Branchville IHZ Study

Summary of Wastewater Collection Treatment Facility and Infrastructure Analysis

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Introduction/Overview

Tighe and Bond contracted with the Town of Ridgefield to provide engineering and technical services for a wastewater disposal and infrastructure analysis which will be conducted in an effort to assess the feasibility of implementing an Incentive Housing Zone (IHZ) in the Branchville area. The density requirement of an IHZ in combination with the soil and hydraulic characteristics, steep slopes and proximity of the Norwalk River to the Branchville area would likely require that sanitary sewer service be extended to the Branchville area. The feasibility of providing this service will be a determining factor in the feasibility of implementing an IHZ in Branchville.

Incentive Housing Zones

Connecticut General Statutes Section 8-13 allows Incentive Housing Zones (IHZ), which are overlay zones that enable Incentive Housing Development by right. The Statute provides incentives to municipalities for creating Incentive Housing Zones (IHZ) in eligible locations, such as, near transit facilities, an area of concentrated development or an area because of existing, planned or proposed infrastructure that is suitable for development as an IHZ. Developable land excludes publicly and privately owned property slated for public uses, parks, recreation areas, dedicated open space land, other land where restrictions prohibit development, wetlands or watercourses and areas exceeding one-half or more acres of contiguous land where steep slopes or other topographic features make it unsuitable for development.

The Statute authorizes the Commissioner of the Department of Housing (DOH) to "make grants to municipalities for the purpose of providing technical assistance and pre-development funds in the planning of incentive housing zones, the adoption of incentive housing zone regulations and design standards, the review and revision as needed of applicable subdivision regulations and applications to the Secretary for preliminary or final approval".

Incentive Housing Development (IHD) means a residential or mixed-use development that meets the following criteria – is located within an DOH approved IHZ, is eligible for financial incentive payments, and sets aside lower cost units for a minimum of 20% of the households earning 80% or less of the area median income (AMI) for minimum of 30 years. A unit is affordable if it costs no more than 30% of a person's annual income to live there.

The municipality's zoning commission must establish the IHZ as an overlay zone. The municipality receives the incentives only for IHDs that are developed in a state-approved IHZ.

Incentive Housing Zone Requirements (shall satisfy 1 thru. 7)

1. The zone shall be consistent with the State Plan of Conservation and Development and be located in an eligible location

2. Regulations of the zone shall permit, as of right, incentive housing development

3. Zone must comply with minimum allowable density requirements:

   - 6 units/acre for single-family housing
   - 10 units/acre for duplex or townhouse housing
   - 20 units/acre for multifamily housing

   Note that for smaller communities, DOH may approve lower densities. Additionally, DOH may waive density requirements for land "owned or controlled" by a municipality, land trust, housing trust fund, or non-profit housing agency, provided development will be 100% set aside at 80% of AMI.

4. Minimum as of right density allowed by the zone must increase the density allowed by the underlying zone by at least 25%

5. Minimum densities prescribed above shall be subject only to site plan or subdivision procedures, and shall not be subject to special permit or special exception procedures, requirements or standards

6. IHZ may consist of one or more sub-zones

7. IHZ land area may not exceed 10% of the total land area or aggregate area comprised of IHZ and sub-zones in a municipality may not exceed 25%

The wastewater feasibility study is related to establishing the potential for achieving the development densities required by the IHZ.

Transit Oriented Development

Transit-oriented development, or TOD, is a type of community development that includes a mixture of housing, office, retail and/or other amenities integrated into a walkable neighborhood and located within a half-mile of quality public transportation. At Reconnecting America, we believe it is essential that TOD creates better access to jobs, housing and opportunity for people of all ages and incomes. Successful TOD provides people from all walks of life with convenient, affordable and active lifestyles and create places where our children can play and our parents can grow old comfortably.

Some of the benefits of TOD include:

1. Reduced household driving and thus lowered regional congestion, air pollution and greenhouse gas emissions
2. Walkable communities that accommodate more healthy and active lifestyles
3. Increased transit ridership and fare revenue
4. Potential for added value created through increased and/or sustained property values where transit investments have occurred
5. Improved access to jobs and economic opportunity for low-income people and working families
6. Expanded mobility choices that reduce dependence on the automobile, reduce transportation costs and free up household income for other purposes.

As a member of the Branchville TOD study team, we also understand that the Branchville area will be studied for the feasibility of implementing TOD strategies and development in the Branchville area. The scope of services described within this engineering and technical memorandum will also support and inform this effort. It is also our understanding that an IHZ will be integrated in the TOD plan if established feasible by this analysis.

It is important to understand that capacity of the existing wastewater infrastructure in the area, and the limitations of the existing soils and other physical constraints that would limit the ability to employ subsurface sewage disposal options. Potential wastewater treatment and disposal alternatives include connection to one of three area wastewater treatment plants, installation of a package treatment system, and installation of a community septic system. This memo presents a summary of our work.

Development Scenario

The proposed development scenario is based upon the Preferred Development Scenario developed by Fitzgerald and Halliday for the Branchville TOD study. The development scenario divides the TOD study area into 32 separate development areas, consisting of a mixture of commercial and residential development. The full build-out development scenario is presented in Figure 1 in Appendix A and consists of:

- 82,500 square feet of commercial space
- 108 one bedroom units
- 232 two bedroom units
- 123 three bedroom units

Development Scenario Compliance with IHZ Statutes

Connecticut General Statutes, Section 8-13 require that development in the IHZ must comply with minimum allowable density requirements:

- 6 units/acre for single-family housing
- 10 units/acre for duplex or townhouse housing
- 20 units/acre for multifamily housing

All proposed development blocks meet the minimum densities with the following exceptions:

- Block 7 has 9.9 townhouse units/acre. The lot size can be adjusted to achieve the IHZ threshold.
- Block 9 has 6.5 townhouse units/acre. There is a potential to add two additional units to achieve the threshold.
- Block 20 has 9.7 townhouse units/acre, but achieves the IHZ threshold when existing apartments are included.

Estimated Wastewater Flows

Wastewater Flows were conservatively estimated using a sewage generation rates as documented in Table 1. The residential sewage generation rates were based upon documented flow rates from similar developments, while the retail/office sewage generation rate was taken from the CTDPH Health Code.

Based upon the sewage generation rates used, the total estimated average sanitary sewer flow is 64,935 gpd, with a peak of 97,403 gpd. There have been no allowances added for infiltration/inflow.

TABLE 1
Sewage Generation Rates: Entire Project

Source	Number	Average Generation Rate	Average Estimated Flow (gpd)	Peak Estimated Daily Flow (gpd)
Commercial (Retail/Office)	82,500 sf	0.1 gpd/sf	8,250	12,375
1-bedroom	108	65 gpd	7,020	10,530
2-bedroom	232	110 gpd	27,060	40,590
3-bedroom	123	165 gpd	22,605	33,908
TOTAL			64,935	97,403

As shown in Figure 1, the development blocks are located partially or entirely within the Towns of Ridgefield, Redding and Wilton. A breakdown of sewage flow within each Town is presented in Table 2.

TABLE 2
Sewage Flow Rates by Town

Town	Estimated Average Flow (gpd)	Peak Estimated Daily Flow (gpd)
Ridgefield	47,910	71,865
Wilton	10,700	10,650
Redding	6,325	9,488
TOTAL	64,935	97,403

Estimated Water Flows

Water Flows were conservatively estimated using the same sewage generation rate above. An allowance was also added for irrigation using an assumption that 500 square feet per proposed dwelling unit would be irrigated. Fire flow was determined based upon the largest building in the proposed development scenario. Table 3 summarizes the water flow rates as follows:

TABLE 3
Estimated Water Flows

Demand Type	Estimated Flows (gpd)
Domestic Water	97,403 gpd
Irrigation	22,900 gpd
Fire	2,000 gpm

Water Service Feasibility

Water Service in the TOD area would be provided by Aquarion Water Company. Aquarion reports that a 16" water main is located in Danbury Road (Route 7) which extends up to

Branchville Road (Route 102). The 16" main then continues westerly up Branchville Road to provide water service to Ridgefield Center.

This 16" main is a transmission main only. Service lines will have to be installed to bring water service to each of the individual lots in the TOD area.

Gas / Electric / Telephone Service Feasibility

Additional utility companies were contacted as part of this project to determine the feasibility of providing gas, electric and telephone service to the TOD project area. The results are as follows:

- Eversource Energy provides three phase electrical service
- Eversource Energy confirmed that gas service to the site is not available
- Frontier Communications provides telephone service
- Comcast provides cable and internet service

Wastewater Service Feasibility

The remainder of this report discussed the feasibility of providing wastewater service to the TOD area. Three types of sewage disposal alternatives have been evaluated:

- Providing wastewater service by connecting to an existing municipal wastewater treatment facility;
- Providing wastewater service through the use of an onsite package treatment plant.
- Providing wastewater service through the installation of an onsite community septic system.

Connection Alternatives: Existing Wastewater Treatment Plants

There are 3 feasible locations where sewage from the project area can be treated and disposed:

1. South Street Wastewater Treatment Facility.
2. Route 7 Wastewater Treatment Facility.
3. Georgetown Wastewater Treatment Facility.

South Street Wastewater Treatment Facility

Overview: The South Street WWTP is located on South Street, east of the downtown business district. The treatment plant provides service to Sewer District No. 1, which includes downtown Ridgefield and the residential areas surrounding the downtown area. This treatment facility currently has a design capacity of 1.0 MGD. The Town is currently undergoing preparation of a Wastewater Facilities Plan (Phase 1) for this facility, which includes the design and construction of an eventual upgrade of the plant. Therefore, it is feasible to assume that capacity for the Branchville area would be available at this plant when the treatment facility is upgraded. However, any capacity increase at this facility must be specifically approved by the Ridgefield WPCA and the CT DEEP. In addition, project financing must be found to offset additional costs associated with any plant expansion required to treat the flow from the IHZ/TOD area.

Feasible Connection Points: There are two potential routes to connect the Branchville area to this plant:

> Alternative 1A: is to extend south from the existing sanitary sewer mains on Sunset Lane in the vicinity of the Quail Ridge Pump Station, and then follow the Ridgefield Rail Trail to Route 102, and then southeasterly along Route 102 to the Branchville area. This route is approximately 13,750 LF long. This route is presented in Figure 2 in Appendix A. This route has been determined to not be feasible as further explained below.
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> Alternative 1B: is to extend south from the existing sanitary sewer mains in Prospect Ridge Road, and then continue along Route 102 southeasterly to the Branchville area. The total distance is approximately 16,500 LF. This route is presented in Figure 3 in Appendix A.

Sewer District No. 1 would need to be expanded to incorporate the Branchville area under either Alternative 1A or 1B.

Upon review of the two alternatives with the Town of Ridgefield, it was learned that the rail trail path is privately owned by Eversource. In addition, the Town is aware of the presence of arsenic throughout the rail trail area. Alternative 1A is therefore not a feasible route for the sewer force main and has been eliminated from further consideration.

Route 7 Wastewater Treatment Facility

Overview: The Town of Ridgefield owns and operates a second treatment plant located on Ethan Allen Highway (U.S. Route 7) behind the medical office building. This plant treats sewage generated by all of Sewer District No. 2, which includes a majority of the businesses along U.S. Route 7 north of Great Pond Road. This treatment facility has a design capacity of 0.12 MGD, and treatment capacity at this plant is fully allocated. It is also not possible for any existing flow capacity to be reallocated to the Branchville area. Therefore, the facility cannot accept any new flows unless the plant is expanded. The Town is in the process of completing a Facilities Plan Report (Phase 2) for this treatment facility, and recommendations for improvements, if any, have not yet been determined.

As with the South Street Treatment Facility, any capacity increase at the Route 7 facility (if expanded) must be specifically approved by the Ridgefield WPCA and the CT DEEP. In addition, project financing must be found to offset additional costs associated with any plant expansion required to treat the flow from the IHZ/TOD area.

Feasible Connection Point: Alternative 2: A sewer connection from the Branchville Area could be made into the existing 8" sewer main located near the intersection of Route 7 with Great Pond Road. Approximately 19,500 LF of pipeline would need to be installed within the Route 7 right of way to reach this connection point. This route is presented in Figure 4 in Appendix A.

Sewer District No. 2 would need to be expanded to incorporate the Branchville area under Alternative 2.

Georgetown Wastewater Treatment Facility

Overview: The Georgetown Wastewater Treatment Plant is located south of Branchville on a site at the south side of Redding Road adjacent to the railroad spur. The developers of the former Gilbert and Bennett property as part of the redevelopment of the G& B site, expanded the existing sewage treatment plant from 75,000 gallons per day to 245,000 gallons per day in order to serve the new village. Treatment capacity at this plant is currently fully allocated, and the facility cannot accept any new flows unless the plant capacity is increased or existing flow capacity reallocated to the TOD area.

Feasible Connection Point: Alternative 3: A sewer connection from the Branchville Area could be made into the existing 8" sewer main located near the existing treatment facility in the Town of Redding. Approximately 5,900 LF of pipeline would need to be installed within the Route 7 right of way and adjoining local streets in the Georgetown section of Redding to reach this connection point. This route is presented in Figure 5 in Appendix A.

An intermunicipal agreement would be required between the Town of Ridgefield and the Town of Redding if connection is made into this treatment system and the treatment facility capacity expanded.

An overview of all 4 connection Alternatives is presented in Figure 6 in Appendix A.

Sewer Connection Cost Development

Opinions of probable cost for each sewer connection alternative were developed based upon the following assumptions:

1. Mobilization costs for each Alternative were assumed to be 5% of the total base cost estimate before contingencies.
2. Contingencies for each alternative were added as follows: 10% Contractor markup, 15% General Conditions, and 40% Engineering/Survey/Contingency.
3. An equivalent unit price per foot for the sewer connection was assumed for each alternative, with the length modified as appropriate.
4. Final paving in all roadways was assumed to be a trench repair, followed by milling and final overlay of ½ the roadway.
5. Traffic control costs were assumed to be a cost of $10/LF for state roadways. This is based upon an assumption of 2 officers, $50/hour, 10 hour work days, and 100'/day of pipe installation.
6. A unit price of $5/LF was assumed for general site restoration including curbing and sidewalk replacements that may be required.
7. The existence/amount of bedrock is not known at this time. For evaluation purposes, a quantity of 0.75 CY/LF of pipe was assumed for one half of the total pipe footage. This equates to approximately 6" of rock being removed within the 4' trench width.
8. An allowance of $20,000 was added for pipe crossings of the Metro-North railroad tracks.
9. Flushing/air release manholes were assumed to be required for approximately every 2,000 LF of pipe.
10. A pump station will be required to pump sewage from the Branchville Area to any one of the connection points. An allowance for the construction of this station has been

added to the overall cost estimates. This allowance assumes that the pump station will be a duplex submersible pump station with a precast concrete wet well and valve vault, and a small building to house an emergency generator and pump controls. The pump station site will be fenced and landscape screening provided as necessary.

A summary of the costs for sewer extensions for each of the Alternatives is presented in Table 4. An itemized breakdown is included in Appendix B.

TABLE 4
Opinion of Probable Costs*

Connection Alternative	Estimated Cost
1B	$6,300,000
2	$7,300,000
3	$2,650,000

* Pipeline only: does not include WWTP improvement costs

Treatment Plant Upgrade Costs

Costs to perform upgrades at the South Street and Route 7 treatment facilities in the Town of Ridgefield were not estimated for this project. It is assumed that any capacity increase required will be provided as part of upgrades which result from the ongoing facility planning work. At both the South Street and Route 7 Treatment Facilities, any capacity increase must be specifically approved by the Ridgefield WPCA and the CT DEEP. In addition, project financing must be found to offset additional costs associated with any plant expansion required to treat the flow from the IHZ/TOD area.

Costs for required improvements, if any, at the Georgetown treatment facility were not estimated for this report. An analysis of the existing treatment plant components must be conducted to confirm the extent of improvements that may be required at this facility.

On Site Sewage Disposal Options

Disposal of sewage flows from the IHZ / TOD area can be accomplished by the use of two types of on-site sewage disposal: a package treatment plant, or community septic system. The feasibility of each of these options was evaluated as part of this project.

Package Treatment Plant: Overview

A package treatment plant is a local treatment plant designed to treat small flows. It is often available in pre-fabricated modular units. These treatment plants are best suited for subsurface discharge (similar to a septic system), as opposed to surface discharge to a river or stream (similar to the existing treatment plants). Discharges to surface waters have much more stringent regulatory requirements, including effluent treatment limits, which can make them cost prohibitive. Subsurface disposal plants have much lower permitting requirements, however, the receiving soils must be conducive to subsurface discharge. The more favorable the soils, the smaller and less costly the package treatment plant will be.

An example of a potential package treatment plant system is the Amphidrome system which is on CTDEEP's approved list of alternative sewage treatment systems. The Amphidrome system is a biological nutrient removal (BNR) process utilizing a submerged attached growth bioreactor operating in a batch mode. The deep, bed sand filter is designed for the simultaneous removal of soluble organic matter such as nitrogen and suspended solids, within a single reactor.

To achieve simultaneous oxidation of soluble material, nitrification, and denitrification in a single reactor, the process must provide aerobic and anoxic environments for the two different populations of microorganisms. The Amphidrome system utilizes two tanks and one submerged attached growth bioreactor, subsequently called Amphidrome reactor. The first tank, the anoxic/equalization tank, is where the raw wastewater enters the system. The tank has an equalization section, a settling zone, and a sludge storage section. It serves as a primary clarifier before the Amphidrome reactor.

This Amphidrome reactor consists of the following three items: underdrain, support gravel, and filter media. The underdrain, constructed of stainless steel, is located at the bottom of the reactor. It provides support for the media and even distribution of air and water into the reactor. The underdrain has a manifold and laterals to distribute the air evenly over the entire filter bottom. The design allows for both the air and water to be delivered simultaneously, or separately, via individual pathways, to the bottom of the reactor. As the air flows up through the media the bubbles are sheared by the sand; producing finer bubbles as they rise through the filter. On top of the underdrain is 18”, (five layers), of four different sizes of gravel. Above the gravel is a deep bed of coarse, round, silica sand media. The media functions as a filter; significantly reducing suspended solids, and provides the surface area for which an attached growth biomass can be maintained.

To achieve the two different environments required for the simultaneous removal of soluble organics and nitrogen, aeration of the reactor is intermittent, rather than continuous. Depending on the strength and the volume of the wastewater, a typical aeration scheme may be three to five minutes of air and ten to fifteen minutes without air. Concurrently, return cycles are scheduled every hour, regardless of the aeration sequence. During a return, water from the clear well is pumped back up through the filter and overflows into the return flow/backwash pipe. A check valve in the influent line prevents the flow from returning to the anoxic/equalization tank, via that route. The return flow/backwash is set at a fixed height above both the media and the influent line; and the flow is by gravity back to the front of the anoxic/equalization tank.

The cyclical forward and reverse flow of the waste stream, and the intermittent aeration of the filter, achieve the required hydraulic retention time and create the necessary aerobic and anoxic conditions to maintain the required level of treatment.

The following is a partial list of approved and installed Amphidrome Wastewater Systems in Connecticut:

- District 17 Middle School, Killingworth, CT
- The Mews Condominiums, Madison, CT
- Daniel Hand High School, Madison, CT

Community Septic System: Overview

A community type system is one where each building or parcel has its own septic tank, but is piped to a centralized subsurface leaching field, which accepts effluent from a number of individual properties. All community systems are regulated by the Connecticut Department of Energy and Environmental Protection.

<u>Potential Additional Pretreatment Requirements</u>: Additional (enhanced) pretreatment, other than by a septic tank, can provide some additional attenuation of pathogens above that provided by a septic tank. Additional pretreatment is often used for reduction of the organic

and solids concentrations in the pretreated effluent discharged to the system. Investigators have shown that additional pretreatment beyond that provided by a septic tank will substantially increase the rate of infiltration into the soil surrounding the system by reducing the clogging effect of the biomat. It can also help to maintain aerobic conditions in the unsaturated zone by reducing the oxygen demand caused by the metabolic processes of soil microorganisms that utilize the organic matter as a source of food and energy. This will result in fostering the growth of aerobic soil microflora that will have antagonistic effects on viruses. If disinfection is provided following the additional pretreatment, pathogens can be greatly attenuated. The requirements for pretreatment can only be known after the soil capacities are evaluated, and effluent totals are known.

Additional pretreatment may include flocculation, clarification, and disinfection, and may be chemical, biological, or ultraviolet in nature.

Feasibility Requirements

In order to determine the feasibility of each of these technologies, the soils capacity to accept proposed sewage flows and its capacity to renovate flow and remove nutrients such as nitrogen and phosphorous would have to be evaluated, along with the feasibility of removing pathogens. Depending on these soil capacity factors, additional pretreatment and/or devices to provide uniform flow distribution may be required.

More specifically, the system constraints are typically dictated by the soil type, loading rate, effects of seasonal high groundwater, vertical separation, groundwater mounding, and horizontal separation from existing features such as structures, slopes and adjoining property lines.

Soil Suitability

Initial screening of the soil types in the project area at the start of this project was based solely upon a review of information included in the NRCS Soil Survey.

Soils in the study area include Ridgebury, Saco and Rippowam soils which are poorly drained and typically found in wetland areas. Ridgebury soils are typically found on slopes between 0 to 8 percent. This component is on depressions on uplands. The parent material consists of coarse-loamy lodgment till derived from gneiss, granite, and/or schist. Depth to a root restrictive layer, densic material, is 14 to 32 inches. The natural drainage class is poorly drained. Water movement in the most restrictive layer is low. Available water to a depth of 60 inches (or restricted depth) is moderate. Shrink-swell potential is low. This soil is not flooded. It is not ponded. A seasonal zone of water saturation is at 3 inches during the months of January, February, March, April, May, November and December. Organic matter content in the surface horizon is about 10 percent.

Hinckley soils are found on both sides of U.S. Route 7 south of Route 102, as well as at the intersection of Route 102 and Playground Road. The Hinckley component makes up 40 percent of the map unit. Slopes are 3 to 15 percent. This component is on eskers on valleys, kames on valleys, outwash plains on valleys, terraces on valleys. The parent material consists of sandy and gravelly glaciofluvial deposits derived from granite and/or schist and/or gneiss. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is excessively drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches is very low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 5 percent.

Udorthents, soils whose composition is unknown because of fill deposition, but are generally well draining occur at the Route 102 / U.S. Route 7 intersection, dividing the two pockets of Hinckley soil described above. The little league field behind the CVS was mentioned by the First Selectman as a site that was believed to have suitable underlying materials. The Udorthents component makes up 50 percent of the map unit. Slopes are 0 to 25 percent. This component is on urban land. The parent material consists of drift. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is low. Available water to a depth of 60 inches is moderate. Shrink-swell potential is low. This soil is not flooded. It is not ponded

The balance of soils in the project area are Charlton – Hollis complex soils, which are loamy and rocky, with shallow bedrock depths and bedrock outcrops.

Reviewing the soil survey in greater detail reveals that the soils most suitable for subsurface disposal are Hinckley soils. These soils are classified as a loamy sand, and fall into Hydrologic Soil Group A, which is well-drained. However, potential issues of concern also exist in these areas specifically in regards to the depth to groundwater and depth to bedrock. Shallow groundwater and/or bedrock in these areas may preclude the use of subsurface systems. It may be necessary to raise the grade by bringing in suitable fill material to create the clearances needed for subsurface disposal.

The initial review concluded that soils in the area were generally limited for subsurface sewage disposal. However, during the charrette meetings, Tighe & Bond was informed that there are pockets of suitable soil in the area. Additionally, discussions with the Health Department revealed that there are no known failing septic systems in the area.

The TOD study team was provided with soil testing results for a septic system feasibility study that was conducted for Joseph Ancona at the Little League field, which is within the band of favorable Hinckley soils described above. The testing revealed that there was no groundwater, but the minimum depth to ledge was 67 inches. Additionally, the percolation rate of the underlying soils was 1 inch in 20 minutes.

Additional Soil Testing Requirements

Our prior experience with Charlton soils indicates that they are often poorly suited for groundwater discharge systems. Conversely, udorthents are generally defined as areas where the existing soils have been disturbed and fill materials have been imported to overlay the virgin substrate material.

If potentially suitable parcels are found for either type of on-site system, the soils would need to be tested for depth to groundwater to evaluate the seasonal high groundwater elevation. Additionally, the hydraulic conductivity of the soil would also need to be evaluated.

Flow Distribution

The basic objective of flow distribution is to uniformly distribute the septic tank effluent to the infiltrative surfaces of the leaching system so as to maximize the volumetric renovative capacity of the soil. However, there is considerable debate as to whether the distribution should be by means of gravity flow to the various units of the leaching system or by means of a pressure distribution system (PDS). In the latter case, this would require the use of septic tank effluent pumping stations or dosing siphons. The arguments on both sides of this issue appear persuasive. The use of pressure distribution for individual residential subsurface soil absorption systems is arguable because of problems resulting from probable lack of maintenance by individual residence property owners. However, for large systems where the system is extensive and system maintenance is required as part of the permit issued for such systems, pressure distribution may be warranted. The extent of the need for uniform flow can only be known after the soil capacities are evaluated, and effluent totals are known.

It is also important to know the source of the flow that will be generated, and the volume of effluent that will be generated by the sources.

Characteristics of Wastewater Flows

Restaurants

Historically, on-site subsurface wastewater absorption systems (SWAS) serving restaurants and other food processing and serving establishments often fail within a short time after being installed. Failure has been evidenced by severe clogging of the infiltrative surface of the SWAS, resulting in backup of wastewater into the building sewers and/or surfacing of inadequately treated wastewater to the ground above the SWAS. These problems generally resulted from failure to take the wastewater characteristics into account when sizing the on-site facilities such as grease trap(s), septic tank(s) and SWAS.

Restaurants are by far the most common food processing and serving establishments that experience problems with an on-site SWAS. Restaurant wastewater typically has a higher organic strength (BOD5) and TSS, and a much higher content of fats, oils and grease (FOG) than residential wastewater. The high FOG content compounds the effect of the high organic strength of restaurant wastewater. At the high temperatures used for many food-processing operations, animal fats, such as butter and lard, and oils from cooked meat are in liquid form. Such fats and oils tend to solidify as the temperature drops and thus a major portion (60-80%) can be separated from the wastewater by cooling under quiescent conditions in properly designed grease traps. However, in recent times, many restaurants have increased their use of vegetable oils in lieu of solid fats. Vegetable oils are harder to separate, as they are in liquid form at much lower temperatures than animal fats and oils. In some instances, specially designed grease interceptors and other grease recovery devices must be used to remove these oils. Many restaurants have ineffective means for removing FOG, with the result that relatively high concentrations of FOG can pass through the septic tank serving the restaurant and reach the biomat that forms on the infiltrative surfaces of the SWAS. When this happens, the FOG can clog the biomat and thereby prevent passage of the wastewater through the infiltrative surfaces. In addition, the high oxygen demand exerted by restaurant wastewater can cause anaerobic conditions to exist below the biomat if the infiltrative surfaces of the SWAS have been sized on the basis of typical residential wastewater infiltrative surface hydraulic loading rates. When such conditions occur, the results will be a reduced ability of the unsaturated soil beneath the SWAS to remove contaminants from the wastewater and degradation of the ground water quality. Where enhanced pretreatment will not be provided to reduce the strength of the restaurant wastewater to or below that of residential wastewater, it is necessary to provide adequate pretreatment for removal of FOG, and reduce the infiltrative surface hydraulic loading rate to account for the high strength of such wastewaters.

Offices

Wastewater from office buildings is generated in office restrooms, public restrooms, and, in some instances retail shops, restaurants and snack bars. While similar in many respects to residential wastewater, office wastewater is apt to have higher nitrogen concentrations because of the lack of dilution from bath and shower wastewater and other low strength wastewater components found in residential wastewater.

Regulatory Requirements

Package Treatment Plant: Since the discharge from the proposed development scenario would exceed 5,000 gpd, the package treatment system would be subject to review and approval by of the Connecticut Department of Energy and Environmental Protection.

Community Septic System: A Permit Application for Wastewater Discharges from Subsurface Sewage Treatment and Disposal Systems is required from CTDEEP. The application includes a fee and public notice requirements, and basic background information on the applicant. The source and volume of effluent must be identifies, and potential storage of toxic and hazardous substances must be inventoried. Additionally, pollutant loading and groundwater mounding analysis must be provided to determine compliance with effluent limitations.

Permit conditions for both systems will also include monitoring and maintenance requirements, scaled to the size and scope of the system.

Groundwater Mounding Analyses: CTDEEP regulations require that a three foot vertical separation be provided between the bottom of the subsurface wastewater absorption system and the groundwater mound as a result of the wastewater discharge.

Downgradient Sensitive Receptors: CTDEEP Guidance for Design of Large-Scale On-Site Wastewater Renovation Systems requires that a travel time of 56-days be provided between the subsurface wastewater absorption system (SWAS) and sensitive receptors (e.g. the outer limit of the cone of depression of a public drinking water supply well, a surface water body used, or intended to be used, as a source of public drinking water supply, a private drinking water supply well serving an individual residence, or an impoundment used for aquaculture) and a 21-day travel time be provided to all other points of concern. The Norwalk River is classified as Surface Water Quality Class B. Class B designated uses are habitat for fish and aquatic life and wildlife and recreation. Cooper Pond Brook is Class A, which designated uses include habitat for fish and other aquatic life and wildlife and recreation, and potential drinking water supplies. Travel times to these receptors will require further detailed study.

Location

Any community septic system or package treatment plant must be located where groundwater and bedrock is relatively deep, soils are generally gravelly and permeable, and a sufficient distance away from wetlands and watercourses such that transport of pollutants is minimized and minimum travel times are achieved.

Sites with Best Potential

The sites with the best potential based upon our secondary screening are those properties located in Udorthents or Hinckley soils areas. Priority should be given to Town-owned properties for further exploration. After a review of Town owned parcels within the vicinity of the TOD area, the only Town parcel meeting this requirement is at Branchville Elementary School.

Two additional privately owned large parcels that can also be considered for potential sites are the existing Little League field, and the parcel immediately north at 34 Playground Road. The Little League field provides more separation distance to watercourses, although the soils may be more suitable on the 34 Playground Road parcel.

The locations of all three parcels are shown on Figure 7 in Appendix A.

A further review of each site determined that the Branchville Elementary School is located too close to the Norwalk River, and the parcel north of the little league field is too close to Cooper Pond Brook. Therefore, the only feasible site was determined to be the Little League field. A more detailed analysis was performed on this site, and the results of these analyses are discussed below.

Design Requirements

Design requirements for a community system are similar to that of a package treatment plant. Each of the categories discussed below is applicable to either type of technology.

Flow Rate

As previously stated, the total average wastewater flow generated from retail and residential development is approximately 61,085 gpd, after applying the peaking factor of 1.5, the peak flow rate is 91,628 gpd.

Ground Slope

Slopes less than 15% are preferred for leaching system installation. Slopes at the Little League field are less than 15% and therefore the site meets this design requirement.

Pretreatment Area Requirements

A wastewater pretreatment system will be required in order to remove nitrogen due to the volume of wastewater discharged. A septic tank effluent total nitrogen concentration of 39 mg/L was assumed for mixed use development without pretreatment. The unpaved land surface area required for pretreatment to dilute the nitrogen in the wastewater down to the CTDEEP acceptable concentration of 10 mg/L is 26.2 acres. This area would have to be in the same drainage area as the leaching system. If the leaching system were constructed in select fill with a discharge to the atmosphere at the toe of the select fill such that the wastewater does not infiltrate into the native soils beneath the mound of select fill, then CTDEEP requires ultraviolet disinfection. Based upon the provided soils data and the design flow, the required area is 3.33 acres. The Little League field is 1.65 acres in size. It does therefore not have enough leaching area to meet the pretreatment design requirement.

Leaching System Long Term Acceptance Rate

Per CTDEEP requirements, the long term acceptance rate (LTAR) of wastewater permitted to be discharged into a soil depends on the permeability of the soil. Therefore, a less permeable soil will require more effective leaching area. Based upon the soil testing results provided to the TOD project team, the leaching area required is 116,279 square feet.

Assuming that the effective leaching area would be 80 percent of the overall site footprint, the result would be a disposal area of 145,348 square feet, or 3.33 acres for full build out. Including the 75 foot buffer required around the entire leaching area, the required land area for either type of on-site treatment system is 283,000 square feet, or 6.49 acres.

It should be noted that the Little League field is only 72,000 square feet. It is therefore insufficiently sized to provide the required leaching area.

Leaching System Size

The leaching system sized for installation would need to consist of 5,814 linear feet of 20-foot wide leaching beds, spaced 5 feet edge to edge. If the Little League field is 270 feet long, the required width of the system is 539 feet, which is more than what is available at the site. Constraining the width to 270 feet results in a 102.3 foot high wastewater mound. Therefore, the Little League field is too constrained, and a parcel with a longer width is needed.

Nitrogen Concentration

CTDEEP requires that the concentration of nitrates (complete conversion of ammonia and organic nitrogen to nitrate is assumed) at the property line or wetlands boundary downgrade from the leaching field be less than or equal to 10 mg/L as nitrogen. A wastewater pre-treatment system will be required to remove the nitrogen from the wastewater prior to discharge to a leaching system. If the pretreatment system produces an effluent with total nitrogen concentrations of less than 10 mg/L, then the CTDEEP requirement will be satisfied.

Bacterial Travel Time

CTDEEP requires a bacterial travel time of 21 days prior to the wastewater plume reaching either a property line or a wetlands boundary. Based on the mound computed, the Little League field does not provide sufficient travel time.

Additional Evaluations

Based upon the evaluations conducted, it is evident that an on-site treatment system is not a feasible option for providing sewer service for the full build-out option of the IHZ / TOD project Area.

Tighe & Bond was therefore asked to evaluate the feasibility of a more limited scenario involving only development of the parcels located on the west side of Route 7, (Development blocks 5 to 14 as shown on Figure 1). This scenario would consist of the following:

- 23,000 sf office/retail
- 66 one bedroom units
- 86 two bedroom units
- 19 three bedroom units

Estimated average wastewater flows with this scenario are 19,185 gpd, and 28,778 gpd after applying the peaking factor. Additional calculations were performed using the design criteria above to determine the suitability of the Little League Field for on-site treatment.

It was determined that the Little League Field does have enough physical space to accommodate the proposed flows for pretreatment and leaching area. However, the site does not meet the minimum 21 day travel time to critical receptors. Therefore, subsurface sewage disposal would be infeasible for the limited build out scenario.

Based upon the soil test data provided, and additional reasonable assumptions about the surrounding soils in the area, the maximum peak flow that can be treated and disposed of at the Little League Field using an on-site system is approximately 8,500 gpd. This corresponds to an area that may include blocks 5 and 7 through 9.

Conclusions

Conclusions reached during the preparation of this report are as follows:

1. Based upon the Preferred Development Scenario for the TOD study area, the peak estimated sewage flow will be 97,500 gpd.
2. Estimated peak water demand is 120,300 gpd.
3. It is feasible to provide water, three phase electric, cable/internet and telephone service to the project site. Gas service is not available.

4. It is feasible to connect the TOD area to 3 existing wastewater treatment facilities. Construction of a new pump station and connecting force main would be required under each of 4 separate connection routes. Costs to connect range from $2.5 million to $7.3 million. Additional costs, if any, to provide capacity at the 3 treatment facilities were not determined.

5. Two types of systems can be used for on-site treatment: Package Wastewater Treatment Plants and Community septic systems. The design requirements for each are similar. Pretreatment of the wastewater will be required under either option

6. Three parcels were identified as potential candidates for on-site sewage disposal. One is Town owned (Branchville Elementary School), and two are privately owned (Little League Field and 34 Playground Road). Branchville School and 34 Playground Road were eliminated from further consideration due to their proximity to existing watercourses.

7. The Little League baseball field by itself is not large enough to support an on-site treatment system under either the full or partial development scenarios evaluated. Based upon the soil test data provided, and additional reasonable assumptions about the surrounding soils in the area, the maximum flow that can be treated and disposed of at the Little League Field using an on-site system is 7,000 gpd.

8. Because there are no other parcels of sufficient size within the study area containing suitable soils to host the leaching field, on-site treatment is not a feasible alternative to provide wastewater treatment and disposal for the TOD project area.

9. Implementation of the IHZ, beyond a limited area of Blocks 5, and 7-9 will require connection to one of the three area wastewater treatment plants. Different combinations of development blocks may be possible, but in total cannot exceed an average daily flow of 5,667 gpd (peak of 8,500 gpd), and must meet the density requirements established by the IHZ.

In order to meet the requirements of the IHZ by statute, the following requirements apply:

1. *The zone shall be consistent with the State Plan of Conservation and Development and be located in an eligible location*

   The zone is consistent with the State Plan of Conservation and Development, which seeks to increase the number of such zones where public transit is available.

2. *Regulations of the zone shall permit, as of right, incentive housing development*

   Within the Town of Ridgefield, the regulations for the B-1 zone, which comprise much of the proposed IHZ area allow incentive housing, but by special permit. The underlying zones within the study area will need to be revised to conform to the statute. Zoning Regulations in the Towns of Wilton and Redding could also be revised to be consistent with CGS 8-13.

3. *Zone must comply with minimum allowable density requirements:*

   - *6 units/acre for single-family housing*
   - *10 units/acre for duplex or townhouse housing*
   - *20 units/acre for multifamily housing*

   Slight modifications to two of the development blocks will be necessary.

4. *Minimum as of right density allowed by the zone must increase the density allowed by the underlying zone by at least 25%*

The Zoning Regulations will need to be modified accordingly.

5. *Minimum densities prescribed above shall be subject only to site plan or subdivision procedures, and shall not be subject to special permit or special exception procedures, requirements or standards*

   Zoning Regulations will need to be modified accordingly.

6. *IHZ may consist of one or more sub-zones*

   The need for sub-zones will be identified as the zoning requirements are developed.

7. *IHZ land area may not exceed 10% of the total land area or aggregate area comprised of IHZ and sub-zones in a municipality may not exceed 25%*

   The proposed IHZ/TOD study area is significantly less than 10 percent of the land area of the municipality.

Inclusion of the IHZ within the Branchville TOD boundary is consistent with the requirement of Connecticut General Statutes Section 8-13, and will meet the minimum density requirements established by statute, provided the changes discussed in the memorandum are implemented. The full build-out of the IHZ Zone, and the TOD project area will need to be served by the public sewer alternatives.

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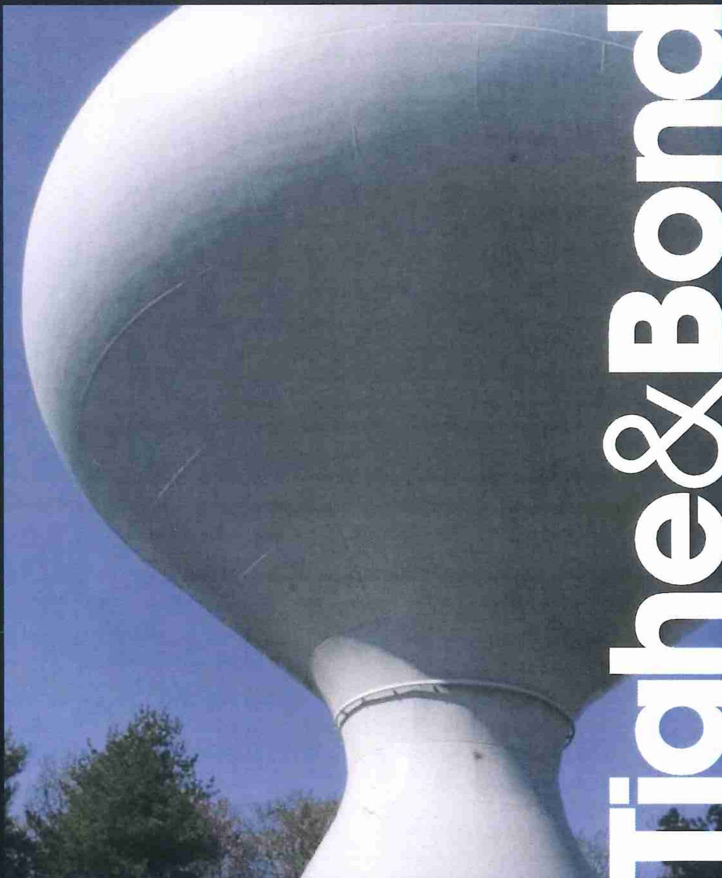


APPENDIX A

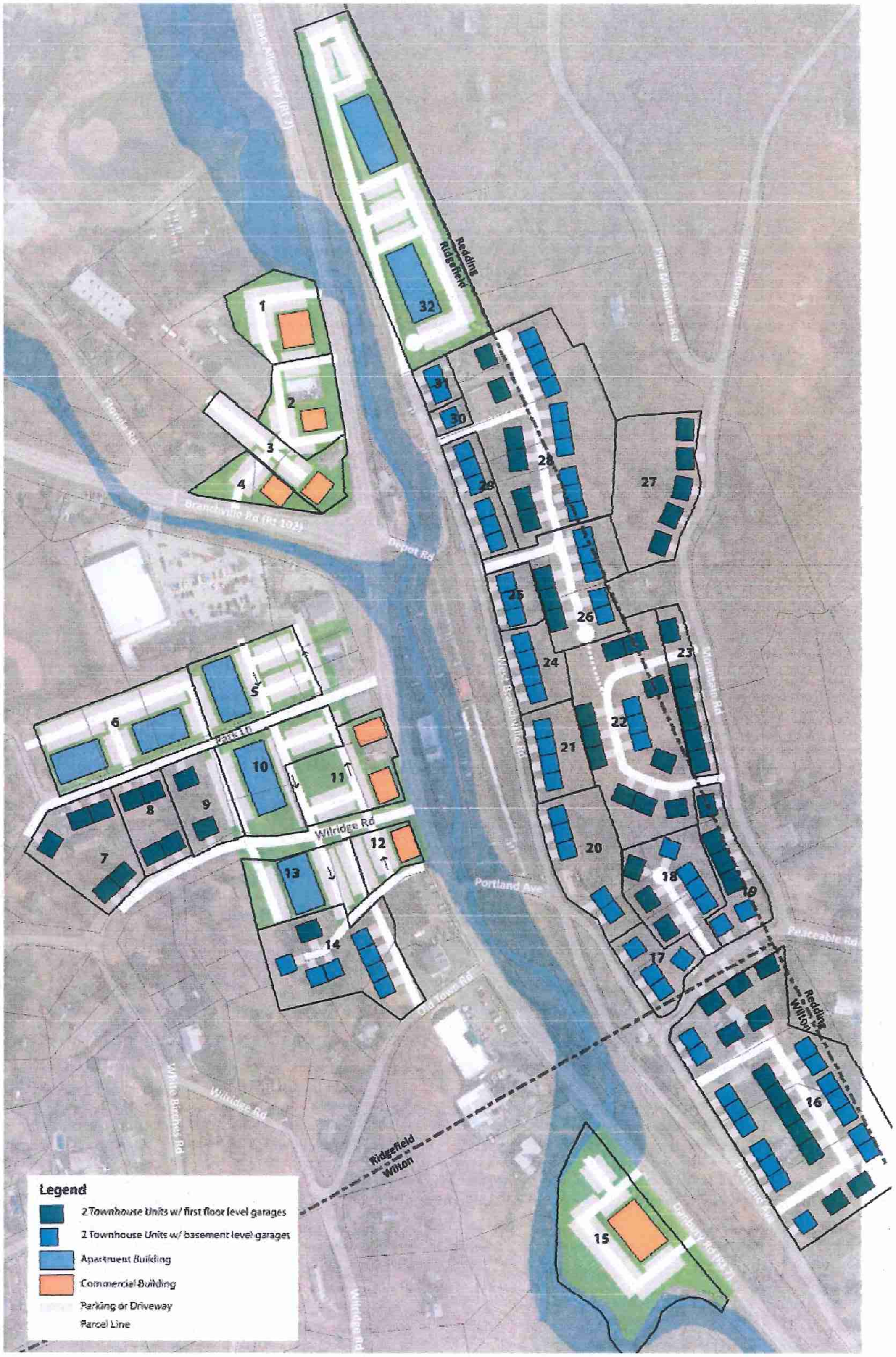


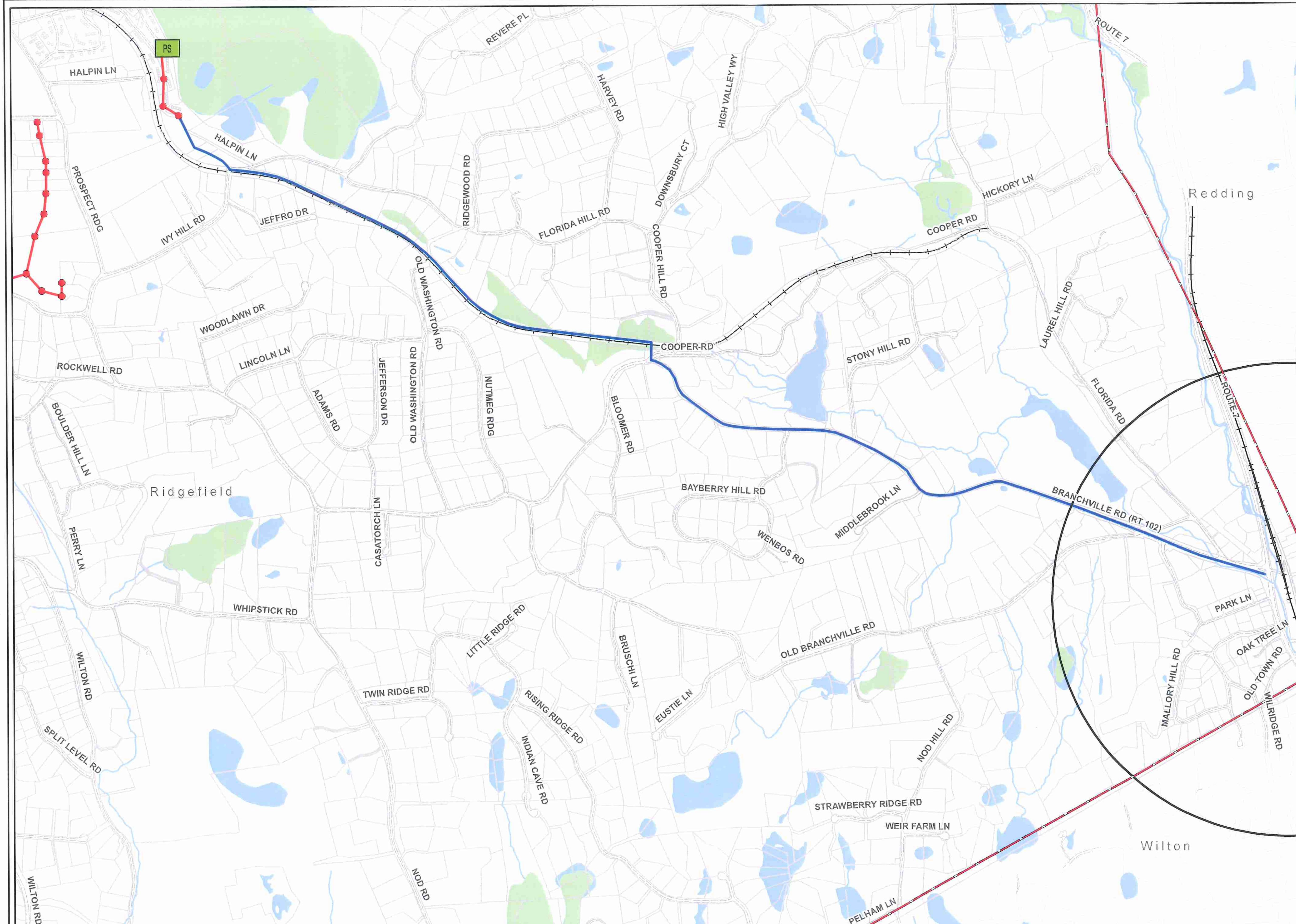
FIGURE 1
PREFERRED DEVELOPMENT SCENARIO
BRANCHVILLE TOD STUDY

Branchville Transit
Oriented Development Study
Ridgefield, Connecticut
May 2016

Tighe&Bond
www.tighebond.com

Data Source: CT DEEP and Town GIS data.

May 31, 2016-3:01pm Plotted By: sansonem
Tighe & Bond, Inc. J:\R\R0306 Ridgefield Wastewater Infrastructure\Drawing\Figures\Figure 1.dwg



SEWER CONNECTION ALTERNATIVE 1A

LEGEND

- Proposed Sewer
- Project Area
- Existing Sewer
- Streams
- ParcelPolygon
- Swamps
- Waterbodies
- Town Boundary

LOCUS MAP

N

0 250 500 1,000

Feet

1:12,000

NOTES

Data source: CT DEEP and Town GIS data

Branchville Transit Oriented Development Study
Ridgefield, Connecticut

May 2016

Figure 2

Tighe&Bond
Engineers | Environmental Specialists

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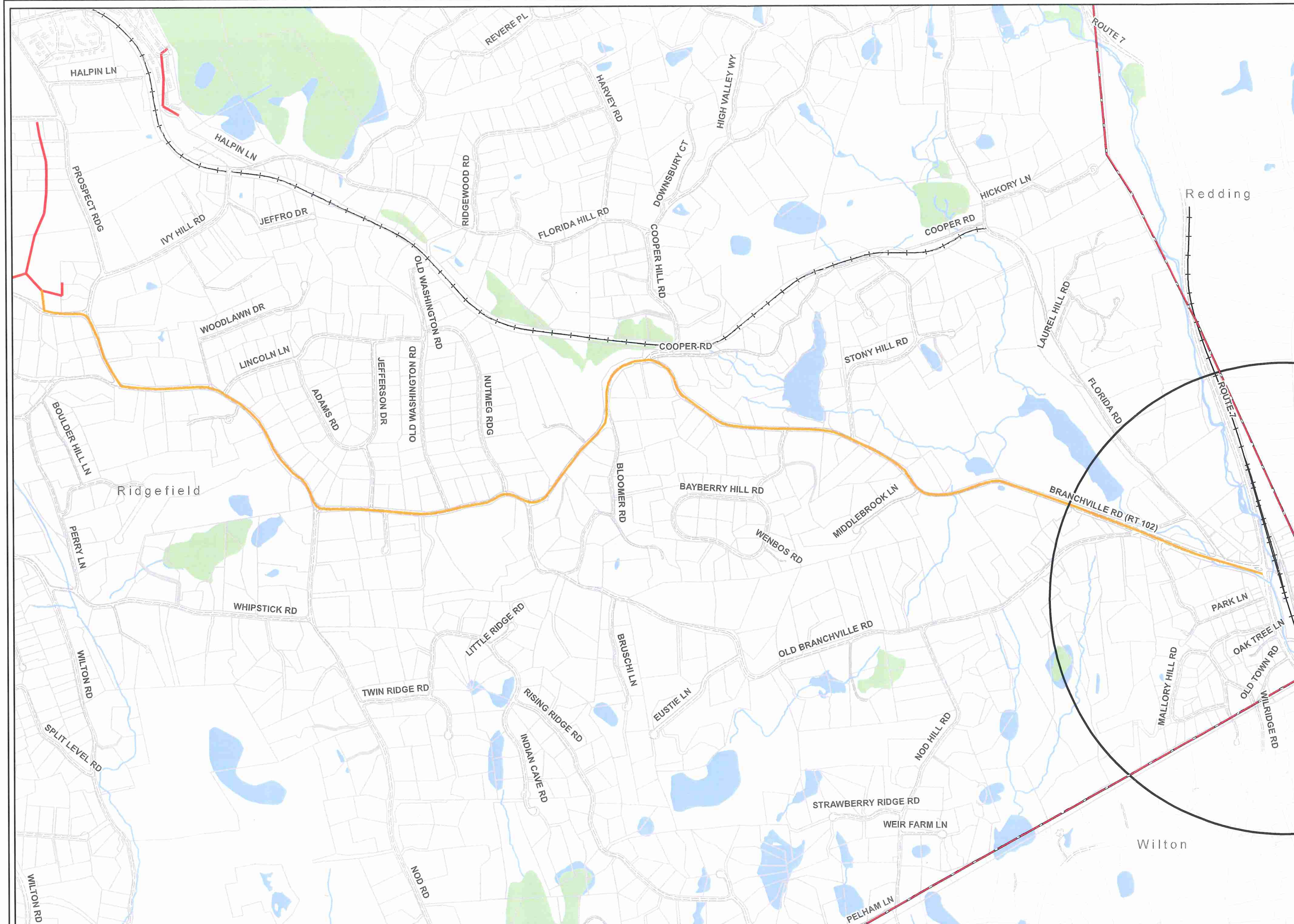

SEWER CONNECTION ALTERNATIVE 1B

LEGEND

- Proposed Sewer
- Project Area
- Existing Sewer
- Streams
- ParcelPolygon
- Swamps
- Waterbodies
- Town Boundary

LOCUS MAP

0 250 500 1,000
Feet
1:12,000

NOTES

Data source: CT DEEP and Town GIS data

Branchville Transit Oriented Development Study
Ridgefield, Connecticut

May 2016

Figure 3

Tighe&Bond
Engineers | Environmental Specialists

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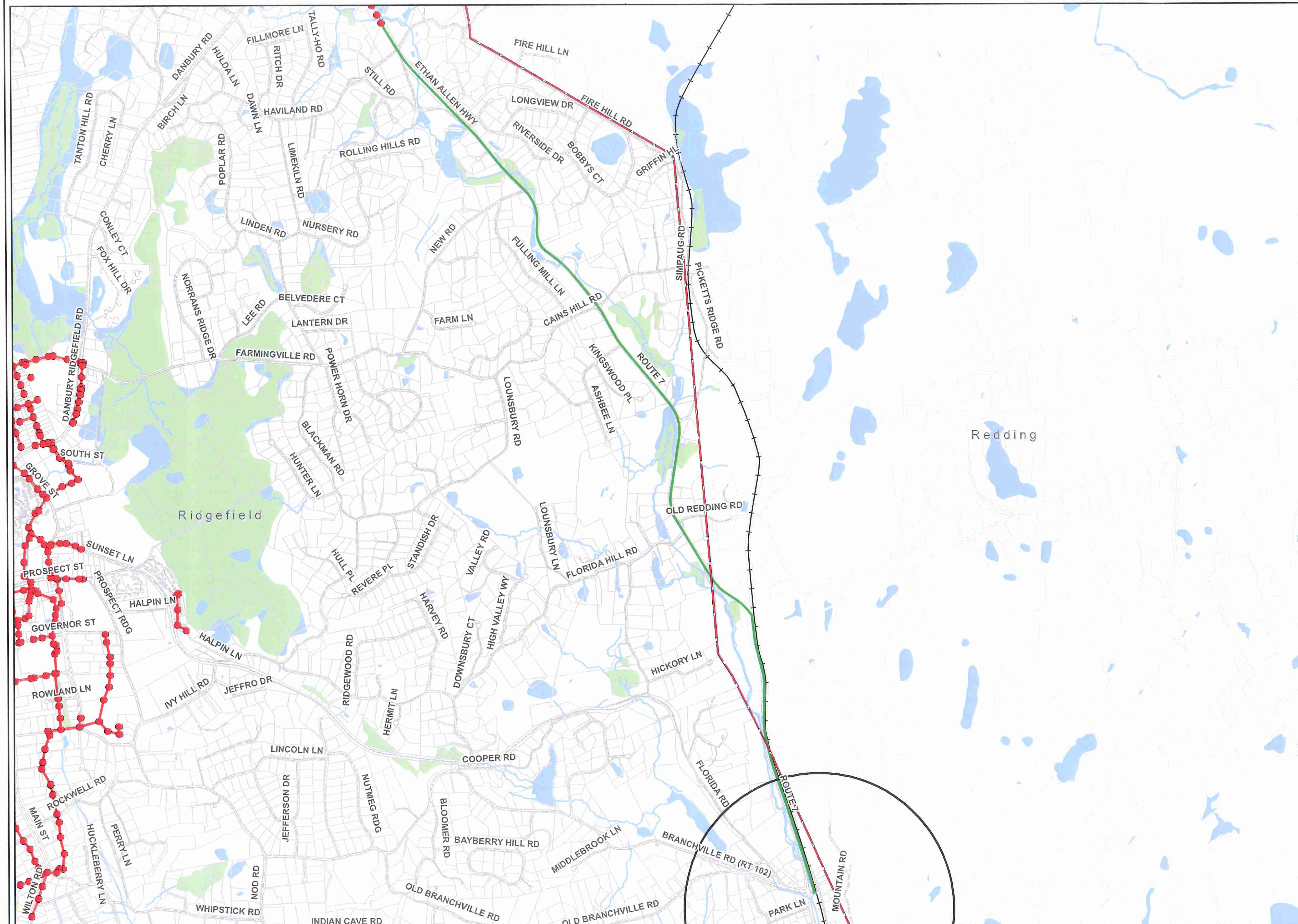

SEWER CONNECTION ALTERNATIVE 2

LEGEND

- Proposed Sewer
- Project Area
- Existing Sewer
- Streams
- ParcelPolygon
- Swamps
- Waterbodies
- Town Boundary

LOCUS MAP

N

0 375 750 1,500

Feet

1:21,000

NOTES

Data source: CT DEEP and Town GIS data

Branchville Transit Oriented Development Study
Ridgefield, Connecticut

May 2016

Figure 4

Tighe&Bond
Engineers | Environmental Specialists

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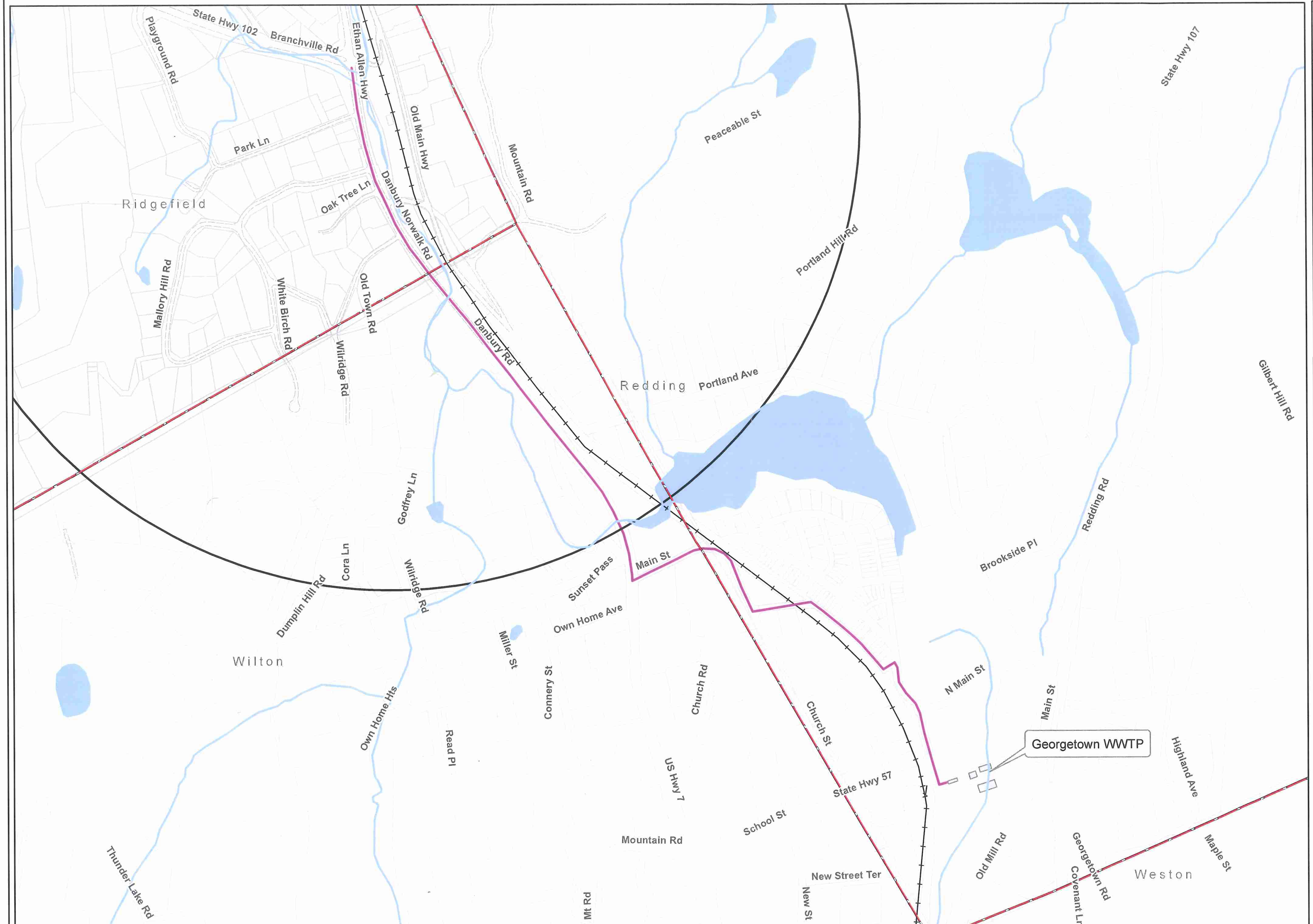

SEWER CONNECTION ALTERNATIVE 3

LEGEND

- Proposed Sewer
- Project Area
- Existing Sewer
- Streams
- ParcelPolygon
- Swamps
- Waterbodies
- Town Boundary

LOCUS MAP

N

0 125 250 500

Feet

1:6,000

NOTES

Data source: CT DEEP and Town GIS data

Branchville Transit Oriented Development Study
Ridgefield, Connecticut

May 2016

Figure 5

Tighe&Bond
Engineers | Environmental Specialists

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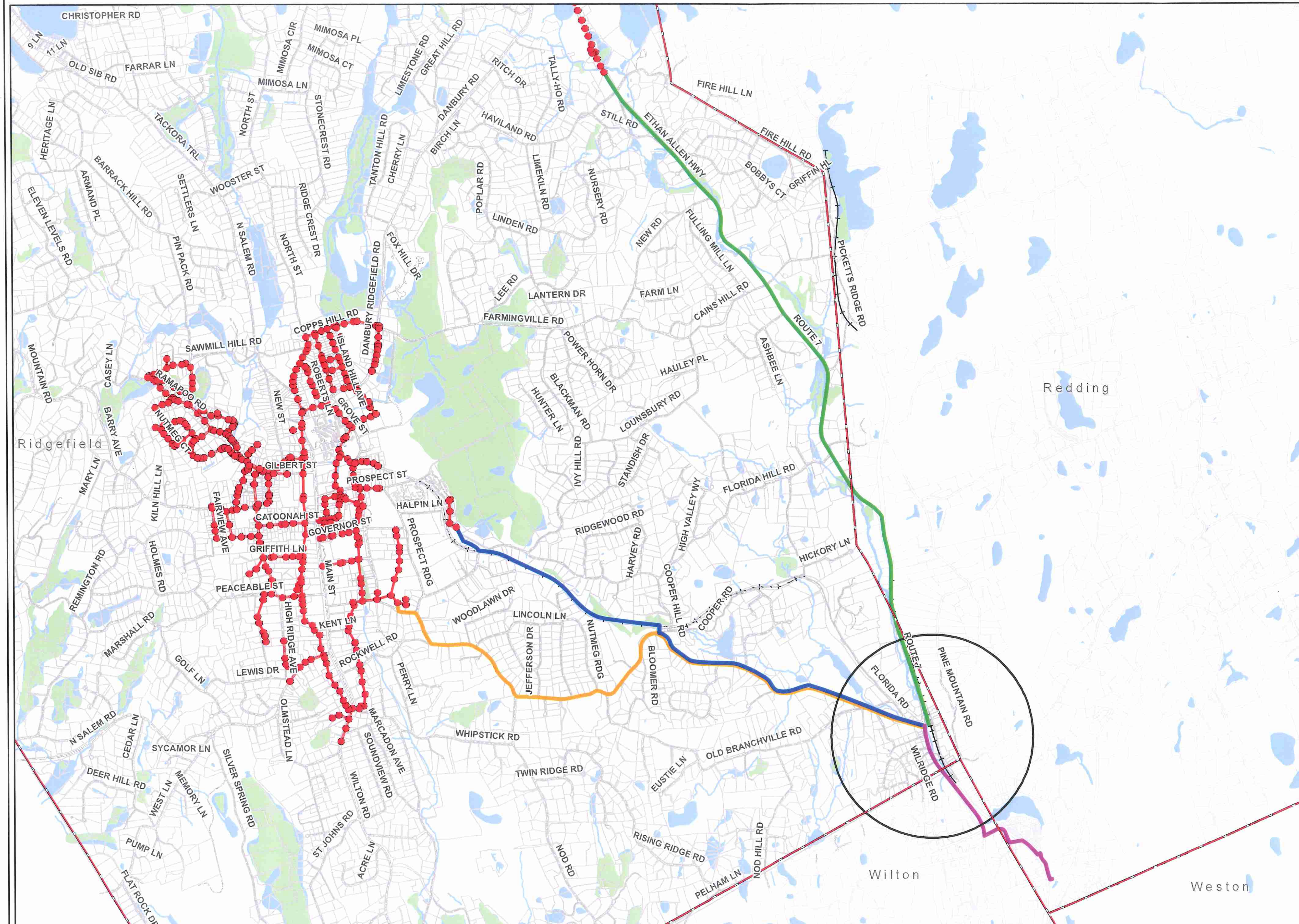

SEWER CONNECTION ALTERNATIVE OVERVIEW

LEGEND

- Alternative 1A
- Alternative 1B
- Alternative 2
- Alternative 3
- Existing Sewer
- Project Area
- Streams
- ParcelPolygon
- Swamps
- Waterbodies
- Town Boundary

LOCUS MAP

N

0 500 1,000 2,000
Feet
1:28,000

NOTES

Data source: CT DEEP and Town GIS data

Branchville Transit Oriented Development Study
Ridgefield, Connecticut

May 2016

Figure 6

Tighe&Bond
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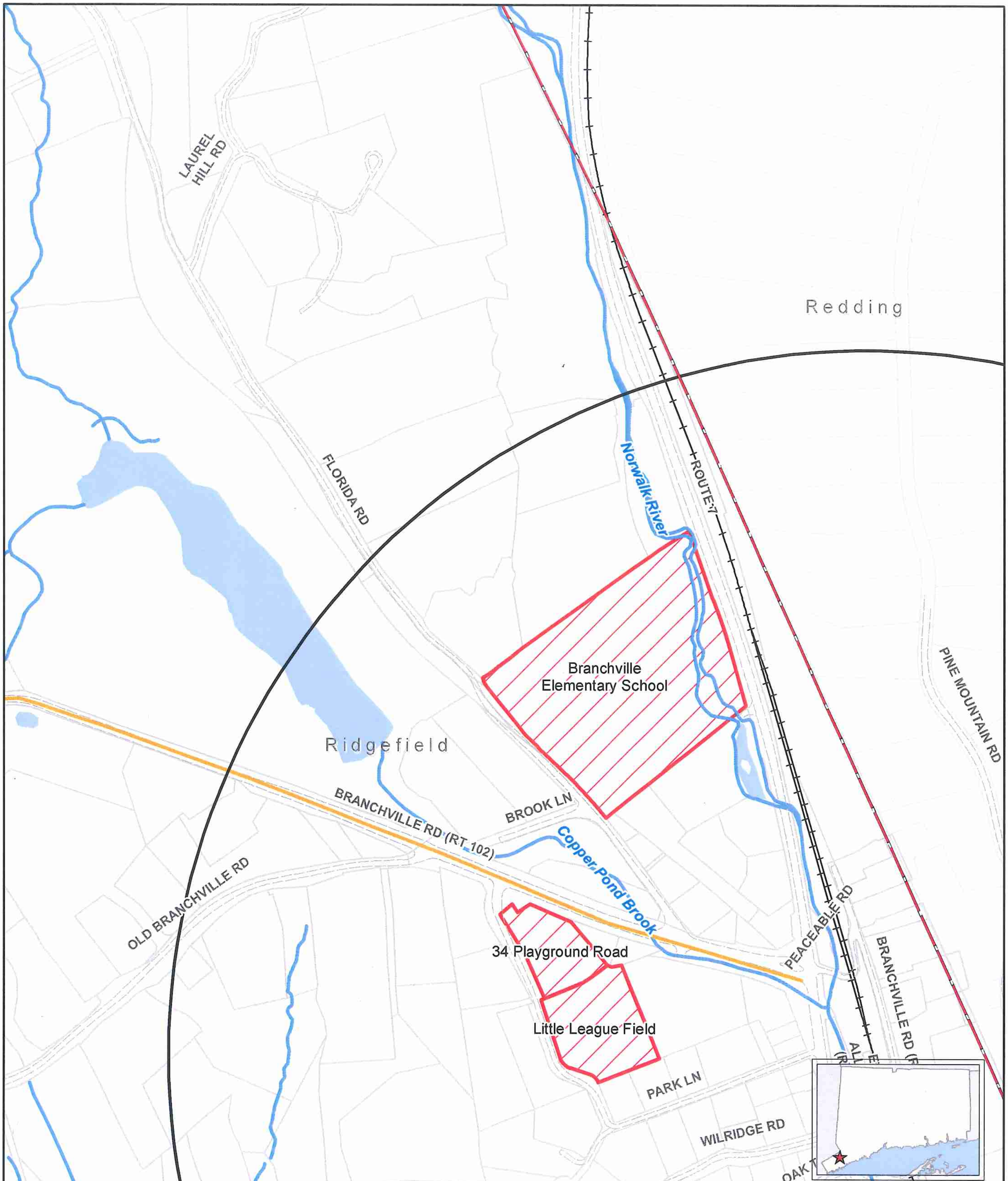

Proposed Sewer
Existing Sewer
Project Area
Feasible Parcels for Initial Consideration
ParcelPolygon
Streams
Swamps
Waterbodies
Town Boundary

1:6,000
0 250 500
Feet

Tighe&Bond
Engineers | Environmental Specialists

Data source: CT DEEP and Town GIS data

FIGURE 7
ON-SITE SEWAGE DISPOSAL FEASIBLE PARCELS FOR INITIAL CONSIDERATION

Branchville Transit Oriented Development Study
Ridgefield, Connecticut
May 2016

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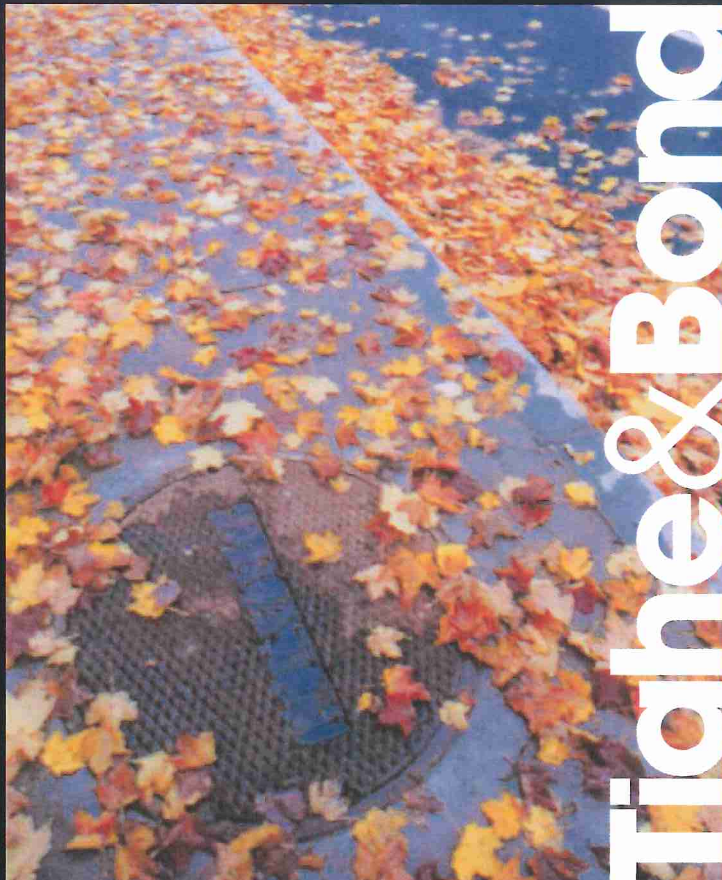

Tighe&Bond

APPENDIX B

Branchville IHZ
Opinion of Probable Cost
Sewer Connection Alternatives

Bid Item No.	Bid Item Description	Alternative 1B: Connection to East Ridge Quantity	Unit	Estimated Unit Cost	Extended Total	Alternative 2: Connection to Route 7 WWTP Quantity	Unit	Estimated Unit Cost	Extended Total	Alternative 3: Connection to Georgetown WWTP Quantity	Unit	Estimated Unit Cost	Extended Total
1	Mobilization/Demobilization (5%)	1	LS	$177,250.00	$177,250.00	1	LS	$205,000.00	$205,000.00	1	LS	$70,000.00	$70,000.00
2	Traffic control	16,500	LF	$10.00	$165,000.00	19,500	LF	$10.00	$195,000.00	5,900	LF	$10.00	$59,000.00
3	Site Restoration	16,500	LF	$5.00	$82,500.00	19,500	LF	$5.00	$97,500.00	5,900	LF	$5.00	$29,500.00
4	Rock Excavation	619	CY	$100.00	$61,875.00	731	CY	$100.00	$73,125.00	221	CY	$100.00	$22,125.00
5	Borrow Material	619	CY	$10.00	$6,187.50	731	CY	$10.00	$7,312.50	221	CY	$10.00	$2,212.50
6	Force Main Piping	16,500	LF	$80.00	$1,320,000.00	19,500	LF	$80.00	$1,560,000.00	5,900	LF	$80.00	$472,000.00
7	Flushing/Air Release Manholes	8	EA	$5,000.00	$40,000.00	4	EA	$5,000.00	$20,000.00	3	EA	$5,000.00	$15,000.00
8	Testing of new piping	16,500	LF	$2.00	$33,000.00	19,500	LF	$2.00	$39,000.00	3,200	LF	$2.00	$6,400.00
9	Processed gravel borrow	3,700	CY	$20.00	$74,000.00	4,350	CY	$20.00	$87,000.00	1,350	CY	$20.00	$27,000.00
10	Temporary Paving	11,000	SY	$40.00	$440,000.00	13,000	SY	$40.00	$520,000.00	4,000	SY	$40.00	$160,000.00
11	Permanent Paving	14,700	SY	$20.00	$294,000.00	17,350	SY	$20.00	$347,000.00	5,250	SY	$20.00	$105,000.00
12	Milling	36,700	SY	$3.00	$110,100.00	43,500	SY	$3.00	$130,500.00	13,150	SY	$3.00	$39,450.00
13	Paving Overlay	36,700	SY	$12.00	$440,400.00	43,500	SY	$12.00	$522,000.00	13,150	SY	$12.00	$157,800.00
14	Connecting Pump Station	1	LS	$300,000.00	$300,000.00	1	LS	$300,000.00	$300,000.00	1	LS	$300,000.00	$300,000.00
15	Pump Station Capacity Increase				$0.00				$0.00				$0.00
16	RR Crossing				$0.00				$0.00				$20,000.00
		Total:			$3,544,312.50	Total:			$4,103,437.50	Total:			$1,485,487.50
		10% Markup/Installation			$354,431.25	10% Markup/Installation			$410,343.75	10% Markup/Installation			$148,548.75
		15% General Conditions			$584,811.56	15% General Conditions			$677,067.19	15% General Conditions			$245,105.44
		40% Engineering/Contingency			$1,793,422.13	40% Engineering/Contingency			$2,076,339.38	40% Engineering/Contingency			$751,656.68
		Subtotal:			$6,276,977.44	Subtotal:			$7,267,187.81	Subtotal:			$2,630,798.36