

LAKE SEDIMENT REMOVAL UTILIZING HYDRAULIC DREDGING AND MECHANICAL DEWATERING

F. Senske¹, S. Simpson², and J. Vetter³

ABSTRACT

Montgomery County DEP operates and maintains Lake Whetstone and Gunners Lake to provide storm water management for adjacent residential communities and for recreational and aesthetic purposes to be enjoyed by County residents.

In 2014, it was determined that sediments had to be removed from the Lakes in order to maintain their capability to receive storm water runoff while also allowing for their continued recreational use. Mobile Dredging & Video Pipe Inc. (MDVP) was contracted by the County to dredge the sediments from both lakes, dewater the material and transport the dry product to disposal and/or beneficial reuse sites.

Utilizing a 203 mm (8 inch) cutter suction head dredge, sediment shaker screens, clarifiers and belt filter presses, MDVP removed and processed nearly 25,875 cubic meters (33,844 cubic yards) of sediment from both lakes. Lake Whetstone was completed in 2015 and the equipment was then moved to Gunners Lake for completion in 2016. In consideration of work being performed within a residential development at each site, the County's contract specifications contained a number of provisions regarding daily working conditions and lake water quality. Small staging areas within the residential communities were utilized by MDVP for equipment to dredge and process lake sediments and then restored to prior condition after the dredging/dewatering work was completed.

To maintain the viability of significant storm water collection systems like lakes and basins, sediment collected in these facilities must be removed on a routine basis. For large systems, such as Lake Whetstone and Gunners Lake, hydraulic dredging and mechanical dewatering of storm water sediments is a cost effective and environmentally sound alternative where space limitations are of concern.

Keywords: Storm Water, Belt Filter Presses, Processing, Beneficial Reuse, Restoration,

INTRODUCTION

As local government entities and builders plan for the implementation of residential and commercial development, it is necessary to incorporate storm water management into their concepts. An example of how this issue was resolved in two communities located in Montgomery County, Maryland was to create lakes that would collect storm water runoff while being attractive landmarks with amenities for the local residents.

Lake Whetstone located in Montgomery Village, Maryland was included in the original design of Montgomery Village. Rather than utilizing the typical design of a storm water basin for this new residential development, the community was planned around a lake. The man-made, 27 acre lake not only provided a place for run off to collect but also contained aesthetic and recreational capabilities not associated with normal storm water collection systems.

¹ Vice President, Mobile Dredging & Video Pipe, INC., 3100 Bethel Road, Chester, PA, USA, T: (610) 497-9500, Email: fsenske@mobiledredging.com

² Project Manager, Mobile Dredging & Video Pipe, INC., 3100 Bethel Road, Chester, PA, USA T: (610) 497-9500, Email: ssimpson@mobiledredging.com

³ President, Mobile Dredging & Video Pipe, INC., 3100 Bethel Road, Chester, PA, USA T: (610) 497-9500, Email: jvetter@mobiledredging.com

Gunners Lake, located 24 kilometers (15 miles) east of Lake Whetstone, serves the same purpose for its residential community. Providing Germantown, Maryland with its own recreational uses as well as picturesque vistas, this lake is instrumental in the collection of storm water runoff.

Although becoming attractive landmark features, the water bodies' primary functions are to collect runoff generated throughout their respective communities. Over the years, storm water sediment collected in the lakes reduced their water depths. This allowed unwanted underwater vegetation to flourish reducing oxygen levels in the lake. This was detrimental to native fish habitat. In addition, the accumulated sediments significantly reduced recreational boat and kayak use while creating unwanted islands within the lakes.

The lakes were last dredged in the mid-1980s at the expense of each community. Shortly thereafter, the respective homeowner's associations convinced the County government to accept responsibility for the maintenance of the lakes since these water bodies received a large portion of their runoff from outside their communities. Since then, Montgomery County oversees structural maintenance of the facilities and is responsible for routine maintenance and upkeep. Projects involving the lakes are funded through the County's Water Quality Protection Charge.

PLANNING AND DESIGN

Since the previous dredging of Lake Whetstone and Gunners Lake, a great deal of sedimentation accumulation occurred in various portions of the lakes. Small islands formed in the lakes and recreational activities were limited. Over the last few years, County officials and the resident's homeowner's associations worked together to develop a plan to have the lakes dredged again. In 2014, the Maryland County Department of Environmental Protection issued bid specifications for the dredging, dewatering and removal of lake sediments from both Lake Whetstone and Gunners Lake. The bid called for the work to begin first at Lake Whetstone followed by Gunners Lake based on environmental permits issued to the County by the State of Maryland. The County planned to complete both lakes in sequence to minimize contract mobilization costs.

The County's plans provided potential contractors with a representative chemical and physical analysis of the sediments in the lakes as well as a proposed schedule of work. Based on the laboratory analysis of the sediments at each site, the County identified acceptable disposal sites for the lake sediments. In addition to the specifications for the dredging and removal of the sediments, numerous operating conditions dealing with the effects of the project on the resident's quality of life were specified. Taking all of these details into consideration it was left up to the Contractor as to what dredging and dewatering methods would be appropriate to complete the project.

At both sites, the project specifications listed conditions that would minimize the impact of the project on the environment and local community. For example, ten hour workdays, Monday through Friday were specified so as to not effect residents weekend activities. Noise levels not exceeding a 75-decibel noise restriction during work hours was imposed. To meet this requirement, equipment layout was strategically designed to place the loudest equipment as far away from residents' homes as possible. To properly monitor the water quality for both lakes, samples were tested multiple times a day throughout the project by the Contractor and the County's Engineer. Turbidity readings could not exceed a maximum of 150 Nephelometric Turbidity Units (NTUs) at any given time while also keeping an average of less than 100 NTUs throughout any given month.

Plans and specifications for the project were advertised in July 2014 and MDVP was the successful low bidder. The County awarded the contract in May 2015 and MDVP began finalizing the design of its dewatering and filtrate treatment system, developing its schedule for equipment delivery and set-up, and mapping out the dredging plan for the first phase of the project at Lake Whetstone.

DREDGING AND DEWATERING

Lake Whetstone

Site work required for the placement of a dredge into Lake Whetstone and the setup of dewatering equipment next to the lake began in June 2015. Before equipment and supplies could be delivered to the site, a grassy area adjacent to the lake had to be stabilized, graded and paved (Figure 1). Fencing was erected around the 1,394 square meter (15,000 square foot) processing area for both security and as a safety precaution against unwanted trespassers.



Figure 1. Processing Site Stabilization Work – Lake Whetstone

The set-up schedule called for the delivery and placement of a 27,215 kilogram (60,000 pound), 203 mm [8-inch] cutter suction hydraulic dredge into the lake. A 199,581 kilogram (220 ton) crane was utilized to lift the dredge off of the flatbed trailer used to transport the unit to the site and place it on the water (Figure 2). Next, 457 meters (1500 feet) of HDPE pipe was installed throughout the lake connecting the dredge to the land based processing equipment.



Figure 2. Dredge Placement in Lake Whetstone

The sediment dewatering area contained 5 belt filter presses (2.2 meter), 2 frac tanks, a Tri-flo debris and sand separation system and a 151,416 Liter (40,000 gallon) portable clarifier. As can be seen on Figure 3, the dredging/dewatering system called for the dredging and conveyance of the lake sediments into the screen for removal of large items such as debris, logs, etc. before the liquid portion was sent to mix tanks. There the flow was equalized and solids kept in suspension ahead of the belt filter presses. Polymer was added to the liquid stream prior to processing through the presses. The dewatered material exiting the presses was dropped onto the paved area where a front-end loader staged the material before loading it onto tri-axel trucks for transport to approved disposal/reuse sites (Figure 4). The filtrate from the dewatering process was pumped through the clarifier in order to meet water discharge standards.

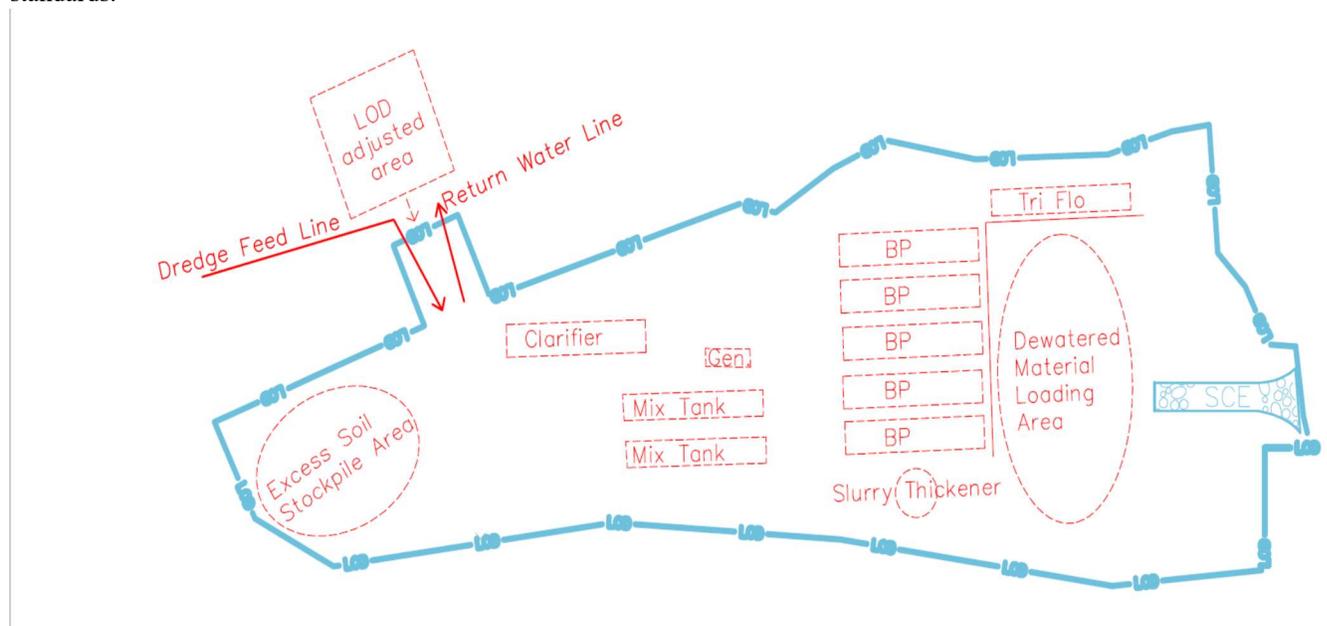


Figure 3. Lake Whetstone Processing Site Layout

Although the County DEP had provided contractors with acceptable disposal sites for the dewatered lake sediments with the bid specifications for this project, MDVP identified other sites that were capable of accepting this material. MDVP was able to secure approvals from State and local regulatory agencies for a beneficial reuse site. There the material was utilized for grading and fill purposes. Although, material generated through the initial screening process was unsuitable for utilization at the reuse site, the majority of the material processed was beneficially reused (Table1).



Figure 4. Lake Whetstone Processing Site (Image Source: Montgomery Village Foundation)

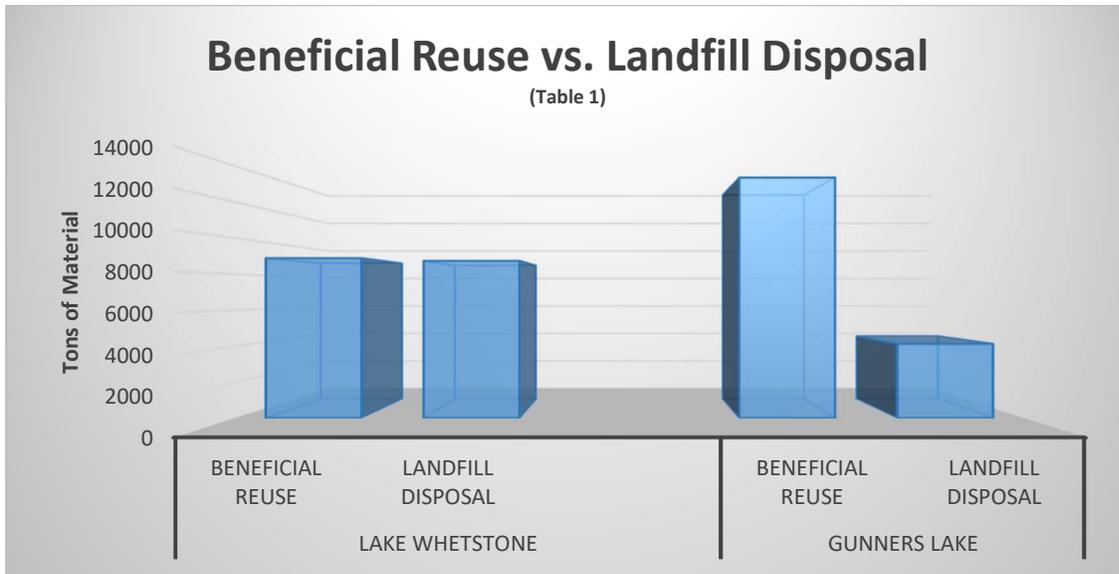


Table 1. Material Reuse/Disposal Comparison

Although most of the Lake Whetstone project ran smoothly, MDVP encountered a few problems that required modifications to routine operation. Due to a Heron nest located on an area within Lake Whetstone, MDVP could only operate in certain sections of the lake during a specific permitted time frame. In addition, freezing temperatures and a significant change in the geotechnical properties of the lake sediment toward the end of this phase of the project required MDVP to adjust the dewatering process from mechanical dewatering to the utilization of geotextile tubes (Figure 5).



Figure: 5. Geotextile Tube Dewatering

Hydrographic surveys were taken before dredging activity commenced at each lake. Monthly hydrographic surveys were conducted for quality control and payment throughout the dredging project at each lake. The monthly hydrographic surveys would be compared to previous surveys to determine how much volume was removed and if the proposed design grade was being achieved.

At the completion of the dredging/dewatering operation, MDVP was required by contract to return the dewatering area to its previous condition. This meant not only the removal of the dredge, pipeline, screens, tanks, presses and other ancillary equipment but also taking up the pavement, removing fence and concrete block and any other material not present prior to the start of the job. Much of the material used for site grading and paving at Lake Whetstone was recycled and reused for site construction at Gunners Lake instead of disposed as waste. Finally, areas along the bank of the lake were revegetated and grass areas were restored to better than previous condition. Overall, it would have been impossible for residents to know that a dredging/dewatering operation had taken place if they had been away during the term of the project.

Gunners Lake

In April, 2016, work moved to Gunners Lake in Germantown, MD. The general plan for dredging and dewatering lake sediment here was similar to that of the Lake Whetstone project but designed specifically for the adjacent residential community. To access the designated operating area, a road needed to be constructed along the west side of the lake. A 305 meter (1000 foot) road was graded and stoned to permit the passage of heavy equipment and trucks to the processing site. The 1,115 square meter (12,000 square foot) processing site itself required extensive grading and stone placement to allow for a level area capable for the placement of five belt filter presses, screens, clarifiers and other equipment (Figure 6).

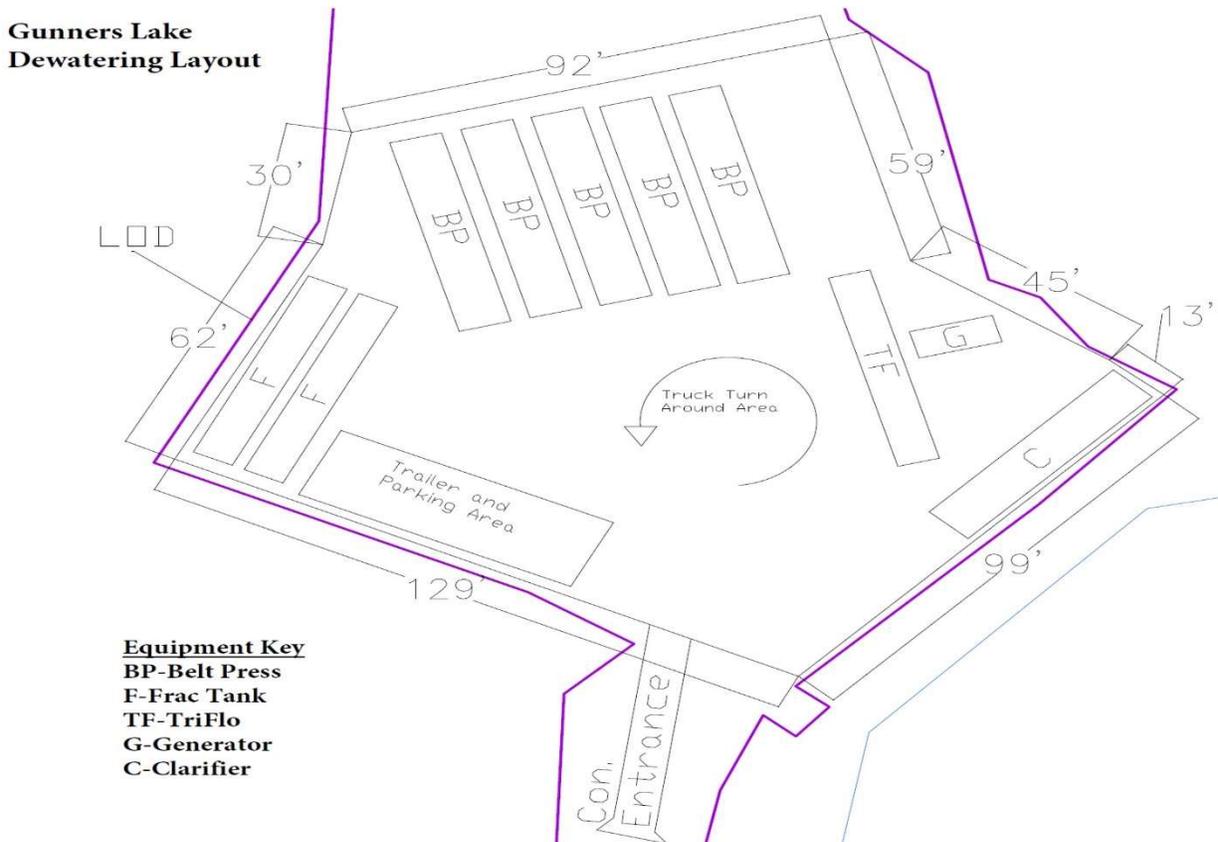


Figure 6. Gunners Lake Processing Site

Over 366 meters (1200 feet) of HDPE pipe were fused together to connect the dredge with the dewatering operation. In conjunction with the County's engineer, MDVP identified the levels to be dredged in various sections of Gunners Lake. Initially it was determined that it would be necessary to mechanically dredge several hundred yards of material prior to beginning the hydraulic dredging operation. This was performed utilizing an excavator and front end loader, which could easily access an island area from the shoreline. MDVP decided to utilize mechanical dredging for this portion of the project due to the location of the island area and because equipment was readily available onsite from the site preparation work that was just completed. Mechanical dredging was able to begin while the mechanical dewatering site setup was being finalized.

Once the hydraulic dredging operation began, material removed from the Lake was processed through the screen and dewatering system producing material that was beneficially used at the site utilized for Lake Whetstone material. Over 80% of the material removed from Gunners Lake was reused while the remainder of the material, sediments containing debris deposited through storm water runoff and vegetation, was sent to a disposal facility as shown in Table 1 above.

Once the dredging and dewatering portion of the project at Gunners Lake was completed, a considerably larger site restoration project began in comparison to Lake Whetstone. Due to the construction road that needed to be built, a larger lake front area was disturbed during the project, which needed to be regraded and revegetated.

CONCLUSION

For this project, nearly 26,000 cubic meters (33,800 cubic yards) of material was removed from the lakes by MDVP with nearly 15,300 cubic meters (20,000 cubic yards) being ultimately reused for grading and fill material.

Each Lake was restored to be both a functioning storm water management system as well as a viable recreational area available to be utilized by the communities surrounding the Lakes.

At the end of each operation at both Lake Whetstone and Gunners Lake, both Montgomery County and the representatives of each of the communities impacted by this maintenance contract were satisfied with the outcome. With both sites restored to their previous condition or better, the Lakes were soon to be enjoyed by the local residents while the water bodies continued to perform the service of collecting storm water generated throughout their communities.

Based on the experience of this lake sediment removal project, it can be concluded that hydraulic dredging and mechanical dewatering should be considered and can be used as an alternative means of maintaining these types of storm water retention basins. This method provides significant advantages on projects where there is limited space for dewatering of sediments with tight water quality restrictions. In addition, hydraulic dredging and mechanical dewatering provides a significant volume and weight reduction in dredge material based on average analysis of material pumped and dewatered during this project. This provides significant cost savings in the area of transportation and disposal of the dewatered product as it is drier and does not require the addition of amendment to meet disposal facility acceptance requirements.

Since hydraulic dredging and mechanical dewatering can be performed in a cost-effective and environmentally sound manner as well as in timeframe that meets regulatory constraints, this practice should be considered as an option when evaluating the maintenance of storm water basins, ponds, lagoons or lakes.

CITATION

Senske, F., Simpson, S., and Vetter, J., "Lake Sediment Removal Utilizing Hydraulic Dredging and Mechanical Dewatering," *Proceedings of The Dredging Summit & Expo '17*, Western Dredging Association, Vancouver, BC, June 26-29, 2017.