Binghamton-Johnson City
Joint Sewage Treatment Plant
Comprehensive Flood Risk Reduction Project

Appendix C

Project Plans and Alternatives Analysis

DRAFT 2.0

Hazard Mitigation Plan

Binghamton-Johnson City Joint Sewage Treatment Plant

PREPARED FOR:

Binghamton-Johnson City
Joint Sewage Treatment Plant
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1.0 INTRODUCTION

1.1 GENERAL

On June 28, 2006, a significant flood event impacted the Binghamton-Johnson City Joint Sewage Treatment Plant (BJCJSTP). Based on information from the US Geological Survey's Susquehanna River gauging station in Vestal, New York, the Susquehanna River crested on Wednesday, June 28, 2006, at 2:23 p.m. The maximum gauge height was at 32.98 feet above flood level.

The City of Binghamton, the Village of Johnson City, the Binghamton-Johnson City Joint Sewage Board, the treatment plant staff, and the staff of C&S have been considering proactive steps to help safeguard the plant from future flood-related damages. Initial planning has begun, using Federal Emergency Management Agency (FEMA) guidelines. These guidelines have been used to develop mitigation goals and objectives. Specifically, FEMA's series of "How-To" guides have been utilized for these hazard mitigation planning efforts. These "How-To" guides were designed to help local governments comply with the requirements of the Disaster Mitigation Act of 2000. The guides' objective is to initiate and to maintain a planning process that will result in safer communities and is applicable to jurisdictions of all sizes, including all resource and capability levels. This mitigation plan has been developed consistent with that guidance with specific goals, objectives and mitigation actions, as outlined below. This Draft 2.0 report is an update based on the initial review comments for the Draft 1.0 report received from the Federal Emergency Management Agency (FEMA), and State Emergency Management Office (SEMO) and presents new information regarding the construction of flood barriers at the treatment plant site and Terminal Pumping Station. Also, additional detail is provided for the costs for each alternative in Appendix A.

1.2 DESCRIPTION OF FACILITIES

The Binghamton-Johnson City Joint Sewage Treatment Plant (BJCJSTP) is an 18.25 MGD wastewater treatment plant. The sewage treatment facilities are jointly owned by the City of Binghamton with 54.8% ownership and the Village of Johnson City with 45.2%. Operation of the facilities is managed by the Binghamton-Johnson City Joint Sewage Board which is made up of both City and Village appointed representatives. The original plant was constructed in 1958 as a primary treatment plant to serve the City of Binghamton, New York. In 1968, additional primary treatment capacity was added to accommodate flow from the Village of Johnson City. The Terminal Pumping Station is the collection point for flows from the Johnson City service area which are then conveyed to the treatment plant. In 1972, the plant was upgraded to provide secondary treatment by adding aeration basins and secondary clarifiers. Subsequent improvements have also been constructed over the years.

At the time of the flooding, significant upgrades were being completed to address combined sewer discharges in the collection system with the goal of providing the equivalent of primary treatment and disinfection for up to 60 MGD of sewage at the plant during wet weather events. In addition, significant secondary and tertiary treatment improvements were being implemented to allow for enhanced treatment of conventional pollutants and removal of nutrients. Much of the newly installed equipment has been damaged and is currently being restored, repaired, or replaced. The Owners and the Joint Sewage Board are responsible for the restoration of property damaged by the flood under the terms of the construction contracts currently in place.

A flood damage assessment was carried out promptly after the flood waters subsided and was the topic of several meetings with FEMA and SEMO and representatives of the City, Village and plant staff.. At these work sessions, causes of the flood damage were discussed and alternative measures to mitigate future impacts were discussed. As a result of these efforts and several subsequent conference calls, the following items were evaluated further as potential hazard mitigation measures.

2.0 FLOOD GATES

2.1 PROJECT DESCRIPTION

Flap gates are used to allow drainage to flow in one direction only, without allowing fluid back up into the channel or sewer. The operating principal is similar to a check valve that does not allow backflow. As part of this planning effort, storm drain lines were investigated as possible conduits for flood waters backing up into the plant. Each of the active storm lines was found to contain protective flap gates with one exception where flood gate installation was investigated. Also a ventilation louver was discovered which would require similar protection.

2.2 LOCATION

There is a 36-inch diameter storm sewer discharge to Fuller Hollow Creek located in the south west corner of the plant. The elevations of the invert and top of the discharge pipe are 828.06 and 831.06 respectively. In the event that the creek level rises to above the top of the discharge pipe, stormwater flowing in to the pipe would need to create enough pressure to open a flap gate against the pressure of the creek water against the other side of the gate. Based on the sewer line profile it appears that if a flap gate were installed on the discharge to Fuller Hollow Creek, the water in the sewer pipe would back up and possibly overflow upstream manhole structures before enough pressure was created to open the flap. Installation of a flap gate at this location is not recommended, however a manually or automatically operated slide gate would be beneficial. Additional hydraulic analysis will be necessary to evaluate the effectiveness of a slide gate at the creek outfall.

A ventilation louver is located on the north side of the C-filter Complex facing Fuller Hollow Creek which can also act as a conduit for rising flood waters. The louver is 60 inches wide by 36 inches high. During the June flood, the water rose to reach the elevation of the louver. In an effort to stop water coming in the louver, a piece of plywood was placed over the opening. As a future mitigation measure, a slide gate should be permanently located to secure this opening in the event of flooding. The stem for the sluice gate would extend from the louver to the top of the C-filter Complex where either a manual or automatic operator would be located.

2.3 COST ESTIMATE

Budgetary costs to install a gate structure on the storm line to Fuller Hollow Creek and to install a flood barrier gate on the louver are estimated at $130,000. This cost includes design and construction of a passage gate in the exterior property fence, access pathway and stairs, modification of the headwall, installation of a manually operated 36" slide gate on the sewer and installation of a barrier type cover or gate on the louver. The costs are further detailed in Table 1.

3.0 RELOCATION OF ELECTRICAL PANELS TO HIGHER ELEVATIONS

3.1 PROJECT DESCRIPTION

Multiple electrical panels were water damaged during the June 2006 flood event. These panels are located in various buildings on the Binghamton-Johnson City Joint Sewage Treatment Plant premises. The panels that were affected the most were those located below an elevation of 838 feet which is the 100 year flood level. Leaving the existing electrical panels in the same locations makes them vulnerable to another 100 year flood event. Even though their location could potentially result in repeat flood damage, the relocation of the panels to a higher elevation is not feasible in most cases due to worker accessibility and safety considerations. In many cases, these panels must be located within a reasonable distance of the powered equipment to allow for worker access. The relocation of the panels and the supporting electronics is difficult and if the panels were moved to a higher location, they would not be readily accessible by the users. In addition, in many of the below grade facilities, even elevated panels would be subject to submergence under certain flood conditions.

The relocation of the electric panels was not considered to be a practical mitigation measure because of the impact to daily routine operations and the potential to incur water damage even if relocated. It may be more effective to provide mitigation measures to stop the water from entering the structures rather than relocating the panels. Alternatives to prevent water intrusion into the susceptible structures are discussed further in Sections 6 and 7.

4.0 REPLACMENT OF THE TERMINAL PUMPING STATION PUMPS AND DRIVES

4.1 PROJECT DESCRIPTION

The influent pumps at the remote Terminal Pumping Station collect flow from the Johnson City service area and pump it to the head of the BJCJSTP. These pumps are critical to the operation of the treatment system and prevent the wastewater from entering the Susquehanna River through untreated overflows or from backing up in the collection system and flooding residential structures.

The existing influent pumps damaged during the recent flooding at the Terminal Pumping Station are dry pit pumps. The pumps are located at elevation 799.50 in the lowest level of the pump station. Extended hollow composite shafts connect the pumps to the motors located on the ground level of the pump station at elevation 836.0. Due to flood waters entering the building and flowing down to the lowest level, all four pumps and the hollow shafts were damaged by water along with mud and debris which entered the Pump Station and bypassed comminutors upstream of the pumps due to the volume of flow.

In order to protect against future damage due to flooding, dry pit submersible pumps with close coupled submersible motors are proposed as mitigation rather than replacement in kind. The dry pit submersible pumps are designed to operate in dry conditions as well as under water. In addition, the proposed pumps will be equipped with cutting impellers to enable the pumps to cut debris which may pass over the comminutors helping to make the debris pass through the pumps easier. The proposed close coupled motors will be attached directly to the pumps eliminating the extended drive shafts. The motors are submersible and can run when exposed to or covered with water. To accommodate the cutting capabilities of the proposed pump impellers, the size of the motors will increase from 125 horsepower to 140 horsepower. Three new gate valves on the suction side of the pumps would also be required for isolation along with piping modifications to accommodate the new pumps due to an increased suction size.

4.2 COST ESTIMATE

The cost to upgrade the Terminal Pumping Station to be more effective under flood conditions is approximately $391,000 and includes installation labor and materials for the upgrade. This is less expensive than the replacement in kind alternative that would be required as part of the Category F flood damage repair. The materials include four new pumps each with a 140 HP motor, associated electrical materials, new suction isolation valves, and piping modifications. The costs are further detailed in Table 2.

5.0 REPLACMENT OF THE HEAD HOUSE PUMPS AND DRIVES

5.1 PROJECT DESCRIPTION

The Head House dry pit pumps are located down stream of the bar screens at the BJCJSTP. The Head House pumps are used to lift the influent to the primary treatment process. The pumps are critical to keep the sewer system from backing up and causing combined sewer overflows into the Susquehanna River.

There are four pumps located in the Head House at elevation 805.00. Each pump is connected to a motor located at elevation 845.00 by extended composite hollow shafts. During the flood event, water entered the lowest level where the pumps are located by backing up through the Head House building. The flood waters and debris damaged the pumps as well as the hollow shafts similar to the situation at the Terminal Pumping Station.

The proposed replacement pumps are dry pit submersible pumps with close coupled 185 HP submersible motors. The submersible pumps and motors would allow the equipment to come into contact with water and remain operational similar to those recommended for the Terminal Pumping Station and will significantly reduce the likelihood of damage from future flood events.

5.2 COST ESTIMATE

The cost to upgrade the Head House pumps and motors is approximately $651,000 and is only slightly more expensive than the replacement in kind alternative which would be required for the Category F damage repair. The materials include four new pumps each with a motor, associated electrical materials and piping modifications. Further cost information is presented in Table 3.

6.0 PLUG ABANDONED CONDUITS

6.1 PROJECT DESCRIPTION

During the flood event it was determined that flow through old conduits was partially responsible for flooding of several below grade areas. In an effort to prevent water from traveling from one area of the plant to another through abandoned conduits, an inspection of all conduits should be completed and any passages should be plugged. All conduits including those which are abandoned and those which are in use should be fitted with watertight terminations.

6.2 LOCATIONS

The entire plant should be inspected area by area to check for conduit that should be plugged. The effort should start with lower elevation areas that are most susceptible to flooding and them progress to the areas of least flooding potential. A preliminary

inspection was completed for this report and three areas of the plant were identified for this mitigation.

6.3 COST ESTIMATE

The cost to implement plugging the conduits would include inspection and inventory of the conduits, material costs, and installation cost. Three areas are currently identified that would require plugging. The order of magnitude cost for this work is $43,000. Additional details are presented in Table 4.

7.0 WATERTIGHT STRUCTURES

7.1 PROJECT DESCRIPTION

Much of the damage from the June flood event occurred because of water levels rising and flooding below grade structures on the Binghamton-Johnson City Joint Sewage Treatment Plant grounds. As a mitigation measure, the installation of watertight doors and flood barriers has been researched.

Traditional watertight doors, typically used for large scale marine applications are large and heavy, and as a result, are not very practical for everyday use however there are a variety of flood protection doors currently entering the market which are more practical for these applications. In order for these to be effective, many building doors on the Binghamton-Johnson City Joint Sewage Treatment Plant premises would need to be replaced. Some of the affected doors include those in the Chlorination and Dechlorination Building, East Scrubber Building, Compost Building, Blower Building, Digester Control Building, and Thickener Pumping Stations 1 and 2. The presence of watertight doors in often used areas may hinder the workers operational access during non-flood periods of time unless special accommodation is incorporated into the design. Also, the installation of effective watertight doors in many of the existing buildings may be difficult.

Rather than installing watertight doors in some lower elevation areas, the use of stop planks or slide barriers was also evaluated. Stop planks are wooden or composite boards that are inserted in mounted framework channels to obstruct flow. When the stop planks are needed to hold back rising waters, the planks can be inserted. While the stop planks are not completely water tight, they dramatically reduce the amount of water coming through a passageway. Under this alternative, stop plank framework would be mounted on each affected door. When a flood threat does exist, the planks would be installed preventing much of the rising water flow from entering the affected building. The water that does enter the building could be pumped out at a defined rate via sump pumps. This approach would be beneficial because the stop plank system would not impede or hinder the efficiency of daily operations while limiting the impact of flood waters. In addition, portable barrier walls and exterior mounted vertical sliding barriers are available which work quite well with overhead garage doors and driveway openings.

There are approximately 40 locations for watertight barriers over the entire plant including the Terminal Pumping Station. The majority of installations would be located in place of the existing mandoors or on the outside of the garage doors. The height of the seals would depend on elevation and location of the doorway. Based on building elevations and past flooding history, assessments for barrier installation can be completed for each structure.

In conjunction with watertight doors, structural waterproofing is necessary to impede water from entering the buildings. Structural waterproofing would be applied to both the brick and concrete on the outside of the buildings. The waterproofing would be applied up to the corresponding height of the seals on the waterproof doors.

In areas where electrical panels are susceptible to flood damage, the use of watertight doors is recommended. Isolation of these areas will also require sealing of HVAC ductwork and electrical conduits where inflow of water is probable.

7.2 COST ESTIMATE

The costs associated with installing watertight fixtures to protect the plant buildings from flood damage include design, materials and labor for the installation. Approximately $ 1,788,000 should be allocated toward this mitigation measure as detailed in Table 5.

8.0 BARRIER CONSTRUCTION

8.1 PROJECT DESCRIPTION

The construction of flood barriers could conceptually provide protection to the Terminal Pumping Station and the Binghamton-Johnson City Joint Sewage Treatment Plant from the Susquehanna River. Barrier construction is commonly used in flood mitigation and it appears that it may be feasible for each of these locations. Barrier costs for both the 100-year and 500-year floods were estimated. At the time of this writing, the 100-year and the 500-year water surface elevations were in the process of being re-calculated. If the re-calculated water surface elevations differ significantly from the current elevations, the cost-estimates presented here could change significantly.

If a barrier is constructed within the floodway, an analysis would have to be undertaken to show the effects (if any) that the construction would have on the water surface elevations of the river. If the construction is shown not to have any effect on the water surface elevations, no mitigation is typically required. If the construction is shown to have an effect on the water surface elevations, mitigation may be required. Mitigation costs were not included as part of this estimate.

The barrier construction materials considered for this analysis were earthen embankments and sheet-pile walls. Earthen embankments tend to be less costly than sheet pile walls, but require more usable space at the site. Where space allowed, earthen embankments were assumed to be buildable. The attached Figures 1 thru 4 show a conceptual location for these barriers.

The construction of barriers at either location would require consideration of localized drainage patterns, the function of exterior and interior electrical equipment, maximum cover allowances for existing underground utilities, above-ground and underground sheet wall penetrations, and other items. The appearance of sheet pile walls could be softened using plantings or other materials. Implementation of this alternative would negate the need for watertight enclosures described in Section 7 for some of the interior and exterior building locations however the exterior access points including those along Old Vestal Road would still require barrier installation.

Terminal Pumping Station

The current 100-year water surface elevation at the Terminal Pumping Station is approximately 836 feet. A barrier built to this elevation would surround approximately ½ the site. The attached Figure 1 shows a conceptual location for this barrier. Based on grades at the site, a barrier to protect against the 100-year water surface elevation would be approximately 250 feet long. Of this total length, approximately 70% may be able to be constructed as an earthen embankment. The remaining barrier length could be constructed using water tight sheet piles. If additional lands could be acquired to the east, the entire barrier may be able to be constructed as an earthen embankment. This land acquisition scenario was not considered in the cost estimate.

The current 500-year water surface elevation at the Terminal Pumping Station is approximately 841 feet. A barrier built to this elevation would surround approximately ¾ of the site. The attached Figure 2 shows a conceptual location for this barrier. Based on grades at the site, a barrier to protect against the 500-year water surface elevation would be approximately 335 feet long. Of this total length, approximately 20% may be able to be constructed as an earthen embankment. The remaining barrier length could be constructed using watertight sheet piles. If additional lands could be acquired to the east, an additional 25% of the barrier may be able to be constructed as an earthen embankment. This land acquisition scenario was not considered in the cost estimate.

It was assumed that the construction of either the 100-year or the 500-year barrier would result in the closing of the northern access driveway. This driveway could remain in operation if fitted with a watertight gate. This watertight gate was not considered in this analysis.

Binghamton-Johnson City Joint Sewage Treatment Plant

The current 100-year water surface elevation at the Binghamton-Johnson City Treatment Plant is approximately 838 feet. A barrier built to this elevation would surround approximately ½ the site. The attached Figure 3 shows a conceptual location for this barrier. Based on grades at the site, a barrier to protect against the 100-year water surface elevation would be approximately 1,075 feet long. Of this total length, approximately 25% may be able to be constructed as an earthen embankment. The remaining barrier length could be constructed using watertight sheet piles. Along the western side of the site, the barriers could be tied to the existing structures such that the existing structure walls acted as flood barriers. The appearance of sheet pile walls could be softened using plantings or other materials.

The current 500-year water surface elevation at the Binghamton-Johnson City Joint Sewage Treatment Plant is approximately 843 feet. A barrier built to this elevation would surround approxi-mately ¾ of the site. The attached Figure 4 shows a conceptual location for this barrier. Based on grades at the site, a barrier to protect against the 500-year water surface elevation would be approximately 1,400 feet long. Of this total length, approximately 20% may be able to be constructed as an earthen embankment. The remaining barrier length could be constructed using watertight sheet piles. Along the western side of the site, the barriers could be tied to the existing structures such that the existing structure walls acted as flood barriers. The construction of the 500-year wall could require the use of flood barrier doors and portable access barrier panels in certain facility doors and drives that face Old Vestal Road.

8.2 COST ESTIMATE

The construction costs for a flood barrier to protect the Terminal Pumping Station from the 100-year flood and the 500-year flood were estimated for preliminary planning purposes at approximately $475,000 and $1,530,000 respectively. Preliminary estimates for construction of a flood barrier to protect the Binghamton-Johnson City Joint Sewage Treatment Plant from the 100-year flood and the 500-year flood were estimated at $3,500,000 and $6,100,000 respectively. Further cost information is presented in Table 6.

9.0 SEDIMENT REMOVAL FROM THE SUSQUEHANNA RIVER AT THE FULLER HOLLOW CREEK OUTLET

9.1 PROJECT DESCRIPTION

It can be seen from aerial photographs that through time, soil deposition has been increasing at the outlet of Fuller Hollow Creek into the Susquehanna River. We estimate that this deposition of soil is up to 20 feet in depth. Deposition of soil reduces the conveyance capacity of the Susquehanna River at this location and increases the water surface elevations in the river. Removing this sediment would restore the hydraulic

capacity of the Susquehanna River at this location and result in lower water surface elevations. This can be quantified during pre design by performing an existing and proposed hydraulic analysis of the Susquehanna River utilizing the U. S. Army Corp. of Engineer's HEC-RAS computer program with supplemental cross section surveys to generate these models.

This soil deposition may also impact the hydraulic efficiency of Fuller Hollow Creek. There have been documented events when the flow in Fuller Hollow Creek exceeds the culvert's capacity at Old Vestal Road where the watercourse overtops Old Vestal Road and flows onto the Plant's property. This failure may be due to the reduction of hydraulic capacity of the culvert and creek due to a backwater effect by the soil deposition.

We estimate that up to approximately 100,000 cubic yards of material would need to be excavated from the Susquehanna River at this location. This will help to restore the hydraulic capacity of the Susquehanna River at this location and reduce the probability of backwater impacts along Fuller Hollow Creek. In order to accomplish this work required permits would need to be obtained from the applicable agencies having jurisdiction over these water bodies. We assume that the material excavated would be classified as exempt construction and demolition debris under 6NYCRR Part 360. The actual quantity and characteristics of the spoils would be determined through surveys, borings and laboratory testing carried out during preliminary design. A work plan would need to be generated that would provide for mitigating the impacts related to the proposed construction.

9.2 COST ESTIMATE

The project would consist of performing two hydraulic analyses, one for existing and one for proposed conditions, permitting, design and the excavation and disposition of material from the Susquehanna River at the mouth of Fuller Hollow Creek. A budgetary cost estimate of approximately $3,030,000 was derived for this alternative as presented in Table 7.

10.0 FLOOD RESPONSE PLANS

10.1 PROJECT DESCRIPTION

Development of flood response plans would provide for proper steps to be taken during a flood event to minimize damages. These plans would include an outline of steps to protect each area of the plant to the best of the staff's ability based on the severity of the flooding. Plans may include items such as closing critical valves to eliminate backflow of flood water, stop plank placement, mobile equipment being moved to higher ground, etc. The plans would also include steps to provide for worker safety and a listing of the proper people and authorities to contact to relay flooding information. These plans will be incorporated into the O&M manuals for each of these alternatives.

11.0 SUMMARY

This report presents several different options for mitigating the impacts of future floods on the Binghamton Johnson City Joint Sewage Treatment Plant facilities. These can be implemented individually or together depending on the level of protection desired. The major alternatives are outlined below.

- *Providing flood gates and watertight doorways.* Watertight fixtures are proposed for those structures, buildings and rooms which contain equipment most susceptible to floodwaters where significant damage occurred during the June 28, 2006 flood. This alternative also includes sealing of abandoned conduits which contributed to the flooding of the structures. The number and location of watertight devices installed may be reduced if the flood barrier alternatives presented in Section 8 are implemented. Certain of these shall remain however, where they protect outside entrance to structures which themselves are incorporated into the flood barrier. This is an effective means to mitigate the potential for future damage.

- *Submersible pumps and motors.* Replacement of the damaged pumps in both the Terminal Pumping Station and Head House must be implemented as part of the damage repair (Category F) work for the existing plant. The concept of utilizing submersible systems which are much less prone to damage in lieu of replacement in kind was treated as a mitigation option. As the total cost for these two mitigation alternatives is comparable to the cost of in kind replacement, it is recommended that the mitigation approach be implemented.

- *Barrier Construction.* This report presents conceptual level estimates for the construction of flood barrier walls around both the Terminal Pumping Station and main treatment plant properties. This approach was evaluated for both the estimated 100 year and 500 year flood events. Although the costs associated with this approach are significantly higher than the other alternatives, the level of protection is much greater. In addition, the ability to recover and provide adequate sewage treatment to protect the health of the public is greatly enhanced. The scope of such an undertaking will require more advanced study and data collection to fully develop the approach beyond that which is presented herein. This additional development work can proceed once the agency has commented on its feasibility.

- *Sediment removal at the mouth of Fuller Hollow Creek.* This alternative includes removal of approximately 100,000 cubic yards of sediments deposited in the floodplain of the Susquehanna River at the mouth of the creek. This deposition has covered portions of the plant outfall and can contribute to back water flooding impacts along the west side of the plant and Old Vestal Road. Removal of this material will mitigate these impacts and can partially offset the area to be taken for construction of a flood barrier wall at the plant.

A cost summary for these mitigation options is included in Table 8.

Table 1

Flood Gates
Mitigation Option
Cost Detail

Flood Gates		
Material	Fuller Hollow Creek	$ 47,000.00
	C-filter Complex Louver	$ 23,000.00
Labor	Fuller Hollow Creek	$ 16,000.00
	C-filter Complex Louver	$ 8,000.00
Subtotal		$ 94,000.00
Contingency (20%)		$ 19,000.00
Subtotal		$ 113,000.00
ELA (15%)[1]		$ 17,000.00
Total		$ 130,000.00

[1] ELA - Engineering, legal, and administrative fees (15%)

Table 2

Terminal Pumping Station Pump Replacement
Mitigation Option
Cost Detail

Terminal Pumping Station Pump Replacement		
Material	Pumps and Motors	$ 148,000.00
	Valves and Piping	$ 28,000.00
	Electrical	$ 8,000.00
Labor		$ 99,000.00
Subtotal		$ 283,000.00
Contingency (20%)		$ 57,000.00
Subtotal		$ 340,000.00
ELA (15%)[1]		$ 51,000.00
Total		$ 391,000.00

[1] ELA - Engineering, legal, and administrative fees (15%)

Table 3

Head House Pump Replacement
Mitigation Option
Cost Detail

Head House Pump Replacement		
Material	Pumps and Motors	$ 269,000.00
	Piping	$ 15,000.00
	Electrical	$ 8,000.00
Labor		$ 180,000.00
Subtotal		$ 472,000.00
Contingency (20%)		$ 94,000.00
Subtotal		$ 566,000.00
ELA (15%)[1]		$ 85,000.00
Total		$ 651,000.00

[1] ELA - Engineering, legal, and administrative fees (15%)

Table 4

Plug Abandonded Conduits
Mitigation Option
Cost Detail

Plug Abandonded Conduits		
Material	Existing Primary Sludge Pumping Station	$ 8,000.00
	New Primary Sludge Pumping Station	$ 8,000.00
	Existing Blower House	$ 6,000.00
Labor		$ 9,000.00
Subtotal		$ 31,000.00
Contingency (20%)		$ 6,000.00
Subtotal		$ 37,000.00
ELA (15%)[1]		$ 6,000.00
Total		$ 43,000.00

[1] ELA - Engineering, legal, and administrative fees (15%)

Table 5

Watertight Structures
Mitigation Option
Cost Detail

Watertight Structures			
Material	39 flood proofing units, Including:		
	Removable Flood Barriers		
	Watertight Doors and Hatches		
		SubTotal	$ 676,000.00
	Structural Waterproofing		$ 250,000.00
		Total	$ 926,000.00
Labor			$ 370,000.00
Subtotal			$ 1,296,000.00
Contingency (20%)			$ 259,000.00
Subtotal			$ 1,555,000.00
ELA (15%)[1]			$ 233,000.00
Total			$ 1,788,000.00

[1] ELA - Engineering, legal, and administrative fees (15%)

Table 6

Barrier Construction
Mitigation Option
Cost Detail

Terminal Pumping Station

100-year Flood Barrier Construction	
Material	$ 111,000.00
Labor	$ 207,000.00
Subtotal	$ 318,000.00
Contingency (30%)	$ 95,000.00
Subtotal	$ 413,000.00
ELA (15%)[1]	$ 62,000.00
Total	$ 475,000.00

500-year Flood Barrier Construction	
Material	$ 358,000.00
Labor	$ 664,000.00
Subtotal	$ 1,022,000.00
Contingency (30%)	$ 307,000.00
Subtotal	$ 1,329,000.00
ELA (15%)[1]	$ 199,000.00
Total	$ 1,528,000.00

Binghamton-Johnson City Joint Sewage Treatment Plant

100-year Flood Barrier Construction	
Material	$ 820,000.00
Labor	$ 1,522,000.00
Subtotal	$ 2,342,000.00
Contingency (30%)	$ 703,000.00
Subtotal	$ 3,045,000.00
ELA (15%)[1]	$ 457,000.00
Total	$ 3,502,000.00

500-year Flood Barrier Construction	
Material	$ 1,421,000.00
Labor	$ 2,639,000.00
Subtotal	$ 4,060,000.00
Contingency (30%)	$ 1,218,000.00
Subtotal	$ 5,278,000.00
ELA (15%)[1]	$ 792,000.00
Total	$ 6,070,000.00

[1] ELA - Engineering, legal, and administrative fees (15%)

Table 7

Sediment Removal at Fuller Hollow Creek
Mitigation Option
Cost Detail

Sediment Removal at Fuller Hollow Creek			
Labor	Mobilization and Demobilization	$	67,000.00
	Clear, Grub, and Build Haul Road	$	28,000.00
	Dredging (100,000 yd^3)	$	1,425,000.00
	Hauling	$	666,000.00
	Disposal[1]	$	11,000.00
Subtotal		$	2,197,000.00
Contingency (20%)		$	439,000.00
Subtotal		$	2,636,000.00
ELA (15%)[2] (includes permitting)		$	395,000.00
Total		$	3,031,000.00

[1] Assumes exempt construction and demolition debris fill classification

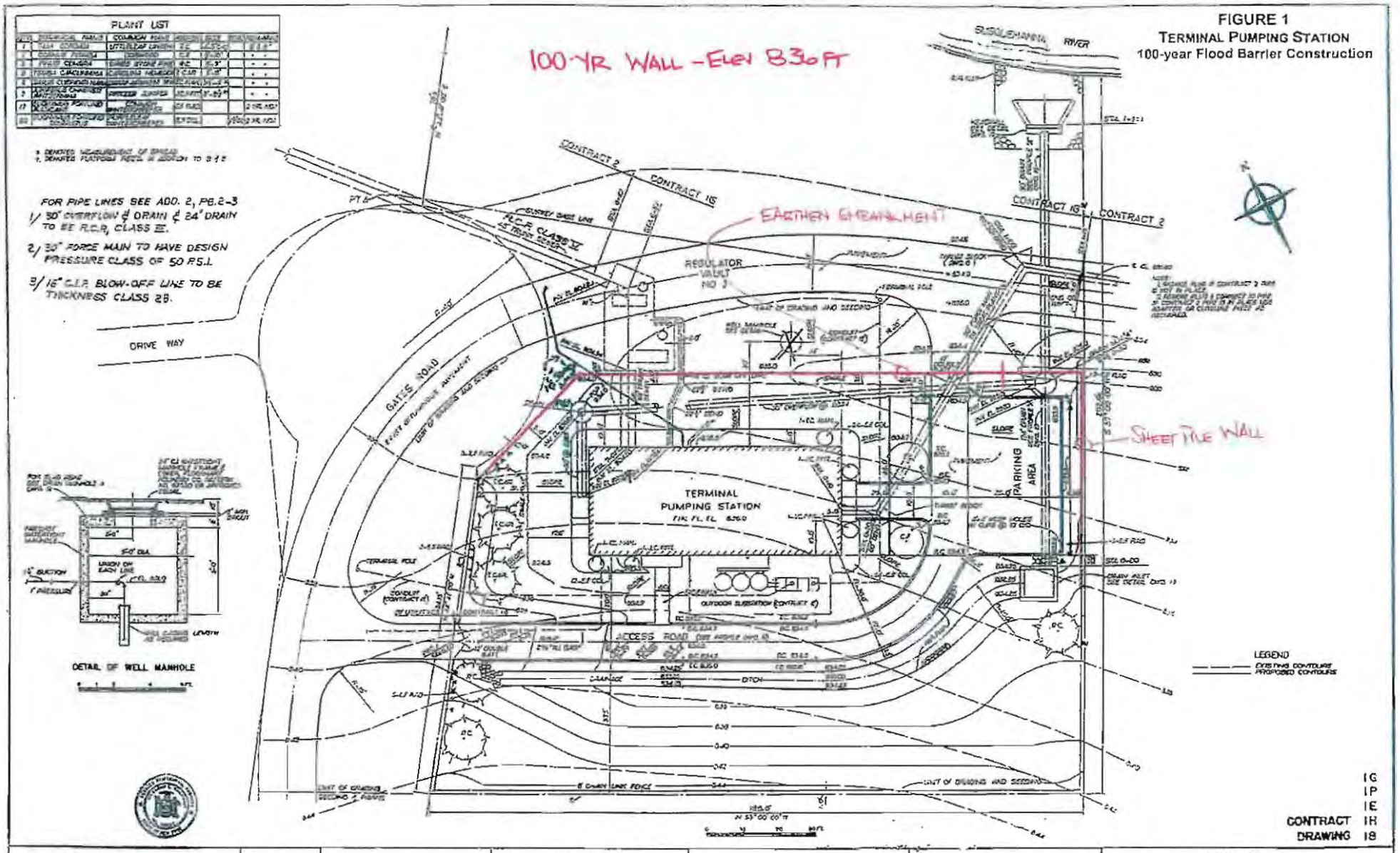
[2] ELA - Engineering, legal, and administrative fees (15%)

Table 8

Summary of Mitigation Options
Cost Detail

Summary			
Flood Gates		$	130,000.00
Terminal Pumping Station Pump Replacement		$	391,000.00
Head House Pump Replacement		$	651,000.00
Plug Abandonded Conduit		$	43,000.00
Watertight Structures		$	1,788,000.00
Barrier Construction	Terminal Pumping Station 100-year	$	475,000.00
	Terminal Pumping Station 500-year	$	1,528,000.00
	Binghamton Johnson City JSTP 100-year	$	3,502,000.00
	Binghamton Johnson City JSTP 500-year	$	6,070,000.00
Sediment Removal at Fuller Hollow Creek		$	3,031,000.00

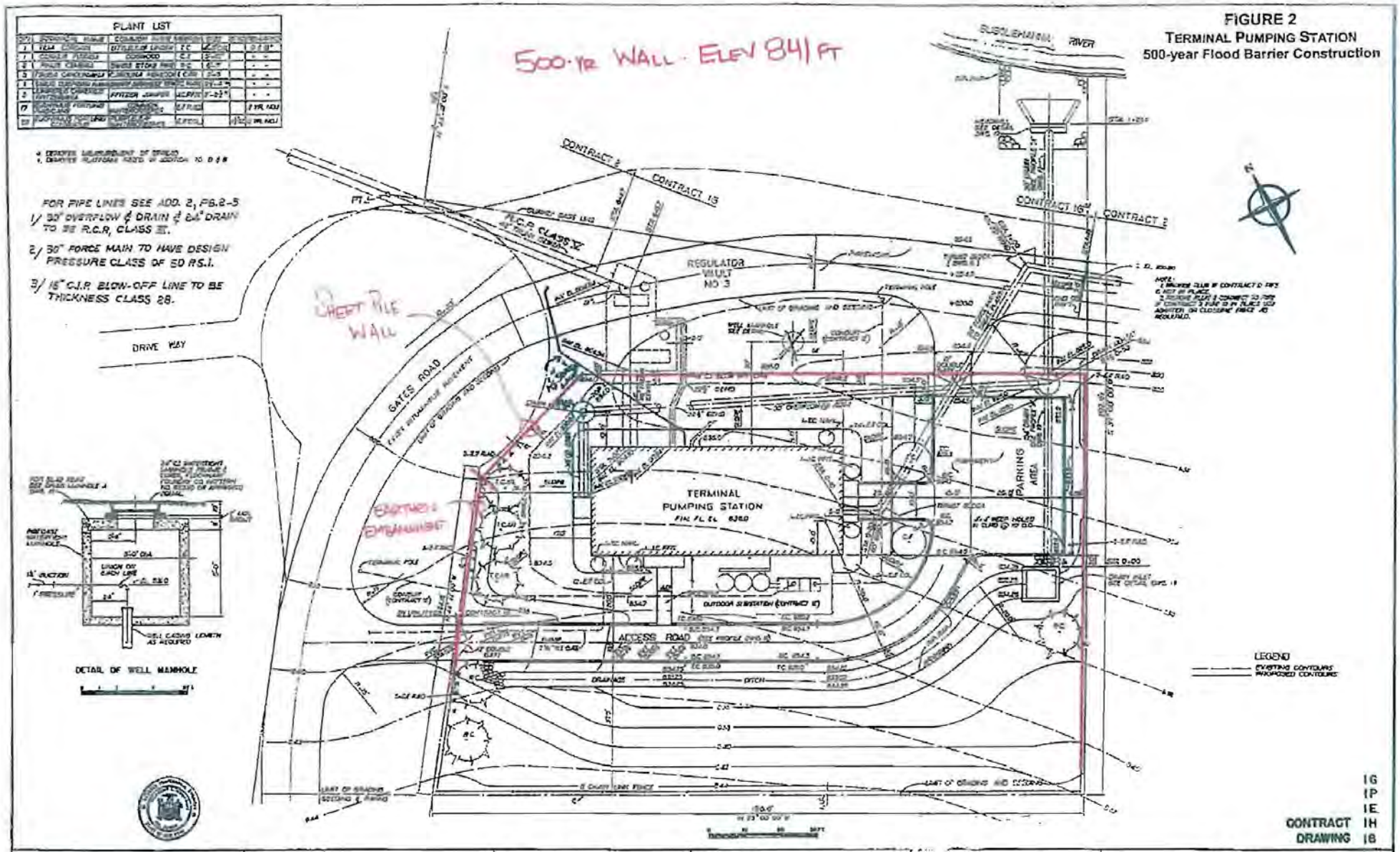
FIGURE 1
TERMINAL PUMPING STATION
100-year Flood Barrier Construction



CONTRACT 1G
DRAWING 1P
1E
1H
1B

CLINTON ROGERT ASSOCIATES CONSULTING ENGINEERS · NEW YORK, N.Y.	DESIGNED J.R. DRAWN N.V. CHECKED H.C.M.	APPROVED BY: Robert H. Rogert DATE ____ CLINTON ROGERT ASSOCIATES	VILLAGE OF JOHNSON CITY NEW YORK	BINGHAMTON - JOHNSON CITY JOINT SEWAGE PROJECT	TERMINAL PUMPING STATION	SITE PLAN AND LANDSCAPING

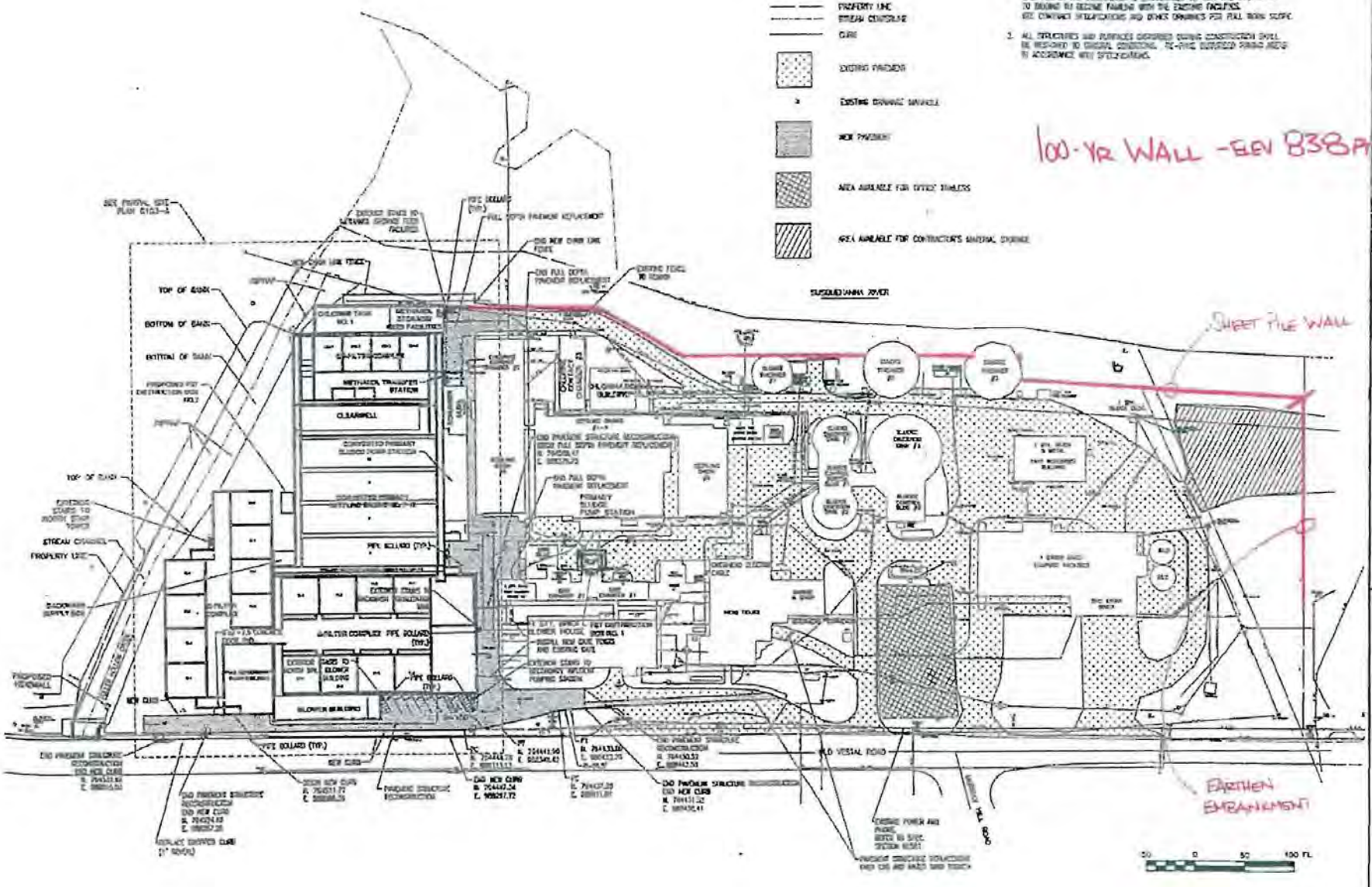
FIGURE 2
TERMINAL PUMPING STATION
500-year Flood Barrier Construction



CONTRACT 1G 1P 1E 1H
DRAWING 1B

CLINTON ROGERS ASSOCIATES CONSULTING ENGINEERS · NEW YORK, N.Y.	DESIGNED J.P. DRAWN H.M. CHECKED U.E.M.	APPROVED BY	VILLAGE OF JOHNSON CITY NEW YORK	BINGHAMTON - JOHNSON CITY JOINT SEWAGE PROJECT	TERMINAL PUMPING STATION	SITE PLAN AND LANDSCAPING

FIGURE 3
BINGHAMTON-JOHNSON CITY JSTP
100-year Flood Barrier Construction



C&S ENGINEERS, INC.

SHUMAKER

BINGHAMTON-JOHNSON CITY JOINT SEWAGE TREATMENT PLANT PHASE III IMPROVEMENTS CONTRACT 3 VESTAL, NEW YORK

MARK	DATE	DESCRIPTION

REVISIONS

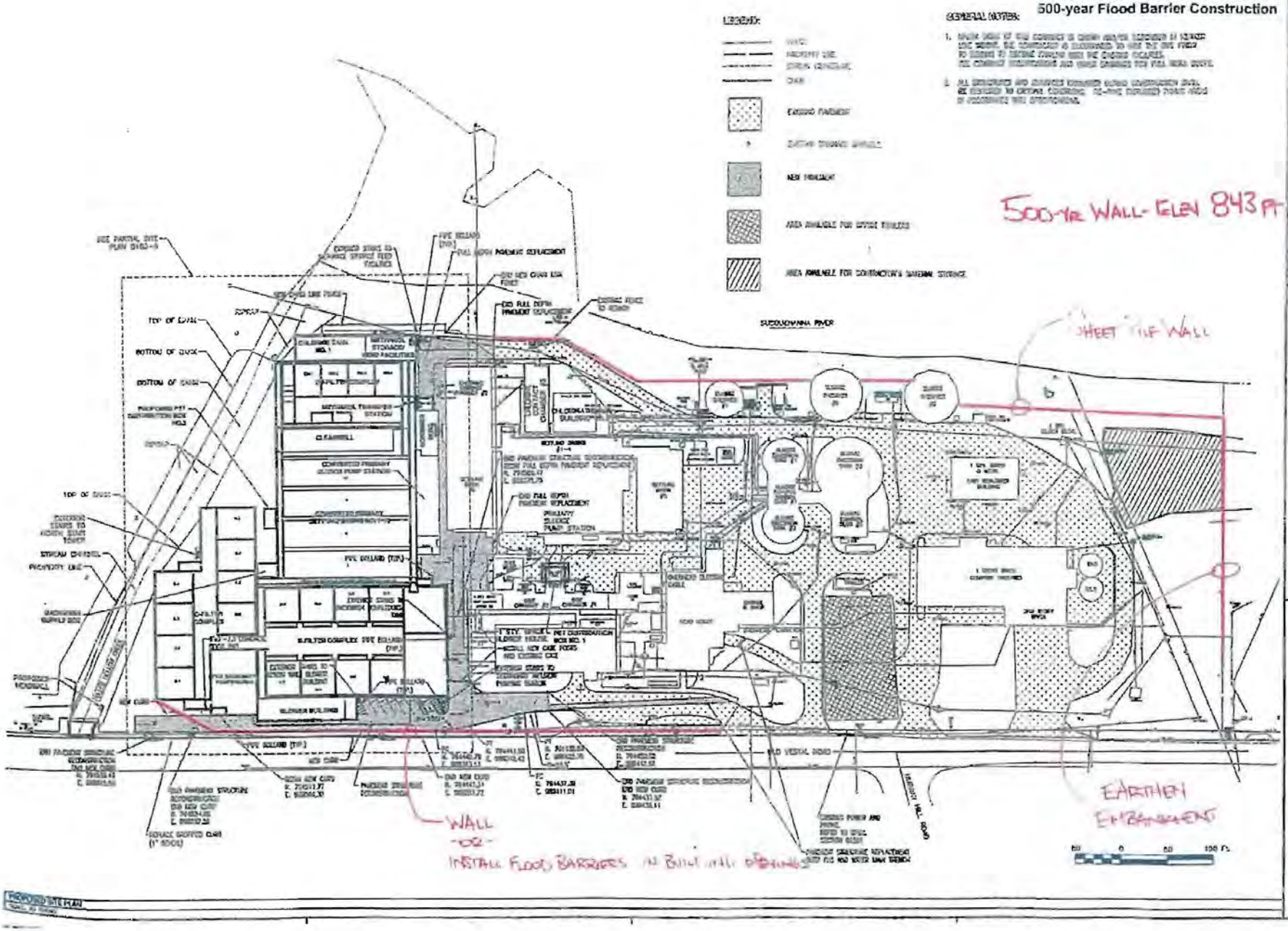
PROJECT NO.
DATE: JANUARY 1994
SCALE: AS SHOWN
DRAWN BY:
CHECKED BY:

NO ALTERATION PERMITTED HEREON EXCEPT AS PROVIDED UNDER SECTION 7209 SUBDIVISION 2 OF THE NEW YORK EDUCATION LAW

PROPOSED SITE PLAN

G102-A

FIGURE 4
BINGHAMTON-JOHNSON CITY JSTP
500-year Flood Barrier Construction



C&S ENGINEERS, INC.

SHUMAKER

BINGHAMTON-JOHNSON CITY JOINT SEWAGE TREATMENT PLANT
PHASE III IMPROVEMENTS
CONTRACT 3
VESTAL, NEW YORK

PROPOSED SITE PLAN

G102-A

REPORT

CITY OF BINGHAMTON
VILLAGE OF JOHNSON CITY

BINGHAMTON-JOHNSON CITY
JOINT SEWAGE TREATMENT PLANT
RESTORATION AND REHABILITATION

FLOOD MITIGATION EVALUATION

May 2012

SAVIN ENGINEERS, P.C.

Savin Engineers, P.C.

BINGHAMTON – JOHNSON CITY JOINT SEWAGE TREATMENT PLANT

FLOOD MITIGATION EVALUATION

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B Soils Boring Report

Executive Summary

The Binghamton – Johnson City Joint Sewage Treatment Plant (BJCJSTP) is located in the Town of Vestal, Broome County, New York and provides service to the City of Binghamton and the Village of Johnson City and a number of other municipalities and industrial users. The BJCJSTP is jointly owned by the City of Binghamton and the Village of Johnson City and operations at the BJCJSTP are managed by the Binghamton – Johnson City Joint Sewage Board.

The BJCJSTP is located on the bank of the Susquehanna River. The Susquehanna River has a history of flooding at Binghamton, including a substantial number of "major" flood events. In June 2006, heavy rainfall resulted in then-record flooding throughout the Binghamton area and caused significant flooding at the BJCJSTP. The flooding damaged the majority of the existing facilities as well as the biological aerated filtration (BAF) facilities that were under construction at the time. Flooding also damaged the offsite Terminal Pumping Station (TPS) which conveys wastewater collected from the Johnson City service area to the BJCJSTP for treatment. In September 2011, an even larger flood event again damaged nearly all of the plant's facilities and inundated the plant's treatment processes. Flooding also damaged the offsite Terminal Pumping Station. Major damage was sustained to process mechanical, electrical, instrumentation and HVAC components throughout the BJCJSTP during these floods. Both floods resulted in significant disruptions to the plant's treatment capacity and the reduction in the quality of the effluent discharged to the Susquehanna River.

As a result, the City of Binghamton retained Savin Engineers, P.C. to perform an evaluation of potential flood mitigation measures that could be implemented at the BJCJSTP and the TPS to protect the facilities from future flooding. The scope of the evaluation was to review and update a previous flood mitigation study that was prepared in 2007 by Calcerinos and Spina Engineers (C&S). The 2007 C&S Report is included as Appendix A.

Based on the observed high water marks following the 2011 flood, it appears that the floodwaters within the BJCJSTP reached an elevation of approximately 842 ft above mean sea level (AMSL) and floodwaters at the TPS reached an elevation of approximately 840 ft AMSL, which approached the 500-year flood elevations as published by the Federal Emergency Management Agency (FEMA). Wastewater treatment plants and pumping stations are required to be protected from flooding associated with a 100-year recurrence interval flood, according to the New York State Building Code and the 10 States Standards for Wastewater Facilities. The facilities at the BJCJSTP and the TPS comply with this requirement. However, due to the repeated flooding over a relatively short period, the City of Binghamton requested that the 500-year flood elevations be used in evaluating the potential flood mitigation improvements. HIGH WATER MARK + 1' PER FEMA MITIGATION

The following flood control measures were evaluated:

- Flood barrier walls
- Waterproof existing structures

- Relocation of electrical panels
- Upgrade of equipment to include submersible motors
- Upgrade and install sump pumps
- Installation of emergency generators
- Sediment removal from Fuller Hollow Creek outlet - ELIGIBLE IN 1650 FLOOD PW 3863

Each flood mitigation measure was conceptually developed to determine the preliminary design requirements and a probable construction cost for implementing the improvements. The flood controls were evaluated based on level of flood protection provided, their compatibility with the existing facilities and their reliability.

Based on this evaluation, the recommended flood mitigation improvements for the BJCJSTP include the construction of a barrier wall around the perimeter of the site. Flood gates would be provided at the driveway entrances to permit vehicular access. Approximately 2500 linear feet of barrier wall would be required. The total probable construction cost is approximately $9.8 million in May 2012 dollars. Including engineering, permitting, construction administration, project administration, legal fees and other project-related costs based on a factor of 25%, the calculated project costs are approximately $12.3 million.

The recommended flood mitigation improvements for the Terminal Pumping Station include the relocation of the electrical panels to a new elevated structure and building improvements to make the structure watertight, including the installation of flood gates and sealing of penetrations. The installation of an emergency generator is also recommended. The total probable construction cost is approximately $2.5 million in May 2012 dollars. Including engineering, permitting, construction administration, project administration, legal fees and other project-related costs based on a factor of 25%, the calculated project costs are approximately $3.2 million.

1.0 Introduction

1.1 Background Information

The Binghamton – Johnson City Joint Sewage Treatment Plant (BJCJSTP) is located in the Town of Vestal, Broome County, New York and provides service to the City of Binghamton and the Village of Johnson City and a number of other municipalities and industrial users. The BJCJSTP is jointly owned by the City of Binghamton and the Village of Johnson City and operations at the BJCJSTP are managed by the Binghamton – Johnson City Joint Sewage Board.

The BJCJSTP is located on the bank of the Susquehanna River. The Susquehanna River is one the largest rivers on the East Coast and drains a significant portion of the land area of New York and Pennsylvania before discharging into the northern end of Chesapeake Bay. The drainage basin upstream of the BJCJSTP comprises a significant portion of central New York State and includes the drainage basins of major tributaries such as the Chenango and Tioughnioga Rivers. The Susquehanna River has a history of flooding at Binghamton, including a substantial number of "major" flood events.

In June 2006, heavy rainfall resulted in then-record flooding throughout the Binghamton area and caused significant flooding at the BJCJSTP. The flooding damaged the majority of the existing facilities as well as the biological aerated filtration (BAF) facilities that were under construction at the time. Damaged equipment included process mechanical, electrical, instrumentation and HVAC system components throughout the BJCJSTP. Flooding also damaged the offsite Terminal Pumping Station which conveys wastewater collected from the Johnson City service area to the BJCJSTP for treatment.

USE THIS TO SET UP BCA

ADD TPS MITIGATION WAS ADDRESS IN PW OF371-80

In September 2011, heavy rainfall again resulted in record flooding throughout the Binghamton area and caused significant flooding at the BJCJSTP. Floodwaters at the BJCJSTP during the 2011 flood were higher than during the 2006 flood. The flooding damaged nearly all of the plant's facilities and inundated the plant's treatment processes resulting in significant disruptions to the plant's treatment capacity. Major damage was sustained to process mechanical, electrical, instrumentation and HVAC components throughout the BJCJSTP. Flooding also damaged the offsite Terminal Pumping Station.

1.2 Scope of Report

Following the 2006 flooding, a draft mitigation plan dated February 2007 was prepared by Calcerinos and Spina Engineers (C&S) evaluating the implementation of a variety of measures to control flooding at the BJCJSTP. As a result of the 2011 flooding, the City of Binghamton and the Village of Johnson City requested that Savin Engineers review and update this report based on the more recent flood damage. A copy of the 2007 C&S Report can be found in Appendix A.

This current report by Savin presents an evaluation of potential measures to mitigate the negative impacts of future flooding at the BJCJSTP. Savin reviewed the alternatives presented in the C&S report and updated the evaluations based on the 2011 flood elevations and resulting damage and updated the cost opinions presented in the C&S report. Savin identified and incorporated the evaluation of additional mitigation measures to provide for the protection of plant facilities as appropriate and allow the plant to restore full treatment capacity as soon as possible following a flood. Savin also coordinated the evaluation of the flood mitigation measures with the proposed rehabilitation measures for the restoration of the BAF Complex.

This report presents a technical evaluation of the implementation of the flood mitigation measures with regards to their basic technical requirements, constructability and operability for plant personnel. Detailed design of these measures is not included in this report. A detailed hydraulic evaluation to determine the affect of flood waters on the plant process streams is not included in this report.

1.3 Applicable Standards and References

This evaluation is prepared in accordance with the applicable codes, design standards and other industry-accepted references, including:

CODES AND STANDARDS TO BE APPLIED

- Federal Emergency Management Agency (FEMA) – Broome County Flood Insurance Study, February 2010.
- Federal Emergency Management Agency (FEMA) – Flood Insurance Rate Maps
- National Oceanic and Atmospheric Administration (NOAA) – National Weather Service, Mid Atlantic River Forecast Center
- US Army Corps of Engineers (USACE) – Flood Proofing Regulations, EP-1165-2-314 (1995)
- New York State Building Code, Section 1612 – Flood Loads
- Great Lakes and Upper Mississippi River Board (GLUMRB, "10 States") – Recommended Standards for Wastewater Facilities
- American Society of Civil Engineers (ASCE) – ASCE 24, Flood Resistant Design and Construction
- American Society of Civil Engineers (ASCE) – ASCE 7, Minimum Design Loads for Buildings and Other Structures

2.0 Flooding at BJCJSTP

2.1 Site Description

2.1.1 BJCJSTP

The BJCJSTP is located on the southern bank of the Susquehanna River approximately 2-1/2 miles downstream (west) of the confluence with the Chenango River in central Binghamton. The plant location is shown in Figure 2-1. The BJCJSTP site slopes towards the River from the south to north and from east to west. The BJCJSTP is bounded by the Susquehanna River to the north; Fuller Hollow Creek to the west, Old Vestal Road to the south and an electrical substation on property to the east. The site plan for the BJCJSTP is shown in Figure 2-2.

The wet-stream process at the BJCJSTP consists of an influent pumping station, grit removal, primary settling, a three-stage biological aerated filters (BAF) secondary process (C, N and DN filters), and chlorine disinfection. The solids stream process consists of sludge pumping, gravity thickening, anaerobic digestion and centrifugal dewatering. Dewatered solids are trucked offsite for landfill disposal. A number of the process tanks at BJCJSTP are located below grade, including the primary settling tanks and the chlorine contact tanks. The majority of the buildings at the BJCJSTP include lower levels below grade in order to provide access to piping, valves, pumping equipment and other process system components. The BAF-C, BAF-N, Secondary Influent Pumping Station and former Blower House structures are interconnected below grade.

The BJCJSTP collection area is served by a system of sanitary and combined sewers. Wastewater is conveyed to the BJCJSTP through a series of gravity sewers and pumping stations. A majority of the influent wastewater is conveyed to the plant through a large trunk sewer along the south side of the Susquehanna River. The other significant contributor to the plant influent is the Terminal Pumping Station located in the Town of Vestal. Other portions of the Town of Vestal drain directly to the BJCJSTP through gravity sewers.

2.1.2 Terminal Pumping Station

NOT TO BE INCLUDED

The Terminal Pumping Station (TPS) is located approximately 1 mile to the northwest of the BJCJSTP on the southern bank of the Susquehanna River also in the Town of Vestal, New York. The TPS sits on a fairly level plot of land that slopes toward the river. The site plan for the TPS is shown in Figure 2-3.

Wastewater is conveyed to the TPS through a series of gravity sewers and pumping stations. The TPS includes channel grinders on the station influent and four dry-pit submersible sewage pumps. The TPS includes a pump house at grade with a finished floor elevation of the ground floor of 836 ft AMSL. There are two levels below grade to provide access to the channel grinders, the main sewage pumps, valves, piping and other system components.

2.2 Flood-Related Damage in 2006 & 2011

In both the 2006 and the 2011 floods, the majority of the damage occurred when equipment including process equipment, electrical equipment, instrumentation and controls, which were not designed for immersion in water were submerged when the plant facilities were inundated by the floodwaters. The degree of effort required to rehabilitate the flood-related damage varied depending on the nature of the affected equipment and the degree to which it was exposed to floodwaters. Some equipment could be simply repaired in place while other equipment had to be shipped out for repairs. Some equipment could not be salvaged and had to be replaced. Based on the observed high water marks following the 2011 flood, it appears that the floodwaters within the BJCJSTP reached an elevation of approximately 842 ft AMSL. Floodwaters at the TPS reached an elevation of approximately 840 ft AMSL.

2.3 Flooding of the Susquehanna River

The Susquehanna River at Binghamton has a history of flooding, including a number of substantial floods. The National Weather Service's Middle Atlantic River Forecast Center database for the Susquehanna River gauging station at Binghamton includes historical flood data for the occurrence of 35 crests above flood stage since 1846, including 15 "major" floods. The crest corresponding to the 2006 flood event was 11.0 feet above flood stage. This was a record level at the time. The crest corresponding to the 2011 flood event was 11.7 feet above flood stage, making the 2011 flood the current flood of record. Both the 2006 and 2011 floods approached the 0.2% annual chance flood elevations (500-year flood) at the gauging station. Unfortunately, hydraulic discontinuities in the river channel, including minor dam structures and changes in the shape and elevation of the river bottom, its banks and its flood plain, make it difficult to draw correlations between the historical data at the gauging station and the river level observed at the BJCJSTP.

The Broome County Flood Insurance Study (FIS) prepared by FEMA dated February 2010 provides stream profiles along the Susquehanna River including the immediate vicinity of the BJCJSTP and the TPS. This study estimates a base flood elevation of approximately 839.8 ft AMSL for the 1% annual chance flood (100-year flood) and a base flood elevation of approximately 842.8 ft AMSL for the 0.2% annual chance flood (500-year flood).

The 2010 FIS estimates a base flood elevation at the site of the TPS of approximately 837.5 ft AMSL for the 1% annual chance flood (100-year flood) and a base flood elevation of approximately 840.5 ft AMSL for the 0.2% annual chance flood (500-year flood).

2.4 Design Flood Elevation

The New York State Building Code, Section 1612 – Flood Loads, defines the Design Flood Elevation as the floodwater elevation associated with the 1% annual chance flood. Likewise, the 10 States Standards for Wastewater Facilities, Section 51.2, requires wastewater treatment plant structures and equipment to be protected from physical damage due to the 1% annual chance flood (100-year flood). However, the BJCJSTP has experienced two separate floods approaching the 0.2% annual chance flood in the past five years which resulted in major damage to the equipment and operability of the BJCJSTP. Accordingly, the minimum Design Flood Elevations used in this evaluation are calculated on the basis of the elevations associated with the 0.2% annual chance flood.

ASCE-24 – Flood Resistant Design and Construction requires that a minimum 1.0 feet of freeboard be added to the base flood elevation for the protection of Category III structures, which includes wastewater treatment facilities. In addition, the DFE shall account for increases in the water surface elevation due to obstructions and other flow restrictions in the floodway. Accordingly, the base flood elevations were rounded up to the next foot prior to adding the required freeboard.

In accordance with the above requirements, the Design Flood Elevations used in this evaluation were 844.0 ft AMSL for the BJCJSTP site and 842.0 ft AMSL for the TPS. A comparison of the Design Flood Elevation to the existing building elevations is shown in Table 2-1. A comparison of the Design Flood Elevation to the existing process tank elevations is shown in Table 2-2.

2.5 Requirements for Maintenance of Operations during Flooding

The 10 States Standards for Wastewater Facilities, Section 51.2, requires that wastewater treatment facilities continue to operate and be accessible during the 25-year flood (4% annual chance flood). A review of the potential flood elevations given in the Broome County Flood Insurance Study indicate that the elevation of the Susquehanna River at the BJCJSTP due to the 25-year flood would be approximately 836.5 ft AMSL. There is no code requirement that wastewater pumping and treatment operations be maintained during the 100-year or 500-year flood events.

Based on a review of the existing structure elevations, it appears that most structures and process tanks are located at elevations above the 25-year flood elevation. However, the elevations of the effluent weirs in the Chlorine Contact Tanks as well as the effluent weirs in Primary Settling Tanks 7 thru 10 are below elevation 836.5 ft AMSL. Although flooding due to a 25-year flood event may result in the submergence of the weirs in the chlorine contact tanks and PSTs 7 thru 10, the process would continue to operate in this condition. A detailed hydraulic evaluation is required during the design phase to confirm that the existing tank structures would contain the processes without overflowing.

Continued operation of the treatment plant during extreme flooding events is not required and this Report does not assume that pumping station and/or plant operations are to be maintained during the 500-year flood event.

3.0 Evaluation Methodology

3.1 Review of Hazard Mitigation Plan prepared by C&S Engineers, 2007

A draft Hazard Mitigation Plan was prepared by C&S Engineers in February 2007. The 2007 C&S report identified several flood mitigation measures that could be implemented to protect the BJCJSTP from future flooding. For this 2012 report, the flood controls presented in the 2007 C&S report were reviewed and updated based on the 2011 flooding. This 2012 report also incorporates the evaluation of additional flood control measures for the protection and restoration of plant facilities as appropriate. This 2012 report also coordinates the flood mitigation evaluation with the proposed rehabilitation measures for the restoration of the BAF Complex.

The following flood control measures were evaluated:

- Flood barrier walls
- Waterproof existing structures
- Relocation of electrical panels
- Upgrade of equipment to include submersible motors
- Upgrade and install sump pumps
- Installation of emergency generators
- Sediment removal from Fuller Hollow Creek outlet

3.2 Conceptual Design of Flood Control Measures

The implementation of individual control measures may not be successful in controlling flooding because there are multiple pathways through which floodwaters could enter the plant structures. Several flood control measures may be required to create an effective flood barrier. In addition, the implementation of multiple flood control measures could improve the redundancy of the flood controls and increase the level of protection provided. The individual flood control measures were therefore combined to create a number of potential flood control projects with varying levels of protection and cost.

In order to evaluate each flood control project, each flood control measure was conceptually designed to outline a draft layout, preliminary equipment requirements and basic construction methodology to implement the alternative at the BJCJSTP and the TPS. The conceptual designs allowed for an approximation of the equipment and construction materials necessary as well as electrical needs and other auxiliary requirements. The specifications, details and installation requirements will be determined as part of the detailed design of the flood control measures and were not determined for this evaluation.

3.3 Evaluation Criteria

After developing the conceptual designs, each flood control project was then evaluated based on the following criteria: protection of plant facilities; compatibility with existing facilities including the restoration of the BAF Facility; reliability to prevent flood damage; and costs. The evaluation of the flood control measures is included in Sections 4 and 5 for the BJCJSTP and TPS, respectively.

3.4 Probable Construction and Project Costs

The opinions of probable construction costs for the individual flood control measures were combined to develop an opinion of probable construction cost for each potential flood control project. Project costs including project management, design and construction administration, legal and other administrative costs were incorporated to develop a total cost on which to compare the various flood projects. Land acquisition costs were not included in the project costs. The project costs are presented based on current (mid-2012 dollars) construction cost indices. The design, permitting and construction is unknown at this time and therefore a projection to the midpoint of construction cannot be made.

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4.0 Evaluation of Flood Control Projects

4.1 Flood Barrier Wall

4.1.1 Description - BJCJSTP

This alternative includes the construction of a flood barrier around the perimeter of the BJCJSTP site. This control measure was discussed in the 2007 C&S report in Section 8.

For levees/floodwalls constructed along rivers, FEMA and USACE guidelines typically require a minimum of 3 feet of freeboard above the predicted flood elevation to prevent overtopping and provide a factor of safety. Because the barrier elevation will be based on the 500-year flood elevation, a freeboard of 3 feet is assumed to be sufficient and the top of the floodwall would be elevation 847 ft AMSL for the 500-year flood. This elevation results in a barrier wall that would extend around approximately three-fourths of the site perimeter. Existing grades are higher at the southeast corner of the site and a barrier wall may not be needed in these areas. The approximate limits of the flood barrier wall are shown on Figure 4-1.

Common flood barrier construction materials include earthen embankments (levees), steel sheet pile walls, and reinforced concrete walls. Earthen barriers generally have lower capital construction costs compared to sheet pile or concrete walls but occupy a larger footprint for placement of the sloped soil embankments. There is limited available area around the perimeter of the site which would not support the construction of an earthen embankment. Sheet pile and concrete walls generally have smaller final footprints than earthen walls but require space and access during construction to drive the sheet piles or to form and place the concrete walls and footings. Sheet pile walls tend to be less expensive to construct than concrete walls and are assumed for the purposes of this evaluation.

The sheeting has not been designed for the site-specific soil conditions but it is assumed for cost calculation purposes that the ratio of buried sheeting to exposed sheeting would be 2:1. Along the north side of the site, the assumed elevation of bedrock would not permit the installation of the sheeting at the above ratio. Tiebacks, anchorages or some other type of bracing (e.g., king-pile system) are assumed to be required to maintain structurual stability in the wall. Architectural and/or landscaping treatments may be needed to reduce the visual impacts of the sheet pile walls, particularly along the site frontage on Old Vestal Road. COST TO CUT INTO BEDROCK WITH SHEETING ?

The anticipated amount of leakage through a sheet pile wall is less than an earthen embankment but more than a concrete wall. In addition, a review of the existing soils data (located in Appendix B) indicates that the underlying soils at the site consist of pervious sands and silts with a high groundwater table. These soils will tend to allow groundwater to be transported under the barrier wall due to the head differential, also known as "piping", resulting in a significant amount of water within the barrier wall that will have to be removed or otherwise mitigated.

Construction of a barrier wall is assumed to require additional measures within the barrier wall to capture and remove the "piped" water, such as site drains and a pumping system.

Watertight flood gates would be provided at the points of entry through the barrier into the BJCJSTP site. However, Old Vestal Road and the access drives at the eastern end of the BJCJSTP site are at higher elevations and may not be affected by flooding. These drives could potentially remain open during flooding to permit access to the plant facilities.

Construction of a barrier wall would require permit approval from the USACE to construct the barrier within the Susquehanna floodway. If the barrier wall is found to increase flood elevations elsewhere, mitigation measures may be required to obtain permit approval.

Approximately 2500 linear feet of barrier wall would be required. The total probable construction cost is approximately $9.8 million in May 2012 dollars. Including engineering, permitting, construction administration, project administration, legal fees and other project-related costs based on a factor of 25%, the calculated project costs are approximately $12.3 million. These costs are shown in Table 4-1A.

4.1.2 Description – Terminal Pumping Station

The design elevation of the top of the flood barrier wall at the TPS including the 3 feet of freeboard is assumed to be EL 845 ft AMSL. This would result in approximately a 10' high solid wall around the perimeter of the site. A steel sheet pile wall would not be an aesthetic solution and would require significant bracing to be structurally adequate. An earthen barrier would require the permanent acquisition of additional land due to the required height and side slopes. The barrier wall at the Terminal Pumping Station is therefore assumed to be of reinforced concrete construction for the purposes of this report.

Interior site drains and a pumping system are assumed to also be required at the TPS site. Watertight flood gates would be provided at the ends of the driveway to provide access. However, due to the height of the wall, these gates would be substantial in size and weight and electrical or hydraulic actuation would be required.

Approximately 525 linear feet of barrier wall would be required. The total probable construction cost is approximately $3.3 million in May 2012 dollars. Including engineering, permitting, construction administration, project administration, legal fees and other project-related costs based on a factor of 25%, the calculated project costs are approximately $4.1 million. These costs are shown in Table 4-1B. DOLLARS OF DAMAGES WILL NOT COVER THIS EVEN WITH DCA

4.2 Waterproof Existing Structures

4.2.1 Description - BJCJSTP

This alternative includes flood proofing the individual structures at the BJCJSTP to make them watertight. ASCE 7, Section 5.3.4.3 requires that the walls and other openings of structures located below the flood elevation shall be substantially impermeable to the passage of water in order to be considered watertight. Flood proofing would be accomplished through such measures as the installation of watertight doors, waterproofing concrete and masonry, and sealing and/or relocating penetrations for piping, conduit and ductwork. The extent of work at each structure depends on the level of exposure for each building and the extent of openings in the existing building envelope. A preliminary listing of the required heights and types of flood protection required at each individual building is shown in Table 4-1. This information is also shown overlaid on the site plan on Figure 4-2. This alternative was discussed in the 2007 C&S report under Section 7.

There are a number of watertight doors configurations that could be employed. The existing doors could be replaced with gasketed, watertight doors. Installation of these doors could be difficult in the existing door openings. One alternative would be the installation of bulkhead doors, which would be attached to the building over the existing doorway. These doors would remain open during non-flood conditions and could be closed when needed. Another alternative is to install slide gate frames at the existing door openings. The slide gates could be stored inside the building and could be inserted when needed.

Based on the existing building and potential flooding elevations, the required gate height varies from approximately 1 foot to approximately 6.5 feet. Large, watertight doors tend to be heavy and could be difficult to operate. Aluminum slide gates could be lighter, but larger gate heights would require hoists or actuators to operate.

Depending on the watertight door or gate configuration used, their installation could present egress issues due to the inability to open the door if sealed from the outside. Special egress doors or secondary escape routes may be required to provide safe egress from the buildings. These details would be resolved during design.

Penetrations in below grades for conduits, piping and other openings would be sealed. Abandoned conduits and penetrations would be plugged to prevent the intrusion of water. Cracks, failed expansion joints, and other sources of leaks in the existing foundation walls and slabs would also be sealed. The location and quantity of such repairs would be determined during design.

Flood proofing existing structures could result in increased lateral loads on the above-grade structures due to the hydrostatic pressure of the floodwaters on the building envelope. The additional lateral loads may require reinforcement of the existing structure. The details of any required reinforcement would be determined during design.

The total probable construction cost is approximately $3.4 million in May 2012 dollars. Including engineering, permitting, construction administration, project administration, legal fees and other project-related costs based on a factor of 25%, the calculated project costs are approximately $4.2 million. These costs are shown in Table 4-2A.

4.2.2 Description – Terminal Pumping Station

The implementation of this alternative at the Terminal Pumping Station would be similar to its implementation at the BJCJSTP.

The total probable construction cost is approximately $370,000 in May 2012 dollars. Including engineering, permitting, construction administration, project administration, legal fees and other project-related costs based on a factor of 25%, the calculated project costs are approximately $460,000. These costs are shown in Table 4-2B.

4.3 Relocation of Electrical Panels

4.3.1 Description - BJCJSTP

This flood control measures involves the relocation of electrical distribution equipment, motor control centers, variable frequency drives, control panels and other sensitive electrical components to locate them above the potential flooding elevations. In many instances, this would require construction of elevated platforms on which to locate and access the electrical equipment. The extent of work at each facility depends on the location of the existing electrical equipment relative to the design flood elevation, the quantity and nature of the electrical equipment and the degree to which the particular electrical components need to be protected. This alternative was discussed in the 2007 C&S report under Section 3.

Much of the damage sustained during the 2006 and 2011 was to electrical equipment which was not designed to be submerged but came into contact with floodwaters when they entered the various facilities. The 2007 C&S report concluded that the relocation of the electrical panels was not practical in most cases due to accessibility and worker safety concerns. The 2007 C&S report also concluded that many of the panels, even if they were relocated, would be susceptible to flood damage based on the configuration/elevation of the structure where they are located.

Relocating the panels to higher ground would not be a simple task in most instances. Electrical panels must be located within a reasonable proximity to the equipment being supplied and the majority of buildings do not have upper floors on which to install the equipment. Accordingly,

raised platforms would be required to support the electrical equipment at the higher elevation and to provide sufficient access for operations personnel and maintenance. Electrical codes prescribe certain minimum clearances around electrical equipment based on the rating and other features of the equipment. These minimum clearances could result in significant plan areas for the raised platforms which could restrict personnel accessibility and maintenance activities within the various facilities. In addition, plant operations would have to be maintained during construction and significant temporary facilities could be required to facilitate electrical panel relocation.

The total probable construction cost is approximately $3.9 million in May 2012 dollars. Including engineering, permitting, construction administration, project administration, legal fees and other project-related costs based on a factor of 25%, the calculated project costs are approximately $4.9 million. These costs are shown in Table 4-3A.

4.3.2 Description – Terminal Pumping Station

The motor control center and pump variable frequency drives are located at grade. The TPS structure consists of a single-story above grade and a higher elevation does not currently exist at which to relocate the motor control center and drives. The configuration of the building prevents the construction of a raised platform within the existing structure without significant modification, including raising the roof elevation and relocating the existing bridge crane to provide adequate clearance. Construction of a platform would also limit maneuverability within the pumping station and could impact pump removal and maintenance operations.

Alternatively, a new structure could be built adjacent to the existing pumping station building to house the motor control center and drives at the required elevation. Building a new structure offers several advantages:

1) Significant structural modifications to the existing structure may require costly structural upgrades to meet new seismic design requirements. The new structure could be seismically isolated from the existing and the structural modifications would not be necessary for the existing structure.
2) The electrical room should be climate controlled to protect the electrical equipment from humidity and temperature damage. It would be more cost-effective to construct and operate this system for a new electrical room than for the existing pumping station building.
3) There is limited space in the existing structure for the relocation of the electrical equipment and the new electrical equipment would likely have to be installed in the same location, requiring the installation and operation of temporary electrical equipment (e.g., temporary generators, breakers and drives) in order to demolish the existing and construct the new. The new structure and electrical system could be built offline from the existing operation and temporary service would only be required for a limited period of time in order to switchover the electrical service.

SUPPORTS MITIGATION AT TPS

For the above reasons, the relocation of the electrical equipment in the TPS is assumed to require the construction of a raised, climate-controlled structure adjacent to the existing building. The total probable construction cost is approximately $1.3 million in May 2012 dollars. Including engineering, permitting, construction administration, project administration, legal fees and other project-related costs based on a factor of 25%, the calculated project costs are approximately $1.6 million. These costs are shown in Table 4-3B.

4.4 Upgrade Equipment to Include Submersible Motors

4.4.1 Description - BJCJSTP

This flood control measure involves the replacement of motors on existing critical equipment with submersible motors to improve the resistance of the plant systems to flooding and decrease the amount of time required to restore treatment operations following a significant flood event.

The most critical pieces of equipment to maintaining operations are the main sewage pumps at the Head House and at the Terminal Pumping Station. The pumps and drives at both locations were replaced with submersible equipment following the 2006 flood.

This alternative would not prevent flood waters from entering the facilities and there would still be a significant cleanup effort once the flood waters recede. The wastewater treatment equipment, such as pumps and valves, would require thorough cleaning and lubrication to remove sediments from wearing parts before being returned to service.

The total probable construction cost is approximately $3.8 million in May 2012 dollars. Including engineering, permitting, construction administration, project administration, legal fees and other project-related costs based on a factor of 25%, the calculated project costs are approximately $4.8 million. These costs are shown in Table 4-4A.

4.4.2 Description – Terminal Pumping Station

As noted above, the main sewage pumps at the Terminal Pumping Station were replaced with submersible equipment following the 2006 flood. However, water did enter and damage the motors of the main sewage pumps at the Terminal Pumping Station during the 2011 flood. The exact reason for this is unclear but could be due to damaged mechanical seals on the pumps, loose caps on the terminal housings, open conduit ends on the pump power feeds, or similar. Regardless of the above failure, submersible motors can be an effective method of preventing damage to equipment in the event of flooding. The pump motors are being replaced as part of the flood damage rehabilitations.

The hydraulic power packs which operate the channel grinders on the pumping station influent were also submerged and damaged as a result of the flood. These power packs have been replaced and relocated to a higher elevation.

There is no additional action required at the TPS under this alternative.

4.5 Upgrade / Install Sump Pumps

4.5.1 Description - BJCJSTP

This flood control measure involves the installation or improvement of sump pumps in all buildings to discharge water that enters the building through the foundation or through openings in the above grade structure. The previous floods have resulted in substantial inundation of most of the plant's facilities. The installation of higher-capacity sump pumps would not be sufficient to maintain the structures without additional improvements at grade to prevent flood waters from entering the facilities. This alternative would be used in conjunction with other alternatives to provide additional protection for the plant's facilities.

At least one existing sump was located in each of the facilities with accessible below-grade structures. However, sump pumps are typically lower-gpm pumps (less than 100 gpm) to remove leakage from the interior of the structure. A flooding event, however, would generate far more water than a typical sump pump could discharge. This alternative would modify those existing sumps to increase the pumping capacity (assumed capacity of 700 gpm) and/or install new sumps to improve the discharge of water from within the structure. Upgrading existing sumps could include the installation of additional pumps and the addition of flood alarms. Installation of new sumps could require construction of drainage improvements within the structure. This alternative assumes the installation of emergency generators (life safety power only) to maintain the operation of the sump pumps in the event that the electrical utility service is lost.

The total probable construction cost is approximately $5.5 million in May 2012 dollars. Including engineering, permitting, construction administration, project administration, legal fees and other project-related costs based on a factor of 25%, the calculated project costs are approximately $6.9 million. These costs are shown in Table 4-5A.

4.5.2 Description – Terminal Pumping Station

The implementation of this alternative at the Terminal Pumping Station would be similar to its implementation at the BJCJSTP. The installation of emergency generators to maintain the operation of the sump pumps is also assumed for the Terminal Pumping Station under this alternative.

The total probable construction cost is approximately $1.0 million in May 2012 dollars. Including engineering, permitting, construction administration, project administration, legal fees and other project-related costs based on a factor of 25%, the calculated project costs are approximately $1.3 million. These costs are shown in Table 4-5B.

4.6 Installation of Emergency Generators

4.6.1 Description - BJCJSTP

This alternative involves the installation of backup generators to supply the plant with electrical power in the event of a power outage. The installation of emergency generators is not a flood control measure in itself; this alternative would be used in conjunction with other alternatives to provide additional reliability to permit the plant to operate certain or all of its equipment if power from the utility could not be provided. The emergency generators would include sufficient generation capacity, at a minimum, to operate essential facilities, including pumping stations, blower facilities, and the solids handling facilities. The connection of key equipment to the emergency generators would permit the plant to maintain operations in the event of power failures in the utility distribution system. There is limited emergency generation capacity onsite with a small generator located at the Sludge Control Building. The emergency generators would be diesel fueled with onsite storage assumed for 24 hours operation at full load.

Several emergency power generation scenarios were investigated:

1) Full plant backup, 4800V Generation: This scenario assumes the installation of medium-voltage generators and a medium-voltage generator paralleling switchgear. Power would be generated at 4800V and delivered to existing switchgear. The total probable construction cost for this scenario is approximately $6.1 million in May 2012 dollars. Including engineering, permitting, construction administration, project administration, legal fees and other project-related costs based on a factor of 25%, the calculated project costs are approximately $7.6 million. These costs are shown in Table 4-6A.

2) Full plant backup, 480V Generation: This scenario assumes the installation of low voltage generators, low-voltage generator paralleling gear, step-up transformers, and secondary medium-voltage breakers. In this scenario, power is generated at 480V and delivered to existing switchgear via step-up transformers. The total probable construction cost for this scenario is approximately $6.9 million in May 2012 dollars. Including engineering, permitting, construction administration, project administration, legal fees and other project-related costs based on a factor of 25%, the calculated project costs are approximately $8.6 million. These costs are shown in Table 4-6B.

3) Life Safety Power only, 480V generation: This scenario assumes sufficient emergency power generation capacity to operate essential safety systems only (lighting, sump pumps, ventilation, etc.). Emergency power would be generated at two locations on either side of the plant. Each location feeds half of the plant's life safety loads and the two systems would not be interconnected. The total probable construction cost for this scenario is approximately $1.5 million in May 2012 dollars. Including engineering, permitting, construction administration, project administration, legal fees and other

project-related costs based on a factor of 25%, the calculated project costs are approximately $1.8 million. These costs are shown in Table 4-6C.

4.6.2 Description – Terminal Pumping Station

The implementation of this alternative at the Terminal Pumping Station would be similar to its implementation at the BJCJSTP. At the Terminal Pumping Station, however, the only scenario investigated was to provide low-voltage generation for the full backup on the pumping station's electrical demand.

The total probable construction cost is approximately $0.9 million in May 2012 dollars. Including engineering, permitting, construction administration, project administration, legal fees and other project-related costs based on a factor of 25%, the calculated project costs are approximately $1.1 million. These costs are shown in Table 4-6D.

4.7 Sediment Removal from Fuller Hollow Creek Outlet

4.7.1 Description

This flood control measure includes the removal of deposition from the Susquehanna River at the outlet of Fuller Hollow Creek. There is a considerable amount of sedimentation and other deposits which extends into the main channel that would reduce the flow capacity of the Susquehanna River at this location resulting in higher upstream water surface elevations along the river. Removal of these sediments would increase flow capacities within the Susquehanna River and increase the discharge capacity of Fuller Hollow Creek thereby reducing upstream water surface elevations due to backwater effects. This alternative was discussed in the 2007 C&S report under Section 9.

There appears to be a significant amount of deposition at the Creek outlet. The 2007 C&S report noted that the depth of the sediment appeared to be upwards of 20 feet in some places with up to approximately 100,000 cubic yards of material to be removed in total.

Removal of the sediments would result in an increase in the flow capacity of the Fuller Hollow Creek stream channel and a reduction of the elevation of the stream profile. Removal of the sediments may also result in improvements to the flow regime in the Susquehanna River. However, the extent of these improvements cannot be determined without performing a detailed hydraulic analysis of the river system and the corresponding reductions in the stream profiles of the river and of Fuller Hollow Creek cannot be readily determined. There are several structures downstream of the BJCJSTP on the Susquehanna River – including the Route 210 Bridge and a dam structure – that restrict flow in the river and would limit the degree to which the water level could be reduced.

Removal of the sediments would require permit approval from the USACE to dredge the Susquehanna River. If the sediments are found to contain harmful or regulated materials, additional requirements and permits may be imposed on their removal and disposal.

Assuming the removal of 100,000 cubic yards of non-hazardous sediments (i.e., general C&D debris disposal), the total probable construction cost is approximately $7.9 million in May 2012 dollars. Including engineering, permitting, construction administration, project administration, legal fees and other project-related costs based on a factor of 25%, the calculated project costs are approximately $9.8 million. These costs are shown in Table 4-7.

5.0 Evaluation and Recommendations

5.1 Evaluation

Each flood mitigation alternatives was rated against the evaluation criteria as shown in Table 5-1 for the BJCJSTP and Table 5-2 for the TPS.

BJCJSTP

As a result of this screening process, three alternatives were identified for further consideration at the BJCJSTP: construction of the flood barrier wall; waterproofing existing structures; and an alternative consisting of the combination of the alternatives to relocate electrical equipment and install submersible pump/equipment motors.

The flood barrier wall offers the highest level of protection and reliability but also comes at the highest cost. This alternative protects all the buildings and process tanks from inundation by flood waters. Access to plant facilities could be maintained throughout the flood event. And the drives from Old Vestal Road on the southeast end of the plant would not need to be blocked during flooding and access to the plant could be maintained. Also, the flood barrier wall does not require action by the plant personnel to prepare the facility for a flood event, other than closing the gates on the driveways entering at the northeast end of the plant.

Waterproofing the existing structures offers a higher level of protection than the remaining alternatives but has a lower reliability due to the number of flood control gates required. These gates would need to be stored when not in use and installed in the event a flood occurs. There is a significant time component associated with this as each gate and stop log must be installed by hand. In addition, a lost or damaged gate would not provide any protection at all and other measures would be required for each such instance. Access to the individual structures would be restricted once the gates and stop logs were installed and it is therefore necessary to install the gates after other flood preparations are made to the plant's facilities. Plant personnel indicate that water levels in the river rose rapidly during the previous flooding. This alternative is less reliable as it carries additional risk that the flood protections would not be in place when required. This was indicated to be a significant concern by BJCJSTP personnel. The plant facilities would not be accessible during flooding.

The combined alternative of relocating electrical equipment and installing submersible motors results in a higher level of protection to the equipment than each alternative offers alone. However, the combined alternative would not prevent flood waters from entering the individual facilities and there would still be a significant cleanup effort to remove sediment from inside the buildings and from the equipment following a flood event. This was indicated to be a significant concern by BJCJSTP personnel. Equipment such as instrumentation, valves, actuators and other

similar equipment and devices, including in the BAF pipe galleries, would not be made submersible and would require maintenance and/or replacement following a flood event. The plant facilities would not be accessible during flooding.

Terminal Pumping Station

At the TPS, the screening analysis resulted in two alternatives being retained for further consideration: construction of a flood barrier wall; and an alternative consisting of the combination the relocation of the electrical panels and the waterproofing of the existing structure alternatives.

The flood barrier offers the highest level of protection and reliability but comes at the highest cost. This alternative protects the entire TPS site from inundation by flood waters. However, Gates Road adjacent to the TPS would be flooded and modifications to the site to raise the elevation of the site entrance from Gates Road could be required to make the site accessible during flooding.

Waterproofing the existing structure also offers a higher level of protection but the station would be vulnerable if flooding occurs from within the station due to the influent. Combining this alternative with the relocation of the electrical panels would provide additional protection and would enable the station to operate following flooding. The pumping station would not be accessible during flooding.

5.2 Recommended Improvements – BJCJSTP

Based on the above evaluation, the recommended alternative for protecting the BJCJSTP from future floods is to construct a flood barrier wall. This alternative offers the plant facilities the most protection from floodwaters. As noted in Section 4, this alternative has a probable total construction cost of approximately $9.8 million and a probable total project cost of approximately $12.3 million in May 2012 dollars. The project costs are comparable to the cost to repair the damage caused by the 2011 flood.

None of the alternatives reviewed provide for the continued operation of the plant facilities during the 500-year flood event. Under existing conditions, when flood waters reach the elevation of the existing outfall structures, the flap gates are forced closed and plant flow is no longer discharged. Influent flow must be isolated at this point to prevent the facilities from being overrun. The flood barrier wall alternative does not alter this scenario.

The City of Binghamton has determined that the design and construction of the flood mitigation improvements would be a separate project from the work to restore the BAF Facilities and the remainder of the BJCJSTP. Although the flood barrier wall will be a distinct project, it is recommended that the design and construction of the site drainage pumping improvements be

incorporated into the plant restoration project. This is so that the utility requirements and placement can be better coordinated.

5.3 Recommended Improvements – Terminal Pumping Station

Based on the above evaluation, the recommended alternative for protecting the Terminal Pumping Station is to relocate the electrical equipment to a new structure built above the flood elevation. It is also recommended that the project to construct the new electrical room structure include the work under the watertight structures alternative. The installation of stop gates at the doorways to the existing Terminal Pumping Station structure and the sealing of existing penetrations would limit the entry of floodwaters into the building improving cleanup efforts following a flood. It is also likely that the operation of the station could be continued during a flood but additional improvements may be necessary due to operations-related considerations such as the access and safety of maintenance personnel to operate the station during a flood. These details need to be evaluated during design. The combined probable total construction cost of these alternatives is approximately $2.5 million and the probable total project cost is approximately $3.2 million in May 2012 dollars.

Binghamton - Johnson City Joint Sewage Treatment Plant
Flood Mitigation Report
Table 2-1: Design Flood Elevation Analysis - Buildings

	100-Year Flood Basis	500-Year Flood Basis
Base Flood Elevation	840	843
Freeboard	1	1
Design Flood Elevation	841	844

Building Name	Ground Floor Elevation	Lowest Floor Elevation	Flood Protection Required (Y/N)	Height of Flood Protection (ft)	Flood Protection Required (Y/N)	Height of Flood Protection (ft)	Interconnected Below Grade to Adjacent Buildings? (Yes / No)	Connected Building	Elevation of Connection
C Filter Complex	840.00	825.00	Y	1.0	Y	4.0	Yes	Backwash Pumping Station	825.00
Backwash Pumping Station / Fine Screenings Bldg	840.00	825.00	Y	1.0	Y	4.0	Yes	C Filter Complex	825.00
							Yes	N Filter Complex	825.00
N Filter Complex	N/A	818.15	N	N/A	N	N/A	Yes	Backwash Pumping Station	825.00
							Yes	Secondary Influent PS	818.34
Secondary Influent Pumping Station	841.80	818.34	N	N/A	Y	2.2	Yes	Blower Building (Old)	826.60
							Yes	N Filter Complex	818.34
DN Filter Complex	847.00	824.40	N	N/A	N	N/A			
Blower Building (New)	839.00	N/A	Y	2.0	Y	5.0			
Head House	845.0	805	N	N/A	N	N/A			
Grit Building	841.0	N/A	N	N/A	Y	3.0			
Grit Washing House 1	845.0	834.0	N	N/A	N	N/A			
Grit Washing House 2	845.0	834.0	N	N/A	N	N/A			
Blower Building (Old)	843.0	830.0	N	N/A	Y	1.0	Yes	Secondary Influent PS	826.60
Primary Sludge Pumping Station 1	840.5	826.75	Y	0.5	Y	3.5			
Primary Sludge Pumping Station 2	837.5	818.75	Y	3.5	Y	6.5			
Scrubber Building	837.4	N/A	Y	3.6	Y	6.6			
East Scrubber Building	840.2	N/A	Y	0.8	Y	3.8			
Chlorination Building	838.7	N/A	Y	2.3	Y	5.3			
Sludge Thickener Pumping Station 1	840.15	825.0	Y	0.9	Y	3.9			
Sludge Thickener Pumping Station 2	841.0	822.5	N	N/A	Y	3.0			
Sludge Control Building 1	840.0	823.5	Y	1.0	Y	4.0			
Sludge Control Building 2	840.0	823.5	Y	1.0	Y	4.0			
Compost Facility	839.7	N/A	Y	1.3	Y	4.3			
Scum Pumping Station	840.5	832.0	Y	0.5	Y	3.5			
Terminal Pumping Station (see Note below)	836.0	799.75	Y	2.5	Y	5.5			

Note: The Design Flood Elevations for the Terminal Pumping Station are EL 839 for the 100-year flood and EL 842 for the 500-year flood.

Binghamton - Johnson City Joint Sewage Treatment Plant
Flood Mitigation Report
Table 2-2: Design Flood Elevation Analysis - Process Tanks

	25-Year Flood Basis	100-Year Flood Basis	500-Year Flood Basis
Design Flood Elevation	836.5	840	843
Freeboard	1	1	1
Building Opening Flood Protection Elevation	837.5	841	844

Process Tank / Structure Name	Top of Tank/Structure Elevation	Notes	Flood Protection Required (Y/N)	Height of Flood Protection (ft)	Flood Protection Required (Y/N)	Height of Flood Protection (ft)	Flood Protection Required (Y/N)	Height of Flood Protection (ft)
Chlorine Contact Tank 1	841.0	Bypass Gate to CL2 Tank 2 at EL 835.50	N	N/A	N	N/A	Y	3.0
	838.5	Overflow Weir at EL 838.50, Discharge to Grade	N	N/A	Y	2.5	Y	5.5
Chlorine Contact Tank 2	840.5		N	N/A	Y	0.5	Y	3.5
Chlorine Contact Tank 3	840.5	Weir EL 832.60	N	N/A	Y	0.5	Y	3.5
Primary Settling Tanks 1 - 6	840.5	Effluent Weirs EL 839.0	N	N/A	Y	0.5	Y	3.5
PST 1-6 Effluent Channel			N/A	N/A	N/A	N/A	N/A	N/A
Primary Settling Tanks 7 - 10	837.5	Effluent Weirs EL 835.83	N	N/A	Y	3.5	Y	6.5
PST 7-10 Effluent Channel			N/A	N/A	N/A	N/A	N/A	N/A
Parhsall Flume 1	845.0		N	N/A	N	N/A	N	N/A
Parshall Flume 2	845.0		N	N/A	N	N/A	N	N/A
Grit Chamber 1	845.0		N	N/A	N	N/A	N	N/A
Grit Chamber 2	845.0		N	N/A	N	N/A	N	N/A
PST Distribution Box 1			N/A	N/A	N/A	N/A	N/A	N/A
PST Distribution Box 2	839.00		N	N/A	Y	2.0	Y	5.0
C Filter Cells	857.50		N	N/A	N	N/A	N	N/A
N Filter Cells	843.50	Effluent Weir EL 841.60	N	N/A	N	N/A	Y	0.5
DN Filter Cells	847.00	Effluent Weir EL 844.85	N	N/A	N	N/A	N	N/A
Backwash Waste Tank	843.50	Overflow at EL 840.0 to PST 7-10 Influent Channel	N	N/A	N	N/A	Y	0.5
DN Clearwell	841.75	Overflow at EL 839.0 to CL2 Contact Tank 1 Inf Channel	N	N/A	N	N/A	Y	2.3
Backwash Supply Box	841.75	Weir to Clearwell Influent Channel at EL 837.50	N	N/A	N	N/A	Y	2.3
Sludge Thickener 1	842.0		N	N/A	N	N/A	Y	2.0
Sludge Thickener 2 and 3	842.0		N	N/A	N	N/A	Y	2.0

FLOOD MITIGATION PLAN
Binghamton-Johnson City Joint Sewage Treatment Plant
Vestal, New York

Flood Mitigation Costs
Table 4-3A: Relocate Electrical Panels Above Flood Zone - BJCJSTP

Date: May 21, 2012

Item	Subitem	Description	Quantity	Units	Unit Cost	Subitem Cost	Item Cost
1		Sludge Control Building					
	a	Electrical Equipment	1	LS	$ 35,000	$ 35,000	
	b	Installation, Wiring and Testing	1	LS	$ 35,000	$ 35,000	
	c	Temporary Electric for Switchover	1	LS	$ 25,000	$ 25,000	
	d	Structural Work - Raised Platforms	1	LS	$ 25,000	$ 25,000	
		Item 1 Subtotal					$ 120,000
2		Sludge Thickener PS 1 and 2					
	a	Electrical Equipment	1	LS	$ 20,000	$ 20,000	
	b	Installation, Wiring and Testing	1	LS	$ 20,000	$ 20,000	
	c	Temporary Electric for Switchover	1	LS	$ 20,000	$ 20,000	
	d	Construct Raised Electrical Enclosure	2	EA	$ 60,000	$ 120,000	
		Item 2 Subtotal					$ 180,000
3		East Scrubber Building					
	a	Electrical Equipment	1	LS	$ 15,000	$ 15,000	
	b	Installation, Wiring and Testing	1	LS	$ 15,000	$ 15,000	
	c	Temporary Electric for Switchover	1	LS	$ 10,000	$ 10,000	
	d	Structural Work - Raised Platforms	1	LS	$ 15,000	$ 15,000	
		Item 3 Subtotal					$ 55,000
4		Head House					
	a	Electrical Equipment	1	LS	$ 40,000	$ 40,000	
	b	Installation, Wiring and Testing	1	LS	$ 40,000	$ 40,000	
	c	Temporary Electric for Switchover	1	LS	$ 100,000	$ 100,000	
	d	Construct Raised Platforms	1	LS	$ 75,000	$ 75,000	
		Item 4 Subtotal					$ 255,000
5		West Primary Sludge PS					
	a	Electrical Equipment	1	LS	$ 226,000	$ 226,000	
	b	Installation, Wiring and Testing	1	LS	$ 226,000	$ 226,000	
	c	Temporary Electric for Switchover	1	LS	$ 100,000	$ 100,000	
	d	Construct Raised Platforms	1	LS	$ 125,000	$ 125,000	
		Item 5 Subtotal					$ 677,000
6		Blower Building - New					
	a	Electrical Equipment	1	LS	$ 286,000	$ 286,000	
	b	Installation, Wiring and Testing	1	LS	$ 286,000	$ 286,000	
	c	Temporary Electric for Switchover	1	LS	$ -	$ -	
	d	Construct Raised Electrical Enclosure	1	LS	$ 150,000	$ 150,000	
		Item 6 Subtotal					$ 722,000
7		Blower Building - Old					
	a	Electrical Equipment	1	LS	$ 57,000	$ 57,000	
	b	Installation, Wiring and Testing	1	LS	$ 57,000	$ 57,000	
	c	Temporary Electric for Switchover	1	LS	$ 100,000	$ 100,000	
	d	Construct Raised Platform	1	LS	$ 50,000	$ 50,000	
		Item 7 Subtotal					$ 264,000
8		Miscellaneous Plantwide Electrical Improvements					
	a	Electrical Equipment	1	LS	$ 100,000	$ 100,000	
	b	Installation, Wiring and Testing	1	LS	$ 100,000	$ 100,000	
	c	Temporary Electric for Switchover	1	LS	$ 25,000	$ 25,000	
	d	Construct Raised Platform	1	LS	$ 25,000	$ 25,000	
		Item 8 Subtotal					$ 250,000

Direct Costs Subtotal	$ 2,273,000
Contingency (+30%)	$ 682,000
Total Direct Costs	$ 2,955,000
Mobilization (+10%)	$ 296,000
Construction Costs Subtotal	$ 3,251,000
Contractor's Overhead and Profit (+20%)	$ 650,000
TOTAL CONSTRUCTION COSTS (May 2012 dollars)	$ 3,901,000
Engineering, Permitting, Construction Management, Project Administration, Legal Fees (+25%)	$ 976,000
TOTAL PROJECT COSTS (May 2012 dollars)	$ 4,877,000

Assumptions
1. Direct and Construction Costs rounded to the nearest $1000.

ENR Construction Cost Factors
ENR CC - May 2012 9290

FLOOD MITIGATION PLAN
Binghamton-Johnson City Joint Sewage Treatment Plant
Vestal, New York

Flood Mitigation Costs
Table 4-1A: Flood Barrier Wall Construction - BJCJSTP

Date: May 21, 2012

Item	Subitem	Description	Quantity	Units	Unit Cost	Subitem Cost	Item Cost
1		Flood Barrier Wall					
	a	Steel Sheet Pile Flood Wall (Depth Varies)	1225	LF	$ 1,800	$ 2,205,000	
	b	Steel Sheet Pile Flood Wall, Braced (Depth Varies)	1275	LS	$ 2,200	$ 2,805,000	
	c	Site Work	1	LS	$ 50,000	$ 50,000	
	d					$ -	
		Item 1 Subtotal					$ 5,060,000
2		Site Drains and Pumping System					
	a	Collection Piping, 8"	2000	LF	$ 125	$ 250,000	
	b	Pumping Stations	2	EA	$ 100,000	$ 200,000	
	c	Discharge Piping, 6"	200	LF	$ 100	$ 20,000	
	d	Site Work	1	LS	$ 50,000	$ 50,000	
		Item 2 Subtotal					$ 520,000
3		Flood Gates at Driveway Entrances					
	a	Sliding Flood Gates	2	EA	$ 50,000	$ 100,000	
	b	Structural Work	1	LS	$ 25,000	$ 25,000	
	c	Site Work	1	LS	$ 10,000	$ 10,000	
	d					$ -	
		Item 3 Subtotal					$ 135,000
4							
	a					$ -	
	b					$ -	
	c					$ -	
	d					$ -	
		Item 4 Subtotal					$ -

Direct Costs Subtotal	$ 5,715,000
Contingency (+30%)	$ 1,715,000
Total Direct Costs	$ 7,430,000
Mobilization (+10%)	$ 743,000
Construction Costs Subtotal	$ 8,173,000
Contractor's Overhead and Profit (+20%)	$ 1,635,000
TOTAL CONSTRUCTION COSTS (May 2012 dollars)	$ 9,808,000
Engineering, Permitting, Construction Management, Project Administration, Legal Fees (+25%)	$ 2,452,000
TOTAL PROJECT COSTS (May 2012 dollars)	$ 12,260,000

Assumptions
1. Direct and Construction Costs rounded to the nearest $1000.

ENR Construction Cost Factors
ENR CCI - May 2012 9290