May 2020
Arrowhead Cove Sediment Removal at Deep Creek Lake

Alternatives Analysis

Prepared for Maryland Environmental Service

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Prepared for
Maryland Environmental Service
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ABBREVIATIONS

County	Garrett County
cy	cubic yard
cy/day	cubic yard per day
cy/hr	cubic yard per hour
DNR	Maryland Department of Natural Resources
HDPE	high-density polyethylene
Lake	Deep Creek Lake
LLDPE	liner low-density polyethylene
min	minutes
NA	Not Applicable
OHB	Operating High Band
OLB	Operating Low Band
SAV	submerged aquatic vegetation
WBCM	Whitney, Bailey Cox & Magnani
WIF	Waterway Improvement Fund

1 Introduction

This alternatives analysis report evaluates the potential dredging and dewatering options for Arrowhead Cove in Deep Creek Lake (Lake) located in Garrett County (County), Maryland. The Lake was constructed in 1925 with a surface area of approximately 3,900 acres and a storage capacity of 106,000 acre-feet (WBCM 2013). Over the years since construction, significant sedimentation has been observed accumulating in the many coves of the Lake, degrading water quality and recreational access in some areas (WBCM 2013).

In 2013, the Maryland Department of General Services and Maryland Department of Natural Resources (DNR) commissioned *Deep Creek Lake: A Sediment Study* (WBCM 2013). The study recommended taking measures that will reduce sediment inflow and not conducting dredging because the overall acre-feet impacted by sedimentation within the 10 coves identified represents only 0.16% of the Lake volume (WBCM 2013) and sediment removal would not directly benefit the Lake's water capacity in the near term. Through funding from DNR and the Waterway Improvement Fund (WIF) Grant, the County requested additional investigations that would identify one or more coves that would benefit from dredging for access purposes as an alternate method to improve public use and recreational access. Utilizing WIF grant criteria including environmental benefit, cost, safety, boating access, etc., Anchor QEA developed the *Deep Creek Lake Dredging Cove Evaluation Report* (Anchor QEA 2017a), which analyzed the same 10 coves identified in the *Deep Creek Lake: A Sediment Study* (WBCM 2013) to rank cove selection to proceed with developing dredging design.

Following the dredging evaluation, Arrowhead Cove was selected to advance into design. This was a result of multiple factors but notably for being ranked first for public boating access improvements (94 boat slips), low impact to development and environmentally sensitive areas, and dredging engineering logistics (constructability and implementation). Arrowhead Cove ranked second for properties within the cove impacted by dredging (70) and as a top location for multiple disposal options.

This alternatives analysis incorporates preliminary site assessments conducted at the Lake including previous sediment characterization activities, an updated bathymetric survey, regional data collection, aerial imagery, and engineering experience from other similar projects. Approximately 15,000 cubic yards of dredging within approximately 3.5 acres of cove area is anticipated based on preliminary scoping, anticipated cost ranges, and shallow water areas identified from surveys. Sediments are expected to be typical mixtures of silts and clays with some sand fraction, typical of deposition within protected cove regions. Shallow water areas were identified through consideration of varying water levels within the Lake system from dam control and typical drafts for recreational vessels. Water levels fluctuate seasonally and are managed within operating bands referred to as Operating High Band (OHB) and Operating Low Band (OLB). Seasonal differences range from 3 to

5 feet between summer and winter months, and 1 to 3 feet year-round between the high and low operational bands.

Methodologies for sediment removal considered in this evaluation include mechanical excavation "in the dry" with gravity dewatering on site adjacent to the Lake (Option 1), hydraulically dredging and mechanically dewatering on site adjacent to the Lake (Option 2A), and hydraulically dredging and passively dewatering at an off-site staging area away from the Lake (Option 2B).

2 Descriptions of Removal Options

2.1.1 Mechanical Excavation "in the Dry" and Dewatering on Site (Option 1)

Option 1 considered mechanical excavation of sediment in the dry. Normal Lake operations result in varying water levels throughout the year, including a partial drawdown during the off season in late fall through the winter. Evaluation of local bathymetry within the Arrowhead Cove region showed significant portions of the cove are fully dry during the drawdown period, allowing for standard excavation-based removal with significantly reduced water management. Although the primary footprint is anticipated to be fully dry, minor variances in water level and storm conditions would likely require a water control diversion structure as a temporary cofferdam. Additionally, diversion of the remaining free-flowing water entering from under Garrett Highway, as shown on the 30% Design Drawings, would require the use of pumps and pipes, siphoning, or similar application to convey water from the dredge footprint. Intermittent water management and ongoing conveyance of water may be required to manage stormwater or groundwater influx during construction using pumps. A prefabricated in-lake access road (e.g., Mabey DURA-BASE® Composite Mats), crane mats, or similar constructed roadway may be required to support low-ground-pressure excavation equipment and transport trucks.

An excavator equipped with an open digging bucket, or similar equipment, would be used for mechanical excavation operations. Excavated sediment would be loaded into haul trucks for transport to an upland dewatering area on site, where the material would be dewatered (e.g., passive gravity dewatering) and conditioned (e.g., adding Portland cement), as required, to meet the requirements for transport and disposal at an off-site commercial disposal facility (landfill or other receiving facility). The area identified for site access, staging of equipment, materials, and dewatering operations is located along the southern shoreline of the Lake and west/northwest of the Inn at Deep Creek as shown on the design drawings.

The total footprint available for staging and dewatering operations is approximately 2.0 acres as shown on the design drawings. It is estimated that a minimum of 1.0 acre would be required for passive dewatering operations associated with Option 1.

2.1.2 Hydraulic Dredging and Mechanically Dewatering on Site (Option 2A)

Option 2A considered hydraulic dredging operations assuming the use of an 8-inch cutterhead dredge, which would remove material from the Lake and transport it via a high-density polyethylene (HDPE) pipeline to an upland sediment dewatering area. The 8-inch cutterhead dredge has been preliminarily identified for this evaluation based on site conditions, including the dredge footprint and water depths, target dredge depths, and past experience with lake dredging projects of similar size and scope in the surrounding area.

Option 2A evaluated the use of mechanical presses such as a belt filter press or a plate-and-frame press that can be used to consolidate and dewater hydraulically dredged material. Mechanical dewatering systems are capable of more continuous production than passive technologies, such as air-drying and geotube dewatering, but they require more equipment and material handling and greater electricity consumption.

Mechanical dewatering typically includes shaker screens, followed by hydro-cyclones, to separate larger particles and minimize water content in the coarser separated materials. Belt filter presses operate in a continuous mode, using a system of filter belts to compress the flocculated sediment while simultaneously transporting the filter cake to the dewatering stockpile. Polymers may be used to assist in the settling of fine-grained sediments prior to the belt filter presses. Based on previous experience, belt filter presses typically produce a filter cake containing approximately 40% to 50% solids by weight. This value is highly dependent on site-specific factors and would need to be assessed through a treatability study. Several belt filter presses running concurrently would be required to maintain pace with incoming slurry quantities but may be limited due to operational room available at the staging location.

Similar to Option 1, the total footprint available for staging and dewatering operations is approximately 2.0 acres. It is estimated that a minimum of 1.0 acre would be required for mechanical dewatering operations associated with Option 2A based on previous project experience. For the purposes of this evaluation, the mechanical dewatering system would consist of a shaker screen assembly, hydro-cyclones for sand separation, belt filter presses for fine particle dewatering, mixing and clarifier tanks, and a polymer injection system to accelerate the dewatering process.

2.1.3 Hydraulic Dredging and Passive Dewatering Off Site (Option 2B)

Similar to Option 2A, Option 2B considers using the same hydraulic dredging operations (8-inch cutterhead dredge and HDPE pipeline to transport dredge material). This option considers the use of dewatering at a location off site from the Lake with the use of geotube dewatering or mechanical dewatering. With dewatering the dredged slurry at an off-site staging area, the preferred dewatering operation would be geotubes due to increased available staging area and reduced dewatering costs compared to mechanical systems.

Geotubes, also referred to as geotextile tubes or geobags, can be used as a passive dewatering method for dewatering hydraulically dredged sediment. Dredged slurry is pumped into the geotubes, and water flows out of the pore spaces in the geotextile, while sediments are contained within the geotubes. To reduce total suspended solids in the water discharged by the geotubes, polymers and flocculants may be added to the dredged slurry prior to entering the geotubes to facilitate coagulation and binding of sediment particles. Once full capacity is reached, the geotubes are left to consolidate and drain as necessary, and the material contained within the geotubes continues to dewater until it reaches the desired water content. The geotubes are then opened, and the dewatered sediment is removed and transferred to trucks for off-site transport and disposal. Dewatering time varies based on sediment properties but is expected to range from 1 to 2 months.

Typical setup of geotubes can be cost effective, and they require less maintenance and equipment compared to a full mechanical dewatering system (as in Option 2A). A geotube dewatering system typically consists of an initial shaker screen system removing large particles, a mixing tank, a polymer dosing system, followed by the bag field containing the number of geotubes necessary to contain the target dredge volume. A large dewatering area and comparatively long drying times are optimal to effectively contain the dredged material and allow for sufficient dewatering of the sediment, but these are not always available at project sites.

Typical geotube layouts consist of a large, generally flat open area where an impermeable liner (HDPE/liner low-density polyethylene [LLDPE]) and gravel drainage layer are installed. This main footprint is contained by a perimeter (soil) berm, with the entire region graded for drainage toward a collection sump where water is collected and transferred back to the dredging area. Geotubes can be manufactured in varying dimensions to meet staging configurations. From 20 to 35 tubes would be expected to contain and manage the full project volume of 15,000 cubic yards. Based on available staging, final configurations of bags would determine total number of bags necessary as well as if multiple rounds of filling and disposal would be required. Addition space for water management piping, coarse material separation and polymer dosing system, and personal facilities is required.

Site access and the total footprint available for staging and dewatering operations for Option 2B differ from Option 1 and Option 2A. Based on previous comparable projects, the minimum dewatering area for Option 2B will be at least 2 acres.

3 Operational Comparisons

Each dredging and dewatering process is viable for implementation but has differing operational considerations. Constructability, productivity, and volume control for the three options are important to consider when selecting the method for performing the work and are discussed in the following sections.

3.1.1 Constructability

The constructability of each potential removal option was evaluated considering key factors such as site access, available staging area and location, sediment management, water management, and inclement weather impacts. Constructability also includes items such as schedule and sequence; however, those will be evaluated as part of other criteria in Section 3.1.2.

Mechanical excavation and hydraulic dredging require a landside access point for the initial mobilization of equipment as well as daily access to the Lake. Mechanical removal requires direct Lake access for removal equipment and transportation of the sediment for the entire project duration, while hydraulic removal requires more limited access during mobilization, smaller access for pipelines, and personnel access for crew shifts. All operations will also require a material staging area to be established in the vicinity of the Lake to accommodate equipment, labor, and management of dredged material and debris. Mechanical removal requires this staging area to be immediately adjacent to limit transport distance, while hydraulic removal introduces the ability to transport sediment to more remote staging areas provided that access routes for pipelines can be established.

To perform Option 1 in the most cost-effective manner, the work must be performed in the off season over winter when Lake water levels are reduced between September and March. This allows for the majority of the work area to be dried prior to dredging, which will reduce water capture during removal and limit water management requirements. To manage inflow into the work area, diversion or pump-around of flow from the upper stream will need to be included, as well as occasional dewatering from collection sumps to manage precipitation within the work area. At this time, performing the work in the dry at other periods via the use of port-a-dams or other control structures has not been considered due to the added costs and risks associated with maintaining those structures and work area separation. Options 2A and 2B would require construction during spring to fall to maximize available draft for the floating dredge equipment.

An approximately 2-acre area identified for staging of equipment and materials and dewatering operations is located along the southern shoreline and west/northwest of the Inn at Deep Creek. This property is owned by DNR and would be available for use on the project without private property owner negotiations. At this stage of the design, no private owner coordination has occurred and project design has been limited to State- or County-owned property. Additional acreage at this location may be available pending negotiations with the adjacent property owner(s), potentially increasing available open space to 2.5 acres. DNR property exists north of the removal footprint and elsewhere along the Lake shore, but it would require more extensive site work and significant tree clearing and was not considered at this time. The currently identified area would be suitable for removal Options 1 and 2A, providing direct landside access to the dredging area for Option 1 and sufficient room for a small hydraulic removal setup for Option 2A, although additional clearing and grading would be required to maximize the space. Option 2B would require an estimated footprint greater than 2 acres for passive dewatering operations and an off-site staging area away from the Lake to house the dewatering operations.

Option 1 would require direct landside access to the Lake, including the potential installation of an in-lake access road that would support excavation equipment and transport trucks traveling to and from the staging area to the location of dredging. Options 2A and 2B would require Lake access to mobilize dredging equipment and access for a dredge pipeline between the hydraulic dredge and the staging/dewatering area, located adjacent to the Lake for Option 2A and located off site away from the Lake for Option 2B. Based on the distances and elevations between the proposed staging and dewatering area and dredge areas, a booster pump is not anticipated to be needed to transport material from the location of dredging to the staging/dewatering area. Should a more remote staging area location be identified (e.g., outside approximately 1 mile from the dredging area or at significant elevation increase), the use of booster pumps may need to be evaluated further.

Sediment storage volume requirements and water management requirements for all options impact the total staging area requirements and potential site locations. Current proposed sediment management can be referenced in the basis of design. Option 1 may require an additional landside stockpile area to allow for sediment to freely drain excess water prior to transport. Option 2A will result in mechanically dewatered or dry material suitable for transport and will require only sufficient room for day-to-day stockpiling for consistent truck transport. Option 2B requires the largest room for sediment management due to the long-term dewatering anticipated, with staging needed to handle the majority of the sediment volume at one time.

For water management, mechanical excavation operations (Option 1) are expected to generate a minimal amount of excess water due to removal operations being conducted in the dry. Limited water runoff from stockpile dewatering as well as precipitation will be captured in a collection sump and managed by a small pump as needed. Hydraulic dredging operations (Options 2A and 2B) generate a significant volume of excess water as dredged slurry, which typically averages between 5% and 15% solids. Equipment for mechanical dewatering as part of Option 2A will include clarifiers and storage tanks to allow for the containment of process water prior to discharge back to the Lake and will require additional room for the equipment. Option 2B will require a larger sump collection system and pumping set up to match the volume throughput of the hydraulic dredge and release water from geotubes, which adds area to the staging requirements in addition to sediment storage. Limitations in size of staging can be managed for each operation but may result in lower dredging production rates and increased project cost. Further discussion of production rates is provided in Section 3.1.2.

Weather-related impacts were considered for each removal option. For Option 1, inclement weather that results in a high influx of rainfall/stormwater could re-saturate exposed sediments, thereby extending the removal and dewatering activities and possibly even requiring excavation equipment to be removed from the Lake. For Options 2A and 2B, equipment would need only to be secured nearshore during inclement weather with limited impacts to temporarily stockpiled material.

For all options, material disposal is considered comparable and viable. Further discussion of disposal option evaluations is included in Appendix A.

Overall, with advantages and disadvantages for all three removal options based on constructability, all three options are considered equally feasible.

3.1.2 Productivity

Production rates were estimated for each of the three removal options based on anticipated equipment, expected dredging conditions, and experience from similar projects (Table 1).

Table 1
Summary of Production Rates

Production Rate Parameter	Removal Options		
	Option 1 - Mechanical Dredging with Passive Dewatering	Option 2A - Hydraulic Dredging with Mechanical Dewatering	Option 2B - Hydraulic Dredging with Geotubes
Pumping Rate (cy/hr)	NA	43	43
Bucket Size (cy)	2	NA	NA
Percent Bucket Full	80%	NA	NA
Bucket Cycle Time (mins)	2.0	NA	NA
Operational Uptime	65%	50%	60%
Hourly Rate (cy/hr)	31.2	21.5	25.8
Daily Rate (cy/day)	312	215	258

Note:
Daily rate: 10 hours per day

Production rates do not vary significantly due to various restrictions on each operation. Option 1 will experience faster removal due to the ease of visual confirmation but will have additional slowdowns associated with access for landside equipment within the dredge area and reconfiguring of access roads during the work. Option 1 will temporarily stockpile material if needed. Cycling trucks and direct loadout of material create a situation where material can be transported for disposal and dredged simultaneously. Hydraulic removal in Options 2A and 2B has similar dredging equipment and will have better access but will experience typical delays associated with work under water, as well as specific considerations for each type of dewatering. The difference between these two options is the operational uptime due to the dewatering method, with higher operational time expected during geotube operations due to reduced needs in balancing system flows, system storage capacity, and mechanic maintenance. Overall, Option 1 was estimated to have the highest production rate of the three options evaluated, which would require fewer dredging days compared to Options 2A and 2B. Therefore, Option 1 is considered the preferred option based on production rate.

Scheduling and sequencing were considered for each removal option. Option 1 requires the work to be performed over winter to take advantage of the Lake drawdown for access and drying of the sediment. This requirement establishes a hard end date for the project when all removal must be completed prior to Lake water levels resuming their higher elevations in early spring. Options 2A and 2B provide a larger range of flexibility in schedule but will need to consider seasonal permit window restrictions associated with fish spawning and the active recreational period discussed further in Section 4. Additionally, due to the hydraulic dredging process, Options 2A and 2B may require a separate debris removal operation prior to the start of dredging and periodically throughout dredging operations. Option 2B would require additional time for adequate dewatering of the geotubes prior to transporting the material to the disposal facility. Additionally, inclement weather may impact the productivity of all three options. Option 1 has the shortest overall estimated project dredging duration, followed by Option 2A, with Option 2B having the longest estimated project dredging duration. Therefore, Option 1 would be the preferred option based on efficiency, productivity, and project duration.

3.1.3 Volume Control

The target removal volume is estimated based on project bounds developed during the initial site selection phase and is anticipated to be 15,000 cubic yards. Target footprints for removal and development of the dredge prism used the 2017 bathymetric survey and the final as-built Lake surface to determine removal areas and dredge depths. Removal volume is assumed to be equal for all three removal options, with variances in volume determined only by allowable overdredge considerations for each method of dredging.

For Option 1, mechanical removal in the dry allows for finer control of equipment following the target dredge prism and less uncertainty in the volume estimate. As a result, it is anticipated that only a 6-inch overdredge allowance would be incorporated for Option 1. For Options 2A and 2B, hydraulic dredging requires additional flexibility in target volume due to inherent inaccuracies in removal by floating equipment and verification by bathymetric survey. Typical dredging projects include up to 1 foot of allowable overdredging to account for in-water operations and survey verification tolerances. Additionally, hydraulic dredging operations (Options 2A and 2B) generally require thicker cuts and a larger sediment face to maximize production, equipment utilization, dredge and pipeline capacity, and dewatering productivity. Thinner dredge cuts may result in decreased productivity and increased water, which requires management. Mechanical excavation operations in the dry (Option 1) expose the sediment surface and allow mechanical excavation equipment to operate with higher accuracy in locations that have tighter operational tolerances (thinner dredge cuts). As a result, Options 2A and 2B include more inherent variability in the potential removal, which may impact the total project volume.

Overall, Option 1 was considered to have greater ability to achieve thin dredge cuts that maximize the overall targeted volume while maintaining productivity, and therefore it is considered the preferred option.

4 Public Concerns

Potential impacts that may concern the public, such as dust, noise, odor, aesthetics, public use of the Lake, and public safety, were evaluated for each of the removal options.

4.1.1 Dust

For Option 1, there is the potential for localized dust generation and air quality impacts during removal and handling operations if the material targeted for removal were to desiccate and become too dry under certain weather conditions. This is due to the material being exposed during removal operations and dewatering activities (dewatering and stockpiling). Depending on dewatering conditions, limited use of drying agents may be necessary to improve the transportability of the dredged material, which may add to dust generation.

Options 2A and 2B are not expected to generate significant dust because the material would be transported as a slurry in sealed pipelines from the Lake to the staging area, and the dewatering operations would confine the dredged material during dewatering, compared to the passive dewatering and stockpiling in Option 1. Option 2A would result in almost immediate transport of material after a short stockpile period, limiting risk of dust generation. Option 2B may generate dust during the opening and excavation of dredged material from the geotubes, but this option would contain the dredged sediment the entire duration of dredging and dewatering to that point. Overall, Option 1 would be expected to have the most potential to generate dust during normal dredging operations; however, all three options were considered comparable regarding their potential to generate dust during loading and transport of processed sediment, depending on the final water content of the sediment.

4.1.2 Noise

There is expected to be a localized increase in noise levels for all three removal options. For Option 1, noise would be generated from the mechanical excavation equipment as well as truck traffic to transport material from the Lake to the staging area. For Options 2A and 2B, the increase in noise level would be due to the hydraulic dredging equipment and equipment associated with dewatering operations (e.g., shaker screens, hydro-cyclones, pumps). Similar to past projects, hospital-grade mufflers can be implemented, noise monitoring can be conducted during construction, and construction operations can be limited to specific timeframes during the day. Overall, Option 1 would be expected to generate slightly more periodic noise as compared to Options 2A and 2B, which would result in more continuous noise. All three operations are expected to result in similar noise levels during truck loading and sediment transportation.

4.1.3 Odor

For Option 1, there is the potential for unwanted odors to affect the surrounding residences and the general public in the vicinity of the Lake. Potential sources of odor include the exposed sediments in the Lake following drawdown, and the stockpiling and dewatering of dredged material at the staging area. Odor is an unavoidable consequence of the natural decay of aquatic plant life and benthic organisms and is expected to be limited based on past project experience. Additionally, odor potential exists under the current Lake drawdown conditions due to the large exposed sediment area during low water conditions. Odor generation is expected to have more limited impact for Option 1 due to reduced public presence in the off season in the area, as well as colder temperatures limiting the release of odors. Odor would be very limited for Options 2A and 2B because dredged material would be contained during transport in the pipeline, during mechanical dewatering, and during dewatering in the geotubes. Overall, Option 1 would be expected to generate the most odor compared to Options 2A and 2B.

4.1.4 Aesthetics

Options 1 and 2A require the installation of a staging and dewatering area along a portion of the southern shoreline of the Lake. This would result in a short-term impact to the aesthetics of the southern shoreline area of the Lake throughout the duration of construction; however, these areas will be restored following construction. Option 2B will require the installation of a staging and dewatering area at an off-site location, which will have a short-term impact to the aesthetics at the selected location that will be restored following construction. Regarding the Lake itself, the drawdown required to support Option 1 will impact the aesthetics of the Lake throughout the duration of removal operations, but this occurs seasonally under existing operating conditions. Additionally, the Lake level will only be drawn down as deemed necessary beyond off season (winter) conditions. After construction is complete, the Lake will naturally refill, and the pre-construction Lake water surface will be restored. For Options 2A and 2B, no drawdown of the Lake is required; therefore, the aesthetics of the Lake will be unchanged during construction. Option 1 is expected to have the shortest duration of all three options, with Option 2B having the longest impact at the off-site staging location. As a result, Option 1 would have an impact to aesthetics comparable to Option 2A and more impact than Option 2B, but for a shorter duration.

For all three removal options, it will likely be necessary to restrict public access to portions of the Lake shoreline during construction. The restrictions are to prioritize the safety of the public. For Options 1 and 2A, there will be truck traffic to and from the Lake and the staging area. For Option 2B, there will be a dredged slurry pipeline from the Lake to the staging area. The perimeter of the staging and dewatering area will be fenced and secured to prevent public access to work areas and equipment. Efforts would be made to limit the footprint of the restricted areas and mitigate the inconvenience to the public. Option 1 would occur in the off season with less exposure to the public but would have a larger visual impact due to the nature of the exposed work area, offsetting some of the benefit of reduced exposure. Overall, public concerns will be minimized for all three removal options and therefore all options are considered generally comparable.

4.1.5 Scheduling

As noted in Section 3.1.1, Option 1 requires a significantly different schedule compared to Options 2A and 2B due to Lake water level requirements. To reduce costs associated with water management and limit impacts associated with drawdown to already existing conditions, the work would be required to be performed in the late fall and winter season. This reduces or eliminates the requirement to utilize extensive port-a-dam setups and added water management structures and adds natural dewatering of the exposed sediments, greatly reducing the water content of the material being managed and shortening the duration between removal and transport off site. The added benefit of this schedule limitation is that the work would be performed in the off season, reducing recreational impacts to the Lake and immediate area significantly. Additionally, this work period would be outside known permit window restrictions for fish spawning, avoiding permit waiver requests or other permitting issues.

Options 2A and 2B offer more general flexibility in overall timing due to the longer period of raised water levels necessary to perform hydraulic dredging. Spring through fall allows a longer range of general available work windows as well as longer work hours during daylight but results in additional impacts to the area during boating season. To perform the work during the summer, coordination with property owners and the public would be necessary to allow for safe working conditions in the area. Some dock sections may require removal to allow equipment access, general boating may be restricted to avoid pipelines, and other activities would be occurring during peak season in the local area. Fish spawning restrictions would limit the in-water work to after June 15, and work would need to be completed prior to October to avoid potential reduced water levels impacting equipment draft. Site restoration for Option 2A may require limited work the following year during appropriate growing seasons depending on timing of site restoration in the fall/winter months. Option 2B provides more flexibility in restoration due to added dewatering time but would impact the selected staging area site for a longer period into the winter season.

Overall, Option 1 provides an optimal schedule window by reducing public impact and avoiding permitting restrictions. Options 2A and Option 2B can be performed during available windows but will require additional local coordination and outreach.

5 Potential Environmental Impacts

Potential environmental impacts were considered for each of the removal options, including submerged aquatic vegetation (SAV), wetlands impacts, and other biological considerations. At the time of this report, formal delineations of SAV and wetlands have not yet been completed within the bounds of the project area. SAV is known to occur within Arrowhead Cove but is anticipated to be limited to areas that remain wetted year-round, generally outside the target dredge footprint but within the vicinity of the work. Similarly, wetlands are known to exist within the Lake system but due to the varying water levels and exposed sediment within the target work area, wetland coverage is expected to be minimal.

Projects of similar scope and size have been dredged using similar hydraulic equipment without pre-removal of SAV; however, a site-specific assessment would be performed to evaluate the volume of expected SAV and whether separate removal operations would be required for Options 2A and 2B prior to or during dredging. SAV removal may consist of raking, trimming, or other means or methods. Any SAV removed may be harvested and replanted where possible. Seeds or shoots for replanting will be coordinated with DNR. At this time, no replanting of SAV is anticipated or incorporated into costs or schedules. Potential planting operations may occur as part of DNR's protective measures against invasive species and will be evaluated further in later design stages.

For all three removal options, there will be a disturbance of the benthic habitat in the designated dredge areas, an unavoidable consequence of sediment removal operations. However, based on experience with similar sediment removal projects in the vicinity of the Lake, the benthic community is expected to naturally re-establish over time following construction and to diversify due to the change from a dewatered overwinter condition to deeper water.

For Option 1, the partial Lake drawdown required for mechanical excavation in the dry may affect the fish and turtle population within the Lake. However, because the partial drawdown will be conducted over winter and outside of target permit window restrictions, fish and turtles are expected to naturally relocate to the deeper portions of the Lake beyond the dredging footprint. For Options 2A and 2B, fish and turtle relocation would not be required because no Lake drawdown is required for the hydraulic dredging options. Typically, operations generate sufficient disturbance that in-water species relocate outside the immediate work area. Overall, environmental impacts are expected to be minimal; however, Option 1 would be considered to have the least level of impact because the biological community would naturally relocate outside the work area to deeper water, and work would be performed outside of spawning or more active spring or summer seasons.

6 Cost

A concept construction cost evaluation comparison was performed for the three removal options. The descriptions of each removal and dewatering operation, equipment needs, and scheduling/sequencing factors presented in previous sections were considered in the concept design cost evaluation. Developed costs utilized existing project knowledge, rate quotes and other site-specific costs where available, and engineering experience for similar projects and scopes when determining production rates and overall construction schedules. In addition, due to the inherent uncertainties associated with mechanical removal, hydraulic dredging, staging area conditions, sediment conditions, and other factors at the 30% design phase, a construction contingency was applied to each option. Table 2 presents a summary of anticipated total unit rate costs for each option for comparison, based on the project total volume of 15,000 cubic yards. As noted in Table 2, Option 1 was estimated to be the most cost-efficient option. A summary of the cost estimate for Option 1 is included in Appendix B for reference.

Table 2
Summary of Alternatives and Concept Construction Cost Estimates

Alternative	Removal Methodology	Dewatering Methodology	Cost ($/cy)
Option 1	Mechanical Excavation	Passive	$104
Option 2A	Hydraulic Dredging	Mechanical – Belt Filter Press	$178
Option 2B	Hydraulic Dredging	Geotubes	$128

7 Comparative Evaluation

Table 3 provides a comparative evaluation of the three removal and dewatering options ranked according to the following nine criteria, with higher values being more desirable:

- **Constructability:** The constructability criterion ranks the removal options in terms of complexities inherent in the design, execution, and performance for each removal option.
- **Productivity, schedule, and sequence**: The productivity, schedule, and sequence criterion ranks the removal options in terms of the estimated production rates and scheduling and sequencing considerations that may impact the overall project duration.
- **Volume control:** The volume control criterion provides preference to removal methodologies that are likely to maximize the volume of sediment targeted for removal and avoid dredging below the dredge template.
- **Dust:** The dust criterion ranks the removal options in terms of estimated concerns to the public.
- **Noise**: The noise criterion ranks the removal options in terms of estimated concerns to the public.
- **Odor:** The odor criterion ranks the removal options in terms of estimated concerns to the public.
- **Aesthetics:** The aesthetics criterion ranks the removal options in terms of estimated concerns to the public.
- **Potential environmental impacts:** The potential environmental impacts criterion ranks the removal options in terms of the estimated impact to the biological community.
- **Cost:** The cost criterion ranks the removal options in terms of estimated overall project costs.

Each ranking criterion was weighted to reflect its relative importance. For example, constructability has been assigned a weighting factor of "3" because the implementation and overall success of the project is dependent on constructability factors, whereas aesthetics has been assigned a weighting factor of "1" because this is a nuisance impact that can be mitigated during construction. The options have been ranked on a scale from 1 to 5, with 5 representing the most favorable ranking and 1 representing the least favorable ranking.

Table 3
Comparative Ranking of Removal Options

Criteria	Weight	Option 1 - Mechanical Dredging with Passive Dewatering	Option 2A - Hydraulic Dredging with Mechanical Dewatering	Option 2B - Hydraulic Dredging with Geotubes
Constructability	3	4	3	3
Productivity, Schedule, Sequence	3	4	3	2
Volume Control	1	5	3	3
Dust	1	2	4	3
Noise	2	3	3	3
Odor	1	2	4	4
Aesthetics	1	2	3	3
Potential Environmental Impacts	3	4	3	3
Cost	2	4	2	3
Weighted Total		**61**	**51**	**49**

As a result, Option 1 yields the highest weighted ranking of the three options. Option 2A and 2B rank closely together, with only minor differences in costs and overall duration. Additional refinements to these categories may occur as design proceeds and additional information is gathered about the site, staging potential, and local conditions. At this time, design assumes that the work will continue as a mechanical removal with staging requirements as indicated; future changes in methodology, access, or available property may impact the selected method and will be considered in future design steps and cost estimates.

8 References

Anchor QEA (Anchor QEA, LLC), 2017a. *Deep Creek Lake Dredging Cove Evaluation Report*. Prepared for Maryland Environmental Service. July 2017.

WBCM (Whitney Bailey Cox & Magnani, LLC), 2013. *Deep Creek Lake: A Sediment Study.* December 2013.

Appendix A
Disposal Options Analysis

Deep Creek Lake Dredging Project: Disposal Options Analysis

Purpose

This Disposal Options Analysis describes available options for disposal or reuse of dewatered dredged material from the Deep Creek Lake (Lake) dredging activities. Available options are reviewed with consideration to the location, availability, cost, and potential impact. Disposal of dredged material can be a significant cost component of a dredging project, and minimization of transportation and disposal fees is critical during initial planning phases. Multiple disposal options were identified and considered within Garrett County (County), Maryland, near the city of Oakland, Maryland.

Background

The Lake is a human-made lake created in 1925 with a surface area of approximately 3,900 acres and a storage volume of 106,000 acre-feet. The Lake is a large recreational hub and is responsible for a large portion of the tourism revenue in the County. Sediment accumulation, coupled with an increased concentration of submerged aquatic vegetation (Bortz and Landry 2015), has led to decreased water depth in some of the coves, restricting access for recreational boating activities. Previous analyses performed by Anchor QEA evaluated and ranked 10 coves within the Lake for potential dredging to reestablish water depth and summarized results in the *Deep Creek Lake Cove Evaluation Report* (Anchor QEA 2017). Final selection of the proposed dredging project location at Arrowhead Cove was determined using guidelines from the Maryland Waterway Improvement Fund.

Existing Conditions

Arrowhead Cove was one of the 10 coves analyzed in the 2017 *Cove Evaluation Report* (Anchor QEA 2017) and the 2013 *Deep Creek Lake: A Sediment Study* (WBCM 2013). Previous investigations have detailed the sedimentation of the Lake since its initial creation in 1925, with 95 years of impacts associated with agriculture, residential and commercial development, roadside ditches, shoreline erosion, and stream degradation (WBCM 2013). Sedimentation of the Lake has resulted in decreasing water quality; decreased nearshore habitat; decreased areas of recreational access for fishing, boating, and swimming; and reduced access areas for boat docks (Anchor QEA 2017).

During a sediment thickness study performed by the United States Geological Survey in 2007, sediment samples collected from Arrowhead Cove indicated that the material was coarse to very coarse silty medium sand (Banks and Johnson 2011). The later 2011 *Deep Creek Lake Sediment Study* published by the Department of Natural Resources Maryland Geological Survey (Wells and Ortt 2011) indicated the physical classification of the sediment material in Arrowhead Cove was predominantly silt with some sand and clays. Differences in sediment description are assumed to be the result of varying locations of sample collection within the cove region. Table 1 summarizes the results of the Arrowhead Cove sediment sample collected in 2011. Figure 1 illustrates the recent sediment conditions from site visits performed in 2019.

Table 1
Physical Characteristics of the Surficial Sediment Sample Collected in Deep Creek Lake[1]

Station	Water Content (% wet weight)	Bulk Density (g/cm^3)	Size Component (% dry weight)				Shepard's Classification
			Gravel	Sand	Silt	Clay	
DCL-29[2]	58.55	1.36	0.0	36.09	42.04	21.88	Sand-Silt-Clay

Notes:
1. Reproduced from Wells and Ortt 2011 (Table 12).
2. Station DCL-29 is located within the designated dredge area in Arrowhead Cove.

g/cm^3: grams per cubic centimeter

Figure 1
Sediment Conditions Within Arrowhead Cove

Note:
The photographs above are from the north shoreline (left) and the south shoreline (right) of Arrowhead Cove and are dated November 11, 2019.

Results from the same study determined concentration of most metals in Lake sediments are within normal background ranges given the geology of the region (Wells and Ortt 2011). After reviewing the chemical and sediment elemental data for sample location DCL-29 for Arrowhead Cove, it is presumed the dredged material will classify as either Category 1 (Residential Unrestricted Use Soil and Fill Material) or Category 2 (Non-Residential Restricted Use Soil and Fill Material) according to the screening criteria from the Maryland Department of the Environment (MDE) *Innovative Reuse and Beneficial Use of Dredged Material Guidance Document* (MDE 2019). Limited elevated concentrations are anticipated from some regional metals with high background concentrations (e.g., arsenic) and some limited polycyclic aromatic hydrocarbons from runoff. Similar conditions exist within many other lake systems in Maryland and are anticipated by MDE; typical reviews approve use under Category 1 as long as only limited low-level detections are found.

Additional sediment sampling including physical and analytical testing is scheduled to be performed to verify the physical and chemical characteristics of the dredged material. Results were not available at the time of development of this stage of the design; supplemental addenda to this analysis or revisions to the design will be developed following more detailed analysis of the site-specific sediment.

Disposal Options

Disposal of dredged material generally falls under either standard waste disposal (landfill waste) or varying innovative reuse options depending on location, material volume, and sediment characteristics. Previous comparable dredging projects in the state of Maryland have disposed of dredged material in a range of ways including standard waste disposal, alternative daily cover or final cover for landfills, and substrate blending material for agricultural lands. Another acceptable disposal option includes mine and quarry reclamation; however, this disposal option is assessed, monitored, and approved on a case-by-case basis. Each disposal option is limited by the locality of the project, material type, transportation options, storing capacity, and cost.

For this evaluation, disposal options within a 10-mile radius of the project location were considered to limit transportation costs. Material is assumed to be transported by tri-axle dump truck or similar short-haul distance vehicles due to road weight limitations and access considerations at the anticipated staging area. Future design stages may refine the distance or consider alternate disposal or reuse options pending further evaluation of costs or potential newly identified receiving locations.

Landfill Waste

Standard waste disposal at an approved landfill is the base option for disposing of dredged sediment. Existing analytical results indicate the sediments targeted for dredging are generally clean and could be accepted by any regional landfill for disposal as standard soil waste without additional controls or extra fees. Disposal as a waste is a viable option for removal of material but requires disposal fees from the receiving landfill, adding to the total project cost.

With the target range of transport from the project area, the Garrett County Solid Waste Disposal and Recycling Facility (Garrett County Landfill) is a currently active facility approximately 6 miles from the project staging area and could receive the sediment for disposal. The facility currently charges a tipping fee of $45.00 per ton for waste categorized as sludge material, land clearing debris, or contaminated, non-hazardous soil. At the current project target volume of 15,000 cubic yards of sediment, this tipping fee would result in up to $1 million of fees for disposal only. Although a viable option for disposal, this option is considered a worst-case cost scenario due to the added fees necessary to handle the dredged material as a waste product. Generally held as a backup option in case alternate reuse options are not successful, landfill disposal is retained as an option but considered too expensive for consideration for this project.

Landfill Cover

An alternate disposal option within landfill facilities is an innovative reuse application of the dredged material as alternate daily, intermediate, or final cover material. Under this scenario, material is provided to a landfill facility to add to their stockpile of materials used to cover daily waste disposal within the landfill or stockpiled for eventual facility closure capping. Facilities typically accept a wide variety of material for this use and are in constant need of sufficient volume for stockpiling and daily use. Depending on throughput of the facility, material transported for this use may be temporarily stockpiled along with existing fill used for cover each day, or longer term storage can be designed and implemented at the landfill to provide future use for long term applications up to years later. This option has been used for material management for several dredging projects within Maryland, including the current application of over 100,000 cubic yards of dredged material from Lake Linganore being stockpiled long term at the Reichs Ford Road Sanitary Landfill in Frederick, Maryland. Based on material characteristics, the dredged material could be used for either daily cover or stored for eventual final cover depending on facility needs.

Preliminary outreach to the Garrett County Landfill has indicated that the facility can accept the full quantity of dredged material targeted as part of this dredging project. Additionally, the landfill accepts clean fill material at no charge, leaving only costs associated with transportation of the material to the landfill, assuming the facility manages the material following drop-off. Additional coordination with the facility is ongoing to determine exact details of their daily needs, including whether temporary stockpile construction would be necessary and whether the facility or the dredging contractor would be required to manage the material.

Costs associated with managing placement and stockpiling for the facility are generally anticipated to be significantly less than standard tipping fees, on the order of a few dollars per ton of material.

Providing a consistent clean source material for the facility provides a secondary benefit to the County, reducing fill search needs and reducing uncertainty in imported material condition or quality. Due to the lack of tipping fees and potential low or zero cost to manage or place the material, alternate daily cover reuse is anticipated to be the final selected disposal option for dredged material for this project.

Quarries and Brownfields Sites

An alternate innovative reuse of dredged material is the use as general fill for reclaiming or closing of quarries or brownfield sites. Quarries, particularly strip mining operations used when extracting or mining coal, create large impacts to surface area and leave behind large pits requiring rehabilitation after the quarry runs out of material. As more facilities end their overall life cycle and operations shift to new or larger locations, these former facilities typically need large volumes of clean fill to restore the pits and potentially close out the facility for future use.

Although these quarry fills are more typically found in neighboring states including Pennsylvania, quarries exist within Maryland that require material to manage their operation and potentially close out end-of-life pits. From initial evaluations, an option for quarry disposal may exist in close proximity to the project area at the current Keystone Lime Company property off Quarry Road, less than 1 mile from the project area. At this stage of the project design, private facilities or property owners have not been contacted directly regarding material disposal; further communication would be necessary at later design stages to evaluate potential reuse options at this facility. No other active quarry operation was identified within the 10-mile radius identified for target material disposal, although multiple facilities exist within longer driving distances in Maryland, West Virginia, and Pennsylvania.

Depending on needs of the local quarry, disposal could save transportation costs with a shorter hauling distance and potential reduced or zero tipping fee and could be considered for repurposing or resale potential depending on the facility operations. MDE assesses quarry and mine reclamation reuse on a case-by-case basis. Additional permitting assessment and monitoring through MDE may be required depending on quarry proximity and depth to the water table, and certain strength characteristics of the dredged material may be required to meet fill specifications.

Brownfield disposal is a separation consideration for reuse where dredged material can be used as clean capping material to provide a barrier over impacted soils at legacy contaminated sites to allow for redevelopment. Typically used to allow dredged material with Category 2 or higher concentrations to be reused in a controlled setting, brownfield redevelopment sites typically require large imported fill quantities and can use dredged material as low-cost fill or a blending agent for their cap materials. Due to low industrial use in the project area, no brownfield sites were identified within the 10-mile radius of the dredging project.

Agricultural Land and Open Space

A final option for dredged material reuse is placement on agricultural or open-space land in the vicinity of the project site, to be used as general fill or as a blending agent. Sediments, particularly in rural locations receiving runoff from farmland, can have high levels of nutrients that can provide benefits to crop land after blending with existing soils. Typical use would install a thin lift of dredged material over existing fields, which would be blended into the soil to add nutrients and change the soil characteristics. Use on agricultural land would require approval by MDE following the current reuse guidance document (MDE 2019), which requires receiving properties to be managed under an existing nutrient management plan managed by the Maryland Department of Agriculture. Only Category 1 materials may be used without additional evaluation or potential additional risk evaluation or testing. Non-agricultural property use would require basic evaluation for human exposure risk associated with the property use and would require Category 1 material or additional approvals for Category 2 material.

Independent review of aerial imagery of the County region identified multiple private agricultural and public disposal areas well within the 10-mile radius of the dredging area. Property sizes, use, and distance vary and would require additional outreach and coordination to identify property owners and discuss potential for accepting material. At this stage of design, no public communication for disposal has occurred; future design stages may evaluate outreach in coordination with County officials to determine potential interest in receiving material.

Properties currently growing crops would be required to evaluate their nutrient management plans to determine if the use of dredged material would require modification or revised management strategies. Property owners would also be required to assess what viable quantities would meet their target soil property needs as well as determine optimal timing for material acceptance. Costs associated with the use on agricultural or open-space land are generally low depending on which party installs the material, trucking distance to the target property, and any necessary additional testing of the material. Although future evaluation is needed, local reuse can provide additional benefits to the community and improve local engagement with the project.

Summary

At the current 30% design stage, multiple options for sediment disposal were evaluated to better understand potential costs and local impacts associated with material transport. Base assumptions regarding sediment properties and analytical properties have been determined from previous sediment studies and will be updated following completion of additional sediment sampling. At this time, material is assumed to be clean and generally conforming to Category 1 status or limited Category 2 status with negotiated acceptance by MDE for reuse as Category 1.

Pending further outreach to private property owners in the project area as part of later design stages, the current proposed disposal method is reuse as alternate daily cover by Garrett County Landfill. The facility is within a short drive distance and charges no fees for material acceptance, and reuse allows a secondary benefit to the County through providing a large volume of clean and consistent material for their facility use. Proposed methods for disposal may change in later stages following additional coordination and more detailed evaluation of costs, permitting, and other considerations.

References

Anchor QEA, 2017. *Deep Creek Lake Dredging Cove Evaluation Report*. Prepared for Maryland Environmental Services. July 2017.

Banks, W.S.L., and C.D. Johnson, 2011. *Collection, Processing, and Interpretation of Ground-Penetrating Radar Data to Determine Sediment Thickness at Selected Locations in Deep Creek Lake, Garrett County, Maryland, 2007*. U.S. Geological Survey Scientific Investigations Report 2011–5223.

Bortz, J., and J.B. Landry, 2015. *Deep Creek Lake Submerged Aquatic Vegetation Survey 2015.* Prepared for Maryland Department of Natural Resources, Maryland Park Services. 2015.

MDE (Maryland Department of the Environment), 2019. *Innovative Reuse and Beneficial Use of Dredged Material Guidance Document*. December 2019.

WBCM (Whitney, Bailey, Cox & Magnani, LLC), 2013. *Deep Creek Lake: A Sediment Study*. DGS Project No. P-008-132-010. Garrett County, Maryland. December 2013.

Wells, D.V., and R.A. Ortt, Jr., 2011. *Deep Creek Lake Sediment Study: Physical and Chemical Characteristics of Lake Sediment*. Prepared for Department of Natural Resources, Maryland Parks Service. September 2011.

Appendix B
Conceptual Opinion of Probable Cost for Option 1

Conceptual Opinion of Probable Cost: Option 1

Arrowhead Cove at Deep Creek Lake - Phase 1 - 30% Design, Garrett County, Maryland

Item No.	Description	Unit	No. of Units	Unit Cost	Estimated Cost
1.0	Mobilization/Demobilization	LS	1	$138,000	$138,000
2.0	Site Facilities and Controls				
2.1	*Site Facilities*	LS	1	$45,000	$45,000
2.2	*Staging Area Construction*	LS	1	$224,000	$224,000
2.3	*Access Road Construction*	LS	1	$74,000	$74,000
3.0	Surveying	LS	1	$40,000	$40,000
4.0	Mechanical Dredging	CY	15,000	$24	$357,000
5.0	Sediment Handling	CY	15,000	$8	$125,000
6.0	Transport and Disposal	TON	21,800	$8	$174,000
7.0	Site Restoration	LS	1	$53,000	$53,000
				Construction Subtotal:	**$1,230,000**
8.0	Construction Overhead and Profit (15%)				$185,000
9.0	Performance and Payment Bonds (1.5%)				$23,000
10.0	Contingency (10%)				$123,000
				Total Cost:	$1,561,000
				Total -30%	$1,092,700
				Total +50%	$2,341,500

Notes:

CY: cubic yard

LS: lump sum

Conceptual Opinion of Probable Cost
Arrowhead Cove at Deep Creek Lake - Phase 1 - 30% Design, Garrett County, Maryland

General Notes:

1 All assumptions, quantities, and unit prices used in this cost estimate are conceptual for the purposes of the Arrowhead Cove, Deep Creek Lake - Phase 1 - 30% Concept Design. Cost estimates will be refined during future design development efforts.

2 All cost estimates include material, labor, and taxes unless otherwise noted. Unit costs are estimated using standard estimating guides (e.g., RS Means Heavy Construction Site Work, Equipment Watch, and Landscape Cost Data), local vendors, professional judgment, and experience from similar projects. The estimates presented are developed using current and generally accepted engineering cost estimation methods, including federal cost estimating guidance (A Guide to Developing and Documenting Cost Estimates During the Feasibility Study [EPA 2000]).

3 All costs are provided in present day dollars and all cost expenditures are assumed to occur at the start of construction. Costs are rounded, as appropriate based on previous estimates from similar projects completed. Dredging is anticipated to occur between October 1 and March 1. Work is to be conducted 5 days per week, 10 hours per day.

4 These estimates were developed using current and generally accepted engineering cost estimation methods. These estimates are based on assumptions about future events, and actual costs may be affected by known and unknown risks including, but not limited to, changes in general economic and business conditions, site conditions that were unknown to Anchor QEA at the time the estimates were performed, future changes in site conditions, regulatory or enforcement policy changes, and delays in performance. Actual costs may vary from these estimates, and such variations may be material. These estimates have not been reviewed by a licensed accountant or securities attorney; Anchor QEA, therefore, makes no representation that these costs form an appropriate basis for complying with financial reporting requirements for such costs.

5 Costs do not include property costs (where applicable), access costs, legal fees, agency oversight, or public relations efforts.

Notes and Assumptions:

The following numbered notes address the associated line item costs:

Item No.	Notes
1.0	Mobilization and demobilization costs have been estimated at 15% of construction cost items 2 - 7.
2.1	Site facilities include general construction items required for day-to-day operations including trailers, generator, portable restrooms, etc.
2.2	Construction of the site staging area includes minor clearing and grubbing, installation of temporary fencing and silt fence, construction of temporary gravel access roads, construction of a temporary sediment stockpile area, and construction of a temporary water diversion structure. Temporary stockpile area assumed to be a 130 ft x 70 ft area consisting of geotextile, gravel, plastic liner, and concrete bin blocks. Water generated within stockpile area will be collected and filtered to reduce suspended solids (geotextile bag filter) and discharged back to waterbody.
2.3	Dredge areas are assumed to be accessible using temporary access roads constructed of timber mats. Approximately 1,000 linear feet of timber mats are anticipated for access to dredge areas. Timber mats will be relocated and repositioned as necessary throughout the duration of work to access dredging areas. Temporary timber mats will be removed from site upon completion of the work. Restoration of temporary access road areas within the lake is not included.
3.0	Survey costs include pre- and post-construction topographic survey of the staging area and dredge area. Survey cost includes two progress surveys of the dredge area for verification of work completed during construction. Survey costs have been estimated based on surveyor quotes from similar projects.
4.0	Dredging is assumed to be performed in the dry, from timber mats (winter months when lake levels are drawn down with a temporary water diversion structure). Dredging to be performed with a fixed arm excavator using a 2 CY bucket. Production rates estimated at 312 CY per day. Dredged material to be placed into off-road haul trucks and transported to staging stockpile area. Dredge volume assumed to be 15,000 CY and includes 0.5 ft overdredge. Costs do not include handling or removal of oversized debris.
5.0	Sediment handling includes stabilization and loadout of dredged material from the staging area. Stabilization assumes the addition of Portland cement to dredged material to aid in dewatering and stabilization prior to transport and disposal. Up to 2% Portland cement by weight has been assumed. Sediment handling volume includes a 5% bulking factor.
6.0	Dredged material will be transported via dump truck to the Garrett County Landfill located approximately 6 miles from the site. Unit costs include transport and an assumed $4/ton tipping fee. The estimated tonnage includes dredged sediment that has been stabilized with the addition of Portland cement and debris. Disposal cost include limited anticipated debris, assumed up to a maximum of 125 tons.
7.0	Site restoration includes the removal of the stockpiling area and gravel access roads. Disturbed areas within the staging area will be restored with topsoil and grass seed. Costs include transport and disposal of removed access road materials and stockpile area materials (e.g. gravel, geotextile, and liner). Restoration costs do not include planting of trees or aquatic vegetation.
8.0	Construction overhead and profit assumed to be 15% of total construction costs.
9.0	Performance and payment bonds assumed to be 1.5% of total construction costs, contingency, and overhead and profit.
10.0	A contingency cost has been included based on 10% of the estimated construction cost.