


MEMORANDUM

TO: Mr. Michael Piscitelli/City of New Haven

FROM: Mr. David Arpin/RTG
Mr. Jim Russell/RTG 

COPY: Ms. Helen Rosenberg/ City of New Haven
Ms. Dawn Henning/ City of New Haven

DATE: June 23, 2017

RE: **Close-Out Memorandum**
Mill River District Shoreline Analysis
City of New Haven
CNH Project No. 15-195-21
RTG Project No. 15103.01

Introduction

This Close-Out Memorandum was prepared to summarize the work completed by RT Group, Inc. (RTG) for the Mill River District Shoreline Analysis. This work was performed for the City of New Haven (the City) and included the following:

- The *Design Flood Memorandum* (RTG, May 13, 2016);
- The *Alternatives Evaluation Report* (RTG, December 30, 2016);
- The *Alternatives Evaluation Memorandum and 50% Plans & Construction Cost Estimate* for the Vacant Lot North of Radiall (RTG, December 16 and 30, 2016); and
- The *50% Plans for the Outfall Tide Gate* (RTG, April 14, 2017).

Background

The *Design Flood Memorandum* was prepared to establish the design criteria for the development of flood protection alternatives for properties located within the identified Study Area. The *Alternatives Evaluation Report* utilized the established design criteria to evaluate the available flood protection alternatives, including their estimated implementation costs. Following the submission of the *Alternatives Evaluation Report*, The City requested that RTG move forward with 50% design for the vacant lot north of Radiall and 50% design for the installation of an outfall tide gate at the Clay Street storm sewer outfall.

With respect to the vacant lot north of Radiall, two (2) flood protection alternatives were evaluated. Based on the site and subsurface conditions encountered, which included a thick deposit of compressible organic silt, the Elevated Development Alternative was carried



forward for 50% design. With respect to the outfall tide gate, a duckbill check valve was selected by the City for 50% design. The check valve was proposed at the Clay Street storm sewer outfall to help alleviate the frequent flooding that was occurring along John Murphy Drive due to backflow through the storm sewer system from the Mill River (the River) during high water conditions.

Summary of Results

The reader is referred to the aforementioned memorandums and reports for a detailed summary of the work completed by RTG to date and recommendations for moving forward. A summary of the 50% design for the vacant lot north of Radiall and the 50% design for the installation of an outfall tide gate (i.e., duckbill check valve) at the Clay Street storm sewer outfall are discussed in more detail below.

Vacant Lot North of Radiall

In the *Alternatives Evaluation Report*, flood protection alternatives were presented by District Area (Areas "A" through "E"), and included (1) Raising Grade, (2) Flood Proofing Barrier, (3) Elevated Development, (4) Dry Flood Proofing, and Ancillary Improvements (e.g., shoreline stabilization consisting of vegetated geogrid and/or over-sheeting). The vacant lot north of Radiall is located within District Area "E", and the Elevated Development alternative was carried forward for 50% design.

In accordance with the *Alternatives Evaluation Memorandum* provided to the City, the Elevated Development Alternative for the vacant lot north of Radiall had an estimated cost of about \$115/SF¹ (2016 US), and assumed that a 20,000 SF hypothetical development would be supported by an elevated pile supported concrete foundation. While this alternative was more expensive than the Raising Grade Alternative (\$90/SF¹, 2016 USD), it ranked higher based on the criteria established to evaluate the alternatives. These criteria included (1) Project Cost, (2) Long-Term Building Performance, (3) Design Life, (4) Constructability, (5) Risk, and (6) Permitting Ease.

Tide Gate at the Clay Street Outfall

In accordance with the 50% Plans prepared for the outfall tide gate, two (2) 36-inch-diameter duckbill check valves with a steel thimble mounting plate were selected to be installed over the existing Clay Street outfall. Based on the actual site conditions encountered, this alternative alone was determined to be impractical for the following reasons: (1) a significant reduction in flow capacity would result due to head losses through the thimble plate and the duckbill check valves, (2) insufficient head would be developed from the runoff along John Murphy Drive to allow for its discharge into the River during high water levels (e.g., MHW and above), and (3) the "storage capacity" of the storm sewer system provided by the duckbill check valves would be insufficient to contain runoff from significant precipitation events.

Footnote:

¹The estimated cost is for flood protection only, and does not include the cost for development itself (e.g., buildings, utilities, roads, parking, site restoration, etc.).



Based on the above, it was determined that additional mechanical means (e.g., pumping) would be required to discharge flood waters from the drainage area in combination with the duckbill check valves to prevent the flood waters from re-entering the area after pumping. RTG investigated the installation of a pump station and found its cost to be significant (see RTG's email to the City dated December 13, 2016). In addition, the pump station would only be effective when River levels were below about El. 6.0 (NAVD 88), as River levels above this would overland flow into the drainage area and overwhelm the pump station.

In discussing the above issues with the City, RTG was directed to explore other less expensive alternatives which included (1) installing check valves at each low-lying curb inlet in the storm sewer system, (2) installing an active tide gate at the outfall in lieu of the duckbill check valves, and (3) installing a second outfall in the storm sewer system at another location in an attempt to add discharge capacity.

After evaluating the above less expensive alternatives, RTG found that the most prevalent issue to overcome was with the catch basin inlet elevations along the affected area of John Murphy Drive being equal to or only slightly above the River level during MHW conditions or greater. Accordingly, additional check valves, active tide gates, or added gravity outfalls would all ultimately not be effective and the area would eventually flood, similar to how it does now.

Moving Forward

Recommendations for moving forward by District Area are summarized in the *Alternatives Evaluation Report* (RTG, December 30, 2016). Recommendations for moving forward at the vacant lot north of Radiall and for the outfall tide gate are discussed in more detail below.

Vacant Lot Located North of Radiall

As presented in the *50% Plans & Construction Cost Estimate* for the vacant lot north of Radiall, elevating the proposed development in order to provide flood protection had an estimated cost of about \$145/SF (2016 USD), which was slightly higher than that estimated previously due to the presence of a thick layer of compressible organic silt. The estimated flood protection cost does not include the cost of the development itself (e.g., buildings, utilities, roads, parking, and site restoration). Assuming that these development costs could range from about \$150 to \$250/SF, the estimated cost for flood protection increases the overall development costs by about 58 to 97 percent.

The estimated cost increase to provide flood protection makes this representative property (and other properties within the District) unattractive to potential buyers/developers. Accordingly, and as mentioned in the *Alternatives Evaluation Report*, the City would need to provide incentives to help promote development within the District. These incentives could include, but would not be limited to providing direct financial assistance to potential buyers/developers in the form of tax subsidies or credits. They could also include having the City obtain the necessary City, State, and Federal Permits ahead of time (e.g., a District-wide



readiness program), in order to streamline the permitting process and create pad ready building sites.

Tide Gate at the Clay Street Outfall

As discussed, the installation of duckbill check valves alone was determined to be insufficient with respect to alleviating flooding in the affected area. Accordingly, RTG suggests the City consider the installation of duckbill check valves at the Clay Street outfall in combination with a pump station that is adequately sized to discharge flow from the storm sewer system during the selected design storm event. As an aside, it should be noted that raising the roadbed elevation of John Murphy Drive was discussed as another potential solution. However, it was determined to be impractical because the roadbed would need to be raised above the neighboring properties, which would prevent storm water runoff from draining from these properties as it does now, resulting in flooding in these areas.

The attached Figure 1 provides a conceptual plan of a pump station installed along the box culvert located upstream of the Clay Street outfall and includes an underground precast concrete vault to house the pumps, a second smaller underground vault to house valves, and associated piping. This system has an estimated cost of about **\$1.7 Million** (Table 1). It should be noted that the pricing is representative of a pumping station capable of passing a 10-year precipitation event ± occurring over the approximately 29-acre drainage area.

Closing

In closing, the work completed as part of the Mill River District Shoreline Analysis provides the City and potential developers with a general idea of the level of effort required to address the current and future flooding threats to new developments, existing developments (i.e., retrofitting), and existing low-lying areas located within the District. This information is critical for the establishment of a District-wide development plan as well as future site-specific development plans.



Tables

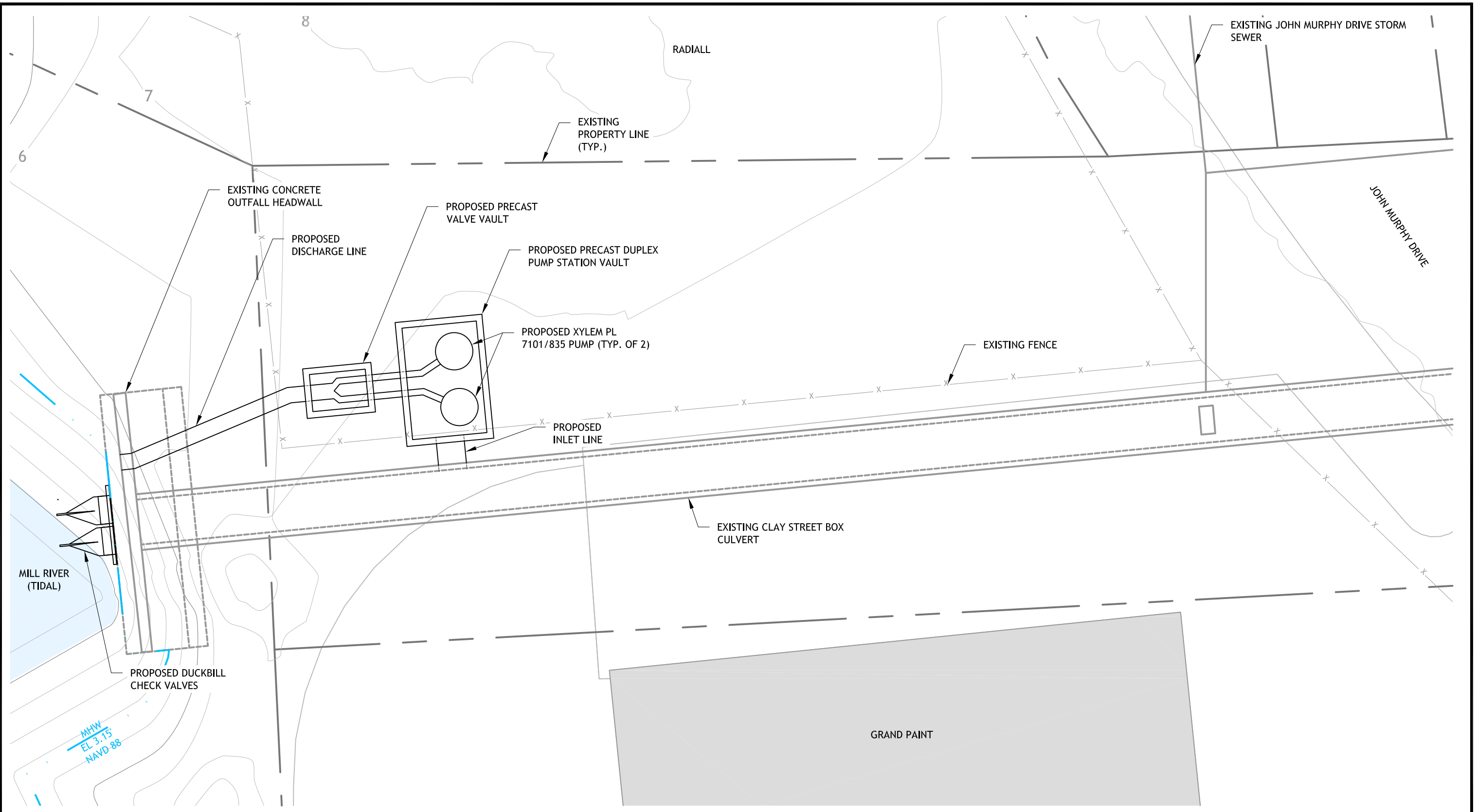
Table 1
Budget-Level Cost Estimate
Conceptual Pump Station and Check Valve
City of New Haven, CT

Item	Description	Unit of Payment	Estimated Quantity	Unit Price	Extended Total	Comments
1	General Requirements					
	Earth Material Submittals	LS	1	\$2,500.00	\$2,500.00	Estimator's Judgement
	Precast Concrete Submittals	LS	1	\$2,500.00	\$2,500.00	Estimator's Judgement
	Water Control Plan Submittals	LS	1	\$2,500.00	\$2,500.00	Estimator's Judgement
	Steel Sheeting Submittals	LS	1	\$2,500.00	\$2,500.00	Estimator's Judgement
	Electrical and Mechanical Submittals	LS	1	\$10,000.00	\$10,000.00	Estimator's Judgement
	Piping Submittals	LS	1	\$10,000.00	\$10,000.00	Estimator's Judgement
	Quality Control (QC) Plan	LS	1	\$1,500.00	\$1,500.00	Estimator's Judgement
	Meetings	EA	8	\$500.00	\$4,000.00	Estimator's Judgement
	Closeout Related Submittals	LS	1	\$5,000.00	\$5,000.00	Estimator's Judgement
	Performance & Payment Bonds	LS	1	\$21,624.54	\$21,624.54	Assume at 2% of Project Cost
	Record Drawings	LS	1	\$10,000.00	\$10,000.00	Estimator's Judgement
					\$72,124.54	
	Calculate Bid Unit Cost	LS	1		\$72,124.54	
2	Mobilization					
	Mobilization	LS	1	\$50,000.00	\$50,000.00	Estimator's Judgement
					\$50,000.00	
	Calculate Bid Unit Cost	LS	1		\$50,000.00	
3	Quality Control					
	Grain Size through No. 200 Sieve	EA	2	\$90.00	\$180.00	Estimator's Judgement
	Moisture Density Relationship	EA	2	\$200.00	\$400.00	Estimator's Judgement
	Dry-Density and As-Placed Moisture Content	1/2 DAY	2	\$300.00	\$600.00	Estimator's Judgement
	Concrete Compressive Strength	EA	20	\$100.00	\$2,000.00	Estimator's Judgement
					\$3,180.00	
	Calculate Bid Unit Cost	LS	1		\$3,180.00	
4	Erosion and Sedimentation Controls					
	Silt Fence/Baled Hay Erosion Check	LF	200	\$8.00	\$1,600.00	Estimator's Judgement
					\$1,600.00	
	Calculate Bid Unit Cost	LS	1		\$1,600.00	
5	Duckbill Check Valves					
	Furnish Anchors	LS	1	\$2,500.00	\$2,500.00	Estimator's Judgement
	Furnish (2) Duckbill Check Valves, Thimble Plate, & Clamps	LS	1	\$27,200.00	\$27,200.00	Per quote from Tideflex dated July 14, 2016 with 5% inflation included
	Install Anchors	DAY	5	\$3,000.00	\$15,000.00	Estimator's Judgement
	Install (2) Duckbill Check Valves, Thimble Plate, & Clamps	DAY	2	\$3,000.00	\$6,000.00	Estimator's Judgement
					\$50,700.00	
	Calculate Bid Unit Cost	LS	1		\$50,700.00	

Table 1
Budget-Level Cost Estimate
Conceptual Pump Station and Check Valve
City of New Haven, CT

Item	Description	Unit of Payment	Estimated Quantity	Unit Price	Extended Total	Comments
1	General Requirements					
6	Pump Station					
	Furnish Temporary Sheeting	LB	120,000	\$1.00	\$120,000.00	Estimator's Judgement, Assume 100 LF of 40-foot-long sheeting @ 30 psf
	Install Temporary Sheeting	DAY	3	\$6,500.00	\$19,500.00	Estimator's Judgement, Assume 40 LF per day
	Excavate for Pump Station, Valve Box, and Discharge Line	CY	300	\$10.00	\$3,000.00	Estimator's Judgement
	Furnish Crushed Stone for Leveling Pad	TON	10	\$18.11	\$181.10	Per Tilcon Connecticut x 1.15 Mark-up
	Place and Compact Crushed Stone	CY	5	\$10.00	\$50.00	Estimator's Judgement
	Furnish HP12x53 Piles (6 Piles/Cap x 1 Cap x 80-feet-long)	LF	480	\$30.08	\$14,438.40	Written Quote from Raymond Piling x 1.15 for Mark-Up
	Furnish Champion Splice	EA	6	\$115.00	\$690.00	Estimator's Judgement
	Install Champion Splice	EA	6	\$300.00	\$1,800.00	Estimator's Judgement
	Install H-Piles	LF	480	\$50.00	\$24,000.00	Estimator's Judgement
	Perform Static Pile Load Test	LS	1	\$0.00	\$0.00	Estimator's Judgement, Assume PDA Testing performed in lieu of Load Test
	PDA Testing on 10% of Production Piles	DAY	1	\$2,300.00	\$2,300.00	Estimator's Judgement
	CAPWAPs	EA	1	\$287.50	\$287.50	Estimator's Judgement
	Form and Pour Pile Caps	CY	10	\$600.00	\$6,000.00	Estimator's Judgement
	Furnish Pump	EA	2	\$217,000.00	\$434,000.00	Per estimate from GA Fleet Associates, Inc. for a 10-Year Storm Event
	Furnish Control Panel	EA	1	\$150,000.00	\$150,000.00	Per estimate from GA Fleet Associates, Inc. for a 10-Year Storm Event
	Furnish Precast Units	LS	1	\$30,000.00	\$30,000.00	Per estimate from United Concrete
	Furnish Piping	LS	1	\$45,000.00	\$45,000.00	Estimator's Judgement
	Install Pump, Panel, Precast Units, and Piping	DAY	10	\$6,500.00	\$65,000.00	Estimator's Judgement
	Cut-off and Abandon Sheeting	DAY	2	\$3,500.00	\$7,000.00	Estimator's Judgement
					\$923,247.00	
	Calculate Bid Unit Cost	LS	1		\$923,247.00	
7	Site Restoration					
	Furnish Loam	CY	100	\$20.00	\$2,000.00	Estimator's Judgement
	Place Loam	CY	100	\$5.00	\$500.00	Estimator's Judgement
	Furnish and Install Seed	SF	0	\$0.50	\$0.00	Estimator's Judgement
					\$2,500.00	
	Calculate Bid Unit Cost	LS	1		\$2,500.00	
8	Demobilization and Clean-up					
	Demobilization and Clean-up	LS	1	\$50,000.00	\$50,000.00	Estimator's Judgement
					\$50,000.00	
	Calculate Bid Unit Cost	LS	1		\$50,000.00	
	SUBTOTAL				\$1,153,351.54	Sum of Items 1-8
	Scope and Budget Contingencies				\$288,337.89	Scope and Budget Contingencies @ 25%
	Supplemental Subsurface Investigation				\$11,533.52	Subsurface Investigation @ 1.0%
	Permitting				\$11,533.52	Assume @ 1.0%
	Final Plans, Specifications, and Engineering				\$86,501.37	Assume @ 7.5%
	Construction Phase Services				\$69,201.09	Assume @ 6.0% (Full-Time Construction Observation Assumed)
	TOTAL ESTIMATE (2017 USD)				\$1,700,000.00	Rounded to the Nearest \$100,000.00

Figures



DRAFT

PLAN
SCALE: 1"=10'

CONCEPTUAL



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DAM SAFETY · WATERFRONT · CONSTRUCTION ENGINEERING · GEOTECHNICAL
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**MILL RIVER DISTRICT
 SHORELINE ANALYSIS
 Outfall Tide Gate**
 CITY of NEW HAVEN
 New Haven, Connecticut

**FIGURE 1
 CONCEPTUAL PUMP
 STATION AND CHECK
 VALVE PLAN**

SHEET 1 of 1
 DATE
 JUN 2017
 PROJ No.
 15103.01