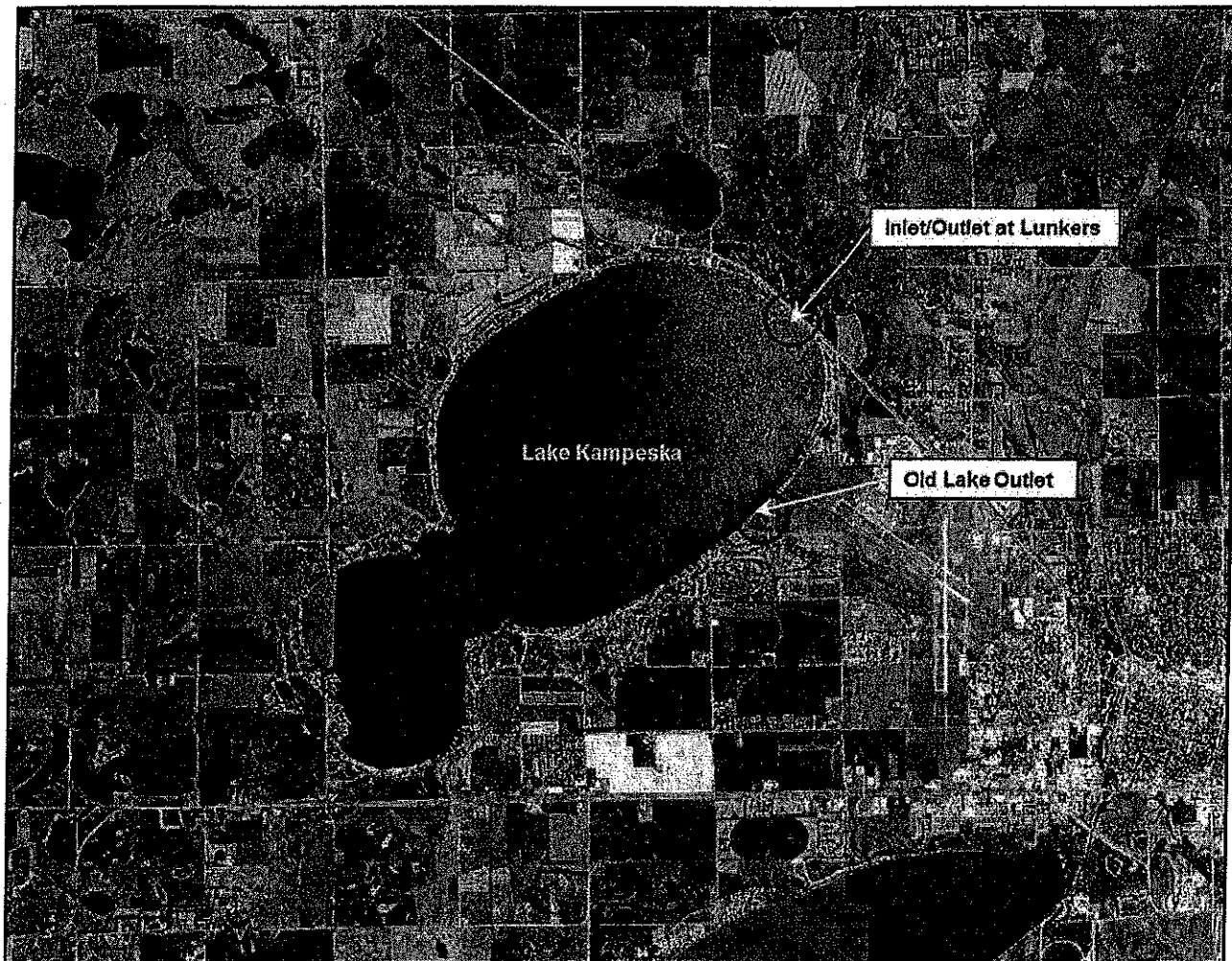


# Lake Kampeska Preliminary Dredging Assessment



Prepared for:  
The Lake Kampeska Water Project District (LKWPD)

December, 2013

by  
HDR Engineering, Inc.

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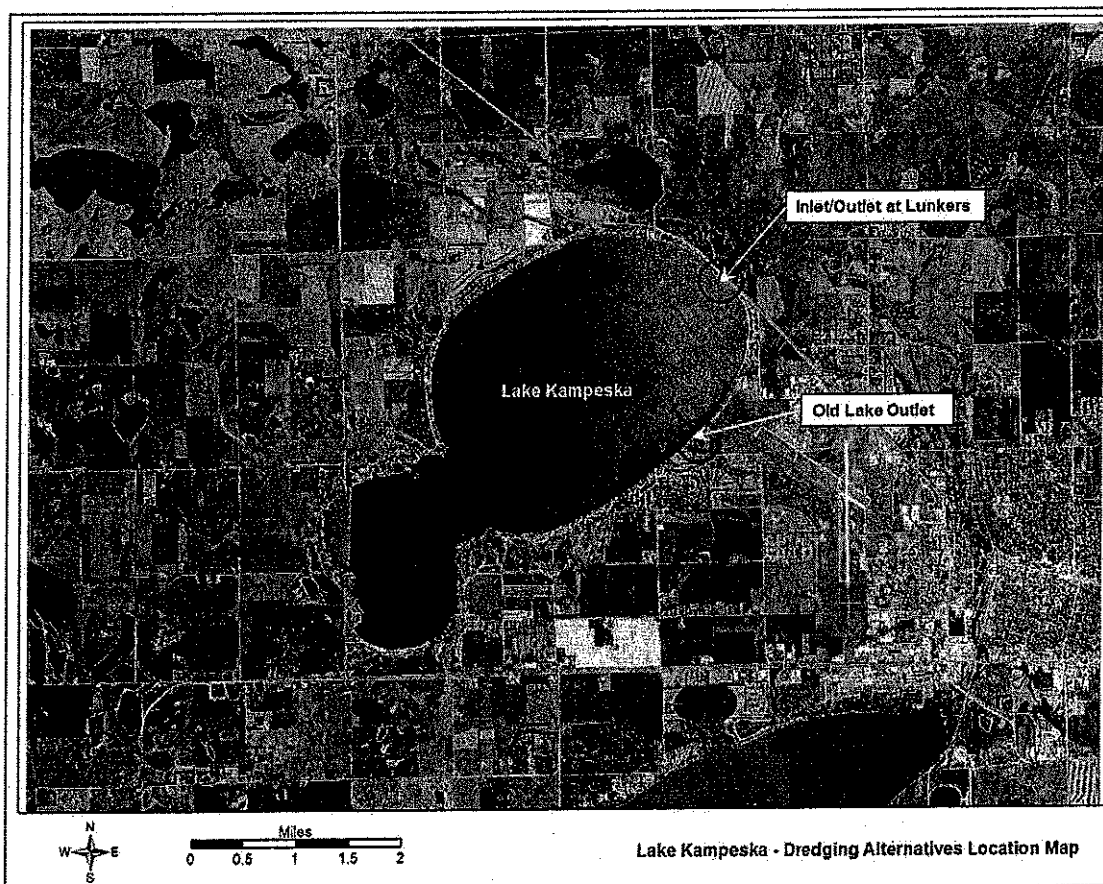
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## 1. Introduction

Lake Kampeska is a natural lake approximately 5,075 acres in size and located within the city limits of Watertown, South Dakota, which is in the northeastern portion of the state. The lake is important as a regional recreational resource. Sediment accumulation has been a concern for many years and shallow water depths have restricted recreational access in certain locations, particularly during seasonal periods of low water levels in the lake.

The purpose of the Lake Kampeska Preliminary Dredging Assessment is to complete a desktop evaluation of selective dredging alternatives within several shallow, sediment impaired areas of the lake that include the area adjacent to the Inlet/Outlet at Lunker's Restaurant for improved navigational access, and at the existing marsh area located near the old Lake Kampeska Outlet for potential marina development (see Figure 1). Preliminary issues to be identified for both areas will include a) dredging, b) regulatory permitting requirements, and c) a preliminary estimate of probable cost. The potential Marina development will include preliminary evaluations of wetland reclamation and excavating a stable navigation channel through the existing shoreline. A concise summary of findings for the Preliminary Dredging Assessment will be provided with a conceptual estimate of probable costs. Additional discussion will be provided regarding the estimated range of probable costs and general requirements for completing a more extensive, large volume dredging project throughout the rest of the lake.

Figure 1. Lake Kampeska Dredging Alternatives Location Map



## 2. Preliminary Assessment of Dredging Requirements

Existing bathymetric mapping will be used to evaluate both areas and develop preliminary dredging depths and quantities. The available bathymetric mapping indicates that water levels were approximately four (4) feet lower than the full pool elevation. Therefore, preliminary dredging depths will be based on typical worst case low water conditions that historically reoccur seasonally and during extended dry periods. A six (6) foot minimum water depth during low water conditions has been selected as a baseline for estimating purposes. Additional sounding data and sediment measurements will be recommended for a future Task Order based on preliminary findings of feasibility and probable cost. HDR understands that the potential marina development will require excavating and dredging a stable navigational access channel into the existing marsh area and then enlarging and deepening the marina basin to allow for safe ingress and egress with temporary mooring capability.

As described above and shown in Figure 2, the two areas being evaluated would require sediment removal from the near shore zone out to where a six (6) foot water depth occurs when the lake is approximately four (4) feet below full pool. This would represent a typical worst case navigational scenario. For purposes of this analysis, an average of two (2) feet of sediment will be assumed to be removed within the limits of the lake dredging areas. An increased sediment cut is anticipated in shallower water near shore and a reduced sediment cut would likely be required in deeper water where navigation is not impacted. A separate volume estimate will be used for the Old Outlet area where a potential marina will be considered since dry, land based excavation is assumed.

The area adjacent to the existing lake Inlet/Outlet at Lunker's Restaurant encompasses a maximum area of approximately 16 acres for preliminary estimation purposes. The actual dredging area required may be smaller depending on the desired level of access to a temporary mooring facility and whether or not a more focused channel is desired for the purpose of reducing the dredging quantity and overall cost. Since there are 1,613.3 cubic yards in one acre-foot, removing an average of two (2) feet of sediment in a 16 acre area would amount to an estimated dredging quantity of 51,626 cubic yards. By reducing the total dredging area to approximately 8 acres, the dredging quantity would be reduced to 25,813 cubic yards of sediment measured in-situ.

The lake side portion of the Old Lake Outlet is preliminarily configured as a 200 ft. wide channel that extends from the shoreline out to approximately 900 feet where the approximate 6 foot depth contour (at low water conditions) is located. This channel would occupy an area approximately 4 acres in size and would require a dredging quantity of approximately 13,333 cubic yards based on a two foot average dredge cut.

In order to construct a stable navigational access channel leading into a deepened and enlarged marina basin, land-based mechanical excavation equipment would be required. Figure 3 approximates the location and preliminary layout of an access channel and marina for evaluation purposes (Source: Watertown 2020, Jackson Park Marina Concept 7-22-13).

Figure 2. Lake Kampeska Bathymetry and Preliminary Dredging Locations

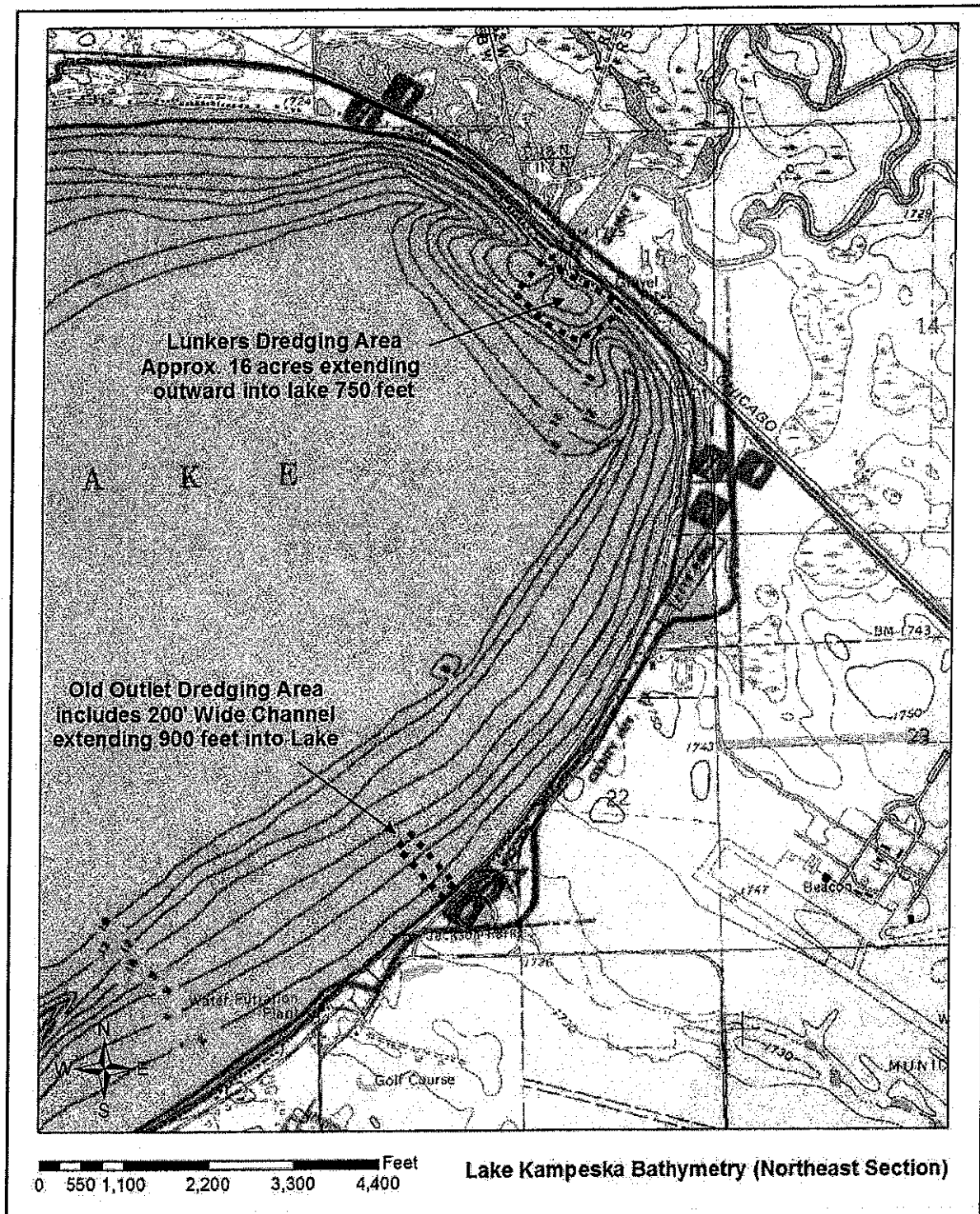
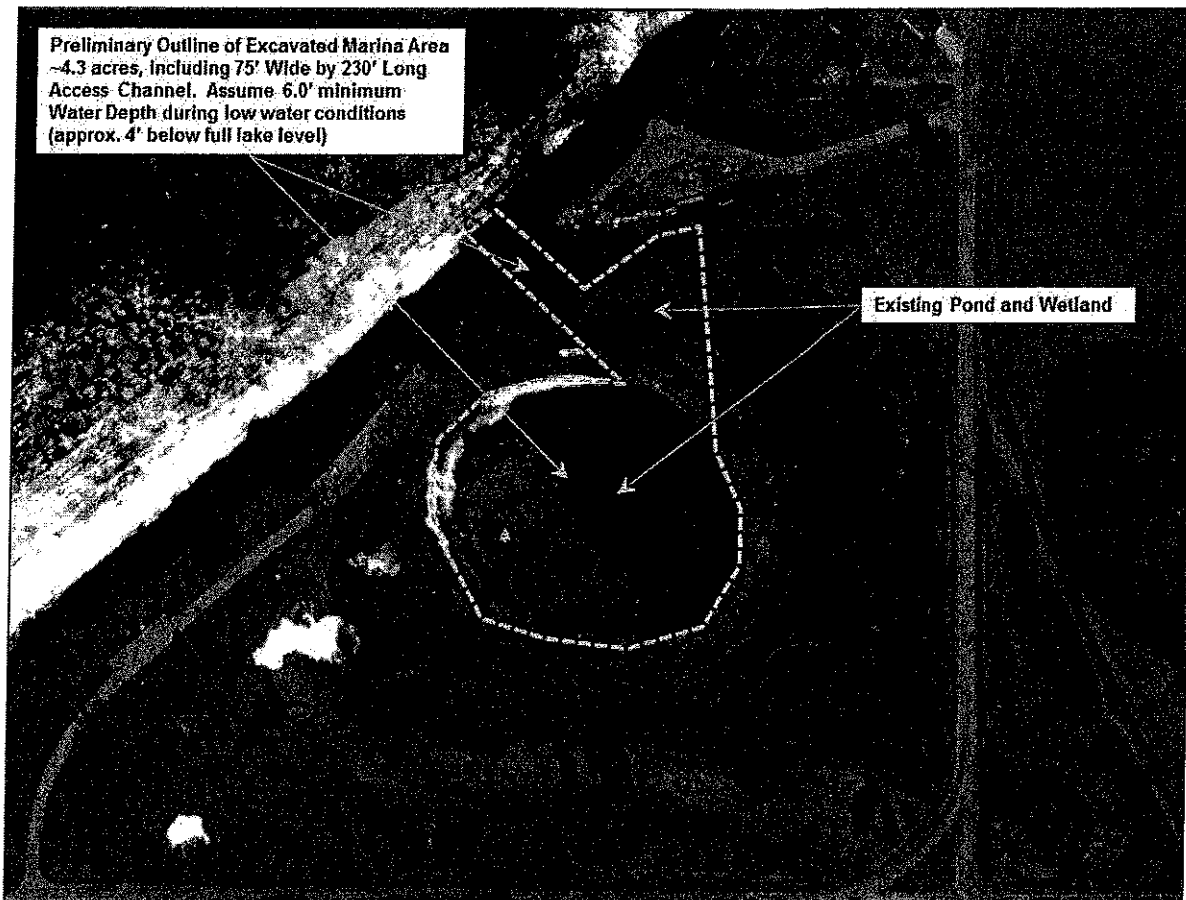
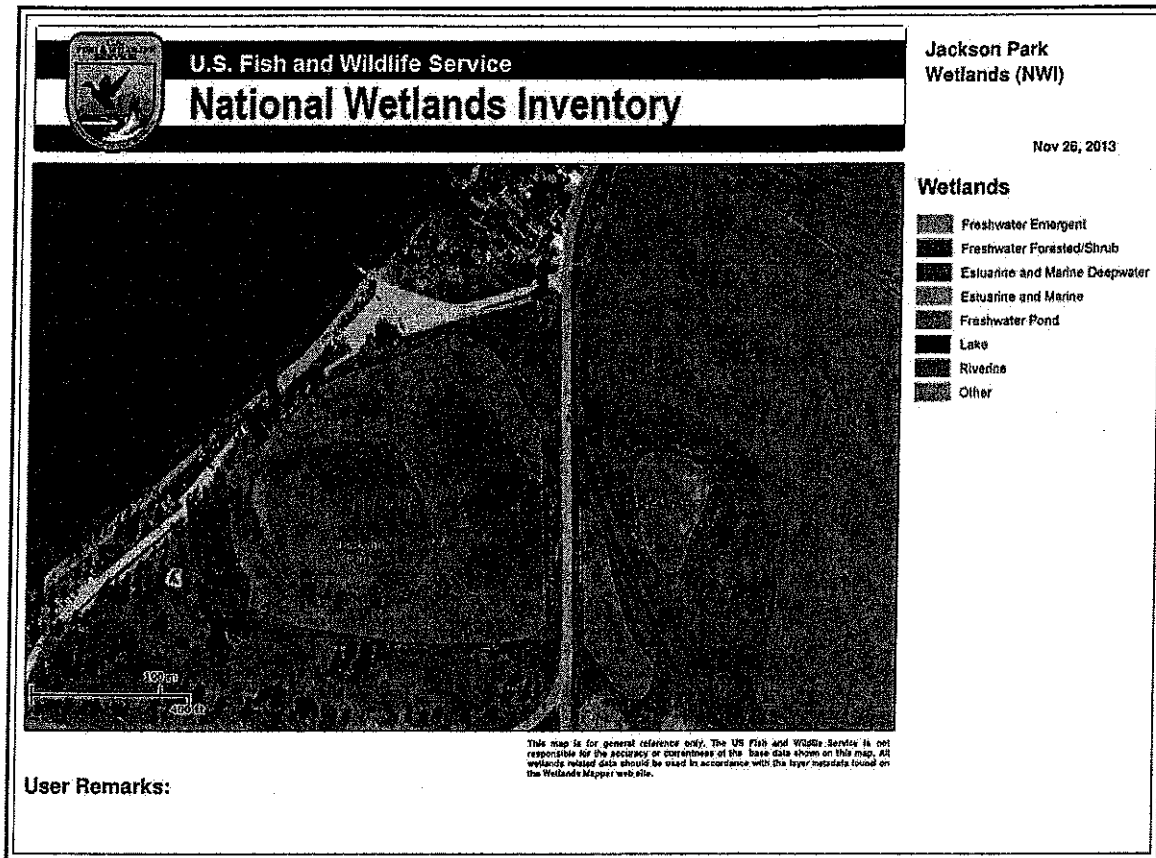


Figure 3. Old Outlet Dredging Location and Preliminary Marina Concept



Based on the preliminary Marina concept outline, approximately 4.3 acres of total land area would be impacted that primarily consists of PEM/ABF (Palustrine Emergent/Aquatic Bed) wetland that is semi-permanently flooded according to the National Wetland Inventory (see Figure 4). Although most of the land within the concept marina area is at or below lake level, the 75 foot wide access channel passes through approximately 150 feet of elevated ground that ranges from 4.0 to 8.0 feet above normal lake level and represents an area of approximately 0.25 acres. For preliminary estimating purposes, a range of 6.0 to 8.0 feet of earth excavation will be used for achieving the desired navigable low water depth for the area within the concept marina outline. A more detailed survey and quantity takeoff will be required if the concept marina goes forward for implementation. Therefore, a 4.3 acre area that includes a 6.0' to 8.0' excavation effort would require approximately 41,624 to 55,499 cubic yards of shore based material to be removed, primarily from within an NWI wetland. In addition to the bulk material excavation, the access channel and marina areas would require approximately 2,200 linear feet of structural stabilization along the excavated shorelines using a combination of riprap and steel sheet pile seawall.

Figure 4. NWI Wetland Map of the Jackson Park Area



### 3. Dredging and Dewatering Alternatives

Dredging is defined as the removal of material by mechanical means from the bottom of lakes, rivers, harbors, or ponds. Dredging is typically completed to maintain safe navigation depths, increase water supply capacity, restore sediment and phosphorus trapping capability, enhance water quality and aquatic habitat, remove contaminated materials, or to recover useable materials or minerals. Early dredging efforts were accomplished with manual labor, using scoops, shovels, and baskets. Later, dredges employed men or animals to power scoops or drags to clear harbors, shipping channels, and canals. Modern dredges are now powered by diesel, gas, or electric engines and range in size from small portable pumps and mini-dredges to large ocean-going vessels.

Dredging projects for inland waterways, lakes and reservoirs generally consist of both waterside (in-water or shoreline) activity - mobilization, staging/support, dredging, and de-mobilization, and upland activity - sediment dewatering and placement. Mobilization consists of delivering the dredge and supporting equipment (i.e. pipeline, barges, etc.) to the waterway and launching the dredge. Staging/support encompasses all those activities necessary to staff and maintain the dredge during the operation, and includes fuel deliveries and periodic maintenance. Dredging is the in-water operation of equipment for the removal of material from the bottom. De-mobilization consists of removing the dredge, pipeline and

associated support equipment from the water and any necessary reclamation or cleanup of the staging/support site. A dredging project is typically measured and priced by the cubic yard of material removed from the lake (measured in-situ), in addition to mobilization and sediment dewatering/placement costs.

Determining the dredging approach for a particular lake or waterbody drives the selection and design of the dredged material dewatering site and final placement site(s), which in turn drives the nature and extent of federal, state, and local permitting required. However, determining these components does not happen in strict sequence – rather, they are considered simultaneously, with information from options for each component affecting the viability of the other options. For example, if hydraulic dredging is the method utilized to remove sediment, there must be a means to store and dewater the sediment. Likewise, for mechanical dredging to be effective, there must be a suitable lakeside staging area accessible to heavy trucks or other mechanism to transport the sediment to a suitable placement location.

The following provides an estimate of the volume of material to be dredged, an overview of the dredging options considered, the general pros and cons of each dredging approach, and their applicability to the selective dredging areas being evaluated at Lake Kampeska. Dredging alternatives considered to be applicable are discussed in further detail below.

#### **4. Dredging Options**

There are three primary means of dredging the identified sediment impaired areas:

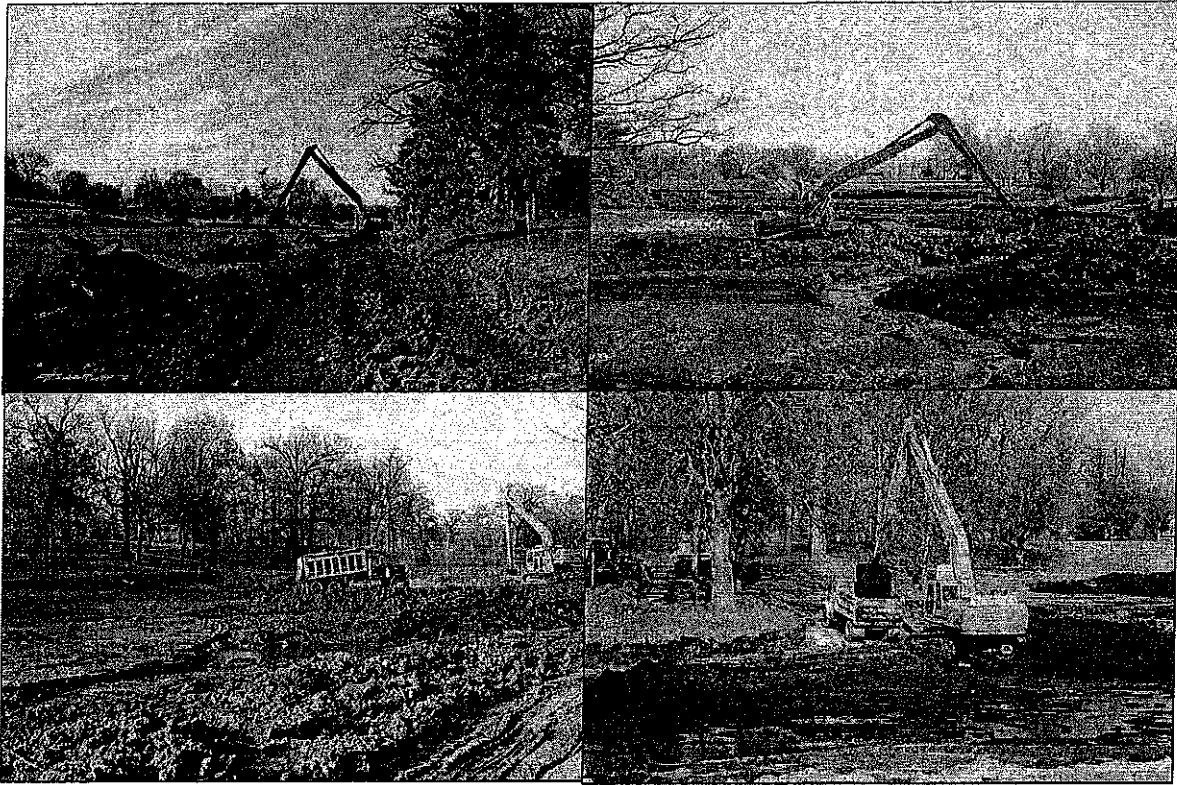
- Partial Lake Drawdown and Excavation (e.g. mechanical “dry” dredging)
- Mechanical Wet Dredging
- Hydraulic Dredging and Sediment Dewatering

##### Partial Lake Drawdown and Excavation

In this approach, the lake would be partially drained or drawn down, the bottom materials would be allowed to dry out, and earth-moving equipment would be brought in to remove the unwanted sediment. This method would require building a haul road to provide access for heavy trucks into the targeted dredging area. In certain applications, this approach can be a viable alternative to other forms of dredging, but has a greater environmental impact, and takes the longest to complete due to unanticipated runoff events. The drained lake system may be unsightly and would not be usable during the drying and excavation phase, which can last several weeks to several months unless a temporary in-lake cofferdam to prevent flooding in selective working areas. Typically, the sediment never truly dries and excavation occurs under muddy conditions (see Figure 5). Partial Lake Drawdown and Excavation is not considered to be a viable approach for Lake Kampeska due to the large surface area and storage volume of the lake, in addition to the risk, expense and environmental impact anticipated.



Figure 5. Partial Lake Drawdown and Mechanical Dry Dredging



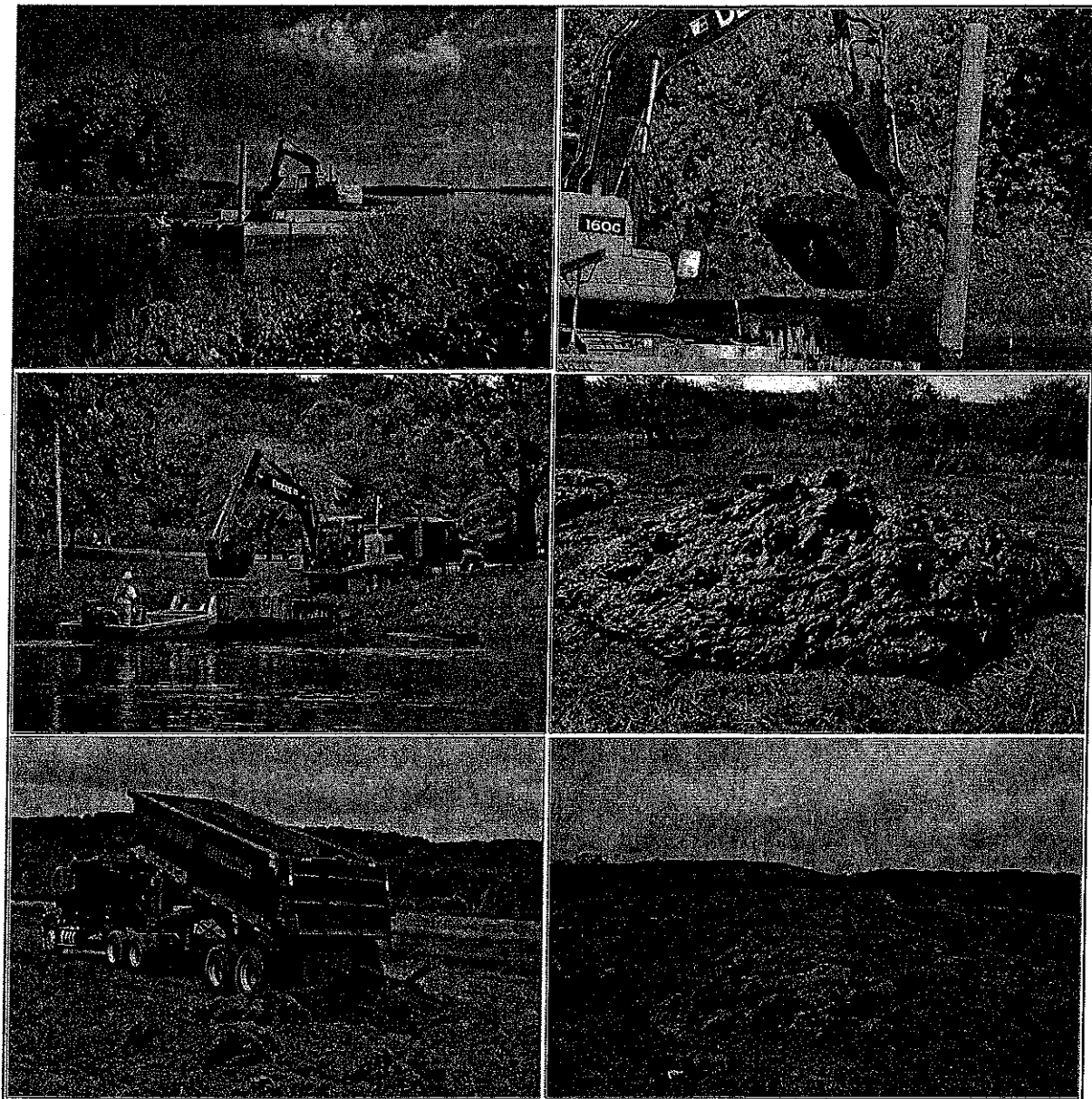
#### Mechanical Wet Dredging

Mechanical wet dredging uses an excavator (such as a track hoe), dragline or a clamshell to remove the sediments. The dredging is conducted either from shore or from a barge in the water. Mechanical wet dredging often creates increased levels of turbidity (suspended sediment) within the water; specialized “environmental” or closed clamshell buckets can be used to reduce the turbidity – however these add cost and add water to the dredged material and are not generally required unless the sediment is contaminated. Mechanical wet dredging produces a plastic to fluid mud of varying consistency; the material can be handled and transported without dewatering although there is risk of spillage if the mud is too fluid. In addition, many facilities that accept dredged material for placement will not accept material with high water content.

Mechanical wet dredging from a barge with sediment transport off-site by truck includes the use of an excavator or clamshell operating from a barge or floating platform in the water (see Figure 6). Sediment is placed into another barge for temporary containment. When the sediment containment barge is full, it is moved to a lakeside staging area, where another excavator removes the material onto the shore or into trucks. This method requires handling the sediment several times. Clamshell dredging can be expensive, and is generally used for deep water river and harbor dredging. Dredging shallow lakes with a properly sized excavator may be more feasible. Mechanical dredging requires good lakeside access to deploy the barges and excavating equipment, and to provide truck access for removing the sediment and hauling it to

the placement site. The dredged material from mechanical wet dredging can be muddy or even soupy in consistency, although it can be handled by equipment without dewatering. However, if the material is too wet, it may require some settling and decanting of excess water prior to transport or placement. The wet sediment is heavy, and trucks may be required to run at 30 to 50 % less volume than load capacity, increasing the number of truck trips and overall hauling costs. Again, a haul road is needed to access the lakeshore staging area. Mechanical dredging from a barge with subsequent truck transport of the sediment may be feasible for selective dredging options at Lake Kampeska with limited availability of lakeside staging areas suitable for heavy truck traffic, limited temporary placement sites for wet sediment, and anticipated high comparative costs.

Figure 6. Examples of Mechanical Wet Dredging



Mechanical dredging from shore with sediment transport off-site by truck is completed using an excavator or clamshell that works from the shoreline of the lake. Surrounding trees and other obstructions are removed, and the shoreline must be leveled. The excavator places the dredged material into trucks for transport. Haul roads are constructed around the shoreline so trucks have access to the excavating equipment. Dredging is typically limited to near shore areas within reach of the equipment – typically 30 to 40 feet (a maximum of about 50 to 60 feet with specialized equipment). This approach is feasible only for small ponds and cove areas with good shoreline access for equipment.

Mechanical dredging from shore is not considered feasible for the Lake Kampeska dredging alternatives due to the inability of this method to reach out to the targeted low water dredging depth of 6 feet, which is located approximately 750 to 900 feet from shore.

#### Hydraulic Dredging and Dewatering

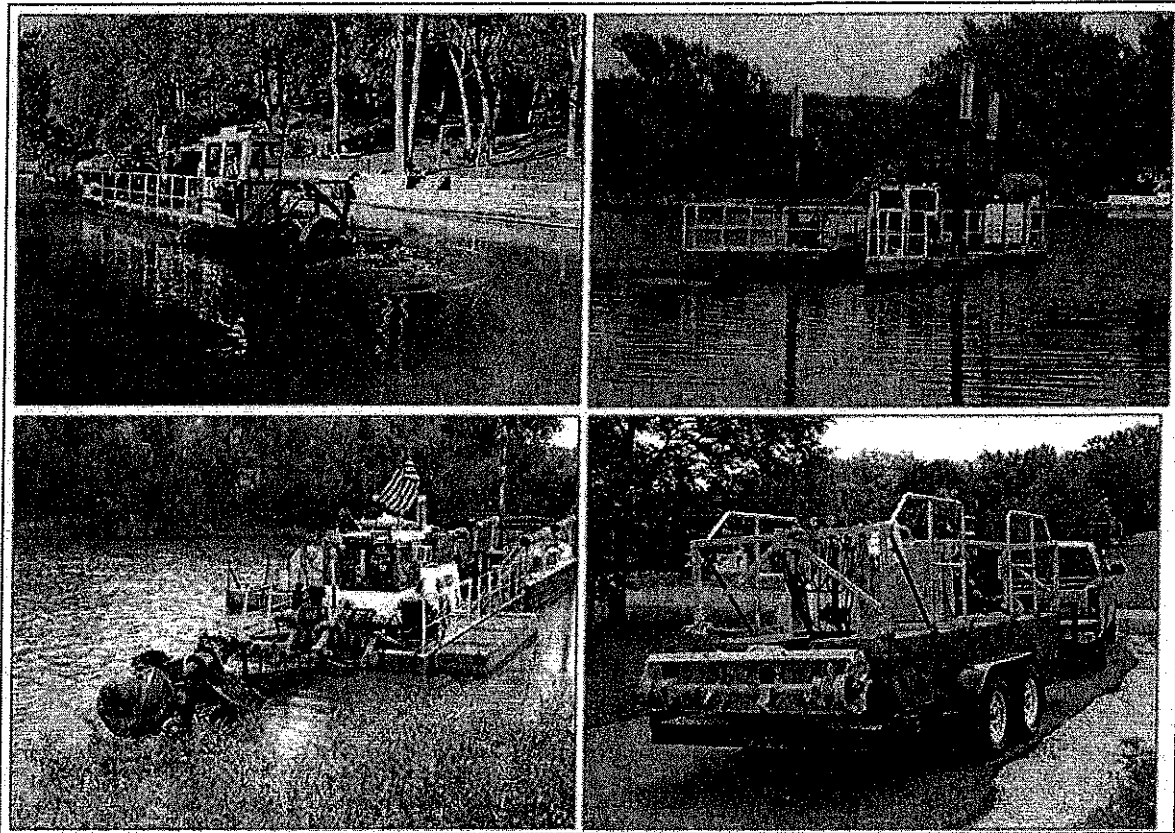
A hydraulic dredge (also called a suction dredge) works like a floating vacuum. The typical dredge used for lakes is generally about the size of a small houseboat, and consists of a diesel motor, pump, and small operators cab (see Figure 7). Smaller hydraulic dredges are also available for small ponds or selective dredging areas that are about the size of a pontoon boat that can be more easily deployed for access to multiple ponds or hard to reach areas. A boom with a rotating cutterhead or horizontal auger is lowered into the sediment to loosen the bottom material. A suction hose attached to the boom pulls in the loosened sediment – much like a snow blower or carpet sweeper attachment on a household vacuum. The sediment slurry is then pumped through a temporary HDPE (high density polyethylene) pipeline to an offsite location for temporary storage and dewatering. The dredge pipeline typically floats on the water surface and/or is laid on the ground surface to reach the dewatering site. Depending on the location and set-up of the dewatering area, there may also be a return line for the clear effluent water discharged after the solids are removed from the dredged sediment slurry. It is generally preferable to allow the clear effluent discharge water to flow back to the lake via existing drainage ways or via pipeline.

Hydraulic dredges typically generate less turbidity than mechanical dredges, and whatever turbidity is generated from the dredging activity can be controlled and isolated with floating turbidity curtains deployed around or at the downstream end of the dredging area. There is minimal disturbance of the lakeshore, and the primary dewatering area does not have to be at the lakeside. Additionally, hydraulic dredging is completed during warm weather conditions at normal lake levels, which minimizes impacts to the fishery and near shore aquatic community. However, there must be an access point to put the dredge into the water. Large hydraulic dredges can be lifted into the lake with a crane, whereas many of the smaller dredges can be launched from an appropriate trailer. Hydraulic dredging operations also require a lakeside staging area where the pipeline pieces can be delivered and assembled, and to support the dredging operation.

A hydraulic dredge can pump the material in the pipeline a short distance. If the distance is greater than one mile, or involves pumping over any substantial hills, one or more booster pumps may be necessary. The booster pumps must be accessible for operations, fueling, and maintenance. The booster pump stations can be on land or on a barge in the water, depending on pipeline configuration and location of the dewatering site(s). Pipelines are typically placed on the surface, and although temporary, need to be solidly constructed to avoid leaks. The pipelines can be routed under roadways using cut and fill, jack and bore or horizontal directional drilling technique. Pipeline and pumping costs increase with distance,

total elevation, number of roadway crossings, and if there are right-of-way issues or special permits required (e.g. stream crossings, wetland issues, etc.).

Figure 7. Examples of Small Hydraulic Dredges



A small, highly portable hydraulic dredge in the 8" to 10" diameter pipeline discharge size would be ideally suited for the targeted dredging alternatives. Ease of mobilization along with operational access in shallow water is a critical component for dredge equipment selection. Assuming sufficient dewatering space and capability, the optimum dredge in this size range would typically be capable of pumping sediment and water slurry at approximately 2,500 to 3,500 gallons per minute or 50 to 100 cubic yards of dredged sediment per working hour. For purposes of this preliminary dredging production evaluation, an average rate of 75 cubic yards per hour will be used. The anticipated 6:00 am to 10:00 pm allowable work day would allow actual dredging production to be approximately 12 to 14 pumping hours due to normal maintenance and other unanticipated inefficiencies. Therefore, a five day work week would allow an estimated weekly dredging rate of approximately 4,875 cubic yards per week (as measured in-situ). A larger, more powerful dredge could pump more cubic yards per week, but for smaller projects, the additional cost of mobilization for larger equipment may not be cost effective.

Since the overall space available for sediment dewatering and temporary storage may be limited, the total time of completion may be extended, particularly if geotextile tubes are used for dewatering the sediment prior to hauling the dry soil off-site.

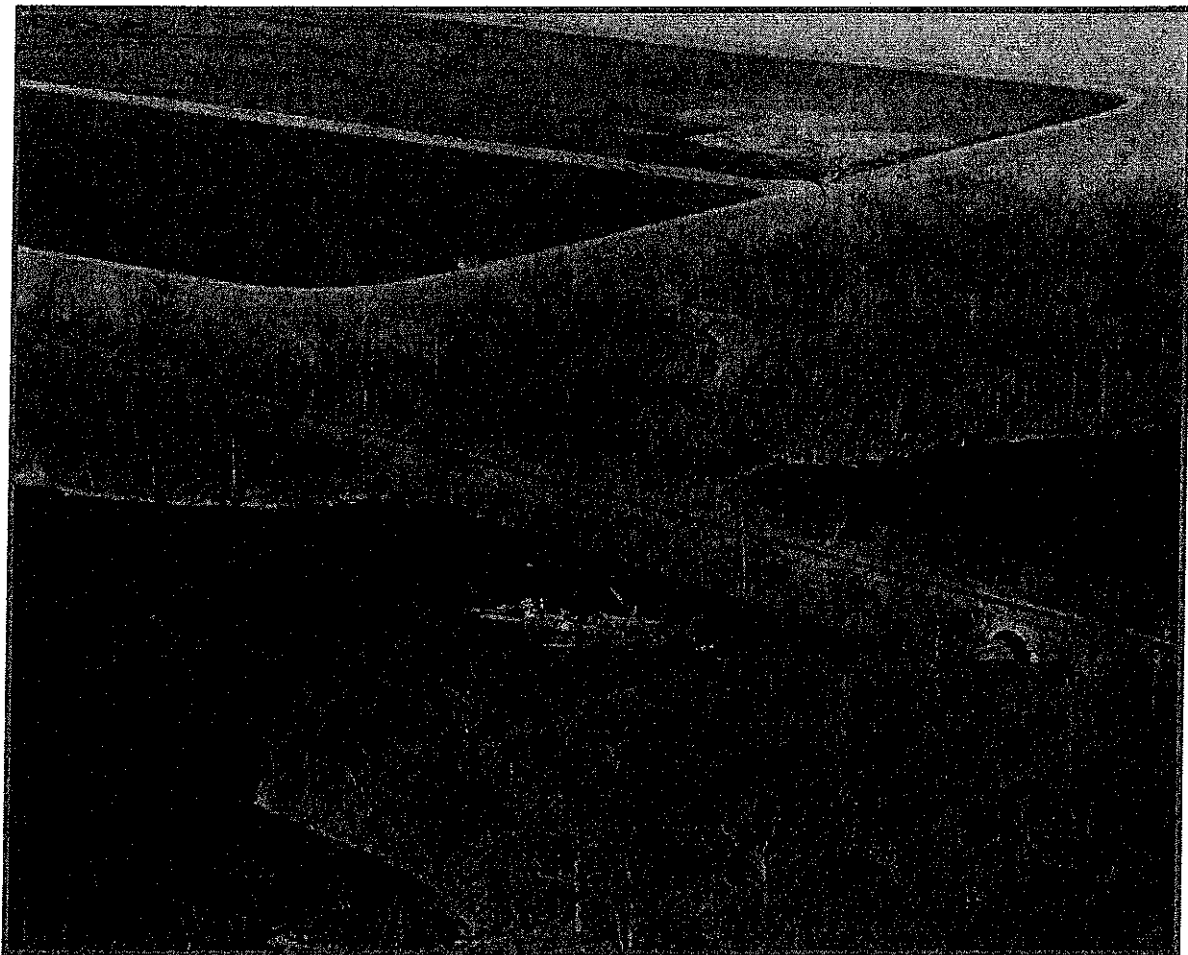
Hydraulic dredging is generally the least obtrusive of the available dredging methods for lakes and reservoirs. However, because hydraulic dredging relies on pumping water at high velocities to move the sediment, some form of dewatering (e.g. separating the sediment from the water used to transport the sediment) is necessary.

Hydraulic dredging is a feasible option for dredging the targeted Lake Kampeska locations provided the dredged material can be cost-effectively stored and dewatered on an acceptable off-site upland location.

### **5. Sediment Dewatering Options**

Generally, the most cost effective approach to dredge and dewater this volume of sediment is to hydraulically pump the sediment and water slurry into an earthen Sediment Dewatering Facility (SDF) (see Figure 8 below). However, this scenario is dependent on securing or leasing a sufficiently sized parcel of open land that is nearly level or gently sloping and is located outside of the floodplain, with no wetlands on the site. It is also desirable to be within one mile of the targeted dredging area with pipeline access and a minimum number of road crossings. Longer pumping distances are certainly feasible, however, a booster pump would be required and higher dredging costs would be incurred as a result.

Figure 8. Sediment Dewatering Facility (SDF) with Hydraulic Dredge in Lake



If a suitable upland storage and dewatering site cannot be secured within close proximity to the targeted dredging areas, the use of alternative dewatering methods such as geotextile tubes (see Figure 9 below) or on-site mechanical dewatering systems (e.g., centrifuges, clarifiers, belt presses, etc.) would be required. Both of these alternative dewatering approaches are generally more expensive than constructing a suitably sized earthen dewatering facility. However, in the event a suitable upland SDF site cannot be acquired or leased, these alternative dewatering approaches may be required. The dewatered material would have to be hauled to one or more locations, preferably for placement on an existing agricultural field or soil processing facility. Geotextile tubes are large geotextile fabric tubes approximately 60 feet in circumference and 100 feet or more in length. They are generally placed in a series and hydraulically filled with dredged sediment and water. Depending upon the total volume proposed to be dredged, a sufficient amount of land area would be required for a short period of time to allow the excess water to discharge back into the waterway and allow the dredged sediment to dry and consolidate within the tubes for eventual off-site hauling.

If sufficient land area does not allow the temporary and potentially repeated placement of geotextile tubes, an onsite mechanical dewatering system can be used on a smaller land area to rapidly dewater the sediment for temporary stockpiling and subsequent off-site hauling (see Figure 9 below). A similar dewatering system was recently utilized in Delavan, WI to dewater approximately 45,330 cubic yards of lake sediment within a 100 foot by 250 foot area behind a Town Fire Station. The dewatered sediment was stock piled and then hauled to an approved soil placement site on a daily basis since available stock pile space was limited. The volume of the sediment as measured within the lake was reduced by nearly 40 percent after being dewatered, which greatly reduced the number of truck loads required

Figure 9. Examples of Geotextile Tubes and Mechanical Dewatering Systems





## **6. Summary of Findings**

Based on the desktop analysis completed for the two locations identified for the preliminary dredging assessment, a concise summary of findings and estimate of probable cost is provided below for planning purposes. It is important to note that the preliminary findings are based on existing bathymetric mapping that was completed during low water conditions and that generalized sediment data was available from a previously completed USGS report. Prior to undertaking a dredging project at either of the identified locations, it is strongly recommended that an updated sediment survey be completed and that several sediment core samples are obtained from both locations in order to physically and chemically characterize the upper two to four feet of lake sediment for design and permitting purposes. The sediment survey would include measurements of the existing water depth and sediment measurements within the targeted dredging areas to confirm sediment depth and whether a hard underlying bottom is present that exhibits a point of refusal due to hard underlying material that may limit dredging effectiveness.

The area adjacent to the Inlet/Outlet at Lunker's Restaurant that was evaluated for the purpose of providing navigational access and temporary mooring facilities for recreational boaters was estimated to require approximately 51,626 cubic yards of sediment within the 16 acre area targeted for dredging. It was noted that this preliminary dredging area would extend out into the lake approximately 750 feet from shore in order to reach a six (6) foot water depth under low water conditions. This area may be potentially reduced in overall size to an approximate eight (8) acre area depending on budget constraints and upland sediment storage availability. If a reduced eight (8) acre area was found to effectively provide the desired navigational access benefit, then approximately 25,813 cubic yards of dredging would be required based on the assumptions described above.

## **7. Project Permitting**

As described above, selective lake dredging in the areas evaluated would require federal, state, and local permits. Federal and state permits (Section 404 and 401) would be required for all in-water activity and activity that affects regulated waters such as streams and wetlands. The federal and state permits are issued on a project basis and each agency's permit would address all regulated activity in and adjacent to the lake, at the staging site, along the dredge pipeline route, and at the dewatering and placement sites. Given the size and complexity of the two areas evaluated, a Nationwide Permit is likely for both dredging areas.

Since there are approximately 4.3 acres of wetlands that would be impacted by the potential marina development at the Old Lake Outlet, an individual permit may be required. Local permits and approvals would be required for changes in land use or land disturbance activity. Since the proposed marina area would impact NWI wetlands, permitting work would include a site specific wetland delineation and some level of mitigation plan to compensate for the impact and alteration of the emergent wetland habitat present within most of the proposed project area. The local permits are issued on a site specific basis.

The following estimates of probable cost have been developed for various dredging options for the Inlet/Outlet area adjacent to Lunker's and have been based on other similar projects that have been completed. Preliminary estimates for hydraulic dredging and conventional dewatering in an earthen SDF; hydraulic dredging and alternative dewatering using either geotextile tubes or mechanical dewatering methods; and wet mechanical dredging using a barge mounted excavator and hauling sediment with

trucks. More accurate costs can be determined prior to actual project implementation by requesting bids from several appropriate contractors. Land acquisition costs have not been included in this preliminary estimate.

#### 8. Preliminary Estimates of Probable Cost for the Lunker's Dredging Area:

Table 1. Preliminary Estimate of Probable Cost with SDF (Lunker's)

Sediment Removal Work Task	Total Quantity	Estimated Cost
Dredging - (~ \$10/CY)	25,813 - 51,626 CY	\$ 258,130 - \$ 516,260
Dredge and Pipeline Mobilization	1 LS	\$ 60,000 - \$ 80,000
Construct Sediment Dewatering Facility (SDF); 5 to 10 acres	1 LS	\$ 100,000 - \$ 150,000
<b>Subtotal</b>		<b>\$ 418,130 - \$ 746,260</b>
Contingency (10%)		\$ 41,813 - \$ 74,626
<b>Subtotal incl. Contingency</b>		<b>\$ 459,943 - \$ 820,886</b>
Engineering, Permitting & Env. Assessment (approx. 15%)	TBD	\$ 68,991 - \$ 123,133
<b>Total Estimated Cost for Lunker's Dredging using SDF</b>		<b>\$ 528,934 - \$ 944,019</b>
Probable Site Reclamation Cost	1 L.S.	\$ 75,000 - \$ 100,000*
<b>Total All Costs Considered (\$20 - \$23/ CY) **</b>		<b>\$603,934 - \$1,044,019</b>

\* preliminary site reclamation costs are dependent on location and landowner requirements

\*\* plus land acquisition costs if required

Table 2. Preliminary Estimate of Probable Costs with Alternative Dewatering (Lunker's)

Sediment Removal Work Task	Total Quantity	Estimated Cost
Dredging and Alternative Dewatering - (\$20/CY)	25,813 - 51,626 CY	\$ 516,260 - \$ 1,032,520
Dredge, Pipeline and Dewatering Mobilization	1 L.S.	\$ 60,000 - \$ 80,000
<b>Subtotal</b>		<b>\$576,260 - 1,112,520</b>
Contingency (10%)		\$ 57,626 - \$ 111,252
<b>Subtotal incl. Contingency</b>		<b>\$ 633,886 - \$ 1,223,772</b>
Engineering, Permitting & Env. Assessment ( ~15%)	TBD	\$ 95,083 - \$ 183,566
<b>Total Estimated Cost for Dredging &amp; Dewatering</b>		<b>\$ 728,969 - \$ 1,407,338</b>
Off-site Hauling if Required (\$10 per CY) (based on 65% of sediment quantity above)	16,778 - 33,557 CY	\$167,780 - \$335,570
Probable Site Reclamation Cost (for grading or spreading of dewatered sediment)	1 L.S.	\$ 75,000 - \$ 100,000*
<b>Total All Costs Considered (\$22- \$36/ CY) **</b>		<b>\$971,749 - \$1,842,908</b>

\* preliminary site reclamation costs are dependent on location and landowner requirements

\*\* plus land acquisition costs if required



Table 3. Preliminary Estimate of Probable Cost with Wet Mechanical Excavation (Lunker's)

Sediment Removal Work Task	Total Quantity	Estimated Cost
Dredging - (\$20/CY)	25,813 - 51,626 CY	\$ 516,260 - \$ 1,032,520
Mobilization and Site Preparation	1 L.S.	\$ 60,000 - \$ 80,000
Subtotal		\$ 576,260 - \$ 1,112,520
Contingency (10%)		\$ 57,626 - \$ 111,252
<b>Subtotal incl. Contingency</b>		<b>\$ 633,886 - \$ 1,223,772</b>
Engineering, Permitting & Env. Assessment (~ 15%)	TBD	\$ 95,083 - \$ 183,566
<b>Total Estimated Cost for mechanical Excavation</b>		<b>\$ 728,969 - \$ 1,407,338</b>
Off-site Hauling if Required (\$10 per CY) (based on 100% of sediment quantity above)	25,813 - 51,626 CY	\$258,130 - \$516,260
Probable Site Reclamation Cost (for grading or spreading of hauled sediment)	1 L.S.	\$ 75,000 - \$ 100,000*
<b>Total All Costs Considered (~ \$35/ CY) **</b>		<b>\$1,062,099 - \$2,023,598</b>

\* preliminary site reclamation costs are dependent on location and landowner requirements

\*\* plus land acquisition costs if required

If mechanical excavation is used for the dredging work, hauling will be based on total dredging volume due to water content. Also, additional hauling costs may be required due to increased weight and reduced truck filling capacity.

The following estimates of probable cost have been developed for various dredging options at the existing marsh area located near the Old Lake Kampeska Outlet for potential Marina development and have been based on other similar projects that have been completed. More accurate costs can be determined prior to actual project implementation by requesting bids from several appropriate contractors. It is important to note that this preliminary estimate only includes dredging, excavation and bank stabilization costs. Engineering and permitting costs are anticipated to be higher than the Lunker's dredging area due to the Marina excavation work being within a wetland, which will require additional regulatory permitting work (e.g., site specific wetland delineation, development of a mitigation plan, etc.).

#### 9. Preliminary Estimates of Probable Cost for the Marina Dredging Area:

Table 4. Preliminary Estimate of Probable Cost with SDF (Marina)

Sediment Removal Work Task	Total Quantity	Estimated Cost
Dredging - (\$10/CY)	13,333 CY	\$ 133,330
Dredge and Pipeline Mobilization	1 L.S.	\$ 40,000 - \$ 60,000
Construct Sediment Dewatering Facility (SDF); 3 to 5 acres	1 L.S.	\$ 50,000 - \$ 75,000
Excavate 4.3 acre Marina Basin and Access Channel, includes Hauling (~ \$20/CY)	41,624 - 55,499 CY	\$832,480 - \$1,109,980
Stabilize Banks with Riprap / Sheetpile (\$75 - \$150/ LF)	2,200 LF	\$165,000 - \$330,000
<b>Subtotal</b>		<b>\$ 1,220,810 - \$ 1,708,310</b>
Contingency (10%)		\$ 122,081 - \$ 170,831
<b>Subtotal incl. Contingency</b>		<b>\$ 1,342,891 - \$ 1,879,141</b>

Engineering, Permitting & Env. Assessment (15%)		<u>\$ 201,434 - \$ 281,871</u>
<b>Total Estimated Cost for Marina Dredging using SDF</b>		<b>\$ 1,544,325 - \$ 2,161,012</b>
Probable Site Reclamation Cost	1 L.S.	\$ 75,000 - \$ 100,000*
Probable Wetland Mitigation Cost (~ 4 acres)	1 L.S.	<u>\$100,000 - \$200,000</u>
<b>Total All Costs Considered (\$18 - \$20/ CY) **</b>		<b>\$1,719,324 - \$2,461,012</b>

\* preliminary site reclamation costs are dependent on location and landowner requirements

\*\* plus land acquisition costs if required

Table 5. Preliminary Estimate of Probable Cost with Alternative Dewatering (Marina)

Sediment Removal Work Task	Total Quantity	Estimated Cost
Hydraulic Dredging & Alternative Dewatering - (\$20/CY)	13,333 CY	\$ 266,660
Dredge, Pipeline and Dewatering Mobilization	1 LS	\$ 60,000 - \$ 80,000
Excavate 4.3 acre Marina Basin and Access Channel, includes Hauling (~ \$20/CY)	41,624 - 55,499 CY	\$832,480 - \$1,109,980
Stabilize Banks with Riprap / Sheetpile (\$75 - \$150/ LF)	2,200 LF	<u>\$165,000 - \$330,000</u>
Subtotal		\$ 1,324,140 - \$ 1,786,640
Contingency (10%)		<u>\$ 132,414 - \$ 178,664</u>
<b>Subtotal incl. Contingency</b>		<b>\$ 1,456,554 - \$ 1,965,304</b>
Engineering, Permitting & Env. Assessment (15%)	TBD	<u>\$ 218,483 - \$ 294,796</u>
<b>Total Estimated Cost for Marina Dredging &amp; Dewatering</b>		<b>\$ 1,675,037 - \$ 2,260,100</b>
Off-site Hauling if Required (\$10 per CY) (based on 65% of sediment quantity above)	8,666 CY	\$86,660
Probable Site Reclamation Cost (for grading or spreading of dewatered sediment)	1 L.S.	\$ 50,000 - \$ 75,000*
Probable Wetland Mitigation Cost (~ 4 acres)	1 L.S.	<u>\$100,000 - \$200,000</u>
<b>Total All Costs Considered (\$22- \$36/ CY) **</b>		<b>\$ 1,911,697- \$ 2,621,760</b>

\* preliminary site reclamation costs are dependent on location and landowner requirements

\*\* plus land acquisition costs if required

Table 6. Preliminary Estimate of Probable Cost with Wet Mechanical Excavation (Marina)

Sediment Removal Work Task	Total Quantity	Estimated Cost
Dredging - (\$20/CY)	13,333 CY	\$ 266,660
Mobilization and Site Preparation	1 L.S.	\$ 60,000 - \$ 80,000
Excavate 4.3 acre Marina Basin and Access Channel, includes Hauling (~ \$20.00/CY)	41,624 - 55,499 CY	\$832,480 - \$1,109,980
Stabilize Banks with Riprap / Sheetpile (\$75 - \$150/ LF)	1 L.S.	<u>\$165,000 - \$330,000</u>
Subtotal		\$ 1,324,140 - \$ 1,786,640
Contingency (10%)		<u>\$ 132,414 - \$ 178,664</u>
<b>Subtotal incl. Contingency</b>		<b>\$ 1,456,554 - \$ 1,965,304</b>
Engineering, Permitting & Env. Assessment (15%)	TBD	<u>\$ 218,483 - \$ 294,796</u>
<b>Total Estimated Cost for Marina Dredging</b>		<b>\$ 1,675,037 - \$ 2,260,100</b>

Off-site Hauling if Required (\$10 per CY) (based on 100% of sediment quantity above)	13,333 CY	\$133,330
Probable Site Reclamation Cost (for grading or spreading of hauled sediment)	1 L.S.	\$ 50,000 - \$ 75,000*
Probable Wetland Mitigation (~ 4 acres)	1 L.S.	\$100,000 - \$200,000
<b>Total All Costs Considered (~ \$35/ CY) **</b>		<b>\$ 1,958,367- \$ 2,668,430</b>

\* preliminary site reclamation costs are dependent on location and landowner requirements

\*\* plus land acquisition costs if required

## 10. Recommended Dredging Approach

Based on the available information, the most cost effective option includes hydraulic dredging of the in-lake sediment using a small, portable hydraulic dredge (8" to 10" discharge pipe) and pumping the dredged sediment into an earthen SDF. The landward portion of any potential marina development would be mechanically excavated. This recommendation assumes that a suitable upland parcel of land can be secured or leased for constructing the SDF. Although this preliminary assessment did not include identifying a suitable parcel, aerial imagery indicates that several parcels appear to be suitable and HDR can include this land evaluation if the project moves forward.

The recommended dredging option for the Lunker's area option includes hydraulically dredging approximately 25,813 - 51,626 CY of sediment and constructing an earthen SDF for storage and dewatering for a preliminary estimated cost ranging from \$603,934 to \$1,044,019, plus any land acquisition costs that may be required (see Table 1). The Marina option at the Old Lake Outlet includes hydraulically dredging approximately 13,333 cubic yards of lake sediment, mechanically excavating the marina basin and access channel soils, and stabilizing the channel and basin shoreline for a preliminary estimated cost ranging from \$1,719,324 to \$2,461,012 (see Table 4).

Although this preliminary evaluation focuses on two identified selective dredging alternatives, a larger scale project would require significantly more land for storing and dewatering the dredged sediment and would exhibit significantly lower dredging unit costs per cubic yard due to the larger dredging quantities. In order to adequately assess and prioritize the specific needs and priorities for planning any potential dredging work at Lake Kampeska, HDR recommends the completion of an updated sediment survey to document current water depth and sediment measurements along with updated sediment core sampling and associated physical and chemical characterization, particularly for shallow areas that may be impacting recreational opportunities and lake water quality.