criteria with certain controls or requirements in place.
Low	Low means an alternative does not meet the criteria without significant adjustments. Criteria are worded to indicate meeting the criteria is beneficial. Alternatives with the highest cost do not meet the cost objective of a cost effective alternative and thus are ranked low.

Exhibit 3
Disposal Method Evaluation
Alternatives Analysis Report
Lake Accotink Dredging Project
Fairfax County, Virginia

ARCADIS

Criteria No.	Category	Criteria	Sub-Criteria	Sub-Criteria Desription	Onsite Expand Island	Onsite Bank Restoration	Onsite County Reuse	Offsite Reuse	Offsite Landfill
1	Park Management	Consistency With Long-Term Park Vision	Future improvements	Compatible with planned long-term improvements	Low. Eliminates lake for boat use in area of island expansion. Meets FCPA goal to improve and promote natural resource protection and management by actively managing natural resources and enhancing sustainability through reuse of dredge material.	High. Meets FCPA goal to improve and promote natural resource protection and management by actively managing natural resources and enhancing sustainability through reuse of dredge material, restoring stream banks, and limiting stream bank erosion. Stream restoration may serve as mitigation.	High. Meets FCPA goal to improve and promote natural resource protection and management by enhancing sustainability through reuse of dredge material.	High. Meets FCPA goal to improve and promote natural resource protection and management by enhancing sustainability through reuse of dredge material.	Low. Does not meet FCPA goal to improve and promote natural resource protection and management by enhancing sustainability through reuse of dredge material.
2			Lost and reduced use	. Minimizes reduced and lost use of park for recreational purposes	Low. Limits park use in area of island expansion during construction.	Medium. Limits park use in area of bank restoration during construction. Area of restricted access not expected to have frequent recreational use. Use restriction would occur regardless of whether fill is from dredge material or purchased fill.	Medium. Limits park use in area of fill during construction. Area of restricted access expected to have frequent recreational use. Use restriction would occur regardless of whether fill is from dredge material or purchased fill.	High. No restrictions to park use.	High. No restrictions to park use.
3	Community	Recreational Use Restrictions During Construction	Park Use	Minimizes park recreational use restrictions	Low. Restricts access to fill area during filling, consolidation, and dewatering. If area used for future dredging, restricts access during future events.	Medium. Restricts access to restoration area during filling. If additional bank restoration performed during future dredging, restricts access during future events. Area of restricted access not expected to have frequent recreational use. Use restriction would occur regardless of whether fill is from dredge material or purchased fill.	Medium. Restricts access during filling. Area of restricted access expected to have frequent recreational use. Use restriction would occur regardless of whether fill is from dredge material or purchased fill.	High. No restrictions to recreational use.	High. No restrictions to recreational use.
4		Community Considerations During Disposal of Dredge Material	Noise	Minimizes Noise in the Park During Disposal	Low. Noise during filling and dewatering. If area used for future dredging, noise also during future events. Noise impacts expected for park users and nearby residents.	Medium. Noise during filling. If bank restoration also performed in future dredging, noise also during future events. Noise impacts expected for park users and nearby residents. Noise impacts would occur regardless of whether fill is from dredge material or purchased fill.	Medium. Noise during filling. Noise impacts expected for park users. Noise impacts would occur regardless of whether fill is from dredge material or purchased fill.	High. No noise in park during disposal as disposal location is outside of park.	High. No noise in park during disposal as disposal location is outside of park.
5			Odor/sDust	Minimizes Odors/Dust in the Park During Disposal	Medium. Potential odor and dust during filling, consolidation, and dewatering. If area used for future dredging, potential odor and dust during future events. Potential odor and dust expected in area of infrequent recreational use.	Medium. Potential odor prior to geotubes being covered. No dust from dredge material as dredge material contained in geotube. Potential odor expected in area of infrequent recreational use.	Medium. Potential odor and dust during filling. Potential odor and dust expected in area of frequent recreational use. Dust impacts would occur regardless of whether fill is from dredge material or purchased fill.	High. No odor or dust in park as disposal location is outside of park.	High. No odor or dust in park as disposal location is outside of park.
6	Environment	Environmental Considerations	Creek Bank	Reduces Creek Bank Erosion	Low. No effect on creek bank erosion.	High. Reduces creek bank erosion.	Low. No effect on creek bank erosion.	Low. No effect on creek bank erosion.	Low. No effect on creek bank erosion.
7			Clearing	No Clearing for Access	Medium. Potential clearing needed along shoreline. Cleared area would be restored so impact would be temporary.	Low. Clearing needed to access restoration area. Cleared area would be restored so impact would be temporary.	High. Clearing not expected to be needed to access fill area. Cleared area would be restored so impact would be temporary.	High. No clearing needed.	High. No clearing needed.
8		Minimizes Floodplain Impacts	Minimizes Floodplain Impact	--	Low. Fill placed in floodplain.	Low. Fill placed in floodplain.	High. Fill probably not placed in floodplain.	High. No fill placed in floodplain.	High. No fill placed in floodplain.
9		Sustainability	Reuse	Beneficial Reuse of Material	High. Dredge material beneficially reused onsite.	High. Dredge material beneficially reused onsite.	High. Dredge material beneficially reused onsite.	High. Dredge material beneficially reused offsite.	Low. No dredge material beneficially reused.
10			Energy Use	Minimizes Energy Use by Reducing Transportation Distance	High. Reduces vehicle miles for offsite disposal. Amount of mileage reduction largest of onsite options because of volume of material used.	Medium. Reduces vehicle miles for offsite disposal. Amount of mileage reduction less than island expansion because less material used.	Medium. Reduces vehicle miles for offsite disposal. Amount of mileage reduction less than island expansion because less material used.	Low. More vehicle miles than onsite disposal.	Low. More vehicle miles than onsite disposal.
11			Restoration	Restores Streambank or Urban Forest	Low. No restoration of island habitat as island would be used for future dredge events.	High. Restores streambank.	Medium. May restore meadow.	Medium. May restore streambank or urban forest.	Low. No streambank or urban forest restoration.
12	Construction	Accessibility	Available Access for Vehicles	--	Medium. No available vehicle access. Will bring vehicle in by barge or create access route.	Low. No available vehicle access expected. Will create access route.	High. Available vehicle access expected.	High. Available vehicle access.	High. Available vehicle access.
13		Site Preparation Requirements	Clearing	Minimizes Clearing	High. Clearing not needed as filling part of lake.	Medium. Clearing needed in restoration area. Moderate amount of clearing expected. Cleared area would be restored so impact would be temporary.	High. Clearing not expected to be needed in fill area. Cleared area would be restored so impact would be temporary.	High. No clearing needed.	High. No clearing needed.
14		Constructability	Constructable	--	Low. Detailed geotechnical investigation needed to support land bridge design. Soft sediments and soils are anticipated within footprint of likely land bridge.	Low. Fine grained dredge material may require polymer addition to facilitate dewatering.	High. Uses standard construction methods.	High. Expected to use standard construction methods.	High. Uses standard construction methods.
15			Material Handling	Minimizes Additional Equipment and Handling of Material to Unload Haul Truck and Place Material	Medium. Material placed directly from pipeline. Equipment to grade material needed. Additional handling required to grade material discharged from slurry pipeline discharge.	High. Dredge material pumped directly into geotubes. No additional handling.	Medium. Equipment to grade material needed. Additional handling required to grade material unloaded from haul truck.	High. Any potential additional equipment or handling needed would be responsibility of entity receiving material.	High. Any potential additional equipment and handling needed would be responsibility of landfill.
16			Available Volume	Can Accept Full Volume of Dredge Material	Medium. Expected to use moderate amount of dredge material.	Low. Expected to reuse small amount of dredge material.	Low. Expected to reuse small amount of dredge material.	Medium. Expected to use moderate amount of dredge material.	High. Can accept full volume of dredge material.

Exhibit 3
Disposal Method Evaluation
Alternatives Analysis Report
Lake Accotink Dredging Project
Fairfax County, Virginia

Criteria No.	Category	Criteria	Sub-Criteria	Sub-Criteria Desription	Onsite Expand Island	Onsite Bank Restoration	Onsite County Reuse	Offsite Reuse	Offsite Landfill
17	Construction (continued)	Long-Term Operation and Maintenance Dredging	Future Disposal	Ability to Meet Future Dredge Event Needs	Low. Use of dredge material to expand island would be one-time disposal option.	Medium. Additional bank restoration may be performed in future dredging events.	Medium. FCPA may have additional fill needs in the future.	Medium. Reuse area may be accepting fill in the future.	High. Landfill likely to accept dredge material in the future.
18		Schedule	Production	Disposal Facility Acceptance Rate of Material Matches Dewatering Production Rate	High. Expected to accept material at rate produced by dredging.	High. Expected to accept material at rate produced by dredging.	High. Expected to accept material at rate produced by dewatering.	Medium. May accept material at smaller rate than produced by dewatering. May require stockpiling material at dewatering facility. There may be an incosistency between the rate at which the dewatering facility produces dewatered material, the amount of material the dewatering facility can stockpile, and the rate at which the offsite facility can accept material.	Medium. If material does not meet geotechnical requirements, there is a daily limit on amount of material that can be accepted at landfill. May require stockpiling material at dewatering facility. There may be an incosistency between the rate at which the dewatering facility produces dewatered material, the amount of material the dewatering facility can stockpile, and the rate at which the landfill can accept material.
19		Costs	Relative Costs	--	High. $	High. $	High. $	Medium. $$. Assumed cost for offsite reuse. Offsite reuse cost would be determined by contractor.	Low. $$$. Cost based on input from nearby landfill. Cost includes transportation and disposal. Landfill requires solidification in addition to dewatering.
				Alternative Summary	Green - 5 Yellow - 5 Red - 9	Green - 7 Yellow - 7 Red - 5	Green - 9 Yellow - 8 Red - 2	Green - 12 Yellow - 5 Red - 2	Green - 12 Yellow - 1 Red - 6

KEY

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Medium	Medium means an alternative meets some of the criteria.
Low	Low means an alternative does not meet the criteria. Criteria are worded to indicate meeting the criteria is beneficial. Alternatives with the highest cost do not meet the cost objective of a cost effective alternative and thus are ranked low.

Exhibit 4
Dewatering Location Evaluation
Alternatives Analysis Report
Lake Accotink Dredging Project
Fairfax County, Virginia

Criteria No.	Category	Criteria	Sub-Criteria	Description	Range	Definition	Howrey Field	Wakefield Park Maintenance Area	Wakefield Ball Fields	Dominion Right-of-Way
1	Park Management	Consistency With Long-Term Park Vision	Compatibility with Existing LAP Infrastructure	Minimizes impacts to existing infrastructure (e.g., buildings, fences, structures, utilities)	Green Yellow Red	Benefit to No Impact Some Impacts Significant Impacts	Low. Requires removal of existing facilities, including ballfields, bleachers, dugouts, fences, and other infrastructure.	Medium. No existing infrastructure within proposed dewatering area. Some impact to existing maintenance facility to allow for access.	Low. Requires removal of existing facilities, including ballfields, bleachers, dugouts, fences, and other infrastructure.	High. No existing infrastructure within proposed dewatering area. Requires siting of processes outside offset directed by Dominion.
2			Compatibility with Future Improvements	Compatible with planned long-term improvements	Green Yellow Red	Benefit to No Impact Potential Impacts Significant Impacts	Low. Restoration of ballfields would be required to maintain existing infrastructure. Based on extent of development, assumed that maintenance of existing use is long-term plan.	High. Based on park master plan use, no improvements in this area are shown. Area may be used for temporary storage by County between dredging events or alternate uses may be considered.	Low. Restoration of ballfields would be required to maintain existing infrastructure. Based on park master plan, anticipate that access may be limited in future if area is further developed.	Medium. Based on park master plan, use of area as multi-use trail can be maintained; however, types of surface cover may be limited.
3			Lost & Reduced Use	Minimizes reduced and lost use of area for recreational purposes	Green Yellow Red	Temporary Reduced Long-Term Reduced Lost Use (Temporary or Long Term)	Low. Would result in complete loss of facility use during dredging events, including site preparation and restoration. May impact long-term use of site. Would require efforts to restore ballfields to maintain use between dredging events.	Medium. Limited existing recreational use in area. Some impacts to trail use through rerouting to existing adjacent trails. Long-term changes to surface from vegetated to gravel or concrete may reduce aesthetics of area for trail users.	Low. Would result in complete loss of facility use during dredging events, including site preparation and restoration. May impact long-term use of site. Would require efforts to restore ballfields to maintain use between dredging events.	Medium. Would result in reduced or lost use of cross-county and connector trails during construction. Long-term changes to surface from vegetated to gravel or concrete may reduce aesthetics of area for trail users.
4			Cultural Resources	Minimize impacts to cultural resources	Green Yellow Red	No Impact Some Impact Possible Known Impact	Medium. Majority of area within previously disturbed/developed area. May require relocation of existing monument and/or construction of new monument.	Low. Includes known recorded cultural resource.	High. Area has been previously developed and no cultural resources are anticipated.	Low. Includes portion of known recorded cultural resource (Civil War-era earthwork).
5	Community	Recreational Use Restrictions During Construction	Compatibility with the Recreational use of the Trail System	Minimizes impacts (e.g., closures, detours) to Cross County trail and connecting LAP trails	Green Yellow Red	No Impact or Crossing Some Rerouting Significant Rerouting or Closure	Low. Existing trail connecting Howrey Field to neighboring community would be unavailable during construction.	Medium. Existing connector trail within proposed work limits would require temporary or permanent rerouting. Area available to reroute trail.	High. Crossing of existing trails would be necessary to access site. Temporary traffic controls would be required to maintain trail access.	Medium. Existing cross-county trail within proposed work limits would require temporary rerouting. Nearby trails and area available to reroute trail.
6			Compatibility with Use of Other Park Facilities	Avoids or minimizes closures of park facilities (e.g., ballfields, marina, parking)	Green Yellow Red	No Impact Some Impact Significant Impact	Low. Would remove three baseball diamonds and rectangular field from use for duration of construction.	High. No existing facilities within proposed work limits.	Low. Would remove two diamonds from use for duration of construction.	High. No existing facilities within proposed work limits.
7			Lake Use	Minimizes impacts to lake use due to dewatering activities, including aesthetic considerations	Green Yellow Red	No Impact Some Impact Significant Impact	High. Located away from Lake Accotink.	High. Located away from Lake Accotink.	High. Located away from Lake Accotink.	High. Located away from Lake Accotink.
8		Community Considerations During Construction	Noise	Relative distance to potential receptors, including recreational users or residential areas	Green Yellow Red	Limited Receptors Park Users (Short Duration) Residential, Park Users (Long Duration)	Low. Area surrounded by residential area and parks. Contractor would be required to meet noise ordinances.	Medium. Area isolated from residential neighborhoods; potential receptors limited to potential recreational users traveling trail. Contractor would be required to meet noise ordinances.	Low. Area isolated from residential neighborhoods but located in proximity to other park uses (tennis courts, baseball field, recreation center) and recreational users. Contractor would be required to meet noise ordinances.	Medium. Area isolated from residential neighborhoods; potential receptors limited to recreational users traveling trail. Contractor would be required to meet noise ordinances.
9			Odors/Dust	Relative distance to potential receptors, including recreational users or residential areas	Green Yellow Red	Park Users with Controls Residential Users with Controls Receptors, No Controls	Medium. Area surrounded by residential area and parks. Contractor would be required to control odors and dust.	High. Area isolated from residential neighborhoods; potential receptors limited to potential recreational users traveling trail. Contractor would be required to control odors and dust.	Medium. Area isolated from residential neighborhoods but located in proximity to other park uses (tennis courts, baseball field, recreation center) and recreational users. Contractor would be required to control odors and dust.	High. Area isolated from residential neighborhoods; potential receptors limited to recreational users traveling trail. Contractor would be required to control odors and dust.
10			Truck Traffic	Minimizes truck traffic on residential roads and minimizes impacts to neighborhoods and park traffic	Green Yellow Red	No Residential/Limited Park Traffic Probable Park Traffic Residential Impacts	High. Park closed to public (no park traffic) and limited residences on residential road.	High. No impacts to residential roads/neighborhoods and limited impact to park users. Some impacts to County staff at maintenance area anticipated.	Medium. No impacts to residential roads/neighborhoods. Impacts to park traffic probable.	Medium. No impacts to residential roads/neighborhoods. Impacts to park traffic probable.
11	Environment	Environmental Considerations	Wetland Impacts	Avoids or minimizes disturbance of existing wetlands	Green Red	No Impacts Significant Impacts	High. No known wetlands within anticipated limits of disturbance.	High. No known wetlands within anticipated limits of disturbance.	High. No known wetlands within anticipated limits of disturbance.	High. No to limited wetlands within anticipated limits of disturbance.
12			Resource Protection Area Impacts	Avoids or minimizes disturbance within Resource Protection Areas	Green Yellow Red	No Impacts Some Impacts (previous disturbed) Significant Impacts	Medium. Portion of existing area is within resource protection area however most is within previously disturbed areas associated with fields.	Low. Significant portion of existing area is within resource protection area.	High. Limits of disturbance assumed to avoid resource protection area.	Low. Significant portion of existing area is within resource protection area.
13			Clearing Impacts	Avoids or minimizes disturbance of existing tree canopy	Green Yellow Red	No or Limited Selective or Potential Significant	Medium. Depending on dewatering method and pr oduction, clearing may be limited. Potential for cle aring up to 2.5 acres to create additional area for dewatering.	Low. Anticipates clearing up to 7 acres to create additional area for dewatering.	High. Location is predominantly clear of trees. Selective tree removal may be required at site access point.	High. Location is predominantly clear of trees as work will be performed within right-of-way below electrical power lines.
14		Floodplain Impacts	--	Avoids or minimizes work within floodplains	Green Yellow Red	Outside Floodplains Portion in Floodplain Significant Portion / All	Low. Significant portion of existing area is within floodplain. Critical system components likely within floodplain requiring construction of protective measures.	Medium. Portion of existing area is within floodplain but may be able to minimize critical components within floodplains to minimize necessary protective measures.	High. Limits of disturbance assumed to be outside floodplain.	Low. Significant portion of existing area is within floodplain. Critical system components likely within floodplain requiring construction of protective measures.
15	Environment (continued)	Sustainability	Bank & Meadows	Minimizes disturbance to existing banks and meadows and/or opportunity to improve same	Green Yellow Red	No Disturbance Limited Disturbance Significant Disturbance	Medium. No streambank or meadows within anticipated limits of disturbance. Limited disturbance for return water discharge point depending on return location.	Medium. No streambank or meadows within anticipated limits of disturbance. Limited disturbance of creek for return water discharge point possible.	Medium. No streambank or meadows within anticipated limits of disturbance. Limited disturbance of creek for return water discharge point possible.	Low. Crossing of existing stream(s) likely required based on anticipated available area and layout. Limited disturbance of creek for return water discharge point possible.

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Criteria No.	Category	Criteria	Sub-Criteria	Description	Range	Definition	Howrey Field	Wakefield Park Maintenance Area	Wakefield Ball Fields	Dominion Right-of-Way
16	Environment (continued)	Sustainability (continued)	Native Landscaping	Minimizes disturbance to native landscaping and/or opportunity to improve same during restoration	Green Yellow Red	Developed Areas Only Limited Disturbance Significant Disturbance	Medium. Some disturbance of existing tree canopy anticipated but predominantly within developed area. Depending on area needed for maintenance dredging, portion of removed canopy may be possible.	Low. Disturbance of existing tree canopy anticipated. Limited restoration of cleared tree canopy anticipated based on need to maintain clearing for future dredging.	High. Limits of disturbance would be limited to existing developed areas with only selective clearing for access. Planting to replace trees may be possible.	High. dewatering area would be limited to existing cleared and maintained areas with limited disturbance of vegetation for access.
17	Construction and Dredging Program Operation	Available Area and Accessibility	Available Area	Relative space available for dewatering area	Green Yellow Red	> 10 acres > 5 acres < 5 acres	Medium. While parcel size is adequate, the topography and parcel shape may limit usable area within property.	Medium. While identified limits of disturbance area is adequate, the topography and area geometry may limit usable area within site.	Low. Area is limited and anticipated to allow for limited dewatering methods and lower production rates.	Medium. While identified limits of disturbance area is adequate, utility offset requirements and area geometry may limit usable area within site.
18			County-Controlled	Extent of County control over property use	Green Yellow Red	County-Owned Utility Easement Third Party Owned	High. County-owned property.	High. County-owned property.	High. County-owned property.	Medium. Within existing easement right-of-way on County property. Work will require coordination and approval of Dominion.
19			Use Restrictions	Limits potential use restrictions by property owner	Green Yellow Red	County-Owned Easement Restriction Third Party Owner Restrictions	High. County-owned property.	High. County-owned property.	High. County-owned property.	Medium. Dominion may impose restrictions on limits of work, allowable heights, or other construction limits that may increase area requirements and/or limit production. Assumes no change in future use of area.
20			Construction Accessibility	Existing site access for construction equipment	Green Yellow Red	Existing Road Access Roads to be Constructed Water Access Only	High. Existing driveway access and parking lot in place. Equipment and vehicle access roads may be necessary to supplement existing site roads.	Medium. Access would be through existing maintenance area. No existing access roads in place within identified work area. Construction of access roads and parking areas would be required.	Medium. Access would use existing park roads. Installation of access point to park roads and access roads within dewatering area may be required.	Medium. Access would use existing park roads. Installation of access point to park roads and access roads within dewatering area may be required.
21			Flooding	Minimizes relative potential for flooding	Green Yellow Red	Outside Floodplains Edge of Floodplain Surrounded by Floodplain	Medium. Portion of area within floodplain but may be less susceptible to flooding based on location/elevation.	Medium. Portion of area within floodplain but may be less susceptible to flooding based on location/elevation.	High. Limits of disturbance assumed to be outside floodplain, minimizing potential for flooding.	Medium. Portion of area within floodplain but may be less susceptible to flooding based on location/elevation.
22			Utility Availability	Proximity to potential utilities	Green Yellow Red	Close to Known Utilities Utilities Anticipated No Known Utilities	High. Existing electrical located onsite; existing service would need to be verified during design. Available water would need to be determined during design depending on process needs.	High. Existing electrical and water anticipated nearby, existing service would need to be verified during design depending on process needs.	High. Existing electrical and water anticipated nearby; existing service would need to be verified during design depending on process needs.	Medium. Existing utilities anticipated within Wakefield Park but may not be close to area. Existing service would need to be verified during design depending on process needs.
23		Site Preparation Requirements	Soil Condition	Relative strength of existing soils and ability to support equipment with minimal improvements	Green Yellow Red	No Known Soft Soils Soft Soils Possible Soft Soils Known/Expected	Medium. Anticipate acceptable surface condition to support equipment and vehicle use based on existing site development. Some low-lying areas subject to flooding may contain soft soils requiring improvement.	Medium. Anticipate acceptable surface condition to support equipment and vehicle use based on existing site development. Some low-lying areas subject to flooding may contain soft soils requiring improvement.	High. Anticipate acceptable surface condition to support equipment and vehicle use based on existing site development.	High. Anticipate acceptable surface condition to support equipment and vehicle use based on existing area use and development.
24			Grading	Relative amount of surface area with acceptable slope for support area; minimizes additional grading	Green Yellow Red	Minimal Grading Some Grading Extensive Grading	Low. Depending on dewatering method and production, extensive grading of the northern portion of the park would be required to provide a flat surface for dewatering process.	Medium. Grading anticipated to provide a suitable grade dewatering process; extent of grading will be based on selected dewatering method and site layout.	High. Based on existing development, minimal grading would be anticipated to prepare site.	Medium. Grading anticipated to provide a suitable grade dewatering process; extent of grading will be based on selected dewatering method and site layout.
25		Flexibility/Compatibility with Various Equipment	Passive Dewater	Anticipated ability of area to accommodate passive dewatering based on current assumptions	Green Yellow Red	Suitable Suitable with Caveats Not Suitable	Medium. Able to accommodate passive dewatering with grading and clearing of the treed areas of the park. Soil anticipated to support construction with minimal improvement.	High. Able to accommodate passive dewatering with some grading. Soil anticipated to support construction with minimal improvement.	Low. Insufficient area based on assumed production and processing times. May be able to accommodate under different assumptions (to be evaluated by Contractor).	Medium. Able to accommodate passive dewatering with some grading and provided overhead utility clearances allow for stacking of tube. Soil anticipated to support construction with minimal improvement.
26			Passive with Desanding	Anticipated ability of area to accommodate passive dewatering with desanding	Green Yellow Red	Suitable Suitable with Caveats Not Suitable	Low. Insufficient existing area for processes; significant grading/clearing would be required.	Low. Insufficient existing area for processes; significant grading/clearing would be required.	Low. Insufficient existing area for processes.	Low. Insufficient existing area for processes.
27			Mechanical Dewatering	Anticipated ability of area to accommodate mechanical dewatering	Green Yellow Red	Suitable Suitable with Caveats Not Suitable	Medium. Able to accommodate mechanical dewatering provided sufficient slurry solids percent is maintained. Option contingent on ability to install concrete pads for tanks and equipment, which may be limited in ballfield areas.	High. Able to accommodate mechanical dewatering provided sufficient slurry solids percent is maintained. Assumes grading and installation of concrete pad is possible with limited restrictions.	Medium. Able to accommodate mechanical dewatering provided sufficient slurry solids percent is maintained. Option contingent on ability to install concrete pads for tanks and equipment. Room within the staging area would be restricted and may limit usability of site.	Medium. Able to accommodate mechanical dewatering provided sufficient slurry solids percent is maintained. Option contingent on sufficient access for equipment delivery, clearance under overhead utilities, and ability to install concrete pads for tanks and equipment.
28			Drying Agent	Anticipated ability of area to accommodate dewatering by drying agent	Green Yellow Red	Suitable Suitable with Caveats Not Suitable	Low. Based on location, hydraulic transport most likely.	Low. Based on location, hydraulic transport most likely.	Low. Based on location, hydraulic transport most likely.	Low. Based on location, hydraulic transport most likely.
29		Efficient Water Return	--	Relative distance to water body and ability of receiving water to accommodate return water discharges	Green Yellow Red	Return to Lake Return to Stream Return to Stream with Significant Crossings	Low. Located away from Accotink Creek and Lake Accotink. Return water would require piping (including street crossings) to return water to system.	Medium. Located near Accotink Creek upstream of the lake. Possible to return water to creek with minimal crossings (trail only). Identification of suitable return area to accommodate anticipated discharge flows would need to be determined.	Medium. Located near Accotink Creek upstream of the lake. Possible to return water to creek with minimal crossings (trail only). Identification of suitable return area to accommodate anticipated discharge flows would need to be determined.	Medium. Located near Accotink Creek upstream of the lake. Possible to return water to creek with minimal crossings (trail only). Identification of suitable return area to accommodate anticipated discharge flows would need to be determined.

Criteria No.	Category	Criteria	Sub-Criteria	Description	Range	Definition	Howrey Field	Wakefield Park Maintenance Area	Wakefield Ball Fields	Dominion Right-of-Way
30	Construction and Dredging Program Operation	Constructability	Offsite Transport	Relative access for offsite transportation access and material loading	Green Yellow Red	Existing Access with Truck Staging Available Existing Access, Limited Staging Secondary Staging or Double Handling	Medium. Existing access point to public roadways. Construction of access roads and truck staging area anticipated. Given limited space, number of trucks able to be staged onsite may be limited and use of existing (residential) roadways for staging would be prohibited.	Medium. Existing access point to public roadways. Construction of access roads and truck staging area anticipated. Given limited space, number of trucks able to be staged onsite may be limited or may require staging with existing maintenance building parking lot.	Low. Existing access point to public roadways anticipated. Given limited space, number of trucks able to be staged within dewatering area anticipated to be very limited, which may require staging of trucks on park roads or parking lots.	Low. Existing access point to public roadways anticipated. Given limited space and requirement to maintain access to Dominion structures, number of trucks able to be staged within dewatering area anticipated to be very limited, which may require staging of trucks on park roads or parking lots.
31			Geotechnical Considerations	Limited geotechnical considerations anticipated based on topography and soil	Green Yellow Red	Typical Assumptions Evaluation Required Detailed Design and Evaluation Req'd	Medium. Potential for extensive grading to the north. Evaluation of slope stability may be necessary but assumes generic slope guidelines can be used.	High. Some grading and evaluation of slope stability may be necessary but assumes generic slope guidelines can be used.	High. Some grading and evaluation of slope stability may be necessary but assumes generic slope guidelines can be used.	High. Some grading and evaluation of slope stability may be necessary but assumes generic slope guidelines can be used.
32			Ease of Permitting	Relative permitting requirements for preparation of dewatering site	Green Yellow Red	No Permits Anticipated Local/State Permits Federal Permits	Low. Would require permit/variance to construct within floodplain and resource protection area.	Low. Would require permit/variance to construct within floodplain and resource protection area.	High. Based on no significant resource protection area, floodplain or wetland impacts, permitting anticipated to be relatively simple.	Low. Would require permit/variance to construct within floodplain and resource protection area.
33			Restoration	Relative ease of restoration	Green Yellow Red	No Restoration Planned Some Restoration Extensive Restoration	Low. Would require removal of dewatering area and reconstruction of ballfields or construction of artificial turf fields over dewatering area pad.	High. Anticipated that area could be left as prepared pad for selected dewatering method.	Low. Would require reconstruction of ballfields or construction of artificial turf fields.	High. Anticipated that area could be left as prepared pad for selected dewatering method.
34		Long-Term Operation and Maintenance Dredging	Compatibility with Maintenance Dredging	Relative ability of area to allow for flexible dredging and/or dewatering methods to be used during maintenance dredging	Green Yellow Red	No Restrictions Possible Restrictions Known Restrictions	Medium. Location allows for both passive and mechanical dewatering. Lower production anticipated. May be able to schedule maintenance dredging around high use of facilities.	High. Location allows for both passive and mechanical dewatering. No schedule restrictions would be anticipated given current use of area. Lower production anticipated.	Low. Location allows for limited dewatering options.	Medium. Location allows for both passive and mechanical dewatering. Potential limits on production or short-term use by Dominion.
35			Future Availability	Likelihood for area to remain available for use over life of maintenance dredging program	Green Yellow Red	Same Availability Potential Change within Range Potential for Significant Change	High. County-owned property.	High. County-owned property.	High. County-owned property.	Medium. Dominion may impose additional restrictions or install new structures that may limit available area for use; however, area use generally anticipated to remain the same (utility corridor).
36			Remobilization Site Preparation	Minimal effort to prepare site for future maintenance dredging events	Green Yellow Red	Limited Site Prep Possible Site Prep Significant Site Prep	Low. Will require removal of ballfield infrastructure and/or construction of temporary pad over ballfield depending on approach. Suggest limiting to outfield area only.	High. Anticipated that area could be left as prepared pad for selected dewatering method between dredging methods.	Low. Will require removal of ballfield infrastructure and/or construction of temporary pad over ballfield depending on approach.	High. Anticipated that area could be left as prepared pad for selected dewatering method between dredging methods.
37		Schedule	Base Dredge Site Preparation and Restoration	Ability to comply with total construction of 3 years by limiting site preparation / restoration duration	Green Yellow Red	Reduce Schedule Meet Schedule Schedule Extension Possible	Low. Time needed to remove ballfield infrastructure, clear and grade limits of work, and restore ballfields at completion of work.	Medium. Time needed for clearing and grading of proposed area.	Medium. Time needed to remove ballfield infrastructure and restore ballfields at completion of work.	Medium. Anticipates relatively minimal duration anticipated to prepare site for dewatering and predominately associated with grading.
38			Production Rate	Ability to accommodate a range of dredging and dewatering production rates to comply with total dredging period of 2 years	Green Yellow Red	High Production Average Minimum Production Low Production	Medium. Area available to accommodate production of 950 cy/day with grading and clearing. Not likely able to accommodate higher productions.	Medium. Area available to accommodate production of 950 cy/day but may not be able to accommodate higher productions.	Low. Overall would anticipate lower production due to limited footprint and access.	Medium. Area available to accommodate production of 950 cy/day assuming ability to stack geotextile tubes. Not likely to accommodate higher productions without expanding footprint within right-of-way.
39			Maintenance Dredge Site Preparation and Restoration	Relative schedule efficiency needed for remobilization, site preparation, and restoration for maintenance dredging events	Green Yellow Red	Minimal Some Extensive	Low. Time needed to install new dewatering pad and remove ballfield infrastructure prior to start of dredging. Plus time needed at end of dredging to remove dewatering pad and restore ballfields.	High. Minimal site preparation or restoration anticipated for future remobilization events.	Low. Time needed to install new dewatering pad and remove ballfield infrastructure prior to start of dredging. Plus time needed at end of dredging to remove dewatering pad and restore ballfields.	High. Minimal site preparation or restoration anticipated for future remobilization events.
40		Costs	Main Dredging Construction	Relative cost based on anticipated site preparation, location-specific operation, and restoration (if applicable). Does not include mitigation.	Green Yellow Red	Relative Low Cost Mid Cost Relative High Cost	Medium. $$. Costs driven by removal and restoration of ballfields. If artificial turf restoration, cost will be significantly higher.	High. $. Costs associated with clearing and site preparation; anticipates limited trail rerouting. Does not include tree planting or mitigation.	Medium. $$. Costs driven by removal and restoration of ballfields. If artificial turf restoration, cost will be significantly higher.	Medium. $$. Anticipates extensive traffic control and trail rerouting in addition to grading and site preparation.
41			Maintenance Dredging	Relative cost for maintenance dredging site preparation and restoration (if applicable).	Green Yellow Red	Relative Low Cost Mid Cost Relative High Cost	Low. $$$. Costs for reconstructing temporary dewatering pad and restoring area for each dredging event.	High. $. Pad remains in place and assumes dewatering system can be remobilized with minimal site preparation.	Low. $$$. Costs for reconstructing temporary dewatering pad and restoring area for each dredging event.	High. $. Pad remains in place and assumes dewatering system can be remobilized with minimal site preparation.
						Alternative Summary	Green - 8 Yellow - 16 Red - 17	Green - 19 Yellow - 15 Red - 7	Green - 17 Yellow - 8 Red - 16	Green - 13 Yellow - 20 Red - 8

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Criteria No.	Category	Criteria	Sub-Criteria	Description	Range	Definition	Lake Accotink Park Upper Settling Basin	Lake Accotink Island (Current Footprint)	Lake Accotink Island (Expanded Footprint)	Concrete Plant
1	Park Management	Consistency With Long-Term Park Vision	Compatibility with Existing LAP Infrastructure	Minimizes impacts to existing infrastructure (e.g., buildings, fences, structures, utilities)	Green Yellow Red	Benefit to No Impact Some Impacts Significant Impacts	High. Existing infrastructure within proposed area would require update and maintenance resulting in net improvement to infrastructure.	Low. Requires access from marina area for material loadout; potential significant impacts.	Low. During startup and preparation of area prior to land bridge, requires access from marina.	High. Not on Park Authority property.
2			Compatibility with Future Improvements	Compatible with planned long-term improvements	Green Yellow Red	Benefit to No Impact Potential Impacts Significant Impacts	High. Based on park master plan use, improvements in this area are not anticipated. Per discussions, repairs to existing drainage infrastructure may be necessary, which would be addressed by this option.	Medium. No planned improvements anticipated assuming intent to maintain island as habitat area, which would be removed by site construction. Potential for alternative interim use between dredging events.	Medium. No planned improvements anticipated assuming intent to maintain island as habitat area, which would be removed by site construction. Would reduce available water surface for recreational use. Potential for alternative interim use between events.	High. Not on Park Authority property.
3			Lost & Reduced Use	Minimizes reduced and lost use of area for recreational purposes	Green Yellow Red	Temporary Reduced Long-Term Reduced Lost Use (Temporary or Long Term)	Medium. Limited existing recreational use in proposed area. Long-term changes to surface from vegetated to gravel or concrete may reduce aesthetics of area for trail users between construction but may open up options for other uses (e.g., picnic area).	Low. Reduction/lost use in marina facility use during construction to accommodate transfer to trucks. Habitat loss leading to possible loss of aesthetic benefits and possible reduction in wildlife viewing.	Low. Reduction in lake area and associated recreational impacts. Reduction in habitat leading to possible loss of aesthetic benefits and possible reduction in wildlife viewing.	High. Not on Park Authority property.
4			Cultural Resources	Minimize impacts to cultural resources	Green Yellow Red	No Impact Some Impact Possible Known Impact	Low. To accommodate production rate, may need to expand outside areas of previous disturbance. There are existing known cultural resources adjacent to proposed location and likely access route, including the trail (rail bed). Assumes historical culverts are downgrade of proposed access.	Medium. No previously recorded resources. Existing historical culvert on Lake Accotink Park road would require additional evaluation to determine need for controls to protect from anticipated truck traffic.	Medium. No previously recorded resources. Existing historical culvert on Lake Accotink Park road would require additional evaluation to determine need for controls to protect from anticipated truck traffic depending on route.	High. Within limits of previous disturbance, no cultural resource anticipated.
5	Community	Recreational Use Restrictions During Construction	Compatibility with the Recreational use of the Trail System	Minimizes impacts (e.g., closures, detours) to Cross County trail and connecting LAP trails	Green Yellow Red	No Impact or Crossing Some Rerouting Significant Rerouting or Closure	Low. Existing trail would be used for truck and construction access, which would require potential closure or extensive traffic control. Limited options for rerouting trail based on existing topography.	Medium. May result in detours or partial closure of trails in marina area to facilitate transfer to trucks.	Low. Existing trail used for truck and construction access, which would require potential closure or extensive traffic control. If material barged, partial closure of trails in marina area may be required.	High. Not on Park Authority property.
6			Compatibility with Use of Other Park Facilities	Avoids or minimizes closures of park facilities (e.g., ballfields, marina, parking)	Green Yellow Red	No Impact Some Impact Significant Impact	High. No existing facilities within proposed work limits.	Medium. Anticipated use of scows and truck loading at marina for offsite disposal likely to limit use of marina area and reduce available parking.	Medium. Anticipated use of barges for equipment access likely to limit use of marina area and reduce available parking.	High. Not on Park Authority property.
7			Lake Use	Minimizes impacts to lake use due to dewatering activities, including aesthetic considerations	Green Yellow Red	No Impact Some Impact Significant Impact	High. Located away from Lake Accotink.	Low. Potential for significant equipment within lake and island reduces availability of lake for recreational purposes during construction.	Low. Potential for significant equipment within lake and island reduces availability of lake for recreational purposes during construction.	High. Not on Park Authority property.
8		Community Considerations During Construction	Noise	Relative distance to potential receptors, including recreational users or residential areas	Green Yellow Red	Limited Receptors Park Users (Short Duration) Residential, Park Users (Long Duration)	Low. Area adjacent to residential area and located in proximity to park. Potential receptors include nearby residents and recreational users on trail (assumed able to reroute). Contractor would be required to meet noise ordinances.	Low. Area near residential area and located in proximity to park facilities. Potential receptors include nearby residents and park users of trails and facilities at marina. Contractor would be required to meet noise ordinances.	Low. Area near residential area and located in proximity to park facilities. Potential receptors include nearby residents and park users of trails and facilities at marina. Contractor would be required to meet noise ordinances.	Medium. Area adjacent to residential area but located within industrial area. Contractor would be required to meet noise ordinances.
9			Odors/Dust	Relative distance to potential receptors, including recreational users or residential areas	Green Yellow Red	Park Users with Controls Residential Users with Controls Receptors, No Controls	Medium. Area adjacent to residential area and located in proximity to park. Potential receptors include nearby residents and recreational users on trail (assumed able to reroute). Contractor would be required to control odors and dust.	Medium. Area near residential area and located in proximity to park facilities. Potential receptors include nearby residents and park users of trails and facilities at marina. Material would require multiple handlings, increasing potential for dust generation. Contractor would be required to control odors and dust.	Medium. Area near residential area and located in proximity to park facilities. Potential receptors include nearby residents and park users of trails and facilities at marina. Material would require multiple handlings, increasing potential for dust generation. Contractor would be required to control odors and dust.	High. Area adjacent to residential area but located within industrial area. Contractor would be required to control odors and dust.
10			Truck Traffic	Minimizes truck traffic on residential roads and minimizes impacts to neighborhoods and park traffic	Green Yellow Red	No Residential/Limited Park Traffic Probable Park Traffic Residential Impacts	Low. No direct impacts to residential roads. Truck traffic noise would impact adjacent neighborhoods. Impacts to park traffic may occur.	Low. Truck access through residential areas and along park road creating significant impacts to neighborhoods and park. Multiple routes may be used to reduce impacts to a specific neighborhood.	Low. Truck access through residential areas and along park road creating significant impacts to neighborhoods and park. Multiple routes may be used to reduce impacts to a specific neighborhood.	High. No impacts to residential roads or park users. Noise impacts to adjacent neighborhoods due to truck traffic anticipated to be similar to existing conditions.
11	Environment	Environmental Considerations	Wetland Impacts	Avoids or minimizes disturbance of existing wetlands	Green Red	No Impacts Significant Impacts	Low. Majority of area is wetlands.	Low. Majority of area is wetlands.	Low. Majority of area is wetlands.	High. No known wetlands within anticipated limits of disturbance.
12			Resource Protection Area Impacts	Avoids or minimizes disturbance within Resource Protection Areas	Green Yellow Red	No Impacts Some Impacts (previous disturbed) Significant Impacts	Low. Area is entirely within resource protection area.	Low. Area is entirely within resource protection area.	Low. Area is entirely within resource protection area.	High. Limits of disturbance assumed to be restricted to areas outside the resource protection area.
13			Clearing Impacts	Avoids or minimizes disturbance of existing tree canopy	Green Yellow Red	No or Limited Selective or Potential Significant	Medium. Located predominately within previously cleared/developed area. Selective clearing of trees from previous disposal footprint required. Clearing of trees likely outside former settling basin footprint.	Low. Would require clearing island of trees and shrubs.	Low. Would require clearing island and shoreline for land bridge of trees and shrubs.	High. Location is predominantly clear of trees as work will be performed within right-of-way below electrical power lines.
14		Floodplain Impacts	--	Avoids or minimizes work within floodplains	Green Yellow Red	Outside Floodplains Portion in Floodplain Significant Portion / All	High. Limits of disturbance assumed to be outside floodplain.	Low. Area is entirely within floodplain requiring construction of protective measures for critical system components.	Low. Area is entirely within floodplain and includes placement of fill within lake footprint to create land bridge.	High. Limits of disturbance assumed to be outside floodplain.
15	Environment (continued)	Sustainability	Bank & Meadows	Minimizes disturbance to existing banks and meadows and/or opportunity to improve same	Green Yellow Red	No Disturbance Limited Disturbance Significant Disturbance	Low. Would require routing of existing stream channel and channel would not be restored.	Medium. Existing island banks likely to be disturbed to allow for installation of transloading area. Improvements may be possible along remaining banks.	Low. Would result in significant disturbance to existing island and lake banks at the land bridge location.	High. No streambank or meadows within anticipated limits of disturbance. Existing area appears to be cleared/maintained field.

Criteria No.	Category	Criteria	Sub-Criteria	Description	Range	Definition	Lake Accotink Park Upper Settling Basin	Lake Accotink Island (Current Footprint)	Lake Accotink Island (Expanded Footprint)	Concrete Plant
16	Environment (continued)	Sustainability (continued)	Native Landscaping	Minimizes disturbance to native landscaping and/or opportunity to improve same during restoration	Green Yellow Red	Developed Areas Only Limited Disturbance Significant Disturbance	Low. Would require removal of all existing vegetation within footprint of dewatering area and limited restoration within footprint would be proposed.	Low. Would require removal of all existing vegetation within footprint of dewatering area and no restoration within footprint would be proposed.	Low. Would require removal of all existing vegetation within footprint of dewatering area and no restoration within footprint would be proposed. Includes loss of some existing mudflats to accommodate land bridge construction.	High. dewatering area would be limited to existing cleared and maintained areas.
17			Available Area	Relative space available for dewatering area	Green Yellow Red	> 10 acres > 5 acres < 5 acres	Medium. Footprint likely to expand outside existing settling basin footprint to accommodate production rates; to be refined during design. The area geometry and soil conditions may limit usable area within site.	Low. Area is limited and anticipated to allow for limited dewatering methods and lower production rates.	Medium. While identified limits of disturbance area is adequate, actual available area subject to ability to construct land bridge and maintain bank stability.	High. Available area anticipated to be readily available but is subject to agreement with existing property owner.
18			County-Controlled	Extent of County control over property use	Green Yellow Red	County-Owned Utility Easement Third Party Owned	High. County-owned property.	High. County-owned property.	High. County-owned property.	Low. Owned by third party. County will need to obtain land lease or similar agreement.
19			Use Restrictions	Limits potential use restrictions by property owner	Green Yellow Red	County-Owned Easement Restriction Third Party Owner Restrictions	High. County-owned property.	High. County-owned property.	High. County-owned property.	Low. Property owner may limit use of property to certain areas and/or hours of operation. Potential for use of area to change between design and dredging events.
20		Available Area and Accessibility	Construction Accessibility	Existing site access for construction equipment	Green Yellow Red	Existing Road Access Roads to be Constructed Water Access Only	Medium. Access would use existing driveway off Rolling Road and existing trail. Installation of access point to trail and access roads within dewatering area required.	Low. Access limited to water. All equipment would require barging to island and barging to remove from island. Potential limitation on ability to barge transport certain equipment based on limited water depth.	Low. Access limited to water during initial mobilization; equipment would require barging to island. Potential limitation on ability to barge transport based on water depth. Removal may be performed via trails but access may be limited or restricted to certain size vehicles.	Medium. Existing access roads to limits of work anticipated but may be subject to access or use restrictions by property owner.
21			Flooding	Minimizes relative potential for flooding	Green Yellow Red	Outside Floodplains Edge of Floodplain Surrounded by Floodplain	High. Limits of disturbance assumed to be outside floodplain, minimizing potential for flooding.	Low. Area is entirely within floodplain and elevation would be within a few feet of water surface.	Low. Area is entirely within floodplain and elevation would be within a few feet of water surface.	High. Limits of disturbance assumed to be outside floodplain, minimizing potential for flooding.
22			Utility Availability	Proximity to potential utilities	Green Yellow Red	Close to Known Utilities Utilities Anticipated No Known Utilities	Medium. Existing utilities anticipated but may not be close to area. Existing service would need to be verified during design depending on process needs.	Low. Existing utilities within island not anticipated. Option to install utilities or use diesel-powered equipment would be determined during design.	Low. Existing utilities within island not anticipated. Option to install utilities or use diesel-powered equipment would be determined during design.	Medium. Existing utilities anticipated but may not be close to area. Existing service would need to be verified during design depending on process needs.
23	Construction and Dredging Program Operation	Site Preparation Requirements	Soil Condition	Relative strength of existing soils and ability to support equipment with minimal improvements	Green Yellow Red	No Known Soft Soils Soft Soils Possible Soft Soils Known/Expected	Low. Location of previous dredge spoils and existing wetland. Existing strength of material unknown and would require detailed geotechnical investigation. Soft soils anticipated that require improvement.	Low. Existing strength of material unknown and would require detailed geotechnical investigation to determine improvements that may be required. Soft soils likely that require improvement.	Low. Detailed geotechnical investigation needed to support land bridge design. Soft sediments and soils are anticipated within footprint of likely land bridge.	Low. Location of previous dredge spoils. Existing strength of material unknown and would require detailed geotechnical investigation. Anecdotal information from property owner indicates presence of soft soils.
24			Grading	Relative amount of surface area with acceptable slope for support area; minimizes additional grading	Green Yellow Red	Minimal Grading Some Grading Extensive Grading	Medium. Based on available topography, relatively flat areas are available within existing footprint. Grading would be required for areas outside the former limits of disturbance needed to accommodate production rates.	High. Based on available topography, relatively flat areas are available; minimal grading is anticipated.	Low. Construction of land bridge will require significant earthwork.	High. Based on available topography, relatively flat areas are available; minimal grading is anticipated.
25			Passive Dewater	Anticipated ability of area to accommodate passive dewatering based on current assumptions	Green Yellow Red	Suitable Suitable with Caveats Not Suitable	Medium. Able to accommodate passive dewatering grading outside former limits of disturbance to accommodate production rate. Soil anticipated to support construction with some improvement.	Low. Insufficient area based on assumed production and processing times. May be able to accommodate under different assumptions (to be evaluated by Contractor).	High. Based on proposed expansion, land bridge area would be designed to accommodate passive dewatering. Significant improvements needed to create land bridge as discussed in site preparation requirements.	High. Able to accommodate passive dewatering with some grading. Soil anticipated to support construction with some improvement.
26		Flexibility/Compatibility with Various Equipment	Passive with Desanding	Anticipated ability of area to accommodate passive dewatering with desanding	Green Yellow Red	Suitable Suitable with Caveats Not Suitable	Low. Insufficient existing area for processes.	Low. Insufficient existing area for processes.	Medium. Area may be designed to accommodate dewatering with appropriate grading and surface preparation to support desanding equipment; contingent on access for mobilization of desanding equipment.	Medium. Available area may be able to accommodate dewatering method with additional grading and surface preparation to support desanding equipment.
27			Mechanical Dewatering	Anticipated ability of area to accommodate mechanical dewatering	Green Yellow Red	Suitable Suitable with Caveats Not Suitable	Medium. Likely to accommodate mechanical dewatering provided sufficient slurry solids percent is maintained. Option contingent on sufficient site access for equipment delivery and ability to improve surface condition to support construction of concrete pads and placement of tanks and equipment.	Low. Insufficient area based on assumed production and processing times. Limited access (including insufficient water depth for barge transport) likely to prevent mobilization of necessary equipment to site.	Low. Land bridge area may be designed to accommodate mechanical dewatering. However, significant improvements of surface (construction of concrete pad likely) and access would be required. Site access may not support use of this method if equipment is mobilized on tractor trailer.	Medium. Able to accommodate mechanical dewatering provided sufficient slurry solids percent is maintained. Option contingent ability to improve surface condition to support construction of concrete pads and placement of tanks and equipment.
28			Drying Agent	Anticipated ability of area to accommodate dewatering by drying agent	Green Yellow Red	Suitable Suitable with Caveats Not Suitable	Low. Based on location, hydraulic transport most likely.	High. Based on location, possible to perform mechanical dredging with barge transport to dewatering area.	High. Based on location, possible to perform mechanical dredging with barge transport to dewatering area.	Low. Based on location, hydraulic transport most likely.
29		Efficient Water Return	--	Relative distance to water body and ability of receiving water to accommodate return water discharges	Green Yellow Red	Return to Lake Return to Stream Return to Stream with Significant Crossings	High. Located adjacent to lake. Water can be readily returned to lake.	High. Located within lake. Water can be readily returned to lake.	High. Located within lake. Water can be readily returned to lake.	Low. Location is outside the Accotink watershed. An existing pond borders proposed dewatering area; however, water may require return to Lake Accotink depending on flow rates.

Exhibit 4
Dewatering Location Evaluation
Alternatives Analysis Report
Lake Accotink Dredging Project
Fairfax County, Virginia

Criteria No.	Category	Criteria	Sub-Criteria	Description	Range	Definition	Lake Accotink Park Upper Settling Basin	Lake Accotink Island (Current Footprint)	Lake Accotink Island (Expanded Footprint)	Concrete Plant
30	Construction and Dredging Program Operation	Constructability	Offsite Transport	Relative access for offsite transportation access and material loading	Green Yellow Red	Existing Access with Truck Staging Available Existing Access, Limited Staging Secondary Staging or Double Handling	Low. Existing access point to public roadways anticipated. Given limited space, number of trucks able to be staged within dewatering area anticipated to be very limited, which may require staging of trucks at secondary location.	Low. Existing access point to public roadways anticipated. Transport would require barge transport to marina (double handling). Given limited space at marina, number of trucks able to be staged anticipated to be very limited and may require staging of trucks on park roads or parking lots.	Low. Existing access point to public roadways anticipated. Given limited space, anticipate needing both barge (see entry for island current footprint). Direct truck transport may be possible with limited to no extra truck staging at dewatering area requiring staging at secondary location.	Medium. Existing access point to public roadways. Construction of access roads and truck staging area anticipated. Available area to stage trucks may be limited by property owner.
31			Geotechnical Considerations	Limited geotechnical considerations anticipated based on topography and soil	Green Yellow Red	Typical Assumptions Evaluation Required Detailed Design and Evaluation Req'd	Low. Evaluation of existing soils will be required to determine improvements needed to support operations. Evaluation of trail (former rail) embankment may be required to confirm ability to support truck traffic.	Medium. Some grading and evaluation of slope stability along edge of island may be necessary. Evaluation of existing soils will be required to determine improvements needed to support operations.	Low. Evaluation of existing soils and sediment will be required to determine land bridge construction methods. Sewer line underneath the lake would have to be evaluated for additional loading from land bridge.	Medium. Some grading and evaluation of slope stability may be necessary. Evaluation of existing soils will be required to determine improvements needed to support operations.
32			Ease of Permitting	Relative permitting requirements for preparation of dewatering site	Green Yellow Red	No Permits Anticipated Local/State Permits Federal Permits	Low. Would require permit to construction in wetland. Assumes mitigation of lost wetlands would be required.	Low. Would require permit/variance to construct within floodplain, wetlands, and resource protection area. Assumes mitigation of lost wetlands would be required.	Low. Would require permit/variance to construct within floodplain, wetlands, and resource protection area. Assumes mitigation of lost wetlands would be required. Significant design effort related to construction within floodplain and filling of lake anticipated.	High. Based on no significant resource protection area, floodplain or wetland impacts, permitting anticipated to be relatively simple.
33			Restoration	Relative ease of restoration	Green Yellow Red	No Restoration Planned Some Restoration Extensive Restoration	High. Anticipated that area could be left as prepared pad for selected dewatering method.	Medium. Anticipated that area could be left as prepared pad for selected dewatering method. Does not include mitigation. Some shoreline support restoration may be required.	High. Anticipated that area could be left as prepared pad for selected dewatering method. Does not include mitigation.	High. Anticipated that area could be left as prepared pad for selected dewatering method.
34		Long-Term Operation and Maintenance Dredging	Compatibility with Maintenance Dredging	Relative ability of area to allow for flexible dredging and/or dewatering methods to be used during maintenance dredging	Green Yellow Red	No Restrictions Possible Restrictions Known Restrictions	Medium. Location may allow for both passive and mechanical dewatering with expansion outside former footprint. No schedule restrictions would be anticipated given current use of area. Lower production anticipated.	Low. Location allows for limited dewatering options. Accessibility may be impaired depending on duration between dredging events.	Medium. Location allows for both passive and mechanical dewatering. Lower production anticipated. May be able to schedule maintenance dredging around high use of facilities.	Medium. Location allows for both passive and mechanical dewatering. Potential limits on production or short-term use.
35			Future Availability	Likelihood for area to remain available for use over life of maintenance dredging program	Green Yellow Red	Same Availability Potential Change within Range Potential for Significant Change	High. County-owned property.	High. County-owned property.	High. County-owned property.	Low. Owned by third party. County will need to obtain land lease or similar agreement. Agreement terms or use of area may change over course of maintenance dredging program.
36			Remobilization Site Preparation	Minimal effort to prepare site for future maintenance dredging events	Green Yellow Red	Limited Site Prep Possible Site Prep Significant Site Prep	High. Anticipated that area could be left as prepared pad for selected dewatering method between dredging methods.	Medium. Without direct access, preparation for barge transport would be anticipated.	High. Anticipated that area could be left as prepared pad for selected dewatering method between dredging methods.	Medium. Anticipated that area could be left as prepared pad for selected dewatering method between dredging methods. Potential for property owner to modify between use.
37		Schedule	Base Dredge Site Preparation and Restoration	Ability to comply with total construction of 3 years by limiting site preparation / restoration duration	Green Yellow Red	Reduce Schedule Meet Schedule Schedule Extension Possible	Low. Anticipated additional time to grade expanded footprint, condition soil and otherwise prepare suitable surface. If limited to previous disturbance limits,extended schedule likely reqiuired. Repair of existing infrastructure required.	High. Relatively small area would result in quicker site preparation time provided sufficient water access is available.	Low. Significant time anticipated to construct land bridge, condition soil and/or prepare suitable surface for dewatering system.	Medium. Anticipated additional time to condition soil or otherwise prepare suitable surface for dewatering system.
38			Production Rate	Ability to accommodate a range of dredging and dewatering production rates to comply with total dredging period of 2 years	Green Yellow Red	High Production Average Minimum Production Low Production	Low. Not be able to accommodate production of 950 cy/day within former limits of disturbance. Area may be able to accommodate production of 950 cy/day if expanded outside previous limits of disturbance and grading can be performed. Not likely to accommodate higher production due to surrounding grades.	Low. Overall would anticipate lower production due to limited footprint and access.	High. Area available to accommodate range of productions evaluated (950 cy/day to 1250 cy/day) depending on dewatering method.	High. Area available to accommodate range of productions evaluated (950 cy/day to 1250 cy/day) depending on dewatering method.
39			Maintenance Dredge Site Preparation and Restoration	Relative schedule efficiency needed for remobilization, site preparation, and restoration for maintenance dredging events	Green Yellow Red	Minimal Some Extensive	High. Minimal site preparation or restoration anticipated for future remobilization events.	Medium. Some site preparation may be required to reinstall transloading infrastructure and/or utilities needed to support offsite transport.	High. Minimal site preparation or restoration anticipated for future remobilization events.	High. Minimal site preparation or restoration anticipated for future remobilization events.
40		Costs	Main Dredging Construction	Relative cost based on anticipated site preparation, location-specific operation, and restoration (if applicable). Does not include mitigation.	Green Yellow Red	Relative Low Cost Mid Cost Relative High Cost	Low. $$$. Anticipates extensive traffic control, trail rerouting in addition to grading and surface preparation. Extent of existing infrastructure repair would be evaluated during design. Does not include mitigation costs.	Medium. $$. Anticipates extensive traffic control and surface preparation (costs limited by size of area). Does not include mitigation costs.	Low. $$$. Anticipates extensive traffic control, trail rerouting in addition to grading and surface preparation. Extent of existing infrastructure repair would be evaluated during design. Does not include mitigation costs.	Low. $$ - $$$. Anticipates extensive surface preparation due to soil condition and grading based on available area plus traffic controls Does not include any access costs that may be negotiated.
41			Maintenance Dredging	Relative cost for maintenance dredging site preparation and restoration (if applicable).	Green Yellow Red	Relative Low Cost Mid Cost Relative High Cost	High. $. Pad remains in place and assumes dewatering system can be remobilized with minimal site preparation.	Medium. $$. Some site preparation may be required to reinstall transloading infrastructure and/or utilities needed to support offsite transport.	High. $. Pad remains in place and assumes dewatering system can be remobilized with minimal site preparation.	High. $. Pad remains in place and assumes dewatering system can be remobilized with minimal site preparation.
						Alternative Summary	Green - 14 Yellow - 10 Red - 17	Green - 7 Yellow - 12 Red - 22	Green - 11 Yellow - 7 Red - 23	Green - 24 Yellow - 10 Red - 7

KEY

High	High means an alternative readily meets the criteria. Criteria are worded to indicate meeting the criteria is beneficial. Alternatives with the lowest cost best meet the cost objective of a cost effective alternative and thus are ranked high.
Medium	Medium means an alternative meets some of the criteria or may be able to meet criteria with certain controls or requirements in place.
Low	Low means an alternative does not meet the criteria without significant adjustments. Criteria are worded to indicate meeting the criteria is beneficial. Alternatives with the highest cost do not meet the cost objective of a cost effective alternative and thus are ranked low.

Exhibit 5
Sediment Transport Pipeline Alignments Evaluation
Alternatives Analysis Report
Lake Accotink Dredging Project
Fairfax County, Virginia

Criteria No.	Category	Criteria	Sub-Criteria	Sub-Criteria Description	Range	Definition	Howrey Field (HF)			
							HF1 - Cross-County Trail	HF2 - Queensberry Ave.	HF3 - Flag Run/Port Royal Road[2]	HF4 - Flag Run/I-495[2]
1	Park Management	Consistency With Long-Term Park Vision	Compatibility with Existing LAP Infrastructure	Minimizes impacts to existing infrastructure such as buildings, fences, structures, utilities, etc.	Green Yellow Red	No Impact Short-term Impact Long-term Impact	Medium: Some known structures within the initial trail alignment inside LAP will be impacted only during construction.	Medium: Some known structures within the initial trail alignment inside LAP will be impacted only during construction.	Low: Potential impacts to the Marina area and trails along flag run will be impacted during construction and dredging operations.	Low: Potential impacts to the Marina area and trails along flag run will be impacted during construction and dredging operations.
2			Compatibility with Future Improvements	Compatible with planned long-term improvements	Green Yellow Red	No Impact Short-term Impact Long-term Impact	High: No known LAP LTI planned along alignment. Potential for net improvement to trails post-construction. Any impacts within LAP will be short-term pending final design of the pipeline connection to dredge pump	High: No known LAP LTI planned along alignment. Potential for net improvement to trails post-construction inside LAP. Any impacts within LAP will be short-term pending final design of the pipeline connection to dredge pump	Medium: Any LAP impacts will be short-term pending final design of the pipeline connection to dredge pump and proximity to the Marina area. Potential impacts from Booster PS siting north of Braddock if no favorable southern location found .	Medium: Any LAP impacts will be short-term pending final design of the pipeline connection to dredge pump and proximity to the Marina area. Potential impacts from Booster PS siting north of Braddock if no favorable southern location found .
3			Lost & Reduced Use	Minimizes reduced and lost use of area for recreational purposes	Green Yellow Red	No Impact Short-term Impact Definite Impact	Medium: Significant length of trail sections need to be closed for open-cut construction. Long-term changes to surface from vegetated to gravel or other may reduce aesthetics of the trail.	Medium: Shorter trail segments at the beginning of the alignment impacted during construction.	Low: Potential impacts to bridge and trail access near Flag Run during construction, main and maintenance dredging (due to above-ground temporary pipe along Flag Run).	Low: Potential impacts to bridge and trail access near Flag Run during construction, main and maintenance dredging (due to above-ground temporary pipe along Flag Run).
4			Cultural Resources[1]	Minimize impacts to cultural resources	Green Yellow Red	No Impact Some Impact Known Impact	Low: Prehistoric lithic scatter recorded near northern alignment. (Refer to WSSI's Cultural Resource Assessment Memo).	Low: Prehistoric lithic scatter recorded near northern alignment. (Refer to WSSI's Cultural Resource Assessment Memo).	Low: Prehistoric lithic scatter recorded near northern alignment. (Refer to WSSI's Cultural Resource Assessment Memo).	Low: Prehistoric lithic scatter recorded near northern alignment. (Refer to WSSI's Cultural Resource Assessment Memo).
5	Community	Recreational Use Restrictions During Construction	Compatibility with the Recreational use of the Trail System	Minimizes impacts (e.g., closures, detours) to Cross County trail and connecting LAP trails	Green Yellow Red	No/Low Impact Short-term Impact Long-term Impact	Medium: Large trail sections need to be closed during construction only.	Medium: Shorter trail segments impacted during construction only.	Low: Impacts due to proximity to the bridge leading to connecting trails and trails along flag run during construction, main and maintenance dredging (due to above-ground temporary pipe along Flag Run).	Low: Impacts due to proximity to the bridge leading to connecting trails and trails along flag run during construction, main and maintenance dredging (due to above-ground temporary pipe along Flag Run).
6			Compatibility with Use of Other Park Facilities	Avoids or minimizes closures of park facilities, e.g., ball fields, marina, restrooms	Green Yellow Red	No/Low Impact Short-term Impact Long-term Impact	High: No park facilities along the alignment.	High: No park facilities along the alignment.	Low: Marina area and other facilities near Flag Run impacted during construction, main and maintenance dredging.	Low: Marina area and other facilities near Flag Run impacted during construction, main and maintenance dredging.
7			Compatibility with LAP and other Park's Parking Facilities	Avoids or minimizes closures to parking within LAP and other parks.	Green Yellow Red	No/Low Impact Short-term Impact Long-term Impact	High: Not near any major parking areas	High: Not near any major parking areas	Low: Parking near the Marina area will be impacted during construction, main and maintenance dredging (due to above-ground temporary pipe along Flag Run).	Low: Parking near the Marina area will be impacted during construction, main and maintenance dredging (due to above-ground temporary pipe along Flag Run).
8		Community Considerations During Construction	Compatibility with Noise Ordinance and Community / Recreational / Residential Requirements	Relative distance to potential receptors, including recreational users or residential areas.	Green Yellow Red	No/Low Impact Short-term Impact Long-term Impact	Medium: Trail located close to neighborhood and frequently used for recreation. However, noise impact expected only during construction.	Low: Proposed pipe alignment along residential street. Noise impact anticipated during const.& booster PS operation	Medium: Majority of the alignment along industrial/commercial area and Braddock road. Noise impacts anticipated during construction and operations from booster PSs. However, no long-term noise impacts anticipated to residential/recreational users.	High: Majority of the alignment behind commercial/industrial area, away from residential areas.
9			Odors/Dust	Relative distance to potential receptors, including recreational users or residential areas.	Green Yellow Red	No/Low Impact Short-term Impact Long-term Impact	Medium: Trail located close to neighborhood and frequently used for recreation. However, dust impact expected only during construction.	Medium: Alignment along residential street. Direct dust impact to residences during construction.	Medium: Majority of the alignment along industrial/commercial areas. Dust impact anticipated only during construction.	High: Majority of the alignment behind commercial/industrial area, away from residential areas
10			Road Closure	Avoids or minimizes length and extent of road closures with potential to impact residential/commercial traffic and pedestrian movement.	Green Yellow Red	No/Low Impact Short-term Impact Long-term Impact	High: Access into the trails and construction near Howrey Field will only require temp lane closures.	Medium: Alignment along wider residential street, with shoulders and bike lanes on both sides. Lanes can be closed on a section basis with localized impacts.	Low: Significant long-term lane/road closure impacts to Port Royal Rd.as lanes are narrow.	High: Majority of the alignment behind commercial/industrial area, away from residential areas.
11			Truck Traffic	Minimizes truck traffic on residential roads and minimizes impacts to neighborhoods and park traffic.	Green Yellow Red	Low Increase Moderate Increase High Increase	Low: Safe, easy access to trails via residential roads only.	Low: Alignment along residential street.	Medium: Potential for impact to residences for access to the upper part of the trail section along Flag Run.	Medium: Potential for impact to residences for access to the upper part of the trail section along Flag Run.

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Criteria No.	Category	Criteria	Sub-Criteria	Sub-Criteria Description	Range	Definition	Howrey Field (HF)			
							HF1 - Cross-County Trail	HF2 - Queensberry Ave.	HF3 - Flag Run/Port Royal Road[2]	HF4 - Flag Run/I-495[2]
12	Environment	Environmental Considerations	Wetland Impacts[1]	Minimizes wetland disturbance during construction/long-term O&M.	Green Yellow	Minimal/No Impact Potential Impact	Medium: 0.63 acres	High: 0.01 ac.	Medium: 0.60 acres	Medium: 0.65 acres
13			Resource Protection Area Impacts	Avoids or minimizes disturbance to Resource Protection Areas - relative extent (area) impacted by construction	Green Yellow Red	Small Area Medium Large Area	Low:	High:	Low:	Low:
14			Stream Impacts[1]	Minimizes disturbance to existing streams/banks - linear footage (LF) impacted during construction.	Green Yellow Red	Lengths < 99 LF Lengths 100 - 999 LF Lengths > 1000 LF	Medium: 104LF	High: 10LF	Low: 1013LF	Low: 993LF
15			Forested Land Cover Impact[1]	Minimizes impacts or disturbance to existing trees/tree canopy.	Yellow Red	Area < 0.99 acre Area > 1.0 acre	Low: 1.66 ac.	Medium: 0.65 ac.	Low: 1.04 ac.	Medium: 0.90 ac.
16		Floodplain Impacts	Floodplains Impact	Avoids or minimizes extent of the work constructed within floodplains.	Green Yellow Red	Small Area Medium Area Large Area	Low:	Medium:	Low:	Low:
17		Sustainability	Energy Usage	Relative energy efficiency during construction and long-term O&M for transporting dredged material.	Green Yellow Red	Relatively Low Use Relatively Higher Use Highest Energy Used	High: Shortest pipe length, no Booster PS	Low: Relatively shorter pipe length. However, multiple booster PSs needed to overcome really high static head.	Low: Longest pipe length + multiple booster PSs needed to overcome really high static head.	Low: Longest pipe length + multiple booster PSs needed to overcome really high static head.
18	Construction, Dredging Operations & Long-Term O&M	Constructability	Geotechnical Impacts	Geotechnical site conditions (ability to support equipment with minimal improvements, dewatering requirements, pipe support, etc.) assuming open-cut construction	Green Yellow Red	Poor Conditions Moderate Conditions Good Conditions	Low: High water table near lake and areas adjacent to the creek may need dewatering and support during construction.	Medium: Challenging conditions near LAP and Braddock/Creek crossing	Low: High water table near lake and creek crossing needing dewatering and support during construction	Low: High water table near lake and creek crossing needing dewatering and support during construction
19			Construction Access	Allows contractor sufficient access to construct, monitor, operate, and maintain the pipeline and pump stations during construction activities.	Green Yellow Red	Existing Access No Ex.Access/Easy to Provide No Ex.Access/Difficult to Provide	Low: Only access thru the trail access areas in between residential blocks.	Medium: Access to Lower/Upper alignments can be challenging thru the trails/treed areas.	Low: Only access to the upper part of trail alignment thru residential areas.	Medium: Access to Lower/Upper alignments can be challenging thru the trails/treed areas.
20			Utility Conflicts	Number of crossings with major utility conicts - e.g. water, sewer, stormwater, power.	Green Yellow Red	<20 Conflicts 20 to 50 Conflicts >50 Conflicts	High: Fewest # of crossings (19) due to the trail location.	Medium: Relatively higher crossings (44) due to residential location.	Low: Highest # of crossings (59) due to industrial/commercial areas	Medium: Relatively higher crossings (37) due to residential location.
21			Permitting Requirements	Relative permitting requirements for slurry transport/pumping construction	General Permit or Individual Permit		Individual Permit	Individual Permit	Individual Permit	Individual Permit
22			Easement acquisition	Relative number of easements required	Green Yellow Red	Low Medium High	Medium: Majority of the construction is along the trail. Easement required for pipe thru Dominion ROW	Low: No easement for pipe installed under roadway and PA ROW. However Booster PS(s)/valves will need to be located within permanent easements. Easement required thru Dominion ROW	Medium: No easement needed for pipe installed under roadway and PA ROW, permanent easements required for installing/O&M access for valves & booster PS(s). Easement required for pipe thru Dominion ROW	Low: Easement required for pipeline behind commercial/industrial properties, potential VDOT ROW and Braddock road crossing. Easement required thru Dominion ROW
23		Long-Term Operation and Maintenance	Infrastructure Security/Public Risk	Relative security/public risk of pipeline to potential for vandalism or damage. Compromise to the integrity of the pipeline or the booster station(s) poses community-related risks.	Green Yellow Red	Low Medium High	Medium: Located along trail, therefore potential for risk. However, pipeline risk is decreased with a buried pipe. No direct residential impacts.	Medium: Majority of alignment along residential street. However, pipeline risk is decreased with a buried pipe.	Low: Majority of alignment along trail proposed to be temporary/above-ground for main and maintenance dredging.	Low: Majority of alignment along trail proposed to be temporary/above-ground for main and maintenance dredging.
24			Pipeline & associated infrastructure O&M	Pipeline Maintenance, replacement/repair- relative accessibility	Green Yellow Red	Low Medium High	Medium: Low # of valves, access thru trail, creek crossing access	Medium: Low # of valves, however potentially challenging access	Medium: Despite relatively higher # of valves, possible to locate them in accessible areas	Medium: Despite relatively higher # of valves, possible to locate them in accessible areas
25			Booster PS & associated infrastructure O&M	Booster PS Maintenance, replacement/repair - relative accessibility	Green Yellow Red	Low Medium High	High: No booster PSs	Low: Access to booster PS(s), valves challenging depending on location	Medium: Booster PSs access potentially challenging pending siting	Medium: Booster PSs access potentially challenging pending siting
26		Schedule	Main Dredging	Relative schedule efficiency for preparation and restoration of site, plus relative schedule implications based on various slurry transport routes	Green Yellow Red	Low Schedule Impact Some Schedule Impact Significant Schedule Impact	High: Majority of the construction is along trail, no booster PSs, flat pipe profile.	Medium: Construction thru residential streets, Braddock crossing can be challenging	Low: Access to trail areas, construction along commercial/industrial areas, road closures, booster PS(s), valves pose challenges depending on location	Low: Access to trail areas, construction along commercial/industrial areas, road closures, booster PS(s), valves pose challenges depending on location
27			Maintenance Dredging	Relative schedule efficiency for re-mobilization, site preparation, and restoration for maintenance dredging	Green Yellow Red	Low Schedule Impact Some Schedule Impact Significant Impact	High: Minimal re-mobilization, site preparation or restoration required with buried pipe installation	High: Minimal re-mobilization, site preparation or restoration required with buried pipe installation	Low: Maintenance dredging crew will need to prepare site and re-lay the temporary above-ground pipe	Low: Maintenance dredging crew will need to prepare site and re-lay the temporary above-ground pipe
28		Costs	Main Dredging Construction	Relative cost based on anticipated conditions to install pipe, Booster PSs (if any) and associated infrastructure.	Green Yellow Red	$ $$ $$$	High: $ - Majority of the construction is along trail, no booster PSs, flat pipe profile.	Medium: $$ - Booster PS(s), utility crossings, residential const. potential to increase costs	Low: $$$ - Longer pipeline length, relatively higher # of valves/booster PSs	Low: $$$ - Longer pipeline length, relatively higher # of valves/booster PSs
29			Maintenance Dredging	Relative cost for performing maintenance dredging assuming minimal site preparation. Assumes same method as main dredging. Does not include site restoration for interim use.	Green Yellow Red	$ $$ $$$	High: $ - Minimal re-mobilization, site preparation or restoration required with buried pipe installation	Medium: $$ - Relatively higher energy and operations cost due to booster PS and valves.	Low: $$$ - Higher energy costs due to pipeline length, booster PSs, re-lay temporary pipe along Flag Run	Low: $$$ - Higher energy and operating costs due to longer pipeline length, relatively higher # of valves/booster PSs
						Alternative Summary	**Green - 11** **Yellow - 10** **Red - 7**	**Green - 7** **Yellow - 15** **Red - 6**	**Green - 0** **Yellow - 8** **Red - 20**	**Green - 3** **Yellow - 8** **Red - 17**

Exhibit 5
Sediment Transport Pipeline Alignments Evaluation
Alternatives Analysis Report
Lake Accotink Dredging Project
Fairfax County, Virginia

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Criteria No.	Category	Criteria	Sub-Criteria	Sub-Criteria Description	Range	Definition	Wakefield Park Maintenance Facility			
							WMF1 - Cross-County Trail	WMF2 - Queensberry Ave.	WMF3 - Flag Run/Port Royal Road[2]	WMF4 - Flag Run/I-495[2]
1	Park Management	Consistency With Long-Term Park Vision	Compatibility with Existing LAP Infrastructure	Minimizes impacts to existing infrastructure such as buildings, fences, structures, utilities, etc.	Green Yellow Red	No Impact Short-term Impact Long-term Impact	Medium: Some known structures within the initial trail alignment inside LAP will be impacted only during construction.	Medium: Some known structures within the initial trail alignment inside LAP will be impacted only during construction.	Low: Potential impacts to the Marina area and trails along flag run will be impacted during construction and dredging operations.	Low: Potential impacts to the Marina area and trails along flag run will be impacted during construction and dredging operations.
2			Compatibility with Future Improvements	Compatible with planned long-term improvements	Green Yellow Red	No Impact Short-term Impact Long-term Impact	High: No known LAP LTI planned along alignment. Potential for net improvement to trails post-const. Any impacts to maintenance facility deemed short-term. Any impacts within LAP will be short-term pending final design of the pipeline connection to dredge pump.	High: No known LAP LTI planned along alignment. Potential for net improvement to trails post-const. Any impacts to maintenance facility deemed short-term. Any impacts within LAP will be short-term pending final design of the pipeline connection to dredge pump.	Medium: Any LAP impacts will be short-term pending final design of the pipeline connection to dredge pump and proximity to the Marina area. Potential impacts from Booster PS siting north of Braddock if no favorable southern location found .	Medium: Any LAP impacts will be short-term pending final design of the pipeline connection to dredge pump and proximity to the Marina area. Potential impacts from Booster PS siting north of Braddock if no favorable southern location found .
3			Lost & Reduced Use	Minimizes reduced and lost use of area for recreational purposes	Green Yellow Red	No Impact Short-term Impact Definite Impact	Medium: Significant length of trail sections need to be closed for open-cut construction. Long-term changes to surface from vegetated to gravel or other may reduce aesthetics of the trail.	Medium: Shorter trail segments at the beginning of the alignment impacted during construction + temp lane/road closure at entrance to WF park may hinder access temporarily.	Low: Potential impacts to bridge and trail access near Flag Run during construction, main and maintenance dredging (due to above-ground temporary pipe along Flag Run) + temp lane/road closure at entrance to WF park may hinder park access temporarily.	Low: Potential impacts to bridge and trail access near Flag Run during construction, main and maintenance dredging (due to above-ground temporary pipe along Flag Run) + temp lane/road closure at entrance to WF park may hinder park access temporarily.
4			Cultural Resources[1]	Minimize impacts to cultural resources	Green Yellow Red	No Impact Some Impact Known Impact	High: No cultural resources recorded. (Refer to WSSI's Cultural Resource Assessment Memo).	Medium: Near- Alignment adjacent to a recorded location. (Refer to WSSI's Cultural Resource Assessment Memo)	High: No cultural resources recorded. (Refer to WSSI's Cultural Resource Assessment Memo).	High: No cultural resources recorded. (Refer to WSSI's Cultural Resource Assessment Memo).
5	Community	Recreational Use Restrictions During Construction	Compatibility with the Recreational use of the Trail System	Minimizes impacts (e.g., closures, detours) to Cross County trail and connecting LAP trails	Green Yellow Red	No/Low Impact Short-term Impact Long-term Impact	Medium: Large trail sections need to be closed during construction only.	Medium: Shorter trail segments impacted during construction only.	Low: Impacts due to proximity to the bridge leading to connecting trails and trails along flag run during construction, main and maintenance dredging (due to above-ground temporary pipe along Flag Run).	Low: Impacts due to proximity to the bridge leading to connecting trails and trails along flag run during construction, main and maintenance dredging (due to above-ground temporary pipe along Flag Run).
6			Compatibility with Use of Other Park Facilities	Avoids or minimizes closures of park facilities, e.g., ball fields, marina, restrooms	Green Yellow Red	No/Low Impact Short-term Impact Long-term Impact	High: No park facilities along the alignment.	High: No park facilities along the alignment.	Low: Marina area and other facilities near Flag Run impacted during construction, main and maintenance dredging.	Low: Marina area and other facilities near Flag Run impacted during construction, main and maintenance dredging.
7			Compatibility with LAP and other Park's Parking Facilities	Avoids or minimizes closures to parking within LAP and other parks.	Green Yellow Red	No/Low Impact Short-term Impact Long-term Impact	High: Not near any major parking areas	High: Not near any major parking areas	Low: Parking near the Marina area will be impacted during construction, main and maintenance dredging (due to above-ground temporary pipe along Flag Run).	Low: Parking near the Marina area will be impacted during construction, main and maintenance dredging (due to above-ground temporary pipe along Flag Run).
8		Community Considerations During Construction	Compatibility with Noise Ordinance and Community / Recreational / Residential Requirements	Relative distance to potential receptors, including recreational users or residential areas.	Green Yellow Red	No/Low Impact Short-term Impact Long-term Impact	Medium: Trail located close to neighborhood and frequently used for recreation. However, noise impact expected only during construction.	Low: Alignment along residential street. Noise anticipated during construction and dredging operations from booster PSs.	Medium: Majority of the alignment along industrial/commercial area and Braddock road. Noise impacts anticipated during construction and operations from booster PSs. However, no long-term noise impacts anticipated to residential/recreational users.	High: Majority of the alignment behind commercial/industrial area, away from residential/recreational areas
9			Odors/Dust	Relative distance to potential receptors, including recreational users or residential areas.	Green Yellow Red	No/Low Impact Short-term Impact Long-term Impact	Medium: Trail located close to neighborhood and frequently used for recreation. However, dust impact expected only during construction.	Medium: Alignment along residential street. Direct dust impact to residences during construction	Medium: Majority of the alignment along industrial/commercial areas. Dust impact anticipated only during construction.	High: Majority of the alignment behind commercial/industrial area, away from residential areas.
10			Road Closure	Avoids or minimizes length and extent of road closures with potential to impact residential/commercial traffic and pedestrian movement.	Green Yellow Red	No/Low Impact Short-term Impact Long-term Impact	High: Access into the trails may require temp lane closures.	Medium: Alignment along wider residential street, with shoulders and bike lanes on both sides. Lanes can be closed on a section basis with localized impacts. Temp lane closure impacts near entrance to WF park.	Low: Significant long-term lane/road closure impacts to Port Royal Rd.as lanes are narrow + temp lane/road closure at entrance to WF park.	High: Majority of the alignment behind commercial/industrial area, away from residential areas + temp lane/road closure at entrance to WF park.
11			Truck Traffic	Minimizes truck traffic on residential roads and minimizes impacts to neighborhoods and park traffic.	Green Yellow Red	Low Increase Moderate Increase High Increase	Low: Safe, easy access to trails via residential roads only.	Low: Alignment along residential street.	Medium: Potential for impact to residences for access to the upper part of the trail section along Flag Run.	Medium: Potential for impact to residences for access to the upper part of the trail section along Flag Run.

Exhibit 5
Sediment Transport Pipeline Alignments Evaluation
Alternatives Analysis Report
Lake Accotink Dredging Project
Fairfax County, Virginia

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Criteria No.	Category	Criteria	Sub-Criteria	Sub-Criteria Description	Range	Definition	Wakefield Park Maintenance Facility			
							WMF1 - Cross-County Trail	WMF2 - Queensberry Ave.	WMF3 - Flag Run/Port Royal Road[2]	WMF4 - Flag Run/I-495[2]
12	Environment	Environmental Considerations	Wetland Impacts[1]	Minimizes wetland disturbance during construction/long-term O&M.	Green Yellow	Minimal/No Impact Potential Impact	Medium: 0.63 acres	High: 0.01 ac.	Medium: 0.60 acres	Medium: 0.65 acres
13			Resource Protection Area Impacts	Avoids or minimizes disturbance to Resource Protection Areas - relative extent (area) impacted by construction	Green Yellow Red	Small Area Medium Large Area	Low:	High:	Low:	Low:
14			Stream Impacts[1]	Minimizes disturbance to existing streams/banks - linear footage (LF) impacted during construction.	Green Yellow Red	Lengths < 99 LF Lengths 100 - 999 LF Lengths > 1000 LF	High: 60LF	High: 30LF	Low: 1003LF	Low: 1003LF
15			Forested Land Cover Impact[1]	Minimizes impacts or disturbance to existing trees/tree canopy.	Yellow Red	Area < 0.99 acre Area > 1.0 acre	Low: 1.69 ac.	Medium: 0.32 ac.	Medium: 0.88 ac.	Medium: 0.90 ac.
16		Floodplain Impacts	Floodplains Impact	Avoids or minimizes extent of the work constructed within floodplains.	Green Yellow Red	Small Area Medium Area Large Area	Low:	High:	Low:	Low:
17		Sustainability	Energy Usage	Relative energy efficiency during construction and long-term O&M for transporting dredged material.	Green Yellow Red	Relatively Low Use Relatively Higher Use Highest Energy Used	High: Shortest pipe length, no Booster PS	Medium: Shortest pipe length + multiple booster PSs needed to overcome really high static head.	Low: Longest pipe length + multiple booster PSs needed to overcome really high static head.	Low: Longest pipe length + multiple booster PSs needed to overcome really high static head.
18	Construction, Dredging Operations & Long-Term O&M	Constructability	Geotechnical Impacts	Geotechnical site conditions (ability to support equipment with minimal improvements, dewatering requirements, pipe support, etc.) assuming open-cut construction	Green Yellow Red	Poor Conditions Moderate Conditions Good Conditions	Low: High water table near lake and areas adjacent to the creek may need dewatering and support during construction	Medium: Challenging conditions (high water table) near LAP	Low: Challenging conditions (high water table) near LAP + unstable stream bank for the initial trail alignment	Low: Challenging conditions (high water table) near LAP + unstable stream bank for the initial trail alignment
19			Construction Access	Allows contractor sufficient access to construct, monitor, operate, and maintain the pipeline and pump stations during construction activities.	Green Yellow Red	Existing Access No Ex.Access/Easy to Provide No Ex.Access/Difficult to Provide	Medium: Only access thru the trail access areas in between residential blocks. Better access to northern alignment from either Braddock road or WF park trails.	Medium: Access to alignment inside LAP and near WF Park can be challenging thru the trails areas.	Low: Only access to the upper part of trail alignment thru residential areas. Access to near WF Park challenging thru treed areas.	Low: Only access to the upper part of trail alignment thru residential areas. Access near WF Park challenging thru treed areas.
20			Utility Conflicts	Number of crossings with major utility conlicts - e.g. water, sewer, stormwater, power.	Green Yellow Red	<20 Conflicts 20 to 50 Conflicts >50 Conflicts	High: Fewest # of crossings (17) due to the trail location.	Medium: Relatively higher crossings (40) due to residential location.	Low: Highest # of crossings (55) due to industrial/commercial areas	High: Fewest # of crossings (19) due to the alignment behind commercial/industrial areas
21			Permitting Requirements	Relative permitting requirements for slurry transport/pumping construction	General Permit or Individual Permit		Individual Permit	Individual Permit	Individual Permit	Individual Permit
22			Easement acquisition	Relative number of easements required	Green Yellow Red	Low Medium High	Medium: Majority of the construction is along the trail. Easement required for pipe thru Dominion ROW.	Low: No easement for pipe installed under roadway and PA ROW. However Booster PS(s)/valves will need to be located within permanent easements	Medium: No easement needed for pipe installed under roadway and PA ROW, permanent easements required for installing/O&M access for valves & booster PS(s).	Low: Easement required for pipeline, valves, booster PSs behind commercial/industrial properties, potential VDOT ROW and Braddock road crossing.
23		Long-Term Operation and Maintenance	Infrastructure Security/Public Risk	Relative security/public risk of pipeline to potential for vandalism or damage. Compromise to the integrity of the pipeline or the booster station(s) poses community-related risks.	Green Yellow Red	Low Medium High	Medium: Located along trail, therefore potential for risk. However, pipeline risk is decreased with a buried pipe. No direct residential impacts.	Medium: Majority of alignment along residential street. However, pipeline risk is decreased with a buried pipe.	Low: Majority of alignment along trail proposed to be temporary/above-ground for main and maintenance dredging.	Low: Majority of alignment along trail proposed to be temporary/above-ground for main and maintenance dredging.
24			Pipeline & associated infrastructure O&M	Pipeline Maintenance, replacement/repair- relative accessibility	Green Yellow Red	Low Medium High	Medium: Low # of valves, access thru trail, creek crossing access	Medium: Low # of valves, however potentially challenging access	Medium: Despite relatively higher # of valves, possible to locate them in accessible areas	Medium: Despite relatively higher # of valves, possible to locate them in accessible areas
25			Booster PS & associated infrastructure O&M	Booster PS Maintenance, replacement/repair - relative accessibility	Green Yellow Red	Low Medium High	High: No booster PSs.	Low: Access to booster PS(s), valves challenging depending on location.	Medium: Booster PSs access potentially challenging pending siting	Medium: Booster PSs access potentially challenging pending siting
26		Schedule	Main Dredging	Relative schedule efficiency for preparation and restoration of site, plus relative schedule implications based on various slurry transport routes	Green Yellow Red	Low Schedule Impact Some Schedule Impact Significant Schedule Impact	High: Majority of the construction is along trail, no booster PSs, flat pipe profile.	Medium: Construction thru residential streets, Braddock crossing can be challenging + booster PS const.	Low: Access to trail areas, construction along commercial/industrial areas, road closures, booster PS(s), valves pose challenges depending on location.	Low: Access to trail areas, construction along commercial/industrial areas, road closures, booster PS(s), valves pose challenges depending on location.
27			Maintenance Dredging	Relative schedule efficiency for re-mobilization, site preparation, and restoration for maintenance dredging	Green Yellow Red	Low Schedule Impact Some Schedule Impact Significant Impact	High: Minimal re-mobilization, site preparation or restoration required with buried pipe installation	High: Minimal re-mobilization, site preparation or restoration required with buried pipe installation.	Low: Maintenance dredging crew will need to prepare site and re-lay the temporary above-ground pipe.	Low: Maintenance dredging crew will need to prepare site and re-lay the temporary above-ground pipe.
28		Costs	Main Dredging Construction	Relative cost based on anticipated conditions to install pipe, Booster PSs (if any) and associated infrastructure.	Green Yellow Red	$ $$ $$$	High: $ - Majority of the construction is along trail, no booster PSs, flat pipe profile.	Medium: $$ - Booster PS(s), utility crossings, residential const. potential to increase costs	Low: $$$ - Longer pipeline length, relatively higher # of valves/booster PSs, utility crossings, difficult const. access.	Low: $$$ - Longer pipeline length, relatively higher # of valves/booster PSs.
29			Maintenance Dredging	Relative cost for performing maintenance dredging assuming minimal site preparation. Assumes same method as main dredging. Does not include site restoration for interim use.	Green Yellow Red	$ $$ $$$	High: $ - Minimal re-mobilization, site preparation or restoration required with buried pipe installation.	Medium: $$ - Relatively higher energy and operations cost due to booster PS and valves.	Low: $$$ - Higher energy costs due to pipeline length, booster PSs, re-lay temporary pipe along Flag Run.	Low: $$$ - Higher energy and operating costs due to longer pipeline length, relatively higher # of valves/booster PSs.
						Alternative Summary	**Green - 13** **Yellow - 10** **Red - 5**	**Green - 8** **Yellow - 16** **Red - 4**	**Green - 1** **Yellow - 9** **Red - 18**	**Green - 5** **Yellow - 6** **Red - 17**

Exhibit 5
Sediment Transport Pipeline Alignments Evaluation
Alternatives Analysis Report
Lake Accotink Dredging Project
Fairfax County, Virginia

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Criteria No.	Category	Criteria	Sub-Criteria	Sub-Criteria Description	Range	Definition	Wakefield Ball Fields			
							WB1 - Cross-County Trail	WB2 - Queensberry Ave.	WB3 - Flag Run/Port Royal Road[2]	WB4 - Flag Run/I-495[2]
1	Park Management	Consistency With Long-Term Park Vision	Compatibility with Existing LAP Infrastructure	Minimizes impacts to existing infrastructure such as buildings, fences, structures, utilities, etc.	Green Yellow Red	No Impact Short-term Impact Long-term Impact	Medium: Some known structures within the initial trail alignment inside LAP will be impacted only during construction.	Medium: Potential for impacts to infrastr. for trail alignment within LAP & areas inside WF Park only during construction.	Low: Potential for impacts to infrastr. for trail alignment within LAP, marina area & areas inside WF Park during construction and dredging operations.	Low: Potential for impacts to infrastr. for trail alignment within LAP, marina area & areas inside WF Park during construction and dredging operations.
2			Compatibility with Future Improvements	Compatible with planned long-term improvements	Green Yellow Red	No Impact Short-term Impact Long-term Impact	High: No known LAP LTI planned along alignment. Potential for net improvement to trails post-const. Any impacts within LAP will be short-term pending final design of the pipeline connection to dredge pump.	High: No known LAP LTI planned along alignment. Potential for net improvement to trails within LAP post-const. Any impacts within LAP will be short-term pending final design of the pipeline connection to dredge pump.	Medium: Any impacts within LAP will be short-term pending final design of the pipeline connection to dredge pump and proximity to the Marina area. Although, no specific LTI has been identified within WF Park, its deemed that any permanent structure (E.g. Booster PS) has the potential to impact any future improvements due to the high profile nature of the WF Park area.	Medium: Any impacts within LAP will be short-term pending final design of the pipeline connection to dredge pump and proximity to the Marina area. Although, no specific LTI has been identified within WF Park, its deemed that any permanent structure (E.g. Booster PS) has the potential to impact any future improvements due to the high profile nature of the WF Park area.
3			Lost & Reduced Use	Minimizes reduced and lost use of area for recreational purposes	Green Yellow Red	No Impact Short-term Impact Definite Impact	Medium: Significant length of trail sections need to be closed for open-cut construction. Long-term changes to surface from vegetated to gravel or other may reduce aesthetics of the trail.	Medium: Significant length of trail sections need to be closed for open-cut construction, mostly at WF Park. Potential for impacts to rec areas near the ballfields pending routing selection for final pipe segment.	Low: Potential impacts to bridge and trail access near Flag Run construction, main and maintenance dredging (due to above-ground temporary pipe along Flag Run) + temp lane/road closure at entrance to WF park may hinder park access temporarily.	Low: Potential impacts to bridge and trail access near Flag Run for initial part of the construction (due to above-ground temporary pipe along Flag Run) + temp lane/road closure at entrance to WF park may hinder park access temporarily.
4			Cultural Resources[1]	Minimize impacts to cultural resources	Green Yellow Red	No Impact Some Impact Known Impact	High: No cultural resources recorded. (Refer to WSSI's Cultural Resource Assessment Memo).	High: No cultural resources recorded. (Refer to WSSI's Cultural Resource Assessment Memo).	High: No cultural resources recorded. (Refer to WSSI's Cultural Resource Assessment Memo).	High: No cultural resources recorded. (Refer to WSSI's Cultural Resource Assessment Memo).
5	Community	Recreational Use Restrictions During Construction	Compatibility with the Recreational use of the Trail System	Minimizes impacts (e.g., closures, detours) to Cross County trail and connecting LAP trails	Green Yellow Red	No/Low Impact Short-term Impact Long-term Impact	Medium: Large trail sections need to be closed during construction only.	Medium: Trail segments in the LAP and WF Park impacted during construction temporarily	Low: Impacts due to proximity to the bridge leading to connecting trails, trails along flag run during construction, main and maintenance dredging (due to above-ground temporary pipe along Flag Run) and inside WF Park.	Low: Impacts due to proximity to the bridge leading to connecting trails, trails along Flag Run during construction, main and maintenance dredging (due to above-ground temporary pipe along Flag Run) and inside WF Park.
6			Compatibility with Use of Other Park Facilities	Avoids or minimizes closures of park facilities, e.g., ball fields, marina, restrooms	Green Yellow Red	No/Low Impact Short-term Impact Long-term Impact	High: No park facilities along the alignment.	Medium: Potential for park facilities with WF park to be impacted during latter part of the pipe construction.	Low: Marina area and other facilities near Flag Run impacted during const. & dredging operations + Potential for park facilities with WF park to be impacted during construction	Low: Marina area and other facilities near Flag Run impacted during const. & dredging operations + Potential for park facilities with WF park to be impacted during construction
7			Compatibility with LAP and other Park's Parking Facilities	Avoids or minimizes closures to parking within LAP and other parks.	Green Yellow Red	No/Low Impact Short-term Impact Long-term Impact	High: Not near any major parking areas	Medium: Parking in/around the ballfields within WF park will be impacted during construction. Impacts during dredging operations not anticipated	Low: Parking near the Marina area will be impacted during const. & dredging operations, Parking in/around the ballfields within WF park will be impacted during construction. Impacts during dredging operations not anticipated	Low: Parking near the Marina area will be impacted during const. & dredging operations + parking within WF park will be impacted during pipe const.
8		Community Considerations During Construction	Compatibility with Noise Ordinance and Community / Recreational / Residential Requirements	Relative distance to potential receptors, including recreational users or residential areas.	Green Yellow Red	No/Low Impact Short-term Impact Long-term Impact	Low: Trail located close to neighborhood and frequently used for recreation. Noise impact expected during construction and dredging operations from Booster PSs.	Low: Alignment along residential street. Noise anticipated during construction and dredging operations from booster PSs.	Medium: Majority of the alignment along industrial/commercial area and WF Park. Noise impacts anticipated during construction and operations from booster PSs. However, no long-term noise impacts anticipated to residential/recreational users, except maybe at WF Park (Booster PS).	Medium: Majority of the alignment behind commercial/industrial area, away from residential areas. However, no long-term noise impacts anticipated to residential/recreational users, except maybe at WF Park (Booster PS).
9			Odors/Dust	Relative distance to potential receptors, including recreational users or residential areas.	Green Yellow Red	No/Low Impact Short-term Impact Long-term Impact	Medium: Trail located close to neighborhood and frequently used for recreation. However, dust impact expected only during construction.	Medium: Alignment along residential street and WF Park. Direct dust impact to residences and recreational users during construction.	Medium: Majority of the alignment along industrial/commercial areas and WF Park. Dust impact anticipated only during construction.	Medium: Majority of the alignment behind commercial/industrial area, away from residential areas. However, potential for dust from construction inside WF park.
10			Road Closure	Avoids or minimizes length and extent of road closures with potential to impact residential/commercial traffic and pedestrian movement.	Green Yellow Red	No/Low Impact Short-term Impact Long-term Impact	High: Access into the trails may require temp lane closures.	Medium: Alignment along wider residential street, with shoulders and bike lanes on both sides. Lanes can be closed on a section basis with localized impacts. Longer lane/road closure impacts near entrance to WF park for booster PS/pipe constr.	Low: Significant long-term lane/road closure impacts to Port Royal Rd.as lanes are narrow + temp lane/road closure at entrance to and inside WF park.	Medium: Majority of the alignment behind commercial/industrial area, away from residential areas+ temp lane/road closure at entrance to and inside WF park.
11			Truck Traffic	Minimizes truck traffic on residential roads and minimizes impacts to neighborhoods and park traffic.	Green Yellow Red	Low Increase Moderate Increase High Increase	Low: Safe, easy access to trails via residential roads only.	Low: Alignment along residential street.	Medium: Potential for impact to residences for access to the upper part of the trail section along Flag Run.	Medium: Potential for impact to residences for access to the upper part of the trail section along Flag Run.

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Alternatives Analysis Report
Lake Accotink Dredging Project
Fairfax County, Virginia

Criteria No.	Category	Criteria	Sub-Criteria	Sub-Criteria Description	Range	Definition	Wakefield Ball Fields			
							WB1 - Cross-County Trail	WB2 - Queensberry Ave.	WB3 - Flag Run/Port Royal Road[2]	WB4 - Flag Run/I-495[2]
12	Environment	Environmental Considerations	Wetland Impacts[1]	Minimizes wetland disturbance during construction/long-term O&M.	Green Yellow	Minimal/No Impact Potential Impact	Medium: 0.63 acres	High: 0.01 ac.	Medium: 0.60 acres	Medium: 0.65 acres
13			Resource Protection Area Impacts	Avoids or minimizes disturbance to Resource Protection Areas - relative extent (area) impacted by construction	Green Yellow Red	Small Area Medium Large Area	Low:	High:	Low:	Low:
14			Stream Impacts[1]	Minimizes disturbance to existing streams/banks - linear footage (LF) impacted during construction.	Green Yellow Red	Lengths < 99 LF Lengths 100 - 999 LF Lengths > 1000 LF	Medium: 104LF	High: 50LF	Low: 1023LF	Low: 1023LF
15			Forested Land Cover Impact[1]	Minimizes impacts or disturbance to existing trees/tree canopy.	Yellow Red	Area < 0.99 acre Area > 1.0 acre	Low: 2.02 ac.	Medium: 0.42 ac.	Medium: 0.98 ac.	Medium: 0.67 ac.
16		Floodplain Impacts	Floodplains Impact	Avoids or minimizes extent of the work constructed within floodplains.	Green Yellow Red	Small Area Medium Area Large Area	Low:	High:	Low:	Low:
17		Sustainability	Energy Usage	Relative energy efficiency during construction and long-term O&M for transporting dredged material.	Green Yellow Red	Relatively Low Use Relatively Higher Use Highest Energy Used	High: Shortest pipe length, no Booster PS	Medium: Shortest pipe length + multiple booster PSs needed to overcome really high static head.	Low: Longest pipe length + multiple booster PSs needed to overcome really high static head.	Low: Longest pipe length + multiple booster PSs needed to overcome really high static head.
18	Construction, Dredging Operations & Long-Term O&M	Constructability	Geotechnical Impacts	Geotechnical site conditions (ability to support equipment with minimal improvements, dewatering requirements, pipe support, etc.) assuming open-cut construction	Green Yellow Red	Poor Conditions Moderate Conditions Good Conditions	Low: High water table near lake and areas adjacent to the creek may need dewatering and support during construction	Medium: Challenging conditions (high water table) near LAP	Low: Challenging conditions (high water table) near LAP + unstable stream bank for the initial trail alignment	Low: Challenging conditions (high water table) near LAP + unstable stream bank for the initial trail alignment
19			Construction Access	Allows contractor sufficient access to construct, monitor, operate, and maintain the pipeline and pump stations during construction activities.	Green Yellow Red	Existing Access No Ex.Access/Easy to Provide No Ex.Access/Difficult to Provide	Medium: Only access thru the trail access areas in between residential blocks. Better access to northern alignment from either Braddock road or WF park trails.	Medium: Access to alignment inside LAP can be challenging thru the trails areas.	Low: Only access to the upper part of trail alignment thru residential areas. Access near WF Park challenging thru treed areas	Low: Only access to the upper part of trail alignment thru residential areas. Access near WF Park challenging thru treed areas
20			Utility Conflicts	Number of crossings with major utility conlicts - e.g. water, sewer, stormwater, power.	Green Yellow Red	<20 Conflicts 20 to 50 Conflicts >50 Conflicts	Medium: Fewer # of crossings (24) due to the trail location.	Low: Higher # of crossings (50) due to residential location.	Low: Highest # of crossings (107) due to industrial/commercial areas	High: Fewest # of crossings (19) due to the alignment behind commercial/industrial areas
21			Permitting Requirements	Relative permitting requirements for slurry transport/pumping construction	General Permit or Individual Permit		Individual Permit	Individual Permit	Individual Permit	Individual Permit
22			Easement acquisition	Relative number of easements required	Green Yellow Red	Low Medium High	High: Majority of the construction is along the trail. Easement required for pipe thru Dominion ROW.	Low: No easement for pipe installed under roadway and PA ROW. However Booster PS(s)/valves will need to be located within permanent easements	Medium: No easement needed for pipe installed under roadway and PA ROW, permanent easements required for installing/O&M access for valves & booster PS(s).	Low: Easement required for pipeline, valves, booster PSs behind commercial/industrial properties, potential VDOT ROW and Braddock road crossing
23		Long-Term Operation and Maintenance	Infrastructure Security/Public Risk	Relative security/public risk of pipeline to potential for vandalism or damage. Compromise to the integrity of the pipeline or the booster station(s) poses community-related risks.	Green Yellow Red	Low Medium High	Medium: Located along trail, therefore potential for risk. However, pipeline risk is decreased with a buried pipe. No direct residential impacts.	Medium: Located along trail, therefore potential for risk. However, pipeline risk is decreased with a buried pipe.	Low: Majority of alignment along trail proposed to be temporary/above-ground for main and maintenance dredging.	Low: Majority of alignment along trail proposed to be temporary/above-ground for main and maintenance dredging.
24			Pipeline & associated infrastructure O&M	Pipeline Maintenance, replacement/repair- relative accessibility	Green Yellow Red	Low Medium High	Medium: Lower # of valves, access thru trail, creek crossing access.	Low: Relatively higher # of valves, majority of them harder to locate in accessible areas.	Medium: Despite relatively higher # of valves, possible to locate them in accessible areas.	Medium: Despite relatively higher # of valves, possible to locate them in accessible areas.
25			Booster PS & associated infrastructure O&M	Booster PS Maintenance, replacement/repair - relative accessibility	Green Yellow Red	Low Medium High	High: No booster PSs.	Low: Access to booster PS(s), valves challenging depending on location.	Medium: Booster PSs access potentially challenging pending siting.	Medium: Booster PSs access potentially challenging pending siting.
26		Schedule	Main Dredging	Relative schedule efficiency for preparation and restoration of site, plus relative schedule implications based on various slurry transport routes	Green Yellow Red	Low Schedule Impact Some Schedule Impact Significant Schedule Impact	High: Majority of the construction is along trail, no booster PSs, flat pipe profile.	Medium: Construction thru residential streets, Braddock crossing can be challenging + booster PS const.	Low: Access to trail areas, construction along commercial/industrial areas, inside WF Park, road closures, booster PS(s), valves pose challenges depending on location.	Low: Access to trail areas, construction behind commercial/industrial areas, inside WF Park, road closures, booster PS(s), valves pose challenges depending on location.
27			Maintenance Dredging	Relative schedule efficiency for re-mobilization, site preparation, and restoration for maintenance dredging	Green Yellow Red	Low Schedule Impact Some Schedule Impact Significant Impact	High: Minimal re-mobilization, site preparation or restoration required with buried pipe installation.	High: Minimal re-mobilization, site preparation or restoration required with buried pipe installation.	Low: Maintenance dredging crew will need to prepare site and re-lay the temporary above-ground pipe.	Low: Maintenance dredging crew will need to prepare site and re-lay the temporary above-ground pipe.
28		Costs	Main Dredging Construction	Relative cost based on anticipated conditions to install pipe, Booster PSs (if any) and associated infrastructure.	Green Yellow Red	$ $$ $$$	High: $ - Majority of the construction is along trail, no booster PSs, flat pipe profile.	Medium: $$ - Booster PS(s), utility crossings, residential const. potential to increase costs.	Low: $$$ - Longer pipeline length, relatively higher # of valves/booster PSs, utility crossings, challenging const. access.	Low: $$$ - Longest pipeline length, relatively higher # of valves/booster PSs, utility crossings, challenging const. access.
29			Maintenance Dredging	Relative cost for performing maintenance dredging assuming minimal site preparation. Assumes same method as main dredging. Does not include site restoration for interim use.	Green Yellow Red	$ $$ $$$	High: $ - Minimal re-mobilization, site preparation or restoration required with buried pipe installation.	Medium: $$ - Relatively higher energy and operations cost due to booster PS and valves.	Low: $$$ - Higher energy costs due to pipeline length, booster PSs, re-lay temporary pipe along Flag Run.	Low: $$$ - Higher energy costs due to pipeline length, booster PSs, re-lay temporary pipe along Flag Run.
						Alternative Summary	**Green - 12 Yellow - 10 Red - 6**	**Green - 7 Yellow - 15 Red - 6**	**Green - 1 Yellow - 9 Red - 18**	**Green - 2 Yellow - 9 Red - 17**

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ARCADIS

Criteria No.	Category	Criteria	Sub-Criteria	Sub-Criteria Description	Range	Definition	Dominion ROW			
							DOM1 - Cross-County Trail	DOM2 - Queensberry Ave.	DOM3 - Flag Run/Port Royal Road[2]	DOM4 - Flag Run/I-495[2]
1	Park Management	Consistency With Long-Term Park Vision	Compatibility with Existing LAP Infrastructure	Minimizes impacts to existing infrastructure such as buildings, fences, structures, utilities, etc.	Green Yellow Red	No Impact Short-term Impact Long-term Impact	Medium: Some known structures within the initial trail alignment inside LAP will be impacted only during construction.	Low: Potential for impacts to infrastr. for trail alignment within LAP, areas inside WF Park & Rec Center during construction and dredging operations.	Medium: Potential for impacts to infrastr. for trail alignment within LAP, marina area and some areas inside WF Park & Rec Center during construction and dredging.	Medium: Potential for impacts to infrastr. for trail alignment within LAP, marina area and some areas inside WF Park & Rec Center during construction and dredging.
2			Compatibility with Future Improvements	Compatible with planned long-term improvements	Green Yellow Red	No Impact Short-term Impact Long-term Impact	High: No known LAP LTI planned along alignment. Potential for net improvement to trails within LAP post-const. Any impacts within LAP will be short-term pending final design of the pipeline connection to dredge pump	Medium: Any impacts within LAP will be short-term pending final design of the pipeline connection to dredge pump and proximity to the Marina area. Although, no specific LTI has been identified within WF Park, its deemed that any permanent structure (E.g. Booster PS) has the potential to impact any future improvements due to the high profile nature of the WF Park area.	Medium: Any impacts within LAP will be short-term pending final design of the pipeline connection to dredge pump and proximity to the Marina area. Although, no specific LTI has been identified within WF Park, its deemed that any permanent structure (E.g. Booster PS) has the potential to impact any future improvements due to the high profile nature of the WF Park area.	Medium: Any impacts within LAP will be short-term pending final design of the pipeline connection to dredge pump and proximity to the Marina area. Although, no specific LTI has been identified within WF Park, its deemed that any permanent structure (E.g. Booster PS) has the potential to impact any future improvements due to the high profile nature of the WF Park area.
3			Lost & Reduced Use	Minimizes reduced and lost use of area for recreational purposes	Green Yellow Red	No Impact Short-term Impact Definite Impact	Medium: Significant length of Cross County trail all the way to the Dominion ROW need to be closed for open-cut construction. Depending on specific route chosen, may impact Rec center facilities on the west side of WF Park.	Medium: Sections of trail in WF Park may need to be closed for open-cut construction. Depending on specific route chosen, may impact Rec center facilities in WF Park.	Medium: Potential impacts to bridge and trail access near Flag Run during construction, main and maintenance dredging (due to above-ground temporary pipe along Flag Run) + depending on specific route chosen, may impact Rec center facilities in WF Park.	Medium: Potential impacts to bridge and trail access near Flag Run during construction, main and maintenance dredging (due to above-ground temporary pipe along Flag Run) + depending on specific route chosen, may impact Rec center facilities in WF Park.
4			Cultural Resources[1]	Minimize impacts to cultural resources	Green Yellow Red	No Impact Some Impact Known Impact	Medium: Near- Alignment adjacent to a recorded location. (Refer to WSSI's Cultural Resource Assessment Memo)	Medium: Near- Alignment adjacent to a recorded location. (Refer to WSSI's Cultural Resource Assessment Memo)	Medium: Near- Alignment adjacent to a recorded location. (Refer to WSSI's Cultural Resource Assessment Memo)	Medium: Near- Alignment adjacent to a recorded location. (Refer to WSSI's Cultural Resource Assessment Memo)
5	Community	Recreational Use Restrictions During Construction	Compatibility with the Recreational use of the Trail System	Minimizes impacts (e.g., closures, detours) to Cross County trail and connecting LAP trails	Green Yellow Red	No/Low Impact Short-term Impact Long-term Impact	Medium: Large trail sections need to be closed during construction only.	Medium: Trail segments in the LAP and WF Park impacted during construction temporarily	Low: Impacts due to proximity to the bridge leading to connecting trails, trails along Flag Run during construction, main and maintenance dredging (due to above-ground temporary pipe along Flag Run) and inside WF Park.	Low: Impacts due to proximity to the bridge leading to connecting trails, trails along Flag Run during construction, main and maintenance dredging (due to above-ground temporary pipe along Flag Run) and inside WF Park.
6			Compatibility with Use of Other Park Facilities	Avoids or minimizes closures of park facilities, e.g., ball fields, marina, restrooms	Green Yellow Red	No/Low Impact Short-term Impact Long-term Impact	Medium: Depending on specific route chosen, may impact Rec center facilities on the west side of WF Park during construction.	Medium: Potential for park facilities with WF park to be impacted during latter part of the pipe construction.	Low: Marina area and other facilities near Flag Run impacted during const. & dredging operations	Low: Marina area and other facilities near Flag Run impacted during const. & dredging operations + Potential for park facilities with WF park to be impacted during construction
7			Compatibility with LAP and other Park's Parking Facilities	Avoids or minimizes closures to parking within LAP and other parks.	Green Yellow Red	No/Low Impact Short-term Impact Long-term Impact	High: Not near any major parking areas	Medium: Parking in/around the ballfields within WF park will be impacted during construction. Impacts during dredging operations not anticipated	Medium: Parking near the Marina area will be impacted during const. & dredging operations, Impacts during dredging operations not anticipated	Medium: Parking near the Marina area will be impacted during const. & dredging operations, Impacts during dredging operations not anticipated
8		Community Considerations During Construction	Compatibility with Noise Ordinance and Community / Recreational / Residential Requirements	Relative distance to potential receptors, including recreational users or residential areas.	Green Yellow Red	No/Low Impact Short-term Impact Long-term Impact	Low: Trail located close to neighborhood and frequently used for recreation. Noise impact expected during construction and dredging operations from Booster PSs.	Low: Alignment along residential street. Noise anticipated during construction and dredging operations from booster PSs.	Medium: Majority of the alignment along industrial/commercial area and WF Park. Noise impacts anticipated during construction and operations from booster PSs. However, no long-term noise impacts anticipated to residential/recreational users, except maybe at WF Park (Booster PS).	Medium: Majority of the alignment behind commercial/industrial area, away from residential areas. However, no long-term noise impacts anticipated to residential/recreational users, except maybe at WF Park (Booster PS).
9			Odors/Dust	Relative distance to potential receptors, including recreational users or residential areas.	Green Yellow Red	No/Low Impact Short-term Impact Long-term Impact	Medium: Trail located close to neighborhood and frequently used for recreation. However, dust impact expected only during construction.	Medium: Alignment along residential street and WF Park. Direct dust impact to residences and recreational users during construction.	Medium: Majority of the alignment along industrial/commercial areas and WF Park. Dust impact anticipated only during construction.	Medium: Majority of the alignment behind commercial/industrial area, away from residential areas. However, potential for dust from construction inside WF park.
10			Road Closure	Avoids or minimizes length and extent of road closures with potential to impact residential/commercial traffic and pedestrian movement.	Green Yellow Red	No/Low Impact Short-term Impact Long-term Impact	High: Access into the trails may require only temp lane closures.	Medium: Alignment along wider residential street, with shoulders and bike lanes on both sides. Lanes can be closed on a section basis with localized impacts. Longer lane/road closure impacts near entrance to WF park for booster PS/pipe constr.	Low: Significant long-term lane/road closure impacts to Port Royal Rd.as lanes are narrow.	Medium: Majority of the alignment behind commercial/industrial area, away from residential areas+ temp lane/road closure at entrance to and inside WF park.
11			Truck Traffic	Minimizes truck traffic on residential roads and minimizes impacts to neighborhoods and park traffic.	Green Yellow Red	Low Increase Moderate Increase High Increase	Low: Safe, easy access to trails via residential and WF Park roads only.	Low: Alignment along residential street and WF Park.	Medium: Potential for impact to residences for access to the upper part of the trail section along Flag Run.	Medium: Potential for impact to residences for access to the upper part of the trail section along Flag Run.

Exhibit 5
Sediment Transport Pipeline Alignments Evaluation
Alternatives Analysis Report
Lake Accotink Dredging Project
Fairfax County, Virginia

Criteria No.	Category	Criteria	Sub-Criteria	Sub-Criteria Description	Range	Definition	Dominion ROW			
							DOM1 - Cross-County Trail	DOM2 - Queensberry Ave.	DOM3 - Flag Run/Port Royal Road[2]	DOM4 - Flag Run/I-495[2]
12	Environment	Environmental Considerations	Wetland Impacts[1]	Minimizes wetland disturbance during construction/long-term O&M.	Green Yellow	Minimal/No Impact Potential Impact	Medium: 0.67 acres	High: 0.01 ac.	Medium: 0.60 acres	Medium: 0.65 acres
13			Resource Protection Area Impacts	Avoids or minimizes disturbance to Resource Protection Areas - relative extent (area) impacted by construction	Green Yellow Red	Small Area Medium Large Area	Low:	High:	Low:	Low:
14			Stream Impacts[1]	Minimizes disturbance to existing streams/banks - linear footage (LF) impacted during construction.	Green Yellow Red	Lengths < 99 LF Lengths 100 - 999 LF Lengths > 1000 LF	Medium: 295LF	High: 60LF	Low: 1013LF	Low: 1013LF
15			Forested Land Cover Impact[1]	Minimizes impacts or disturbance to existing trees/tree canopy.	Yellow Red	Area < 0.99 acre Area > 1.0 acre	Low: 2.05 ac.	Medium: 0.47 ac.	Medium: 0.96 ac.	Medium: 0.66 ac.
16		Floodplain Impacts	Floodplains Impact	Avoids or minimizes extent of the work constructed within floodplains.	Green Yellow Red	Small Area Medium Area Large Area	Low:	High:	Low:	Low:
17		Sustainability	Energy Usage	Relative energy efficiency during construction and long-term O&M for transporting dredged material.	Green Yellow Red	Relatively Low Use Relatively Higher Use Highest Energy Used	Medium: Relatively longer pipe length, may need one Booster PS to pump the distance	Medium: Shortest pipe length + multiple booster PSs needed to overcome really high static head.	Low: Longest pipe length + multiple booster PSs needed to overcome really high static head.	Low: Longest pipe length + multiple booster PSs needed to overcome really high static head.
18	Construction, Dredging Operations & Long-Term O&M	Constructability	Geotechnical Impacts	Geotechnical site conditions (ability to support equipment with minimal improvements, dewatering requirements, pipe support, etc.) assuming open-cut construction	Green Yellow Red	Poor Conditions Moderate Conditions Good Conditions	Low: High water table near lake and areas adjacent to the creek may need dewatering and support during construction	Medium: Challenging conditions (high water table) near LAP	Low: Challenging conditions (high water table) near LAP + unstable stream bank for the initial trail alignment	Low: Challenging conditions (high water table) near LAP + unstable stream bank for the initial trail alignment
19			Construction Access	Allows contractor sufficient access to construct, monitor, operate, and maintain the pipeline and pump stations during construction activities.	Green Yellow Red	Existing Access No Ex.Access/Easy to Provide No Ex.Access/Difficult to Provide	Low: Only access thru the trail access areas in between residential blocks. Better access to northern alignment from either Braddock road or WF park trails. Access near Dominion ROW will be challenging.	Medium: Access to alignment inside LAP can be challenging thru the trails areas. Access near Dominion ROW will be challenging.	Low: Access to the upper part of trail alignment feasible only thru residential areas. Access near WF Park challenging	Low: Access to the upper part of trail alignment feasible only thru residential areas. Access near WF Park challenging thru treed areas.
20			Utility Conflicts	Number of crossings with major utility conlicts - e.g. water, sewer, stormwater, power.	Green Yellow Red	<20 Conflicts 20 to 50 Conflicts >50 Conflicts	Medium: Fewer # of crossings (26) due to the trail location.	Low: Higher # of crossings (49) due to residential location.	Low: Highest # of crossings (66) due to industrial/commercial areas	Medium: Fewer # of crossings (23) due to the trail and behind the industrial/commercial area location.
21			Permitting Requirements	Relative permitting requirements for slurry transport/pumping construction	General Permit or Individual Permit		Individual Permit	Individual Permit	Individual Permit	Individual Permit
22			Easement acquisition	Relative number of easements required	Green Yellow Red	Low Medium High	Low: Even though lower half of the alignment is along the trail, upper half is within Dominion ROW and will need easement to put a pipe.	Low: No easement for pipe installed under roadway and PA ROW. However Booster PS(s)/valves will need to be located within permanent easements	Medium: No easement needed for pipe installed under roadway and PA ROW, permanent easements required for installing/O&M access for valves & booster PS(s).	Low: Easement required for pipeline, valves, booster PSs behind commercial/industrial properties, potential VDOT ROW and Braddock road crossing.
23		Long-Term Operation and Maintenance	Infrastructure Security/Public Risk	Relative security/public risk of pipeline to potential for vandalism or damage. Compromise to the integrity of the pipeline or the booster station(s) poses community-related risks.	Green Yellow Red	Low Medium High	Medium: Located along trail, therefore potential for risk. However, pipeline risk is decreased with a buried pipe. No direct residential impacts.	Medium: Located along trail, therefore potential for risk. However, pipeline risk is decreased with a buried pipe.	Low: Majority of alignment along trail proposed to be temporary/above-ground.	Low: Majority of alignment along trail proposed to be temporary/above-ground & inside WF park.
24			Pipeline & associated infrastructure O&M	Pipeline Maintenance, replacement/repair- relative accessibility	Green Yellow Red	Low Medium High	Medium: Lower # of valves, access thru trail, creek crossing access	Low: Relatively higher # of valves, majority of them harder to locate in accessible areas.	Medium: Despite relatively higher # of valves, possible to locate them in accessible areas.	Medium: Despite relatively higher # of valves, possible to locate them in accessible areas.
25			Booster PS & associated infrastructure O&M	Booster PS Maintenance, replacement/repair - relative accessibility	Green Yellow Red	Low Medium High	Medium: Access thru trails, Braddock road and WF Park.	Low: Access to booster PS(s), valves challenging depending on location.	Medium: Booster PSs access potentially challenging pending siting.	Medium: Booster PSs access potentially challenging pending siting
26		Schedule	Main Dredging	Relative schedule efficiency for preparation and restoration of site, plus relative schedule implications based on various slurry transport routes	Green Yellow Red	Low Schedule Impact Some Schedule Impact Significant Schedule Impact	Medium: Longer pipe length, majority along trails, 2 creek crossings + potential location of booster PSs and valves	Medium: Construction thru residential streets, Braddock crossing can be challenging + booster PS const.	Low: Access to trail areas, construction along commercial/industrial areas, inside WF Park, road closures, booster PS(s), valves pose challenges depending on location.	Low: Access to trail areas, construction behind commercial/industrial areas, inside WF Park, road closures, booster PS(s), valves pose challenges depending on location.
27			Maintenance Dredging	Relative schedule efficiency for re-mobilization, site preparation, and restoration for maintenance dredging	Green Yellow Red	Low Schedule Impact Some Schedule Impact Significant Impact	High: Minimal re-mobilization, site preparation or restoration required with buried pipe installation.	High: Minimal re-mobilization, site preparation or restoration required with buried pipe installation.	Low: Maintenance dredging crew will need to prepare site and re-lay the temporary above-ground pipe.	Low: Maintenance dredging crew will need to prepare site and re-lay the temporary above-ground pipe.
28		Costs	Main Dredging Construction	Relative cost based on anticipated conditions to install pipe, Booster PSs (if any) and associated infrastructure.	Green Yellow Red	$ $$ $$$	Low: $$$ - Longest pipeline length, relatively higher # of valves/booster PSs, utility crossings, challenging const. access.	Medium: $$ - Booster PS(s), utility crossings, residential const. potential to increase costs	Low: $$$ - Longer pipeline length, relatively higher # of valves/booster PSs, utility crossings, challenging const. access.	Low: $$$ - Longest pipeline length, relatively higher # of valves/booster PSs, utility crossings, challenging const. access.
29			Maintenance Dredging	Relative cost for performing maintenance dredging assuming minimal site preparation. Assumes same method as main dredging. Does not include site restoration for interim use.	Green Yellow Red	$ $$ $$$	Low: $$$ - Higher energy costs due to pipeline length, booster PSs..	Medium: $$ - Relatively higher energy and operations cost due to booster PS and valves.	Low: $$$ - Higher energy costs due to pipeline length, booster PSs, re-lay temporary pipe along Flag Run.	Low: $$$ - Higher energy costs due to pipeline length, booster PSs, re-lay temporary pipe along Flag Run.
						Alternative Summary	**Green - 4 Yellow - 14 Red - 10**	**Green - 5 Yellow - 16 Red - 7**	**Green - 0 Yellow - 13 Red - 15**	**Green - 0 Yellow - 14 Red - 14**

Criteria No.	Category	Criteria	Sub-Criteria	Sub-Criteria Description	Range	Definition	Lake Accotink Upper Settling Basin	Concrete Plant	
							Upper Settling Basin - Trail Alignment	VCP1 - Residential Alignment	VCP2 - Amtrak ROW
1	Park Management	Consistency With Long-Term Park Vision	Compatibility with Existing LAP Infrastructure	Minimizes impacts to existing infrastructure such as buildings, fences, structures, utilities, etc.	Green Yellow Red	No Impact Short-term Impact Long-term Impact	Low: Impacts to nearby dam, downstream of dam areas during construction and dredging operations.	Low: Impacts to the LAP Marina area, park entrance, park road during construction and dredging operations.	Low: Impacts to the LAP Marina area, park entrance, park road during construction and dredging operations.
2			Compatibility with Future Improvements	Compatible with planned long-term improvements	Green Yellow Red	No Impact Short-term Impact Long-term Impact	Medium: Potential for impact to the future Dam stream crossing construction project	Medium: Transloading area construction is deemed to be permanent for main and maintenance dredging, with the potential to impact the area near the marina, park entrance and the dam. No specific LTI has been identified in these areas. However, it is assumed that due to the high profile nature of these areas, PA would have planned LTI.	Medium: Transloading area construction is deemed to be permanent for main and maintenance dredging, with the potential to impact the area near the marina, park entrance and the dam. No specific LTI has been identified in these areas. However, it is assumed that due to the high profile nature of these areas, PA would have planned LTI.
3			Lost & Reduced Use	Minimizes reduced and lost use of area for recreational purposes	Green Yellow Red	No Impact Short-term Impact Definite Impact	Medium: Trail leading to/from Old Settling basin will need to be closed for the construction duration.	Medium: Marina, trails, park road and other facilities near the park entrance will be impacted/closed during construction.	Medium: Marina, trails, park road and other facilities near the park entrance will be impacted/closed during construction.
4			Cultural Resources[1]	Minimize impacts to cultural resources	Green Yellow Red	No Impact Some Impact Known Impact	Low: O&A Railroad + Civil War era earthworks recorded near northern alignment. (Refer to WSSI's Cultural Resource Assessment Memo).	Medium: Near- Alignment adjacent to a recorded location. (Refer to WSSI's Cultural Resource Assessment Memo)	Low: Yes
5	Community	Recreational Use Restrictions During Construction	Compatibility with the Recreational use of the Trail System	Minimizes impacts (e.g., closures, detours) to Cross County trail and connecting LAP trails	Green Yellow Red	No/Low Impact Short-term Impact Long-term Impact	Medium: Trail leading to/from Old Settling basin will need to be closed for the construction duration only.	Medium: Trails near the entrance to LAP, Marina area will be impacted during construction.	Medium: Trails near the entrance to LAP, Marina area will be impacted during construction.
6			Compatibility with Use of Other Park Facilities	Avoids or minimizes closures of park facilities, e.g., ball fields, marina, restrooms	Green Yellow Red	No/Low Impact Short-term Impact Long-term Impact	Medium: Facilities near the dam and entrance to the trail (parking) impacted during construction, pending final location of slurry transport pipe connection to dredge pump.	Medium: Marina area and other facilities near park entrance impacted during construction.	Medium: Marina area and other facilities near the park entrance impacted during construction.
7			Compatibility with LAP and other Park's Parking Facilities	Avoids or minimizes closures to parking within LAP and other parks.	Green Yellow Red	No/Low Impact Short-term Impact Long-term Impact	Medium: Parking near the O&A railroad area will be impacted during const. only	Low: Parking near Marina area and other facilities near the dam and park entrance impacted during const. & dredging operations	Low: Parking near Marina area and other facilities near the dam and park entrance impacted during const. & dredging operations
8		Community Considerations During Construction	Compatibility with Noise Ordinance and Community / Recreational / Residential Requirements	Relative distance to potential receptors, including recreational users or residential areas.	Green Yellow Red	No/Low Impact Short-term Impact Long-term Impact	Low: Trail located central to the LAP recreation and access areas. Noise anticipated during construction and dredging operations.	Low: Alignment through residential neighborhood. Noise anticipated during construction and dredging operations from booster PSs.	Medium: Although alignment would be on Amtrak ROW, the railroad abuts the residential neighborhood. Noise anticipated during construction and dredging operations from booster PSs.
9			Odors/Dust	Relative distance to potential receptors, including recreational users or residential areas.	Green Yellow Red	No/Low Impact Short-term Impact Long-term Impact	Medium: Majority of alignment near highly used LAP areas. Potential for dust during construction only.	Medium: Alignment through residential neighborhood. Potential for dust during construction only.	High: Low:
10			Road Closure	Avoids or minimizes length and extent of road closures with potential to impact residential/commercial traffic and pedestrian movement.	Green Yellow Red	No/Low Impact Short-term Impact Long-term Impact	High: Access into the trails may only require temp lane closures.	Low: Alignment through residential neighborhood. Roads are narrow with no dedicated parking or bike lanes. Will require significant long-term lane/road closures for safe construction.	Medium: Initial alignment on Amtrak ROW, away from roads. However, proposed last 4,000' of alignment is on the road, that will require lane closures.
11			Truck Traffic	Minimizes truck traffic on residential roads and minimizes impacts to neighborhoods and park traffic.	Green Yellow Red	Low Increase Moderate Increase High Increase	Low: Safe, easy access to trails via Park roads only.	Low: Alignment through residential neighborhood.	Medium: Initial alignment on Amtrak ROW, away from roads. However, proposed last 4,000' of alignment is on the road, that will require lane closures.

Exhibit 5
Sediment Transport Pipeline Alignments Evaluation
Alternatives Analysis Report
Lake Accotink Dredging Project
Fairfax County, Virginia

ARCADIS

Criteria No.	Category	Criteria	Sub-Criteria	Sub-Criteria Description	Range	Definition	Lake Accotink Upper Settling Basin	Concrete Plant	
							Upper Settling Basin - Trail Alignment	VCP1 - Residential Alignment	VCP2 - Amtrak ROW
12	Environment	Environmental Considerations	Wetland Impacts[1]	Minimizes wetland disturbance during construction/long-term O&M.	Green Yellow	Minimal/No Impact Potential Impact	High: None	High: None	High: None
13			Resource Protection Area Impacts	Avoids or minimizes disturbance to Resource Protection Areas - relative extent (area) impacted by construction	Green Yellow Red	Small Area Medium Large Area	Medium:	High:	High:
14			Stream Impacts[1]	Minimizes disturbance to existing streams/banks - linear footage (LF) impacted during construction.	Green Yellow Red	Lengths < 99 LF Lengths 100 - 999 LF Lengths > 1000 LF	High: 20LF	High: 20LF	Medium: 455LF
15			Forested Land Cover Impact[1]	Minimizes impacts or disturbance to existing trees/tree canopy.	Yellow Red	Area < 0.99 acre Area > 1.0 acre	Medium: 0.76 ac.	Medium: 0.44 ac.	Medium: 0.52 ac.
16		Floodplain Impacts	Floodplains Impact	Avoids or minimizes extent of the work constructed within floodplains.	Green Yellow Red	Small Area Medium Area Large Area	High:	High:	High:
17		Sustainability	Energy Usage	Relative energy efficiency during construction and long-term O&M for transporting dredged material.	Green Yellow Red	Relatively Low Use Relatively Higher Use Highest Energy Used	Medium: Shortest pipe length + multiple booster PSs needed to overcome really high static head.	Low: Longest pipe length + multiple booster PSs needed to overcome really high static head.	Low: Longest pipe length + multiple booster PSs needed to overcome really high static head.
18	Construction, Dredging Operations & Long-Term O&M	Constructability	Geotechnical Impacts	Geotechnical site conditions (ability to support equipment with minimal improvements, dewatering requirements, pipe support, etc.) assuming open-cut construction	Green Yellow Red	Poor Conditions Moderate Conditions Good Conditions	Medium: Challenging conditions (high water table) near LAP	Unknown. No geotechnical borings were conducted along this alignment.	Unknown. No geotechnical borings were conducted along this alignment.
19			Construction Access	Allows contractor sufficient access to construct, monitor, operate, and maintain the pipeline and pump stations during construction activities.	Green Yellow Red	Existing Access No Ex.Access/Easy to Provide No Ex.Access/Difficult to Provide	High: Access to alignment inside LAP easy as entire alignment can be accessed with the PA property.	Medium: Poor access thru residential neighborhoods and close to/on residential properties as majority of the alignment thru this area. Access for latter half of alignment via residential/industrial areas.	Low: Access to 1st half of alignment on Amtrak ROW, no access agreement currently exists and can be extremely challenging to obtain. Access for latter half of alignment via residential/industrial areas.
20			Utility Conflicts	Number of crossings with major utility conlicts - e.g. water, sewer, stormwater, power.	Green Yellow Red	<20 Conflicts 20 to 50 Conflicts >50 Conflicts	High: Least # of utilities impacted.	Low: Highest # of crossings (50) due to industrial/commercial areas	High: Least # of utilities (16) impacted.
21			Permitting Requirements	Relative permitting requirements for slurry transport/pumping construction	General Permit or Individual Permit		Individual Permit	Individual Permit	Individual Permit
22			Easement acquisition	Relative number of easements required	Green Yellow Red	Low Medium High	High: None. Entirety of the alignment inside the LAP.	Low: Easement required for pipeline, valves, booster PSs thru residential properties, potential VDOT ROW.	Low: Easement required for Amtrak ROW for pipeline, valves, booster PSs, potential VDOT ROW.
23		Long-Term Operation and Maintenance	Infrastructure Security/Public Risk	Relative security/public risk of pipeline to potential for vandalism or damage. Compromise to the integrity of the pipeline or the booster station(s) poses community-related risks.	Green Yellow Red	Low Medium High	Medium: Located along trail, therefore potential for risk. However, pipeline risk is decreased with a buried pipe. No direct residential impacts.	Medium: Majority of alignment thru residential neighborhood. However, pipeline risk is decreased with a buried pipe.	Medium: Located along trail, therefore potential for risk. However, no direct residential impacts.
24			Pipeline & associated infrastructure O&M	Pipeline Maintenance, replacement/repair- relative accessibility	Green Yellow Red	Low Medium High	Medium: Lower # of valves, access thru trail	Low: Access to majority of the alignment will be challenging due to location behind/thru residences and length of the pipe.	Low: Access to majority of the alignment will be challenging - on Amtrak ROW, length of the pipe.
25			Booster PS & associated infrastructure O&M	Booster PS Maintenance, replacement/repair - relative accessibility	Green Yellow Red	Low Medium High	Medium: Access thru trails.	Low: Access to majority of alignment challenging due to location behind / thru residences and length of pipe.	Low: Access to majority of the alignment will be challenging - on Amtrak ROW, length of the pipe.
26		Schedule	Main Dredging	Relative schedule efficiency for preparation and restoration of site, plus relative schedule implications based on various slurry transport routes	Green Yellow Red	Low Schedule Impact Some Schedule Impact Significant Schedule Impact	Medium: Majority of the construction is along trail with potential multiple booster PSs, valves with a steep pipe profile.	Low: Poor.	Low: Poor.
27			Maintenance Dredging	Relative schedule efficiency for re-mobilization, site preparation, and restoration for maintenance dredging	Green Yellow Red	Low Schedule Impact Some Schedule Impact Significant Impact	High: Minimal re-mobilization, site preparation or restoration required with buried pipe installation.	Medium: Moderate	Medium: Moderate
28		Costs	Main Dredging Construction	Relative cost based on anticipated conditions to install pipe, Booster PSs (if any) and associated infrastructure.	Green Yellow Red	\$ \$\$ \$\$\$	Medium: \$\$- Majority of the construction is along trail, booster PSs and valves, steep pipe profile.	Low: \$\$\$ - Longest pipeline, booster PSs, utility crossings	Low: \$\$\$ - 2nd Longest pipeline, booster PSs, utility crossings
29			Maintenance Dredging	Relative cost for performing maintenance dredging assuming minimal site preparation. Assumes same method as main dredging. Does not include site restoration for interim use.	Green Yellow Red	\$ \$\$ \$\$\$	High: \$ - Minimal re-mobilization, site preparation or restoration required with buried pipe installation.	Low: \$\$\$ - High interim maintenance cost due to pipeline length & high operational costs primarily from high energy usage (long pipeline + booster PSs).	Low: \$\$\$ - High interim maintenance cost due to pipeline length & high operational costs primarily from high energy usage (long pipeline + booster PSs).
						Alternative Summary	**Green - 9 Yellow - 15 Red - 4**	**Green - 4 Yellow - 10 Red - 13**	**Green - 5 Yellow - 11 Red - 11**

KEY

High	High means an alternative meets the criteria. Criteria are worded to indicate meeting the criteria is beneficial. Alternatives with the lowest cost best meet the cost objective of a cost effective alternative and thus are ranked high.
Medium	Medium means an alternative meets some of the criteria.
Low	Low means an alternative does not meet the criteria. Criteria are worded to indicate meeting the criteria is beneficial. Alternatives with the highest cost do not meet the cost objective of a cost effective alternative and thus are ranked low.

Legend:

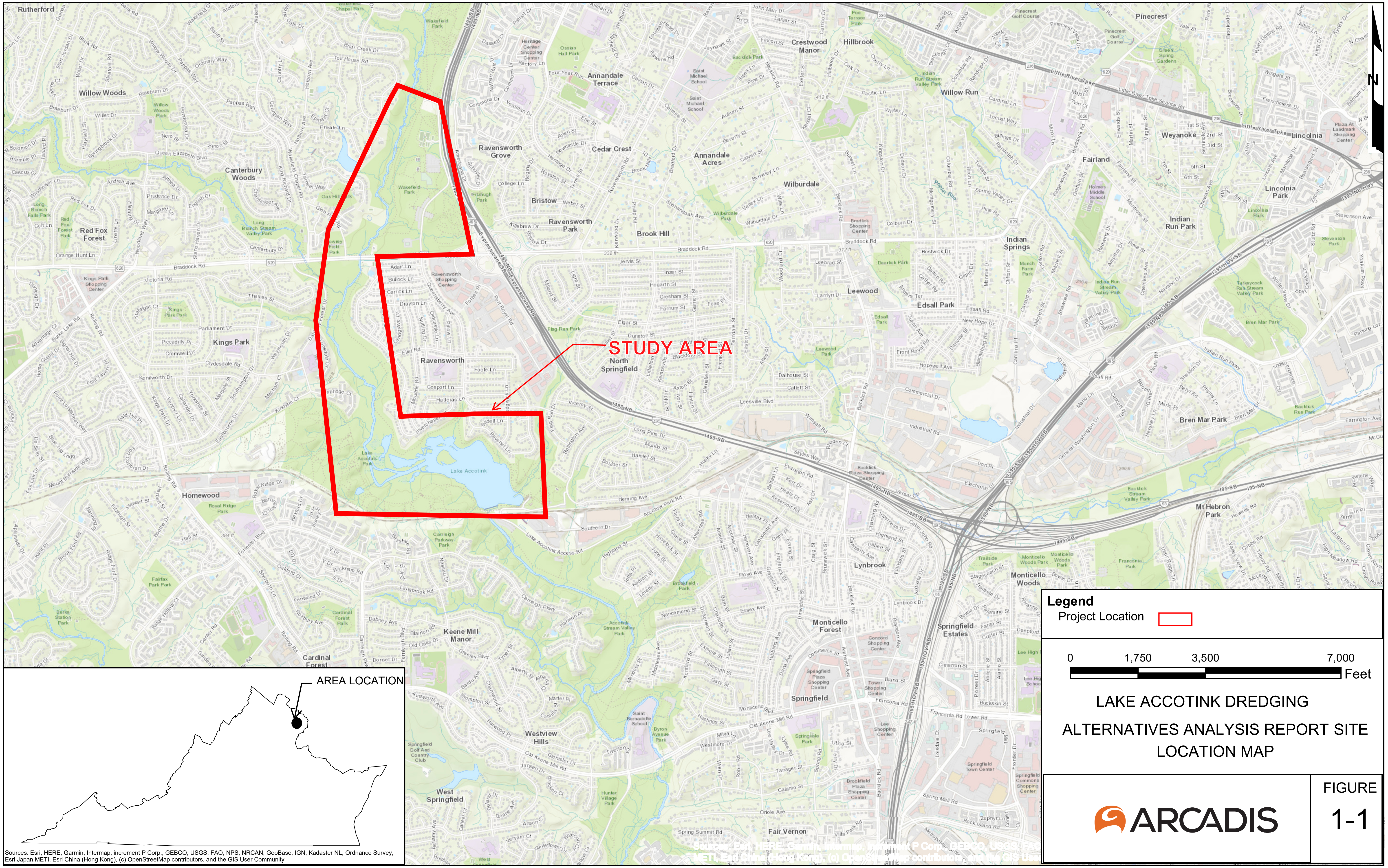
Short-Term Impact: During Construction Only

Long-Term Impact: During Construction + Main & Maintenance Dredging Operations

Notes:

1. This information is incorporated from Summary of Impacts prepared by WSSI and included as Appendix C of the Alternatives Analysis Report.
2. Pipeline alternatives assume a buried pipe, except for Flag Run alternatives, where approx. 3,000 to 4,000 LF of initial pipe alignment will be routed temporarily above-ground to a permanent (buried) pipe connection point as a result of stream bank conditions near Flag Run.

Figures



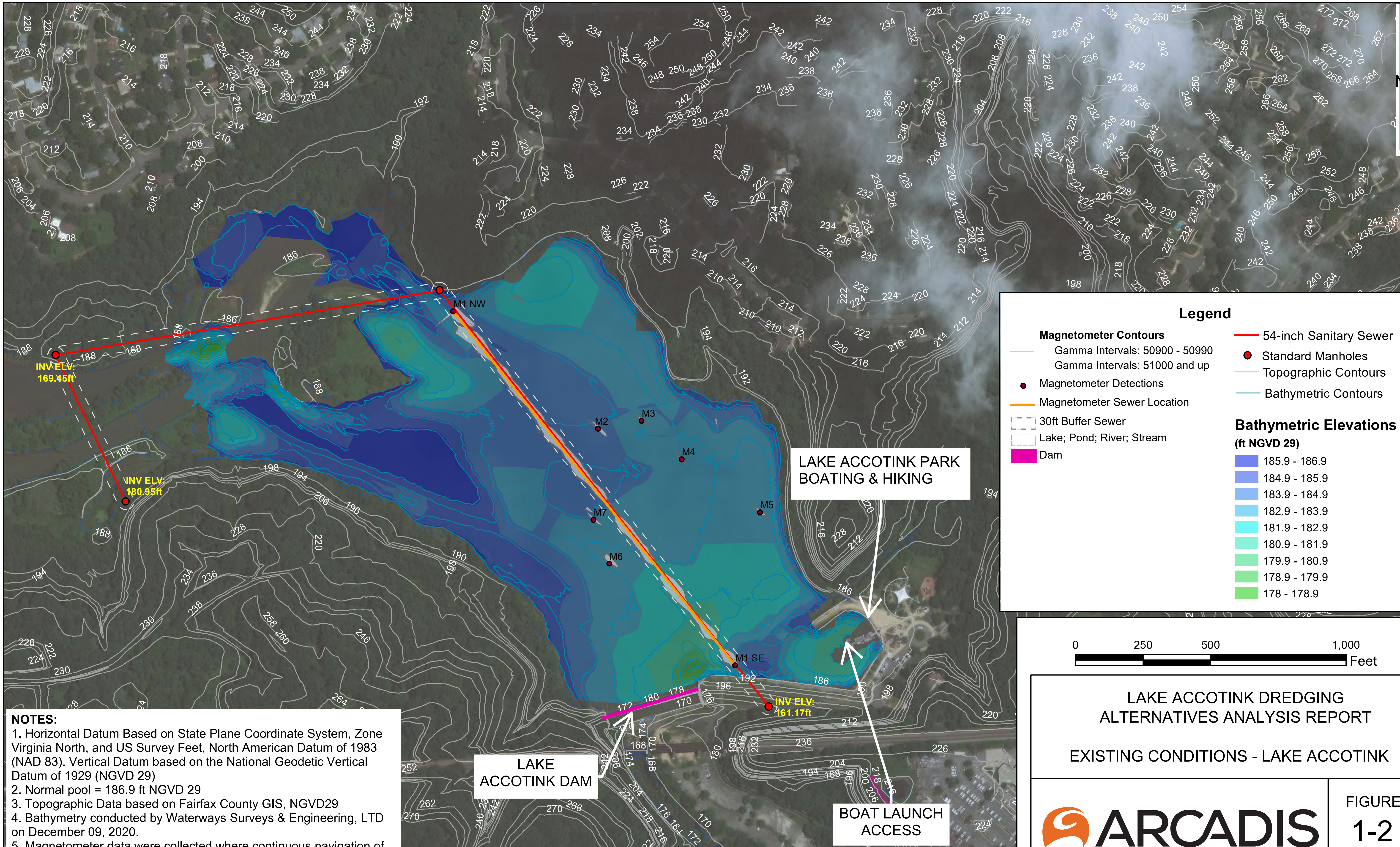
LAKE ACCOTINK DREDGING

ALTERNATIVES ANALYSIS REPORT SITE LOCATION MAP

FIGURE 1-1

ARCADIS

JULY 2021



NOTES:

1. Horizontal Datum Based on State Plane Coordinate System, Zone Virginia North, and US Survey Feet, North American Datum of 1983 (NAD 83). Vertical Datum based on the National Geodetic Vertical Datum of 1929 (NGVD 29)
2. Normal pool = 186.9 ft NGVD 29
3. Topographic Data based on Fairfax County GIS, NGVD29
4. Bathymetry conducted by Waterways Surveys & Engineering, LTD on December 09, 2020.
5. Magnetometer data were collected where continuous navigation of the survey boat was possible.

Source: ESRI, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGrid, IGN, and the GIS User Community

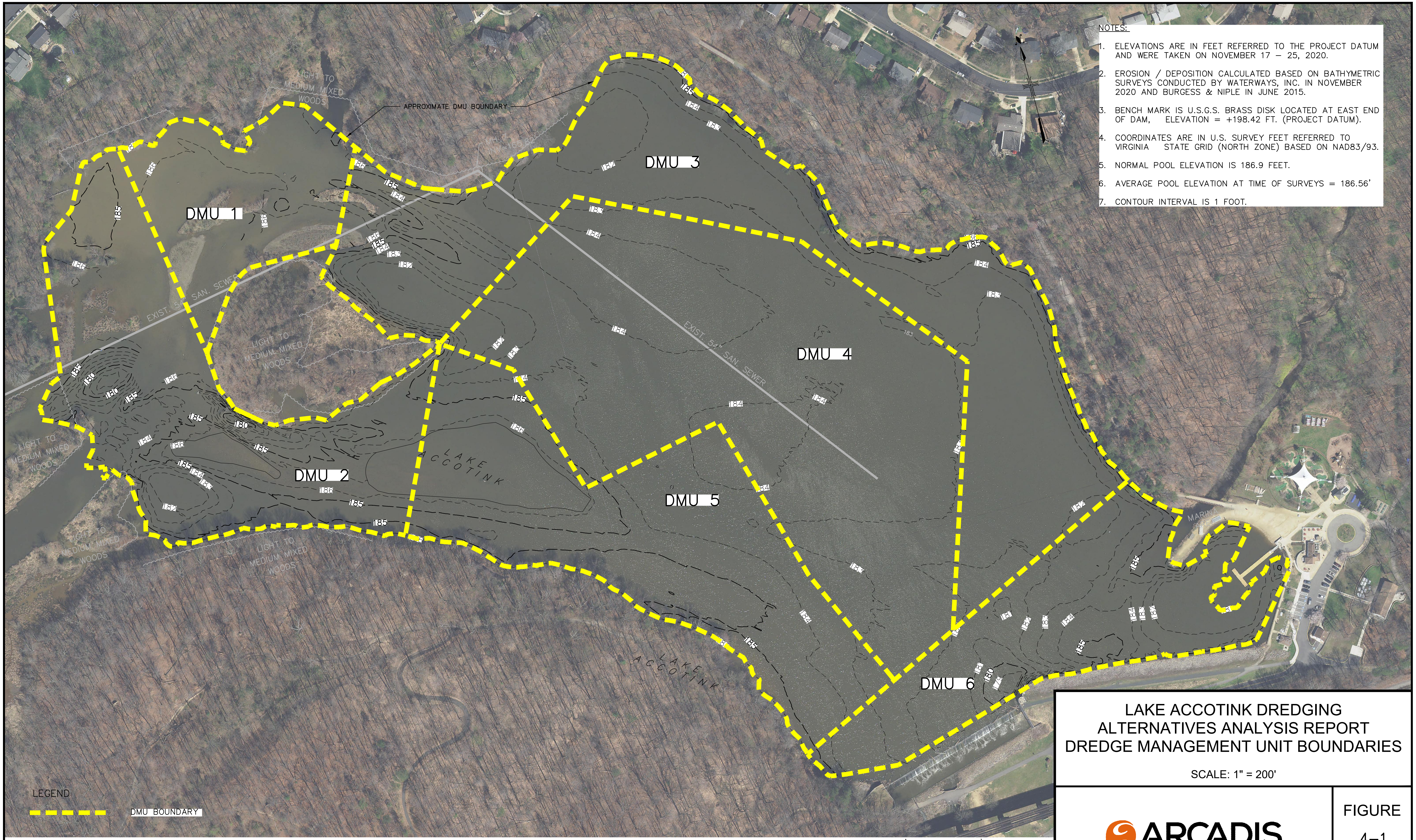
LAKE ACCOTINK DREDGING ALTERNATIVES ANALYSIS REPORT

EXISTING CONDITIONS - LAKE ACCOTINK

ARCADIS

FIGURE 1-2

JULY 2021



NOTES:

1. ELEVATIONS ARE IN FEET REFERRED TO THE PROJECT DATUM AND WERE TAKEN ON NOVEMBER 17 – 25, 2020.
2. EROSION / DEPOSITION CALCULATED BASED ON BATHYMETRIC SURVEYS CONDUCTED BY WATERWAYS, INC. IN NOVEMBER 2020 AND BURGESS & NIPLE IN JUNE 2015.
3. BENCH MARK IS U.S.G.S. BRASS DISK LOCATED AT EAST END OF DAM, ELEVATION = +198.42 FT. (PROJECT DATUM).
4. COORDINATES ARE IN U.S. SURVEY FEET REFERRED TO VIRGINIA STATE GRID (NORTH ZONE) BASED ON NAD83/93.
5. NORMAL POOL ELEVATION IS 186.9 FEET.
6. AVERAGE POOL ELEVATION AT TIME OF SURVEYS = 186.56'
7. CONTOUR INTERVAL IS 1 FOOT.

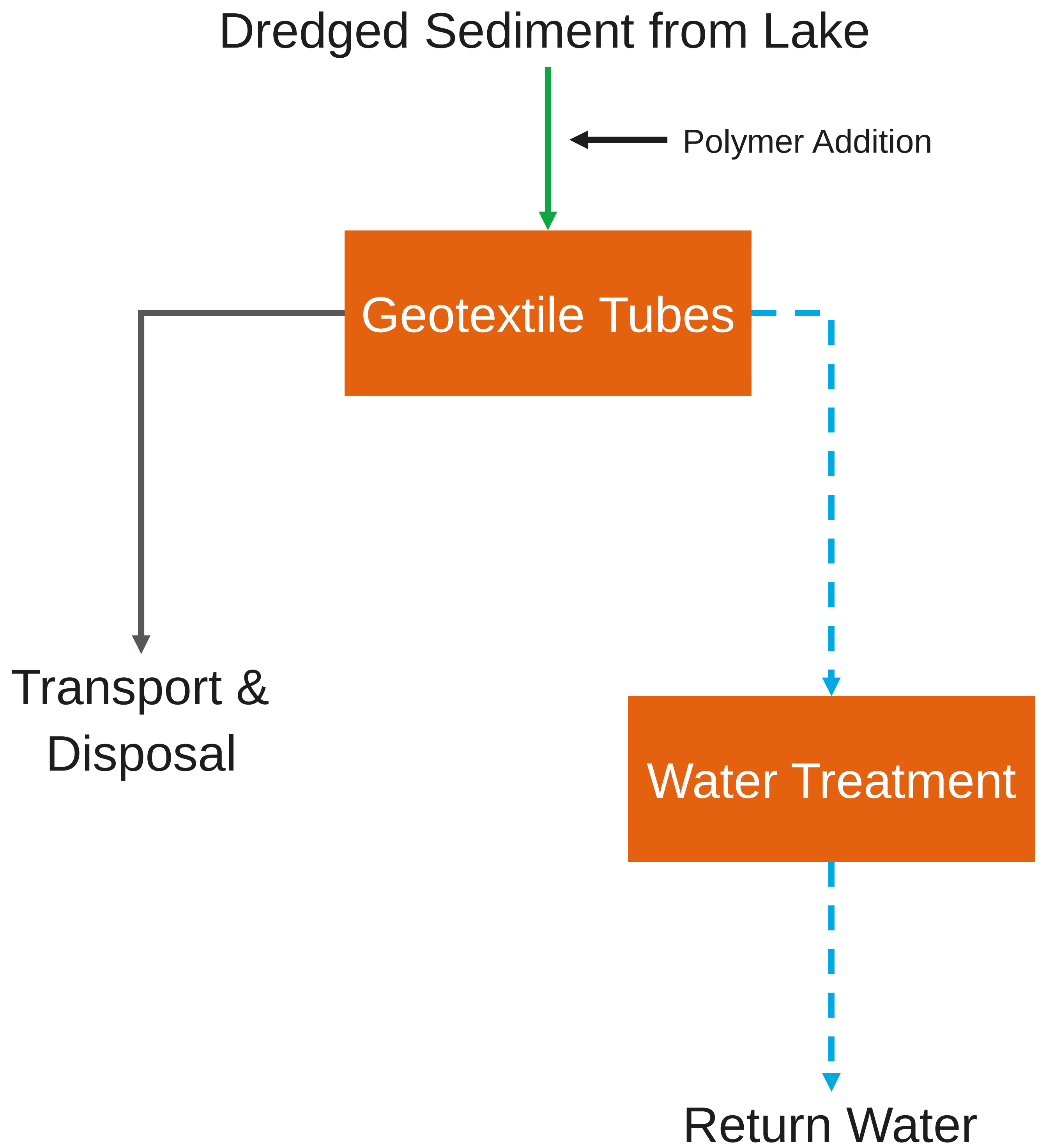
LAKE ACCOTINK DREDGING ALTERNATIVES ANALYSIS REPORT
DREDGE MANAGEMENT UNIT BOUNDARIES

SCALE: 1" = 200'

ARCADIS

FIGURE 4–1

JULY 2021



LEGEND

- Sediment Slurry
- Dewatered Solids
- Separated Water

LAKE ACCOTINK DREDGING
ALTERNATIVES ANALYSIS REPORT

PASSIVE DEWATERING SCHEMATIC

ARCADIS

FIGURE
4-2

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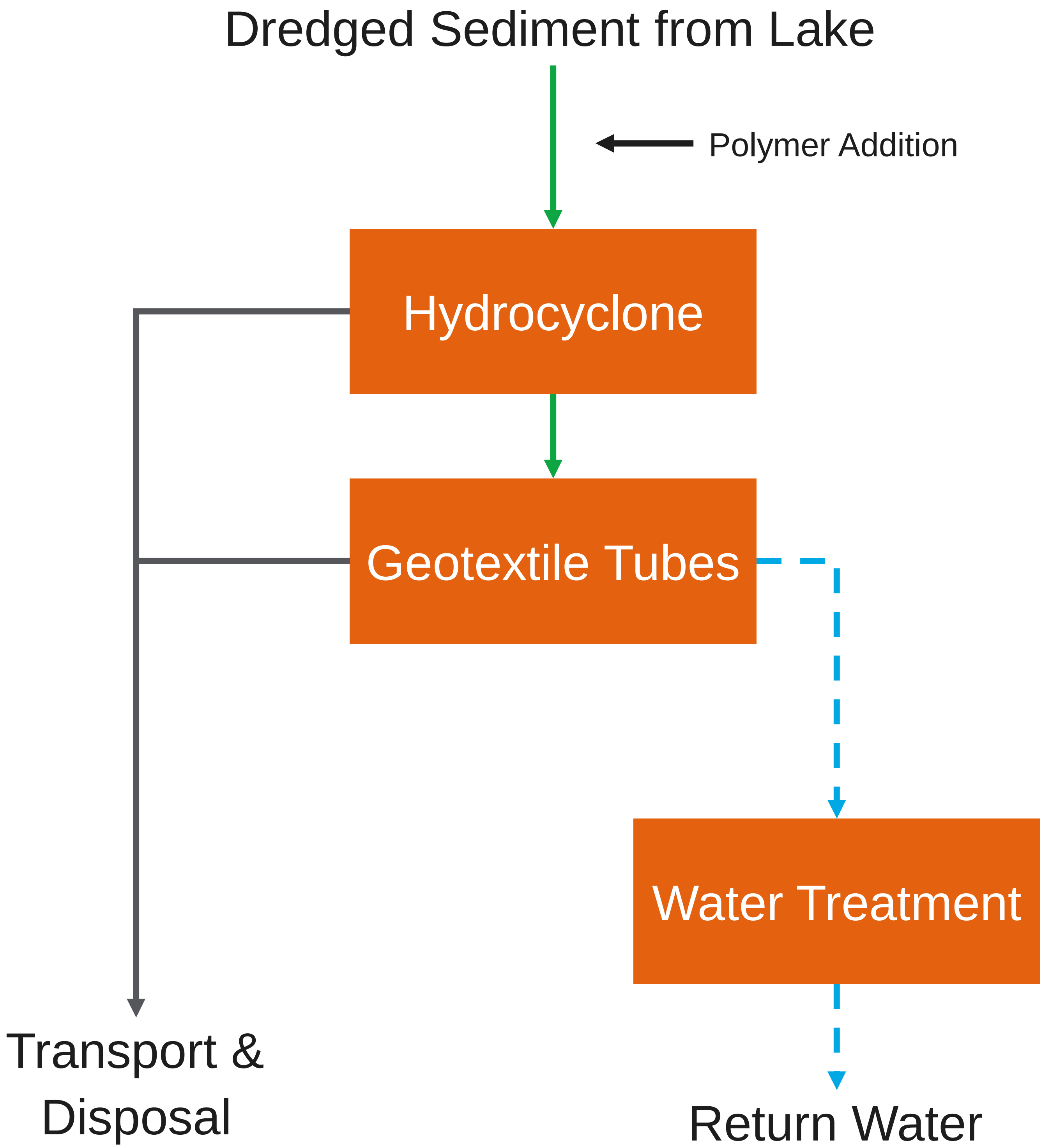

LEGEND

- Sediment Slurry
- Dewatered Solids
- Separated Water

LAKE ACCOTINK DREDGING
ALTERNATIVES ANALYSIS REPORT

PASSIVE DEWATERING, WITH
DESANDING, SCHEMATIC

ARCADIS

FIGURE
4-3

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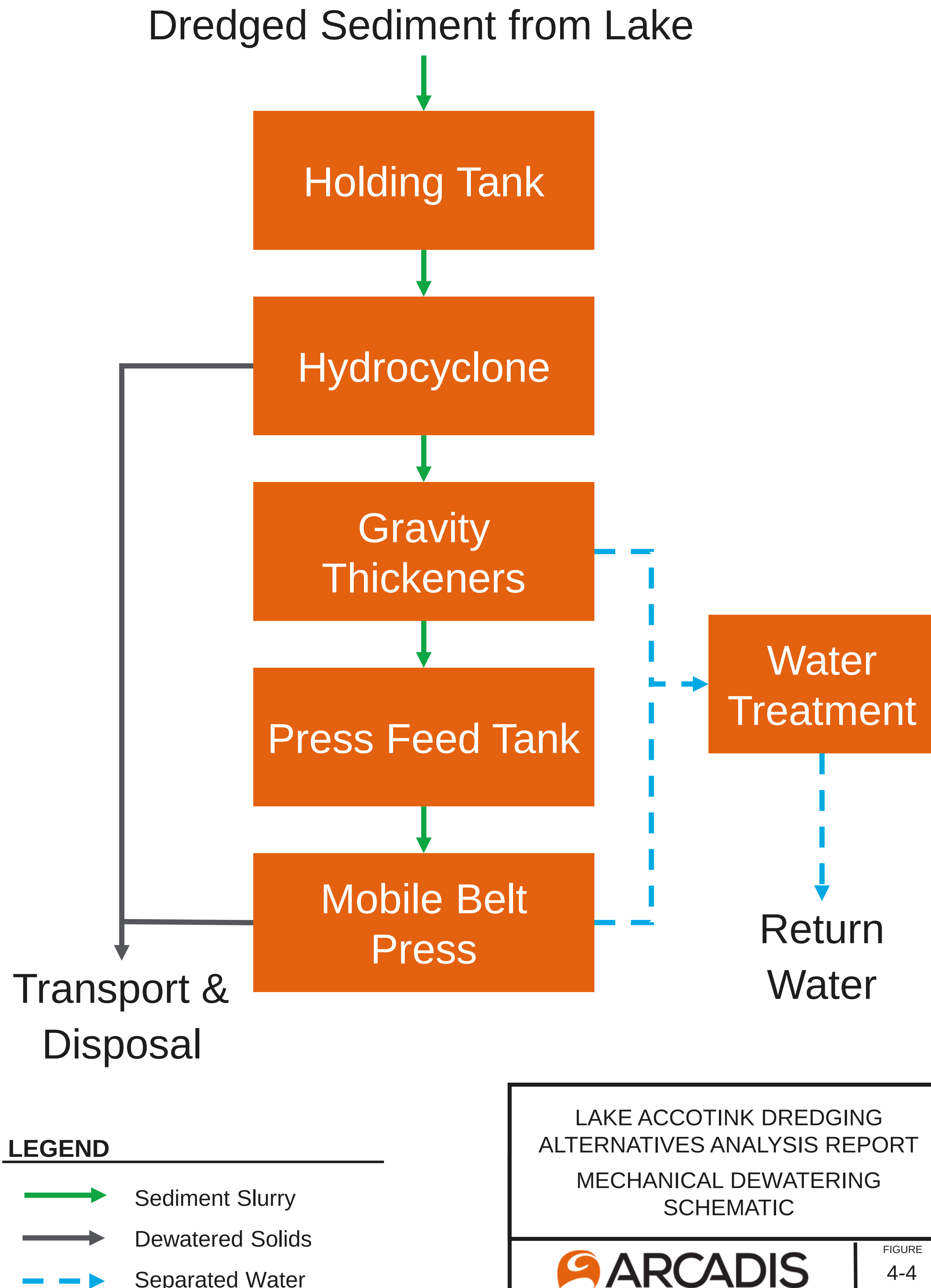

LAKE ACCOTINK DREDGING ALTERNATIVES ANALYSIS REPORT

MECHANICAL DEWATERING SCHEMATIC

ARCADIS

FIGURE 4-4

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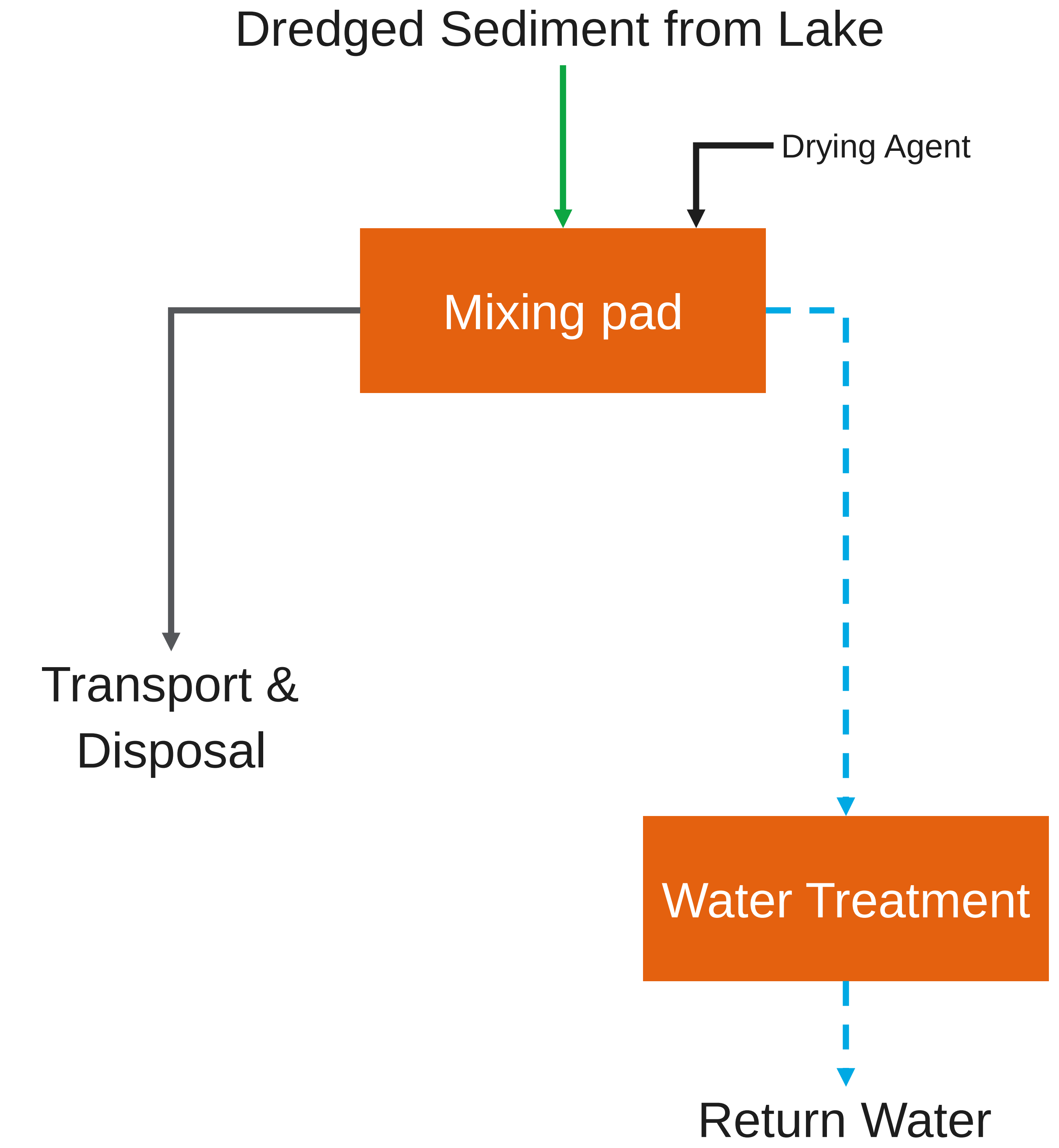


LEGEND

- Sediment Slurry
- Dewatered Solids
- Separated Water

LAKE ACCOTINK DREDGING
ALTERNATIVES ANALYSIS REPORT

GRAVITY DEWATERING WITH DRYING AGENT SCHEMATIC

ARCADIS

FIGURE
4-5

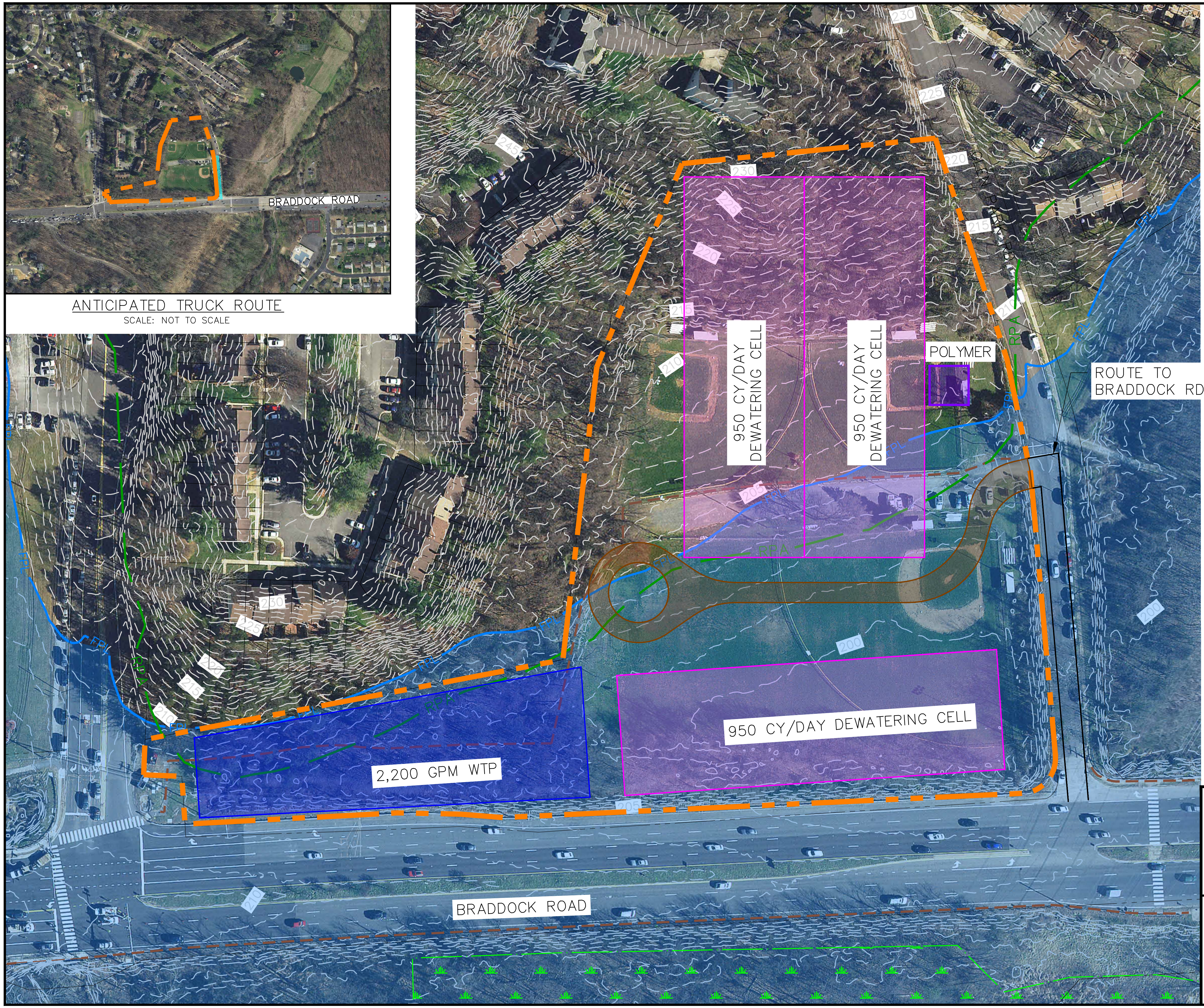
LAKE ACCOTINK DREDGING
ALTERNATIVES ANALYSIS REPORT
DEWATERING LOCATION MAP

SCALE: 1" = 1500'

ARCADIS

FIGURE
6-1

JULY 2021



LEGEND:

- PARCEL BOUNDARY
- EXISTING STREAM
- EXISTING FCPA TRAIL
- FEMA FLOODPLAIN (FPL)
- RESOURCE PROTECTION AREA (RPA)
- WETLANDS
- MAJOR CONTOUR
- MINOR CONTOUR
- DEWATERING SITE LIMITS
- DEWATERING AREA
- WATER TREATMENT PLANT
- SUPPORT AREA
- TRUCK ROUTE
- ACCESS ROAD

ABBREVIATION:

CY/DAY CUBIC YARD PER DAY
GPM GALLONS PER MINUTE
WTP WATER TREATMENT PLANT

BASEMAP NOTES:

1. WETLAND INFORMATION IS FROM DESKTOP STUDY PERFORMED BY WETLAND STUDIES AND SOLUTIONS, INC. (WSSI) AS PRESENTED IN THE FIELD ASSESSMENT REPORT.
2. TOPOGRAPHIC CONTOUR, PARCELS, FCPA TRAILS, RPA, AND FEMA INFORMATION ARE BASED FAIRFAX COUNTY GIS.
3. AERIAL IMAGERY REFERENCE: VITA, VIRGINIA BASE MAP PROGRAM, ORTHOIMAGERY, DATED 2017.
4. THE HORIZONTAL DATUM IS VA STATE PLANE NORTH, NAD83, US FOOT. THE VERTICAL DATUM IS NORTH AMERICAN VERTICAL DATUM 1929 (NGVD29).

0 100' 200'

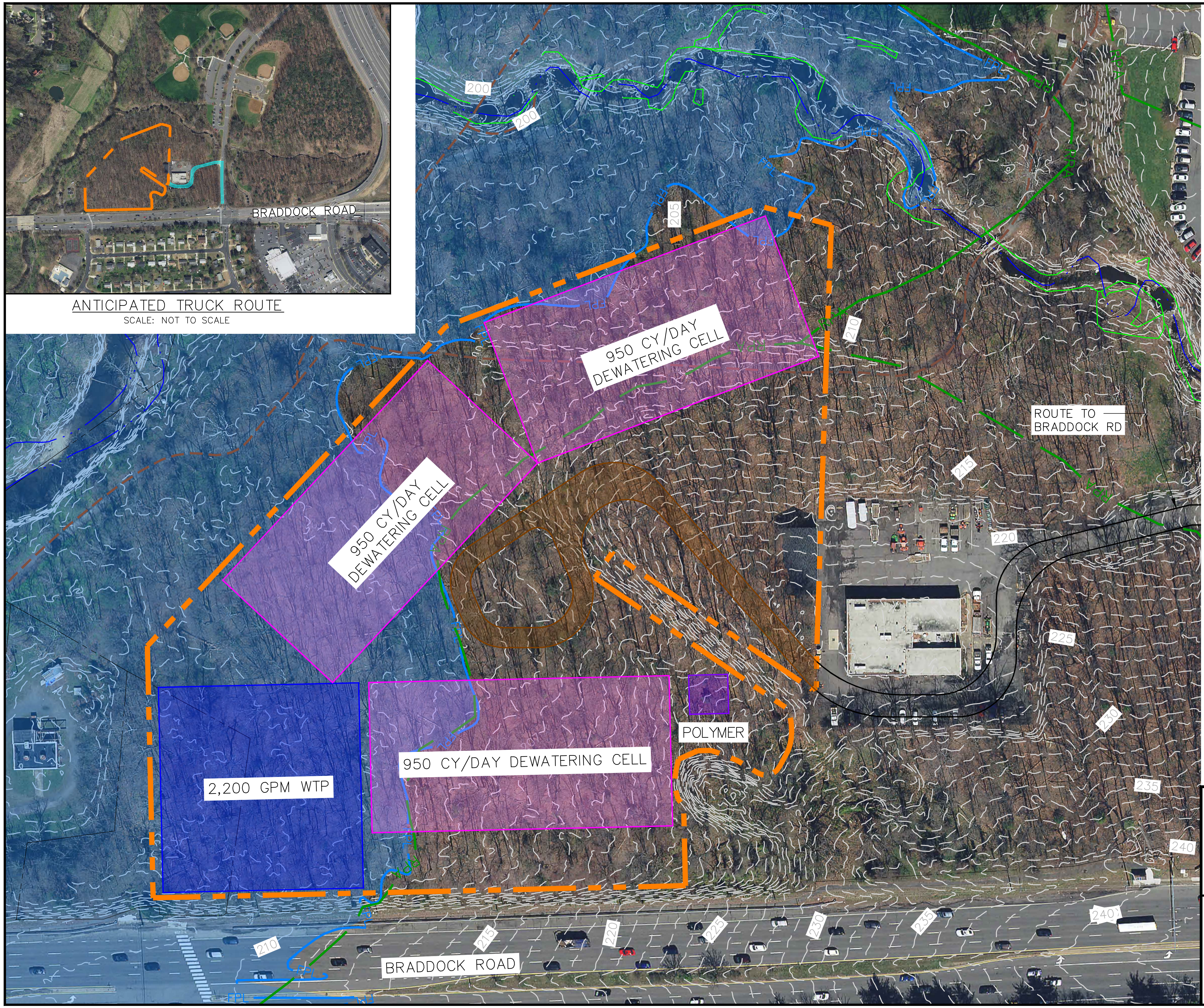
LAKE ACCOTINK DREDGING
ALTERNATIVES ANALYSIS REPORT
HOWREY FIELD
DEWATERING LOCATION

SCALE: 1" = 100'

ARCADIS

FIGURE 6–2

JULY 2021



LEGEND:

- PARCEL BOUNDARY
- EXISTING STREAM
- EXISTING FCPA TRAIL
- FPL — FEMA FLOODPLAIN (FPL)
- RPA — RESOURCE PROTECTION AREA (RPA)
- WETLANDS
- 200 — MAJOR CONTOUR
- MINOR CONTOUR
- DEWATERING SITE LIMITS
- DEWATERING AREA
- WATER TREATMENT PLANT
- SUPPORT AREA
- TRUCK ROUTE
- ACCESS ROAD

N

ABBREVIATION:

CY/DAY	CUBIC YARD PER DAY
GPM	GALLONS PER MINUTE
WTP	WATER TREATMENT PLANT

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0 100' 200'

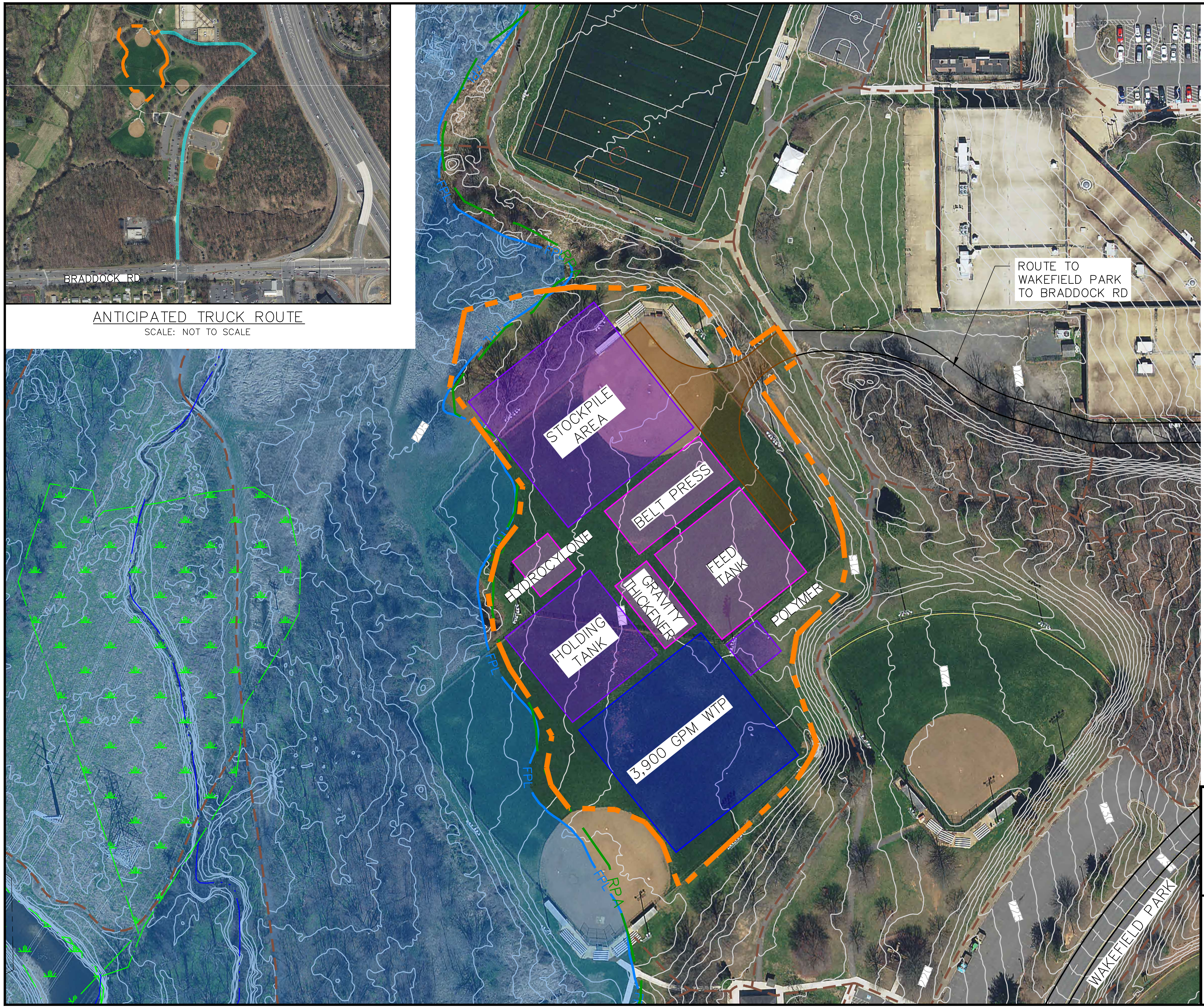
LAKE ACCOTINK DREDGING
ALTERNATIVES ANALYSIS REPORT
WAKEFIELD PARK MAINTENANCE FACILITY
DEWATERING LOCATION

SCALE: 1" = 100'

ARCADIS

FIGURE
6–3

JULY 2021



LEGEND:

- PARCEL BOUNDARY
- EXISTING STREAM
- EXISTING FCPA TRAIL
- FEMA FLOODPLAIN (FPL)
- RESOURCE PROTECTION AREA (RPA)
- WETLANDS
- MAJOR CONTOUR
- MINOR CONTOUR
- DEWATERING SITE LIMITS
- DEWATERING AREA
- WATER TREATMENT PLANT
- SUPPORT AREA
- TRUCK ROUTE
- ACCESS ROAD

N

ABBREVIATION:

GPM GALLONS PER MINUTES
WTP WATER TREATMENT PLANT

BASEMAP NOTES:

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3. AERIAL IMAGERY REFERENCE: VITA, VIRGINIA BASE MAP PROGRAM, ORTHOIMAGERY, DATED 2017.
4. THE HORIZONTAL DATUM IS VA STATE PLANE NORTH, NAD83, US FOOT. THE VERTICAL DATUM IS NORTH AMERICAN VERTICAL DATUM 1929 (NGVD29).
5. DUE TO SIZE CONSTRAINTS, PROPOSED LAYOUT IS FOR MECHANICAL DEWATERING

0 100' 200'

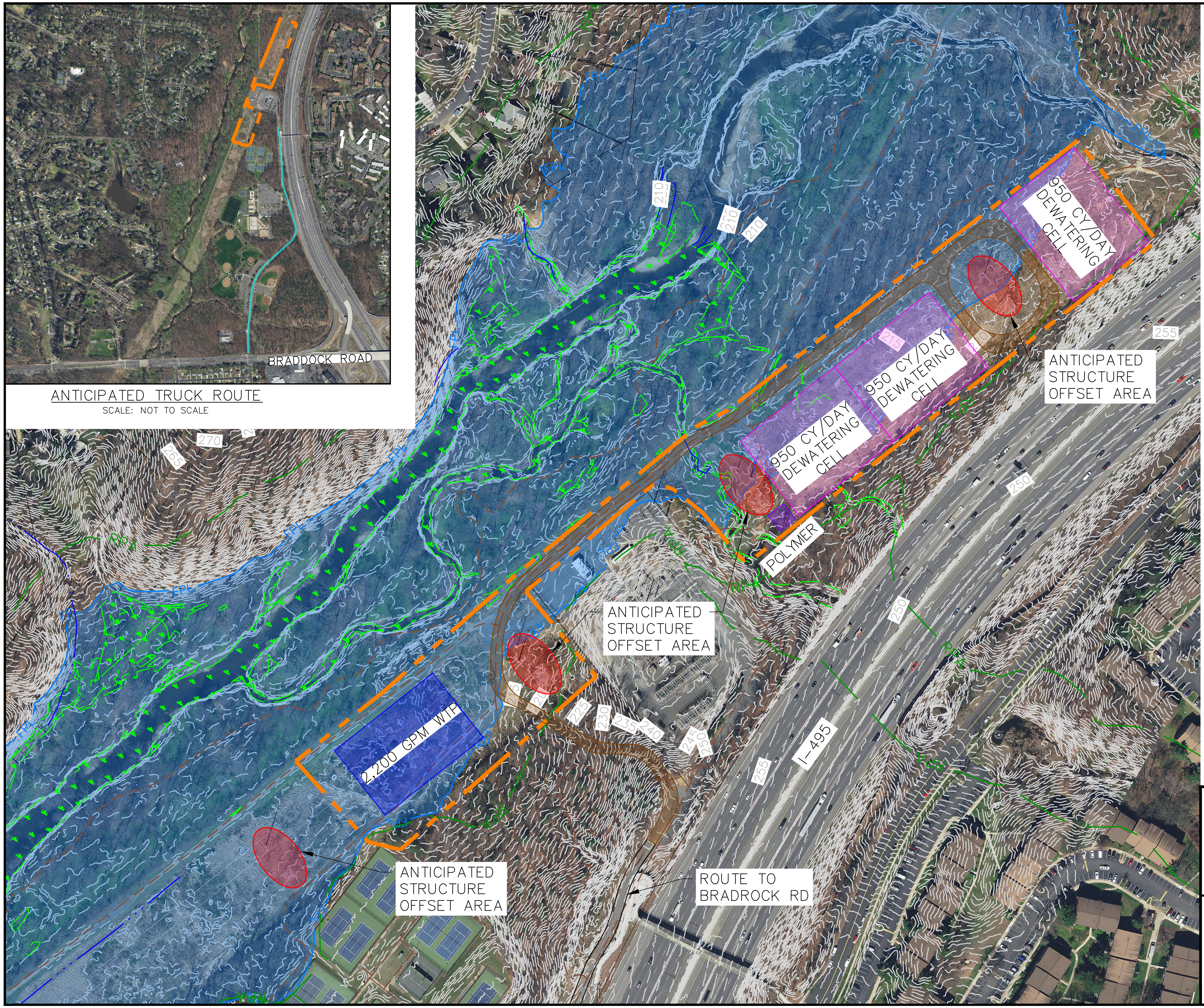
LAKE ACCOTINK DREDGING
ALTERNATIVES ANALYSIS REPORT
WAKEFIELD BALL FIELDS
DEWATERING LOCATION

SCALE: 1" = 100'

ARCADIS

FIGURE 6–4

JULY 2021



LEGEND:

- PARCEL BOUNDARY
- EXISTING STREAM
- EXISTING FCPA TRAIL
- FEMA FLOODPLAIN (FPL)
- RESOURCE PROTECTION AREA (RPA)
- WETLANDS
- MAJOR CONTOUR
- MINOR CONTOUR
- DEWATERING SITE LIMITS
- DEWATERING AREA
- WATER TREATMENT PLANT
- SUPPORT AREA
- TRUCK ROUTE
- ACCESS ROAD

ABBREVIATION:

CY/DAY	CUBIC YARD PER DAY
GPM	GALLONS PER MINUTES
WTP	WATER TREATMENT PLANT

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4. THE HORIZONTAL DATUM IS VA STATE PLANE NORTH, NAD83, US FOOT. THE VERTICAL DATUM IS NORTH AMERICAN VERTICAL DATUM 1929 (NGVD29).
5. AN OFFSET OF 50-FEET WAS SET AROUND UTILITY STRUCTURES LOCATED WITHIN THE DOMINION RIGHT-OF-WAY.

0 200' 400'

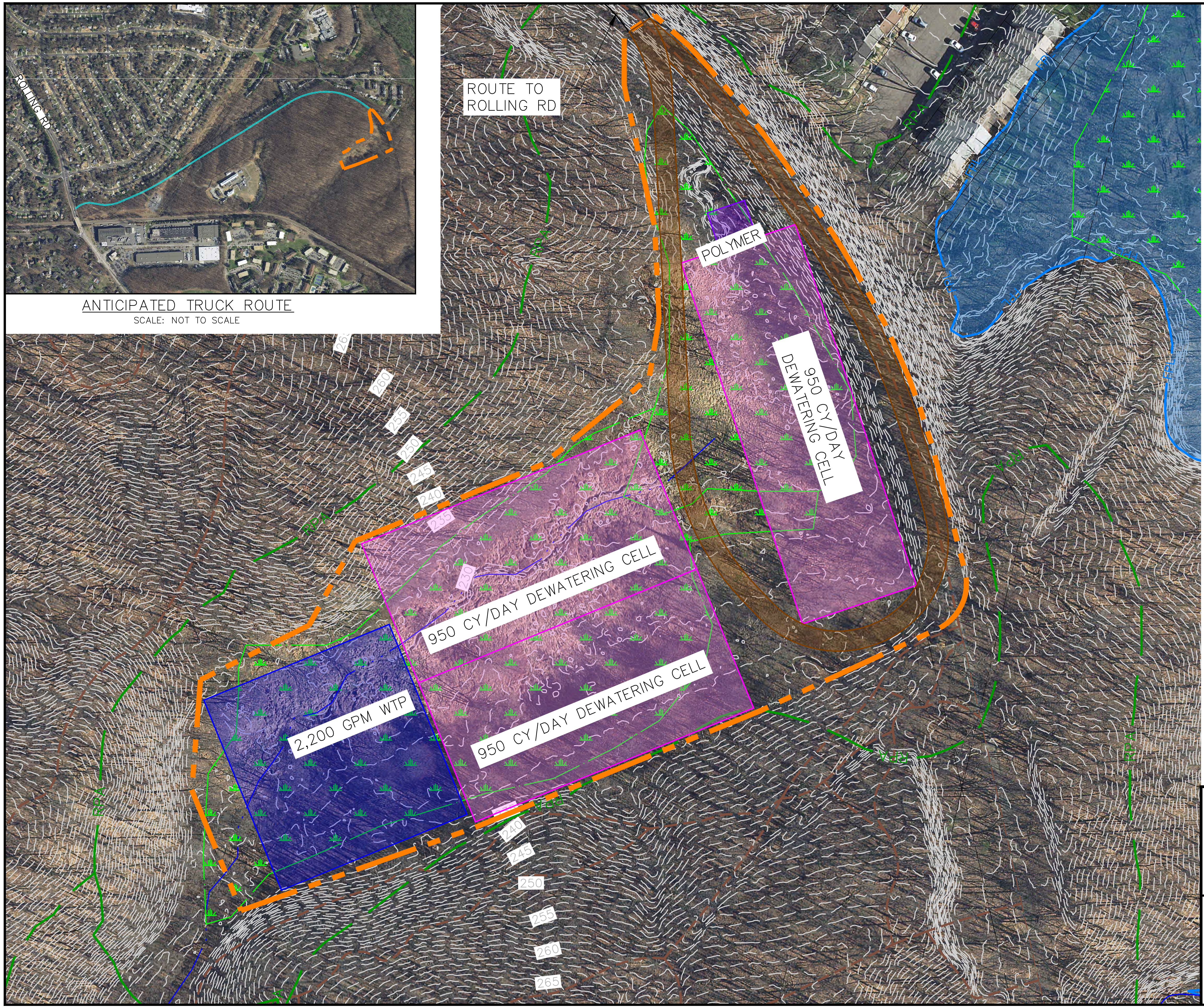
LAKE ACCOTINK DREDGING ALTERNATIVES ANALYSIS REPORT
DOMINION RIGHT-OF-WAY DEWATERING LOCATION

SCALE: 1" = 200'

ARCADIS

FIGURE 6-5

JULY 2021



LEGEND:

- PARCEL BOUNDARY
- EXISTING STREAM
- EXISTING FCPA TRAIL
- FEMA FLOODPLAIN (FPL)
- RESOURCE PROTECTION AREA (RPA)
- WETLANDS
- MAJOR CONTOUR
- MINOR CONTOUR
- DEWATERING SITE LIMITS
- DEWATERING AREA
- WATER TREATMENT PLANT
- SUPPORT AREA
- TRUCK ROUTE
- ACCESS ROAD

ABBREVIATION:

CY/DAY CUBIC YARD PER DAY
GPM GALLONS PER MINUTE
WTP WATER TREATMENT PLANT

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0 100' 200'

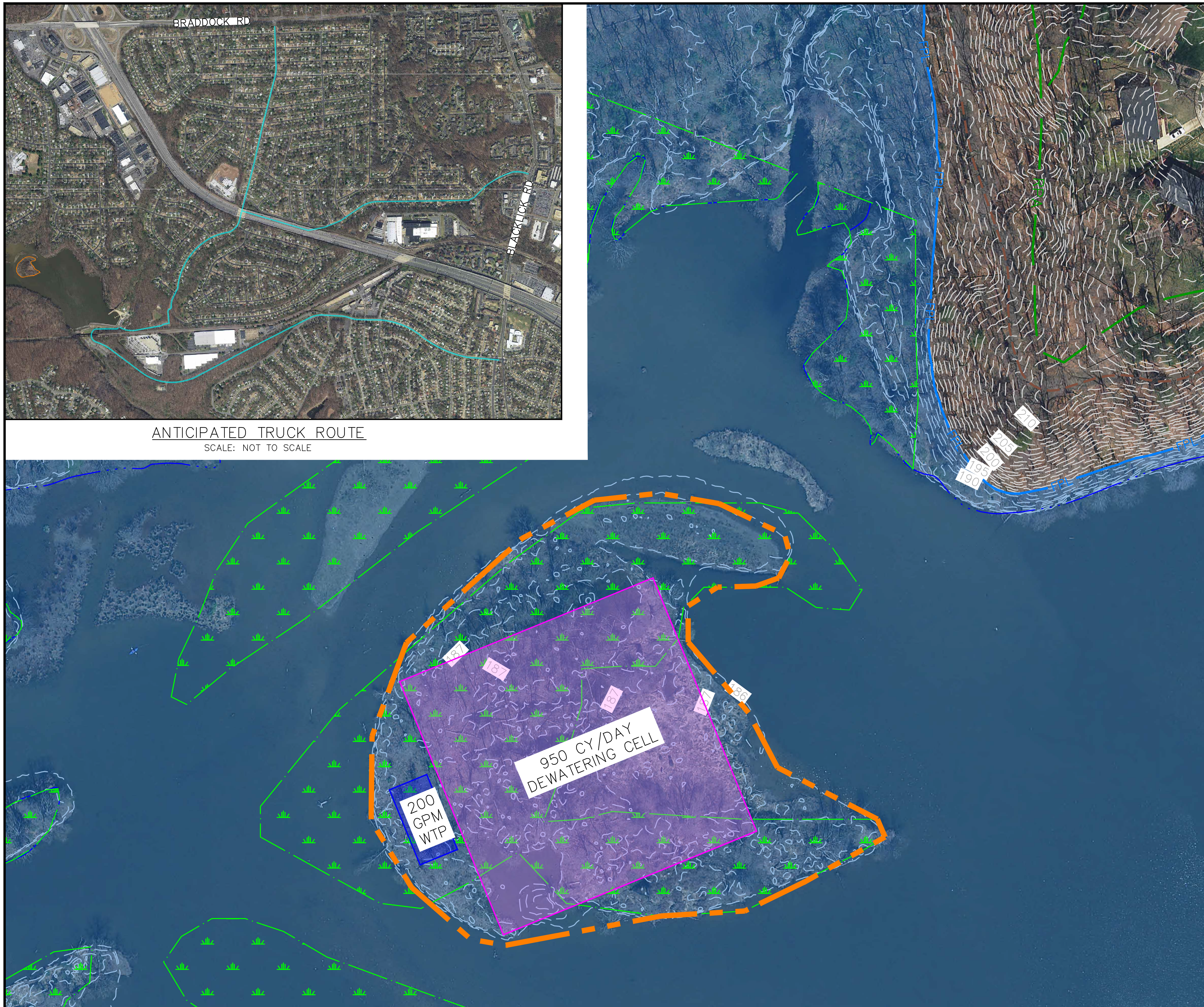
LAKE ACCOTINK DREDGING ALTERNATIVES ANALYSIS REPORT
LAKE ACCOTINK UPPER SETTLING BASIN DEWATERING LOCATION

SCALE: 1" = 100'

ARCADIS

FIGURE 6-6

JULY 2021



N

LEGEND:

- PARCEL BOUNDARY
- EXISTING STREAM
- EXISTING FCPA TRAIL
- FEMA FLOODPLAIN (FPL)
- RESOURCE PROTECTION AREA (RPA)
- WETLANDS
- MAJOR CONTOUR
- MINOR CONTOUR
- DEWATERING SITE LIMITS
- DEWATERING AREA
- WATER TREATMENT PLANT
- TRUCK ROUTE
- ACCESS ROAD

ABBREVIATION:

CY/DAY CUBIC YARD PER DAY
GPM GALLONS PER MINUTE
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4. THE HORIZONTAL DATUM IS VA STATE PLANE NORTH, NAD83, US FOOT. THE VERTICAL DATUM IS NORTH AMERICAN VERTICAL DATUM 1929 (NGVD29).
5. LAYOUT SHOWN FOR REFERENCE ONLY TO SHOW PASSIVE DEWATERING NOT ABLE TO BE ACCOMMODATE ON ISLAND BASED ON CURRENT ASSUMPTIONS. DUE TO SIZE CONSTRAINTS, DRYING AGENT DEWATERING IS ASSUMED.

0 100' 200'

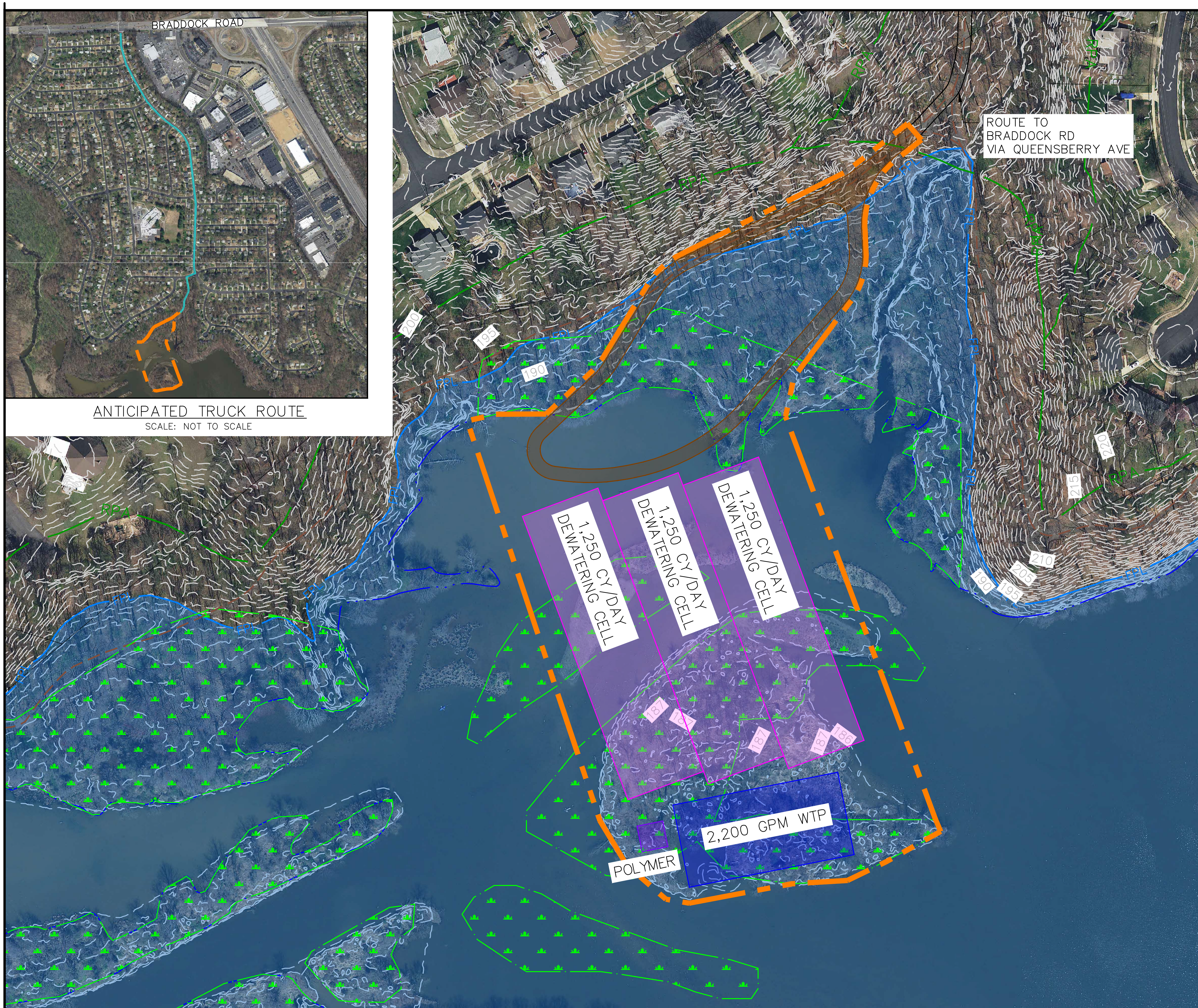
LAKE ACCOTINK DREDGING
ALTERNATIVES ANALYSIS REPORT
LAKE ACCOTINK ISLAND - CURRENT
FOOTPRINT DEWATERING LOCATION

SCALE: 1" = 100'

ARCADIS

FIGURE
6–7

JULY 2021



LEGEND:

- PARCEL BOUNDARY
- EXISTING STREAM
- EXISTING FCPA TRAIL
- FEMA FLOODPLAIN (FPL)
- RESOURCE PROTECTION AREA (RPA)
- WETLANDS
- MAJOR CONTOUR
- MINOR CONTOUR
- DEWATERING SITE LIMITS
- DEWATERING AREA
- WATER TREATMENT PLANT
- SUPPORT AREA
- TRUCK ROUTE
- ACCESS ROAD

ABBREVIATION:

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GPM GALLONS PER MINUTE
WTP WATER TREATMENT PLANT

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4. THE HORIZONTAL DATUM IS VA STATE PLANE NORTH, NAD83, US FOOT. THE VERTICAL DATUM IS NORTH AMERICAN VERTICAL DATUM 1929 (NGVD29).

0 150' 300'

LAKE ACCOTINK DREDGING ALTERNATIVES ANALYSIS REPORT
LAKE ACCOTINK ISLAND - EXPANDED FOOTPRINT DEWATERING LOCATION

SCALE: 1" = 150'

ARCADIS

FIGURE 6–8

JULY 2021

LEGEND:

- PARCEL BOUNDARY
- EXISTING STREAM
- EXISTING FCPA TRAIL
- FEMA FLOODPLAIN (FPL)
- RESOURCE PROTECTION AREA (RPA)
- WETLANDS
- MAJOR CONTOUR
- MINOR CONTOUR
- DEWATERING SITE LIMITS
- DEWATERING AREA
- WATER TREATMENT PLANT
- SUPPORT AREA
- TRUCK ROUTE
- ACCESS ROAD

ABBREVIATION:

CY/DAY	CUBIC YARD PER DAY
GPM	GALLONS PER MINUTE
WTP	WATER TREATMENT PLANT

BASEMAP NOTES:

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4. THE HORIZONTAL DATUM IS VA STATE PLANE NORTH, NAD83, US FOOT. THE VERTICAL DATUM IS NORTH AMERICAN VERTICAL DATUM 1929 (NGVD29).

0 150' 300'

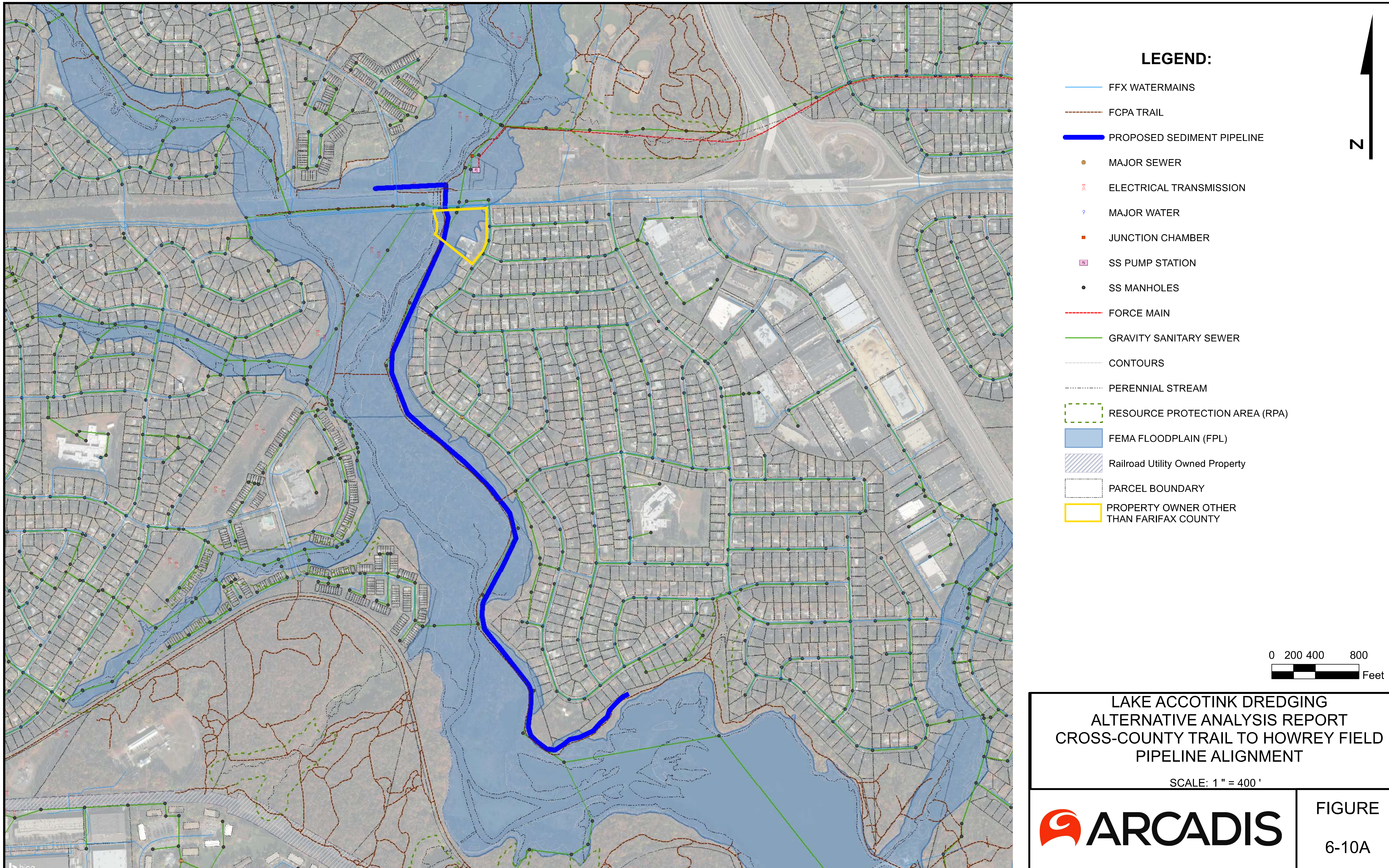
LAKE ACCOTINK DREDGING
ALTERNATIVES ANALYSIS REPORT
CONCRETE PLANT
DEWATERING LOCATION

SCALE: 1" = 150'

ARCADIS

FIGURE 6–9

JULY 2021



LAKE ACCOTINK DREDGING
ALTERNATIVE ANALYSIS REPORT
CROSS-COUNTY TRAIL TO HOWREY FIELD
PIPELINE ALIGNMENT

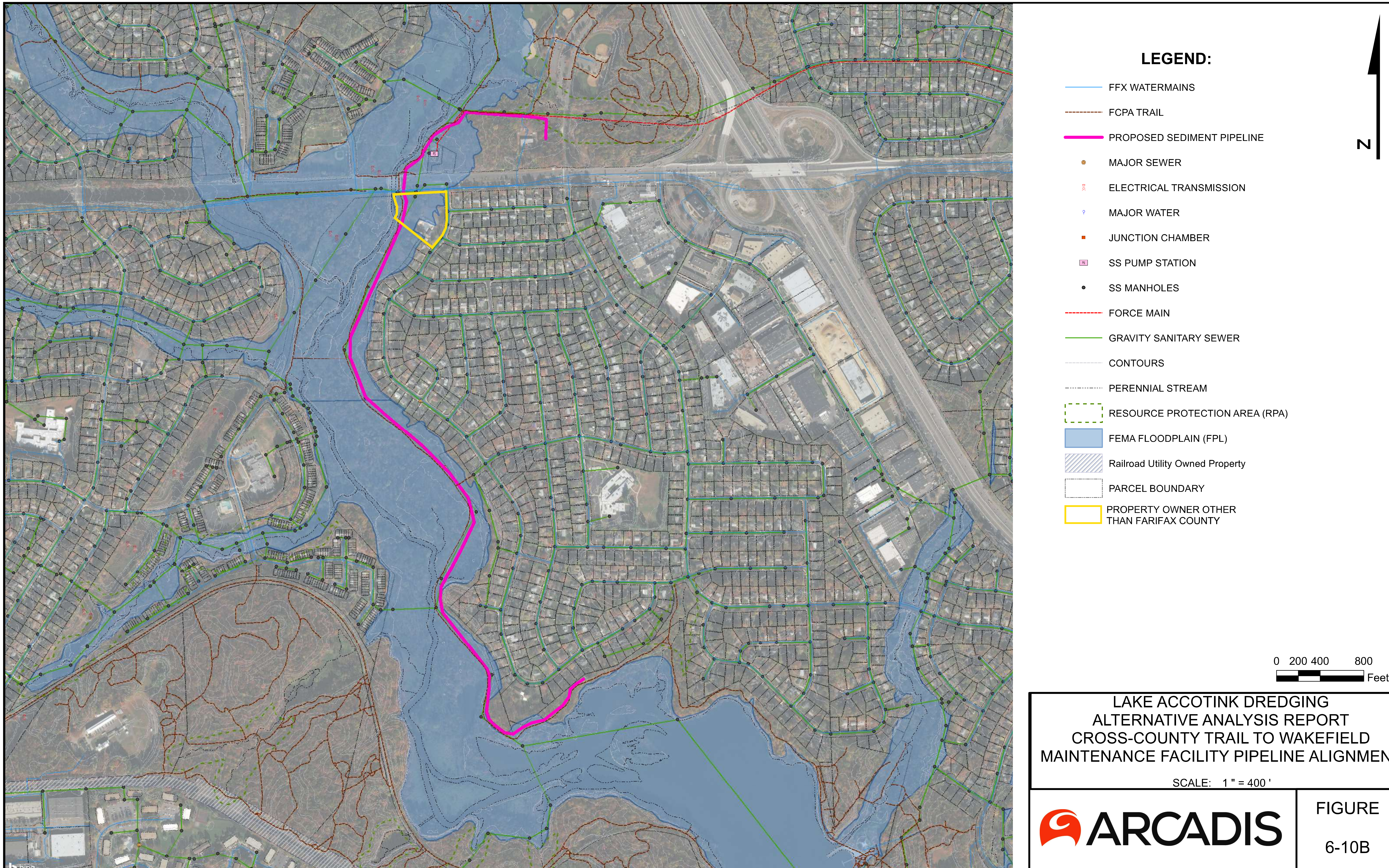
SCALE: 1 " = 400 '

ARCADIS

FIGURE

6-10A

JULY 2021



LAKE ACCOTINK DREDGING
ALTERNATIVE ANALYSIS REPORT
CROSS-COUNTY TRAIL TO WAKEFIELD
MAINTENANCE FACILITY PIPELINE ALIGNMENT

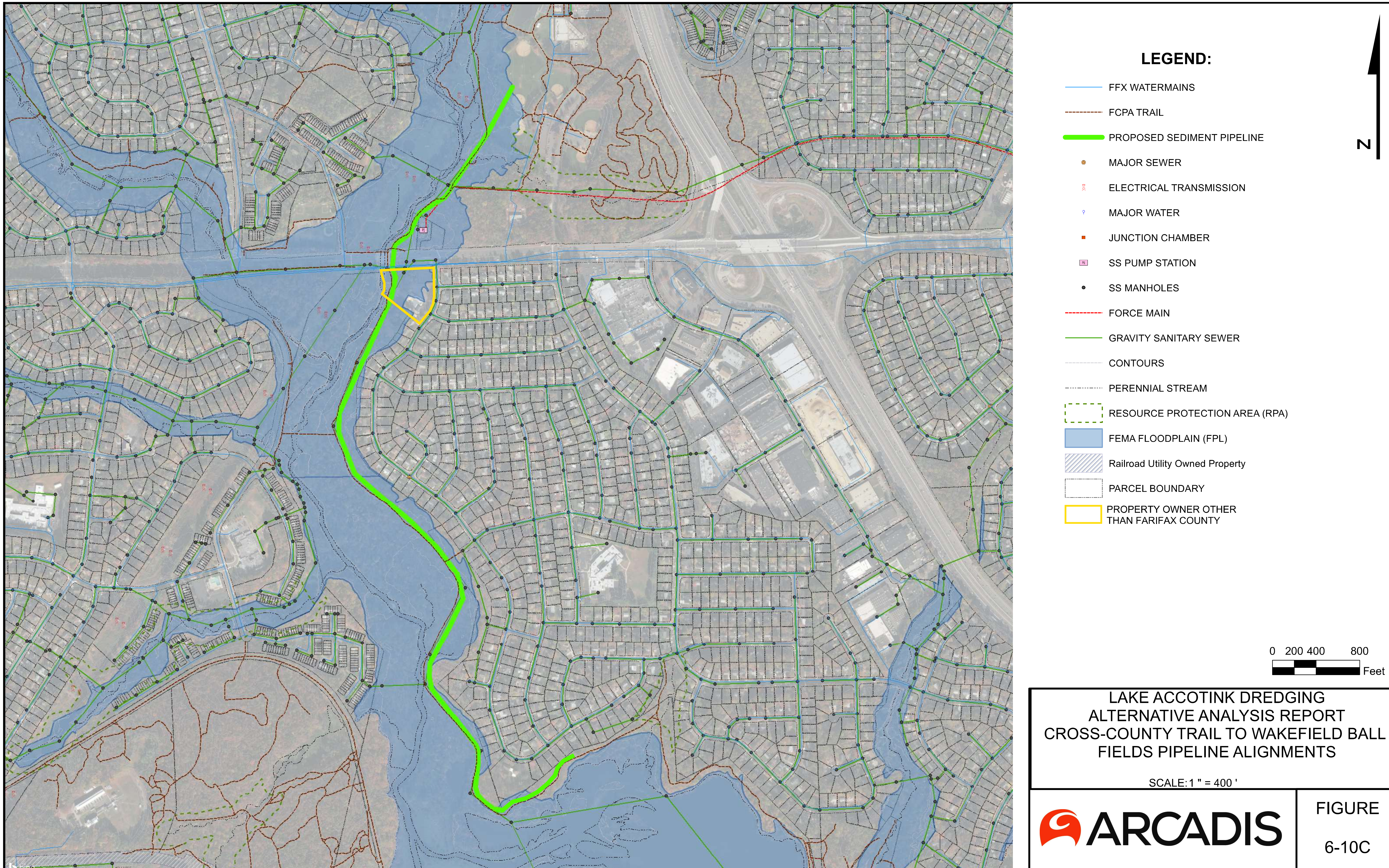
SCALE: 1 " = 400 '

ARCADIS

FIGURE

6-10B

JULY 2021



LAKE ACCOTINK DREDGING ALTERNATIVE ANALYSIS REPORT
CROSS-COUNTY TRAIL TO WAKEFIELD BALL FIELDS PIPELINE ALIGNMENTS

SCALE: 1 " = 400 '

ARCADIS

FIGURE 6-10C

JULY 2021

LEGEND:

- FCPA TRAIL
- PROPOSED SEDIMENT PIPELINE
- FFX WATERMAINS
- Communication
- ELECTRIC
- MAJOR SEWER
- ELECTRICAL TRANSMISSION
- MAJOR WATER
- JUNCTION CHAMBER
- SS PUMP STATION
- SS MANHOLES
- FORCE MAIN
- GRAVITY SANITARY SEWER
- CONTOURS
- PERENNIAL STREAM
- RESOURCE PROTECTION AREA (RPA)
- FEMA FLOODPLAIN (FPL)
- Railroad Utility Owned Property
- PARCEL BOUNDARY
- PROPERTY OWNER OTHER THAN FARIFAX COUNTY

N

0 250 500 1,000 Feet

LAKE ACCOTINK DREDGING
ALTERNATIVE ANALYSIS REPORT
CROSS-COUNTY TRAIL TO DOMINION
ROW PIPELINE ALIGNMENT

SCALE: 1 " = 500 '

ARCADIS

FIGURE

6-10D

JULY 2021

LAKE ACCOTINK DREDGING
ALTERNATIVE ANALYSIS REPORT
QUEENSBERRY AVE TO HOWREY FIELD
PIPELINE ALIGNMENT

SCALE: 1 " = 400 '

ARCADIS

FIGURE

6-11A

JULY 2021

LEGEND:

- FFX WATERMAINS
- FCPA TRAIL
- PROPOSED SEDIMENT PIPELINE
- MAJOR SEWER
- ELECTRICAL TRANSMISSION
- JUNCTION CHAMBER
- SS PUMP STATION
- SS MANHOLES
- FORCE MAIN
- GRAVITY SANITARY SEWER
- CONTOURS
- PERENNIAL STREAM
- RESOURCE PROTECTION AREA (RPA)
- FEMA FLOODPLAIN (FPL)
- PARCEL BOUNDARY

N

0 150 300 600 Feet

LAKE ACCOTINK DREDGING
ALTERNATIVE ANALYSIS REPORT
QUEENSBERRY AVE TO WAKEFIELD PARK
MAINTENANCE FACILITY PIPELINE ALIGNMENT

SCALE: 1 " = 300 '

ARCADIS

FIGURE 6-11B

JULY 2021

LEGEND:

- FCPA TRAIL
- PROPOSED SEDIMENT ALIGNMENT
- FFX WATERMAINS
- MAJOR SEWER
- ELECTRICAL TRANSMISSION
- MAJOR WATER
- JUNCTION CHAMBER
- SS PUMP STATION
- SS MANHOLES
- FORCE MAIN
- GRAVITY SANITARY SEWER
- CONTOURS
- PERENNIAL STREAM
- RESOURCE PROTECTION AREA (RPA)
- FEMA FLOODPLAIN (FPL)
- Railroad Utility Owned Property
- PARCEL BOUNDARY

N

0 200 400 800 Feet

LAKE ACCOTINK DREDGING ALTERNATIVE ANALYSIS REPORT QUEENSBERRY AVE TO WAKEFIELD BALL FIELD PIPELINE ALIGNMENT

SCALE: 1 " = 400 '

ARCADIS

FIGURE 6-11C

JULY 2021

N

LEGEND:

- FCPA TRAIL
- PROPOSED SEDIMENT PIPELINE
- FFX WATERMAINS
- ELECTRIC
- MAJOR SEWER
- ELECTRICAL TRANSMISSION
- MAJOR WATER
- JUNCTION CHAMBER
- SS PUMP STATION
- SS MANHOLES
- FORCE MAIN
- GRAVITY SANITARY SEWER
- CONTOURS
- PERENNIAL STREAM
- RESOURCE PROTECTION AREA (RPA)
- FEMA FLOODPLAIN (FPL)
- Railroad Utility Owned Property
- PARCEL BOUNDARY

0 250 500 1,000 Feet

LAKE ACCOTINK DREDGING
ALTERNATIVE ANALYSIS REPORT
QUEENSBERRY AVE TO DOMINION
ROW PIPELINE ALIGNMENT

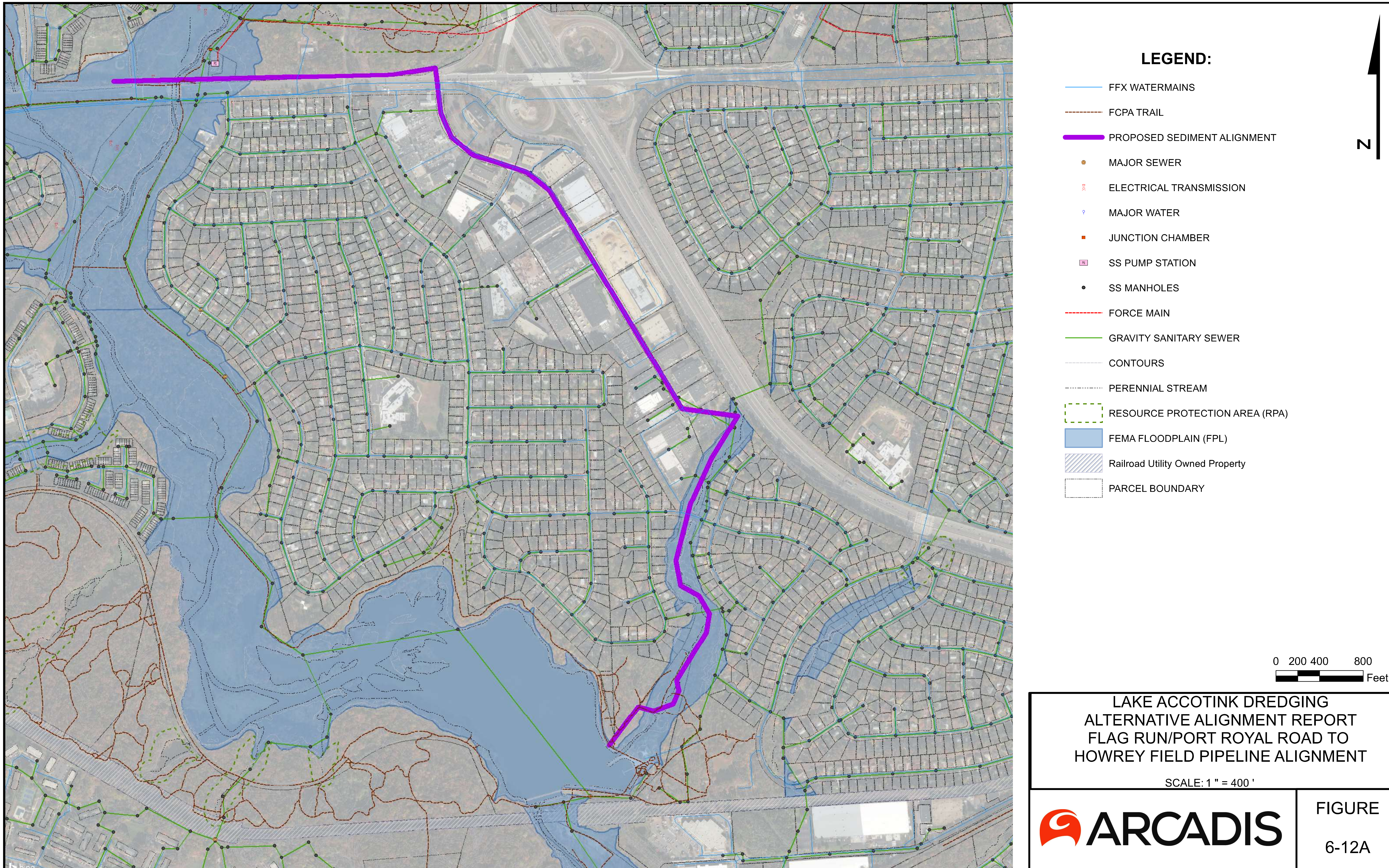
SCALE: 1 " = 500 '

ARCADIS

FIGURE

6-11D

JULY 2021



LAKE ACCOTINK DREDGING
ALTERNATIVE ALIGNMENT REPORT
FLAG RUN/PORT ROYAL ROAD TO
HOWREY FIELD PIPELINE ALIGNMENT

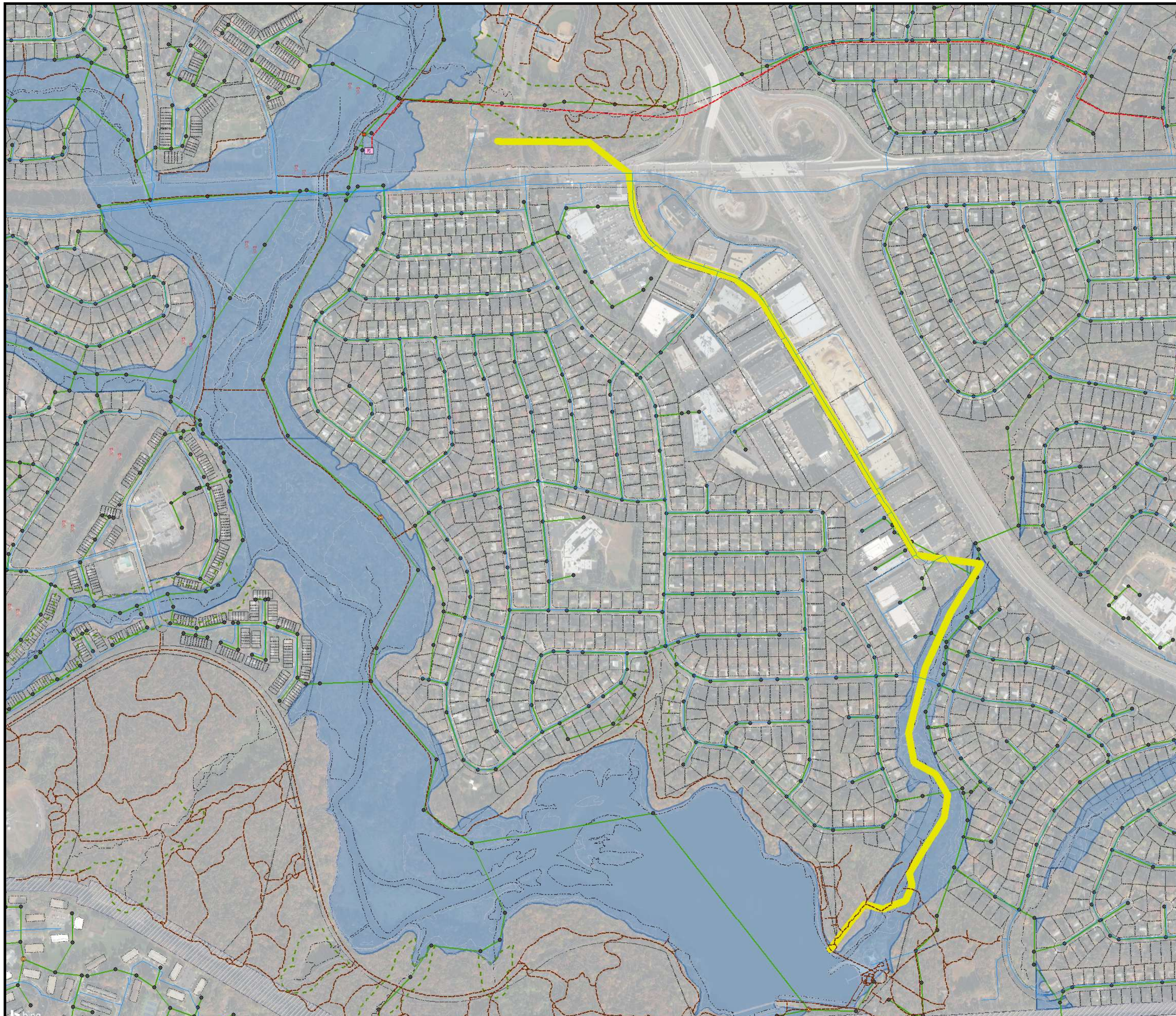
SCALE: 1 " = 400 '

ARCADIS

FIGURE

6-12A

JULY 2021



LEGEND:

- FFX WATERMAINS
- FCPA TRAIL
- PROPOSED SEDIMENT PIPELINE
- MAJOR SEWER
- ELECTRICAL TRANSMISSION
- MAJOR WATER
- JUNCTION CHAMBER
- SS PUMP STATION
- SS MANHOLES
- FORCE MAIN
- GRAVITY SANITARY SEWER
- Private, Gravity Lines
- CONTOURS
- PERENNIAL STREAM
- RESOURCE PROTECTION AREA (RPA)
- FEMA FLOODPLAIN (FPL)
- Railroad Utility Owned Property
- PARCEL BOUNDARY

N

0 200 400 800 Feet

LAKE ACCOTINK DREDGING
ALTERNATIVE ANALYSIS REPORT
FLAG RUN/PORT ROYAL ROAD TO
WAKEFIELD PARK MAINTENANCE FACILITY
PIPELINE ALIGNMENT

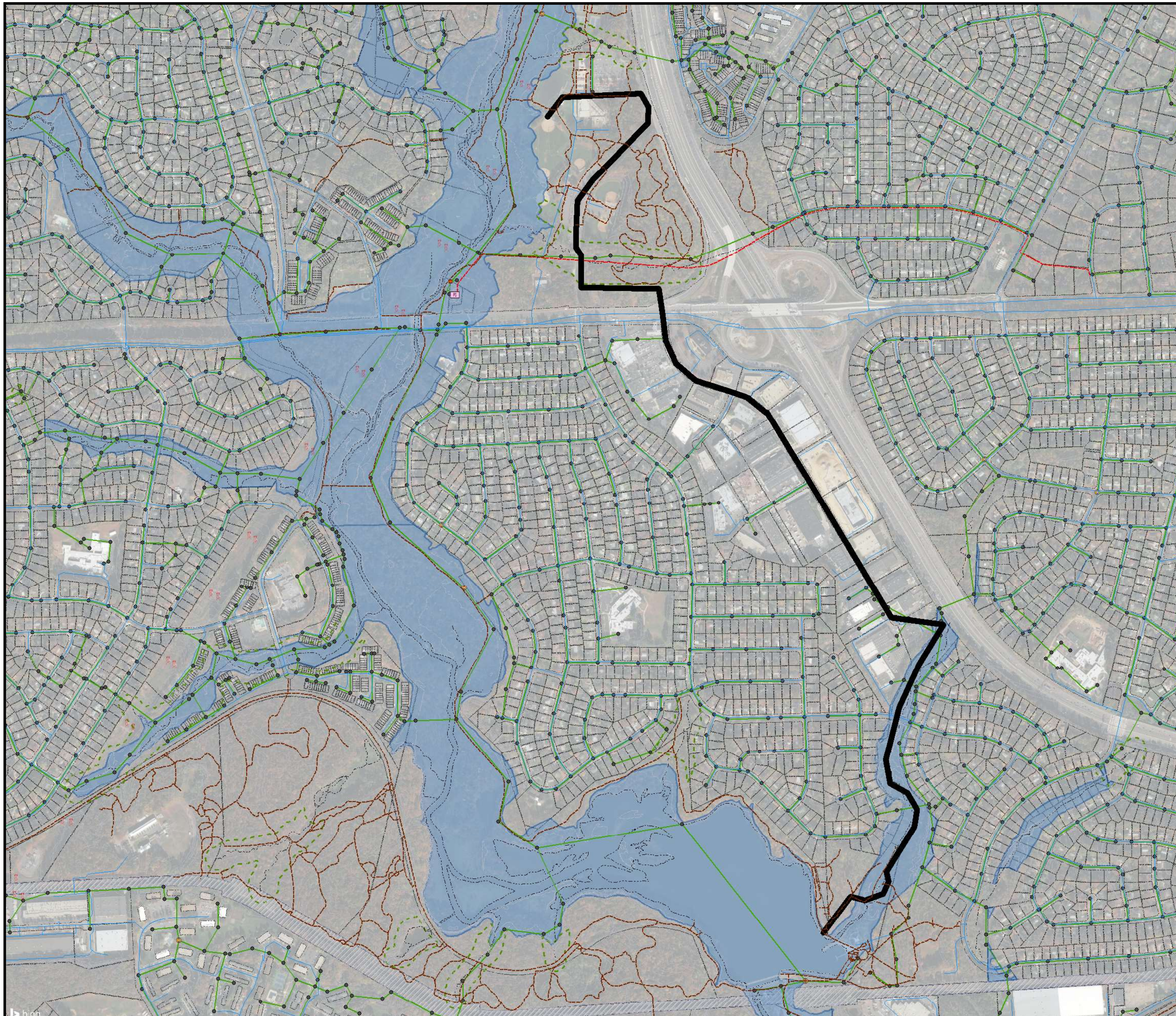
SCALE:1 " = 400 '

ARCADIS

FIGURE

6-12B

JULY 2021



LEGEND:

- FCPA TRAIL
- PROPOSED SEDIMENT PIPELINE
- FFX WATERMAINS
- MAJOR SEWER
- ELECTRICAL TRANSMISSION
- MAJOR WATER
- JUNCTION CHAMBER
- SS PUMP STATION
- SS MANHOLES
- FORCE MAIN
- GRAVITY SANITARY SEWER
- CONTOURS
- PERENNIAL STREAM
- RESOURCE PROTECTION AREA (RPA)
- FEMA FLOODPLAIN (FPL)
- Railroad Utility Owned Property
- PARCEL BOUNDARY

N

0 250 500 1,000
Feet

LAKE ACCOTINK DREDGING
ALTERNATIVE ANALYSIS REPORT
FLAG RUN/PORT ROYAL ROAD TO WAKEFIELD
BALL FIELDS PIPELINE ALIGNMENT

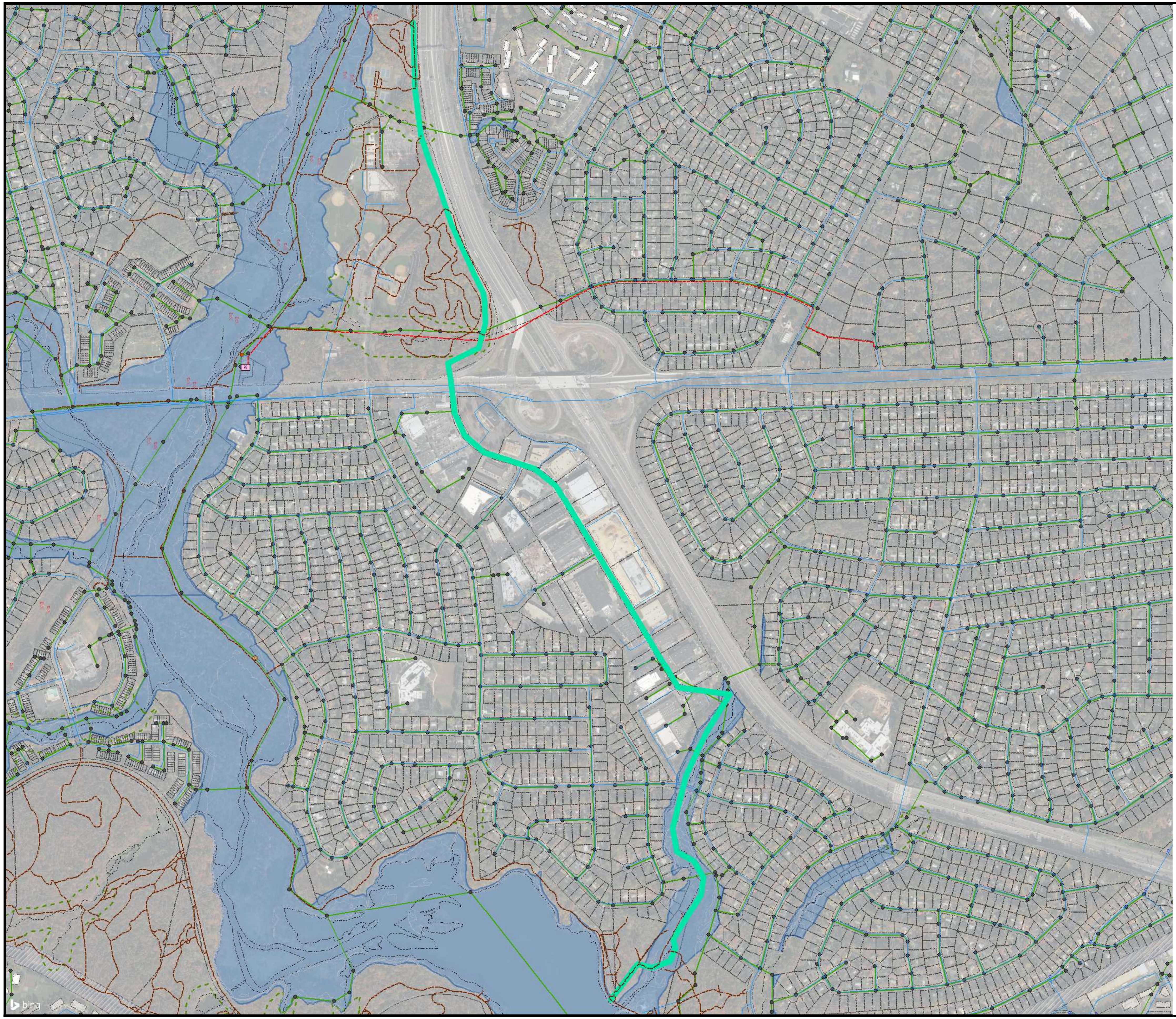
SCALE: 1 " = 500 '

ARCADIS

FIGURE

6-12C

JULY 2021



LEGEND:

- FCPA TRAIL
- PROPOSED SEDIMENT PIPELINE
- FFX WATERMAINS
- MAJOR SEWER
- ELECTRICAL TRANSMISSION
- MAJOR WATER
- JUNCTION CHAMBER
- SS PUMP STATION
- SS MANHOLES
- FORCE MAIN
- GRAVITY SANITARY SEWER
- CONTOURS
- PERENNIAL STREAM
- RESOURCE PROTECTION AREA (RPA)
- FEMA FLOODPLAIN (FPL)
- Railroad Utility Owned Property
- PARCEL BOUNDARY

N

0 250 500 1,000 Feet

LAKE ACCOTINK DREDGING ALTERNATIVE ANALYSIS REPORT
FLAG RUN/PORT ROYAL ROAD TO DOMINION ROW PIPELINE ALIGNMENT

SCALE: 1 " = 500 '

ARCADIS

FIGURE 6-12D

JULY 2021

LEGEND:

- FFX WATERMAINS
- FCPA TRAIL
- PROPOSED SEDIMENT ALIGNMENT
- MAJOR SEWER
- ELECTRICAL TRANSMISSION
- MAJOR WATER
- JUNCTION CHAMBER
- SS PUMP STATION
- SS MANHOLES
- FORCE MAIN
- GRAVITY SANITARY SEWER
- CONTOURS
- PERENNIAL STREAM
- RESOURCE PROTECTION AREA (RPA)
- FEMA FLOODPLAIN (FPL)
- Railroad Utility Owned Property
- PARCEL BOUNDARY

N

0 200 400 800 Feet

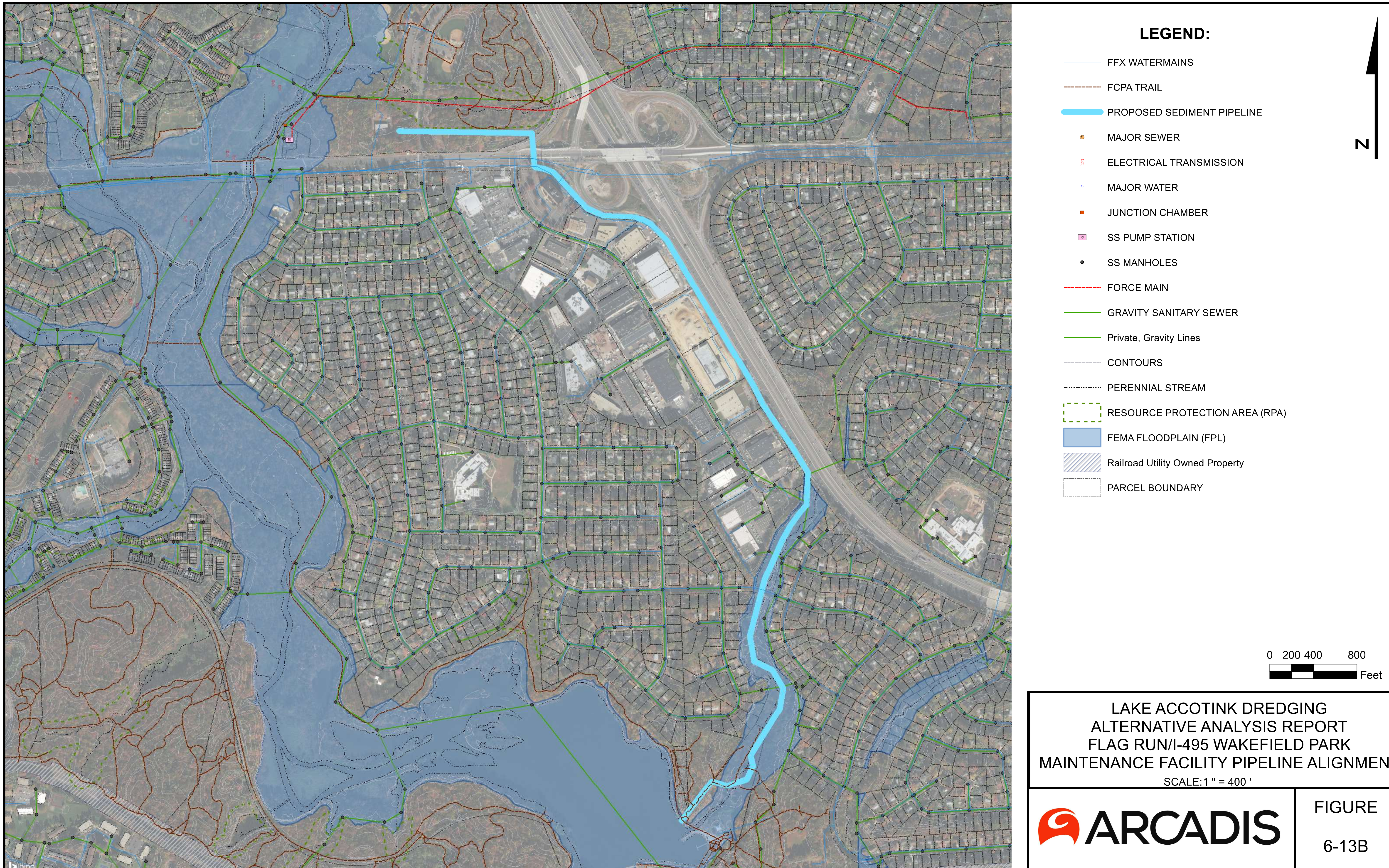
LAKE ACCOTINK DREDGING
ALTERNATIVE ANALYSIS REPORT
FLAG RUN/I-495 TO HOWREY FIELD
PIPELINE ALIGNMENT

SCALE: 1 " = 400 '

ARCADIS

FIGURE 6-13A

JULY 2021



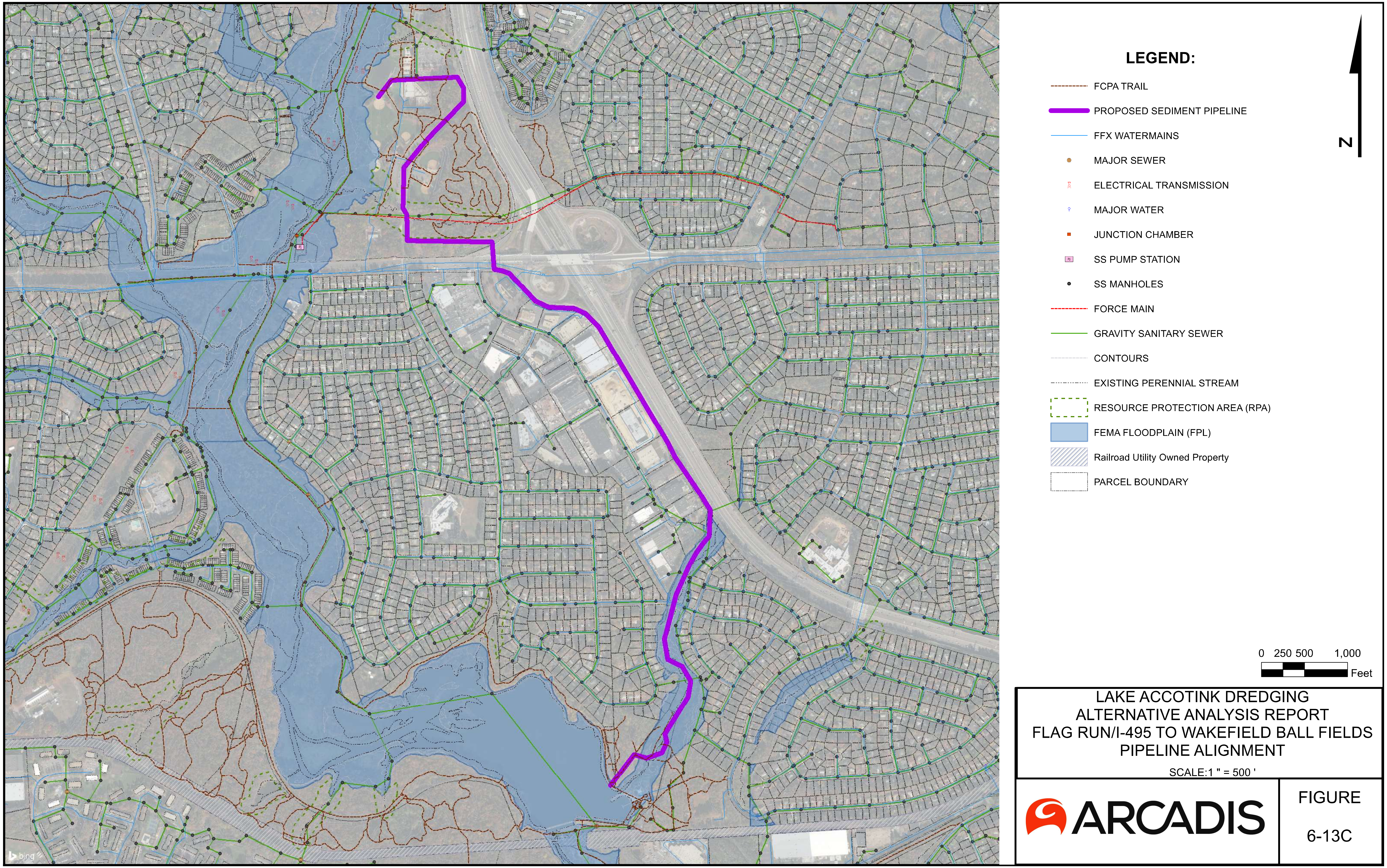
LAKE ACCOTINK DREDGING
ALTERNATIVE ANALYSIS REPORT
FLAG RUN/I-495 WAKEFIELD PARK
MAINTENANCE FACILITY PIPELINE ALIGNMENT

SCALE:1 " = 400 '

ARCADIS

FIGURE 6-13B

JULY 2021



LAKE ACCOTINK DREDGING
ALTERNATIVE ANALYSIS REPORT
FLAG RUN/I-495 TO WAKEFIELD BALL FIELDS
PIPELINE ALIGNMENT

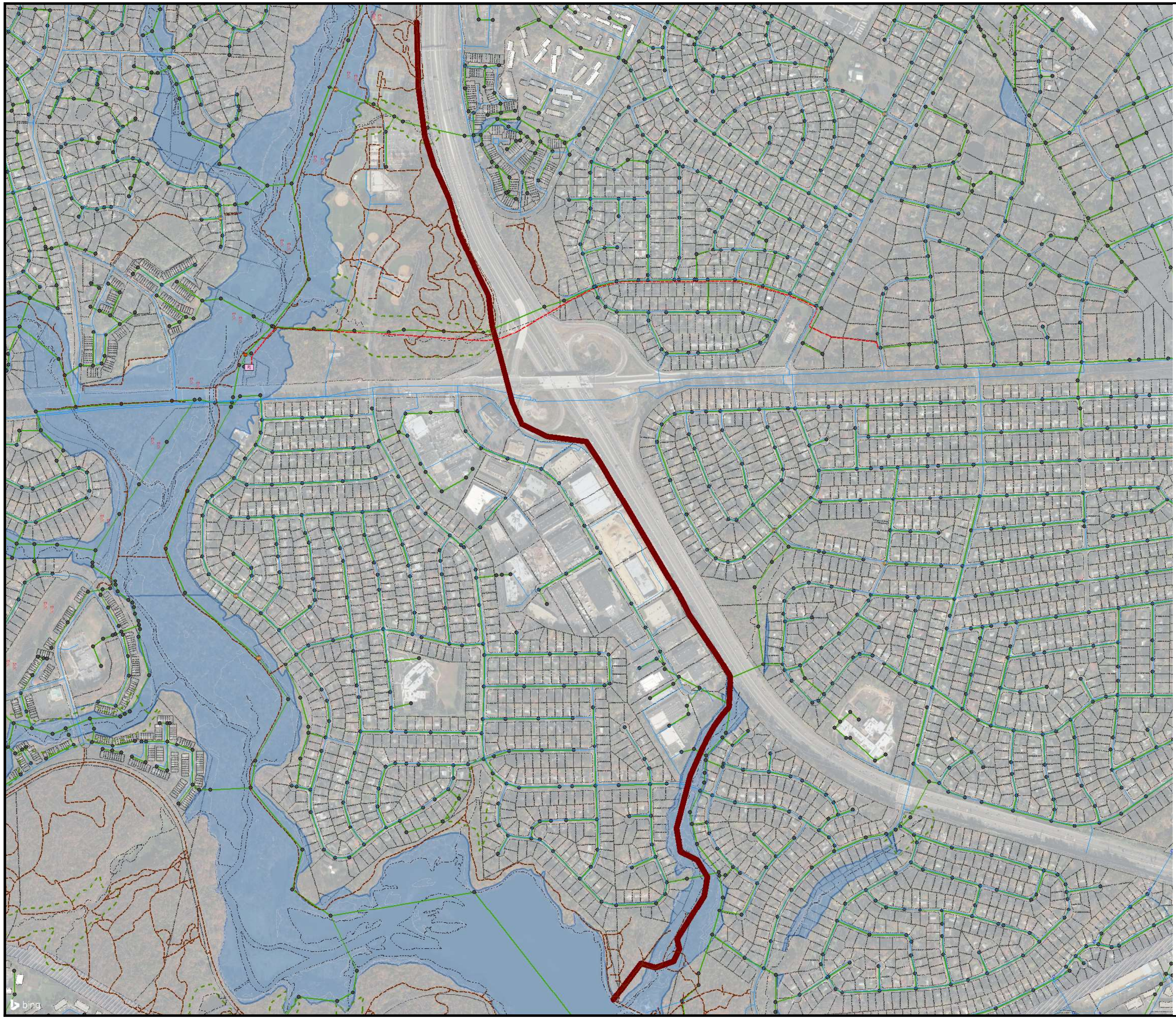
SCALE:1 " = 500 '

ARCADIS

FIGURE

6-13C

JULY 2021



N

LEGEND:

- FCPA TRAIL
- PROPOSED SEDIMENT PIPELINE
- FFX WATERMAINS
- MAJOR SEWER
- ELECTRICAL TRANSMISSION
- MAJOR WATER
- JUNCTION CHAMBER
- SS PUMP STATION
- SS MANHOLES
- FORCE MAIN
- GRAVITY SANITARY SEWER
- CONTOURS
- PERENNIAL STREAM
- RESOURCE PROTECTION AREA (RPA)
- FEMA FLOODPLAIN (FPL)
- Railroad Utility Owned Property
- PARCEL BOUNDARY

0 250 500 1,000
Feet

LAKE ACCOTINK DREDGING
ALTERNATIVE ANALYSIS REPORT
FLAG RUN/I-495 TO DOMINION
ROW PIPELINE ALIGNMENT

SCALE: 1 " = 500 '

ARCADIS

FIGURE

6-13D

JULY 2021

LEGEND:

- FFX WATERMAINS
- FCPA TRAIL
- PROPOSED SEDIMENT PIPELINE
- MAJOR SEWER
- ELECTRICAL TRANSMISSION
- SS MANHOLES
- GRAVITY SANITARY SEWER
- CONTOURS
- PERENNIAL STREAM
- RESOURCE PROTECTION AREA (RPA)
- FEMA FLOODPLAIN (FPL)
- Railroad Utility Owned Property
- PARCEL BOUNDARY

N

0 150 300 600
Feet

LAKE ACCOTINK DREDGING
ALTERNATIVE ANALYSIS REPORT
LAKE ACCOTINK UPPER SETTLING BASIN
PIPELINE ALIGNMENT

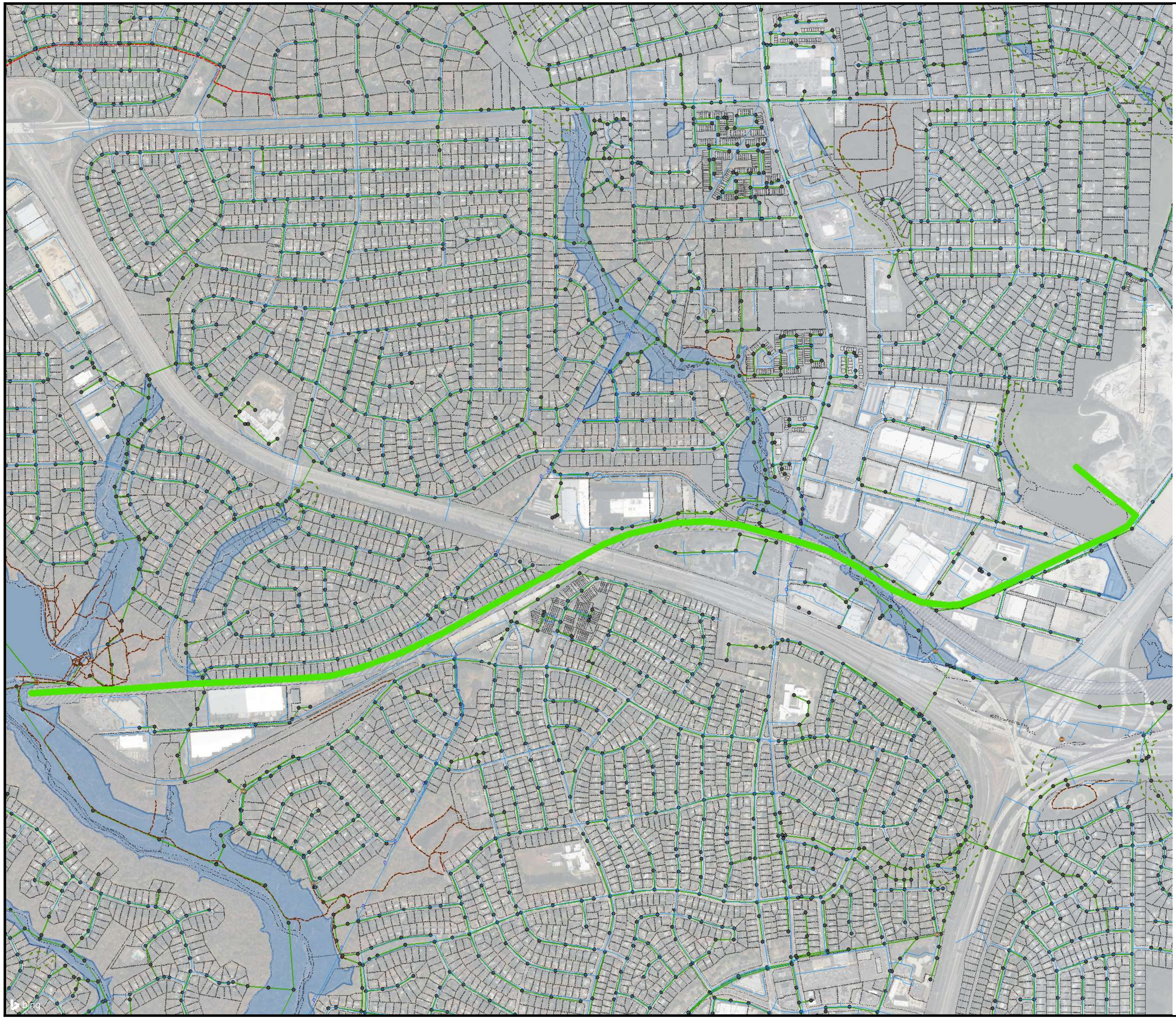
SCALE:1 " = 300 '

ARCADIS

FIGURE

6-14

JULY 2021



N

LEGEND:

- PROPOSED SEDIMENT PIPELINE
- FFX WATERMAINS
- FCPA TRAIL
- COMMUNICATION
- MAJOR SEWER
- ELECTRICAL TRANSMISSION
- MAJOR WATER
- SS PUMP STATION
- SS MANHOLES
- FORCE MAIN
- GRAVITY SANITARY SEWER
- CONTOURS
- PERENNIAL STREAM
- RESOURCE PROTECTION AREA (RPA)
- FEMA FLOODPLAIN (FPL)
- Railroad Utility Owned Property
- PARCEL BOUNDARY

0 300 600 1,200 Feet

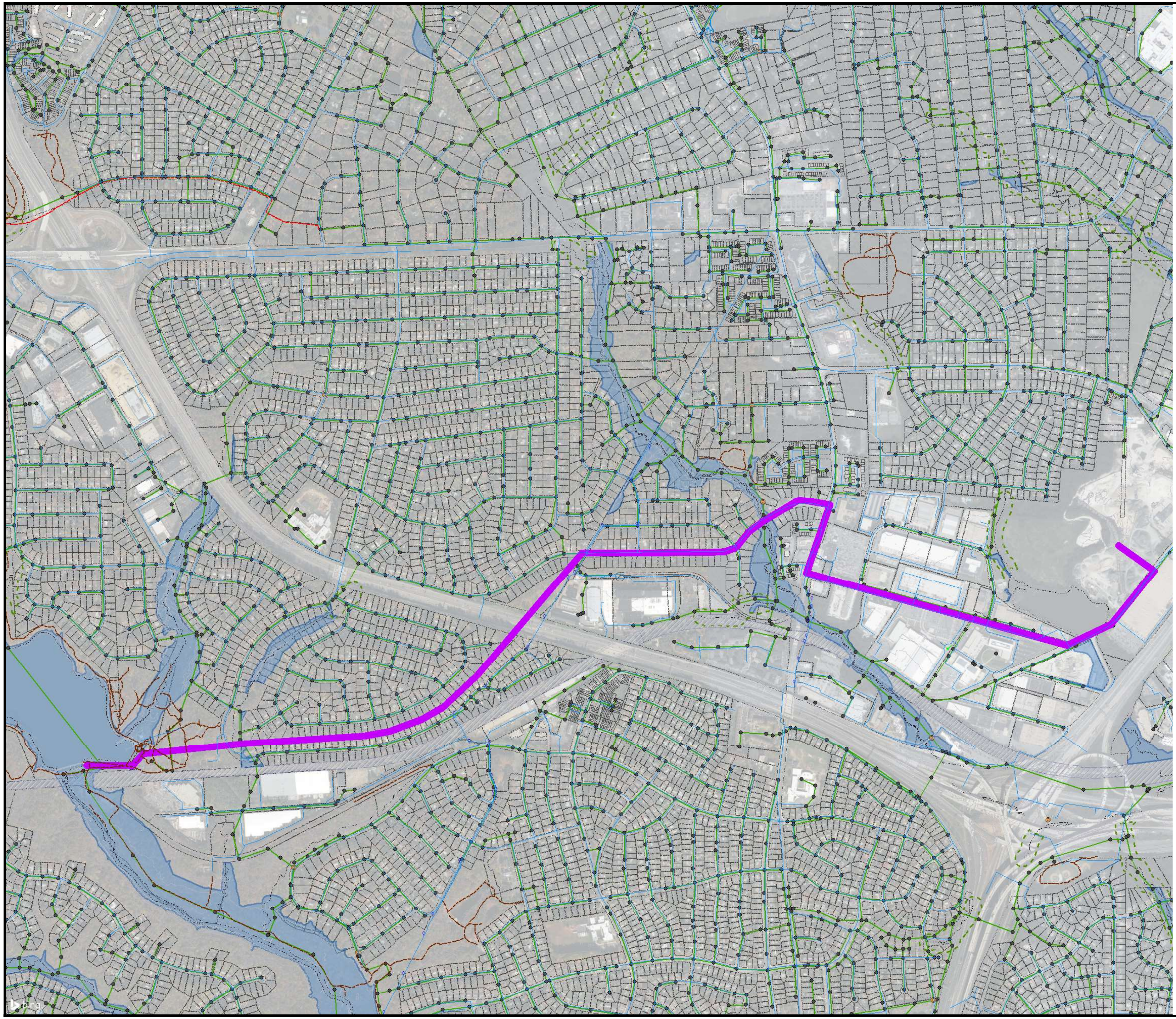
LAKE ACCOTINK DREDGING
ALTERNATIVE ANALYSIS REPORT
AMTRAK ROW TO CONCRETE PLANT
PIPELINE ALIGNMENT

SCALE: 1 " = 600 '

ARCADIS

FIGURE 6-15

JULY 2021



LEGEND:

- FFX WATERMAINS
- FCPA TRAIL
- PROPOSED SEDIMENT PIPELINE
- Communication
- MAJOR SEWER
- ELECTRICAL TRANSMISSION
- MAJOR WATER
- SS MANHOLES
- FORCE MAIN
- GRAVITY SANITARY SEWER
- CONTOURS
- PERENNIAL STREAM
- RESOURCE PROTECTION AREA (RPA)
- FEMA FLOODPLAIN (FPL)
- Railroad Utility Owned Property
- PARCEL BOUNDARY

N

0 325 650 1,300 Feet

LAKE ACCOTINK DREDGING ALTERNATIVE ANALYSIS REPORT
RESIDENTIAL ROUTE TO CONCRETE PLANT PIPELINE ALIGNMENT

SCALE: 1 " = 650 '

ARCADIS

FIGURE 6-16

JULY 2021

Appendix A

Sedimentation Evaluation

Technical Memorandum

SUBJECT
Lake Accotink Dredging Project - Sedimentation Evaluation

DATE
July 9, 2021

NAME
Shannon Dunn
Shannon.Dunn@arcadis.com

Introduction

Lake Accotink was created after a dam was constructed first in 1918 and then rebuilt in 1943 to provide a source of drinking water for Camp Henderson (now Fort Belvoir). The lake functions as a regional stormwater best management practice (BMP) for the Accotink Creek Watershed (HDR 2002). Suspended sediment in Accotink Creek surface water deposits in Lake Accotink as the water slows down entering the lake (HDR 2002). The lake fills in with sediment, reducing water depth, and requiring periodic dredging of the lake to restore water depth for recreational and habitat use and for stormwater BMP sediment trapping function.

As part of the Lake Accotink Dredging Project, a sedimentation evaluation of Lake Accotink was performed to evaluate the sedimentation rate monitoring method, frequency of monitoring, and frequency of future dredging events. Estimated sedimentation rates were reviewed and updated to evaluate the rate at which the lake was filling in. A monitoring approach was developed to include data collection, data analysis and data quality objectives (DQOs) for sedimentation monitoring were developed. The DQOs include the frequency of monitoring lake infilling, the monitoring method, and the data analysis. DQOs are presented in Table A-1.

Sedimentation Rate Estimates

Multiple sedimentation rates for Lake Accotink have been estimated since the 1980s. This section compiles the previous sedimentation rates and presents new estimates based on recent data.

Previous Estimates

Previous sedimentation rate estimates are presented in Table A-2 (F.X. Browne 1988; HDR 2002; Virginia Department of Environmental Quality 2017; Wetland Studies and Solutions, Inc [WSSI] 2017a, 2017b). There are two general estimation methods that were used to calculate sedimentation rates for Lake Accotink. One method is to use Brune's curve (Brune 1953) to estimate the lake trapping efficiency. The Brune method uses annual stormwater runoff inflow to the lake and lake capacity. The inflow input includes gauging station data on surface water elevations, surface water discharge rate, and suspended sediment concentrations. The other method used to calculate sedimentation rates is to compare bathymetry for the lake from multiple years and the lake surface water elevation. The estimated sedimentation rates ranged from 8,000 to 22,750 cubic yards per year.

Current Estimates

The new sedimentation rate for the dredging project was estimated by comparing 2015 and 2020 bathymetry for Lake Accotink. The normal pool elevation of 186.9 feet National Geodetic Vertical Datum of 1929 (NGVD29) was used for the estimate. The difference in lake water storage volume was estimated using the bathymetry and the pool elevation. The 2020 lake water volume was subtracted from the 2015 lake water volume to estimate the amount of accumulated sediment. The volume was converted to mass using an assumed bulk density of 63 pounds per cubic foot (Arcadis 2021). The sediment accumulation was divided by the elapsed time between bathymetric surveys (approximately 5 years) to estimate the mass per year accumulation.

The estimated sedimentation rate is presented in Table A-2 and is 8,000 tons/year or 9,400 cy/year. This is lower than previous estimates (see Section 2.1 and Table A-2). The reason for the difference in sedimentation rate estimates may be because the sediment trapping capacity decreases as the lake water volume decreases. As described above, as Accotink Creek water enters Lake Accotink, the water slows down because of the greater water depth and volume in the lake compared to the creek. The decreased energy of the water and increased residence time of the water in the lake results in sediment deposition. As the lake fills with sediment, the water depth and volume in the lake decreases. This reduces the sediment trap efficiency of the lake. Although the trapping efficiency decreases as the lake volume decreases, the sedimentation rate in the lake appears to be relatively constant (Figure A-1). The exception would be once the lake is nearly filled with sediment, the sedimentation rate must decrease. The lake is currently nearly filled with sediment. Water depths are very shallow. This may explain why the new sedimentation rate estimate is lower than previous estimates.

Bathymetry in the lake indicates that after dredging events, sediment deposits in the western part of the lake where Accotink Creek enters the lake. The sediment surface elevation is highest on the north and south side of the island. Sediment surface elevation decreases moving east from the island. The deepest water depths in the lake are on the east side of the lake. As the western part of the lake fills in, sedimentation shifts to the east in the lake.

Lake Volume Estimates

Lake Accotink water volume has been estimated by HDR (2002) and WSSI (2017a). Lake water volume over time is shown on Figure A-1. Lake water volume increases after dredging events but has not returned to earlier volume. For example, the lake volume increased after the 1984 to 1985 dredging event but remained less than the 1960s volume when the previous dredging occurred. The reason for the difference may be because the lake was maintained at a different water elevation in the 1960s. Similarly, the lake volume increased after the 2002 dredging event but remained less than the 1985 volume when the previous dredging occurred. The reason for the difference is some of the 2002 dredge material was used to expand the island in the lake, which reduced the water volume of the lake.

Lake Accotink sediment trap efficiency has been estimated by HDR (2002) and WSSI (2017a) using Brune's curve, which estimates trapping efficiency based on a comparison of lake volume to incoming sediment flow. Trap efficiency is shown on Figure A-2. Generally, dredging increases the trap efficiency of the lake by increasing the lake volume. After the 1985 and 2008 dredging events, the lake sediment trap efficiency was about 75 percent and 60 percent, respectively, compared to the average of 47%. The trap efficiency decreases as the lake accumulates sediment, as described below.

Sedimentation Monitoring

Lake Accotink will be periodically monitored to evaluate the rate at which sediment is accumulating in the lake. The Fairfax County Park Authority (FCPA) and Fairfax County Department of Public Works and Environmental Services (DPWES) will use this information to evaluate when the next dredging event will be. This section describes the sedimentation monitoring approach.

Data Quality Objectives

The DQOs for sedimentation monitoring are presented in Table A-1. The DQOs were developed using United States Environmental Protection Agency (USEPA) guidance (2006). The DQO process is a systematic approach to describe what the data gap is, what information is needed to fill that data gap, what the study boundaries are, what the analytic approach is, what precision and accuracy are needed for the data, how the data will be collected, and how the data will be used. The DQO process provides all the information needed to prepare the monitoring plan and set expectations with stakeholders on the investigation.

Frequency of Monitoring

Sedimentation monitoring frequency is proposed for every two years. Approximately 2 inches per year of sedimentation is estimated using the area of the lake (about 55 acres) and the average sedimentation rate (about 18,000 cubic yards per year). That is, on average there would be a 2-inch difference in sediment surface elevation each year. In comparing bathymetry surveys from multiple surveys, there has to be about a 6-inch difference in sediment elevation to be confident there is a real difference in the surveys because of the horizontal and vertical accuracy and precision of the surveys (Herzog and Bradshaw 2005). Their work is from 16 years ago. With improvement in technology, that 6-inch limit has probably decreased an inch or two. It is assumed with recent survey technology the limit is now 4 inches. At Lake Accotink, in two years there is an estimated 4-inch change in sediment surface elevation. Therefore, performing bathymetry surveys every other year should be sufficient to detect a measurable change in sediment elevation. Performing a survey more frequently than that would leave too much uncertainty about whether there is an elevation difference or the observed difference is just noise in the accuracy of the survey. Doing a survey less frequently than that may not provide sufficient information to budget for a dredging event every 3 to 5 years. The biennial frequency also provides periodic data for FCPA and DPWES planning purposes on dredging frequency.

Monitoring Method

The sedimentation monitoring method will be a combination of collecting data in the lake and downloading data from publicly available sources. A bathymetry survey will be performed in the lake to measure sediment surface elevation. Lake water elevation data will be obtained from the Lake Accotink dam operator. Discharge rate and sediment load data will be downloaded from United States Geological Survey gauges.

Data Analysis

Lake Accotink average water depth and volume will be estimated by evaluating the lake water elevation and the sediment surface elevation (from the bathymetry survey). The water depth will be compared to the minimum required water depth for recreational boating. If the water depth is less than the minimum required depth for boating, it indicates the need for dredging to restore water depth.

The sediment trap efficiency will be estimated by the Brune method as applied to Lake Accotink (HDR 2002; WSSI 2017a). If the lake is going to be used to obtain pollutant reduction credits for compliance with the County's Municipal Separate Storm Sewer System (MS4) Permit Chesapeake Bay Total Maximum Daily Load Special Condition, the lake volumes will be used to evaluate if the lake is meeting the retrofit requirements. Sediment trap efficiency will also provide valuable information to support estimates of the efficiency of the lake to trap sediments and reduce nutrient loads. As data are collected, trap efficiency and rate of volume change can also be used as indicators for the need for dredging.

The volume of accumulated sediment will be estimated by two methods. One method will be by comparing post dredging bathymetry to the sedimentation monitoring bathymetry survey. The other method will be by comparing the lake water depth to target lake water depth, which may be impacted by other factors besides sedimentation (e.g., a wet or dry year, changes in dam operation, etc). The difference between these two values is the amount of accumulated sediment. The volume of accumulated sediment and whether Lake Accotink conditions meet recreational boating and stormwater BMP objectives will be used in a cost benefit analysis of whether to dredge the lake or to allow more sediment to accumulate prior to dredging.

Frequency of Subsequent Dredging Events

The frequency of future maintenance dredging events will be based on a cost benefit analysis of the cost of dredging the volume of sediment in the lake at the time of evaluation and the benefit of restoring lake water volume. A main component of the cost of dredging is the volume of sediment that would be dredged. The cost for dredging will be estimated based on the volume of sediment that has accumulated in the lake since the previous dredging. The benefits of dredging include maintaining optimal water depth for recreational boating and for stormwater BMPs. The costs and benefits of dredging will be evaluated by FCPA and DPWES to determine the next dredging event.

Conclusions

Sedimentation monitoring, including bathymetry survey and review of publicly available data, will be performed every other year. Water depth for recreational boating, lake volume, and the efficiency of the lake as a stormwater BMP will be evaluated based on the monitoring data. The frequency of subsequent dredging events will be based on a cost benefit analysis of the cost of dredging the volume of sediment in the lake at the time of the evaluation and the benefit of restoring lake water volume.

Attachments

Tables

A-1 Data Quality Objectives

A-2 Estimated Sedimentation Rate Per Year

Figures

A-1 Lake Volume over Time

A-2 Trapping Efficiency Over Time

References

Arcadis. 2021. Field Assessment Report (Final) Lake Accotink Dredging Project. June 18.

Brune, Gunnar M. 1953. Trap Efficiency of Reservoirs. Transactions American Geophysical Union. Volume 34, Number 3. June.

F.X. Browne. 1988. Lake Accotink Phase II Restoration Project Final Report. June.

HDR. 2002. Lake Accotink Sediment Management Program Study. January.

Herzog, J. and A. S. Bradshaw. 2005. A Method for Comparing Bathymetric Survey Data to Determine Changes in Sediment Elevation. The Hydrographic Journal. No. 118. October.

USEPA. 2006. Guidance on Systematic Planning Using the Data Quality Objectives Process. EPA QA/G-4. EPA/240/B-06/001. February.

Virginia Department of Environmental Quality. 2017. Volume II, Sediment TMDLs for the Accotink Creek Watershed, Fairfax County, Virginia. August 30.

WSSI. 2017a. Lake Accotink Sustainability Plan Fairfax County, Virginia. May 31.

WSSI. 2017b. Draft Lake Accotink Master Plan, Fairfax County, Virginia. November 17.

Tables

Table A-1. Data Quality Objectives
Appendix A - Sedimentation Evaluation
Alternatives Analysis Report
Lake Accotink Dredging Project
Fairfax County, Virginia

Data Quality Objective	Step 1. State the Problem	Step 2. Identify the Goal of the Study	Step 3. Identify the Information Inputs	Step 4. Define the Boundaries of the Study		Step 5. Develop the Analytical Approach
DQO Number	**Description of Issue**	***Study Questions***	***Inputs for Study Questions***	***Spatial***	***Temporal***	***Parameter(s) of Interest***
1	Lake Accotink will accumulate sediment after dredging. Future dredging would be needed to maintain the water depth for recreational use . The rate at which sediment will accumulate and thus when the future dredging event would be needed is unknown.	What is the average lake water depth?	Lake bathymetry and lake surface water elevation.	The lake areal boundary from Lake Accotink Creek confluence with Lake Accotink to Lake Accotink dam.	Every two years.	Sediment elevation in feet NGVD29 datum and surface water elevation in feet NGVD29 datum.
2	Lake Accotink will accumulate sediment after dredging. Future dredging would be needed to maintain the water depth for recreational use . The rate at which sediment will accumulate and thus when the future dredging event would be needed is unknown.	What is the cost benefit of dredging at the time of evaluation versus dredging in the future?	Lake bathymetry, lake surface water elevation, Accotink Creek discharge, and if available Accotink Creek sediment load.	Lake Accotink watershed.	Every two years.	Sediment elevation in feet NGVD29, surface water elevation in NGVD29 datum, Accotink Creek discharge rate, and Accotink Creek sediment load.
3	Lake Accotink will accumulate sediment after dredging. Future dredging would be needed to maintain sediment trap efficiency for stormwater best management practice (BMP). The rate at which sediment will accumulate and thus when the future dredging event would be needed is unknown.	What is the volume of sediment accumulated in the lake and the lake sediment trap efficiency?	Lake bathymetry, lake surface water elevation, Accotink Creek discharge, and if available Accotink Creek sediment load.	Lake Accotink watershed.	Every two years.	Sediment elevation in feet NGVD29, surface water elevation in feet NGVD29, Accotink Creek discharge rate, and Accotink Creek sediment load.

Data Quality Objective	Step 6. Specify Performance or Acceptance Criteria		Step 7. Develop the Pan for Obtaining Data	
DQO Number	***Hypotheses***	***Acceptable Limits on Decision Errors***	***Sufficiency of Existing Data***	***Study Design Summary***
1	The hypothesized condition is the lake water depth is sufficient to allow recreational boating. The alternative condition is the lake water depth is not sufficient to allow recreational boating.	Bathymetry horizontal accuracy within +/- 0.1 ft and vertical accuracy within +/- 0.1 ft. Water elevation accuracy based on dam operator's gauge's accuracy.	Existing data do not provide information on water depth post dredging.	Perform bathymetry survey of the lake once every two years. Acquire lake water elevation data for the past two years concurrent with the bathymetry survey. Evaluate average lake water depth. Compare lake water depth to minimum required water depth for recreational boating.
2	The hypothesized condition is the cost of performing the dredging at the time of evaluation outweighs the benefit of restoring lake water volume. The alternative condition is the benefit of restoring lake water volume outweighs the cost of dredging.	Bathymetry horizontal accuracy within +/- 0.1 ft and vertical accuracy within +/- 0.1 ft. Water elevation accuracy based on dam operator's gauge's accuracy. Accotink Creek discharge and sediment load accuracy based on USGS accuracy.	Existing data do not provide information on accumulated sediment volume post dredging.	Perform bathymetry survey of the lake once every two years. Acquire lake water elevation data for the past two years concurrent with the bathymetry survey. Download USGS discharge and sediment load from USGS gauges 01654500 and 01654000, for the past two years concurrent with the bathymetry survey. Estimate volume of accumulated sediment in lake. Volume of accumulated sediment used in cost benefit analysis of whether to dredge lake or allow more sediment to accumulate prior to dredging.
3	The hypothesized condition is the volume of sediment accumulated in the lake and the lake sediment trap efficiency meets the BMP requirement. The alternative condition is the volume of sediment accumulated in the lake and the lake sediment trap efficiency do not meet the BMP requirement.	Bathymetry horizontal accuracy within +/- 0.1 ft and vertical accuracy within +/- 0.1 ft. Water elevation accuracy based on dam operator's gauge's accuracy. Accotink Creek discharge and sediment load accuracy based on USGS accuracy.	Existing data do not provide information on sedimentation rate post dredging.	Perform bathymetry survey of the lake once every two years. Acquire lake water elevation data for the past two years concurrent with the bathymetry survey. Download USGS discharge and sediment load from USGS gauges 01654500 and 01654000, for the past two years concurrent with the bathymetry survey. Estimate sediment trap efficiency of the lake. Trap efficiency used to verify BMP efficiency.

Acronyms:
BMP = best management practice
DQO = data quality objective
ft = feet
NGVD29 = National Geodetic Vertical Datum of 1929
USGS = United States Geological Survey

Table A-2. Estimated Sedimentation Rate Per Year
Appendix A - Sedimentation Evaluation
Alternatives Analysis Report
Lake Accotink Dredging Project
Fairfax County, Virginia

ARCADIS

Author	Methodology	Time Frame	Rate Type	Sedimentation Rate[1]		Reference	Notes
				(ton/yr)	(CY/yr)		
F.X. Browne	NA	NA	NA	**9,350**	*15,400*	HDR. 2002.	Unclear on source - Revised based on monitoring data, F.X. Browne utilized 9,350 ton/yr number going forward, potentially looking at suspended solid load only without bed load.
F.X. Browne	Monitoring data for sampling events between 10/1984 and 2/1986 - hydrograph analysis of discharge x TSS conc.	1984 - 1986	Avg	**10,200**	*16,800*	F.X. Browne. 1988.	Total annual sediment load (bed + suspended sediment load) based on collected monitoring data
HDR	Trap efficiency of Lake Accotink (Brune's curve)	1986 - 2000	Min (1995)	**6,800**	*11,200*	HDR. 2002.	Used sediment transport function and data from USGS Gauging Station 01654000. Brune's procedure used to obtain trap efficiency. Evaluated accuracy against HEC-6 model.
			Avg	**10,600**	*17,400*		
			Max (1994)	**13,700**	*22,600*		
HDR	Bathymetric survey comparison, 1985 vs 2001, estimated by determining the difference in storage volumes below the normal pool elevation for each bathymetric survey, divided by the time span.	NA	Avg	*10,200*	**16,733**	HDR. 2002.	Lower 1/4 of the lake was not surveyed in 1985, storage capacity unknown. Elevations between 185 ft and 186.9 ft NGVD29 (normal pool elevation) were extrapolated. Most sedimentation occurs in the upper 3/4 of the lake
VADEQ	STEPL Model - inputs are based on reach length, bank height, lateral erosion rate. Lateral erosion rate based on visual determination. Sediment inflow, would not include reduction based on trapping efficiency of Lake Accotink.	2011	Avg	**7,500**	*12,300*	VADEQ. 2017.	VADEQ modeled sediment inflow only from Upper Accotink and Long Branch Creek, does not include any trapping efficiency. Assumed 47% sediment trapping efficiency for Lake Accotink from HDR 2002 that has been used in subsequent calculations. VADEQ used this trapping efficiency when calculating sediment load to the Lower Accotink watershed.
VADEQ	GWLF Model - Includes sediment inputs based on land use type and available data (e.g. USGS), date range of available data for inputs varies	NA	Avg	**7,000**	*11,500*	VADEQ. 2017.	Same as above.
WSSI	Used HDR methodology to evaluate sediment loads from 2011 to 2015 based on flow data.	2011-2015	Avg	*13,100*	**21,620**	WSSI. 2017a.	Assumed average flow of 46,000 CY sediment/year and a trapping efficiency of 47%, average from 2011 - 2015 data is approximately 21,000 CY.
WSSI	Not specified	Up to 2017	Avg	*13,800*	**22,750**	WSSI. 2017b.	Methodology references HDR study (HDR 2002) and Sustainability Plan (WSSI 2017a). Confirmed used procedure described in HDR (2002).
Arcadis	Bathymetric survey comparison, 2015 vs. 2020, estimated by determining the difference in storage volumes below the normal pool elevation for each bathymetric survey, divided by the time span.	2015 to 2020	Avg	*8,000*	**9,400**	--	Similar methodology from HDR, using difference in 2015 bathymetry and bathymetry collected as part of the Field Assessment. Likely underestimates sedimentation load at mudflat areas where elevation is above normal pool.

Notes:
1. Sedimentation rates in **BOLD** indicates sedimentation value in units provided by source. Sedimentation rates in italics indicate a calculated value. For values calculated for F.X. Browne, HDR, VADEQ, and WSSI, a submerged sediment bulk density of 45 pounds per cubic foot was assumed, consistent with calculations provided within these reports (HDR 2002). For the Arcadis estimate, the submerged bulk density was assumed to be 63 pounds per cubic foot was assumed, based on data collected during the field assessment (Arcadis 2021).

References:

F.X. Browne. 1988. Lake Accotink Phase II Restoration Project Final Report. June.
HDR. 2002. Lake Accotink Sediment Management Program Study. January.
Virginia Department of Environmental Quality (VADEQ). 2017. Volume II, Sediment TMDLs for the Accotink Creek Watershed, Fairfax County, Virginia. August 30.
WSSI. 2017a. Lake Accotink Sustainability Plan Fairfax County, Virginia. May 31.
WSSI. 2017b. Draft Lake Accotink Master Plan, Fairfax County, Virginia. November 17.

Note: Normal pool elevation is equal to 186.9 feet NGVD29.

Supporting Data sets - Utilized for HDR calculation methodologies

Author	Reference	Notes
USGS	USGS Floodplain Delineation of 1977	Evaluated bathymetry, topography, and aerial photographs for conditions in the 1960s to evaluate stream areas that have experienced significant change - erosion, widening, etc.
USGS	USGS Stream Gauging - Station 01654000	Physical data available for gauging station available online, correlating with TSS data available from STORET. TSS data does not appear available for Station 016545000, but discharge/turbidity/etc. available. Links below.
FCPA	Stream Assessment Survey	Channel data used for hydrologic modelling.

Abbreviations
Avg = average
CY = cubic yard
ft = feet
Max = maximum
Min = minimum
NA = not available
TSS = total suspended solids
VADEQ = Virginia Department of Environmental Quality
yr = year

Figures

Figure A-1. Lake Volume Over Time
Appendix A - Sedimentation Evaluation
Alternatives Analysis Report
Lake Accotink Dredging Project
Fairfax County, Virginia

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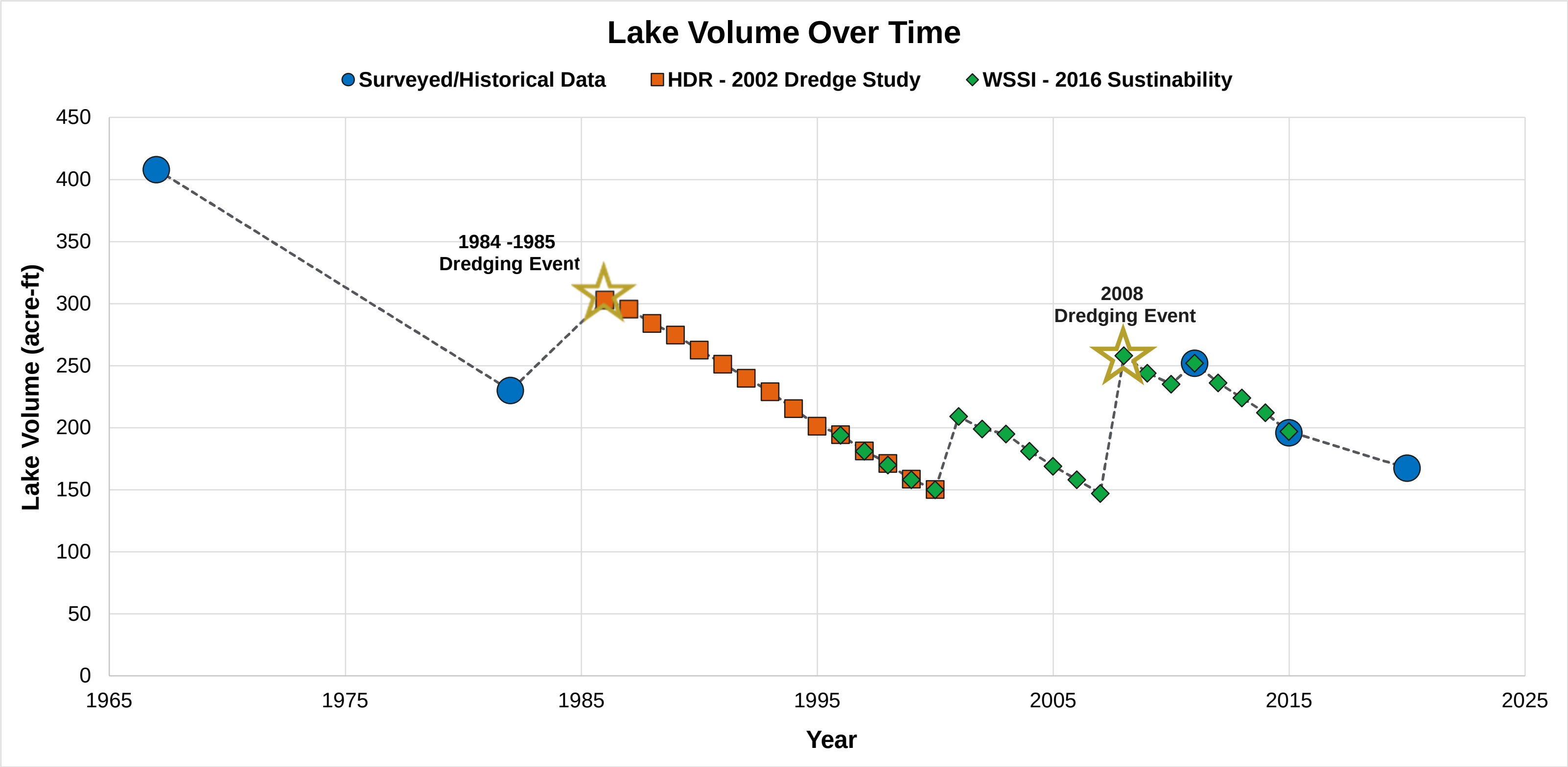


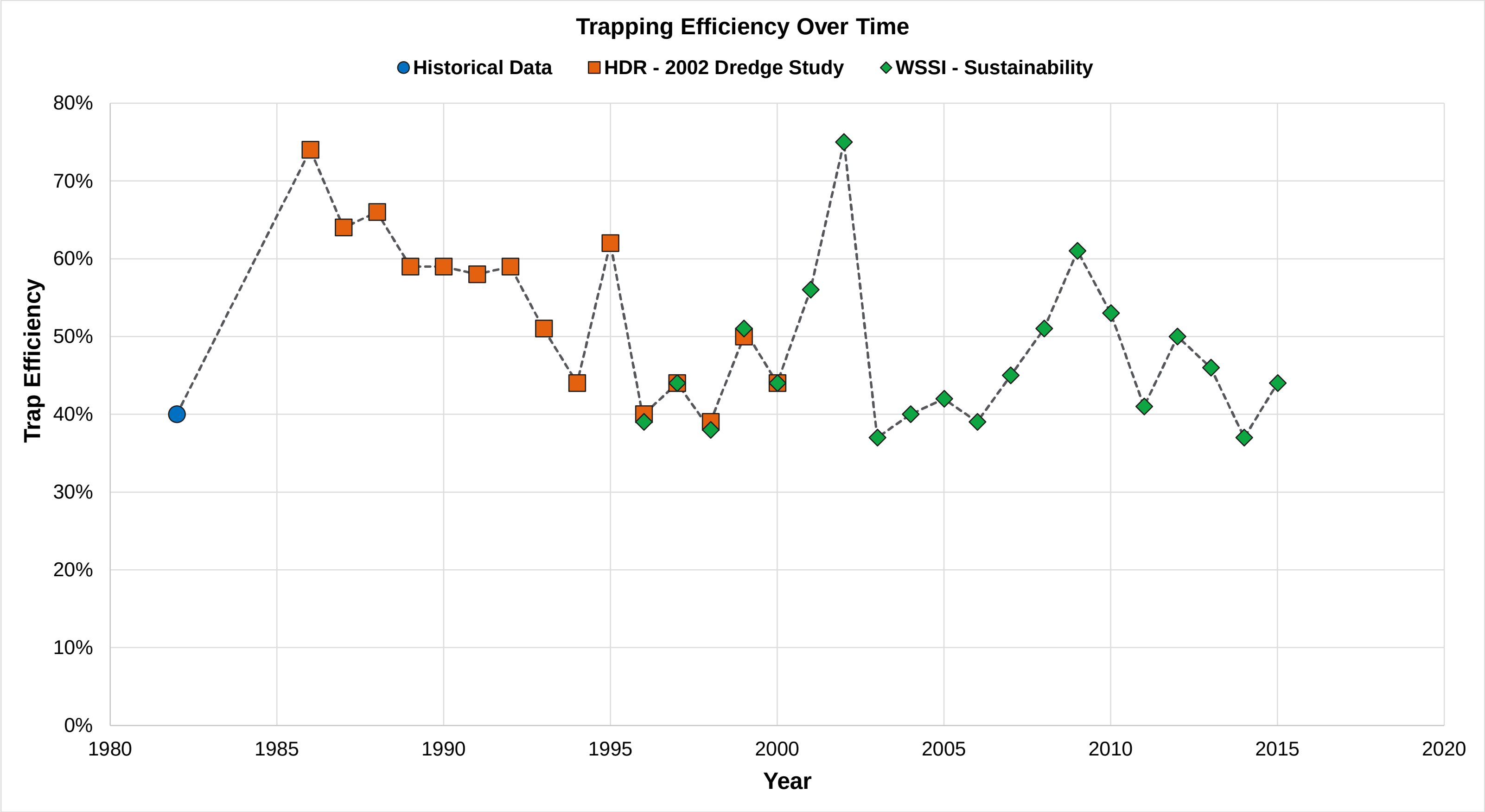
Notes:

1. Lake volumes based on historical data or recent bathymetric surveys are shown in blue. Historical lake volumes from 1967 and 1982 are taken from *Lake Accotink Sustainability Plan* (WSSI 2017) and are assumed to be based on bathymetry. The 2011, 2015, and 2020 lake volumes are based on bathymetric survey data collected in those years.

2. HDR volumes were calculated and presented in the sedimentation evaluation presented in the *Lake Accotink Dredge Study* (HDR 2002).

3. WSSI volumes taken from Lake Accotink Sustainability Plan (WSSI 2017) were calculated following the methodology developed in HDR 2002. Calculations were updated to use the surveyed volume of the lake from 2011 when estimating lake volume for 2012 through 2015.

ARCADIS



Notes:

1. All trapping efficiency values are estimated based on the ratio of lake volume to sediment inflow.

2. HDR trapping efficiencies were calculated and presented in the sedimentation evaluation presented in the *Lake Accotink Dredge Study* (HDR 2002).

3. WSSI trapping efficiencies taken from Lake Accotink Sustainability Plan (WSSI 2017) were calculated following the methodology developed in HDR 2002. Calculations were updated to use the surveyed volume of the lake from 2011 when estimating trapping efficiency for 2012 through 2015.

Appendix B

Dewatering Method Area Calculation

Calculation Sheet

Client: Fairfax County, Virginia **Project: 30037594**
Prepared By: Jeff Pryor **Date: 06/28/2021**
Checked By: Lauren Quig **Date: 06/30/2021**
Amanda Kohler **Date: 7/7/2021**

Subject:

Basis of design to determine the size of the dewatering area and the required capacity of the onsite temporary water treatment system that will be required during the dredging activities at Lake Accotink (Site) based on dewatering method.

Note, details for each dewatering method, including process description and flowchart, benefits and drawbacks of each option, and costs are not presented in this calculation sheet. Reference the *Alternatives Analysis Report* text, associated attachments, and appendices for these details.

Objectives:

- Estimate the area required for sufficient dewatering of dredged sediment and estimate process flows for the following proposed methods:
  - Passive dewatering using geotextile tubes;
  - Passive dewatering using geotextile tubes, including desanding;
  - Mechanical dewatering using belt presses; and
  - Gravity dewatering with drying agent.
- Evaluate the impact of dredge rate and slurry percent solids on dewatering area size.

Assumptions:

A discussion of calculation input rationale for each of the analyses is provided below. The following assumptions apply to all calculations:

- Dewatering methodologies and processes are preliminary and presented to evaluate the identified potential dewatering areas for space constraints during construction. Actual dewatering method, equipment, and operations will be determined by the selected dewatering contractor in consultation with Fairfax County and Arcadis.
- Calculations are for dewatering areas, temporary water treatment plant, and estimated support areas only. Areas required for hydraulic pipeline, upland dredging laydown areas, and associated support facilities are not included in this calculation.
- For all analyses, the total dredge volume was assumed to be 500,000 cubic yards. The total dredge volume was based on existing bathymetry for the Site, the project goal of achieving an average water depth of eight feet, and the anticipated rate of continued sedimentation during the dredging project.
- Minimum dredging rate assumes 24 months of dredging operations and average 22 days per month.

- Operations are assumed to be 12 hours per day, five days a week. Due to proximity to residential areas and recreational use of the park area, it is assumed no operations would be completed on weekends or holidays and operations could not be run 24 hours per day.
- Geotextile tube and mechanical dewatering options assume use of hydraulic dredging and slurry transport to the dewatering area. Gravity dewatering with a drying agent assumes use of mechanical dredging and transport by barge to the dewatering area.
- Specific gravity, grain size distribution, and in-situ water content were based on the average of sediment core data collected and submitted for analysis during the Field Assessment (Arcadis 2021).
  - Specific gravity = 2.57
  - In-situ water content = 0.6 grams (g) water/ g solids
  - Percent fine material = 78%, percent coarse material = 22%; note percent fines classified as percent of material passing number 200 (75 micrometer [µm]) sieve.
- Density of water was assumed to be 62.4 pounds per cubic foot (lb/cf).
- Equipment sizing and other operational parameters (e.g., maximum throughput) were based on data from projects operating similar dewatering operations or from discussions with vendors. Source of input parameters is provided in the notes of each table.
- All dewatering operations assume that process waters are treated on-site at a temporary water treatment plant, consisting of equalization tanks and sand filters, prior to discharge.
  - It is assumed that site water does not require treatment for any potential chemical contaminants but does require some treatment to meet suspended solid criteria for the Accotink Creek watershed only.
  - Detailed calculations for access, piping, and support areas for the water treatment plant were not performed at this time. These areas were estimated by applying a scaling factor of 500% to the area of the water treatment tanks and filtration units.

Passive Dewatering using Geotextile Tubes

Area calculations for passive dewatering using geotextile tubes are presented in Table B-1. Additional assumptions for this calculation include:

- Preliminary evaluations for dewatering area size indicated that none of the potential dewatering areas could accommodate the full dredge volume in geotextile tubes.
  - Based on these calculations and the available dewatering areas, it was assumed that passive dewatering areas would include three cells, one cell actively with geotextile tubes actively being filled, one cell dewatering, and the final cell dewatering.
  - Each dewatering cell was sized to hold half a month of dredge production, assumed to be on average 11 working days over the course of construction.
  - Because of the three-cell approach, it was assumed that no additional material stockpile area would be required.
- Percent solids after dredging was set at 50% based on an evaluation of the average final percent solids achieved during the laboratory scale dewatering treatability tests completed with geotextile tubes during the field assessment (Arcadis 2021).

  - Final dewatered percent solids average 43% for treatability tests on sediment considered to be representative of the typical grain size encountered during the field assessment.
  - Treatability tests were limited in duration during the field assessment. The final value of 50% solids considers the increased dewatering time anticipated during construction and previous project experience.
- Parameters for geotextile tube sizing are based on analysis provided by TenCate, a geotextile tube manufacturer, using their proprietary sizing software. Calculations for TenCate are included as Attachment 1.
  - Geotextile tube dimensions were set as a representative size based on discussions with TenCate. Note, these dimensions can be optimized and customized as needed based on the final dewatering area selected.
  - Calculated areas assume geotextile tubes can be stacked in three layers to minimize overall dewatering area footprint.
- A polymer support area was included for the mechanical dewatering option, scaled from a previous project at 70% based on the difference in overall system throughput.

Passive Dewatering using Geotextile Tubes, including Desanding

Area calculations for passive dewatering using geotextile tubes including desanding are presented in Table B-2. Additional assumptions for this calculation include:

- A hydrocylone would be used to remove sands greater than 75 µm. Removal efficiency for the hydrocyclone was set at 80% based on prior project experience.
- Preliminary evaluations for dewatering area size indicated that none of the potential dewatering areas could accommodate the full dredge volume in geotextile tubes.
  - Based on these calculations and the available dewatering areas, it was assumed that passive dewatering areas would include three cells, one cell actively with geotextile tubes actively being filled, one cell dewatering, and the final cell dewatering.
  - Each dewatering cell was sized to hold one month of dredge production, assumed to be on average 22 working days over the course of construction. Note this increase in dewatering time was assumed based on removal of the sand fraction from the sediment slurry.
  - Because of the three-cell approach, it was assumed that no additional material stockpile area would be required.
- Percent solids after dredging was set at 50% based on an evaluation of the average final percent solids achieved during the laboratory scale dewatering treatability tests completed with geotextile tubes during the field assessment (Arcadis 2021).
  - Final dewatered percent solids average 43% for treatability tests on sediment considered to be representative of the typical grain size encountered during the field assessment.
  - Treatability tests were limited in duration during the field assessment. The final value of 50% solids considers the increased dewatering time anticipated during construction and previous project experience.
- Parameters for geotextile tube sizing are based on analysis provided by TenCate, a geotextile tube

manufacturer, using their proprietary sizing software. Calculations for TenCate are included as Attachment 1.

- Geotextile tube dimensions were set as a representative size based on discussions with TenCate. Note, these dimensions can be optimized and customized as needed based on the final dewatering area selected.
- Calculated areas assume geotextile tubes can be stacked in three layers to minimize overall dewatering area footprint.

- A polymer support area was included for the mechanical dewatering option, scaled from a previous project at 70% based on the difference in overall system throughput.

Mechanical Dewatering using Belt Presses

Area calculations for mechanical dewatering using belt presses are presented in Table B-3. Additional assumptions for this calculation include:

- Both the slurry inlet holding tanks and belt press feed tanks were assumed to have a hydraulic residence time of three hours to give capacity to hold slurry so dredge operations can continue in scenarios where dewatering operations are offline.
- A hydrocylone would be used to remove sands greater than 75 µm. Removal efficiency for the hydrocyclone was set at 80% based on prior project.
- Gravity thickeners are assumed to have a removal efficiency of 99.5% based on previous project experience. The hydraulic loading rate (500 gallons per square foot per day) was based on the midpoint of the recommended range for primary sludge (Metcalf and Eddy 2003), and the solids loading rate is based on previous project experience.
- Cake produced from presses is assumed to achieve 50% solids. The solids capacity of the presses assumes 80 cubic yards of material processed per cycle, with two cycles possible per hour based on discussions with vendors.
- A stockpile area was included for the mechanical dewatering option, assuming that up to two days of production would need to be held on site. The stockpile assumes conical piles with a 35-degree angle of repose and a maximum height of 10 feet.
- A polymer support area was included for the mechanical dewatering option, scaled from a previous project at 70% based on the difference in overall system throughput.
- Significant process and wash water would be required for mechanical dewatering. Detailed mass balances for these processes were not calculated at this time. To compensate, overall water coming into the system was increased by 10% to capture wash and process water needs. A 25,000-gallon plant water tank was also included in the overall area calculation.

Gravity Dewatering with Drying Agent

Area calculations for gravity dewatering using a drying agent are presented in Table B-4. Additional assumptions for this calculation include:

- The bucket fill is assumed to be 60% based on previous mechanical dredging projects.
- Similar to passive dewatering, this option assumes that dewatering will occur in three stages, material placement, material dewatering, and material offloading. For sizing, each one of these stages is assumed to last one day.
- The dewatering pad size assumes material will be stacked to a height of 1.5 feet and includes a 25% increase in size as a safety factor.

Sensitivity Analysis and Results:

To determine the sensitivity of the mass balance model, the percent solid content of the material and the dredge production rate were varied across a range of values that might be expected during the construction activities.

- Dredge production rate was varied at a high and low value for all potential dewatering methods based on experience on previous dredging projects, with the low value equal to 950 cubic yards per day and the high value set at 1,250 cubic yards per day.
- For hydraulic dredging options, the percent solid in the dredge slurry was also varied at a high and a low value based on experience on previous dredging projects. The low value was selected at 7% solids by weight and the high value was selected at 15% solids. This is also consistent with slurry percentages evaluated during the treatability testing conducted as part of the field assessment (Arcadis 2021).

Results of the sensitivity analysis are presented below in Table B-5.

Table B-5 – Results of Area Calculation and Sensitivity Analysis

	Dewatering Area Size in Acres			
Run No.	**1**	**2**	**3**	**4**
Dredge Rate (cy/d)	**950**	**950**	**1250**	**1250**
Slurry Percent Solids[1]	**7%**	**15%**	**7%**	**15%**
Dewatering Method				
Passive dewatering using geotextile tubes	4.1	3.5	4.9	4.2
Passive dewatering using geotextile tubes, including desanding	5.8	5.2	7.4	6.5
Mechanical dewatering using belt presses	4.6	3.2	5.8	4.0
Gravity dewatering with drying agent[1]	1.7	--	2.2	--

[1]Slurry percent solids does not apply to gravity dewatering option; cy/d = cubic yards per day; No. = number

References:

Arcadis. 2021. Field Assessment Report, Lake Accotink Dredging Project, Fairfax County Virginia. June 18.

Metcalf and Eddy. *Wastewater Engineering Treatment Disposal Reuse.* 2003.

Attached Tables:

B-1 Passive Dewatering using Geotextile Tubes Area Calculation
B-2 Passive Dewatering using Geotextile Tubes, including Desanding, Area Calculation
B-3 Mechanical Dewatering using Belt Presses Area Calculation
B-4 Gravity Dewatering with Drying Agent Area Calculation

Attachments:

1 Supplemental TenCate Information

Tables

Color Key:

(light yellow)	Input Value
(light blue)	Varying Input per Run
(light green)	Dewatering Area
(green)	Final Value

Acronyms and Abbreviations:

cf = cubic feet
cy = cubic yard
cy/day = cubic yard per day
cy/hr = cubic yard per hour
ft = feet
ft/day = feet per day
gal = gallon
gal/day = gallon per day
gpm = gallon per minute
hr = hour
HRT = hydraulic residence time
lb = pound
lb/cf = pound per cubic foot
mg/L = milligram per liter
sf = square feet
sf/day = square foot/day
sf/tank = square foot/tank
sf/unit = square foot/unit
SWD = side water depth
sy = square yard
sy/day = square yard/day
ton/cy = tons/cubic yard
No. = number
TSS = total suspended solid
Vt = total volume
Ws = weight of solids
Wt = total weight
Ww = weight of water

Table B-1. Passive Dewatering using Geotextile Tubes Area Calculation
Appendix B - Dewatering Area Sizing
Alternatives Analysis Report
Lake Accotink Dredging Project
Fairfax County, Virginia

	Run	1	2	3	4	Comments	Equation
	Dredge Rate (cy/day)	950	950	1250	1250		
	Slurry %	0.07	0.15	0.07	0.15		
Parameter	**Unit**	**Value**	**Value**	**Value**	**Value**		
SG, solids		2.57	2.57	2.57	2.57	Average specific gravity of sediment samples collected during Field Assessment	
Density, water	lb/cf	62.4	62.4	62.4	62.4	Literature value	
Months in Cycle		0.5	0.5	0.5	0.5		
Dredging Days/month		22	22	22	22		
Dredge rate, sediment	cy/day	950	950	1,250	1,250	Range of potential dredge rates; input at top by run	
Duration	hr/d	12	12	12	12		
Total Dredge Volume, per cycle	cy	10,450	10,450	13,750	13,750	Total Dredge volume in cycle	
Sediment, in situ							
Percent Solids (Ws/Wt)		63%	63%	63%	63%	Calculated	Percent Solids = 1/(Water Content + 1)
Percent Moisture (Ww/Wt)		38%	38%	38%	38%	Calculated	Percent Moisture = 1 - Percent Solids
Water Content (Ww/Ws)		0.6	0.6	0.6	0.6	Average in-situ water content of sediment samples collected during Field Assessment.	
Wet bulk density (Wt/Vt)	lb/cf	100.9	100.9	100.9	100.9	Calculated	Wet Bulk density (lb/cf) = Dry Bulk density (lb/cf)/Percent Solids (%)
	ton/cy	1.36	1.36	1.36	1.36	Calculated	Wet Bulk density (ton/cy) = Wet Bulk density (lb/cf)*27 (cf/cy)/2000 (lb/ton)
Dry bulk density (Ws/Vt)	lb/cf	63.1	63.1	63.1	63.1	Calculated	Dry Bulk density (lb/cf) = (SG, solids*density, water (lb/cf))/(1+ SG, solids*Water Content)
	ton/cy	0.85	0.85	0.85	0.85	Calculated	Dry Bulk density (ton/cy) = Dry Bulk density (lb/cf)*27 (cf/cy)/2000 (lb/ton)
Weight of material, in situ	wet tons	14,240	14,240	18,737	18,737	Calculated	Wet weight (tons) = Wet Bult density (tons/cy)*Total Dredge volume per Cycle (cy)
	dry tons	8,900	8,900	11,711	11,711	Calculated	Dry weight (tons) = Dry Bulk density (tons/cy)*Percent Solids
	tons water	5,340	5,340	7,026	7,026	Calculated	Water weight (tons) = Wet weight (tons)*Percent Solids
Water Volume, in situ	gal water	1,280,408	1,280,408	1,684,748	1,684,748	Calculated	Water volume (gal) = Water weight (tons)*2000/density of Water (lb/cf)* 7.481 (gal/cf)
Sediment, slurry							
Percent Solids (Ws/Wt)		0.07	0.15	0.07	0.15	Range of potential percent solids in slurry; input at top by run.	
Percent Moisture (Ww/Wt)		93%	85%	93%	85%	Calculated	Percent Moisture = 1 - Percent Solids
Water Content (Ww/Ws)		13.3	5.7	13.3	5.7	Calculated	Water Content = (1/Percent Solids) - 1
Wet bulk density (Wt/Vt)	lb/cf	65.2	68.7	65.2	68.7	Calculated	Wet Bulk density (lb/cf) = Dry Bulk density (lb/cf)/Percent Solids (%)
	ton/cy	0.88	0.93	0.88	0.93	Calculated	Wet Bulk density (ton/cy) = Wet Bulk density (lb/cf)*27 (cf/cy)/2000 (lb/ton)
Dry bulk density (Ws/Vt)	lb/cf	4.6	10.3	4.6	10.3	Calculated	Dry Bulk density (lb/cf) = (SG, solids*density, water (lb/cf))/(1+ SG, solids*Water Content)
	ton/cy	0.06	0.14	0.06	0.14	Calculated	Dry Bulk density (ton/cy) = Dry Bulk density (lb/cf)*27 (cf/cy)/2000 (lb/ton)
Specific gravity material		1.04	1.10	1.04	1.10	Calculated	SG = Wet Bulk density(lb/cf)/density of Water (lb/cf)
Weight of material, slurry	wet tons	127,144	59,334	167,294	78,071	Calculated	Slurry Wet weight (tons) = in situ Dry weight (tons)/Percent Solids
	dry tons	8,900	8,900	11,711	11,711	Calculated	(same as in situ dry weight)
	tons water	118,243	50,434	155,584	66,360	Calculated	Slurry Water weight (tons) = Wet weight (tons) - Dry weight (tons)
	tons water added	112,903	45,094	148,557	59,334	Calculated	Water added (tons) = slurry Water weight (tons) - in situ Water weight (tons)
Volume of water, slurry	gal water	28,351,902	12,092,747	37,305,134	15,911,509	Calculated	
	gal water added	27,071,493	10,812,338	35,620,386	14,226,761	Calculated	Water added (gal) = slurry Water volume (gal) - in situ Water volume (gal)
Total Volume, slurry	cy	144,476	63,980	190,100	84,184	Calculated	Total volume, slurry (cy) = Water volume added (gal)/201.974 (gal/cy) + Total Dredge volume, per cycle (cy)
	gal	29,182,257	12,923,102	38,397,707	17,004,082	Calculated	Total volume, slurry (gal) = Water volume added (gal) + Total Dredge volume, per cycle (cy)*201.974 (cy/gal)

	Run	1	2	3	4	Comments	Equation
	Dredge Rate (cy/day)	950	950	1250	1250		
	Slurry %	0.07	0.15	0.07	0.15		
Parameter	Unit	Value	Value	Value	Value		
Sediment, after dewatering							
Percent Solids (Ws/Wt)		0.50	0.50	0.50	0.50	Assumed final percent solids at 50% (increase from treatability study based on extended time)	
Percent Moisture (Ww/Wt)		50%	50%	50%	50%	Calculated	Percent Moisture = 1 - Percent Solids
Water Content (Ww/Ws)		100%	100%	100%	100%	Calculated	Water Content = (1/Percent Solids) - 1
Wet bulk density (Wt/Vt)	lb/cf	89.8	89.8	89.8	89.8	Calculated	Wet Bulk density (lb/cf) = Dry Bulk density (lb/cf)/Percent Solids (%)
	ton/cy	1.21	1.21	1.21	1.21	Calculated	Wet Bulk density (ton/cy) = Wet Bulk density (lb/cf)*27 (cf/cy)/2000 (lb/ton)
Dry bulk density (Ws/Vt)	lb/cf	44.9	44.9	44.9	44.9	Calculated	Dry Bulk density (lb/cf) = (SG, solids*density, water (lb/cf))/(1+ SG, solids*Water Content)
	ton/cy	0.61	0.61	0.61	0.61	Calculated	Dry Bulk density (ton/cy) = Dry Bulk density (lb/cf)*27 (cf/cy)/2000 (lb/ton)
Specific gravity material		1.44	1.44	1.44	1.44	Calculated	SG = Wet Bulk density(lb/cf)/density of Water (lb/cf)
Weight of material, after dewatering	wet tons	17,800	17,800	23,421	23,421	Calculated	Dewatered Wet weight (tons) = Dewatered Dry weight (tons)/Percent Solids
	dry tons	8,900	8,900	11,711	11,711	Calculated	Dewatered Dry weight (tons) = slurry Dry weight (tons)
	tons water	8,900	8,900	11,711	11,711	Calculated	Dewatered Water weight (tons) = Wet weight (tons) - Dry weight (tons)
	tons water dewatered	109,343	41,534	143,873	54,649	Calculated	Water Dewatered (tons) = slurry Water weight (tons) - Dewatered Water weight (tons)
Volume of water, after dewatering	gal water	2,134,014	2,134,014	2,807,913	2,807,913	Calculated	Volume of Water after Dewatering (cy water) = weight of Water after Dewatering (tons water)*2000 (lb/ton)/(62.4 (lb/cf)*27 (cf/cy))
	gal water dewatered	26,217,888	9,958,733	34,497,221	13,103,595	Calculated	Volume of Water Dewatered (cy) = volume of Water in slurry (cy water) -volume of Water after Dewatering (cy water)
Total Volume (disposal Quantity)	cy	14,676	14,676	19,311	19,311	Calculated	Total volume for Disposal (cy) = weight of Material (wet tons)/Wet Bulk density (ton/cy)
Dewatering Area							
Dredge rate, sediment	cy/day	950	950	1,250	1,250	Range of potential dredge rates; input at top by run.	
Production rate, slurry	cy/day	13,134	5,816	17,282	7,653	Calculated	Production rate, slurry (cy/day) = Dredge rate (cy/day)*(total slurry volume (cy)/total Dredged volume (cy))
	gal/day	2,652,932	1,174,827	3,490,701	1,545,826	Calculated	
	gpm	3,685	1,632	4,848	2,147	Calculated	
Total pumping days	days	11	11	11	11	Calculated	Total Pumping Days = Total volume, slurry (cy)/ Production rate, slurry (cy/day)
Geotextile Tube volume per unit length	cy/ft	7.54	7.54	7.54	7.54	From Tencate spec sheet.	
Percent of maximum filled capacity		0.8	0.8	0.8	0.8	From Tencate spec sheet.	
Total Geotextile Tube length need	ft	2,433	2,433	3,201	3,201	Calculated	Total Geotextile Tube length, needed (ft) = Total volume, disposal quantity (cy)/(Geotextile Tube volume per unit length (cy/ft)*Percent of maximum filled capacity (%))
Geotextile Tube cross sectional area	sf	204	204	204	204	From Tencate spec sheet.	
Geotextile Tube pumping height	ft	6	6	6	6	From Tencate spec sheet.	
Geotextile Tube fill width	ft	37.2	37.2	37.2	37.2	From Tencate spec sheet.	
Geotextile Tube usage rate	ft/day	177	177	233	233	Calculated	Geotextile Tube usage rate (ft/day) = Total volume, disposal quantity (cy)/Total pumping days (day)/Geotextile Tube volume per unit length(ft/day)
Geotextile Tube area per day	sf/day	6,586	6,586	8,666	8,666	Calculated	Geotextile Tube area per day (sf/day) = Geotextile Tube usage rate (ft/day)*Geotextile Tube fill width (ft)
	sy/day	732	732	963	963	Calculated	Geotextile Tube area per day (sy/day) = Geotextile Tube area per day (sf/day)/9 (sf/sy)
Total Geotextile Tube Area - 1 layer	sf	90,557	90,557	119,154	119,154	Calculated	Geotextile Tube area (sf) = Total Geotextile Tube length (ft)*Geotextile Tube fill width (ft)
	sy	10,062	10,062	13,239	13,239	Calculated	Geotextile Tube area (sy = Geotextile Tube area (sf)/9 (sf/sy)
Total number of Geotextile Tubes - 1 layer		25	25	33	33	Calculated	Total Geotextile Tubes = Total Geotextile Tube area (1 layer) (sf)/Geotextile Tube area (sf)

	Run	1	2	3	4	Comments	Equation
	Dredge Rate (cy/day)	950	950	1250	1250		
	Slurry %	0.07	0.15	0.07	0.15		
Parameter	Unit	Value	Value	Value	Value		
Dewatering Area							
Geotextile Tube length	ft	100	100	100	100	Assumed, to be varied based on available dewatering area.	
Geotextile Tube area	sf	3,722	3,722	3,722	3,722	Calculated	Geotextile Tube area (sf) = Geotextile Tube length (ft)*Geotextile Tube length (ft)
Number of Geotextile Tube sections, total	geotextile tubes	25	25	33	33	Calculated	Number of Geotextile Tube sections, total (geotextile tubes) = Total Geotextile Tube area (1 layer) (sf)/Geotextile Tube length (ft)
Number of layers	layers	3	3	3	3	From Tencate spec sheet	
Number of Geotextile Tube sections in bottom layer	geotextile tubes	10	10	12	12	Calculated, assuming one less section per layer	Number of Geotextile Tubes sections in bottom layer = [(Number of Geotextile Tube sections, total/number of layers) + (number of layers - 1)]/2
Dewatering Cell Footprint, minimum	sf	44,664	44,664	53,597	53,597	Calculated. Assumes 20% increase for piping/collection system	Dewatering Cell Footprint, min (sf) = Geotextile Tube area (sf)*No. of Geotextile Tube sections in bottom layer*1.2
Footprint, minimum	acre	1.03	1.03	1.23	1.23	Calculated	Dewatering Cell Footprint, min (acre) = Dewatering Cell Footprint, min (sf)/43560 (sf/acre)
Water Treatment Area							
Dewatering Rate	gal/day	2,383,444	905,339	3,136,111	1,191,236	Calculated	Dewatering rate (gal/day) = volume of Water Dewatered (cy)/(Total Dredge volume (cy)/Dredge rate (cy/day))*201.974 (gal/cy)
Dewatering Rate	gpm	1,655	629	2,178	827	Calculated	Dewatering rate (gpm) = Dewatering rate (gal/day)*720 (minutes/working day)
Equalization Volume	gal	238,344	90,534	313,611	119,124	Calculated	Equalization volume (gallons) = Dewatering rate (gal/day)*0.1
Equalization Tanks		24	9	31	12	Typical - 10,000 gallon tanks	
Tank Area	sf/tank	300	300	300	300	Typical - assumed	
Sand Filtration	gpm	550	550	550	550	Assumed.	
Sand Filtration Units		4	2	4	2	Calculated	Sand Filtration Units = Dewatering rate (gpm)/Sand Filtration rate (gpm)
Sand Filtration Unit Area	sf/unit	250	250	250	250	From Baker Corp	
Polymer Area	sf	2,100	2,100	2,100	2,100	Scaled from previous project based on system throughput.	
Footprint, minimum	sf	42,852	18,180	54,142	22,469	Calculated. Assumes 500% increase for piping/tank clearance/access	Footprint (sf) = (Equalization Tanks*Tank area (sf)) + (Sand Filtration*Sand Filtration Unit area (sf/unit))
Footprint, minimum	acre	1.0	0.4	1.2	0.5	Calculated	Footprint (acre) = Footprint (sf)/43560 (sf/acre)
Total Dewatering and Water Treatment Area							
Dewatering Cells		3	3	3	3	Assumed - 1 cell active fill, active dewater, active load out.	
Dewatering Footprint	acre	3.08	3.08	3.69	3.69	Calculated from above	Dewatering Footprint (sf) = Dewatering Cells*Dewatering Cell Footprint, min (sf)
Water Treatment Area	acre	0.984	0.417	1.24	0.516	Calculated from above.	Same as calculation above for Water Treatment area Footprint, minimum (acre)
Total	**acre**	**4.06**	**3.49**	**4.93**	**4.21**		

Table B-2. Passive Dewatering using Geotextile Tubes, including Desanding, Area Calculation
Appendix B - Dewatering Area Sizing
Alternatives Analysis Report
Lake Accotink Dredging Project
Fairfax County, Virginia

	Run	1	2	3	4	Comments	Equation
	Dredge Rate (cy/day)	950	950	1250	1250		
	Slurry %	0.07	0.15	0.07	0.15		
Parameter	Unit	Value	Value	Value	Value		
SG, solids		2.57	2.57	2.57	2.57	Average specific gravity of sediment samples collected during Field Assessment.	
Density, water	lb/cf	62.4	62.4	62.4	62.4	Literature Value	
Months in Cycle		1	1	1	1		
Dredging Days/month		22	22	22	22		
Dredge rate, sediment	cy/day	950	950	1,250	1,250	Range of potential dredge rates; input at top by run.	
Duration	hr/day	12	12	12	12	Assumed.	
Total Dredge Volume, in situ	cy	500,000	500,000	500,000	500,000	Full dredge production; based on estimate from E. Hover.	
Total Dredge Volume, per cycle	cy	20,900	20,900	27,500	27,500	Total Dredge volume in cycle	
Sediment, in situ							
Percent Solids (Ws/Wt)		63%	63%	63%	63%	Calculated	Percent Solids = 1/(Water Content + 1)
Percent Moisture (Ww/Wt)		38%	38%	38%	38%	Calculated	Percent Moisture = 1 - Percent Solids
Water Content (Ww/Ws)		0.60	0.60	0.60	0.60	Average in-situ water content of sediment samples collected during Field Assessment.	
Wet bulk density (Wt/Vt)	lb/cf	101	101	101	101	Calculated	Wet Bulk density (lb/cf) = Dry Bulk density (lb/cf)/Percent Solids (%)
	ton/cy	1.36	1.36	1.36	1.36	Calculated	Wet Bulk density (ton/cy) = Wet Bulk density (lb/cf)*27 (cf/cy)/2000 (lb/ton)
Dry bulk density (Ws/Vt)	lb/cf	63.1	63.1	63.1	63.1	Calculated	Dry Bulk density (lb/cf) = (SG, solids*density, water (lb/cf))/(1+ SG, solids*Water Content)
	ton/cy	0.85	0.85	0.85	0.85	Calculated	Dry Bulk density (ton/cy) = Dry Bulk density (lb/cf)*27 (cf/cy)/2000 (lb/ton)
Weight of material, in situ	wet tons	28,480	28,480	37,474	37,474	Calculated	Wet weight (tons) = Wet Bult density (tons/cy)*Total Dredge volume per Cycle (cy)
	dry tons	17,800	17,800	23,421	23,421	Calculated	Dry weight (tons) = Dry Bulk density (tons/cy)*Percent Solids
	tons water	10,680	10,680	14,053	14,053	Calculated	Water weight (tons) = Wet weight (tons)*Percent Solids
Water Volume, in situ	gal water	2,560,817	2,560,817	3,369,496	3,369,496	Calculated	Water volume (gal) = Water weight (tons)*2000/density of Water (lb/cf)* 7.481 (gal/cf)
Sediment, slurry							
Percent Solids (Ws/Wt)		0.07	0.15	0.07	0.15	Range of potential percent solids in slurry; input at top by run.	
Percent Moisture (Ww/Wt)		93%	85%	93%	85%	Calculated	Percent Moisture = 1 - Percent Solids
Water Content (Ww/Ws)		13.29	5.67	13.29	5.67	Calculated	Water Content = (1/Percent Solids) - 1
Wet bulk density (Wt/Vt)	lb/cf	65.2	68.7	65.2	68.7	Calculated	Wet Bulk density (lb/cf) = Dry Bulk density (lb/cf)/Percent Solids (%)
	ton/cy	0.88	0.93	0.88	0.93	Calculated	Wet Bulk density (ton/cy) = Wet Bulk density (lb/cf)*27 (cf/cy)/2000 (lb/ton)
Dry bulk density (Ws/Vt)	lb/cf	4.6	10.3	4.6	10.3	Calculated	Dry Bulk density (lb/cf) = (SG, solids*density, water (lb/cf))/(1+ SG, solids*Water Content)
	ton/cy	0.06	0.14	0.06	0.14	Calculated	Dry Bulk density (ton/cy) = Dry Bulk density (lb/cf)*27 (cf/cy)/2000 (lb/ton)
Specific gravity material		1.04	1.10	1.04	1.10	Calculated	SG = Wet Bulk density(lb/cf)/density of Water (lb/cf)
Weight of material, slurry	wet tons	254,287	118,667	334,588	156,141	Calculated	Slurry Wet weight (tons) = in situ Dry weight (tons)/Percent Solids
	dry tons	17,800	17,800	23,421	23,421	Calculated	(same as in situ dry weight)
	tons water	236,487	100,867	311,167	132,720	Calculated	Slurry Water weight (tons) = Wet weight (tons) - Dry weight (tons)
	tons water added	225,807	90,187	297,114	118,667	Calculated	Water added (tons) = slurry Water weight (tons) - in situ Water weight (tons)
Volume of water, slurry	gal water	56,703,803	24,185,493	74,610,268	31,823,017	Calculated	Volume of water, slurry (gal) = slurry water weight (tons)*[2000 (lb/ton)/(62.4 (lb/cf)*7.481 (cf/gal))]
	gal water added	54,142,987	21,624,676	71,240,772	28,453,521	Calculated	Water added (gal) = slurry Water volume (gal) - in situ Water volume (gal)
Total Volume, slurry	cy	288,952	127,960	380,200	168,368	Calculated	Total volume, slurry (cy) = Water volume added (gal)/201.974 (gal/cy) + Total Dredge volume, per cycle (cy)
	gal	58,364,515	25,846,205	76,795,414	34,008,164	Calculated	Total volume, slurry (gal) = Water volume added (gal) + Total Dredge volume, per cycle (cy)*201.974 (cy/gal)
Production rate, slurry	cy/day	13,134	5,816	17,282	7,653	Calculated	Production rate, slurry (cy/day) = Dredge rate (cy/day)*(total slurry volume (cy)/total Dredged volume (cy))
	gal/day	2,652,932	1,174,827	3,490,701	1,545,826	Calculated	Production rate, slurry (gal/day) = Production rate, slurry (cy/day)*201.974 (gal/cy)
	gpm	3,685	1,632	4,848	2,147	Calculated	Production rate, slurry (gpm) = Production rate, slurry (gal/day)*720 (min/day)
Total pumping days	days	22	22	22	22	Calculated	Total pumping days = Total volume, slurry (cy)/Production rate, slurry (cy/day)

	Run	1	2	3	4	Comments	Equation
	Dredge Rate (cy/day)	950	950	1250	1250		
	Slurry %	0.07	0.15	0.07	0.15		
Parameter	Unit	Value	Value	Value	Value		
Hydrocyclone							
Hydrocyclone Influent Flow	gpm	3,685	1,632	4,848	2,147	Calculated	(same as Production rate, slurry (gpm))
Hydrocyclone Total Influent Solids	lb/day	1,618,190	1,618,190	2,129,197	2,129,197	From Slurry Holding Tank	
Hydrocyclone Influent TSS	mg/L	73,090	165,047	73,090	165,047	From Slurry Holding Tank	
Sand in Hydrocyclone Skid Influent	percent	22%	22%	22%	22%	Based on Field Assessment - based on average of clayey silt (predominant material) submitted for gradation	
Hydrocyclone Influent Sand Load	lb/day	356,002	356,002	468,423	468,423	Calculated	Hydrocyclone Influent Sand Load (lb/day) = Hydrocyclone Total Influent Solids (lb/day)*Sand in Hydrocylcone Skid Influent (%)
	tons/hr	14.8	14.8	19.5	19.5	Calculated	Hydrocyclone Influent Sand Load (ton/hr) = Hydrocyclone Influent Sand Load (lb/day)/2000 (lb/ton)*Duration (hr/d)
Sand Removal Efficiency	percent	80%	80%	80%	80%	Assumed. Could vary for hauling vs. dewatering calcs, as observed in projects with similar scope.	
Hydrocyclone Underflow Sand Load (Dry)	lb/day	284,801	284,801	374,739	374,739	Calculated	Hydrocyclone Underflow Sand Load (lb/day) = Hydrocyclone Influent Sand Load (lb/day)*Sand Removal Efficiency (%)
	tons/hr	11.9	11.9	15.6	15.6	Calculated	Hydrocyclone Underflow Sand Load (tons/hr) = Hydrocyclone Underflow Sand Load (lb/day)/2000 lb/ton*Duration (hr/day)
Hydrocyclone Underflow Sand Removal	tons	3,133	3,133	4,122	4,122	Calculated	Hydrocyclone Underflow Sand Removal (tons) = Hydrocyclone Underflow Sand Removal (ton/hr)*Duration (hr/day)*Total pumping days
Hydrocyclone Underflow Water Removal	tons	783	783	1,031	1,031	Calculated	Hydrocyclone Underflow Water Removal (tons) = Hydrocyclone Underflow Sand Removal (tons)*Water Content
	gallons	187,793	187,793	247,096	247,096	Calculated	Hydrocyclone Underflow Water Removal (gallons) = Hydrocyclone Underflow Water Removal (tons)*2000 (ton/lb)/(62.4 (lb/cf)*7.481 (gal/cf))
Hydraulic Underflow Sand Percent Solids (Ws/Wt)	percent	80%	80%	80%	80%	Assumed	
Hydraulic Underflow Sand Percent Moisture (Ww/Wt)	percent	20%	20%	20%	20%	Calculated	Hydraulic Underflow Sand Percent Moisture (%) = 1 - Hydraulic Underflow Sand Percent Solids (%)
Water Content (Ww/Ws)	percent	25%	25%	25%	25%	Calculated	Water Content = (1/Percent Solids) - 1
Hydraulic Underflow Sand Dry Bulk Density (Ws/Vt)	lb/cf	97.64	97.64	97.64	97.64	Calculated	Dry Bulk density (lb/cf) = (SG, solids*density, water (lb/cf))/(1+ SG, solids*Water Content)
Hydraulic Underflow Wet Bulk Density (Wt/Vt)	lb/cf	122.05	122.05	122.05	122.05	Calculated	Wet Bulk density (lb/cf) = Dry Bulk density (lb/cf)/Percent Solids (%)
Hydrocyclone Hydraulic Underflow	gpm	30.3	30.3	39.9	39.9	Calculated. Hydraulic equivalent volume of underflow sand load	
Hydrocyclone Overflow	gpm	3,654	1,601	4,808	2,107	Calculated	Hydrocyclone Overflow (gpm) = Hydrocyclone Hydraulic Underflow (gpm) - Hydrocyclone Influent Flow (gpm)
Hydrocyclone Total Overflow Solids	lb/day	1,333,389	1,333,389	1,754,459	1,754,459	Calculated	Hydrocyclone Total Overflow Solids (lb/day) = Hydrocyclone Total Influent Solids (lb/day) - Hydrocyclone Underflow Sand Load (lb/day)
Hydrocyclone Footprint	sf	1,920	1,280	2,560	1,280	From Del Tanks	
Sediment, after dewatering							
Percent Solids (Ws/Wt)		0.50	0.50	0.50	0.50	Assumed final percent solids at 50% (increase from treatability study based on extended time)	Percent Solids = 1/(Water Content + 1)
Percent Moisture (Ww/Wt)		50%	50%	50%	50%	Calculated	Percent Moisture = 1 - Percent Solids
Water Content (Ww/Ws)		100%	100%	100%	100%	Calculated	Water Content = (1/Percent Solids) - 1

	Run	1	2	3	4	Comments	Equation
	Dredge Rate (cy/day)	950	950	1250	1250		
	Slurry %	0.07	0.15	0.07	0.15		
Parameter	**Unit**	**Value**	**Value**	**Value**	**Value**		
Wet bulk density (Wt/Vt)	lb/cf	89.8	89.8	89.8	89.8	Calculated	Wet Bulk density (lb/cf) = Dry Bulk density (lb/cf)/Percent Solids (%)
	ton/cy	1.21	1.21	1.21	1.21	Calculated	Wet Bulk density (ton/cy) = Wet Bulk density (lb/cf)*27 (cf/cy)/2000 (lb/ton)
Dry bulk density (Ws/Vt)	lb/cf	44.9	44.9	44.9	44.9	Calculated	Dry Bulk density (lb/cf) = (SG, solids*density, water (lb/cf))/(1+ SG, solids*Water Content)
	ton/cy	0.606	0.606	0.606	0.606	Calculated	Dry Bulk density (ton/cy) = Dry Bulk density (lb/cf)*27 (cf/cy)/2000 (lb/ton)
Specific gravity material		1.44	1.44	1.44	1.44	Calculated	SG = Wet Bulk density(lb/cf)/density of Water (lb/cf)
Weight of material, after dewatering	wet tons	29,335	29,335	38,598	38,598	Calculated	Dewatered Wet weight (tons) = Dewatered Dry weight (tons)/Percent Solids
	dry tons	14,667	14,667	19,299	19,299	Calculated	Dewatered Dry weight (tons) = slurry Dry weight (tons)
	tons water	14,667	14,667	19,299	19,299	Calculated	Dewatered Water weight (tons) = Wet weight (tons) - Dry weight (tons)
	tons water dewatered	221,036	85,417	290,837	112,390	Calculated	Water Dewatered (tons) = slurry Water weight (tons) - Dewatered Water weight (tons)
Volume of water, after dewatering	gal water	3,516,855	3,516,855	4,627,441	4,627,441	Calculated	Volume of Water after Dewatering (cy water) = weight of Water after Dewatering (tons water)*2000 (lb/ton)/(62.4 (lb/cf)*27 (cf/cy))
	gal water dewatered	52,999,155	20,480,845	69,735,730	26,948,480	Calculated	Volume of Water Dewatered (cy) = volume of Water after Dewatering (cy water) - volume Bulked during Dredging (cy wet)
Total Volume (disposal Quantity)	cy	24,186	24,186	31,824	31,824	Calculated	Total volume for Disposal (cy) = weight of Material (wet tons)/Wet Bulk density (ton/cy)
Dewatering Area							
Dredge rate, sediment	cy/day	950	950	1,250	1,250	Range of potential dredge rates; input at top by run.	
Production rate, slurry	cy/day	13,134	5,816	17,282	7,653	Calculated	Production rate, slurry (cy/day) = Dredge rate (cy/day)*(total slurry volume (cy)/total Dredged volume (cy))
	gal/day	2,652,932	1,174,827	3,490,701	1,545,826	Calculated	Production rate, slurry (gal/day) = Production rate, slurry (cy/day)*201.974 (gal/cy)
	gpm	3,685	1,632	4,848	2,147	Calculated	Production rate, slurry (gpm) = Production rate, slurry (gal/day)*720 (min/day)
Total pumping days	days	22	22	22	22	Calculated	Total pumping days = Total volume, slurry (cy)/Production rate, slurry (cy/day)
Geotextile Tube volume per unit length	cy/ft	7.54	7.54	7.54	7.54	From Tencate spec sheet; see input sheet.	
Percent of maximum filled capacity		0.8	0.8	0.8	0.8	From Tencate spec sheet; see input sheet.	
Total Geotextile Tube length need	ft	4,010	4,010	5,276	5,276	Calculated	Total Geotextile Tube length, needed (ft) = Total volume, disposal quantity (cy)/(Geotextile Tube volume per unit length (cy/ft)*Percent of maximum filled capacity (%))
Geotextile Tube cross sectional area	cf	203.52	203.52	203.52	203.52	From Tencate spec sheet; see input sheet.	
Geotextile Tube pumping height	ft	6	6	6	6	From Tencate spec sheet; see input sheet.	
Geotextile Tube fill width	ft	37.22	37.22	37.22	37.22	From Tencate spec sheet; see input sheet.	
Geotextile Tube usage rate	ft/day	145.8	145.8	191.8	191.8	Calculated	Geotextile Tube usage rate (ft/day) = Total volume, disposal quantity (cy)/Total pumping days (day)/Geotextile Tube volume per unit length(ft/day)
Geotextile Tube area per day	sf/day	5,427	5,427	7,141	7,141	Calculated	Geotextile Tube area per day (sf/day) = Geotextile Tube usage rate (ft/day)*Geotextile Tube fill width (ft)
	sy/day	603	603	793	793	Calculated	Geotextile Tube area per day (sy/day) = Geotextile Tube area per day (sf/day)/9 (sf/sy)
Total Geotextile Tube Area - 1 layer	sf	149,239	149,239	196,367	196,367	Calculated	Geotextile Tube area (sf) = Total Geotextile Tube length (ft)*Geotextile Tube fill width (ft)
	sy	16,582	16,582	21,819	21,819	Calculated	Geotextile Tube area (sy = Geotextile Tube area (sf)/9 (sf/sy)
Total number of Geotextile Tubes - 1 layer		41	41	53	53	Calculated	Total Geotextile Tubes = Total Geotextile Tube area (1 layer) (sf)/Geotextile Tube area (sf)
Dewatering Area							
Geotextile Tube length	ft	100	100	100	100	Assumed, to be varied based on available dewatering area.	
Geotextile Tube area	sf	3,722	3,722	3,722	3,722	Calculated	Geotextile Tube area (sf) = Geotextile Tube length (ft)*Geotextile Tube length (ft)
Number of Geotextile Tube sections, total	geotextile tubes	41	41	53	53	Calculated	Number of Geotextile Tube sections, total (geotextile tubes) = Total Geotextile Tube area (1 layer) (sf)/Geotextile Tube length (ft)
Number of layers	layers	3	3	3	3	From Tencate spec sheet	
Numbr of Geotextile Tube sections in bottom layer	geotextile tubes	15	15	19	19	Calculated, assuming one less section per layer	Number of Geotextile Tubes sections in bottom layer = [(Number of Geotextile Tube sections, total/number of layers) + (number of layers - 1)]/2
Dewatering Cell Footprint, minimum	sf	66,996	66,996	84,862	84,862	Calculated. Assumes 20% increase for piping/collection system	Dewatering Cell Footprint, min (sf) = Geotextile Tube area (sf)*No. of Geotextile Tube sections in bottom layer*1.2
Footprint, minimum	acre	1.5	1.5	1.9	1.9	Calculated	Dewatering Cell Footprint, min (acre) = Dewatering Cell Footprint, min (sf)/43560 (sf/acre)

	Run	1	2	3	4	Comments	Equation
	Dredge Rate (cy/day)	950	950	1250	1250		
	Slurry %	0.07	0.15	0.07	0.15		
Parameter	Unit	Value	Value	Value	Value		
Water Treatment Area							
Dewatering Rate	gal/day	2,409,052	930,947	3,169,806	1,224,931	Calculated	Dewatering rate (gal/day) = volume of Water Dewatered (cy)/(Total Dredge volume (cy)/Dredge rate (cy/day))*201.974 (gal/cy)
Dewatering Rate	gpm	1,673	646	2,201	851	Calculated	Dewatering rate (gpm) = Dewatering rate (gal/day)*720 (minutes/working day)
Equalization Volume	gal	240,905	93,095	316,981	122,493	Calculated	Equalization volume (gallons) = Dewatering rate (gal/day)*0.1
Equalization Tanks		24	9	32	12	TYP. 10,000 gallon tanks	
Tank Area	sf/tank	300	300	300	300	Typical from Baker	
Sand Filtration	gpm	550	550	550	550	Assumed.	
Sand Filtration Units		4	2	5	2	Calculated	Sand Filtration Units = Dewatering rate (gpm)/Sand Filtration rate (gpm)
Sand Filtration Unit Area	sf/unit	250	250	250	250	From Baker Corp	
Polymer Area	sf	2,100	2,100	2,100	2,100	Scaled from previous project based on system throughput.	
Footprint, minimum	sf	43,236	18,564	55,897	22,974	Calculated. Assumes 500% increase for piping/tank clearance/access	Footprint (sf) = (Equalization Tanks*Tank area (sf)) + (Sand Filtration*Sand Filtration Unit area (sf/unit))
Footprint, minimum	acre	1.0	0.4	1.3	0.5	Calculated	Footprint (acre) = Footprint (sf)/43560 (sf/acre)
Total Dewatering and Water Treatment Area							
Dewatering Cells		3	3	3	3	Assumed - 1 cell active fill, active dewater, active load out.	
Dewatering Footprint	acre	4.83	4.76	6.14	5.99	Calculated from above	
Water Treatment Area	acre	0.99	0.43	1.28	0.53	Calculated from above.	
Total	**acre**	**5.83**	**5.19**	**7.42**	**6.52**		

	Run	1	2	3	4	Comments	Equation
	Dredge Rate (cy/day)	950	950	1250	1250		
	Slurry %	0.07	0.15	0.07	0.15		
Parameter	Unit	Value	Value	Value	Value		
Specific gravity, solids		2.57	2.57	2.57	2.57	Average specific gravity of sediment samples collected during Field Assessment.	
Density, water	lb/cf	62.4	62.4	62.4	62.4	Literature Value	
Dredge Volume, in situ	cy	500,000	500,000	500,000	500,000	Full dredge production; based on estimate from E. Hover.	
Dredge rate, sediment	cy/day	950	950	1,250	1,250	Assumed upper bound	
Duration	hrs/day	12	12	12	12	Assumed	
Sediment, in situ							
Percent Solids (Ws/Wt)		63%	63%	63%	63%	Calculated	Percent Solids = 1/(Water Content + 1)
Percent Moisture (Ww/Wt)		38%	38%	38%	38%	Calculated	Percent Moisture = 1 - Percent Solids
Water Content (Ww/Ws)		0.60	0.60	0.60	0.60	Average in-situ water content of sediment samples collected during Field Assessment.	
Wet bulk density (Wt/Vt)	lb/cf	101	101	101	101	Calculated	Wet Bulk density (lb/cf) = Dry Bulk density (lb/cf)/Percent Solids (%)
	ton/cy	1.36	1.36	1.36	1.36	Calculated	Wet Bulk density (ton/cy) = Wet Bulk density (lb/cf)*27 (cf/cy)/2000 (lb/ton)
Dry bulk density (Ws/Vt)	lb/cf	63.1	63.1	63.1	63.1	Calculated	Dry Bulk density (lb/cf) = (SG, solids*density, water (lb/cf))/(1+ SG, solids*Water Content)
	ton/cy	0.852	0.852	0.852	0.852	Calculated	Dry Bulk density (ton/cy) = Dry Bulk density (lb/cf)*27 (cf/cy)/2000 (lb/ton)
Weight of material, in situ	wet tons	681,343	681,343	681,343	681,343	Calculated	Wet weight (tons) = Wet Bult density (tons/cy)*Total Dredge volume per Cycle (cy)
	dry tons	425,839	425,839	425,839	425,839	Calculated	Dry weight (tons) = Dry Bulk density (tons/cy)*Percent Solids
	tons water	255,504	255,504	255,504	255,504	Calculated	Water weight (tons) = Wet weight (tons)*Percent Solids
Water Volume, in situ	gal water	61,263,563	61,263,563	61,263,563	61,263,563	Calculated	Water volume (gal) = Water weight (tons)*2000/density of Water (lb/cf)* 7.481 (gal/cf)
Sediment, slurry							
Percent Solids (Ws/Wt)		7%	15%	7%	15%	Range of potential percent solids in slurry; input at top by run.	
Percent Moisture (Ww/Wt)		93%	85%	93%	85%	Calculated	Percent Moisture = 1 - Percent Solids
Water Content (Ww/Ws)		1329%	567%	1329%	567%	Calculated	Water Content = (1/Percent Solids) - 1
Wet bulk density (Wt/Vt)	lb/cf	65.2	68.7	65.2	68.7	Calculated	Wet Bulk density (lb/cf) = Dry Bulk density (lb/cf)/Percent Solids (%)
	ton/cy	0.880	0.927	0.880	0.927	Calculated	Wet Bulk density (ton/cy) = Wet Bulk density (lb/cf)*27 (cf/cy)/2000 (lb/ton)
Dry bulk density (Ws/Vt)	lb/cf	4.6	10.3	4.6	10.3	Calculated	Dry Bulk density (lb/cf) = (SG, solids*density, water (lb/cf))/(1+ SG, solids*Water Content)
	ton/cy	0.0616	0.139	0.0616	0.139	Calculated	Dry Bulk density (ton/cy) = Dry Bulk density (lb/cf)*27 (cf/cy)/2000 (lb/ton)
Specific gravity material		1.04	1.10	1.04	1.10	Calculated	Specific gravity = Wet Bulk density(lb/cf)/density of Water (lb/cf)
Weight of material, slurry	wet tons	6,083,421	2,838,930	6,083,421	2,838,930	Calculated	Slurry Wet weight (tons) = in situ Dry weight (tons)/Percent Solids
	dry tons	425,839	425,839	425,839	425,839	Calculated	(same as in situ dry weight)
	tons water	5,657,582	2,413,090	5,657,582	2,413,090	Calculated	Slurry Water weight (tons) = Wet weight (tons) - Dry weight (tons)
	tons water added	5,402,078	2,157,587	5,402,078	2,157,587	Calculated	Water Added (tons) = slurry Water weight (tons) - in situ Water weight (tons)
Volume of water, slurry	gal water	1,356,550,322	578,600,317	1,356,550,322	578,600,317	Calculated	Volume of water, slurry (gal) = slurry water weight (tons)*[2000 (lb/ton)/(62.4 (lb/cf)*7.481 (cf/gal))]
	gal water added	1,295,286,759	517,336,754	1,295,286,759	517,336,754	Calculated	Water Added (gal) = slurry Water volume (gal) - in situ Water volume (gal)
Total Volume, slurry	cy	6,912,723	3,061,238	6,912,723	3,061,238	Calculated	Total volume, slurry (cy) = Water volume added (gal)/201.974 (gal/cy) + Total Dredge volume, per cycle (cy)
	gal	1,396,280,259	618,330,254	1,396,280,259	618,330,254	Calculated	Total volume, slurry (gal) = Water volume added (gal) + Total Dredge volume, per cycle (cy)*201.974 (cy/gal)
Production rate, slurry	cy/day	13,134	5,816	17,282	7,653	Calculated	Production rate, slurry (cy/day) = Dredge rate (cy/day)*(total slurry volume (cy)/total Dredged volume (cy))
	gal/day	2,652,932	1,174,827	3,490,701	1,545,826	Calculated	Production rate, slurry (gal/day) = Production rate, slurry (cy/day)*201.974 (gal/cy)
	gpm	4,053	1,795	5,333	2,362	Calculated - includes 10% increase for wash water demand	Production rate, slurry (gpm) = Production rate, slurry (gal/day)*720 (min/day)
Total pumping days	days	526	526	400	400	Calculated	Total pumping days = Total volume, slurry (cy)/Production rate, slurry (cy/day)
Slurry Holding Tank							
Influent Solids Load	lb/day	1,618,190	1,618,190	2,129,197	2,129,197	Calculated	Influent Solids Load (lb/day) = weight of material, slurry (dry tons)*2000 (lb/ton)/Total pumping days (days)
Influent Solids Concentration	mg/L	73,090	165,047	73,090	165,047	Calculated	Influent Solids Concentration (mg/L) = Influent Solids Load (lb/day)*453592 (mg/lb)/Production rate, slurry (gal/day)*3.78541 (gal/mg)

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	Run	1	2	3	4	Comments	Equation
	Dredge Rate (cy/day)	950	950	1250	1250		
	Slurry %	0.07	0.15	0.07	0.15		
Parameter	**Unit**	**Value**	**Value**	**Value**	**Value**		
Hydraulic Residence Time	hr	3	3	3	3	Assumed - can be modified based on size constraints	
Number of Slurry Tanks		1	1	1	1	Assumed - can be modified based on size constraints	
Slurry Holding Tank Volume	gallons	729,556	323,078	959,943	425,102	Calculated	Slurry Holding Tank volume (gal) = (Production rate, slurry (gpm)/Number of slurry tanks)*Hydraulic Residence Time (hr)*60 (min/hr)
	MG	0.730	0.323	0.960	0.425	Calculated	
Holding Tank Side Water Depth	feet	11	11	11	11	Assumed - can be modified based on size constraints	
Slurry Tank Freeboard	feet	1	1	1	1	Assumed - can be modified based on size constraints	
Slurry Tank Total Height	feet	12	12	12	12	Calculated	Slurry Tank Total height (ft) = slurry Tank SWD + slurry Tank Freeboard
Slurry Holding Tank Diameter	feet	108	72	122	82	Calculated	Slurry Holding Tank Diameter = 2*sqrt[Slurry Holding Tank Volume (gal) / (Slurry Holding Tank SWD (ft) * 7.48 (gal/cf) *π)]
Slurry Tank Footprint	SF	9,161	4,072	11,690	5,281	Calculated	Slurry Tank Footprint (sf) = π*(slurry Holding Tank Diameter (ft)/2)^2*Number of slurry Tanks
Hydrocyclone							
Hydrocyclone Influent Flow	gpm	4,053	1,795	5,333	2,362	Calculated - + 10% for wash water	
Hydrocyclone Total Influent Solids	lb/day	1,618,190	1,618,190	2,129,197	2,129,197	From Slurry Holding Tank	
Hydrocyclone Influent TSS	mg/L	73,090	165,047	73,090	165,047	From Slurry Holding Tank	
Sand in Hydrocyclone Skid Influent	percent	22%	22%	22%	22%	Based on Field Assessment - based on average of clayey silt (predominant material) submitted for gradation	
Hydrocyclone Influent Sand Load	lb/day	356,002	356,002	468,423	468,423	Calculated	Hydrocyclone Influent Sand Load (lb/day) = Hydrocyclone Total Influent Solids (lb/day)*Sand in Hydrocylcone Skid Influent (%)
	tons/hr	14.8	14.8	19.5	19.5	Calculated	Hydrocyclone Influent Sand Load (ton/hr) = Hydrocyclone Influent Sand Load (lb/day)/2000 (lb/ton)*Duration (hr/d)
Sand Removal Efficiency	percent	80%	80%	80%	80%	Assumed. Could vary for hauling vs. dewatering calcs, similar to LPR.	
Hydrocyclone Underflow Sand Load (Dry)	lb/day	284,801	284,801	374,739	374,739	Calculated	Hydrocyclone Underflow Sand Load (lb/day) = Hydrocyclone Influent Sand Load (lb/day)*Sand Removal Efficiency (%)
	tons/hr	11.9	11.9	15.6	15.6	Calculated	Hydrocyclone Underflow Sand Load (tons/hr) = Hydrocyclone Underflow Sand Load (lb/day)/2000 lb/ton*Duration (hr/day)
Hydraulic Underflow Sand Percent Solids (Ws/Wt)	percent	80%	80%	80%	80%	Assumed	
Hydraulic Underflow Sand Percent Moisture (Ww/Wt)	percent	20%	20%	20%	20%	Calculated	Hydraulic Underflow Sand Percent Moisture (%) = 1 - Hydraulic Underflow Sand Percent Solids (%)
Water Content (Ww/Ws)	percent	25%	25%	25%	25%	Calculated	Water Content = (1/Percent Solids) - 1
Hydraulic Underflow Sand Dry Bulk Density (Ws/Vt)	lb/cf	97.6	97.6	97.6	97.6	Calculated	Dry Bulk density (lb/cf) = (SG, solids*density, water (lb/cf))/(1+ SG, solids*Water Content)
Hydraulic Underflow Wet Bulk Density (Wt/Vt)	lb/cf	122	122	122	122	Calculated	Wet Bulk density (lb/cf) = Dry Bulk density (lb/cf)/Percent Solids (%)
Hydrocyclone Hydraulic Underflow	gpm	30.3	30.3	39.9	39.9	Calculated. Hydraulic equivalent volume of underflow sand load	Hydrocyclone Hydraulic Overflow (gpm) = [(Dry Hydrocyclone Underflow Sand Load (lb/day)/Hydraulic Underflow Sand Percent Solids (%))/Hydraulic Underflow Wet Bulk density (Wt/Vt)]*7.481 (gal/cf)/(Duration (hr/day)/60 (min/hr))
Hydrocyclone Overflow	gpm	4,023	1,765	5,293	2,322	Calculated	Hydrocyclone Overflow (gpm) = Hydrocyclone Hydraulic Underflow (gpm) - Hydrocyclone Influent Flow (gpm)
Hydrocyclone Total Overflow Solids	lb/day	1,333,389	1,333,389	1,754,459	1,754,459	Calculated	Hydrocyclone Total Overflow Solids (lb/day) = Hydrocyclone Total Influent Solids (lb/day) - Hydrocyclone Underflow Sand Load (lb/day)
Hydrocyclone Footprint	sf	1,920	1,280	2,560	1,280	From Del Tank	
Gravity Thickener							
Gravity Thickener Removal Efficiency	percent	99.5%	99.5%	99.5%	99.5%	Based on previous project experience.	
Gravity Thickener Underflow Solids Load	lb/day	1,326,722	1,326,722	1,745,686	1,745,686	Calculated	Gravity Thickener Underflow Solids Load (lb/day) = Hydrocyclone Total Overflow Solids (lb/day)/Gravity Thickener Removal Efficiency (%)
Thickened Sludge Percent Solids (Ws/Wt)	percent	15%	15%	15%	15%	Assumed	

	Run	1	2	3	4	Comments	Equation
	Dredge Rate (cy/day)	950	950	1250	1250		
	Slurry %	0.07	0.15	0.07	0.15		
Parameter	Unit	Value	Value	Value	Value		
Hydraulic Underflow Sand Percent Moisture (Ww/Wt)	percent	85%	85%	85%	85%	Calculated	Hydraulic Underflow Sand Percent Moisture (%) = 1 - Hydraulic Underflow Sand Percent Solids (%)
Water Content (Ww/Ws)	percent	567%	567%	567%	567%	Calculated	Water Content (%) = Hydraulic Underflow Sand Percent Moisture (%)/Thickened Sludge Percent Solids(%)
Gravity Thickener Dry Bulk Density (Ws/Vt)	lb/cf	10.3	10.3	10.3	10.3	Calculated	Dry Bulk density (lb/cf) = (SG, solids*density, water (lb/cf))/(1+ SG, solids*Water Content)
Gravity Thickener Wet Bulk Density (Wt/Vt)	lb/cf	68.7	68.7	68.7	68.7	Calculated	Wet Bulk density (lb/cf) = Dry Bulk density (lb/cf)/Percent Solids (%)
Gravity Thickener Underflow	gpm	1,471.6	1,471.6	1,936.3	1,936.3	Calculated	Gravity Thickener Underflow (gpm) = [Gravity Thickener Underflow Solids Load (lb/day)/Gravity Thickener Dry Bulk density (%)*7.481 (gal/cf)]/Duration (hr/day)*60 (min/hr)
Gravity Thickener Hydraulic Loading Rate	gal/ft^2-d	500	500	500	500	Assumed. Metcalf & Eddy Chapter 14 - midpoint of range for primary sludge 380-760 gal/ft^2-d	
Gravity Thickener Solids Loading Rate (lb/ft2-d)	lb/ft^2-d	375	375	375	375	Assumed, based on previous project experience.	
Gravity Thickener Total Surface Area - Hydraulic Constraint Per Tank	ft^2	4,238	4,238	5,577	5,577	Calculated	= Gravity Thickener Underflow (gpm)*1440(min/day)/Gravity Thickener Hydraulic Loading rate (gal/sf-d)
Gravity Thickener Total Surface Area - Solids Constraint Per Tank	ft^2	3,538	3,538	4,655	4,655	Calculated	Gravity Thickener Underflow Solids Load (lb/day)/Gravity Thickener Solids Loading rate (lb/sf-d)
No. Gravity Thickeners		2	2	2	2	Assumed - can increase # to decrease size.	
Diameter per Gravity Thickener	ft	40	40	45	45	Calculated	Diameter = 2 * sqrt[Gravity Thickener Total Surface Area / (No. of Gravity Thickeners * π)]
Gravity Thickener Overflow	gpm	2,551	293	3,357	386	Calculated. To WTP.	Gravity Thickener Overflow (gpm) = Hydrocyclone Overflow (gpm) - Gravity Thickener Underflow (gpm)
Gravity Thickener Overflow Solids	lb/day	6,667	6,667	8,772	8,772	Calculated. To WTP.	Gravity Thickener Overflow Solids (gpm) = Hydrocyclone Overflow Solids (gpm) - Gravity Thickener Underflow Solids (gpm)
Gravity Thickener Overflow TSS	mg/L	435	3,787	435	3,787	Calculated. To WTP.	Gravity Thickener Overflow TSS (mg/L) = Gravity Thickener Overflow Solids (lb/day)*453592 (mg/lb)/[Gravity Thickener Overflow(gpm)*3.78541 (gal/mg)*Duration (hr/day)*60(min/hr)]
Gravity Thickener Footprint	sf	2,513	2,513	3,181	3,181	Calculated.	Gravity Thickener Footprint (sf) = No. of Gravity Thickeners*π*(Diameter per Gravity Thickener (ft)/2)^2
Sludge Holding Tank and Filter Press Feed Tanks							
Influent Flow	gpm	1,471.6	1,471.6	1,936.3	1,936.3	Calculated.	(same as Gravity Thickener Overflow)
Influent Solids Load	lb/day	1,326,722	1,326,722	1,745,686	1,745,686	Calculated.	(same as Gravity Thickener Underflow Solids Load)
No. Sludge Holding Tank and Filter Press Feed Tanks Required		1	1	1	1	Assumed	
Sludge Holding Tank and Filter Press Feed Tanks HRT	hr	3	3	3	3	Assumed	
Sludge Holding Tank and Filter Press Feed Tanks Volume (gal)	gallons	264,885	264,885	348,533	348,533	Calculated	Tank volume (gal) = Influent flow (gpm)*Sludge Holding Tank and Filter Press Feed Tanks HRT (hour)
Holding Tank Side Water Depth	feet	4	4	4	4	Assumed	
Holding Tank Freeboard	feet	0.75	0.75	0.75	0.75	Assumed	
Holding Tank Total Height	feet	4.75	4.75	4.75	4.75	Calculated	Holding Tank Total height (ft) = Holding Tank SWD (ft) + Holding Tank Freeboard (ft)
Holding Tank Diameter	feet	108	108	122	122	Calculated	Holding Tank Diameter = 2*sqrt[Holding Tank Volume (gal) / (Holding Tank SWD (ft) * 7.48 (gal/cf) *π)]
Holding Tank Footprint	sf	2290	2290	2922	2922	Calculated	Holding Tank Footprint (sf) = π*(Holding Tank Diameter (ft)/2)^2*Number of Holding Tanks
Filter Press		47.85625397					
Solids Removal Efficiency	percent	99.90%	99.90%	99.90%	99.90%	Assumed	
Belt Press Cake Percent Solids (Ws/Wt)	percent	50%	50%	50%	50%	Assumed, based on previous project experience and vendor information.	
Cake Dry Load	lb/day	1,325,395	1,325,395	1,743,941	1,743,941	Calculated.	Cake Dry Load (lb/day) = Influent Solids Load (lb/day)*Solids Removal Efficiency
	lb/day	2,650,790	2,650,790	3,487,881	3,487,881	Calculated.	Cake Wet Load (lb/day) = Cake Dry Load (lb/day)/Belt Press Cake Percent Solids (%)
	ton/hr	110	110	145	145	Calculated	Cake Wet Load (ton/hr) = Cake Wet Load (lb/day)/(2000 (lb/ton)/Duration (hr/day))

	Run	1	2	3	4	Comments	Equation
	Dredge Rate (cy/day)	950	950	1250	1250		
	Slurry %	0.07	0.15	0.07	0.15		
Parameter	**Unit**	**Value**	**Value**	**Value**	**Value**		
Cake Wet Load	gpm	307	307	403	403	Calculated	Cake Wet Load (gpm) = Cake Wet Load (cf/hr)/(60 (min/hr)*7.481 (gal/cf))
	cf/hr	2,459	2,459	3,235	3,235	Calculated.	Cake Wet Load (cf/hr) = Cake Wet Load (lb/day)/(Cake Wet Bulk density (lb/cf)/Duration (hr/day))
Cake Underflow Percent Moisture (Ww/Wt)	percent	50%	50%	50%	50%	Calculated	Cake Underflow Percent Moisture (%) = 1 - Belt Press Cake Percent Solids (%)
Cake Water Content (Ww/Ws)	percent	100%	100%	100%	100%	Calculated	Cake Water Content (%) = Cake Underflow Percent Moisture (%)/Belt Press Cake Percent Solids (%)
Cake Dry Bulk Density (Ws/Vt)	lb/cf	44.92	44.92	44.92	44.92	Calculated	Dry Bulk density (lb/cf) = (SG, solids*density, water (lb/cf))/(1+ SG, solids*Water Content)
Cake Wet Bulk Density (Wt/Vt)	lb/cf	89.84	89.84	89.84	89.84	Calculated	Wet Bulk density (lb/cf) = Dry Bulk density (lb/cf)/Percent Solids (%)
Cake Hydraulic Underflow	gpm	153.3	153.3	201.7	201.7	Calculated. Hydraulic equivalent volume of underflow cake.	Cake Hydraulic Underflow (gpm) = Cake Wet Load (lb/day)/(Cake Wet Bulk density(gpm)*7.481 (gal/cf)*1440 (min/day)
Filtrate Flow	gpm	1,318.3	1,318.3	1,734.6	1,734.6	Calculated	Filtrate Flow (gpm) = Influent Flow (gpm) - Cake Hydraulic Underflow (gpm)
Filtrate Solids Load (lb/day)	lb/day	1,327	1,327	1,746	1,746	Calculated	Filtrate Solids Load (lb/day) = Influent Solids Load (lb/day) - Cake Dry Load (lb/day)
Filtrate TSS	mg/L	167	167	167	167	Calculated	
Solids Capacity - Filter Press	cf/hr	160	160	160	160	Assumed - 80-100 cf/drop, 1-2 drops/hr from vendor	
No. Filter press required		16	16	21	21	Calculated	No. Filter press required = Cake Wet Load (cf/hr)/Solids Capacity, Filter Press (cf/hr)
Filter Press Footprint	SF	6,144	6,144	8,064	8,064	From Del Tanks: https://www.deltank.com/uploads/4/8/0/5/48055163/filter_press_brochure.pdf	
Stockpile Area							
Days of Production Stockpiled	days	2	2	2	2	Assumed.	
Total Volume of Cake Stockpile	cy	2,186	2,186	2,876	2,876	Calculated.	Total Volume of Cake Stockpile (cy) = Days of Production Stockpiled (day)*Cake Wet Load (lb/day)/(Cake Wet Bulk density (lb/cf)/27 (cf/cy))
Total Volume of Hydrocyclone Stockpile	cy	216	216	284	284	Calculated	Volume of Hydrocyclone Stockpile (cy) = Days of Production Stockpiled (day)*Hydrocyclone Underflow Sand Load (Dry)/(Hydraulic Underflow Sand Dry Bulk density (lb/cf)/27 (cf/cy)
Height of Stockpile	ft	10.0	10	10	10	Assumed.	
Stockpile Radius	ft	11.9	11.9	11.9	11.9	Calculated assuming using 35 degree angle of repose	Stockpile Radius (ft) = height of Stockpile (ft)/tan(40π/180)
Volume per Stockpile	cy	55.1	55.1	55.1	55.1	Calculated.	Volume per Stockpile (cy) = [(π*(Stockpile Radius (ft))2*Stockpile height (ft))/3]/27 (cf/cy)
Total Number of Stockpiles		44	44	57	57	Calculated	Number of Stockpiles = (Volume of Cake Stockpile (cy) + Volume of Hydrocyclone Stockpile (cy))/Volume per Stockpile (cy)
Stockpile Area Footprint	sf	24,769	24,769	32,590	32,590	Calculated.	Stockpile Footprint (sf) = Number of Stockpiles*(2*Stockpile Radius)^2
Other Support Areas							
Polymer Area	sf	2,100	2,100	2,100	2,100	Scaled from previous project based on system throughput.	
Plant Water Tanks	gal	25,000	25,000	25,000	25,000	Assumed.	
Plant Water Tank, Height	ft	15	15	15	15	Assumed.	
Plant Water Tank Footprint, minimum	sf	223	223	223	223	Calculated	Plant Water Tank Footprint, min (sf) = Plant Water Tanks (gal)*0.1337 (sf/gal)/Plant Water Tank height (ft)
Plant Water Tank Diameter	ft	17	17	17	17	Calculated	Holding Tank Diameter = 2*sqrt(Plant Water Tank Footprint (sf) / π)
Water Treatment Area							
Water Treatment Flow	gal/day	2,786,040	1,160,125	3,665,843	1,526,480	Calculated.	Water Treatment Flow (gal/day) = Water Treatment Flow (gpm)*Duration (hr/day)*60 (min/hr)
Water Treatment Flow	gpm	3,870	1,611	5,091	2,120	Calculated. Filtrate flow + Gravity Thickener Overflow	Water Treatment Flow (gpm) = (Water Treatment flow (gpm) Gravity Thickener Overflow (gpm)
Water Treatment TSS	mg/L	344	826	344	826	Calculated	Water Treatment TSS (mg/L) = (Filtrate flow (lb/day)*Filtrate TSS (mg/L) + Gravity Thickener Overflow (gpm)*Gravity Thickener TSS (mg/L))/Water Treatment flow (gpm)
Equalization Volume	gal	278,604	116,012	366,584	152,648	Calculated	Equalization volume (gal) = 0.1*Water Treatment Flow (gpm)
Equalization Tanks		28	12	37	15	TYP. 10,000 gallon tanks	
Tank Area	sf/tank	300	300	300	300	Typical from Baker	
Sand Filtration	gpm	550	550	550	550	Assumed	

	Run	1	2	3	4	Comments	Equation
	Dredge Rate (cy/day)	950	950	1250	1250		
	Slurry %	0.07	0.15	0.07	0.15		
Parameter	**Unit**	**Value**	**Value**	**Value**	**Value**		
Sand Filtration Units		8	3	10	4	Calculated	Sand Filtration Units = Water Treatment Flow (gpm)/Sand Filtration (gpm)
Sand Filtration Unit Area	sf/unit	250	250	250	250	From Baker Corp: https://ur.bakercorp.com/assets/0/77/2147483653/38e22b06-549a-4470-9ce3-8825ec2cae28.pdf	
Water Treatment Area	sf	10,358	4,230	13,498	5,579	Calculated	Water Treatment area (sf) = Sand Filtration unit area (sf/unit)*Sand Filtration units + Tank area(sf/unit)*Equalization volume (gal)
Total Dewatering and Water Treatment Area							
Dewatering Area	sf	24,351	18,622	30,740	23,051	Calculated	Dewatering area (sf) = Slurry Tank Footprint (sf) + Hydrocyclone Footprint (sf) + Gravity Thickener Footprint (sf) + Holding Tank Footprint (sf) + Filter Press Footprint (sf) + Plant Water Tank Diameter (sf)
Stockpile Area	sf	24,769	24,769	32,590	32,590	Calculated	(see above for Stockpile area)
Water Treatment Area	sf	10,358	4,230	13,498	5,579	Calculated	(see above for Water Treatment area)
Footprint, minimum	sf	198,315	139,030	253,778	175,743	Calculated. Assumes 500% increase for dewatering and water treatment area for piping/tank clearance/access	Footprint, min = 0.5*(Dewatering area (sf) + Water Treatment area (sf)) + Stockpile area (sf)
Footprint, minimum	**acres**	**4.55**	**3.19**	**5.83**	**4.03**	**Calculated. Assumes 500% increase for piping/tank clearance/access**	**Footprint, min (acre) = Footprint, min (sf)/43560 (sf/acre)**

Table B-4. Gravity Dewatering with Drying Agent Area Calculation
Appendix B - Dewatering Area Sizing
Alternatives Analysis Report
Lake Accotink Dredging Project
Fairfax County, Virginia

	Run	1	2	Comments	Equation
	Dredge Rate (CY/day)	950	1250		
Parameter	Unit	Value	Value		
SG, solids		2.57	2.57	Average specific gravity of sediment samples collected during Field Assessment.	
Density, water	lb/cf	62.4	62.4	Literature Value	
Construction Time	days	527	400		
Dredge rate, sediment	cy/day	950	1,250	Range of potential dredge rates; input at top by run.	
Duration	hr/day	12	12		
Total Dredge Volume, per cycle	cy	500,000	500,000	Total Dredge volume in cycle	
Bucket Fill	%	0.6	0.6	Assumed	
Bulk Free Water Production Rate	gal/day	76,750	100,987	Calculated	Bulk Free Water Production rate (gal/day) = (1 - Bucket Fill (%))*Dredge rate(cy/day)*201.974 (gal/cy)
Total Water Volume Added	gal	40,447,313	40,394,800	Calculated	Total Water volume added (gal) = Bulk Free Water Production rate (gal/day)*Construction Time (day)
Total Water Volume Added	cy	200,234	199,974	Calculated	Total Water volume added (cy) = Total Water volume added (gal)/201.974 (gal/cy)
Sediment, in situ					
Percent Solids (Ws/Wt)		63%	63%	Calculated	Percent Solids = 1/(Water Content + 1)
Percent Moisture (Ww/Wt)		38%	38%	Calculated	Percent Moisture = 1 - Percent Solids
Water Content (Ww/Ws)		0.6	0.6	Average in-situ water content of sediment samples collected during Field Assessment.	
Wet bulk density (Wt/Vt)	lb/cf	101	101	Calculated	Wet Bulk density (lb/cf) = Dry Bulk density (lb/cf)/Percent Solids (%)
	ton/cy	1.36	1.36	Calculated	Wet Bulk density (ton/cy) = Wet Bulk density (lb/cf)*27 (cf/cy)/2000 (lb/ton)
Dry bulk density (Ws/Vt)	lb/cf	63.1	63.1	Calculated	Dry Bulk density (lb/cf) = (SG, solids*density, water (lb/cf))/(1+ SG, solids*Water Content)
	ton/cy	0.85	0.85	Calculated	Dry Bulk density (ton/cy) = Dry Bulk density (lb/cf)*27 (cf/cy)/2000 (lb/ton)
Weight of material, in situ	wet tons	681,343	681,343	Calculated	Wet weight (tons) = Wet Bult density (tons/cy)*Total Dredge volume per Cycle (cy)
	dry tons	425,839	425,839	Calculated	Dry weight (tons) = Dry Bulk density (tons/cy)*Percent Solids
	tons water	255,504	255,504	Calculated	Water weight (tons) = Wet weight (tons)*Percent Solids
Water Volume, in situ	cy water	303,304	303,304	Calculated	Water volume (gal) = Water weight (tons)*2000/density of Water (lb/cf)* 7.481 (gal/cf)
Wet Volume, in situ	cy wet	500,000	500,000	Calculated	Wet volume (cy) = weight of Material (wet tons)/Wet Bulk density (ton/cy)
Solids Volume, in situ	cy solids	196,696	196,696	Calculated	Solids volume (cy) = Water volume (cy) - Wet volume (cy)
Sediment, after dredging					
Percent Solids (Ws/Wt)		50.1%	50.1%	Calculated	Percent Solids = 1/(Water Content + 1)
Percent Moisture (Ww/Wt)		49.9%	49.9%	Calculated	Percent Moisture = 1 - Percent Solids
Water Content (Ww/Ws)		99.6%	99.6%	Calculated	Water Content = (1/Percent Solids) - 1
Wet bulk density (Wt/Vt)	lb/cf	89.9	89.9	Calculated	Wet Bulk density (lb/cf) = Dry Bulk density (lb/cf)/Percent Solids (%)
	ton/cy	1.21	1.21	Calculated	Wet Bulk density (ton/cy) = Wet Bulk density (lb/cf)*27 (cf/cy)/2000 (lb/ton)
Dry bulk density (Ws/Vt)	lb/cf	45.0	45.1	Calculated	Dry Bulk density (lb/cf) = (SG, solids*density, water (lb/cf))/(1+ SG, solids*Water Content)
	ton/cy	0.61	0.61	Calculated	Dry Bulk density (ton/cy) = Dry Bulk density (lb/cf)*27 (cf/cy)/2000 (lb/ton)
Specific gravity material		1.44	1.44	Calculated	SG = Wet Bulk density(lb/cf)/density of Water (lb/cf)

	Run	1	2	Comments	Equation
	Dredge Rate (CY/day)	950	1250		
Parameter	Unit	Value	Value		
Weight of Material Bulked during Dredging	wet tons	850,020	849,801	Calculated	slurry Wet weight (tons) = in situ Dry weight (tons)/Percent Solids
	dry tons	425,839	425,839	Calculated	(same as in situ dry weight)
	tons water	424,181	423,962	Calculated	slurry Water weight (tons) = Wet weight (tons) - Dry weight (tons)
	tons water added	168,677	168,458	Calculated	Water added (tons) = slurry Water weight (tons) - in situ Water weight (tons)
Volume Bulked during Dredging	cy wet	700,234	699,974	Calculated	volume Bulked (cy wet) = volume Bulked (cy water) + volume Bulked (cy solids)
	cy solids	196,696	196,696	Calculated	volume Bulked (cy solids) = Solids volume in situ (cy solids)
	cy water	503,538	503,278	Calculated	Water added (gal) = slurry Water volume (gal) + in situ Water volume (gal)
Sediment, after dewatering					
Percent Solids (Ws/Wt)		0.60	0.60	Assumed final percent solids at 60%	
Percent Moisture (Ww/Wt)		40%	40%	Calculated	Percent Moisture = 1 - Percent Solids
Water Content (Ww/Ws)		67%	67%	Calculated	Water Content = (1/Percent Solids) - 1
Wet bulk density (Wt/Vt)	lb/cf	98.5	98.5	Calculated	Wet Bulk density (lb/cf) = Dry Bulk density (lb/cf)/Percent Solids (%)
	ton/cy	1.33	1.33	Calculated	Wet Bulk density (ton/cy) = Wet Bulk density (lb/cf)*27 (cf/cy)/2000 (lb/ton)
Dry bulk density (Ws/Vt)	lb/cf	59.1	59.1	Calculated	Dry Bulk density (lb/cf) = (SG, solids*density, water (lb/cf))/(1+ SG, solids*Water Content)
	ton/cy	0.798	0.798	Calculated	Dry Bulk density (ton/cy) = Dry Bulk density (lb/cf)*27 (cf/cy)/2000 (lb/ton)
Specific gravity material		1.58	1.58	Calculated	SG = Wet Bulk density(lb/cf)/density of Water (lb/cf)
Weight of material, after dewatering	wet tons	709,732	709,732	Calculated	Dewatered Wet weight (tons) = Dewatered Dry weight (tons)/Percent Solids
	dry tons	425,839	425,839	Calculated	Dewatered Dry weight (tons) = slurry Dry weight (tons)
	tons water	283,893	283,893	Calculated	Dewatered Water weight (tons) = Wet weight (tons) - Dry weight (tons)
	tons water dewatered	140,288	140,069	Calculated	Water Dewatered (tons) = slurry Water weight (tons) - Dewatered Water weight (tons)
Volume of water, after dewatering	cy water	336,950	336,950	Calculated	volume of Water after Dewatering (cy water) = weight of Water after Dewatering (tons water)*2000 (lb/ton)/(62.4 (lb/cf)*27 (cf/cy))
	cy water dewatered	363,285	363,025	Calculated	volume of Water Dewatered (cy) = volume of Water after Dewatering (cy water) - volume Bulked during Dredging (cy wet)
Total Volume (disposal Quantity)	cy	533,700	533,700	Calculated	Total volume for Disposal (cy) = weight of Material (wet tons)/Wet Bulk density (ton/cy)
Drying Agent Dewatering Pad					
Maximum Expected Dredging Rate	cy/day	950	1,250	Range of potential dredge rates; input at top by run.	
Material Placement Duration	day	1	1	Assumed	
Dewatering Duration	day	1	1	Assumed	
Material Offloading Duration	day	1	1	Assumed	
Total Storage Volume	cy	2,850	3,750	Calculated	Total Storage volume (cy) = Dredge rate (cy/day)*(Material Placement Duration (day) + Dewatering Duration (day) + Material Offloading Duration (day)
Addition of Drying Agent	percent by weight	10%	10%	Assumed	
Total Volume of Sediment	cy	3,135	4,125	Calculated	Total volume of Sediment (cy) = Total Storage volume (cy)*(1 + Drying Agent (% by weight))
Material Height	ft	1.5	1.5	Assumed	
Dewatering Pad Size	sf	71,000	93,000	Calculated	Dewatering Pad Size (sf) = Total volume of Sediment (cy)/Depth of Sediment (1.5 feet) * (1 + 25 % Safety Factor)
Dewatering Pad Size	acre	1.63	2.13	Calculated	Dewatering Pad Size (acre) = Dewatering Pad Size (sf)/43560 (sf/acre)

	Run	1	2	Comments	Equation
	Dredge Rate (CY/day)	950	1250		
Parameter	Unit	Value	Value		
Water Treatment Area					
Dewatering Rate	gal/day	139,411	183,304	Calculated	Dewatering rate (gal/day) = volume of Water Dewatered (cy)/(Total Dredge volume (cy)/Dredge rate (cy/day))*201.974 (gal/cy)
Dewatering Rate	gpm	194	255	Calculated	Dewatering rate (gpm) = Dewatering rate (gal/day)*720 (minutes/working day)
Equalization Volume	gal	13,941	18,330	Calculated	Equalization volume (gallons) = Dewatering rate (gal/day)*0.1
Equalization Tanks		1	2	TYP. 10,000 gallon tanks	
Tank Area	sf/tank	300	300	Typical from Baker	
Sand Filtration	gpm	550	550	Assumed.	
Sand Filtration Units		1	1	Calculated	Sand Filtration Units = Dewatering rate (gpm)/Sand Filtration rate (gpm)
Sand Filtration Unit Area	sf/unit	250	250	From Baker Corp	
Footprint, minimum	sf	3,341	4,000	Calculated. Assumes 500% increase for piping/tank clearance/access	Footprint (sf) = (Equalization Tanks*Tank area (sf)) + (Sand Filtration*Sand Filtration Unit area (sf/unit))
Footprint, minimum	acre	0.0767	0.0918	Calculated	Footprint (acre) = Footprint (sf)/43560 (sf/acre)
Total Dewatering and Water Treatment Area					
Dewatering Footprint	acre	1.63	2.13	Calculated from above	(same as Dewatering Pad Size (acre)
Water Treatment Area	acre	0.0767	0.0918	Calculated from above.	(same as Water Treatment area Footprint, minimum (acre)
Total	**acre**	**1.71**	**2.23**		

Attachment 1

Supplemental TenCate Information

TenCate Geotube® Containment and Dewatering

Geotube® Simulator
Cross Section

2/12/21	Project:	

Units:	English		Circumferential Tensile Force (T) =	67.69	lb/in.
Water Level:	Fully Emerged		Geotube® Base Contact Width (B) =	33.85	ft
			Geotube® Filled Width (W) =	37.22	ft
Geotube® Height (H) =	6	ft	Geotube® Cross Section Area (A) =	203.52	sq ft
Geotube® Circumference (C) =	80	ft	Geotube® Volume Per Unit of Length (V) =	7.54	cu yd/ft
Relative Density of Fill Material =	1.45	sg	FS of Circumferential Failure =	6.6	FS
Geotube® Fabric Type:	GT500		Axial Direction FS (AFS) =	6.5	FS
Geotube® Fabric Type:	Rigid Mechanical		FS of Fill Port Failure =	6.7	FS

The equations used in the Geotube® Simulator are based on the paper "Two-dimensional analysis of geosynthetic tubes" by R. H. Plaut and S. Suherman, Acta Mechanica, Volume 129, 1998, pages 207-218, and on further research by Professor Raymond H. Plaut. The software was developed by Benjamin Z. Dymond. The work was performed at Virginia Tech.

Appendix C

Permitting and Mitigation Memo

Wetland Studies and Solutions, Inc.® a DAVEY company

M E M O R A N D U M

TO: Michael Wooden, P.E., Arcadis (via email: Michael.Wooden@arcadis.com)

FROM: Frank Graziano, P.E., WSSI

DATE: July 9, 2021

RE: Lake Accotink Dredging – Permitting Protocols, Timeframes, and JPA Requirements

The following details summarize WSSI's understanding of the necessary Clean Water Act Section §404 and §401 and Chesapeake Bay Preservation Act permitting protocol and specific information required to prepare a complete Joint Permit Application (JPA) for the Lake Accotink dredging project. Activities considered in development of the following plan include dredging within the lake, construction of a sediment transport pipeline and development of a sediment dewatering area. Note this plan does not account for permitting requirements associated with potential off-site disposal of dewatered sediment.

Permit Requirements and Approval Timeframes

Clean Water Act Section §404 and §401 Permitting

- Department of Environmental Quality (DEQ) – Individual Permit
  - Anticipated as necessary due to amount of total impact to jurisdictional waters.
  - Anticipated approval timeframe: 6 – 12 months from submission of the JPA.
  - Requires a 30-day Public Notice period where DEQ prepares the notice and the Applicant coordinates publishing within a newspaper having general circulation in the area of the project.

- U.S. Army Corps of Engineers (COE) – Individual Permit
  - Anticipated as necessary due to amount of total impact to jurisdictional waters.
  - Anticipated approval timeframe: 8 – 12 months from submission of the JPA.
  - Requires a 30-day Public Notice period administered entirely by COE and posted on the COE's website.

- Virginia Marine Resource Commission (VMRC) Permit
  - Necessary due to drainage area of impacts being larger than 5 square miles.
  - Anticipated approval timeframe: 3 – 6 months from submission of the JPA.
  - VMRC jurisdiction includes historic Accotink Creek stream bed and not the entirety of Lake Accotink.
  - Requires a 15-day Public Notice period where VMRC administers and coordinates publishing within a newspaper having general circulation in the area of the project.

If proposed impacts exceed 1-acre of wetland impact and 1,500 linear feet of stream impact, Individual Permits (IP) from the COE and DEQ will need to be requested. If any proposed impacts have a drainage area of 5-square miles or greater (i.e. within the historic footprint of Accotink Creek), a VMRC permit will be required. Approval of a DEQ IP takes approximately 6-12 months and a COE IP take approximately 8-12 months from submission of a JPA. IPs are typically valid for up to 15 years and may be able to cover future maintenance dredging activities, pending discussion and approval from the regulating agencies. Note based off the initial impact assessments, IPs from the COE and DEQ, and a VMRC Permit will be required due to the cumulative impact to Lake Accotink and its surrounding wetlands and stream tributaries.

If proposed impacts remain under 1 acre of wetland impact and 1,500 linear feet of stream impact, General Permits (GP) can be requested from the COE and DEQ. If it is determined the proposed design can be permitted under this impact threshold, approval of GPs would take approximately 4-5 months from submission of the JPA. All GPs are valid for the life of the given permit cycle, which authorization under the current GP is set to expire on 8/1/2023. If additional time is necessary to complete the project under a GP authorization, a request for re-authorization under the next GP permit cycle would need to be submitted prior to the current expiration date of 8/1/2023.

<u>Chesapeake Bay Preservation Act</u>

A request will have to be made to Fairfax County to classify this project as water dependent and an allowed use. In that event, development and submittal of a Water Quality Impact Assessment (WQIA) may be required to demonstrate that impacts to the Resource Protection Area (RPA) have been considered and have been minimized in the design of the project. Any proposed restoration of the disturbed areas within the RPA would also be discussed in the WQIA.

JPA Requirements

The following details outline the basic information necessary to include within the project's JPA for the COE, the DEQ, and the VMRC to deem the application complete. Note this outline is not intended to be a comprehensive list, and WSSI will provide a detailed list of information necessary to obtain from the Applicant when the project design is confirmed.

- <u>Purpose and Need</u>

    - The regulatory agencies presume that you should be able to develop your project without disturbing any jurisdictional wetlands or other waters of the United States (other than unavoidable road or utility crossings). Therefore, the main purpose of the permit application is to convince the agencies why your project needs to be constructed in the intended design. For IP's, alternate site, as well as on-site alternatives, must be considered and discussed within the JPA. A brief narrative that defines the project purpose and need as narrowly as possible while addressing project location, jurisdiction, transportation access, and what part of market segment you intend to service (i.e. residential, retail, commercial, industrial, etc.) will be required. As the purpose of this project is specific to Lake Accotink, an alternative site analysis may not be required to prepare if the intended design is represented as the Least Environmentally Damaging Practicable Alternative (LEDPA). WSSI will confirm this at a Pre-Application Meeting with the agencies.

- Avoidance and Minimization Analysis

  - This analysis provides the justification that the proposed impacts to wetlands and other waters of the U.S. are necessary to implement the desired project plan. The evolution of the project design, including avoidance of site constraints, recommendations from local government staff with respect to utility alignments, sizing and placement of facilities, etc., should be described in detail to provide the basis for why the project has been designed as proposed. Within this analysis, the following information will be required:

    - An overall narrative describing the evolution of the project design including any formal review comments and site constraints that influenced the development plan. This narrative should also discuss alternative development plans considered to demonstrate that avoidance and minimization has been achieved to the maximum extent practicable (i.e. the LEDPA).

    - A detailed narrative describing measures taken to avoid and/or minimize each particular impact, as well as justification for why further avoidance and/or minimization is not practicable.

- Mitigation Plan

  - According to the DEQ's Guidance Memo Number 09-2004 dated March 19, 2009[1] and Section 33 of the Code of Federal Regulations, Chapter II, Part 332 – Compensatory Mitigation for Losses of Aquatic Resources[2], when compensatory mitigation is required, it is preferred in the following order: 1) Mitigation bank credits, 2) In-lieu fee program credits, 3) Permittee-responsible mitigation under a watershed approach, 4) Permittee-responsible mitigation through on-site and in-kind mitigation, 5) Permittee-responsible mitigation through off-site and/or out-of-kind mitigation.

  - It is assumed any permanent impact to jurisdictional waters will be offset through the purchase of mitigation bank credits obtained through the open market.

    - Currently, wetland credits cost roughly $345,000 - $500,000 per credit

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1 As posted on the DEQ website on March 25, 2009 and dated March 19, 2009.
2 As published in the Federal Register on April 10, 2008 (73 F.R. 19594), effective June 9, 2008.

    - Currently, stream credits cost roughly $450-$550 per linear foot of permanent impact

- WSSI will evaluate the number of credits available for purchase on the market once the delineation is conducted, the project area(s) is/area confirmed, and before initiation of the permitting process. If no mitigation credits are available for purchase by the time construction is intended to commence, permittee-responsible mitigation (PRM) will be required. If PRM is required, a conceptual plan must be submitted within the JPA in order for the agencies to deem the JPA complete. Thus, this could add additional lead time in preparation of the conceptual plan and permit application. Note PRM can be constructed both on- and off-site, however is viewed as a last resort mitigation option.

- If PRM via on-site mitigation creation is only the last resort option, but a preferred and feasible option, there is potential for on-site creation in the following locations:

    - Two previous settling basins to the west of Lake Accotink which could be converted to wetland mitigation areas.
    - Numerous tributaries draining directly into Lake Accotink which could be restored using Natural Channel Design (NCD) and converted into stream mitigation areas.

- Note the consideration to implement PRM (versus purchasing mitigation bank credits) would be heavily scrutinized by the agencies and approval to use PRM would need to occur prior to inclusion within the mitigation proposal within the JPA, given it is not the preferred mitigation method.

Next Steps – Pre-Application Meeting

Following the selection of preferred site alternatives and delineations of the project limits, WSSI can quantify wetland and stream impacts and prepare a conceptual Overall Wetlands and Other Waters of the U.S. (WOTUS) Impact Map to present at a Pre-Application Meeting with the DEQ, COE, and VMRC. This meeting will be instrumental in obtaining direct feedback from the agencies on the preferred site alternatives and understanding what specific additional information they will require to be included within the JPA. During this meeting, WSSI can discuss the site's potential advantages for implementing on-site PRM as a primary means for compensatory mitigation versus purchasing mitigation credits.

Limitations

The permitting assumptions outlined herein are based off WSSI's reconnaissance review of wetland and stream information available, previous experiences with Clean Water Act Section §401 and §404 and Chesapeake Bay Preservation Act permitting, and conversations with state and federal regulatory agency representatives. The anticipated permitting scenario is subject to change based off the intended design and proposed cumulative impacts to wetlands and other waters of the U.S

(WOTUS). The JPA requirements outlined herein do not constitute a comprehensive list of information necessary to include within the JPA, but rather are intended to highlight the core components of the JPA. A comprehensive list of information and data necessary to prepare and submit a complete application will be provided to the Applicant prior to preparation of the JPA and is dependent on the specific permitting scenario. In addition, market analyses of wetland and stream mitigation credits show that the cost and availability of credits may vary.

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Appendix D

Cultural Resources Assessment

Cultural Resources Assessment
Lake Accotink Pipe Alignment and Dewatering Sites Alternatives
WSSI# 22647.03
Prepared by Boyd Sipe, M.A., RPA
May 18, 2021 (Revised July 11, 2021)

The following review of previously recorded cultural resources within and near the project alternative alignments was established using the Virginia Department of Historic Resources' (DHRs) online Virginia Cultural Resource Information System (V-CRIS). Please note that V-CRIS data indicates little systematic archeological survey within any of the studied alignments. As such, additional resources will likely be identified during Phase I cultural resources investigations.

Three previously recorded architectural resources were found within the studied alignments; Howrey Field (Resource 029-6868), a recreational site and athletic complex built in 1968, Fairfax County Water Treatment Plant (Resource 029-6867), Ravensworth Farm Neighborhood (Resource 029-6869), and North Springfield Neighborhood (Resource 029-6881). These resources were recorded in June 2021 as part of a Phase I cultural resources investigation conducted of an approximately 3.2-mile-long portion of Braddock Road (Route 620)from Humphries Drive to Ravensworth Road in Fairfax County, Virginia; the survey was conducted by Commonwealth Heritage Group (CHG) on behalf of the Virginia Department of Transportation (VDOT). According to the DHR resource forms, CHG recommended all three resources not eligible for listing in the National Register of Historic Places (NRHP); however, the resources have not been formally evaluated and the report documenting the Phase I investigation is not yet available.

Seven previously recorded archeological sites, Sites 44FX0714, 44FX074. 44FX1414, 44FX1972, 44FX1974, 44FX2734, and 44FX2736, were noted within or adjacent to various alignments, as detailed below. None of these sites have been formally evaluated for listing in the NRHP. According to the DHR resource forms, CHG revisited Sites 44FX0714 and 44FX0741 during the June 2021 survey noted above. Both sites were recorded as prehistoric lithic scatters based on prior investigations by Fairfax County staff. According to the DHR resource forms, the recent survey conducted by CHG did not relocate Site 44FX0714 but identified prehistoric and a late 19th/20th-century historic domestic components for Site 44FX0714 and expanded the site boundary. CHG recommended both sites not eligible for listing in the NRHP; however, the resources have not been formally evaluated and the report documenting the Phase I investigation is not yet available. Site 44FX1414 was recorded by Fairfax County staff as a prehistoric lithic scatter in 1988. Site 44FX2736 was recorded by John Milner Associates, Inc. in 2004 as Civil War-era earthworks and was described as a trench.

In our opinion, Sites 44FX0714 and 44FX0741, recorded in various Howrey Field alignments, would not likely be determined eligible for listing in the NRHP but could meet Fairfax County criteria for local significance. Likewise, Site 44FX1414, a prehistoric lithic scatter site mapped adjacent to the Concrete Plant/Residential Alignment would not likely be determined eligible for listing in the NRHP but could meet Fairfax County criteria for local significance. We feel that Sites 44FX1972, 44FX1974, 44FX2734, and 44FX2736, all Civil War-era military resources, may be eligible for listing in the NRHP and likely meet Fairfax County criteria for local significance. Site 44FX2736 is mapped adjacent to all Dominion ROW alignments and within the Dominion ROW Dewatering Site. Sites 44FX1972, 44FX1974, and 44FX2734 are mapped adjacent to or within the Lake Accotink Upper Settling Basin.

Howrey Field

Howrey Field via Cross-County Trail

- Intersects Howrey Field (Resource 029-6868) and Fairfax County Water Treatment Plant 029-6867.
- Intersects Site 44FX0714.

Howrey Field via Queensberry Avenue

- Intersects Howrey Field (Resource 029-6868), Fairfax County Water Treatment Plant 029-6867, and Ravensworth Farm Neighborhood (Resource 029-6869).
- Intersects Sites 44FX0714 and 44FX0741.

Howrey Field via Flag Run/Port Royal Road

- Intersects Howrey Field (Resource 029-6868) and Fairfax County Water Treatment Plant 029-6867.
- Intersects Sites 44FX0714 and 44FX0741.

Howrey Field via Flag Run/I-495

- Intersects Howrey Field (Resource 029-6868)

Wakefield Park Maintenance Facility

Wakefield Park Maintenance Facility via Cross-County Trail

- Intersects Fairfax County Water Treatment Plant 029-6867

Wakefield Park Maintenance Facility via Queensberry Avenue

- Intersects Ravensworth Farm Neighborhood (Resource 029-6869).

Wakefield Park Maintenance Facility via Flag Run/Port Royal Road

- Intersects no previously recorded resources.

Wakefield Park Maintenace Facility via Flag Run/I-495

- Intersects no previously recorded resources.

Wakefield Ball Fields

Wakefield Ball Fields via Cross-County Trail

- Intersects Fairfax County Water Treatment Plant (029-6867).

Wakefield Ball Fields via Queensberry Avenue

- Intersects Ravensworth Farm Neighborhood (Resource 029-6869).

Wakefield Ball Fields via Flag Run/Port Royal Road

- Intersects no previously recorded resources.

Wakefield Ball Fields via Flag Run/I-495

- Intersects no previously recorded resources.

Dominion ROW

Dominion ROW via Cross-County Trail

- Intersects Fairfax County Water Treatment Plant (029-6867).
- Within or adjacent to recorded location of Site 44FX2736..

Dominion ROW via Queensberry Avenue

- Intersects Ravensworth Farm Neighborhood (Resource 029-6869).
- Adjacent to recorded location of Site 44FX2736.

Dominion ROW via Flag Run/Port Royal Road

- Within or adjacent to recorded location of Site 44FX2736.

Dominion ROW via Flag Run/I-495

- Within or adjacent to recorded location of Site 44FX2736.

Concrete Plant

Concrete Plant, Residential Alignment

- Intersects North Springfield Neighborhood (Resource 029-6881).
- Within or adjacent to recorded location of Site 44FX1414.

Concrete Plant via Amtrak ROW

- Within or adjacent to recorded location of Site 44FX1414.

Lake Accotink Upper Settling Basin

- Generally, runs with or adjacent to mapped location of Site 44FX1972, Lake Accotink 3; O&A Railroad. Site 44FX1972 represents a preserved portion of the mid-19th-century Orange & Alexandria rail bed and associated culverts within Accotink Park. The O&ARR was the major transportation and supply linking Washington and supply depots along the Potomac within the Army of the Potomac. The site has not been evaluated for listing in the NRHP.

- Also adjacent to mapped location of Site 44FX1974, recorded in 1992 as Civil War-era U.S. Army camp. The site has not been evaluated for listing in the NRHP.

- Also adjacent to mapped location of Site 44FX2734, recorded in 2004 as Civil War-era earthworks and described as rifle pits. The site has not been evaluated for listing in the NRHP.

Dewatering Locations

Howrey Field

- Includes Howrey Field (Resource 029-6868).

Wakefield Park Maintenance Facility

- Includes Site 44FX0741.

Wakefield Ball Fields

- Includes no previously recorded resources.

Dominion ROW

- Includes portion of Site 44FX2736, Civil War-era earthworks and is described as a trench. The site has not been evaluated for listing in the NRHP.

Lake Accotink Upper Settling Basin Dewatering Location

- Includes Site 44FX1972, a preserved portion of the mid-19th-century Orange & Alexandria rail bed and associated culverts within Accotink Park. The O&ARR was the major transportation and supply linking Washington and supply depots along the Potomac within the Army of the Potomac. The site has not been evaluated for listing in the NRHP.

Lake Accotink Island – Current Footprint

- Includes no previously recorded resources.

Lake Accotink Island – Expanded Footprint

- Includes no previously recorded resources.

Concrete Plant

- Includes no previously recorded resources.

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