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January 6, 2014

Mr. Neil Andres, Superintendent
Department of Public Works
Town of Eastham
Via E-mail

Mr. Dawson Farber
Harbormaster/Shellfish Constable
Town of Orleans
Via E-mail

RE: Rock Harbor Dredging

Dear Mr. Andres,

As requested during our meeting on December 17, 2013 with representatives from the Town of Eastham and the Town of Orleans, CLE Engineering, Inc. (CLE) has prepared this review of dredging and dredge material disposal as an alternative to the method and cost described at the meeting. The proposed methodology consisting of use of the Barnstable County Dredge (BCD) to hydraulically dredge the sand anticipated in the first 500' of the channel entrance. The sand would be pumped to the Eastham boat ramp parking lot for dewatering and trucking to four beaches in Eastham. The silty material in the remaining 1,100 feet of channel will be dredged with a bucket from a barge mounted crane and deposited into dump scows (mechanical dredging) that will be towed offshore to the Cape Cod Bay Disposal Site (CCBDS). Due to the shallow water extending a significant distance seaward from the mouth of the channel it will be necessary to use relatively small shallow draft scows with towing at the high tides. CLE understands that the Towns request that CLE identify a less expensive option for the dredging of Rock Harbor than was presented.

CLE agreed to investigate alternatives to the proposed partial hydraulic dredging by the Barnstable County Dredge with on land dewatering and subsequent beach nourishment and the partial mechanical dredging with transport of the silty material to the CBDS. A review of the numerous dredge projects designed, permitted and managed over the last 10 years throughout New England and New York was made. The following is a general description with cost estimates for possible alternative methods.

<u>Alternative 1.</u> Hydraulic dredging by the BCD with disposal at the CCBDS.

It is recognized that the BCD provides a low cost hydraulic dredge option. Typically the BCD jobs are limited to sandy material with a short pipeline discharge to a beach as beach nourishment. The BCD can typically pump the sand/water slurry approximately 4,000 feet. A booster pump can be added to the discharge pipeline to extend its distance to approximately 11,500 feet. CLE considered the option where the BCD dredged the entire Rock Harbor (38,600 cubic yards) and pumped it to a dump scow anchored in sufficiently deep water (ideally 27' at low tide) off the mouth of the channel. The dump scow would then transport the dredged material to the CCBDS for disposal. As shown on Figure 1, pumping without a booster pump would require the shallow draft scow towing on high tides as described above. The addition of a booster pump would allow for the use of larger scows moored in deeper water and reduce the dependency on high tides.

Problems with that option include the following:

Operational: the discharge from the hydraulic dredge may require an additional "spider barge" or other distribution manifold (see Figure 2). The ability of the BCD to interface with private contractors' equipment may be an issue.

Contractual: It is possible that private dredge contractors would be unwilling to rent any barges without the expectation of a contract for the dredging as well. Spider barges are rare.

Logistical: the discharge from a hydraulic dredge pipe line is approximately 80% water and 20% sediment. Therefore once the scow is full it would haul mostly water to the disposal site making the operation inefficient and not cost effective. It is possible that a series of dump scows could be tied off end to end to function as a series of settling tanks. The sediment could be discharged into one end of the treatment train where increasingly less turbid water is pumped the dump scows toward the other end of the series for ultimate discharge to the ocean. When the first dump scow has a sufficient load of sediment it could be towed to the CCBDS and placed at the downstream end of the series of dump scows on its return. The process would have

Regulatory: To CLE's knowledge the on barge dewatering of sediment is rarely if ever considered for silty material of this quantity. We did obtain permits for on barge dewatering of approximately 1,000 cubic yards in New Haven Harbor in Connecticut. There were water clarity standards to be met before the overflow water could be discharged. The Massachusetts DEP and the Army Corps of Engineers would likely require a minimum water clarity be demonstrated before the overflow water could be discharged. Additionally they will likely require a turbidity curtain be deployed to encircle the scows in order to contain the turbidity (see Figure 3). The time required for the fine silt particles to settle out of the water is likely to be in the order of many days rather than hours; leaving barges sitting idle. Once the clear water has been pumped off creating additional volume the barge additional dredged sediment could be discharged into it and the settling period would begin again. The efficiency of the operation could be increased by using multiple barges; one could be transported to the CCBDS while one is settling and one is receiving dredged sediment.

Cost: Based on the assumptions and costs provided in Alternative 1 the anticipated project cost using the BCD and private contractor's scows is likely to be much higher than the currently proposed methodology.

Alternative 2. Hydraulic dredging by the BCD with mechanical dewatering followed by disposal at the Cape Cod Bay Disposal Site.

As described above a booster pump can be added to the discharge pipeline to extend its distance to approximately 11,500 feet maximum. CLE considered the option where the BCD dredged the entire Rock Harbor (38,600 cubic yards) and pumped it to a belt press system on a barge spudded in sufficiently deep water off the mouth of the channel. The dewatered sediment would leave the belt press system on a conveyor discharging into a dump scow that would be towed to the CCBDS.

Problems with that option include the following:

Operational: the discharge from the BCD requires an additional spud anchored deck barge on which to place the filter press. At least 2 additional dump scows would be required; one could be loading while the other is in transit. The sediment processing rate would determine the size and number of barges required. The ability of the BCD to interface with private contractors' equipment may be an issue.

Contractual: It is unlikely a dredge contractor would rent any barges without the expectation of a contract for the dredging as well. Spider barges and filter presses are of limited supply, particularly during the dredging season so their prices would be at a premium. Belt presses are very sensitive to cold weather and are susceptible to freezing.

Regulatory: The discharge water from the filter press would likely be required to meet some clarity standard before it could be discharged. To CLE's knowledge the on barge dewatering of sediment by means of a filter press is rarely if ever considered for silty material of this quantity for projects on Cape Cod. It is likely the offshore handling and dewatering barges would likely be required to be encircled by a turbidity curtain (Figure 3). Additionally it may be necessary to add polymer flocculent to promote solids settling. The regulators would likely require analysis of the flocculent prior to allowing its disposal at the CCBDS.

Cost: Based on the assumptions and costs provided in Alternative 2 the anticipated project cost using the BCD and private contractor filter press and scows is likely to be much higher than the currently proposed methodology.

Alternative 3. Hydraulic dredging by the BCD with filter press dewatering followed by disposal on land sites.

A hydraulic dredge could be used to pump the entire sediment volume to a landside dewatering area(s) adjacent to the channel. The sediment would be pumped into series of processing container from where it would be passed through filter presses and loaded onto trucks and hauled offsite. CLE did design and oversee a project for a pond in Waltham, MA and a canal in New York that used hydraulic dredging followed by mechanical dewatering with the sediment trucked offsite. A diagram summarizing the process is provided as Figure 4.

Problems with that option include the following:

Operational: A suitably sized area (minimum of ½ acre) close to the channel within which to set up the dewatering plant will need to be identified. A source of supplemental fresh water will be required for the process. Uses for the dried materials and disposal of the unsuitable screenings will need to be identified. The stump dump site in Dennis or the Bourne landfill may be options. The large number of trips (3,200+ @ 12 CY trucks) required to haul 38,600 cubic yards of material offsite must be considered.

Contractual: CLE's experience is that the BCD may be unable or unwilling to discharge into the landside dewatering treatment system and therefore a private hydraulic dredge contractor may be required.

Regulatory: The disposal of the dried sediments and screenings will require a complex series of chemical analyses and site assessments prior to approval. Additionally it may be necessary to add polymer flocculent to promote solids settling. The regulators would likely require analysis of the flocculent prior to allowing its disposal on land.

Cost: Based on the assumptions and costs from those projects provided in Alternative 3 the anticipated project cost using the BCD and private contractor dewatering plant and trucking is likely to be much higher than the currently proposed methodology.

Alternative 4. Hydraulic dredging by the BCD with geotube dewatering followed by disposal on land sites.

A hydraulic dredge could be used to pump the entire sediment volume to a dewatering area(s) adjacent to the channel. The sediment would be treated with polymer flocculent and pumped into tubes constructed of porous geotextile fabric (geotubes) through which the water flows out and either infiltrates into the ground or flows overland back to the channel (see Figure 5). After approximately 2 – 3 months a sufficient volume of water drains from the sediment allowing it to be loaded into trucks and hauled offsite. CLE is currently managing the dredging of East Bay for the Town of Barnstable that employs this technology.

Problems with that option include the following:

Operational: A suitably sized area (3 or 4 acres) close to the channel within which to set up the dewatering plant will need to be identified. Uses for the dried materials and disposal of the unsuitable screenings will need to be identified. The stump dump site in Dennis or the Bourne landfill may be options. The large number of trips (3,200+ @ 12 CY trucks) required to haul 38,600 cubic yards of material offsite must be considered.

Contractual: CLE's experience is that the BCD may be unable or unwilling to discharge into the landside dewatering treatment system and therefore a private hydraulic dredge contractor may be required.

Regulatory: The disposal of the dried sediments and screenings will require an additional complex series of chemical analyses and site assessments prior to approval for disposal at upland sites.

Cost: Based on the assumptions and costs from those projects provided in Alternative 4 the anticipated project cost using the BCD with a private contractor geotube dewatering system and trucking is likely to be much higher than the currently proposed methodology.

CONCLUSION:
The following table compares the currently proposed method of combined hydraulic dredging of sand for use as beach nourishment and mechanical dredging for ocean disposal at the CCBDS with the four alternatives presented above.

Alternative	**Total Cost**	**Cost per cubic yard**
Currently proposed hydraulic and mechanical	$1,719,500	$45 - $50
Alternative 1 Hydraulic with no dewatering	$2,642,350	$68
Alternative 2 Hydraulic with on barge mechanical dewatering	$3,078,350	$80
Alternative 3 Hydraulic with mechanical dewatering & land disposal	$4,860,450	$126
Alternative 4 Hydraulic with geotube dewatering & land disposal	$5,801,250	$150

As a general comparison of dredging project costs, CLE is currently managing a dredging project in New Haven Harbor for a marine shipping terminal in New Haven, CT. It is involves maintenance dredging of approximately 1,500 cubic yards of sediment along the face of a ship dock in 37' of water. The material is to be dredged mechanically with sediment loaded into a dump scow and towed to an offshore disposal site. The project takes advantage of the fact the dredge contractor was already in the vicinity with all the equipment so the mobilization and demobilization costs was minimized making this the most cost effective option. The cost for the dredging and disposal for this project is approximately $78/cubic yard. The cost to dredge the same area and volume in 2012 was approximately $103/ cubic yard.

CLE is currently managing the East Bay dredging project for the Town of Barnstable. It involves hydraulic dredging by a private contractor as the BCD was unable to discharge into the geotubes used for dewatering. The dried sediment will then be trucked to Dennis as fill at a regulated stump dump facility. The cost for that project is approximately $180 per cubic yard. The cost to dredge the Barnstable Inner Harbor in 2012 with disposal at the CCBDS was approximately $85 per cubic yard.

CLE notes that all the cost estimates have a degree of uncertainty. The actual dredge volumes, sediment characteristics, permit conditions and disposal options have yet to be determined. Actual costs as provided contractors in response to a Request for bid are likely to vary from the engineer's estimate and between contractors. The mobilization/demobilization costs are highly variable and are dependent of the availability of equipment. The cost will also depend on the number of contractors interested in the project in the project, fuel costs, permit conditions, time of year, other competing jobs, etc. As noted during the meeting, results of the sediment sampling analysis will allow for the development of a revised cost estimate for the proposed method.

The pursuit of permits proposing any alternative other than the currently proposed alternative may be outside the current scope of CLE's contract. The permit application process and receipt of permits for methodology other than that currently proposed may also delay the dredging of Rock Harbor until the winter of 2015. CLE also notes the disposal of dredged sediment at the CCBDS is only allowed from May 16 to December 31 of any year due to concerns for Right Whales in the vicinity. It is likely that whatever technology is used it will be necessary to cut the boating season shortly after Labor Day to allow sufficient time for the dredging.

In consideration of the above analysis, CLE believes the currently proposed methodology of a combined hydraulic dredging of the sand for use as beach nourishment and a mechanical dredging of the silty material for disposal at the Cape Cod Bay Disposal Site to be the most cost effective alternative.

Please contact me with any questions and to provide direction. I anticipate sediment sampling to be completed by mid-January with the laboratory analysis completed by mid-February. That information will be useful in developing a more accurate dredging methodology and construction cost.

Very truly yours,
CLE Engineering Inc.,

Jeffrey W. Oakes

Jeffrey Oakes, P.E.
Senior Project Manager

ROCK HARBOR DREDGING PROJECT
DRAFT
ENGINEER'S CONSTRUCTION COST ESTIMATE
ALTERNATIVE 1

Hydraulic Dredging Without Dewatering And Ocean Disposal							
Item No.	Quantity		Item Description	Unit Price	Total	Cost per cubic yard
1	65	EA	Timber Pile Removal/Reinstallation	$ 1,350	$ 87,750	
2	1	LS	Dredge Mob/DeMob with spider scow, settling basin scows (3) and tugs	$ 200,000	$ 200,000	
3	38,600	CY	Barnstable County Hydraulic Dredge with booster, pump to offshore scow	$ 11	$ 424,600	
4	193,000	CY	Transport and Dump at CCBDS	$ 10	$ 1,930,000	
TOTAL ESTIMATED COST-HYDRAULIC DREDGE AND DISPOSAL					$ 2,642,350	$68

BID SUMMARY TABULATION	
HYDRAULIC DREDGING WITHOUT DEWATERING AND OCEAN DISPOSAL	$ 2,642,350

ASSUMPTIONS:
Item 1 Slighter higher cost than was awarded for the Barnstable Inner Harbor dredge project 2012
Item 2 Best estimate
Item 3 From Barnstable County Dredge
Item 4 Assumed only 20% solids so 5 times as many trips would be required

ROCK HARBOR DREDGING PROJECT
DRAFT
ENGINEER'S CONSTRUCTION COST ESTIMATE
ALTERNATIVE 2

Hydraulic Dredging, Barge Dewatering And Ocean Disposal						
Item No.	Quantity		Item Description	Unit Price	Total	Cost per cubic yard
1	65	EA	Timber Pile Removal/Reinstallation	$ 1,350.00	$ 87,750.00	
2	1	LS	Dredge Mob/DeMob spud barge platform, spider barge, filter press, 2 dump s	$ 250,000.00	$ 250,000.00	
3	38,600	CY	Barnstable County Hydraulic Dredge with booster , pump to offshore scow	$ 11.00	$ 424,600.00	
4	38,600	CY	Pass Through Filter Press	$ 50.00	$ 1,930,000.00	
5	38,600	CY	Transport and Dump at CCBDS	$ 10.00	$ 386,000.00	
TOTAL ESTIMATED COST-HYDRAULIC DREDGE AND DISPOSAL					**$ 3,078,350.00**	$80

BID SUMMARY TABULATION	
HYDRAULIC DREDGING, BARGE BASED DEWATERING AND OCEAN DISPOSAL	$ 3,078,350.00

ASSUMPTIONS:

Item 1	Slighter higher cost than was awarded for the Barnstable Inner Harbor dredge project 2012
Item 2	Based on East Bay est for filter press plus est for spud barge and spider barge
Item 3	From Barnstable County Dredge
Item 4	Based on estimate for East Bay
Item 5	Best estimate

ROCK HARBOR DREDGING PROJECT
DRAFT
ENGINEER'S CONSTRUCTION COST ESTIMATE
ALTERNATIVE 3

Hydraulic Dredging, Mechanical Dewatering And Trucking To Disposal Sites						
Item No.	**Quantity**		**Item Description**	**Unit Price**	**Total**	**Cost per cubic yard**
1	65	EA	Timber Pile Removal/Reinstallation	$1,350	$87,750	
2	1	LS	Dewatering plant Mob/DeMob	$160,000	$160,000	
3	38,600	CY	Barnstable County Hydraulic Dredge, pump to parking lot	$7	$270,200	
4	38,600	CY	Pass through Filter press	$50	$1,930,000	
5	38,600	CY	Excavator to load trucks at dewatering site for transport	$7	$250,900	
6	38,600	CY	Trucking to Disposal sites	$6	$231,600	
7	38,600	CY	Tipping fee	$50	$1,930,000	
TOTAL ESTIMATED COST-HYDRAULIC DREDGE, MECHANICAL DEWATERING, LAND DISPOSAL					4,860,450	$126

BID SUMMARY TABULATION	
HYDRAULIC DREDGING, MECHANICAL DEWATERING AND DISPOSAL	$ 4,860,450

ASSUMPTIONS:

Item 1	Slighter higher cost than was awarded for the Barnstable Inner Harbor dredge project 2012
Item 2	Estimate based on Barnstable East Bay project
Item 3	From Barnstable County Dredge
Item 4	Estimate based on Barnstable East Bay project
Item 5,6	Estimate based on Barnstable Inner Harbor dredge project 2012, based on 13 mile RT

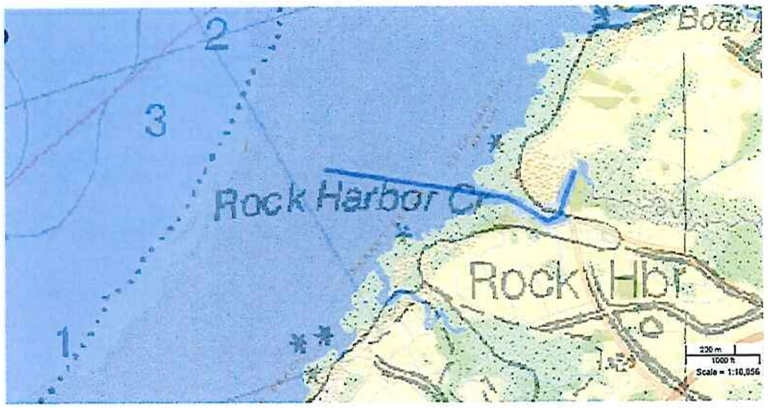
ROCK HARBOR DREDGING PROJECT
DRAFT
ENGINEER'S CONSTRUCTION COST ESTIMATE
ALTERNATIVE 4

Hydraulic Dredging, Dewatering With Geotubes And Trucking To Disposal Sites						
Item No.	Quantity		Item Description	Unit Price	Total	Cost per cubic yard
1	65	EA	Timber Pile Removal/Reinstallation	$1,350	$87,750	
2	1	LS	Dewatering Site preparation	$20,000	$20,000	
3	38,600	CY	Hydraulic dredging and geotube dewatering	$85	$3,281,000	
4	38,600	CY	Excavator to load trucks at dewatering site for transport to beach	$7	$250,900	
5	38,600	CY	Trucking to Disposal sites	$6	$231,600	
6	38,600	CY	Tipping Fee	$50	$1,930,000	
TOTAL ESTIMATED COST-HYDRAULIC DREDGE, GEOTUBE DEWATERING , LAND DISPOSAL					$5,801,250	$150

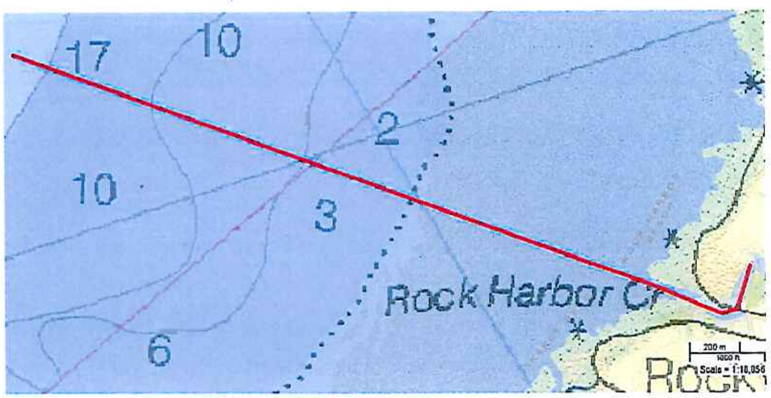
BID SUMMARY TABULATION	
HYDRAULIC DREDGING, DEWATERING WITH GEOTUBES AND TRUCKING TO DISPOSAL SITES	$ 5,801,250.00

ASSUMPTIONS:

Item 1 Slighter higher cost than was awarded for the Barnstable Inner Harbor dredge project 2012
Item 2 Best estimate
Item 3 Estimate based on Barnstable East Bay project
Item 4 Estimate based on Barnstable Inner Harbor dredge project 2012
Item 5 Estimate based on Barnstable Inner Harbor dredge project 2012
Item 6 Estimate based on Barnstable East Bay project



HYDRAULIC DREDGE PUMP TO SCOW
4,000' ±



HYDRAULIC DREDGE PUMP WITH BOOSTER PUMP
TO SCOW 11,000' ±

FIGURE 1 DREDGE PUMP

PROJECT: ROCK HARBOR CREEK DREDGING AND DISPOSAL
EASTHAM AND ORLEANS, MASSACHUSETTS

CLIENT: THE TOWNS OF
EASTHAM AND ORLEANS, MASSACHUSETTS

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ROCK HARBOR CREEK MAINTENANCE DREDGE

SCALE: NTS	CHECKED	DATE 1-2-2013	DRAWING No.
DRAWN BY: DMG	BY:		COMP CODE 12123
REVISION No.	DATE	COMMENT	

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FIGURE 2
SPIDER BARGE

Spider Barge No 175 Charleston

Great Lakes Dredge Alaska Charleston Harbor SC

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FIGURE 3
BARGE MOUNTED FILTER PRESS AND TURBIDITY CURTAIN


HUGHES 990

Turbidity Barriers

SILTDAM TURBIDITY BARRIERS

FLOATING SILT CONTAINMENT BARRIERS

SILTDAM turbidity barriers are designed to prevent the migration of silt and turbidity from exiting a work area. Typical uses include; dredging, shoreline revetments, sheet wall or pile driving, aquatic weed control/harvesting, and marine construction activities.

SILTDAM turbidity barriers are designed to accommodate a variety of wind, sea and current conditions. Our standard barriers offer the additional benefit of debris and oil containment at the water line with the use of 22 oz PVC oil boom fabric around the floatation compartment. The floatation compartment is completely heat-sealed, each floatation element is additionally heat sealed on each end to create a completely watertight compartment and prevent the floats from shifting.

Below the floatation compartment we install the skirt section to the desired depth. Skirt materials consist of either permeable, woven polypropylene geotextile fabrics or impermeable polypropylene and PVC fabrics. The barriers are ballasted continually along the bottom using galvanized steel chain.

TYPICAL SPECIFICATIONS

Boom Length: 50 or 100 ft sections.
Other lengths available.

Floatation Element: Cylindrical, internal closed cell foam.

Net Buoyancy: 6" dia. 12/lbs/ft
8" dia. 21/lbs/ft
12" dia. 50 lbs/ft

Floatation Cover: 22 oz/yd^2 PVC coated polyester. Other coatings available.

22 oz/yd^2 PVC is a heavy-duty material for rough service applications.

Ballast: 5/16" galvanized chain standard 1.1 lbs/ft.
Other ballast weights available

Tension: Optional, 5/16" PVC coated, galvanized aircraft cable top tension.

End Connectors: Standard connectors are grommeted end/tow plates and lacing grommets. Tool free aluminum universal slide connectors and lacing grommets are also available.

Curtain Depth: 3 to 75 feet

Brockton Equipment / Spilldam, Inc.
P.O. Box 960, Brockton, MA 02303
Tel. 508-583-7850 800-699-2374 Fax 508-583-5231

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FIGURE 4
FILTER PRESS

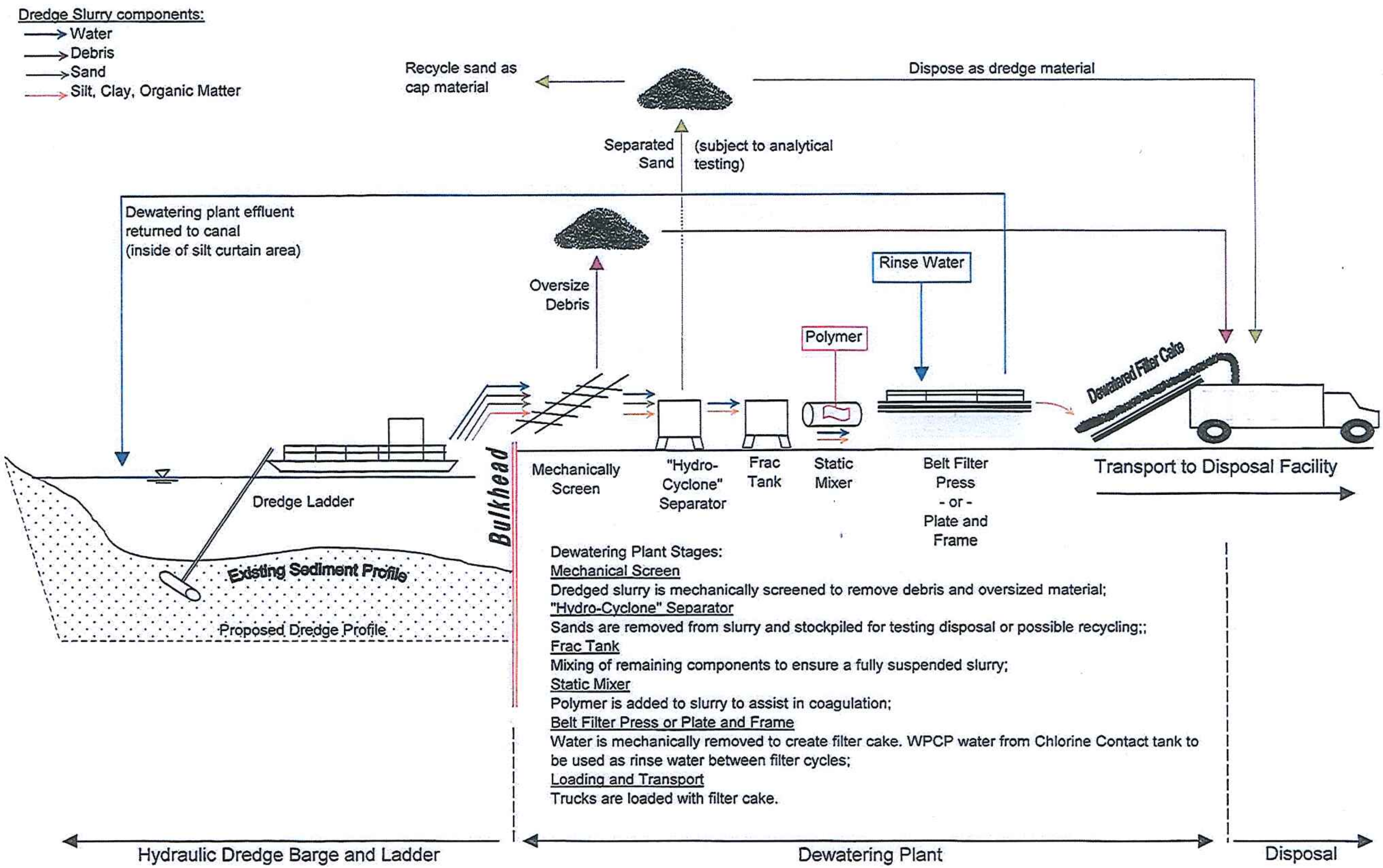

Figure 8. *Flow Diagram of Proposed Dewatering Process.*

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FIGURE 4
FILTER PRESS DEWATERING

REPRESENTATIVE SMALL SCALE FILTER PRESS DEWATERING PLANT

CONVEYOR LOADING TRUCK WITH PRESS DRIED SEDIMENT

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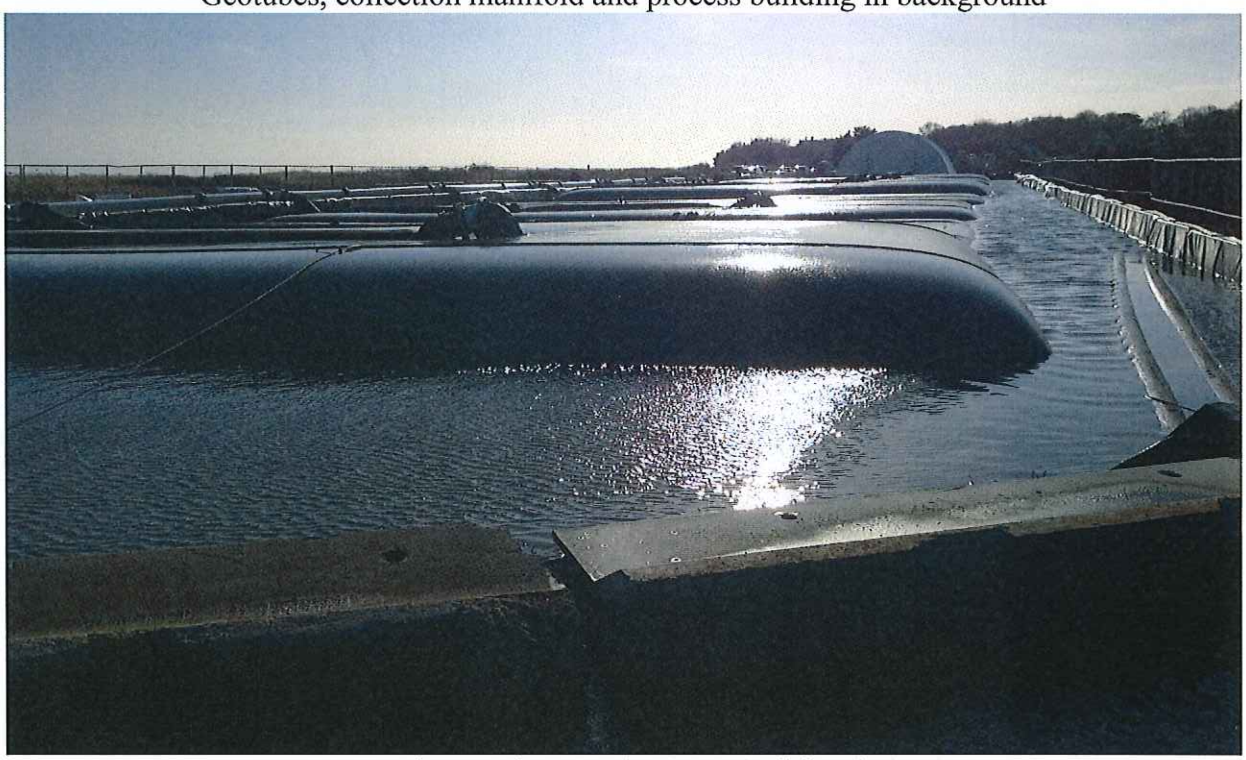
FIGURE 5 GEOTUBES

Geotubes, collection manifold and process building in background



Geotubes, containment berm and process building in background