KLINGNER & ASSOCIATES, P. C.
Engineers • Architects • Surveyors

Memorandum

To:	Matthew Newell, Paul Caswell	***Of:***	City of Decatur
Copy to:			
From:	Gavin H. Risley		
RE:	Oakley Sedimentation Basin – Capacity Increase Review / Contract Agreement Review Assistance		
Project Name:	City of Decatur – Dredge Project Assistance		
Project No:	18-0006		
Date:	March 23, 2018		

Execution of Scope of Work Items 3 (Capacity Review) and 4 (Contract Agreement Review Assistance) are complete with the issuance of this memorandum. The Capacity Review Scope of Work is defined as a review of the previously collected dredge performance statistics with the sole deliverable being a memorandum summarizing the findings of the review/analysis in comparison to the calculated quantities by the design engineer, Chastain & Associates, LLC. The Contract Agreement Review Assistance Scope of Work requires a review of downtime claims/payment made under the existing contract agreement between the City of Decatur and Great Lakes Dredge and Dock (GLDD) and a review of GLDD's ability to hire sub-contractors toward the execution of the proposed dike height increase. The sole deliverable of this Scope Item is the production of a memorandum summarizing the documents reviewed, findings, and recommendations regarding those items described to be reviewed.

Dredge performance statistics were requested from the design engineer as well as statistics regarding the outflow from Oakley Sedimentation Basin. The requested datasets were largely unavailable with the permitted pumping rates being the bulk of the data provided, however, the Illinois State Water Survey reports issued in 2001 and 2002 indicated that in Lake Basin 6 the sediments are primarily silts and clays, which is located upstream of Lake Basins 3 and 4 that would require future dredging. Based upon the datasets provided, it appears that no data was collected / analyzed to specifically characterize the sediments being dredged prior to the commencement of dredge activities. Furthermore, no data appears to have been collected during dredging to characterize the dredge production/flow rates and/or outflow rates of the basin. These data sets are crucial to making accurate quantity calculations for the sizing of dredge material containment basins. The need for these material properties is documented in several references, including but not limited to:

"The index properties (including bulk density, void ratio, porosity, water content, percent solids, Atterberg limits, and specific gravity) are ultimately needed as geotechnical parameter inputs into the engineering planning, design, construction, operational, and management aspects of dredging and dredged material placement." [Lee, L.T. (2004). "Predicting geotechnical parameters for dredged materials using the slump test method and index property correlations," DOER Technical Notes Collection (ERDC TN-DOER-D-X), U.S. Army Engineer Research and Development Center, Vicksburg, Mississippi. www.wes.army.mil/el/dots/doer/]

"Field investigations are necessary to provide data for containment area design. The channel must be surveyed to determine the volume of material to be dredged, and channel sediments must be sampled to obtain material for laboratory tests….Laboratory sedimentation tests provide data for designing the containment area to meet effluent suspended solids criteria and to provide adequate storage capacity for the dredged solids." [U.S. Army Corps of Engineers. (1987). "Confined Disposal of Dredged Material." Engineering Manual 1110-2-5027. U.S. Army Corps of Engineers Headquarters, Washington D.C.

It appears, due to the lack of data collected, that assumptions and/or approximations have largely been utilized in the establishment of a bulking factor and basin water routing to create a height increase recommendation (although these assumptions appear to be within generally accepted estimates). Presently, Chastain has provided a height increase recommendation of four (4) feet based upon these approximations/assumptions and recently collected aerial survey data.

The original intent was to perform a capacity confirmation analysis utilizing the requested dredge performance statistics and dredged material properties; however, based upon the unavailability of those items, only a review of the Chastain performed calculations was executed in accordance with the Scope of Work and by specific request of Matthew Newell (email dated March 7, 2018).

Chastain arranged for an aerial survey of Oakley Basin to be performed with the results reported on March 2, 2018. The aerial survey was utilized to create an existing surface triangular irregular network (TIN). A TIN utilizes survey data points to create triangular facets connecting similar elevations to form a representative surface of the area surveyed. A TIN can be developed for both the existing (pre-project) and proposed conditions of a project, which can be compared to determine the appropriate cut/fill quantities for a project. This process was executed by Chastain and output reports of the process were provided to us via a draft letter dated March 12, 2018.

Chastain provided the most recently collected aerial survey dataset available to Klingner on March 6, 2018. Utilizing the raw survey points from these files, Klingner developed a TIN for the existing conditions as well as for the proposed four (4) feet berm increase or operating surface level of 715.5 feet (713.5 + 4ft – 2ft freeboard) for Oakley Sediment Basin 1 and 2 areas. The Polishing Pond area was given a final TIN of elevation 708 ft. These TINS were developed similar to Chastain's process as a means to check the software volume outputs provided by Chastain. The existing and proposed TINs were intersected to determine the volume available between them. The volume determined to be available for sediment storage was 2.966 million cubic yards, which compares well to the 2.903 million cubic yards determined during the Chastain TIN intersection process. The primary difference in results was likely with the Polishing Pond area volume, which is most likely attributed to the basic Klingner TIN development. Klingner developed a proposed condition TIN based upon a singular line surrounding each of the Basin areas, which may be slightly different than the process of creating proposed contour lines most likely utilized by Chastain.

It is our understanding the dredge cut volume required to complete the project is estimated to be 2,029,928 cubic yards. The process of dredging this material and depositing into the basin will result in a bulking of the dredged materials. The bulking factor is a ratio of the volume deposited after excavation to the volume in place before excavation. The volume after deposition "grows" due to agitation of the previously consolidated sediments and the entrainment of water through the hydraulic dredging process. The Bulking factors can range considerably, especially in an environment that contains multiple sediment material types such as clays, sands, and silts. Silts typically result in the largest bulking factors ranging up to 2.0. According to particle size distribution plots, silt sediment is documented to be prevalent within Lake Decatur by Illinois State Water Survey. The variability of bulking factors can be significant and can cause substantial containment over or under sizing;

"*Depending upon the texture of sediment to be dredged, bulking factors of 1.0 to 2.0 were applied to estimate required volume of the (containment) facility. While this design approach was easy, uncertainty and dissatisfaction were associated with the use of these bulking factors because they depended heavily on practical experience and local conditions. It was observed that by using these factors some containments have been undersized by as much as 50 percent, and others oversized by as much as 100 percent*." [Tso-Wang Lin (1983) "Sedimentation and self weight consolidation of dredge spoil" Iowa State University].

As previously indicated the collection and analysis of the sediment properties to approximately determine a bulking factor has not been performed, therefore the use of these bulking factor estimates are the only currently available method to predict the bulking of the Lake Decatur sediments deposited into the sedimentation basin.

Both Chastain and Great Lakes Dredge & Dock Company (GLDD) have attempted to calculate and/or predict the Lake Decatur Sediment Bulking Factors based upon the typical ranges, sediment type present, and the apparent consolidation since the start of dredging in 2014. There can be, as indicated previously, large variations in deposition volume determinations based upon these bulking factor estimates. According to Chastain, GLDD has estimated a bulking factor of 1.09 (9%) based upon the apparent bulking of materials since they were placed in the basin since 2014. A bulking factor of 1.09 would fall on the low end of typical bulking factor ranges and would fall more closely within the range of sand bulking. It is assumed that GLDD determined this bulking factor by comparing the estimated material dredged versus the estimated volume of material as placed in the containment since 2014. The risk associated with utilizing this bulking factor is sediments dredged since 2014 may have continued to consolidate since being placed, which could produce a lower bulking factor estimate when examining current conditions of the potentially consolidated materials. Additionally, it appears by recent information provided by Chastain, that over dredging has occurred with nearly 9.76 million cubic yards placed in the basin through the end of 2017. This conflicts with GLDD's statement that "GLDD has placed approximately 8,772,000 cubic yards in the basin." The conflicting accounts over what has been placed into the basin would prevent an accurate bulking factor determination.

Chastain has utilized a bulking factor of 1.25 in their evaluation for capacity increase recommendations. The 1.25 bulking factor is slightly higher than the Illinois Environmental Protection Agency's recommended value for lake dredging of 1.20. The 1.25 bulking factor does fall more closely within the range of published values; however this estimate may be low compared to published estimates of silt bulking factor values. The recent Chastain quantity calculations, as previously referenced, indicate that approximately 2.903 million cubic yards would be available within the Basin for a four (4) foot berm increase. Chastain also indicated that the required in place dredge quantity remaining is 2.03 million cubic yards. The available quantity versus the in place quantity to be removed indicates that there would be space for an approximate 1.43 bulking factor within the Chastain proposed capacity enlargement. A 1.43 bulking factor falls within the range of typical published values for silts/clays (indicated by Illinois State Water Survey to exist within Lake Decatur) and falls on the mid- to high end of the published ranges (Bray (1979) indicates silt bulking factors of 1.10 to 1.40, Huston (1970) indicates silts at 2.0, and Lacasse et al. (1977) indicates 0.6 to 1.3 for sand and silts and 1.0 to 2.0 for clays). The 1.43 bulking factor exceeds both factors implemented and/or calculated previously by Chastain and GLDD, 1.25 and 1.09 respectively.

There are inherent risks, as previously described, in utilizing bulking factors to make dredge basin containment sizing determinations. The collection, characterization of material data and sedimentation analysis for the sizing of dredge material containment basin is recommended by Klingner. That being said, based solely upon the available information and the recommendations of witnessed bulking factors by both Chastain and GLDD it could be inferred that an available bulking factor allowance of 1.43 would be sufficient. Caution should be utilized when using this bulking factor, as the Illinois State Water Survey indicated that primarily silt/clay sediments exist upstream of the Lake Basins remaining to be dredged.

Regarding the control of water, it appears that the ponding depths and material distribution within the Oakley Sediment Basin have largely been ignored in the development and capacity calculations by Chastain. This is likely due to the project specifications dictating the responsibility of these items to the contractor (GLDD). The specifications indicate the Contractor's responsibility for meeting effluent concentrations and freeboard permit requirements and for distributing materials within the basin to sufficiently place the required dredge material quantity. The current proposal by Chastain indicates that at the full dredge material quantity placed (using bulking factor of 1.43 as previously

described) would leave GLDD with zero allowable ponding depth to remain at or below the two (2) feet of required freeboard. Using a bulking factor of 1.25, Chastain indicated during a telephone conference on March 22, 2018 that an available ponding depth or operational water depth of 0.67 feet would be available. The reasonableness or suitability of this ponding depth is unable to be determined due to the lack of information regarding the dredge materials previously indicated as well as the unavailability of information regarding GLDD's operation of the basin. The operation data including the necessary/anticipated retention time, anticipated inflow, anticipated outflow, and the anticipated flowrates/routing of water through the interior areas would all be data necessary to make ponding depth determinations. In addition, the evaluation should consider potential rain events such as 10-year, 24-hour rain events. As dictated by the Project's specifications the operation of the Containment Basin including effluent quality and ponding depth is the responsibility of the contractor.

Klingner would point out that the 0.67 feet is only allowable for the 1.25 bulking factor and the 1.43 bulking factor would eliminate the 0.67 feet of ponding depth and the implied buffer or extra capacity of the containment basin. Additionally, it is important to recognize that with an available ponding depth of 0.67 feet to the freeboard elevation that a rainfall event over the containment area would likely halt operations and very likely would impact the available freeboard. It is important to recognize that this issue remains contractually a contractor responsibility. Based upon the data available and the discrepancies / lack of data presented within, it is Klingner's opinion that it would be prudent to provide additional operational water or ponding depth moving forward. Klingner would recommend that the final selected berm height increase and the resulting operating/ponding depth be submitted to GLDD with a request that GLDD's operating plan indicate their capability to meet the permit requirements and project schedule within the design parameters. This operating plan should be submitted to the City / Design Engineer for review. The operating plan is to be produced by the selected contractor as outlined by Special Provision 7 in the Project Specifications. GLDD's production of the operating plan would indicate their ability to perform the work within the design tolerances.

Chastain's recommendation and GLDD's apparent preference to perform the Change Order under the Contract Based Proposal provided by GLDD on February 6, 2018 is also Klingner's recommended preference. While the Contract is ultimately between the Owner (Decatur) and the Contractor (GLDD), the City's Legal Counsel is likely to provide the most judicious advice. It is Klingner's opinion that, under the current circumstances, remaining in compliance with the existing contract would be in both parties best interest.

Based upon the data presented by Chastain via email (March 22, 2018) and by the City Engineer via telephone conference (March 22, 2018), it appears that knowledge of under sizing of the Containment Basin existed prior to eventual dredging shutdown due to lack of capacity. In light of this information and other information provided for Klingner review, it does appear that downtime claims to some extent would be reasonably expected by GLDD. The amount of these claims and the calculations are debatable, as such Klingner would recommend an audit and full review of these claims by the City and Chastain prior to compensating any amounts requested by GLDD.

Klingner has fulfilled the Scope of Work items identified under our executed agreement with the City of Decatur. If the City of Decatur wishes Klingner to provide further recommendations or analysis, Klingner can perform those services as an additional service.

Additional services may include, but are not limited to: collection and analysis of dredge material to determine properties to more accurately evaluate a bulking factor; review of the operating plan to be developed by GLDD; and make recommendation for an increase in containment capacity as defined by the developed datasets.