HDR | ONE COMPANY *Many Solutions*℠

Final Preliminary Engineering Report

To: David Pergrin, Harford County Division of Water & Sewer Chris Skaggs, Northeast Maryland Waste Disposal Authority	
From: Scott Davis/Wiliam Lai, HDR	Project: Pumping of Reclaimed Water from Joppatowne WWTP to the NMWDA Waste to Energy Facility
CC:	
Date: June 27, 2008	Job No: 147-67242

RE: Pumping of Reclaimed Water from Joppatowne Wastewater Treatment Plant to the NMWDA Waste to Energy Facility Preliminary Engineering Report

EXECUTIVE SUMMARY

In June 2007, HDR was hired by the Northeast Maryland Waste Disposal Authority (NMWDA) and the Harford County Department of Public Works to evaluate the feasibility of pumping treated effluent from the Joppatowne wastewater treatment plant (WWTP) to the proposed expanded Harford County Waste to Energy (WTE) facility. The proposed WTE facility requires a source of water for cooling towers, ash quenching, and general utility water. Re-use of WWTP effluent to contribute to this need would be beneficial to the NMWDA and the County for several reasons:

- The use of treated effluent for cooling tower water makeup will save the County from having to provide high quantities of potable water to the WTE;
- The discharge from the Joppatowne WWTP enters into Chesapeake Bay. Less effluent into the Bay will reduce nutrient disposal that impacts water quality in the Bay;
- The sustainability of using WWTP effluent at the WTE presents an ideal opportunity to improve the environment while saving valuable resources at a relatively low cost to the County.

HDR has submitted five technical memorandums evaluating the feasibility of reusing WWTP effluent and addressing force main routing and effluent pump station alternatives. This report summarizes and details the findings of the technical memorandums.

Effluent Reuse Design Criteria:

- The WWTP produces on average 0.8 to 1.0 MGD of treated effluent. Using daily influent flow data from August 2005 through February 2007, a peak 7-day average flow of 1.2 MGD (833 gpm) was determined and will be used for sizing the pump station and force main.
- To maintain adequate velocity at this flow rate, a 10-inch HDPE force main is recommended. However, the County wishes to also consider a 12-inch diameter force main. It should be noted that the detailed design of the effluent reuse system shall include pump sizing, including pump curves and manufacturer's cut sheets, and costs to accommodate the larger diameter pipe.
- Subsequent to the evaluation of the design criteria for the effluent reuse system, it was noted that a new pump station within the County has the potential to deliver up to 200,000 gpd of additional flow to the Joppatowne WWTP. However, the design criteria of 1.2 MGD for the pump station and a 10-inch or 12-inch force main will be able to accommodate this additional flow.
- Based on the elevation difference between the WWTP and WTE, and the friction loss in a 10-inch force main approximately 3-1/2 miles long, it is estimated that a pump with a motor sized between 50 hp to 100 hp will be required in the effluent reuse pump station, depending on the type of pump and pump efficiency. A 50 hp vertical turbine pump was selected.
- Review of the WWTP effluent shows a consistent effluent that is relatively clean, which is expected in a largely residential collection area. The effluent pH, nitrate, TSS, and alkalinity are within the requirements of the WTE.
- The WWTP may be upgraded to meet Enhanced Nutrient Removal (ENR) requirements, which will include a new denitrification filter. The Total Nitrogen and TSS concentrations could decrease, while pH could increase slightly. Total Nitrogen is anticipated to be less the 4 mg/L-N.

Force Main Routing:

- A scoring matrix was compiled to compare the environmental, community, and operations impact and constructability of potential force main routes. Based on results of the scoring matrix, preliminary construction cost estimate, and County preferences, two routes were determined to be the most feasible for the force main.
- One of these routes lies primarily within County-owned utility easements; the other route lies largely within street rights-of-way. These two routes were evaluated in greater depth, with plan and profiles developed for each route, photos taken along the routes, and property research performed on the parcels and easements used by the routes.

- The final selected route is largely within utility easements, minimizing the length of construction along roads, which increases the ease of pipe installation and lessens the impact on traffic. Part of the route will require installing the main in an easement occupied by Baltimore Gas & Electric overhead power lines. The main will have to be jack and bored under the railroad to the WTE. Figure E-1 shows both routes and the modified route, with the selected route shown in red.
- Construction in Forest Interior Dwelling Species (FIDS) areas should not be disturbed during April through August, which is the breeding season for most FIDS. For areas with early nesting FIDS such as Barred Owl present, the seasonal restriction may be expanded to February through August.
- There may be minor changes to the final force main routing pending acquisition of easements.

Pump Station Conceptual Design:

- Based on the WWTP flow and the distance and terrain between the WWTP and WTE, the effluent reuse pump station will be sized to transfer 850 gpm at a total head of 165 ft. The total dynamic head will be dependent on the diameter of the force main selected by the County during detailed design.
- Based on the County pump station requirements, the station will be designed as a duplex system with variable frequency drives. After considering different pump types, a vertical turbine pump was selected to be designed at this pump station, due to its motor efficiency.
- Electrical inspection of the WWTP was conducted. Based on that inspection, the pump station will be designed with a new dedicated electric service separate from the WWTP electrical distribution system, which will allow direct measurement of electricity used by the pump station. An emergency generator will be provided for backup power to the pump station.
- Three pump station alternatives were reviewed. A new packaged pump station situated in the northwest corner of the site is selected as the best alternative based on cost and lowest impact to the WWTP operations and future ENR upgrades. The wet well will be below grade, with the pumps and controls located above grade in a pre-engineered building. The wet well will have an overflow line that discharges to the outfall in times of high flow. The pump station will be designed to include a sodium hypochlorite storage system, which will be required to provide residual chlorine if the WWTP is upgraded with UV disinfection. Residual chlorine will be required if UV is installed to prevent microbial re-growth in the wet well, force main, or WTE storage tank. Figure E-2 shows the location of the pump station within the WWTP site and the force main route out of the facility.

- New piping and valving work between the existing chlorine contact tank, the new effluent reuse pump station, and the WWTP outfall is shown on Figure E-2. The system must be designed to ensure the flow path has no short circuiting or backflow conditions. The detailed design of the pump station must include a hydraulic profile of the chlorine contact tank through the effluent flow meter chamber.

It is noted that beyond the selection of force main route and pump station design, there are other issues that must be addressed during the preliminary and final design. These issues include:

- Acquisition of an easement from Oldecastle Precast for the portion of the force main route east of Magnolia Road;
- Approval from Amtrak for the railroad crossing;
- Approval from AT&T for crossing their utility corridor parallel to the railroad tracks.
- Acquiring all permits shown in Table 5-1;
- Stormwater treatment at the WWTP since the pump station will be located in the existing stormwater management area in the northwest corner of the site. In addition, the proposed ENR upgrades could require modifications to the stormwater management system;
- Instrumentation and control;

The conceptual opinion of probable cost for the selected options is presented in 2008 dollars. The force main installation is estimated to be $4,030,000, which does not include land acquisition or easement costs or permits for the Amtrak rail crossing. The Amtrak crossing will have an initial fee plus an annual license fee, which can be paid in lump sum. The pump station installation, including retrofit of the chlorine contact tank, is estimated to be $2,500,000. Total project cost is then $6,530,000.

1. OBJECTIVE

The proposed Harford County Waste to Energy (WTE) facility will require utility water for various uses within the facility. One of the main uses for this water is for cooling tower water makeup, for which the facility may need upwards of 1.4 mgd to process 1,500 tons per day of municipal solid waste. This preliminary engineering report (PER) reviews the feasibility of re-using effluent from the Joppatowne wastewater treatment plant (WWTP) as cooling water make up for the proposed WTE. The reuse of this effluent would be beneficial to NMWDA for several reasons:

- The use of treated effluent for cooling water makeup will save the County from having to provide potable water to the WTE;
- The discharge from the Joppatowne WWTP enters into Chesapeake Bay. Less effluent into the Bay will reduce the amount of nutrients that impact water quality in the Bay.
- The sustainability of using WWTP effluent at the WTE presents an ideal opportunity to improve the environment while saving valuable resources at a relatively low cost to the County.

This PER presents the information gathered and findings from five (5) technical memorandums (TM) submitted to the County during the course of the project, attached as Appendices 1 through 5, and incorporates comments received from the County.

- TM No. 1, the effluent from the WWTP was evaluated based on flow rate and water quality, with force main and pump sizing presented as a result of the analysis.
- TM Nos. 2 and 3 presented the screening criteria established to evaluate numerous potential force main routes from the WWTP to the WTE, the result of which were the two best route options for additional review.
- TM No. 4 reviewed potential pump type and arrangement and pump station locations at the WWTP;
- TM No. 5 evaluates and analyzes the two force main route options in greater detail to select the final force main route.

This report presents final sizing of the force main and pump station based on anticipated plant flow and pump sizing, a final recommended force main route from the WWTP to the WTE, and a final effluent pump station location at the WWTP.

The WWTP is located off of Joppatowne Road in the northwestern part of Joppatowne. Adjacent to the WWTP site is a post office and shopping complex. The proposed WTE will be located adjacent to the existing WTE within the Harford County WTE property area, which is located within the Aberdeen Proving Ground military base. An aerial plan of the WWTP site is shown in Figure 1-1. Photographs of the WWTP are shown in Attachment A of TM 4.

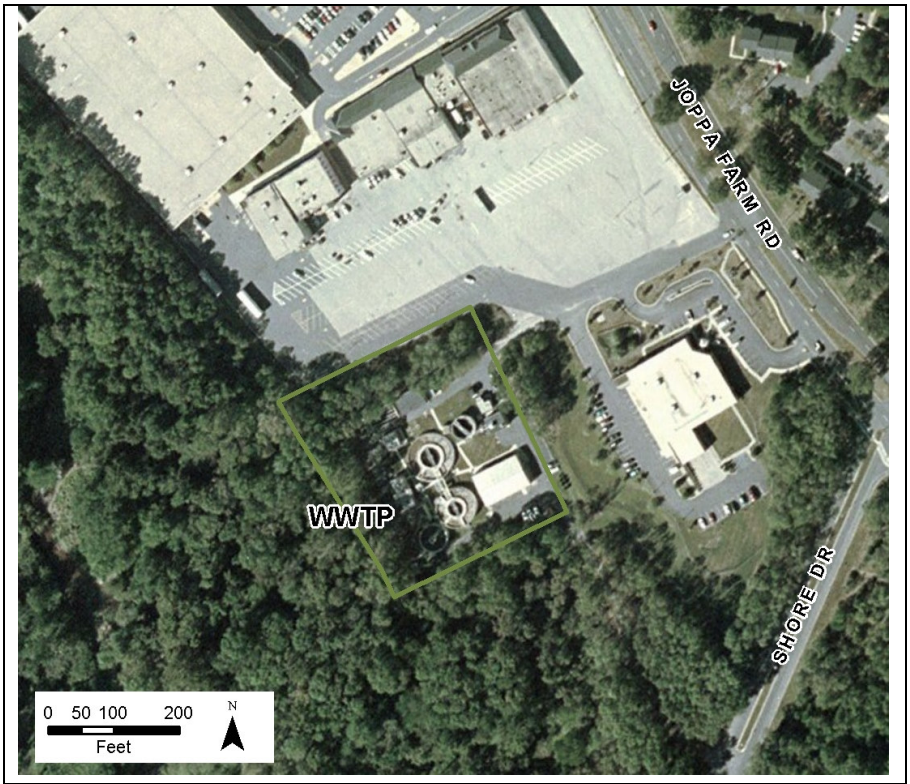


Figure 1-1: Aerial photograph of the WWTP site

2. WWTP EFFLUENT FLOW

2.1. Historical WWTP Data

Historical WWTP influent and effluent flow data was used to determine average effluent flow from the WWTP, which is required to properly size the force main and pump station. This data is shown in Figure 2-1. The WWTP has a rated capacity of 0.95 MGD and flow averages 0.8 to 1.0 MGD. Daily peaks over 2.0 MGD were observed during storm events, although since 2006 the peak day flow was less than 1.7 MGD. Flows below 0.5 MGD were observed when portions of the influent flow were diverted to the Sod Run WWTP.

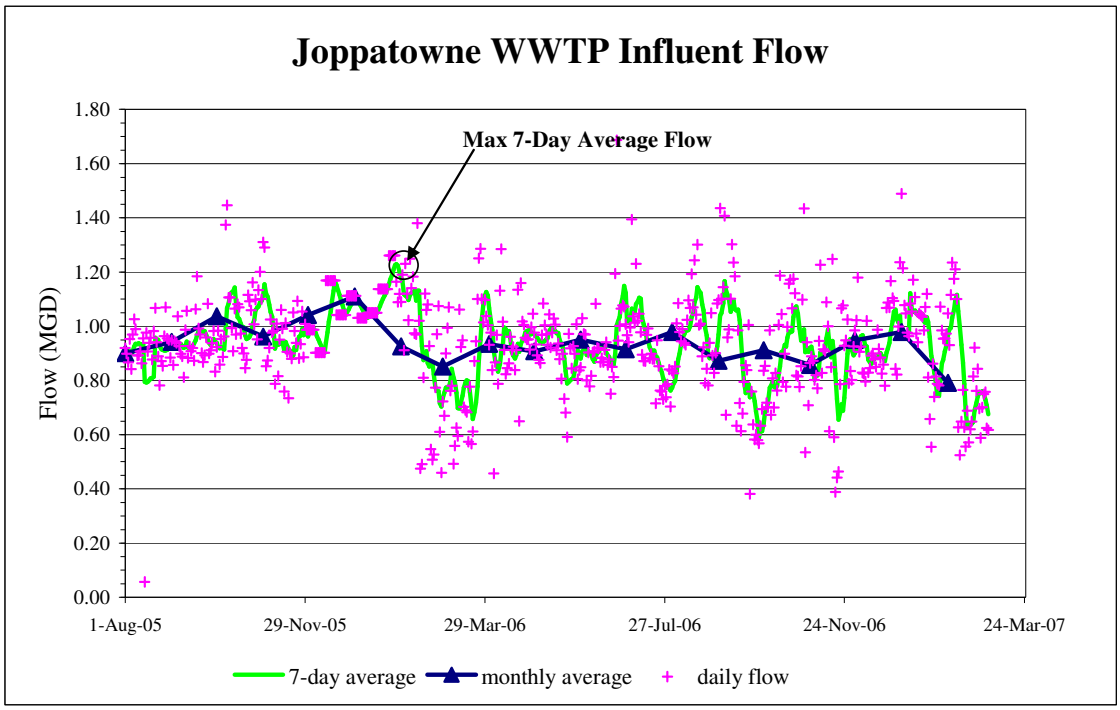
2.2. Flow Summary for Pump Station and Force Main Sizing

Since there is no standard for determining the flow capacity of the effluent reuse system, a reasonable criteria needed to be established where a majority of the WWTP effluent could be reused without sizing the system for a peak flow that may be a very rare occurrence and would poorly serve average and low flow conditions. After analyzing and assessing the data, a maximum seven day average flow was determined to be the best criteria for sizing the effluent

reuse system. This flow is equal to 1.2 MGD, or approximately 833 gpm. Figure 2-1 displays the daily flow data, monthly average, and seven day average. Based on this design flow:

- To remain within the Harford County guidelines of 3 to 6 ft/sec for velocity in force mains, a 10-inch diameter HDPE pipe is recommended. At the anticipated flow of 833 gpm, the velocity will be 3.4 ft/sec in a 10-inch diameter pipe. Velocities lower than 3.6 ft/sec would be anticipated at low flow periods since the pumps will be on variable frequency drives (VFDs). The analysis used to determine the plant flow for sizing force main is presented in Technical Memorandum #1 (Appendix 1).
- HDPE is recommended due to its ease of installation, lower roughness coefficient, and lower cost. As noted above, a 10-inch pipe is recommended to maintain the required velocity.

Figure 2-1: Joppatowne WWTP Influent Flow



A 10-inch pipe may be considered an uncommon size for fittings and valves that may not be readily available via local distributors. However, HDPE fittings, valves and pipe lengths can be fabricated to keep a spare parts inventory for use if the force main is compromised. Increasing the pipe to 12-inch diameter, which is a more common pipe size, would result in a lower velocity (only 2.4 ft/sec at 833 gpm) that is below the Harford County guidelines. A lower velocity would allow for the potential of solids settling in the pipe. In addition, increasing the force main to 12-

inch diameter will result in a decrease in total head of approximately 50 ft, which would result in the selected pump operating at a lower efficiency at the rated horsepower. HDR has not reviewed alternate pumps at the 12-inch diameter operating point and recommends using a 10-inch diameter pipe and keeping required spare parts in stock. The detailed design should include pump sizing, pump curves, and costs for a 12" force main, which is preferred by the County.

It should be noted that the County indicated that a new pump station is being brought online that could increase flow to the Joppatowne WWTP by 200,000 gpd. However, the criteria for the effluent reuse pumps and force main will be capable for handling this additional flow.

2.3. WTE Influent Requirements and Sampling Data

The new WTE facility will likely have a water treatment operation designed to ensure that the cooling water meets a high quality level that exceeds the WWTP regulatory effluent limitations. However, the water quality of the Joppatowne WWTP effluent should be reviewed with the understanding that poor water quality would make the effluent an uneconomical choice for WTE use. Ideal water quality requirements for a similar WTE facility include a pH between 5.0 and 8.3 (ideally 7.0 to 7.3), phosphate less than 65 mg/L, and chlorine less than 0.3 mg/L. In addition, dissolved metals can lead to corrosion and scaling can be formed from dissolved minerals such as calcium and magnesium.

Water quality information from WWTP historical effluent sampling data is shown in Table 2-1 and additional sampling results are shown in Table 2-2. The following is noted:

- The WWTP effluent meets the WTE pH requirements and has low to moderate alkalinity and hardness, which should not require substantial pre-treatment to prevent scaling.
- The effluent nitrate is below 1.5 mg/L and will likely concentrate in the WTE cooling tower blowdown.
- Total suspended solids (TSS) average less than 4 mg/L and total dissolved solids, which includes any dissolved metals or minerals, average 283 mg/L.

Table 2-1: Historical Monthly Average Effluent Water Quality

Parameter	Unit	Average Month	Max Month Average
TSS	mg/L	3.3	6.9
BOD	mg/L	6.6	11.4
Total Phosphorus	mg/L	0.7	1.4
Ortho-phosphorus	mg/L	0.4	1.1
TKN	mg/L	3.1	9.2
Ammonia as N	mg/L	1.3	5.6
Nitrate and Nitrite as N	mg/L	3.4	10.1
Organic Nitrogen	mg/L	2.0	5.7
Total Nitrogen	mg/L	6.6	11.9
Fecal Coliform	MPN	6	36
Alkalinity	mg/L	81	118

Table 2-2: Requested Sample Analysis - Joppatowne WWTP Effluent Grab Samples Nov. 2007

Parameter	Unit	Average	Max
Ammonia as N	mg/L	0.20	0.36
Alkalinity	mg/L	81	92
Chloride	mg/L	77	90
Hardness	mg/L	79	84
Ortho-phosphorus	mg/L	0.8	1.3
Conductivity	uS/cm	482	495
Sulfate	mg/L	34.4	37.5
TDS	mg/L	283	302
Turbidity	NTU	1.3	2.7
pH		7.1	7.5

Detailed sampling data can be seen in Technical Memorandum #4 (Appendix 4).

The WWTP may be undergoing an upgrade to meet Enhanced Nutrient Removal (ENR) requirements, which would include addition of a denitrification filter. The upgrade would result in effluent with lower Total Nitrogen, likely less than 4 mg/L, lower TSS, and higher pH.

3. FORCE MAIN ROUTING

3.1. Route Screening

The Joppatowne WWTP and the WTE are situated approximately 3.5 miles apart on opposite ends of Joppatowne. The determination of the best, most feasible force main route from the WWTP to the WTE requires dividing the region into four sub-regions and determining the optimum routes through each sub-region. These routes were then combined to create two alternatives for routing the force main from the WWTP to the WTE.

A scoring matrix was developed to eliminate the highest impact routes. Categories used in the matrix include:

- Operations Impact;
- Community Impact;
- Environmental Impact;
- Constructability; and
- Land Acquisition.

Each category had potential impact factors, such as length through wetlands or length through 100-yr flood plains, that were scored. These scores were multiplied by a weighting factor, which represents the level of importance of the impact factor. The scores for each ranking factor were totalized, with the highest score indicating the best route.

Table 3-1 shows the categories and the scoring for the two highest scoring routes from the initial screening, which are shown in Figure 3-1. The relative cost presented below is not an actual construction cost but was generated to compare the various routes. The two more feasible routes are described as follow:

- Alternative 1 – Easement route: Utilizes the BG&E utility easement to Foster Branch, then follows Trimble Road and Fort Hoyle Road to the Magnolia Middle School property. The route then uses the County-owned Magnolia Middle School property to Magnolia Road and then follows sewer easements through the property east of Magnolia Road to get to the proposed WTE.
- Alternative 2 – ROW (Right of Way): Utilizes County ROW in roads and follows Joppa Farm Road and Fort Hoyle Road to the Amtrak crossing into Aberdeen Proving Grounds to reach the WTE.

Table 3-1: Comparison of Alternatives 1 and 2 from Initial Screening Matrix

Route	*Operations*	*Community*	*Environmental*	*Constructability*	*Land Availability*	*Total Score*	*Relative Cost*
Alternative 1	30	261	468	501	56	1316	$2,085,000
Alternative 2	30	231	479	455	66	1261	$2,441,250

3.2. Final Route Assessment

3.2.1. In Depth Review of Alternatives 1 and 2

The two routes presented to the County are shown in Figure 3-1. Within the WWTP, both routes follow the northern perimeter fence east to the chemical delivery access gate, which is off of Joppa Farm Road. The main entrance to the treatment plant, located off of Shore Drive, has fewer buried pipes to cross and a wider corridor to route the force main to, however this easement is being traded for a new easement and will not be available for the force main. Appendix B in TM 5 contains photographs along the Alternative 1 - Easement route, including all intersections. Appendix C in TM 5 contains photographs along the Alternative 2 - ROW route. Note the photographs in Appendices B and C of TM 5 show the force main exiting along Shore Drive as the route revision to the Joppa Farm Road exit was not required when the walk through was performed. The routes were modified slightly from the routes presented in TM #3 based on the detailed site inspection of each route.

For Alternative 1 - Easement, which totals approximately 21,350 ft (4.05 miles), the force main follows the route outlined below, with approximate mile marker at the end of the section noted:

- Leaves the WWTP via the northern access road (0.08 miles);
- Goes east on Joppa Farm Road (0.3 miles);
- Turns northeast on Barksdale (0.4 miles);
- Goes east through the BG&E easement to Garnett Road (1.7 miles);
- Goes north on Garnett road to Trimble Road to connect route 1A-3 with route 2-1 (1.9 miles);
- Crosses Foster Branch on Trimble Road (2.0 miles);
- Travels east on Trimble Road (2.45 miles);
- South on Fort Hoyle Road to Magnolia Middle School (2.9 miles);
- East through the southern portion of the Magnolia Middle School property to Magnolia Road (3.55 miles);
- Crosses Magnolia Road and follows the new sewer line east through the woods (3.75 miles);
- Turns south at the sewer easement's turn to the north and proceeds to the rail crossing and WTE (4.05 miles).

For Alternative 2 - ROW, which totals approximately 18,450 ft (3.5 miles), the force main will follow the route described below:

- Leaves the WWTP via the northern access road (0.08 miles);
- Goes east on Joppa Farm Road to the end at Haverhill Road, crossing Foster Branch along the way (2.3 miles);
- Goes east through Hackley's Reserve to Fort Hoyle Road (2.55 miles);
- South on Fort Hoyle Road (2.95 miles);
- Crosses the railroad at the access gate on Fort Hoyle Road (3.0 miles);
- Runs east parallel to the rail tracks to the WTE (3.5 miles).

The two routes, Alternatives 1 and 2, were compared using the same impacts as above with additional input from walking each route. In addition, a probable cost estimate was prepared for each option. Land ownership issues were researched and elevation profiles were prepared for each route alternative. The detailed scoring and rankings can be seen in TM 5 and a summarized in Table 3-2 below.

Table 3-2: Detailed Comparison of Alternatives 1 and 2

		Alternative 1	*Alternative 2*	
Maintenance Access	ft	2,000	2,000	Even
Business	ft	1,000	1,000	Even
Schools	ft	450	450	Even
Residential	ft	19,500	18,000	Even – Alt 1 is through backyards in easement
Intersections	number	12	21	Alt 1
Truck Route	ft	0	2,000	Alt 1
Chesapeake Bay Critical Area	ft	2,785	5,585	Alt 1 (although Alt 2 is largely paved)
Wetlands and Vernal Pools	ft	910	2,150	Alt 2
100-yr Flood Plain	ft	2,000	2,000	Even
Minor Stream Crossings	number	3	4	Alt 1
Sensitive Species	ft	0	0	Even
FIDS	ft	1,600	0	Alt 2
Tree Clearing	ac	1.05	1.15	Even – Hackley's Reserve will likely be cleared during force main construction
Construction Duration	weeks	23	24	Even
Foster Branch Crossing	ft	200	320	Even – Direct bury at each location
Amtrak Crossing	ft	200	200	Alt 1 – Large elevation difference for Alt 2
Length on Roads	ft	7,900	16,050	Alt 1
Easement Acquisition	ft	1,000	1,400	Alt 2 (should be able to use new easement in Hackley's Reserve)
Probable Construction Cost (2008)		$4,118,100	$4,418,000	Alt 1

Although the cost and scores were very similar for both routes, Alternative 1 was initially deemed to be the most feasible force main route.

3.2.2. Modification of Recommended Route with County Comments

Subsequent reviews of the alternatives and discussions with the County were held to further improve on the final force main route. There were three alternatives, or suggestions, to the Alternative 1 route that were considered.

The first suggestion was to follow Foster Knoll Road south to the utility easement, then route east to Hackley's Reserve. Initial review of this portion of the utility easement shows it to be privately-owned open space. Detailed investigation of the ownership and access/usage rights has not been performed as this segment of the utility corridor was not used in Alternatives 1 and 2,

which received the more in depth analysis in Technical Memorandum #5. Further investigation of this option would require land ownership and allowable access and usage.

The second suggestion was to route the force main south on Magnolia Road, rather than follow the new sewer easement east of Magnolia Road, and hang the force main under the Amtrak overpass. In the County's experience, it will likely take 2 to 3 years of negotiating to get approval to hang the force main under the overpass and only 1 year for a perpendicular crossing under the tracks. Therefore, routing south along Magnolia Road was not reviewed in this PER.

The third suggestion was to route Alternative 1 south on Haverhill Road, from the intersection with Trimble Road, to Joppa Farm Road, at which point the route will turn east through Hackley's Reserve, as shown in Figure 3-2. The key issue with the proposed route modification is to minimize the length of the route on the roads, especially Trimble Road and Fort Hoyle Road, which are narrow, high traffic roads with significant underground utilities already in place. The modified Alternative 1 route exits Hackley's Reserve on Fort Hoyle Road and rejoins the original Alternative 1 route. Note that although Alternative 1 in Technical Memorandum #5 is routed through the new forest area, the revised Alternative 1 route is close to the Middle School and can be seen in Figure 3-3 below. The new forest area was found during the in depth walk through of Alternative 1, however the route was not modified as it was felt the forest could be restored. Upon review with the County, it was determined that the route should bypass the new forest area.

Figure 3-3: Looking west towards Fort Hoyle Road at alternate route through Magnolia Middle School property.

This proposed modification to Alternative 1 was scored and a probable construction cost generated in order to compare to the original Alternatives 1 and 2. The cost is about $4,030,000, which is actually slightly less than the Alternative 1 cost shown in Table 3-2 due to the shorter length of route through paved areas. Table 3-3 compares Alternative 1 and the modified route.

Table 3-3: Detailed Comparison of Alternatives 1 and 2

		Alternative 1	*Modified Alternative 1*	
Residential	ft	19,500	18,100	Modified
Intersections	number	12	11	Modified
Wetlands and Vernal Pools	ft	910	1,790	Alt 1 (Modified higher due to high water table soils in Hackley's Reserve and on Haverhill)
Minor Stream Crossings	number	3	5	Alt 1 (Stream in Hackley's Reserve)
Tree Clearing	ac	1.05	1.51	Even – Hackley's Reserve will likely be cleared during force main construction
Length on Roads	ft	7,900	6,250	Modified
Easement Acquisition	ft	1,000	2,400	Even (should be able to use new easement in Hackley's Reserve)
Probable Construction Cost (2008)		$4,118,100	$4,023,800	Modified

3.3. Final Route

The final, modified route combines portions of Alternatives 1 and 2 from Technical Memorandum #5 and is shown in Figure 3-4. The modified route has a probable construction cost of $4,030,000 and compares favorably to the original Alternative 1.

Based on this analysis, the modified route, as shown in attached Figure 3-4, is the final recommended route. The modified route is shown going through the Magnolia Middle School property just south of the Middle School due to the presence of a newly planted forest area that can not be disturbed along the southern property line.

Total construction cost of the 4.05 mile route from the WWTP to the WTE was estimated to be $4.03 million in 2008 dollars. The key outstanding issue with this route is the cost and ability to purchase an easement through the southern portion of the Oldcastle Precast property east of Magnolia Road. This cost is not included in the cost estimate provided above. The final force main route may be modified slightly pending acquisition of the required easements.

Construction in Forest Interior Dwelling Species (FIDS) areas would not be allowed during April through August, which is the breeding season for most FIDS. For areas with early nesting FIDS such as Barred Owl present, the seasonal restriction may be expanded to February through August.

4. PUMP STATION DESIGN ALTERNATIVES

4.1. Pump Design

As noted in Section 2 of this report, the effluent reuse system will be designed to transfer a maximum of 1.2 MGD, or approximately 850 gpm, from the WWTP to the proposed WTE. The force main will be 10-inch diameter HDPE. Based on the length of the main and the elevation difference between the WWTP grade and the WTE grade, the total dynamic head calculated is 165 feet, which assumes the WTE will have an aboveground storage tank. With this information, a pump type can be selected considering pump operation, efficiency, maintenance, and cost.

Three different pump styles were considered, each having favorable and less favorable facets that allow for an assessment on the best pump for this pump station.

- A vertical turbine pump, with its pump bowl immersed in the well and its motor mounted above the pump at the operating level, at grade, could be installed over a new wet well. A pump that could operate under this hydraulic condition is a 7-stage, 12DKH by Weir Floway, with a 50 hp motor, 8-inch column, and 12-inch discharge at the head. The discharge head and motor is approximately 5 feet tall, from base plate to top of motor. This is the most efficient pump, since the pump is not designed to pass a solid. The material cost for this duplex pump system would be $49,000, in 2008 dollars. Vertical turbine pumps have a high efficiency, which leads to a lower horsepower and energy costs. The pump will require a hoist and ceiling hatch for removal from the wet well.
- A vacuum primed pump system, with its pump and motor at grade and a suction line in to the wet well, can be installed over a new wet well. Under this alternative, the Smith and Loveless (S&L) pump that would operate under the above flow characteristics is an 8D4V, with a 100hp motor, 8-inch suction, and 8-inch discharge. The cost for this duplex pump system would be $77,000 in 2008 dollars. Vacuum primed pumps have lower efficiency and higher energy costs.
- A submersible pump, with its motor and pump submerged in the wet well, could be used in almost any arrangement. A pump that would meet the hydraulic characteristics mentioned above would be an AFP 1002 pump by ABS. This pump would have an 84.5 hp motor, with 4-inch discharge line. The pump and motor are about 5 feet tall, and about 20 inches wide. The cost for this pump would be $66,000, in 2008 dollars.

Submersible pumps are commonly used for similar applications, however they have a low efficiency and high energy costs, as seen by the higher horsepower required. The size of the submersible pumps would likely require a hoist for removal.

Based on an assessment of the various pump design options, the vertical turbine pump was determined to be the best pump for the effluent reuse pump station, due to the efficiency of the pump and the low solids in the effluent flow.

4.2. Pump Station Conceptual Design

The effluent reuse pump station design is based operation and maintenance reliability and ease; cost of installation and maintenance; impact to the WWTP operation and maintenance; and future WWTP upgrades. After reviewing the WWTP treatment process and discussions with the County, it was agreed that the pump station must meet the following criteria:

- A new electric service will be required to feed the new pump station. The new electrical switchgear and motor control panel will be placed in and dedicated to the new pump station. The existing WWTP electrical system does not have available capacity to add the pump station without upgrade or significant interlocks.
- Emergency power will be needed to maintain pump station operation during a power outage. The generator will be mounted in an outdoor enclosure adjacent to the pump station.
- Instrumentation and telemetry will be required to monitor the operation of the pump station and record the amount of effluent transported to the WTE.
- The electrical equipment, VFDs, and controls will be housed in the new pump station control building to facilitate operation and maintenance.
- Ability for the chlorine contact tank effluent to flow by gravity to the pump station. The design should not require the effluent flow to be pumped twice and, if at all possible, should not have valving.
- Achieving the chlorine contact time requirement of 30 minutes at peak flow, even if the reused effluent is not going to the outfall, since overflow from the pump station to the outfall must have the required chlorine contact time.
- The treated effluent/stored water should flow by gravity to the outfall in the event of high flow, when either the WTE tank is at a high level and doesn't require cooling water or the flow into the pump station wet well is greater than the pump capacity.
- The new pump station must not adversely impact future ENR design, even though the plans for ENR are only conceptual. The County anticipates that denitrification filters will be installed west of the utility water building, so this area is not available for a new pump station. Discussions with County personnel indicate that ultraviolet disinfection is being considered to replace chlorination. The pump station options will consider this possible

upgrade as well, including where the effluent sample point would be and how to handle possible bacteria growth in the pump station since there is no residual chlorine present with UV disinfection. The pump station will include space for a liquid sodium hypochlorite storage and delivery system to provide residual chlorine after the UV disinfection.

Three pump station options met these criteria. The three options are described as follows:

- Alternative No. 1 – Retrofitting the existing chlorine/utility water building. The building has a sub-grade 19,300 gallon tank under its operating floor that currently serves to detain the process flow for chlorine contact time and provides dechlorination. The upper portion of the building provides storage for the gaseous chlorine and sulfur dioxide plus out-of-service utility water pumps.
- Alternative No. 2 – New pre-engineered pump station. A pre-engineered, pre-packaged pump station could be installed to accept flow downstream of the chlorine contact tank in the northwest corner of the site.
- Alternative No. 3 – Wet well established inside the chlorine contact tank.

All three options require increasing the height of the chlorine contact tank walls to provide the required 30 minute contact time.

The selection and scoring process is detailed in Technical Memorandum #4 (Appendix 4). The recommended option is installing a new pump station and wet well in the northwest corner of the site, which is currently used for stormwater management. This location allows for direct flow by gravity to the wet well, with an overflow that discharges to the existing chlorine contact tank under the utility water building. Dechlorination would be performed in the existing chlorine contact tank prior to exiting in the outfall.

The retrofit of the chlorine contact/utility water building was close in score, although this was only due to the environmental impact of putting the new wet well/pump station in the stormwater management area, which is adjacent to wetlands and near the 100-yr flood plain. The cost was higher for this alternative and the constructability was considerably more difficult given the retrofit work required in the utility water building. The County indicated that use of the chlorine contact/utility water building should be avoided if possible to allow for demolition or re-use of the building at a future date.

4.3. Final Pump Station Recommendation

The recommended alternative in TM #4 requires use of the utility water building for dechlorination of overflow from the new wet well. By routing the wet well effluent to a new

metering manhole located on the outfall pipe, the utility water building would be bypassed. The new metering manhole would contain a Parshall flume or weir and ultrasonic level gauge to determine effluent flow to the outfall. Dechlorination could be accomplished at the exit of the new wet well by installation of a small mixing chamber prior to the overflow to the outfall.

There is also a possibility that the plant will convert to UV disinfection. If UV disinfection is installed, there will be no residual to prevent microbial growth. Therefore, the pump station must be sized to allow space for a sodium hypochlorite tote, delivery pumps, and controls to add hypochlorite to the WTE feed.

Figure 4-1, attached, shows the revised pump station location and force main route out of the WWTP, including the new meter pit and the enlarged pump station area to accommodate the future hypochlorite system. The detailed design shall include a hydraulic profile from the modified chlorine contact tank downstream to the effluent flow meter chamber. The recommended electrical option is a new dedicated service to the pump station.

Total opinion of probable cost of the Pre-Fabricated Pump Station was estimated to be approximately 2.5 million in 2008 dollars. This estimate includes a base budget cost from a pre-fabricated pump station vendor, as well as other mechanical, electrical, structural, instrumentation, and site improvement items and tasks not included in the budget price from the vendor. General conditions were assumed to be 10% of contract price, while overhead and profit were assumed to be 15% each. Additionally, due to the conceptual nature of the estimate, a 50% contingency was added to the estimate. A complete breakdown of tasks and items can be found attached.

5. SUMMARY

The effluent pump station is rated for 1.2 MGD (approximately 850 gpm). Two redundant vertical turbine pumps capable of pumping 850 gpm at 156-ft TDH are recommended. The pumps will be controlled by variable frequency drives, with one pump in operation and one standby.

A new pump station and wet well will be constructed in the northwest portion of the WWTP in the current stormwater treatment area. The pump station will be sized to include a future hypochlorite tote to provide residual chlorine if UV disinfection is installed at the WWTP. In order to maintain adequate contact time in the chlorine contact tank, the walls of the tank will have to be raised 1'-8". Overflow from the wet well will receive dechlorination then will flow through a new meter pit for flow measurement prior to the outfall. The pump station will have

new, dedicated electrical service and an emergency generator. A new stormwater management area will be required since the existing space will be used for the new pump station. The estimated cost of the pumping facility portion of the project is approximately $2,500,000.

The recommended route for the 10-inch HDPE force main is as follows:

- Leaves the WWTP via the northern access road;
- Goes east on Joppa Farm Road;
- Turns northeast on Barksdale;
- Goes east through the BG&E easement to Garnett Road;
- Goes north on Garnett road to Trimble Road;
- Crosses Foster Branch on Trimble Road;
- Travels east on Trimble Road;
- Turns south onto Haverhill Road;
- Turns east at the intersection with Joppa Farm Road and travels through Hackley's Reserve to Fort Hoyle Road;
- Crosses Fort Hoyle Road and goes east through the Magnolia Middle School property, just south of the school building, to Magnolia Road;
- Crosses Magnolia Road and follows the new sewer line east through the woods;
- Turns south at the sewer easement's turn to the north and proceeds to the rail crossing and WTE, requiring a new easement from the property owner, Oldcastle Precast.

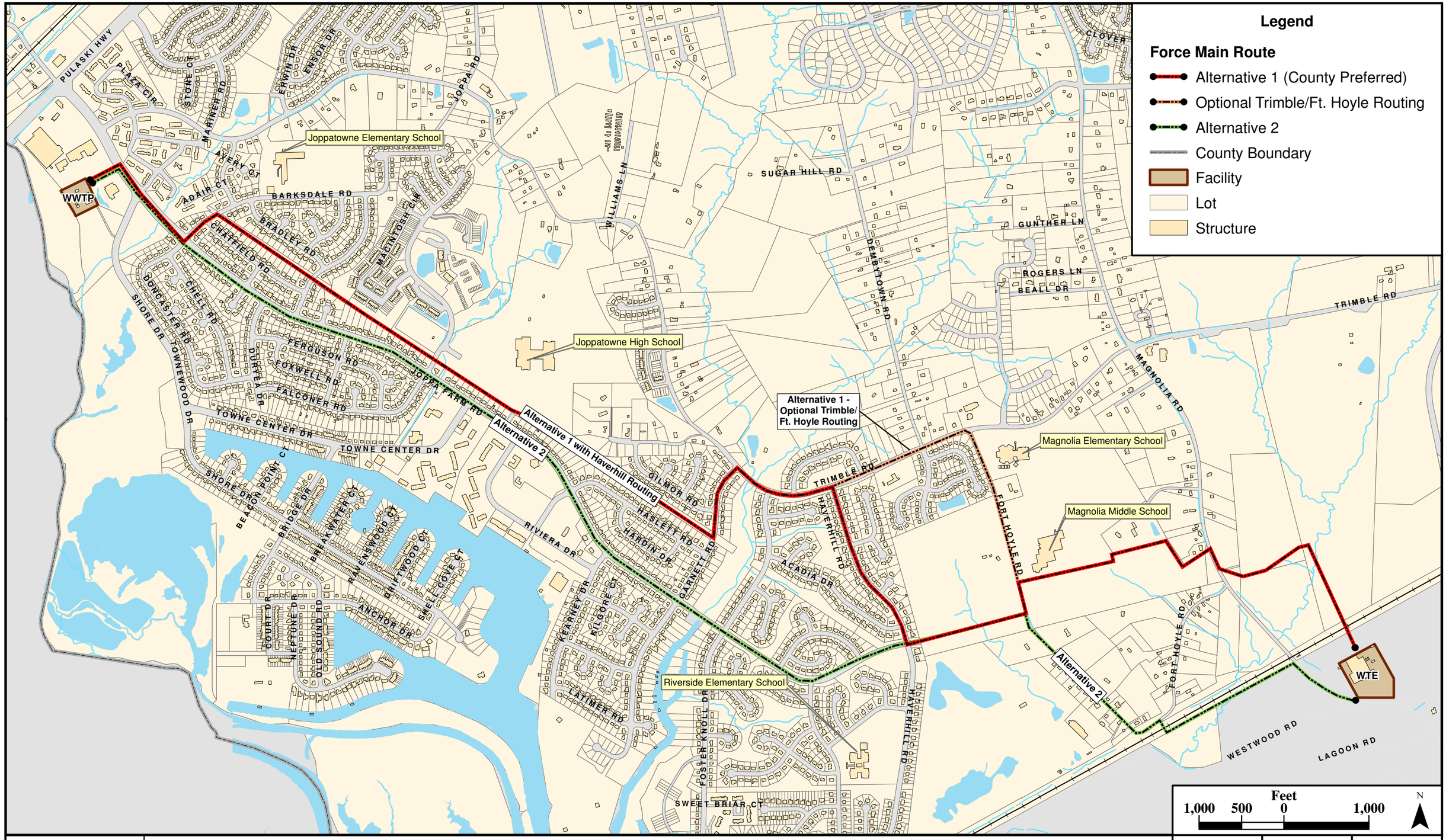
This route largely utilizes the BG&E utility easement and minimizes the route length along roads. The main issue to be resolved is acquisition of an easement through the southern portion of the Oldcastle Precast property. In addition, the route out of the WWTP can not be finalized until the County clarifies ownership of easements along the northern property line and determines if the new shopping plaza encroached on the County property. This force main alignment portion of the project is estimated to cost approximately $4,030,000.

Total project cost is estimated to be $6,530,000 in 2006 dollars.

There are numerous permits required to complete this project. These permits include, but are not limited to, those shown in Table 5-1.

Table 5-1: Required Permits

Agency	*Permit Type*	*Permit Name*	*Purpose*	*Typical Agency Processing Time (days)*
Amtrak	Crossing	Crossing	Amtrak must approve all crossings of their rail lines. Crossing must meet the requirements of Amtrak specification 02081A	~365
AT&T	Crossing	Crossing	AT&T must approve all crossings of their utility corridors	~365
USACE	Section 10 RHA, Section 404 CWA	Individual Permit	Individual permit for fill or disturbance in wetlands and waters greater than 0.5 acre MDSPGP-3 threshold	~300
MDE	COMAR 26.23, Section 401WQC; CZC	Non-tidal wetlands and waterways permit (individual)	Protect state water quality; includes 25' buffer	~300
USACE/MDE	Section 402, CWA	NPDES General Permit For Stormwater Discharge from Construction Activity	Control pollution generated from construction activities	2
MDE	Water & Sewerage Construction Permit	Major Project permit	Ensure that infrastructure projects throughout the State are designed on sound engineering principles and comply with State design guidelines to protect water quality and public health.	90
MDNR	COMAR 08.19.04, Forest Protection Act	Forest Conservation Plan	Protect forest lands and water quality	~30
Harford County	Building Permit	Building Permit	Assure compliance with planning and zoning laws	14
Harford County	Chesapeake Bay Critical Area Program	Critical Area Buffer disturbance	Protect water quality in the Chesapeake Bay watershed including 1000' buffer zone; also protect sensitive species, including FIDS	14
Harford County	Chesapeake Bay Critical Area Program	Natural Resource District	Protect streams, wetlands, steep slopes, etc. including 75'-150' buffer zone	14

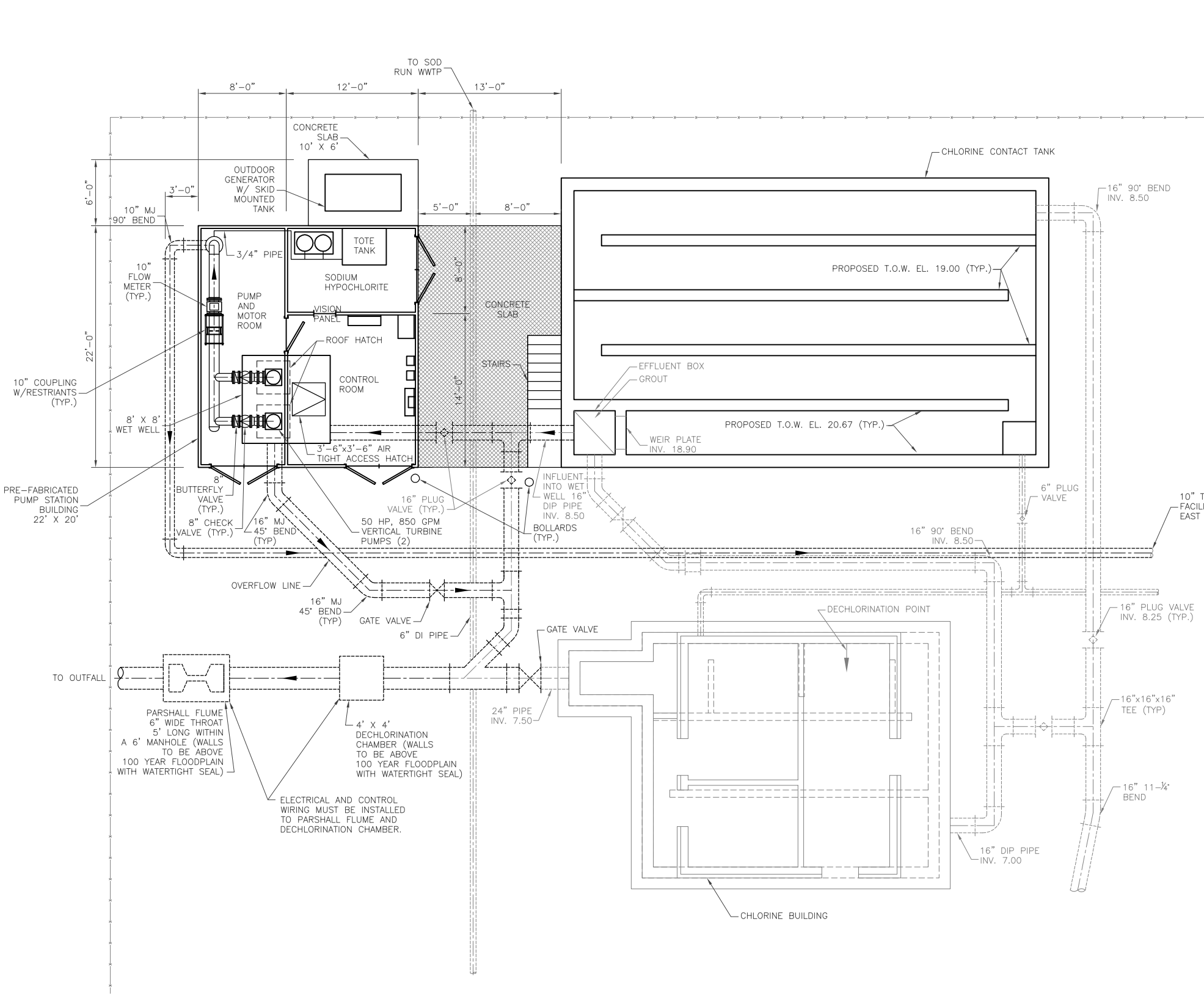


HDR

NORTHEAST MARYLAND WASTE DISPOSAL AUTHORITY
PRELIMINARY ENGINEERING REPORT - PUMPING OF RECLAIMED WATER TO WTE FACILITY, JOPPATOWNE, MD
FINAL ROUTE OPTION COMPARISON

Job No.	Date	Figure No.
0067642	4/16/08	E-1

\\Prl-srv2\Projects\001978_NORTHEAST MARYLAND WASTE DISPOSAL AUTH\0067242_NMWDA-JM-JOPPATOWNE WWTP EFFLU\GIS\map_docs\mxd\PER\FigE-1_RouteComparison.mxd



NOTES:

1. THE INFORMATION ON THIS DRAWING IS CREATED FROM A 1997 AS-BUILT CREATED BY STEARNS & WHELER.

2. THE WORK FOR THIS ALTERNATIVE INCLUDES BUT IS NOT LIMITED TO THE FOLLOWING:

A) SITE WORK FOR INSTALLATION OF A 22'-0" X 20'-0" PRE-FABRICATED BUILDING.

B) MODIFICATIONS TO STORMWATER MANAGEMENT SYSTEM.

C) SEPARATE PURCHASE OF PUMPS, VALVES, ELECTRICAL EQUIPMENT AND INSTRUMENTATION CONTROLS.

D) CHLORINE CONTACT TANK WALL TO BE RAISED 1'-8" TO ACHIEVE 30-MIN CONTACT REQUIREMENTS.

E) CONSTRUCTION OF A 10'-0" X 6'-0" CONCRETE SLAB FOR PUMP STATION GENERATOR.

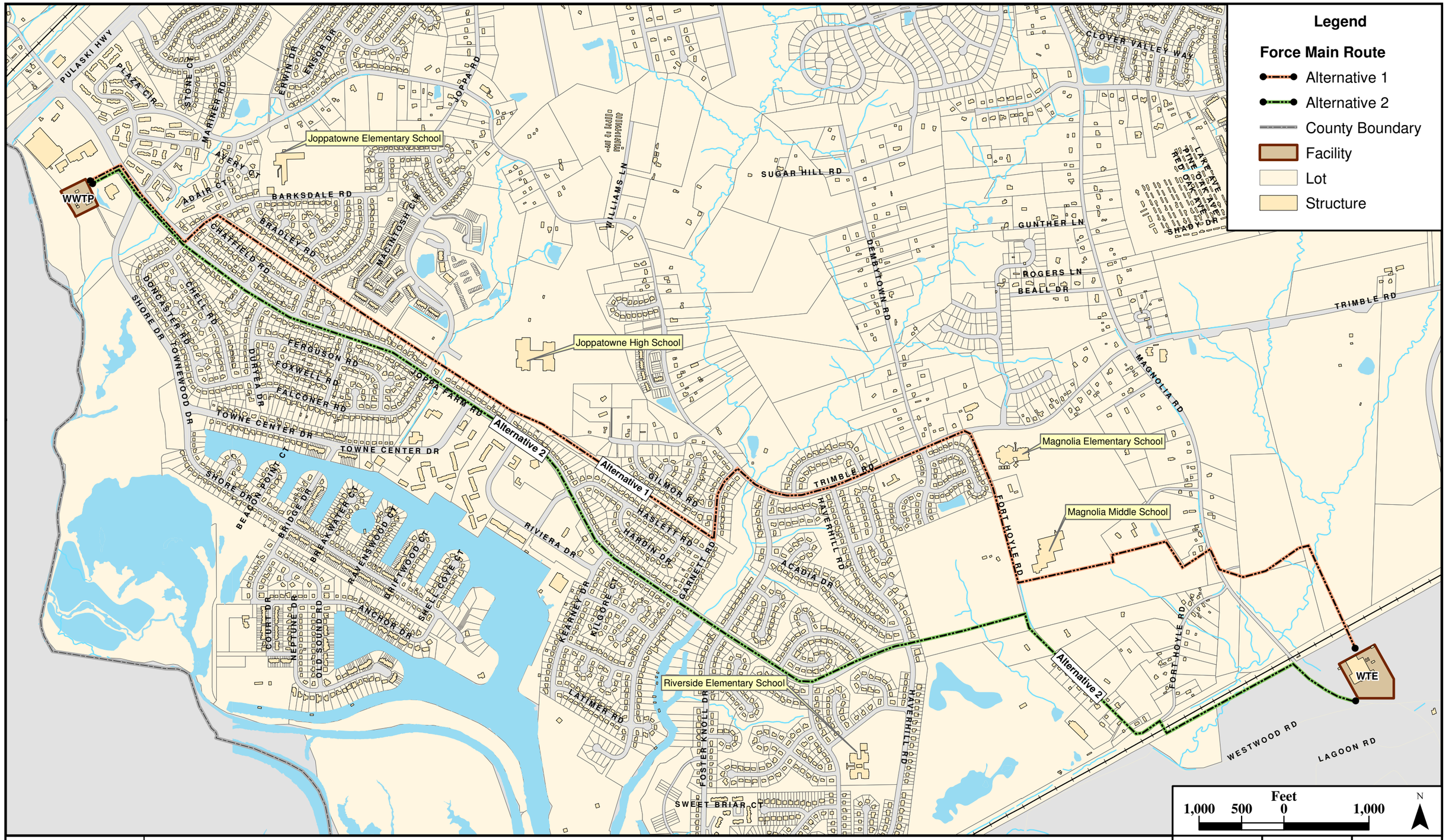
F) INSTALL A 5'-0" PARSHALL FLUME WITH A 6" WIDE THROAT WITHIN A 6'-0" MANHOLE.

3. PARSHALL FLUME AND DECHLORINATION CHAMBER MUST BE CONSTRUCTED ABOVE 100-YEAR FLOOD PLAIN ELEVATION.

4. DECHLORINATION PIPING, ELECTRICAL, AND COMMUNICATION LINES ARE TO BE ROUTED TO THE DECHLORINATION CHAMBER.

5. ELECTRICAL AND COMMUNICATION LINES ARE TO BE ROUTED TO THE FLOW METER CHAMBER.

HDR Engineering, Inc.	**Effluent Reuse Study** **Northeast Maryland Waste Disposal Authority** **Joppatowne, Harford County, Maryland**	**DATE** **JULY 2008** **FIGURE** **E-2**	**PRE-ENGINEERED PUMP STATION SITE PLAN**

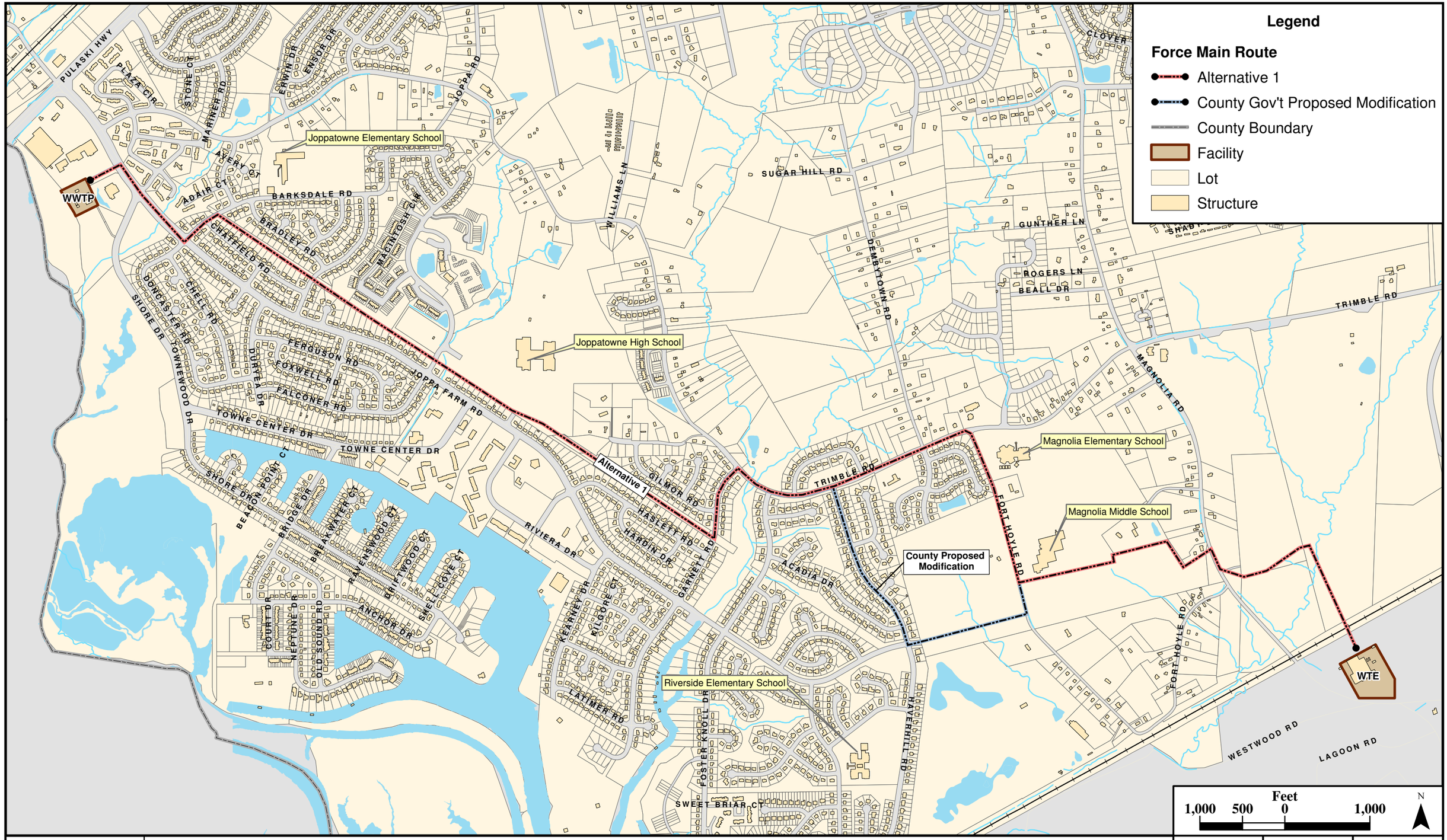


HDR

NORTHEAST MARYLAND WASTE DISPOSAL AUTHORITY
PRELIMINARY ENGINEERING REPORT - PUMPING OF RECLAIMED WATER TO WTE FACILITY, JOPPATOWNE, MD
ROUTES FOR ADDITIONAL REVIEW BASED ON INITIAL SCREENING

Job No.	Date	Figure No.
0067642	4/16/08	3-1

\\Prl-srv2\Projects\001978_NORTHEAST MARYLAND WASTE DISPOSAL AUTH\0067242_NMWDA-JM-JOPPATOWNE WWTP EFFLU\GIS\map_docs\mxd\PER\Fig3-1_RouteAddlReview.mxd

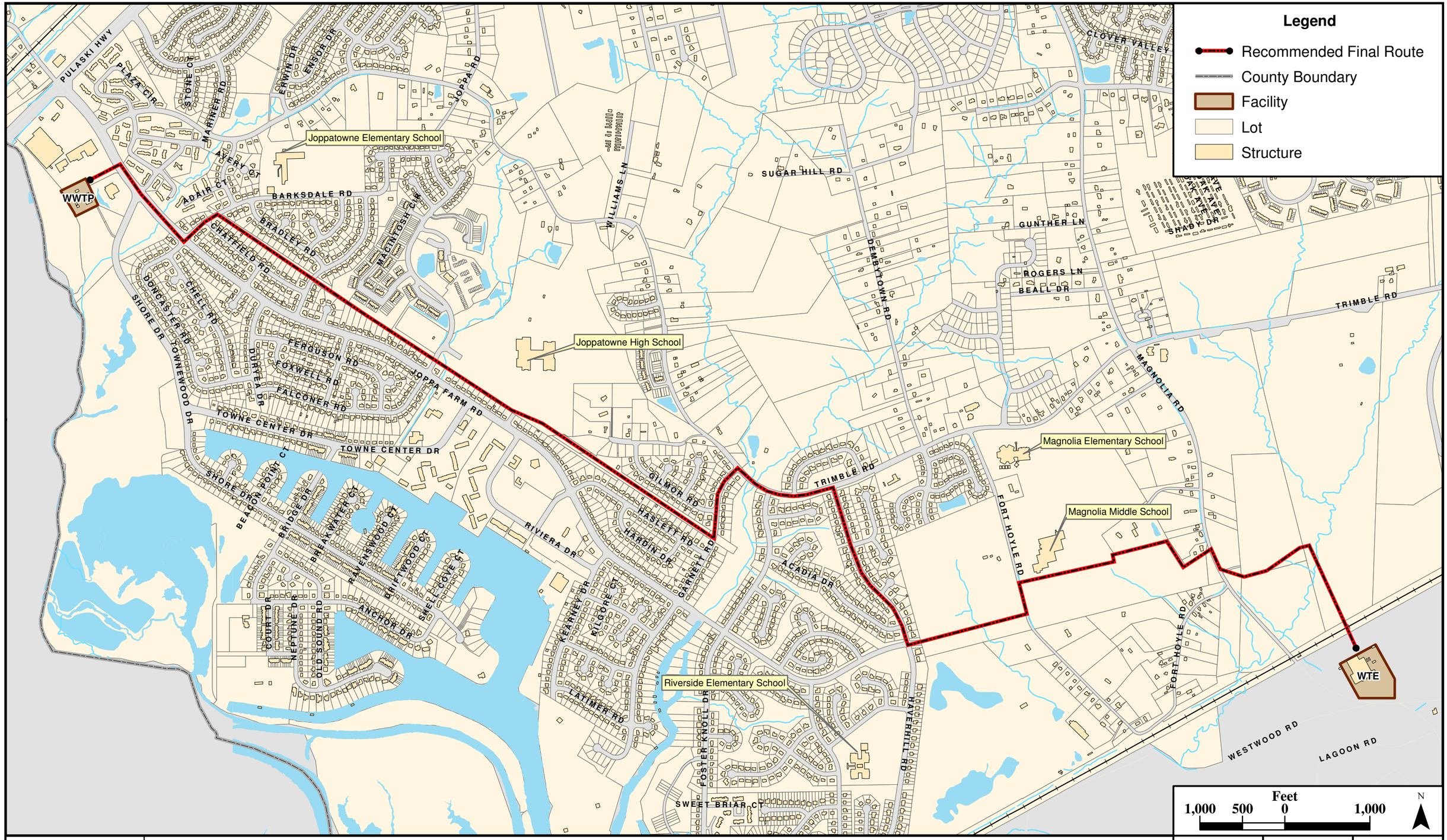


HDR

NORTHEAST MARYLAND WASTE DISPOSAL AUTHORITY
PRELIMINARY ENGINEERING REPORT - PUMPING OF RECLAIMED WATER TO WTE FACILITY, JOPPATOWNE, MD
MODIFIED ALTERNATIVE 1 ROUTE PROPOSED BY COUNTY

Job No.	Date	Figure No.
0067642	4/16/08	3-2

\\Prl-srv2\Projects\001978_NORTHEAST MARYLAND WASTE DISPOSAL AUTH\0067242_NMWDA-JM-JOPPATOWNE WWTP EFFLU\GIS\map_docs\mxd\PER\Fig3_2_ModifiedAlt1.mxd

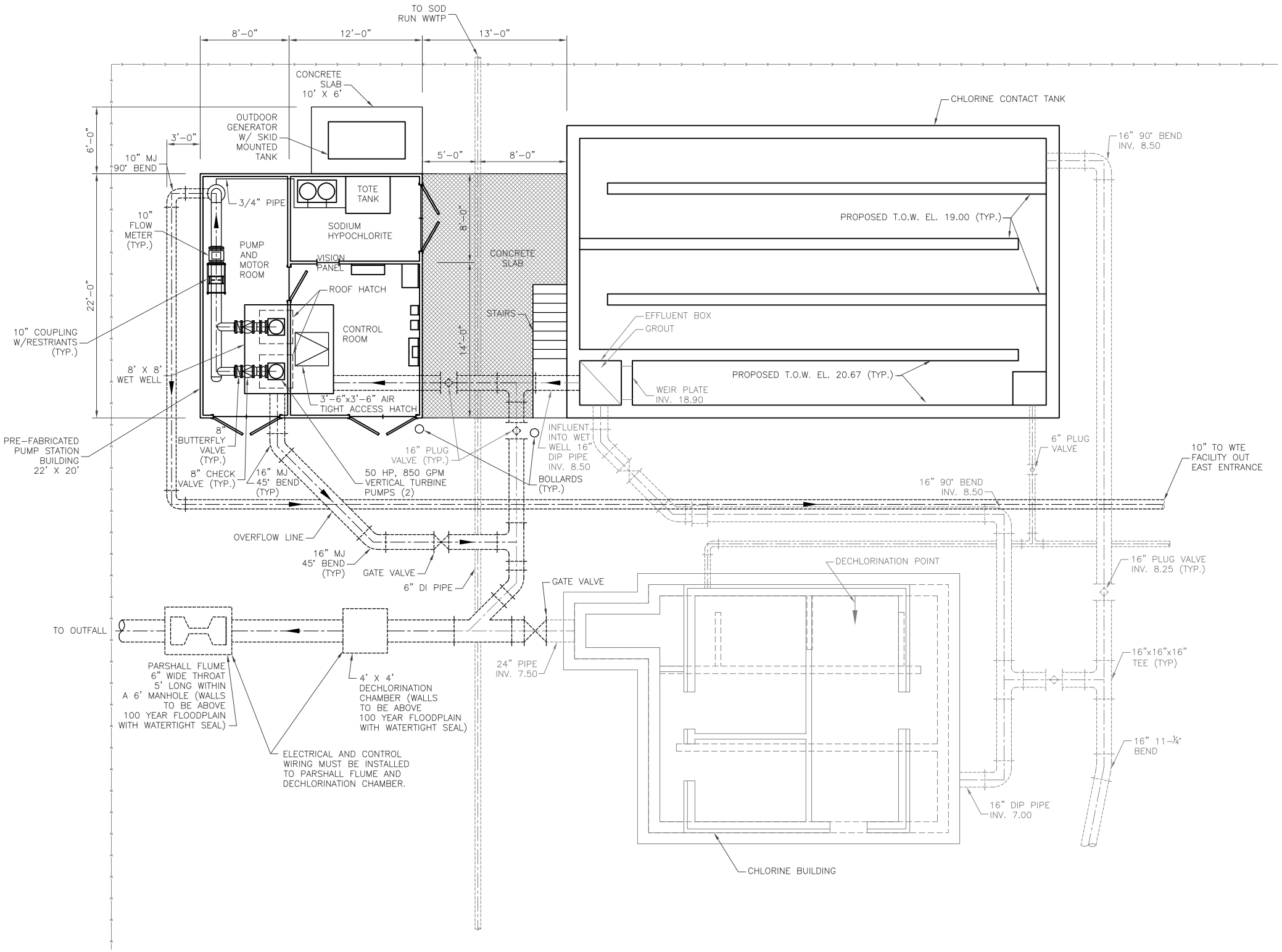


HDR

NORTHEAST MARYLAND WASTE DISPOSAL AUTHORITY
PRELIMINARY ENGINEERING REPORT - PUMPING OF RECLAIMED WATER TO WTE FACILITY, JOPPATOWNE, MD
RECOMMENDED FINAL ROUTE

Job No.	Date	Figure No.
0067642	4/16/08	3-4

\\Prl-srv2\Projects\001978_NORTHEAST MARYLAND WASTE DISPOSAL AUTH\0067242_NMWDA-JM-JOPPATOWNE WWTP EFFLU\GIS\map_docs\mxd\PER\Fig3_4_FinalRoute.mxd



NOTES:

1. THE INFORMATION ON THIS DRAWING IS CREATED FROM A 1997 AS-BUILT CREATED BY STEARNS & WHELER.

2. THE WORK FOR THIS ALTERNATIVE INCLUDES BUT IS NOT LIMITED TO THE FOLLOWING:

A) SITE WORK FOR INSTALLATION OF A 22'-0" X 20'-0" PRE-FABRICATED BUILDING.

B) MODIFICATIONS TO STORMWATER MANAGEMENT SYSTEM.

C) SEPARATE PURCHASE OF PUMPS, VALVES, ELECTRICAL EQUIPMENT AND INSTRUMENTATION CONTROLS.

D) CHLORINE CONTACT TANK WALL TO BE RAISED 1'-8" TO ACHIEVE 30-MIN CONTACT REQUIREMENTS.

E) CONSTRUCTION OF A 10'-0" X 6'-0" CONCRETE SLAB FOR PUMP STATION GENERATOR.

F) INSTALL A 5'-0" PARSHALL FLUME WITH A 6" WIDE THROAT WITHIN A 6'-0" MANHOLE.

3. PARSHALL FLUME AND DECHLORINATION CHAMBER MUST BE CONSTRUCTED ABOVE 100-YEAR FLOOD PLAIN ELEVATION.

4. DECHLORINATION PIPING, ELECTRICAL, AND COMMUNICATION LINES ARE TO BE ROUTED TO THE DECHLORINATION CHAMBER.

5. ELECTRICAL AND COMMUNICATION LINES ARE TO BE ROUTED TO THE FLOW METER CHAMBER.

HDR Engineering, Inc.	**Effluent Reuse Study** **Northeast Maryland Waste Disposal Authority** **Joppatowne, Harford County, Maryland**	DATE **JULY 2008** FIGURE **4-1**	**PRE-ENGINEERED PUMP STATION SITE PLAN**

Pump Station Estimate

PROJECT	67242 Joppatowne, MD WWTP Pump Station		
LOCATION			
CATEGORY		SHEET 1	OF 1
ESTIMATOR: G. Moreno	NO DESIGN COMPLETED / SCHEMATIC DESIGN	DATE SUBMITTED	
CHECKED BY: W. Lai	FINAL DESIGN / OTHER: _____	FILENAME	

Pre-Fabricated Pump Station - NW Corner of WWTP		Cost Labor & Material	
Infra-Tech, LLC Budget Price		$ 725,000	
Misc. Add-Ons	15%	$ 108,750	
Mechanical		$ 34,000	
Electrical		$ 184,000	
Structural		$ 80,000	
Site Improvements		$ 156,500	
Instrumentation		$ -	
		TOTAL	$1,288,250
General Conditions	10%		$128,825
Overhead	15%		$193,238
Profit	15%		$193,238
Contingency	50%		$644,125
	2008	TOTAL	$2,447,675
Escalation 2 years @ 6% per year	12.36%		$250,887
	2010	TOTAL	$2,698,562
	2010	SAY	$2,698,600

Infra-Tech, LLC budget price includes installation and furnishing of the following: (see attached):

Mechanical CD=Crew Day

Pre-Fabricated Pump Station

DESCRIPTION	QUANTITY No. UNITS	QUANTITY UNIT MEASURE	MATERIAL PER UNIT	MATERIAL TOTAL	CD Installation	$3,000/CD	COMMENTS
Install new equipment							
8" Vertical Shaft Pumps	1.0	LS	$ -	$ -			Included in Infra-Tech Budget
8" Check Valves	1.0	LS	$ -	$ -			Included in Infra-Tech Budget
8" Plug Valves	1.0	LS	$ -	$ -			Included in Infra-Tech Budget
8" Internal Piping	1.0	LS	$ -	$ -			Included in Infra-Tech Budget
Heat and Ventilation system	1.0	LS	$ -	$ -			Included in Infra-Tech Budget
Wet Well Floats	1.0	LS	$ -	$ -			Included in Infra-Tech Budget
330 gal. Hypochlorite Tote Tank and Pumping System	1.0	LS	$ 10,000.00	$ 10,000.00	1.0	$ 3,000.00	
Parshall Flume and 4' Manhole	1.0	LS	$ 15,000.00	$ 15,000.00	2.0	$ 6,000.00	
SUBTOTAL				$25,000.00		$9,000.00	**$34,000.00**

Electrical

CD=Crew Day

Pre-Fabricated Pump Station

DESCRIPTION	QUANTITY No. UNITS	QUANTITY UNIT MEASURE	MATERIAL PER UNIT	MATERIAL TOTAL	CD Installation	$3,000/CD	COMMENTS
Kohler Generator (Model REOZJB125)	1.0	LS	$ -	$ -			Included in Infra-Tech Budget
Setting of Generator	1.0	LS	$ -	$ -			Included in Infra-Tech Budget
New Service	1.0	LS	$ 50,000.00	$ 50,000.00	5.0	$ 15,000.00	
Motor Control Center	1.0	LS	$ 75,000.00	$ 75,000.00	4.0	$ 12,000.00	
Wiring to PLC	1.0	LS	$ 20,000.00	$ 20,000.00	4.0	$ 12,000.00	
SUBTOTAL				$145,000.00		$39,000.00	$184,000.00

Structural CD=Crew Day

Pre-Fabricated Pump Station

DESCRIPTION	QUANTITY No. UNITS	QUANTITY UNIT MEASURE	MATERIAL PER UNIT	MATERIAL TOTAL	CD Installation	$3,000/CD	COMMENTS
Steel Double Leaf Entrance Door	1.0	LS	$ -	$ -			Included in Infra-Tech Budget
Standing Seam Metal Roof	1.0	LS	$ -	$ -			Included in Infra-Tech Budget
8" Split Face Block Walls	1.0	LS	$ -	$ -			Included in Infra-Tech Budget
Set Building Foundation	1.0	LS	$ -	$ -			Included in Infra-Tech Budget
Crane for Setting Building and Roof	1.0	LS	$ -	$ -			Included in Infra-Tech Budget
8' x 8' . 13' Deep Wet Well	1.0	LS	$ 40,000.00	$ 40,000.00	0.0	$ -	Labor Included in Infra-Tech Budget
Raise Walls of Chlorine Contact Tank	1.0	LS	$ 25,000.00	$ 25,000.00	5.0	$ 15,000.00	
SUBTOTAL				$65,000.00		$15,000.00	$80,000.00

Site Improvements CD=Crew Day

Pre-Fabricated Pump Station

DESCRIPTION	QUANTITY No. UNITS	QUANTITY UNIT MEASURE	MATERIAL PER UNIT	MATERIAL TOTAL	CD Installation	$3,000/CD	COMMENTS
Set Wet Well	1.0	LS	$ -	$ -			Included in Infra-Tech Budget
New 10" HDPE Force Main and Trench Work	60.0	LF	$ 300.00	$ 18,000.00	5.0	$ 15,000.00	
Misc. Excavation	1.0	LS	$ 10,000.00	$ 10,000.00	2.0	$ 6,000.00	
Site Grading	150.0	SY	$ 150.00	$ 22,500.00	5.0	$ 15,000.00	
Dewatering	1.0	LS	$ 20,000.00	$ 20,000.00	5.0	$ 15,000.00	
Reconstruction of Stormwater Mgmnt System	1.0	LS	$ 20,000.00	$ 20,000.00	5.0	$ 15,000.00	
SUBTOTAL				$90,500.00		$66,000.00	$156,500.00

Instrumentation and Controls CD=Crew Day

Pre-Fabricated Pump Station

DESCRIPTION	QUANTITY No. UNITS	QUANTITY UNIT MEASURE	MATERIAL PER UNIT	MATERIAL TOTAL	CD Installation	$3,000/CD	COMMENTS
8" Flow Meter, Signal Converter, Chart Recorder	1.0	LS	$ -	$ -			Included in Infra-Tech Budget
Bihlertech Control System	1.0	LS	$ -	$ -			Included in Infra-Tech Budget
Adjustable Speed Motor Drives	1.0	LS	$ -	$ -			Included in Infra-Tech Budget
Transducer Level Sensor	1.0	LS	$ -	$ -			Included in Infra-Tech Budget
Backup Control Floats	1.0	LS	$ -	$ -			Included in Infra-Tech Budget
Harford County Supplied SCADA Unit	1.0	LS	$ -	$ -			Included in Infra-Tech Budget
Pre-Wiring	1.0	LS	$ -	$ -			Included in Infra-Tech Budget
Automatic Transfer Switch	1.0	LS	$ -	$ -			Included in Infra-Tech Budget
SUBTOTAL				$0.00	$0.00		$0.00