

Introduction

This Big Branch Pump Station (BBPS) Preliminary Engineering Report (PER) consists of the planning and preliminary design of a pump station and associated pipelines to serve the Big Branch drainage basin which lies within the Town of Apex Service Area. The basin is currently partially developed and served by 4 small pump stations. These pump stations will eventually be taken offline and replaced with gravity sewer to the proposed Big Branch Pump Station. The Town selected a project team comprised of Hazen and Sawyer and CJS Conveyance to complete the PER for the project.

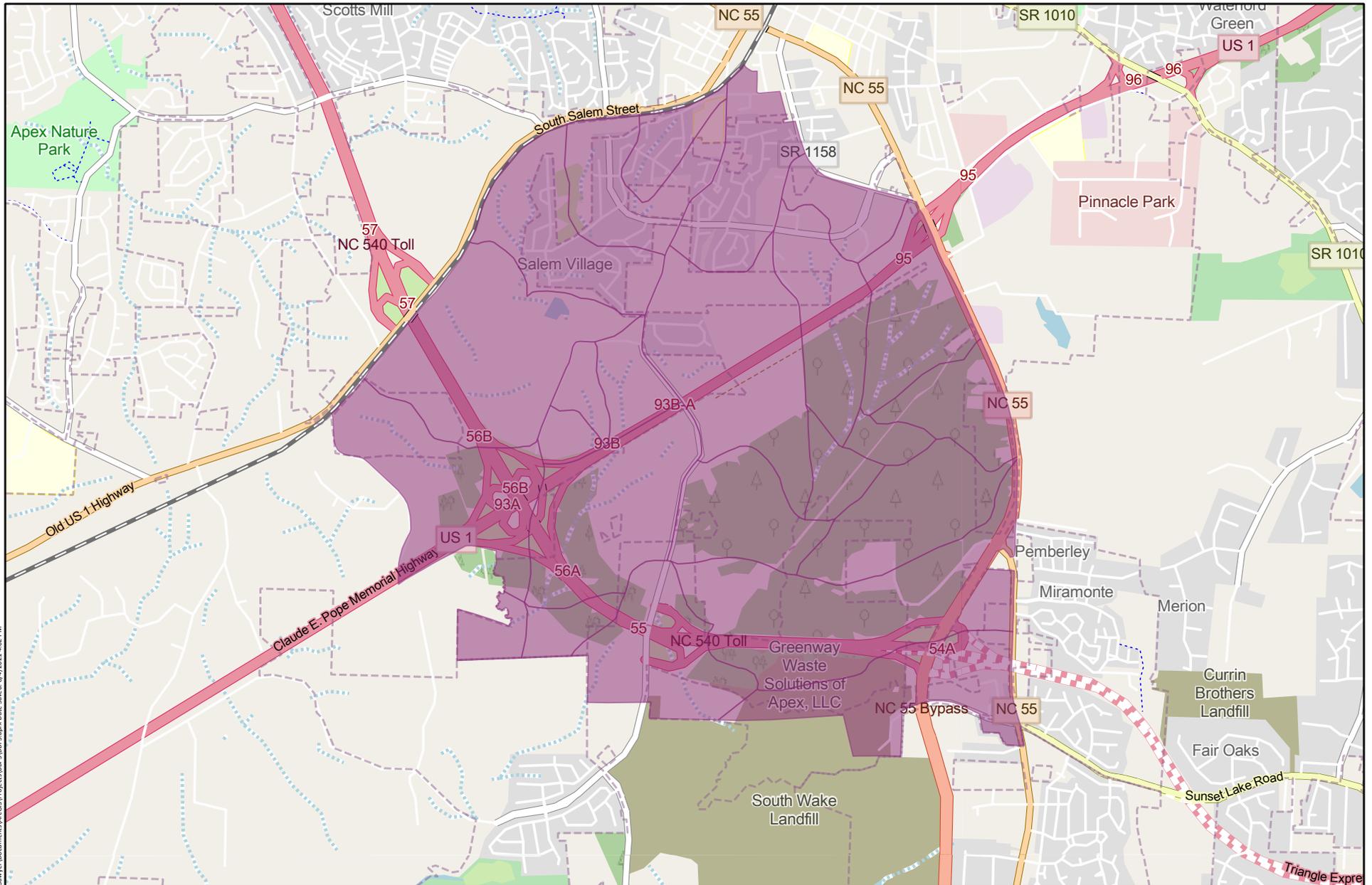
The PER includes the following:

- A review and update of flow projections for the Big Branch sewer basin,
- Evaluation of a single pump station system (BBPS) with a deep gravity sewer/tunnel versus a dual pump station system (BB1PS & BB2PS),
- Evaluation of pump station site and force main alignments,
- A preliminary design of the new pump station(s) and associated pipelines,
- Cost estimate, funding options, and project phasing

This PER is a compilation of a series of Technical Memorandums (TMs) that are being submitted as part of this project. The TMs submitted to the Town and included in the PER are as follows:

- TM – 1: Big Branch Wastewater Master Plan Phase I: Flow and Population Projections
- TM – 2: Pump Station Site Selection
- TM – 3: Gravity Sewer Assessment
- TM – 4: Force Main Assessment
- TM – 5: Preliminary Pump Station Design
- TM – 6: Transient Analysis
- TM – 7: Cost Estimate, Funding, and Project Phasing

Figure ES-1 shows the Big Branch Drainage Basin that will be served by this project.



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Town of Apex
Big Branch Pump Station

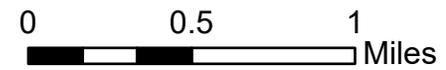


FIGURE ES-1:
 BIG BRANCH
 DRAINAGE BASIN

Flow and Population Projections

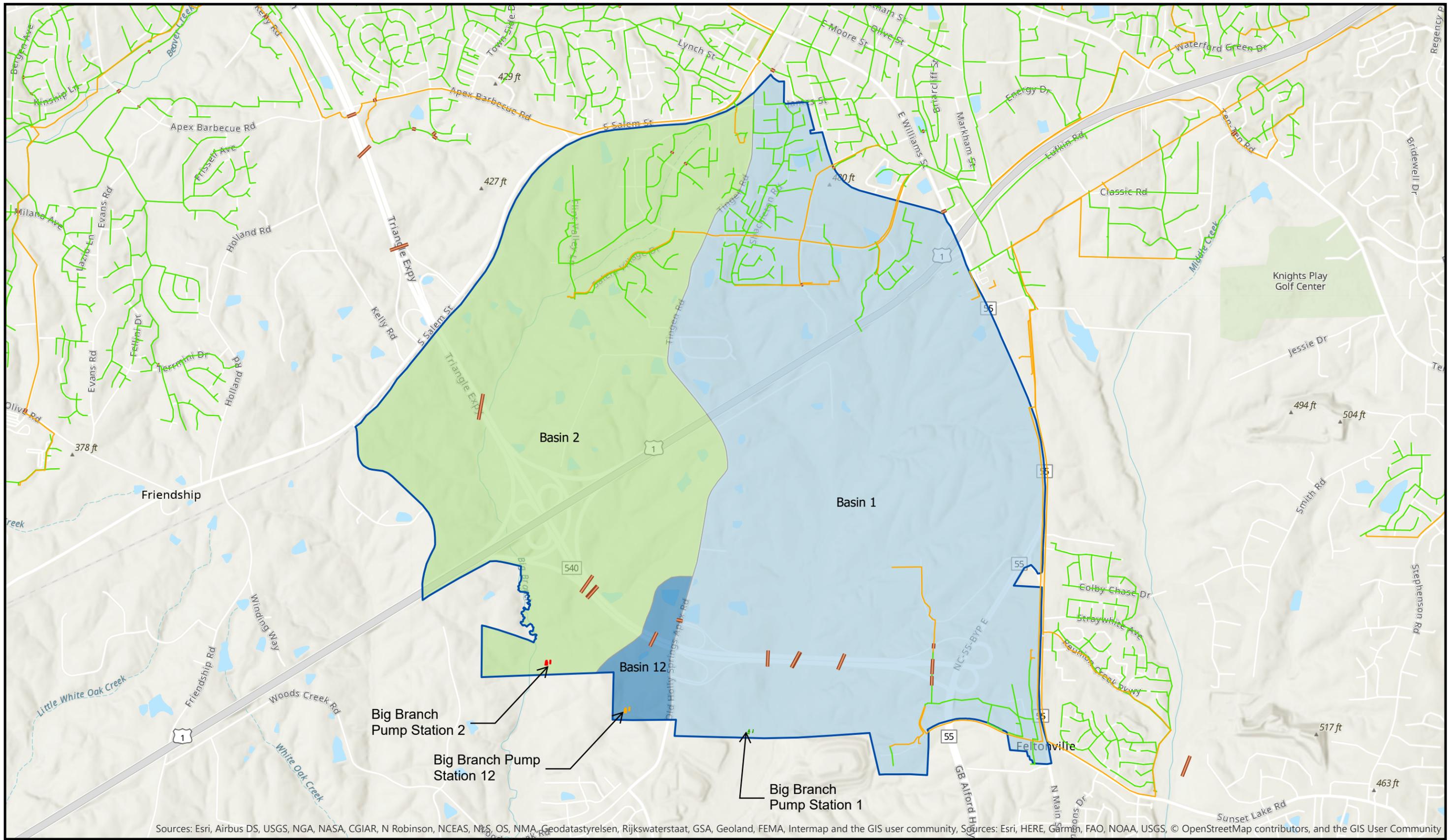
The study area, Big Branch basin, is located in Southern Apex and generally enclosed by the major roads NC-540, South Salem Street, and NC Highway 55 with a portion lying south of NC-540. This location is primarily undeveloped and is primed for rapid developmental. Results presented in this PER are based on a spreadsheet model utilizing data from the Town of Apex Future Land Use Mapping (FLUM), transportation studies performed by the Triangle J Council of Governments (TJCOG), and the proposed Veridea development. Results from this analysis were used to determine the size and timing of the proposed Big Branch Pump Station, discharge force main, and associated upstream gravity sewer. **Table ES-1** presents the average day and peak hour flow projections for the Big Branch drainage basin.

Table ES-1: Big Branch Drainage Basin Flow Projections

	2025	2035	2045	Build-Out
Annual Average Day (MGD)	1.3	2.5	3.5	4.6
Peak Hour (MGD)	3.8	7.2	10.1	13.3

Pump Station Site Selection

The Big Branch Basin comprises three main sub-basins: Big Branch 1, Big Branch 2, and Big Branch 12, as shown in **Figure ES-2**. A pump station site was identified in each sub-basin that would be optimal for gravity sewer drainage.



Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NIS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community, Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

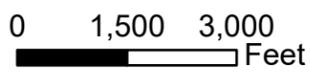
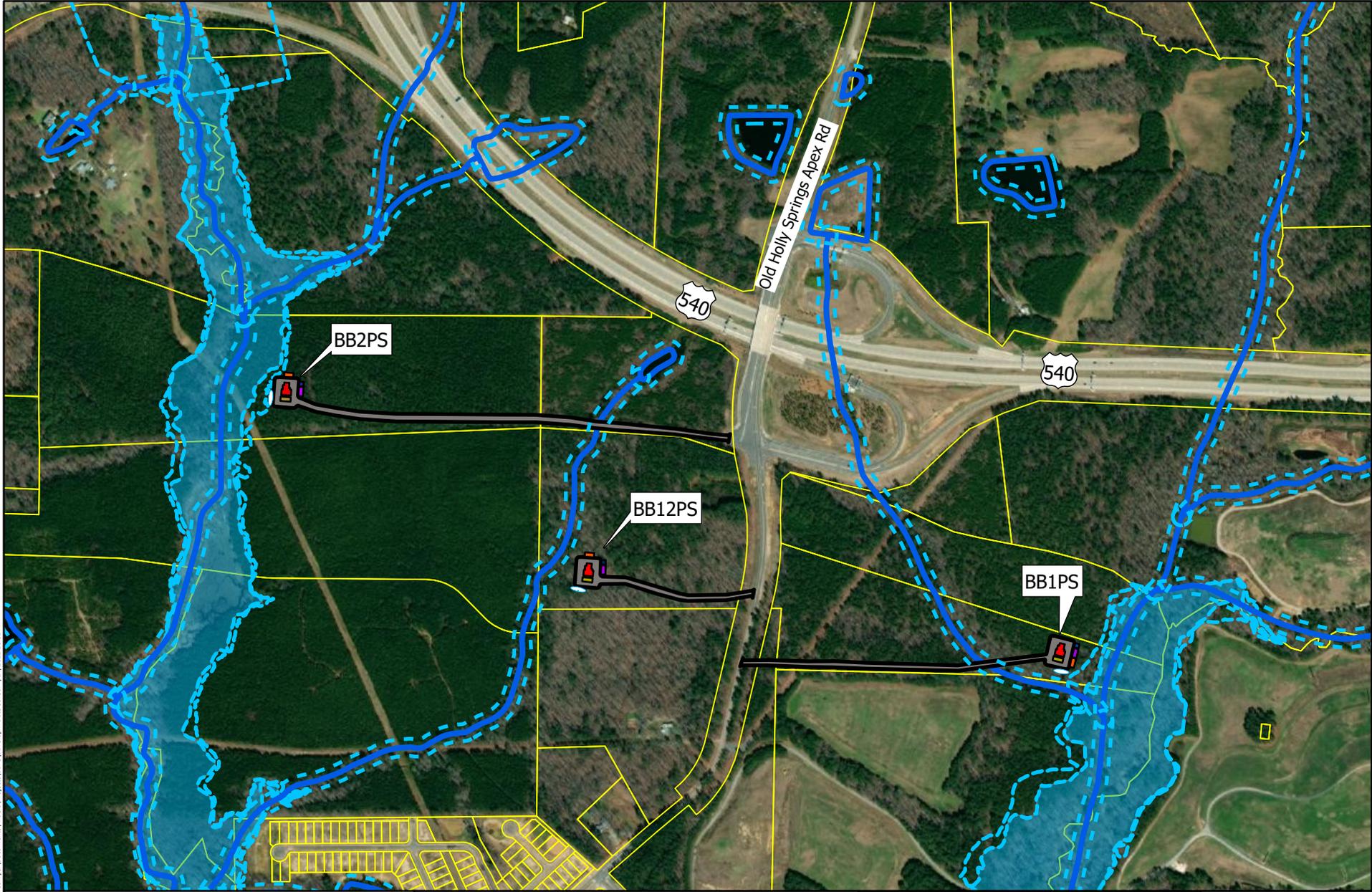


Figure ES-2 Big Branch Basins



The three potential pump station sites in each sub-basin were laid out and evaluated for the Big Branch Pump Station. The sites, shown in **Figure ES-3**, were compared using excavation and structural costs, access road costs and environmental factors of each location. Facilities assumed to be required at each site for the evaluation include an electrical generator, vapor and liquid phase odor control, and an electrical building housing the pump station's motor control center and variable frequency drives.

The BB12PS site was eliminated after evaluation due to it requiring a very deep pump station, which will be more costly than the other sites. The BB2PS site was determined to be the optimal site for a single pump station alternative, while the BB1PS was further evaluated as part of the two pump station alternative.



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Town of Apex
Big Branch 2 Pump Station

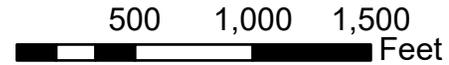


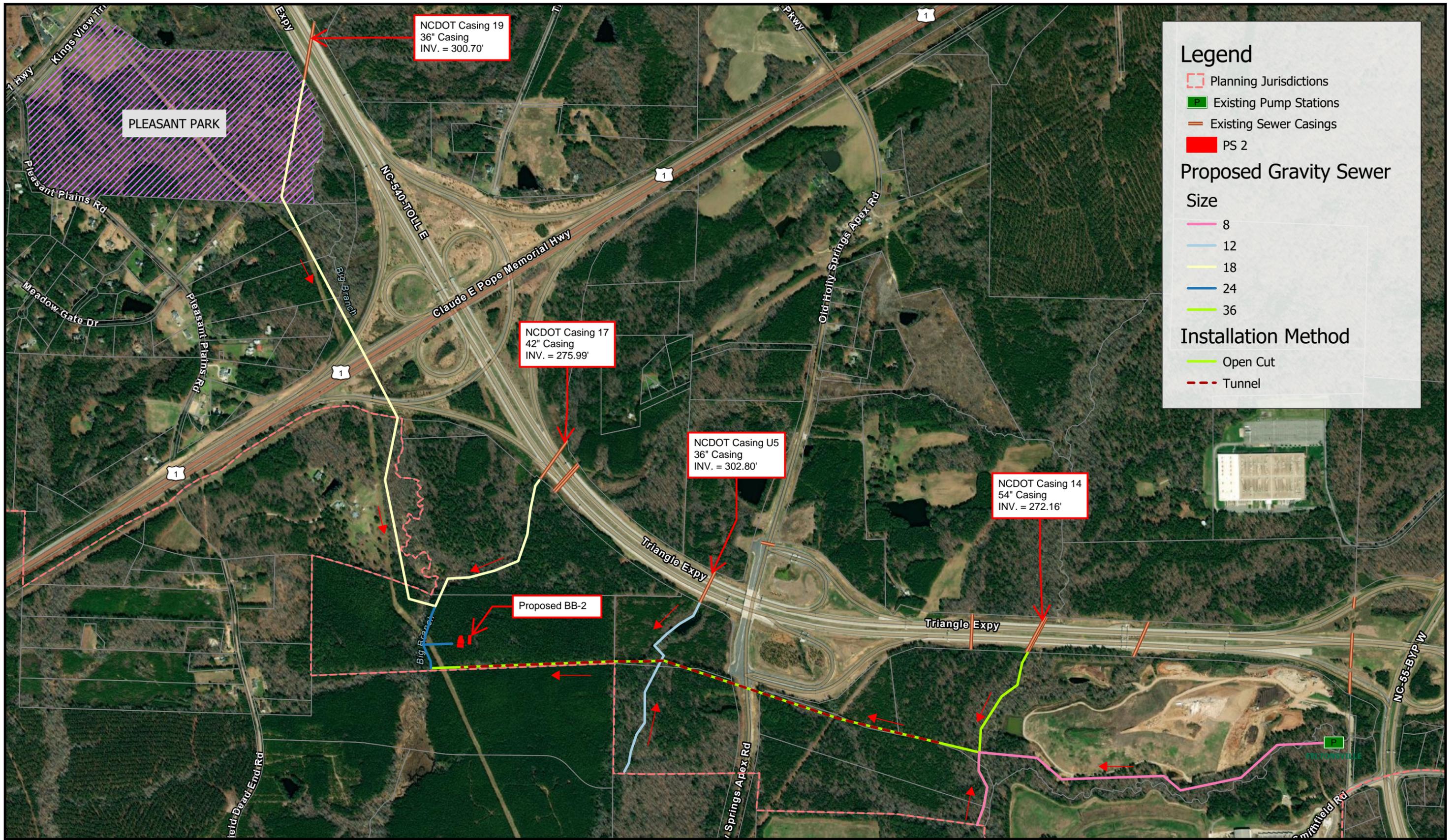
FIGURE No. ES-3
 OVERALL SITE COMPARISON



Gravity Sewer Evaluation

The overall Big Branch basin consists of multiple drainageways which end at the Town of Apex boundary and would traditionally require multiple pump stations. This evaluation was undertaken to assess the size and location of gravity sewer mains along these primary drainage ways while also assessing the suitability and impacts of utilizing tunneling of gravity sewer to allow for a single pump station. The tunnels would be utilized to cross basin divides which have extended sections that are beyond the 25-foot maximum depth typical of open-cut installation (depths of up to 80 feet are encountered). The gravity sewer along primary drainageways was considered to be identical with slight modifications for both the multi-pump station and single pump station option.

A total of three route options were developed that could serve the two identified potential pump station BBPS sites, BB2PS and BB12PS. These routes consisted of the initial route identified in the RFQ (Option No. 1), a modified RFQ route to avoid property in the Holly Springs town limits (Option No. 2), and a third route to the north that avoided Holly Springs property and did not bisect any parcels along the route (Option No. 3). A profile was developed for each route and pump station combination to determine the length of open-cut sewer required and the viability and length of tunnel required for the relative assessment of the options. All route options were deemed to be suitable for tunnel installation with multiple viable methods available that will be determined after detailed geotechnical investigations during the final design. Route Option No. 3 with a BB2PS location was deemed the most suitable option for a single pump station option. Option No. 3 had the shortest amount of gravity sewer required among all tunnel route options while the BB2PS location had the further benefit of requiring the shortest length of tunnel and a shallower pump station. This taken in combination with Option No. 3 being completely within the Town of Apex and being least impactful to property makes Option No. 3 the most suitable option. **Figure ES-4** shows the recommend gravity sewer option.



Legend

- Planning Jurisdictions
- Existing Pump Stations
- Existing Sewer Casings
- PS 2

Proposed Gravity Sewer Size

- 8
- 12
- 18
- 24
- 36

Installation Method

- Open Cut
- Tunnel



0 400 800 1,600 Feet

Figure ES-4 GS Option No. 3, BB2 PS Location



Single vs Dual Pump Station Alternative Evaluation

Two pump station alternatives were assessed for ease of operation and cost-effectiveness. The single pump station alternative requires a single pump station, located at the BB2PS site, that can convey the entire Big Branch Basin flow. The BBPS will utilize a six-pump arrangement with high and low flow pumps to handle the wide range of flows in the basin.

The dual pump station alternative requires two separate pump stations to serve the Big Branch Basin, BB1PS in the Big Branch 1 Basin and BB2PS in the Big Branch 2 Basin. The pump stations will utilize a four-pump arrangement as each will be receiving less flow than that of the BBPS.

A cost evaluation was performed for both alternatives and found cost were not significantly different and would not be the deciding factor for alternative selection. A single pump station alternative will require less maintenance and simpler operations for the Town staff, therefore, it is the recommended alternative. The subsequent figures and sections assume the single pump station option, which will be referred to as Big Branch Pump Station (BBPS). The recommended BBPS site is shown in **Figure ES-5** below.

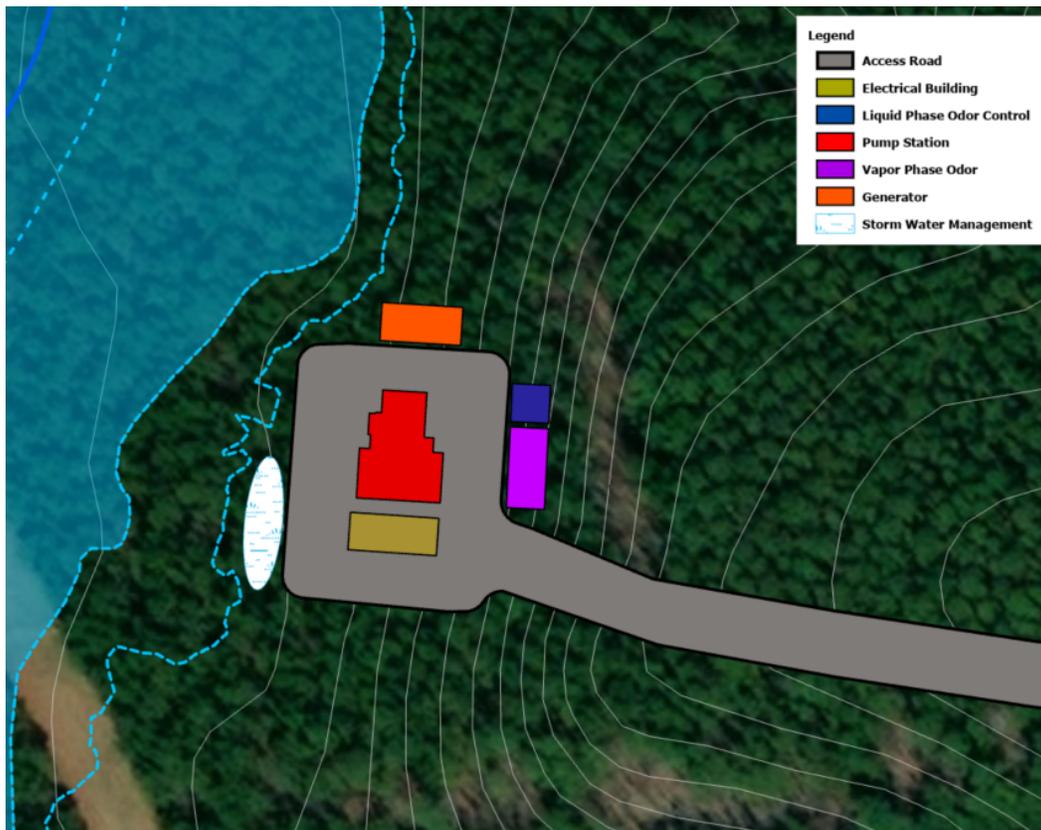


Figure ES-5: Recommended BB2PS Site

Preliminary Pump Station Design

The BBPS will convey wastewater from the Big Branch drainage basin to the Western Wake Regional Water Reclamation Facility (WWRWRF). All major components for the pump station were evaluated based on constructability, cost-effectiveness, and ease of operation. Hydraulic and transient analyses were also performed to determine the necessary surge protection equipment needed at the pump station. The following pump station elements are recommended for the new BBPS:

- Dual 20" discharge force mains to Western Wake Regional Water Reclamation Facility
- Single pump station option
 - Six submersible non-clog pumps
 - Four 250 Horsepower (High Flow)
 - Two 100 Horsepower (Low Flow)
- Variable speed drives with bypass reduced voltage soft starters
- Two influent channels
 - Multi-rake mechanical screen in the primary channel
 - Channel grinder in the bypass channel
- Dual confined inlet wet wells
- Odor control
 - Dry media adsorption system (vapor-phase treatment)
 - Bioxide chemical feed system (liquid-phase odor control)
- Flow metering
 - Magnetic flow meter
 - Evaluate Parshall flume influent measurement during final design
- Surge Protection
 - Four (4) Air Release/Vacuum Valves at pump station
 - Twelve (12) Air Release/Vacuum Valves on the force main

Figures ES-6 through ES-8 show the recommended pump station wet well and channel arrangement.

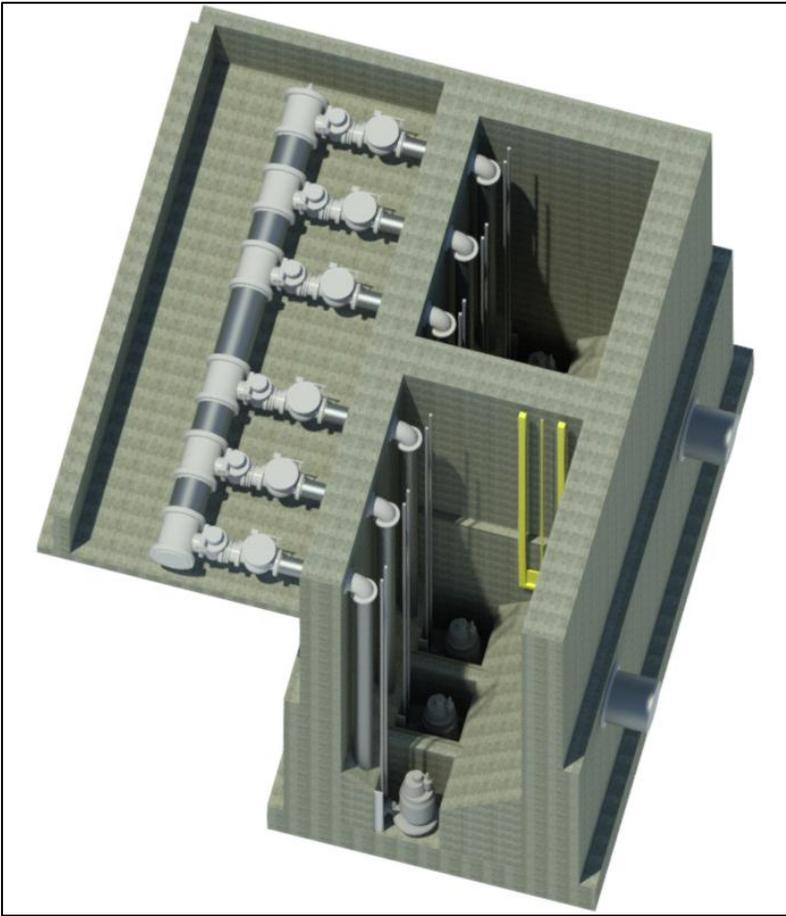
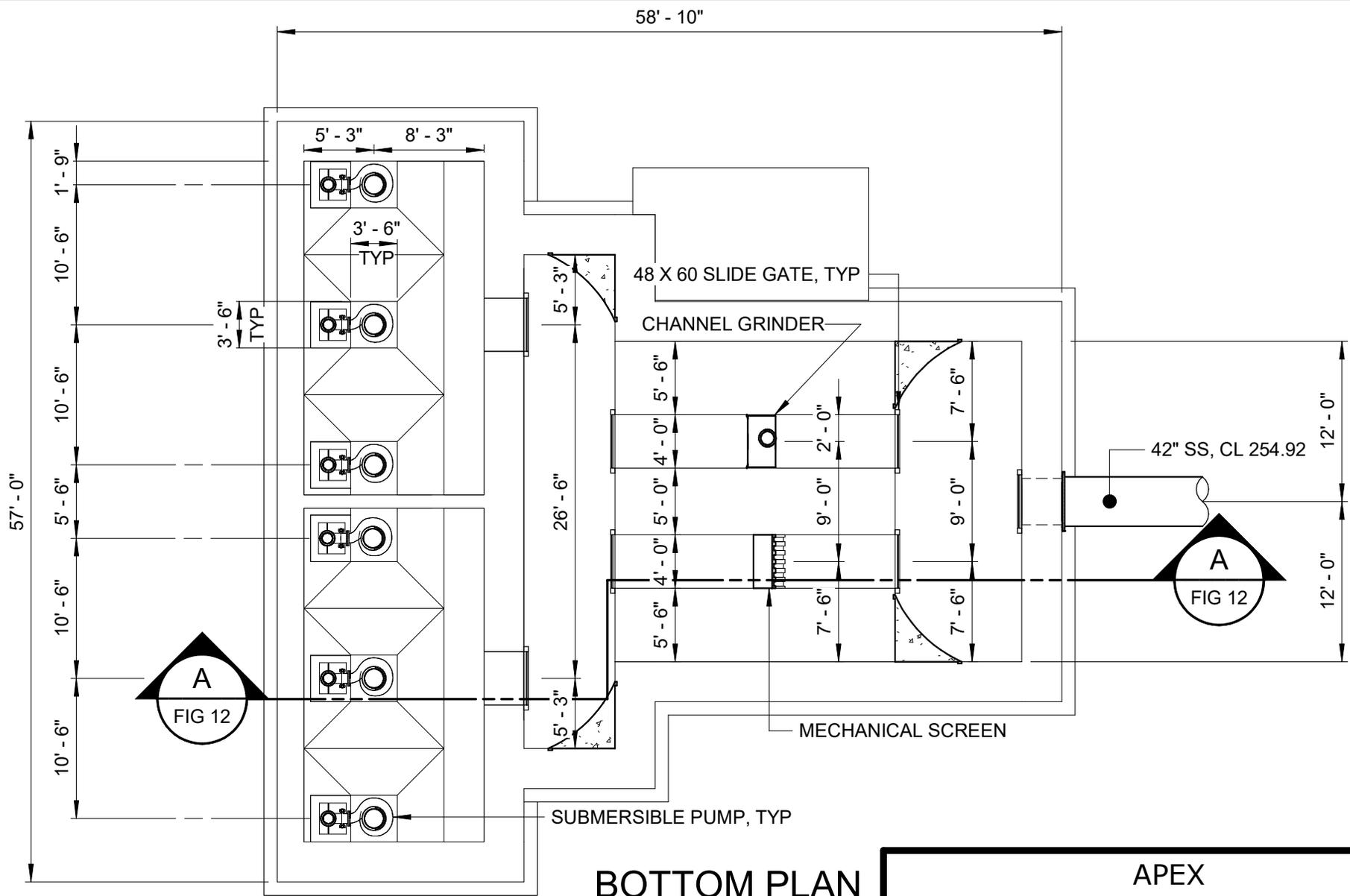


Figure ES-6: Recommended Confined Inlet Arrangement



BOTTOM PLAN
 3/32" = 1'-0"

**APEX
 BIG BRANCH 2 PUMP STATION**

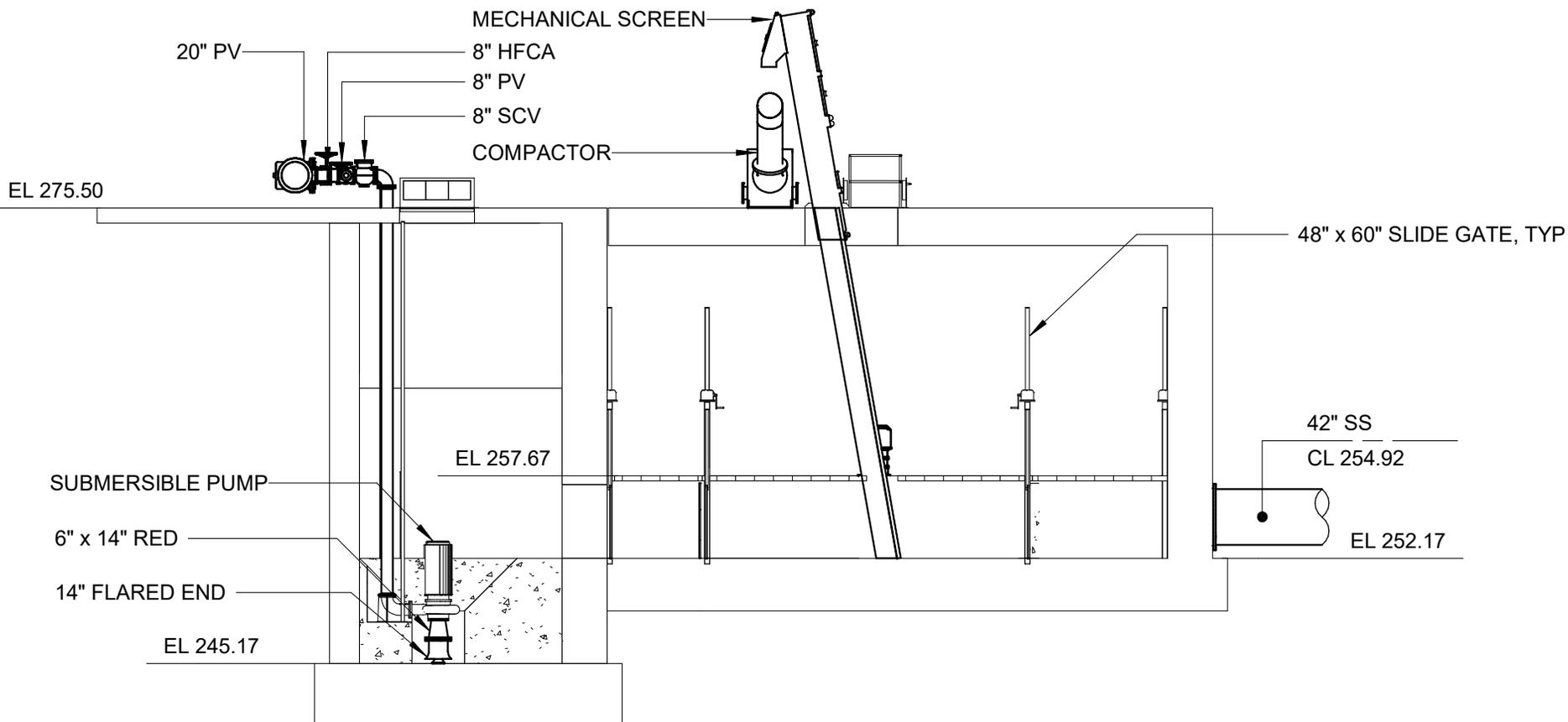
FIGURE ES-7

Hazen

HAZEN AND SAWYER
 498 SEVENTH AVENUE, 11th FLOOR
 NEW YORK, NEW YORK 10018

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SECTION A
3/32" = 1'-0"
FIG 11

Hazen
HAZEN AND SAWYER
498 SEVENTH AVENUE, 11th FLOOR
NEW YORK, NEW YORK 10018

APEX
BIG BRANCH 2 PUMP STATION
FIGURE ES-8

Force Main Evaluations

Routing options were evaluated for the proposed dual force mains associated with the BBPS to recommend a general force main route from the proposed pump station to the intended discharge point at the Western Wake Regional Water Reclamation Facility (WWRWRF). As previously evaluated, dual 20-inch force mains are most appropriate for the BBPS to accommodate the range of flows anticipated over the life of the station with acceptable operating velocities. Route options were developed with the assumption the dual force mains would be installed in the same corridor throughout within either a single easement cross-country or a road right-of-way with either one main in the right-of-way and one adjacent to it or potentially on opposite sides of the road. The length and location of each potential arrangement will be determined once final design survey is available.

A total of four route options were developed that could serve the BBPS. These routes consisted of a route north of US 1 (Route Option No. 1), a route along US 1 within the right-of-way (Route Option No. 2), and two routes south of US 1 (Route Option No. 3 and 4). The four route options were evaluated based on the following force main routing considerations:

- Corridor Widths
- NCDOT Road Crossings
- Major Utility Easements
- Environmental Features
- Topography
- Future Development Impacts

A relative assessment of the four route options was performed based on the routing consideration criteria above and input from Town of Apex staff. All routes were similar with regards to length and elevation as well as the number of NCDOT roadway crossings, utility easement crossings, and environmental impacts. The most significant differences between the routes were impact to jurisdictions outside the Town of Apex, potential for impact to developments outside Apex, and the number of easements required. The main concerns were impacts outside the Town of Apex. Due to the complexity of coordination during design and construction, as well as for future development, Town of Apex staff indicated it would be preferable to have the force mains routed completely within the Town's ETJ to the extent possible. Based on this approach and with no significant advantages of going south of US 1 and outside the Apex ETJ and into the Holly Springs ETJ, the two routes to the north of US 1 (Route Options No. 1 and 2), which were entirely within the Town of Apex ETJ, were deemed preferable. **Table ES-2** below identifies key details for the assessed routes.

Table ES-2 – General Route Information

Routes	Length	Min/Max Elevation	US 1 Crossing Required	Holly Springs ETJ Impact
No. 1 – North of US 1	29,400'	262'/388'	Yes	No
No. 2 – US 1 Right-of-Way	26,800'	262'/370'	Yes	No
No. 3 – South of US 1 Secondary Road Right-of-Way	29,100'	248'/362'	Yes	Yes
No. 4 – South of US 1 Existing Easement Parallel	29,200'	252'/356'	Yes	Yes

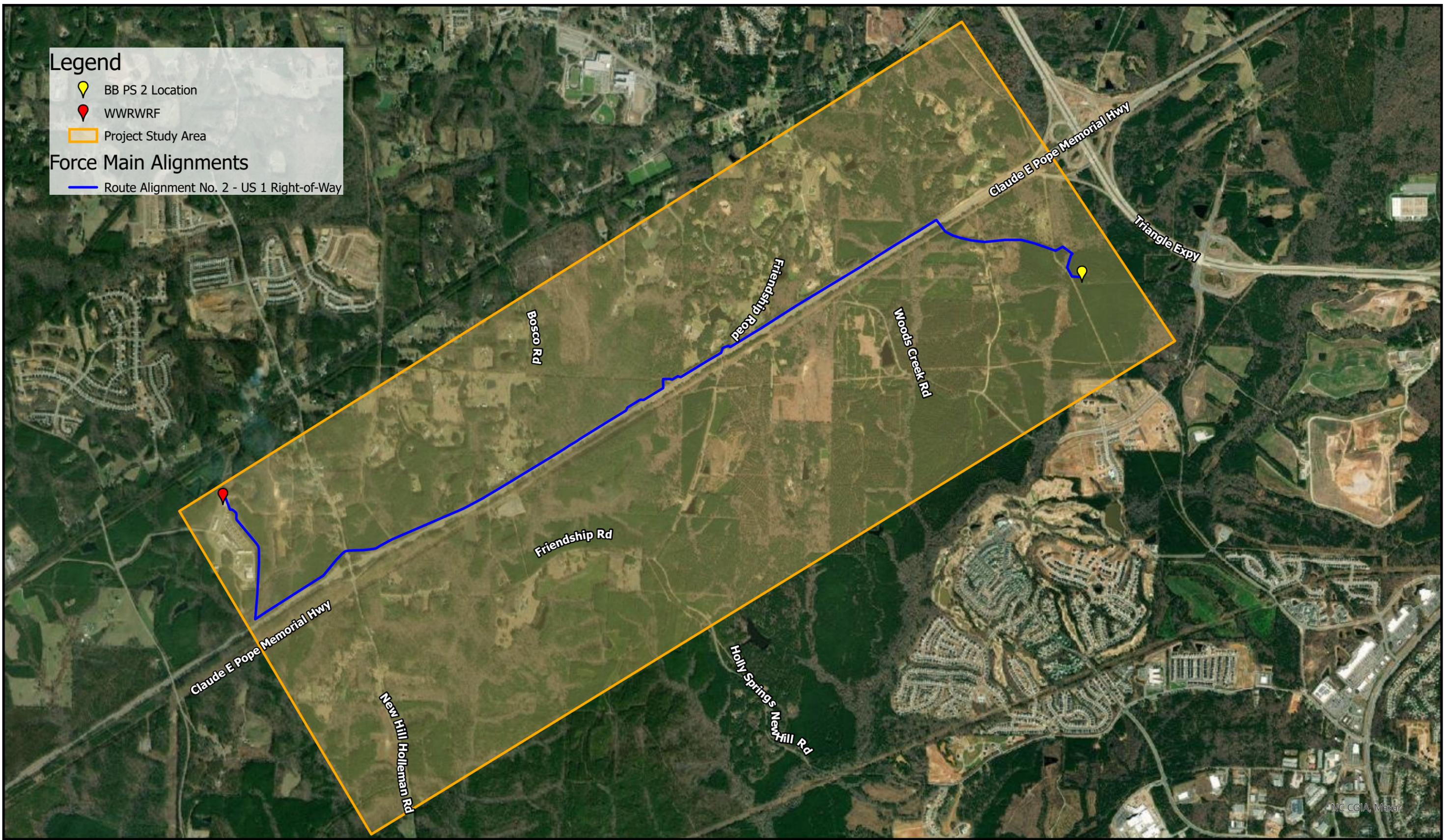
Further evaluation of Route Options No. 1 and 2 included consultation with NCDOT as Route Option No. 2 proposed to use US 1 controlled access right-of-way for installation of the proposed force mains. A meeting was held with District, Division, and Central Utilities NCDOT staff to discuss the potential for using US 1 right-of-way. It was determined that a perpendicular crossing was allowable, but a parallel occupancy of the right-of-way would require demonstration of extenuating circumstances during the design phase prior to approval by NCDOT. Route Option No. 2 is recommended as the proposed route due to the length advantage, reduction of easements and limited private property disruption. However, in the event that NCDOT does not approve the installation in the right-of-way, Route Option No. 1 is recommended. **Figure ES-9** shows the proposed route and the anticipated dual force main installation approaches for the route.

Legend

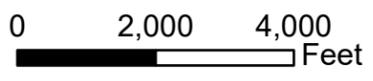
-  BB PS 2 Location
-  WWRWRF
-  Project Study Area

Force Main Alignments

-  Route Alignment No. 2 - US 1 Right-of-Way



NC CGIA, Maxar



**Figure ES-9 Proposed Big Branch 2
Force Main Route**



Cost Estimate, Funding, and Project Phasing

Preliminary cost estimates were developed for the Big Branch Pump Station (BBPS) Project for the Town of Apex. This costs include the associated gravity sewer and force main. **Table ES-3** provides a summary of the total construction cost estimate for the recommended alternative.

Table ES-3: Preliminary Construction Cost

Category	Cost
Big Branch 1 Draw	\$870,000
Big Branch 1-2 Draw	\$590,000
Big Branch 2 Draw	\$820,000
Cross Country Gravity Sewer	\$12,320,000
Feltonville Branch	\$640,000
Pleasant Park Branch	\$1,550,000
Big Branch Pump Station	\$14,280,000
Single Force Main	\$6,940,000
Total	\$38,010,000
Final Design Phase Services (7%)	\$2,650,000
Survey Investigations (1%)	\$380,000
Geotechnical Borings (1%)	\$380,000
Construction Phase Services (6%)	\$2,270,000
Total	\$43,690,000

Various funding opportunities were also evaluated to determine if the Town has eligibility to receive extra funding towards the project costs. **Table ES-4** provides a summary of the identified opportunities the Town is eligible to pursue.

Table ES-4: Funding Opportunities

Funding Opportunity	Advantages	Application Dates
American Rescue Plan Act (ARPA)	<ul style="list-style-type: none"> • Grant funding directly allocated to Town from federal government • No anticipated National Environmental Policy Act review requirements • Town was allocated \$5.2 million of ARPA funds. • Draft State Budget includes \$360 million of ARPA funds that the Town could apply for 	No application required for Town allocation. State fund application process has not been finalized but anticipated to be available Spring 2022.
NC DEQ Clean Water State Revolving Fund	<ul style="list-style-type: none"> • Below market rate interest • Can be combined with other grant funding sources such as ARPA • Projects can be funded up to \$30 million per funding round 	Fall and Spring Rounds Annually
EDA Public Works and Economic Adjustment Assistance Program	<ul style="list-style-type: none"> • Grant Financing up to an estimated \$ 3 million • Generally, requires a 50/50 match from the Town • Requires a demonstrated economic benefit associated with the capital project 	Rolling Applications