# Branchville

## Transit Oriented Development Plan

## Technical Appendix

Market Analysis

Stormwater Management Standards

Community System Feasibility Analysis

Wastewater Treatment Collection Facility and Infrastructure Analysis

**February 2017**

FITZGERALD & HALLIDAY, INC.
Innovative Planning, Better Communities

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BRANCHVILLE Transit Oriented Development Study

# MARKET REPORT SUMMARY

# BRANCHVILLE TOD STUDY
# Ridgefield, CT

Prepared for:

Western Ct Council of Governments &
Branchville TOD Task Force

By:

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**June 2016 (v.10)**

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June 24, 2016

TO: Francisco Gomes, Fitzgerald & Halliday, Inc.

FROM: Lawrence Kenney

RE: **Branchville TOD Area – Market Assessment of Development Potential**

Pursuant to your request, we have undertaken an analysis of select real estate sectors in order to evaluate development potential within a ¼ mile radius of a commuter rail station in Branchville (Ridgefield), CT, located off Ethan Allen Highway (Route 7). Specific objective of the study has been to evaluate the market environment for office, retail and housing in Ridgefield, and more specifically the Branchville Transit Oriented Development Area (TOD Area), and to assess development opportunity for alternative uses within the targeted TOD Area.

As presented herein with accompanying charts and tables, the following areas are covered: 1) An analysis of demographic growth trends, economic profile and housing characteristics in Ridgefield and Branchville TOD area, 2) Market analysis of the office, retail and housing markets in Ridgefield, Branchville and the region, 3) Review of Site and Locational Factors, and 4) Assessment of Development Potential.

This report is submitted to the Client subject to the following limiting conditions:

1. No responsibility is assumed for matters of a legal nature.

2. No responsibility is assumed for errors in information furnished by others and believed to be reliable at the time of compilation.

3. This report is not intended to reflect the market or financial feasibility of developing any property with the Study Area/Site under any of the development alternatives examined herein. Furthermore, no opinions either expressed or implied are provided herein with regard to the potential profitability or feasibility of any concept or development proposed for the area.

In conclusion, we are pleased to have been provided the opportunity to serve you in this capacity.

Sincerely,

Lawrence A. Kenney
Senior Vice President

## Demographic-Economic Profile

### Population – Households

- According to the US Census, Ridgefield's population expanded last decade (2000-2010) by 995 residents representing an annual rate of increase of 0.4% over the ten year period. Continued steady growth is expected over the current decade with population projected to rise by 0.6% annually for period 2010-2020.

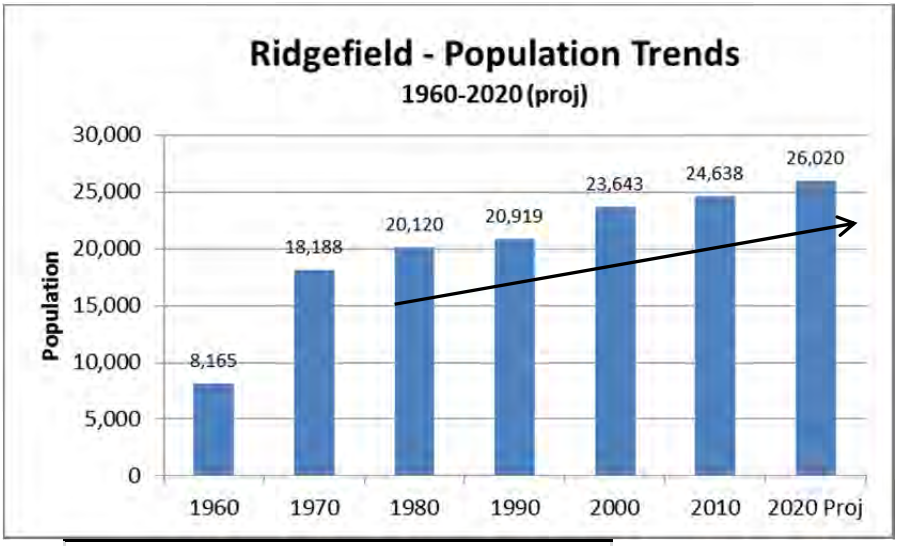
- Meanwhile, Branchville TOD market area, defined as a 1 mile radius radiating from Branchville Road and Route 7, posted a strong 11% gain in population for the period 2000-2010 (1.09% annually). Population expansion, however, is expected to moderate in Branchville (though remain respectable) going forward with projected annual increase of 0.69%. It is furthered noted that population density is modest at 1,696 persons in a square mile radius, but consistent with a suburban profile.

- A slower, steadier pattern of population growth is evident in Ridgefield over recent decades that is projected to continue through current decade (*Refer to graph below*).

**Population Trends**

| Population | Branchville 1-Mile | Ridgefield | Fairfield County |
|---|---|---|---|
| **2000 Total population** | 1,474 | 23,643 | 882,567 |
| **2010 Total Population** | 1,642 | 24,638 | 916,829 |
| **Annual Percentage Growth** | 1.09% | 0.41% | 0.38% |
| **2015 Total Population (est)** | 1,696 | 25,286 | 940,546 |
| **2020 Total Population (proj.)** | 1,755 | 26,060 | 969,384 |
| **2015– 2020 Annual Rate** | 0.69% | 0.60% | 0.61% |

Source: 2010 Census, ESRI Business Systems — Study Area = 1 mile Radius




Source: 2010 Census, ESRI Business Systems

With exception of the 13% jump from 1990 to 2000, population growth in Ridgefield has been steady and moderate at near 5% annum since the 80s.

- Ridgefield is projected to see a rise in household growth this decade of 0.54% annually leading to a projected gain of 479 households by 2020 compared to the 368 increase in 2000-2010. Healthy gains are also projected for the county, equivalent to 0.61% annually. On a state wide basis, much flatter growth is anticipated projected at 0.26% annually 2010-2020.

**Household Trends**

| Households | Branchville 1-Mile | Ridgefield | Fairfield County |
|---|---|---|---|
| **2000 Total Households** | 530 | 8,433 | 324,232 |
| **2010 Total Households** | 621 | 8,801 | 335,545 |
| **Annual Percentage Growth** | 1.60% | 0.43% | 0.34% |
| **2015 Total Households (est)** | 643 | 9,015 | 343,803 |
| **2020 Total Households (proj.)** | 667 | 9,280 | 354,449 |
| **2015– 2020 Annual Rate** | 0.74% | 0.58% | 0.61% |

Source: 2010 Census, ESRI Business Systems — Study Area = 1 mile Radius

Ridgefield is projected to see a rise in household formation this decade which typically leads to increase in housing demand.

- Three out of four household types in Ridgefield are families, compared to 69% for the county.

- One fifth of all households in Branchville and Ridgefield are single HHs (20%), a market base most likely to consider rental housing.

**Household Types**

| Household Types | Branchville Study Area | Ridgefield | Fairfield County |
|---|---|---|---|
| **2010 Total Households** | 621 | 8,801 | 350,854 |
| **Family Households** | 75.7% | 76.3% | 69.4% |
| **Single/Non-Family Households** | 24.3% | 23.7% | 30.6% |
| **.....Single Households** | 20.3% | 20.7% | 24.9% |

Source: 2010 Census, ESRI Business Systems — Study Area = 1 mile Radius

## Income

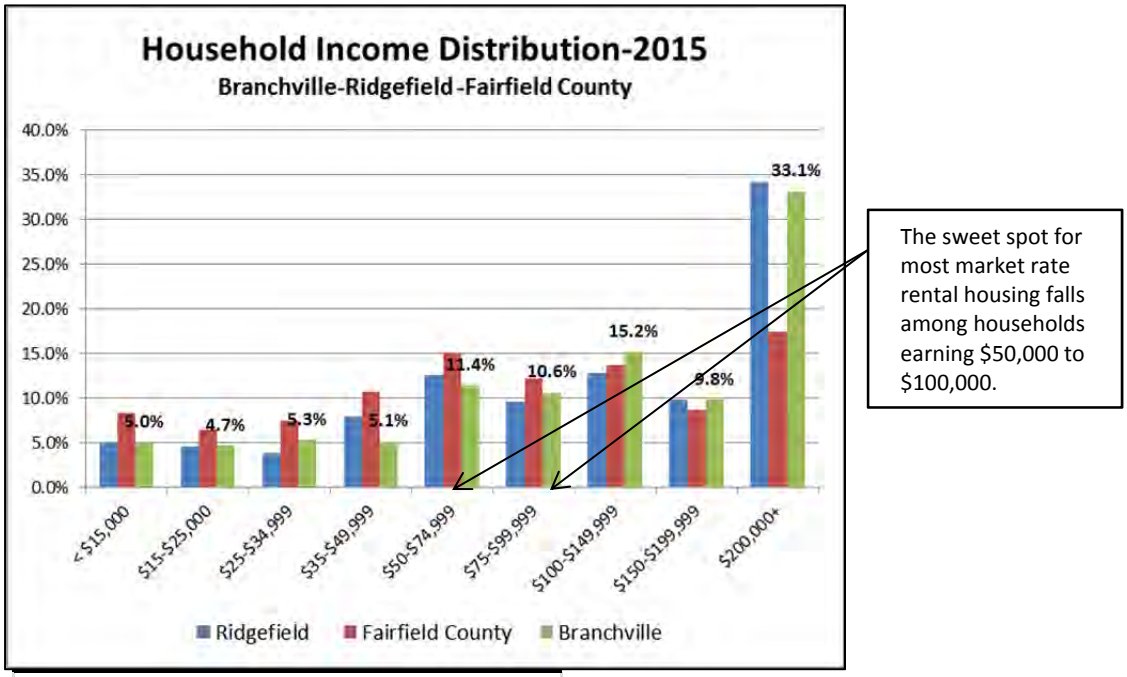
- Median household income in Ridgefield for 2015 was $125,313 reflective of an upper income household base. This compares to $78,451 for the County. Meanwhile the income profile for Branchville TOD area is $122,112 essentially in line with the town. Projections for 2020 point to improvement in income growth for all three areas which has lagged below inflation for much of this decade. (*Refer to table on following page*)

**Income Trends**

| Median HH Income | Branchville Study Area | Ridgefield | Fairfield County |
|---|---|---|---|
| **2015** | $122,112 | $125,313 | $78,451 |
| **2020 (projected)** | $141,553 | $138,366 | $88,746 |
| **Annual Avg % Growth** | 2.9% | 2.0% | 2.5% |

Source: 2010 Census, ESRI Business Systems  Study Area = 1 mile Radius

- Household income distribution in Ridgefield and Branchville TOD as compared to Fairfield County overall is shown in graph below. Over one-third (33%) of all households in Ridgefield/Branchville earn over $200,000 as compared to 17% in the county, providing further evidence of Ridgefield's household wealth. Fewer than 10% report earnings under $25,000 in town. Meanwhile solid income support in town is also observed between $50,000 and $150,000 with 37% of all households, an income band typically targeted for new construction rental in recent years. *(Percentages shown below are for Branchville which are close in line with town)*




Source: 2010 Census, ESRI Business Systems

- Differences in income profile between homeowners and renters in Ridgefield are reflected in table on following page. Among renters, 30% report earnings under $25,000/year compared to 4% for homeowners. However, it is observed that a significant block of high income renters in Ridgefield reside in town (29%) earning over $100,000.

**Income Trends by Tenure – Ridgefield**

| HH Income Distribution | Ridgefield HH Owner | Ridgefield Renter |
|---|---|---|
| ***2015 Total Households*** | ***7,404*** | ***1,615*** |
| **< $15,000** | 2.5% | 17.2% |
| **$15-$25,000** | 2.3% | 12.4% |
| **$25-$34,999** | 1.7% | 8.9% |
| **$35-$49,999** | 5.4% | 7.4% |
| **$50-$74,999** | 8.1% | 13.7% |
| **$75-$99,999** | 8.7% | 11.6% |
| **$100-$149,999** | 15.1% | 13.2% |
| **$150,000 or more** | 56.2% | 15.5% |
| **Median** | **$168,271** | **$59,231** |

Source: 2010 Census, ESRI Business Systems

Strong income support for rental is noted in the sizeable block of high Income renters in Ridgefield earning over $50,000 –

## Age Characteristics

- Ridgefield's population is becoming decidedly older with median age rising from 39.0 in 2000 to 45.4 by 2015. While this trend is largely due to an aging baby boom population, it is somewhat exaggerated in Ridgefield compared to the county and state where median age in 2015 was 40.3 and 41.0, respectively.

- By 2020, the 55+ population in Ridgefield will account for 36.3% of the town's resident base, up from 26% in 2010. Meanwhile, the 65+ population is projected to expand by 48% during 2010-20, while conversely the population under 65 is expected to decline by -1%. One area of unexpected growth for the town is noted in the age cohort 20-34 which is projected to climb 44% in size in the current decade.

| | Ridgefield Age Distribution | | | |
|---|---|---|---|---|
| **Age Cohort** | **2010** | **2015** | **Proj.2020** | **%Δ 2010-20** |
| ***Total Population*** | ***24,638*** | ***25,286*** | ***26,060*** | **5.8%** |
| 0-9 | 3,403 | 5,015 | 2,912 | -14.4% |
| 10-14 | 2,495 | 2,457 | 2,215 | -11.2% |
| 15-19 | 1,868 | 2,115 | 1,993 | 6.7% |
| 20-24 | 647 | 1,001 | 1,035 | 60.0% |
| 25-34 | 1,239 | 1,267 | 1,678 | 35.4% |
| 35-44 | 3,347 | 2,525 | 2,462 | -26.4% |
| 45-54 | 5,009 | 4,820 | 4,301 | -14.1% |
| 55-64 | 3,248 | 3,892 | 4,481 | 38.0% |
| 65+ | 3,375 | 4,102 | 4,977 | 47.5% |

Source: 2010 Census, ESRI Business Systems

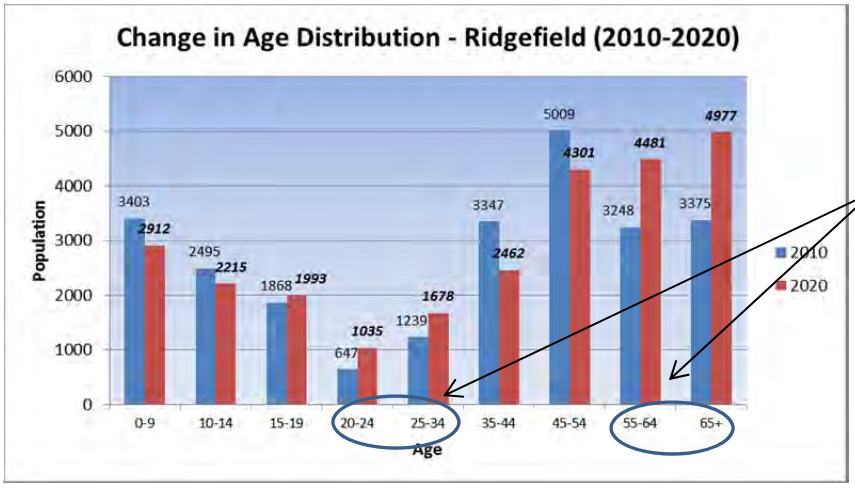
- A comparison of Branchville/ Ridgefield's Age Distribution with Fairfield County reveals little difference in composition between the two areas with the exception of town's share of young adults age 20-34 which in Ridgefield is well below the county and state. This group, however, is projected to grow by 44% in town by 2020, compared to projected 9% increase county-wide. Meanwhile, Ridgefield's share of population among young adults is expected to rise from 7.7% in 2010 to 10.4% in 2020.

**Age Distribution – 2015 by Area**

| Population by Age - 2015 | Branchville Study Area | Ridgefield | Fairfield County |
|---|---|---|---|
| **Age 0-19** | 28.2% | 30.0% | 26.4% |
| **Age 20-34** | 9.9% | 9.4% | 17.4% |
| **Age 35-64** | 43.2% | 44.5% | 41.1% |
| **Age 65+** | 18.7% | 16.1% | 15.1% |
| **Median Age -2015** | 46.9 | 45.4 | 40.3 |
| Source: 2010 Census, ESRI Business Systems | | Study Area=1 mile Radius | |

**Change in Age Composition (2010-2020) by Area**

| % Change in Population Age | Branchville Study Area | Ridgefield | Fairfield County |
|---|---|---|---|
| **Age 0-19** | -11.5% | -8.3% | -3.2% |
| **Age 20-34** | 106.3% | 43.8% | 8.8% |
| **Age 35-64** | -4.5% | -3.1% | 1.8% |
| **Age 65+** | 30.4% | 47.5% | 32.4% |
| **Median Age - 2015** | 46.9 | 45.4 | 40.3 |
| Source: 2010 Census, ESRI Business Systems | | Study Area=1 mile Radius | |

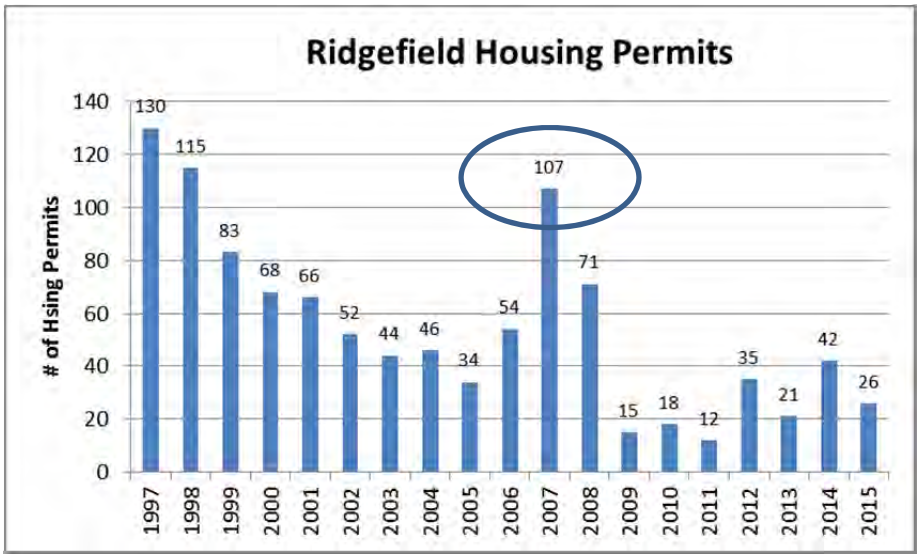



Sizable increases in share of population among young adults (age 20-34) and seniors 55+ are projected this decade for Ridgefield.

## Housing Characteristics

*Housing Permits*

- Housing permit activity has been low in Ridgefield in recent years, averaging 15/units a year 2009-2011 in the aftermath of housing collapse, followed by a bump-up to 31 units/annually from 2012–2015. Peak housing activity in the last ten years occurred in 2007 and 2008 with 107 and 71 permits, respectively, associated with development of the 73-unit *Regency at Ridgefield* townhome complex and 50-unit *Terraces of Ridgefield*. While modest housing growth is noted in recent years, the trend towards moderation stretches back to 1997 when permits hit 130 units and subsequently dropped each year to its low point prior to recession of 34 units in 2005.




Major spike in permits in 2007-8 linked to development of Regency at Ridgefield and Ridgefield 619 (previously Terraces at Ridgefield).

*Housing Tenure*

- Homeowners account for 82% of all occupied housing units in Ridgefield in 2015; renters make up 18%. Owner-occupancy rates in Ridgefield have been falling over the last fifteen years, a trend seen nationally and state-wide, but are expected to stabilize by 2020.

| HH's | Branchville | | Ridgefield | | Fairfield County | |
|---|---|---|---|---|---|---|
| | 2010 | 2015 | 2010 | 2015 | 2010 | 2015 |
| Own-Occp | 82.3% | 79.8% | 84.0% | 82.0% | 68.6% | 65.9% |
| Own-Units | 511 | 512 | 7,394 | 7,404 | 230,098 | 226,463 |
| Rent-Occp | 17.7% | 20.2% | 16.0% | 18.0% | 31.4% | 34.1% |
| Rent Units | 110 | 130 | 1,403 | 1,615 | 105,476 | 117,110 |
| Ttl Occp Units | 621 | 642 | 8,797 | 9,109 | 335,574 | 343,574 |
| Ttl HsingUnits | 669 | 682 | 9,420 | 9,616 | 361,221 | 369,435 |
| Hsing Vacancy* | 6.8% | 7.4% | 6.2% | 7.1% | 7.1% | 6.9% |
| Rent Vacancy | 1.9% | 2.3% | 1.2% | 1.3% | 2.5% | 2.4% |

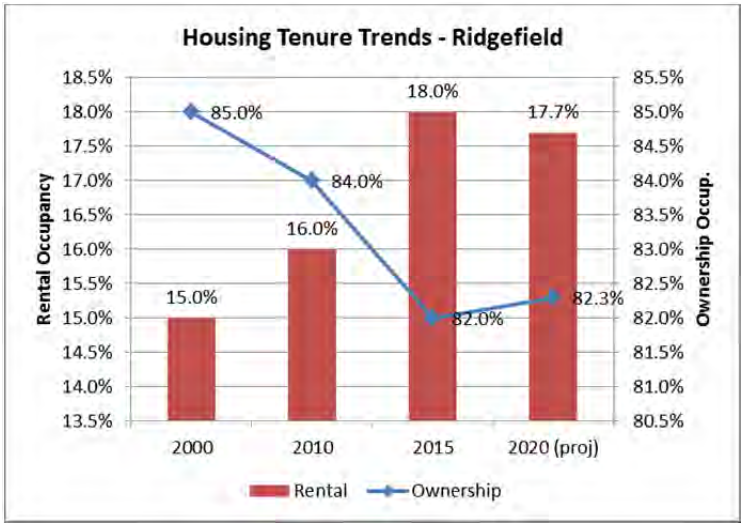
Source: 2010 Census, ESRI Business Systems * Total Vacancy=Ownership, Rental,Seasonal, + Other Vacancy

*Housing Vacancy*

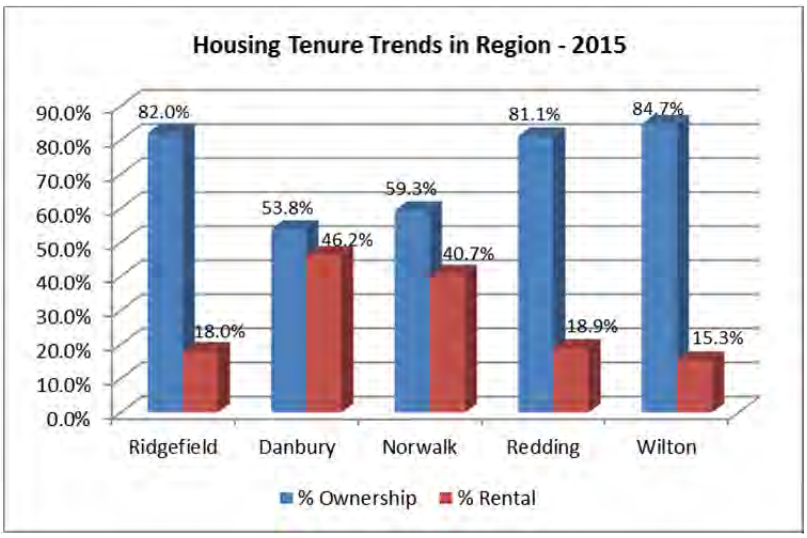
- Housing vacancy in town hit 7.1% in 2015, up from 6.2% in 2010, representing both vacant rental and for-sale homes, as well as un-occupied seasonal homes. Vacancy among only rental units was 1.3% in 2015, indicative of a very tight market.

| HH's | Branchville | | Ridgefield | | Fairfield County | |
|---|---|---|---|---|---|---|
| | 2010 | 2015 | 2010 | 2015 | 2010 | 2015 |
| **Hsing Vacancy*** | 6.8% | 7.4% | 6.2% | 7.1% | 7.1% | 6.9% |
| **Rent Vacancy** | 1.9% | 2.3% | 1.2% | 1.3% | 2.5% | 2.4% |

Source: 2010 Census, ESRI Business Systems * Total Vacancy=Ownership, Rental,Seasonal, + Other Vacancy




Ridgefield's sharp trend upward in rental occupancy over last two decades is projected to dip by 2020.




In suburban-exurban communities Ridgefield, Redding and Wilton, rental is less than one in five units, with SF rentals accounting for 30%-40% of market.

*Tenure by Housing Type*

- An estimated 32% of homes rented in Ridgefield are single family, while 26% are condos. Only 12% are found in professionally managed properties. Governmental assisted housing accounts for 16% of rental housing. Not included in table below is private assisted housing for the elderly (*Ridgefield Crossing*).

**Tenure by Housing Type - Ridgefield (2010)**

| | Ownership | Renter |
|---|---|---|
| ***Total by Tenure*** | ***7,404*** | ***1,615*** |
| 1, detached | 92.0% | 32.4% |
| 1, attached | 3.7% | 7.0% |
| 2-4 | 1.6% | 21.7% |
| 5 + | 2.7% | 38.9% |

Source: 2010 Census, ESRI Business Systems

## Labor Force & Employment

- Ridgefield's job base is fairly sizeable for a town of its size with an employment base of 10,534 in 2014, only slightly smaller than its resident labor force of 11,794. Job growth has also been positive in Ridgefield expanding by 7.5% over the last five years.

**Labor Force & Employment Trends**

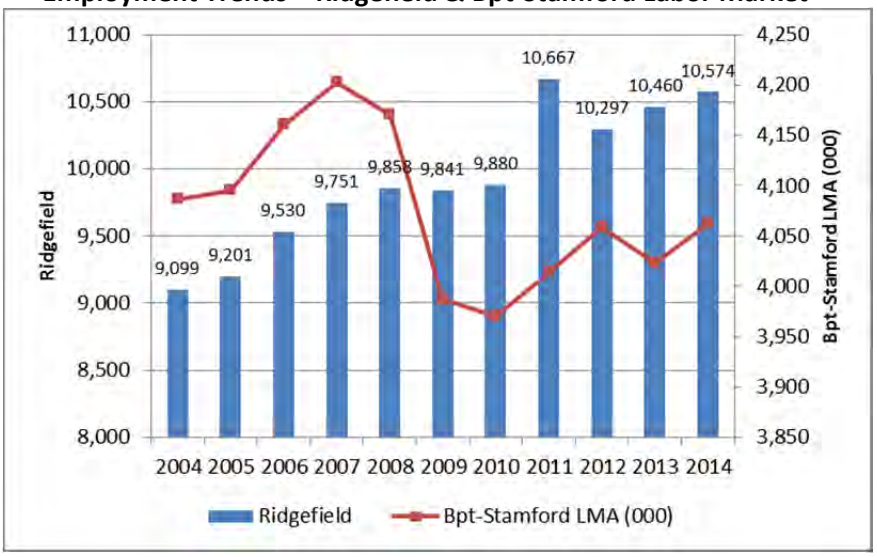
| Labor Force +Employment | Ridgefield | Bpt-Stamf. LMA |
|---|---|---|
| **Labor Force-2015** | 11,794 | 464,800 |
| **Unemployment -2014** | 3.9% | 5.5% |
| **Total Employment -Workplace (2014)** | 10,574 | 406,234 |
| **2009 - 2014 - Annual Growth** | 1.5% | 0.4% |
| **2013 - 2014 - Annual Growth** | 1.1% | 1.0% |

Source: CT Dept. of Labor

Job expansion in town for 2014 reflected broad gains within various sectors as opposed to outsized gains in one or two sectors.

- Remarkably, Ridgefield has been able to maintain consistent job growth year over year over the last decade even over the course of the Great Recession. In fact, its sharpest increase in jobs over the ten year period occurred in 2011 with a 7.9% gain, a point in time when the state was still grappling with steep job losses. Beginning with 2012, job expansion has been more measured averaging 1.3% annually.

**Employment Trends – Ridgefield & Bpt-Stamford Labor Market**




Source: CT Dept of Labor, Quarterly Census of Empl. & Wages

- Ridgefield's job base is diverse with manufacturing - largely associated with Boeringer Ingleheim - still a key member of the local economy[1]. Other leading sectors in town include Retail Trade and Health Care & Social Services, both accounting for 10.8% of the town's job base. Government is also an important sector with 1,274 jobs as of 2014.

**Major Job Sectors – Ridgefield**

| Industry Sector - 2015* | % Share of Jobs |
|---|---|
| **Retail Trade** | 10.8% |
| **Health Care & Social Assistance** | 10.8% |
| **Accommodation & Food Services** | 7.2% |
| **Management of Co. & Enterprses** | 6.2% |
| **Admin Support & Waste Mng** | 4.9% |
| **Government** | 11.8% |

Source: CT Dept. of Labor

* Data on Manufacturing was suppressed;
Share of jobs in this sector estimated at 15-20%

[1] Due to small number of manufacturing firms in town, jobs data was suppressed for this sector in order to maintain privacy of employment profiles of individual firms.

## Commutation Trends

- Based on 2010 commutation data, Ridgefield's net-outflow of resident workers commuting to jobsites outside the city (10,914) was closely equivalent to net in-flow of workers commuting to Ridgefield (16,280). An estimated 32% of town's employed workforce in 2010 resided in Ridgefield; while conversely 68% traveled to worksites outside the town.

- Top commuter sites for Ridgefield resident workers outside the town were Westchester County (15.1%), Danbury (8.2%), New York County (7.6%) and Stamford (7.2%). Seven of the top 8 out-commuter sites are accessible by rapid transit via Branchville rail station.

- In-commuters arrived from across the state (and outside state), but mostly originated from neighboring towns/cities of Danbury, New Milford and Bethel and neighboring Westchester County. Commutation trends are often helpful in gauging geographic source of demand for housing

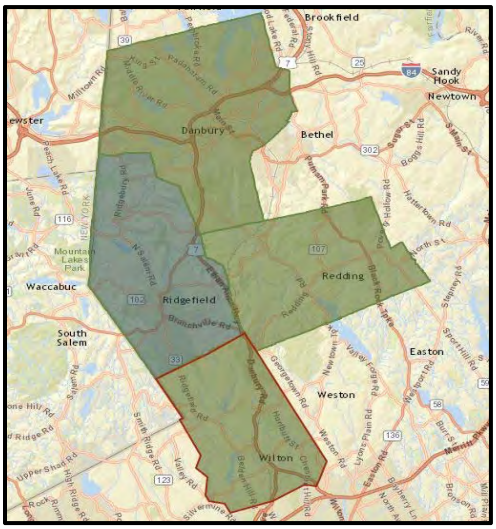
**Year 2010 COMMUTER TRENDS - RIDGEFIELD**

| Inbound Commuters to Ridgefield | Number | % | Outbound Commuters from Ridgefield | Number | % |
|---|---|---|---|---|---|
| **Ridgefield** | **3,746** | **32.8%** | **Ridgefield** | **3,746** | **34.3%** |
| Danbury | 2,009 | 17.6% | Westchester County | 1,650 | 15.1% |
| New Milford | 628 | 5.5% | Danbury | 893 | 8.2% |
| Westchester County | 525 | 4.6% | New York County | 828 | 7.6% |
| Bethel | 452 | 4.0% | Stamford | 791 | 7.2% |
| Brookfield | 378 | 3.3% | Norwalk | 461 | 4.2% |
| Redding | 339 | 3.0% | Greenwich | 280 | 2.6% |
| Newtown | 216 | 1.9% | New Canaan | 244 | 2.2% |
| New Fairfield | 202 | 1.8% | Wilton | 216 | 2.0% |
| Bridgeport | 191 | 1.7% | Redding | 181 | 1.7% |
| **SubTotal** | **8,686** | **76.0%** | **SubTotal** | **9,290** | **85.1%** |
| **Total In-Commuters** | **11,429** | | **Total Out-Commuters** | **10,914** | |

Source: US 2010 Census

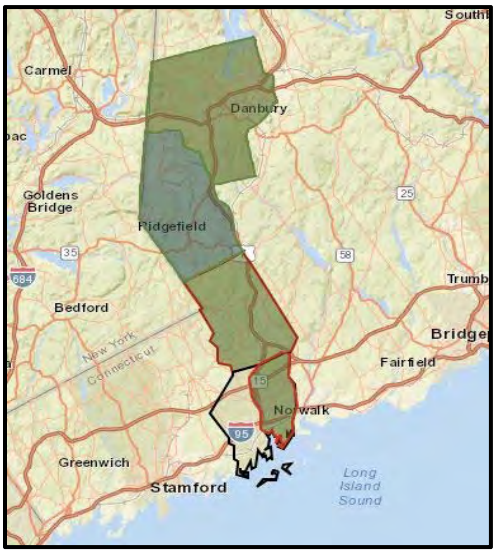
68% of workers residing in Ridgefield in 2010 commuted to jobs outside the town, most accessible by rapid transit available at Branchville.

## Real Estate Market Analysis



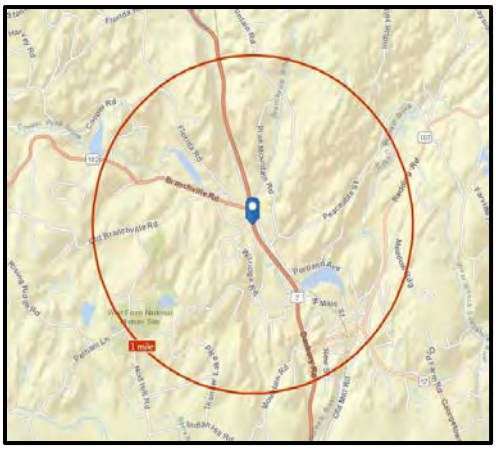

### Defined Trade Area – Retail & Office

As part of the Real Estate Analysis, a Trade Area has been defined for the retail and office market which best represents the competitive marketplace for Ridgefield and Branchville. In addition to Ridgefield, the Study Area includes Danbury, Wilton – and in the case of Retail, Redding is added. *Further submarket real estate analysis centered on the Route 7 corridor from Branchville to Cannondale*. (Refer to map at left)




### Defined Trade Area – Housing

A Trade Area for housing was defined for Ridgefield and Branchville as part of the Real Estate Analysis which best represents the competitive marketplace for the town and village. In addition to Ridgefield, the Study Area includes Danbury, Wilton and East Norwalk (Route 7). (Refer to map at left)



### Defined Market Area – Branchville TOD Area

In order to evaluate demographic-economic profile of the Branchville area for Transit Oriented Development, a 1 mile radius was defined for the area centered at the axis of 35 Ethan Allen Highway (Route 7) – located across from the Branchville Train Station. This area encompasses Branchville business district and surrounding Ridgefield community as well as portions of Georgetown, consisting primarily of residential. *Note: A ¼ mile radius area – essentially Branchville Business District - was defined for evaluating area of development potential*.

## Ridgefield Office Market

According to CoStar Group, a national provider of real estate information, Ridgefield's leasable office market amounts to 815,000 square feet. Office inventory in the town varies considerably ranging from conventional office primarily serving professional services, small businesses, non-profit, and legal and financial service market to corporate headquarters and executive office space.

The vast majority of the leasable office space in Ridgefield, or 80%, is found in the Ridgefield Center area including lower Danbury Road. Much of this space, or 41%, is located in newer properties built since 1980. The newest office building in the Ridgefield Center area is a 19,600 sf mixed use property at 159 Danbury Road built in 2015. The property includes both office and residential, with the later representing mix of one and two bedrooms. Office space in this building is renting at $30.00 NNN.

A second smaller office node in Ridgefield is situated around or near the intersection of Route 7 and Route 35. This area supports a total of 145,000 sf office much of it linked to a 60,000 sf medical office building located at 901 Ethan Allen Highway.

Below is a summary of key market highlights on the office market in Ridgefield, Branchville and surrounding area.

### Ridgefield Region[2] Office Market

*Office Inventory – Ridgefield Region*

The office market in the Ridgefield region is considerable totaling over 8.6 million sf. If the office inventory located on Route 7 -Merritt Parkway submarket were included, the total would jump to 11.7 million sf making it second only to Stamford in size (19.7 million). Ridgefield is a minor player within the regional office market accounting for 9.4% of the office market, but in absolute numbers, it supports a sizeable base given town size of 815,000 sf.

**Ridgefield Region Office Market - Inventory**

| Market | # of Properties | Total Inventory (sf) |
|---|---|---|
| Ridgefield | 65 | 815,574 |
| Danbury | 252 | 5,337,452 |
| Wilton | 119 | 2,478,462 |
| **Total** | **436** | **8,631,488** |

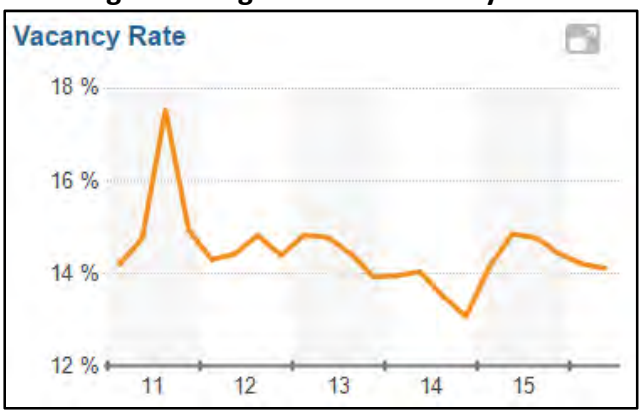
*Source: Costar Group*

[2] Ridgefield Region for office consists of Ridgefield, Danbury and Wilton

*Office Vacancy - Region*

Vacancy within the region appears mostly manageable ranging from 7.1% in Ridgefield to 14.6% in Danbury. However, a total 1.1 million square feet is on the market with an average lease-up time of 20 months. In Ridgefield, the lease-up time is shorter averaging 15 months. Meanwhile, over last five years, there has been little change in regional vacancy which has been moving sideways over-under 14% since 1st quarter 2012.

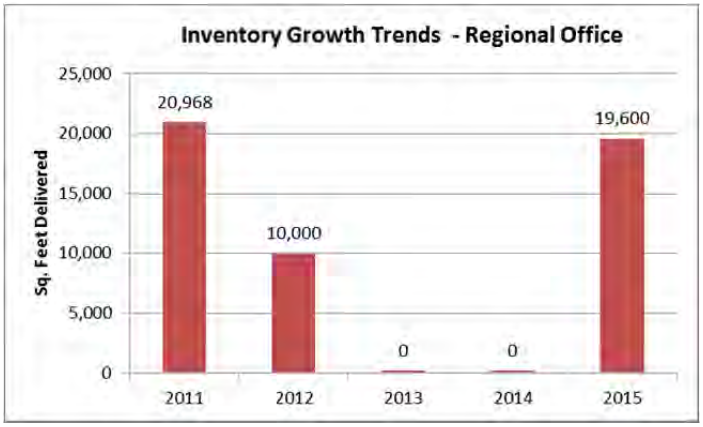
**Ridgefield Region Office Vacancy Trends**




Source: CoStar Group

*Office Inventory Growth - Region*

The lack of inventory growth has helped keep office vacancy in the region somewhat stabilized even as the economy remains sluggish. Over last five years, 51,000 sf has been added to inventory amounting to a 0.6% increase in supply, indicative of low investment demand for new construction. By contrast, in the years 2006 to 2010 a total of 371,200 sf was added.




Source: Costar Group

*Office Absorption Trends – Region*

Data on office absorption is showing a net loss over the last five years. In other words, more space has become vacant than absorbed placing added pressure on vacancy.

**Ridgefield Region Office Absorption Trends**


Source: Costar Group

## Ridgefield Local Office Market

*Inventory – Local Office*

In evaluating the local office market, we looked at Ridgefield and two submarkets: the Route 7 corridor extending from Branchville to Cannondale (Wilton) and the Village of Branchville. With respect to the latter, there is very little inventory that falls into the category as office with only 5 properties identified totaling 22,170 sf.

**Ridgefield Local Office Market - Inventory**

| Market | # of Properties | Total Inventory (sf) |
|---|---|---|
| Town of Ridgefield | 65 | 815,574 |
| Rt 7 Branchville-Cannondale | 48 | 281,882 |
| Branchville (0.25 mile radius) | 5 | 22,173 |

*Source: Costar Group*

*Vacancy and Lease Rate Trends – Local Office*

Office vacancy within Ridgefield and Branchville-Georgetown-Cannondale submarket are at relatively low with reported rates of 7.6% and 8.6%, respectively. Vacancy data was unavailable for the properties in Branchville, though it appears roughly 5,000 sf is on the market which

would translate into a 16% vacancy, a rate somewhat exaggerated by the small number of properties.

Some indications of an improving office market occurring locally are noted in a five year analysis of vacancy rates. In Ridgefield, vacancy has dropped from a high of 11.6% in 2011 to its current level of 7.1%. Branchville-Georgetown-Cannondale peak occurred in 2012 with 9.3% vacancy that has since fallen to 8.6%.

**Ridgefield Local Office Market - Vacancy & Lease Rate**

| Market | Vacancy Rate | Average Lease Rate ($/sf) |
|---|---|---|
| Town of Ridgefield | 7.1% | $27.26 |
| Rt 7 Branchville-Cannondale | 8.6% | $23.47 |
| Branchville (0.25 mile radius) | N/A | $18.00 |

*Source: Costar Group*

### *Building Configuration & Market Base – Local Office*

Building Configuration diverges considerably within the three submarkets. In Ridgefield nearly 30% of all properties, or 19 properties, are in buildings 15,000 sf or more, a size tailored towards accommodating traditional office users.

By comparison, in the Branchville-Georgetown-Cannondale submarket only one property exceeds 15,000 sf – represented by a mixed-use retail-office property of 17,000 sf – of which the upper second-story space consisting of 8,000 sf is office (notably - half is used as dancing studio). Two-thirds of Branchville-Georgetown-Cannondale's office inventory is found in properties under 5,000 sf indicative of a smaller scale – retail service orientation of this market.

In the Branchville Village TOD submarket only five properties were identified representing a mix of office and mixed use properties with office. Four of the properties fell under 5,000 sf and one consists of 8,500 sf of office in a retail-office building.

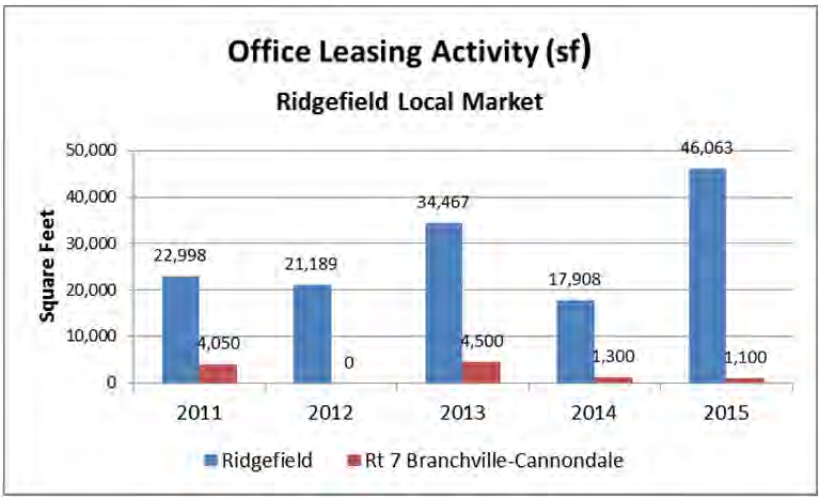
### *Leasing Activity – Local Office*

Lease-up of office space in Ridgefield over the last five years has been surprisingly significant given size of market base in town. Since 2011, a total of 142,625 sf has been leased, representing an average of 28,525 sf a year. On an annual basis, the lease-up amounts to 3.5% absorption of inventory. Much of Ridgefield's office leasing is focused on properties within or on periphery of Ridgefield Center and along Danbury Road. It is largely driven by demand from traditional office employment sectors. These include professional services, finances, real estate, information, business services and management and more recently, healthcare.

Leasing activity in Branchville-Georgetown-Cannondale submarket, on the other hand, has been very light for the period 2011-2015. On average, the Branchville-Cannondale submarket leased just under 2,200 square feet a year, representing a small 0.01% annual lease-up of its market base.

While the broader Ridgefield office market caters to more traditional office sectors (professional services, finance, ect), the Branchville Rt7 office market base is mostly tailored to smaller retail oriented office use – proxies or substitutes to office[3] - where walk in demand is a component. Instead of job growth which normally anticipates office demand, this market generally responds to changes in population which for the region has been somewhat muted over the past decade.

No leasing activity associated with office was identified for Branchville in last five years.




Source: CoStar Group, AMS Consulting


15 Ethan Allan Highway, Branchville
Retail-office mix use property

[3] One of the most difficult spaces to fill in retail-oriented commercial areas is upper story office space. Landlords have had to become creative in expanding market focus to include personal services (hair salons, tailors, photo finishing) arts and design services, repair services, skills training businesses and fitness centers, ect.

## Ridgefield Retail Market

The retail market in the Ridgefield region is considerable amounting to over 8.2 million square feet, or 59 sf ft per capita. Within this market, Ridgefield supports a sizeable retail base relative to its population size and suburban location amounting to 1.02 million square feet, or 40.3 sf ft per capita. Wilton's retail nearly equals Ridgefield in size with 920,000 sf (49 sf per capita), while Redding 's retail market is miniscule at 90,700 sf (10 sf per capita). Danbury dominates the market with 6.1 million sf, representing one of the larger urban retail markets in the state.

### Ridgefield Regional[4] Retail Market

*Retail Inventory – Region*

Ridgefield's regional retail market (Ridgefield, Danbury, Wilton, and Redding) consists of 8.2 million square feet. Danbury accounts for 75% of the market (6.2 million sf) followed by Ridgefield at 1.01 million sf and Wilton with 920,000 sf. Redding was included in this survey in light of its small business base in Georgetown. Total retail in Redding is estimated at 90,700 sf, essentially all in Georgetown.

Danbury functions as the retail center for the region, led by Danbury Fair Mall (1.2 million sf), but both Ridgefield and Wilton have developed a strong retail core designed to serve both local needs of its residents and a broader demand that pulls from the region.

Ridgefield Center in particular offers a diversified mix of national-regional retail outlets, locally-owned stores, numerous boutique stores and shops, businesses catering to personal services and needs, coupled with a lively casual dining and restaurant base.

**Ridgefield Region Retail Market - Inventory**

| Market | # of Properties | Total Inventory (sf) |
|---|---|---|
| Ridgefield | 97 | 1,019,984 |
| Danbury | 385 | 6,170,180 |
| Redding | 15 | 90,783 |
| Wilton | 78 | 920,397 |
| **Total** | **575** | **8,201,344** |

*Source: Costar Group*

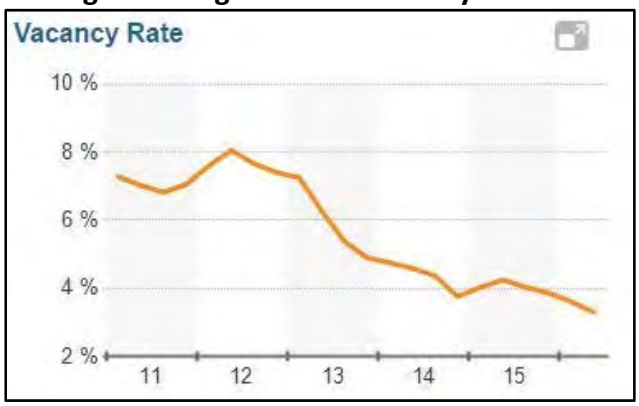
*Retail Vacancy - Region*

Although initially hit hard by the recession, retail vacancy has been on a downward trajectory for the region over the last five years as shown in the graph below.

[4] Ridgefield Region for retail consists of Ridgefield, Danbury, Redding and Wilton.

In 1st quarter 2016, retail vacancy stood at 3.2% down from a peak of 8% in 2012. In Ridgefield, retail vacancy for 2016 was even lower at 2.5%, essentially full occupancy.

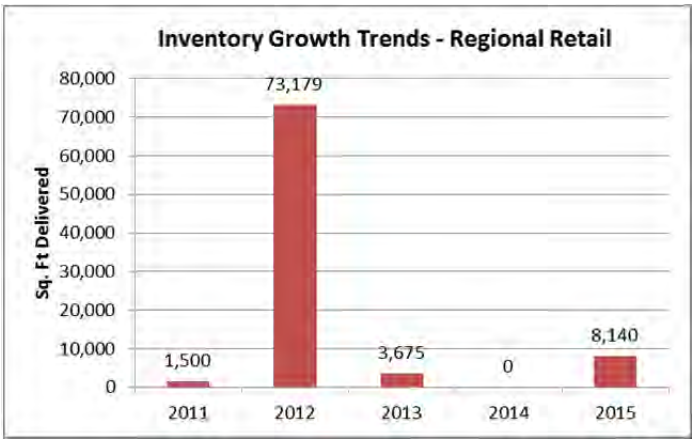
**Ridgefield Region Retail Vacancy Trends**




Source: CoStar Group

*Retail Inventory Growth - Region*

The one area of notable softness in the retail market within the region is observed in lack of new delivered space over the last five years, or indeed since 2007, outside of 70,000 sf in 2012.

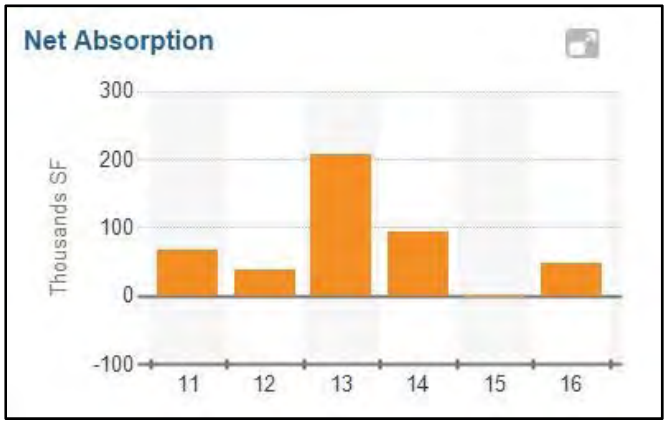



Source: Costar Group

*Retail Absorption Trends – Region*

Net absorption in retail, on the other hand, has been positive over last five years in the region with the exception of 2015 when it was essentially flat (leased space equaled vacated space) .

**Ridgefield Region Retail Absorption Trends**




Source: CoStar Group

## Ridgefield Local Retail Market

*Local Retail Market Inventory*

On the local level, we examined market conditions for retail within the same submarkets identified for the office market. They Include:

- Ridgefield
- Rt 7/ Branchville -Georgetown-Cannondale
- Branchville Village

As noted earlier, Ridgefield supports a well-established retail base of 1.0 million square feet. Over 80% of this retail is concentrated in Ridgefield Center and area just north of the downtown. Smaller retail nodes in Ridgefield are found in Branchville and at the junction of Route 7 and Danbury Road.

As a matter of market definition, Branchville and Georgetown function as a single market thus the submarket – Branchville/Georgetown-Cannondale. This retail base consists of 278,500 sf. The Branchville TOD area is a subset of this market and supports 71,500 sf.

Below is a summary of building inventory in the three submarkets.

**Ridgefield Local Retail Market - Inventory**

| Market Area | # of Properties | Total Inventory (sf) |
|---|---|---|
| Town of Ridgefield | 97 | 1,019,984 |
| Rt 7 Branchville-Cannondale | 43 | 278,479 |
| Branchville (0.25 mile radius) | 10 | 71,542 |

*Source: Costar Group*

*Local Retail Market - Vacancy & Lease Rates -Local*

Similar to the region overall, vacancy rates are low ranging from 2.5% in Ridgefield to 4.9% in Branchville TOD. Asking rents for retail are relatively high averaging between $22.43/sf (Branchville-Cannondale) to $27.91/sf (Ridgefield) and have been rising steadily by as much as 8% annually since 2012.

**Ridgefield Local Retail Market - Vacancy & Lease Rates**

| Market Area | Average Vac. Rate | Average Lease Rate ($/sf) |
|---|---|---|
| Town of Ridgefield | 2.5% | $27.91 |
| Rt 7 Branchville-Cannondale | 4.4% | $22.43 |
| Branchville (0.25 mile radius) | 4.9% | $24.20 |

*Source: Costar Group*

**Town of Ridgefield – Asking Rent Trends**


Source: CoStar Group

*Leasing Activity - Local*

Strong leasing activity and low vacancy over the last five years has helped push up lease rates particularly in Ridgefield. Overall in the past five years, Ridgefield witnessed lease-up of retail space equaling nearly 100,000 sf. Not surprisingly, Branchville-Georgetown -Cannondale and Branchville TOD posted much smaller totals of 24,200 sf and 12,500 sf, respectively. (*Refer to chart on leasing trends on following page*)

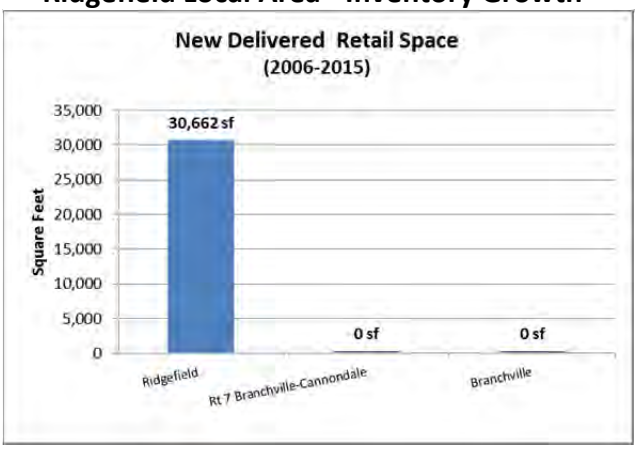
**Ridgefield Local Area - Retail Leasing Trends**


Source: CoStar Group

*Inventory Growth – Local*

Similar to what was observed for the region, the local market has yet to witness much new inventory growth over the last ten years. As can be seen in chart below neither Branchville TOD nor Rt 7 Branchville-Cannondale submarkets recorded any new growth from 2006-2015. Meanwhile, Ridgefield Center –Danbury Rd reported only a modest 30,600 sf gain over this time span, an expansion of inventory of only 3.3%.

**Ridgefield Local Area - Inventory Growth**




Source: CoStar Group

## Branchville TOD Business Survey

*Retail & Service Business Mix – Branchville Study Area*

Field Survey was undertaken in order to obtain data on business mix in the Branchville Village. Based on this research, it was determined that there are 59 businesses in the district with approximately 200 workers.

Notably, retail trade accounts for much of the business base in Branchville with over 30% of all establishments in the Study Area. Within the Retail sector, strongest representation was found in Building Material/Garden Supplies stores, Food and Beverage Stores (including a recently installed small convenience store) and Miscellaneous retail.

Among Service-based industries, notable sectors include Other Services (repair services, laundry and dry cleaning, and personal care services), Food Service (full serve restaurants and fast food-dining), Auto Services and Professional Services (regarding the latter - specifically photo finishing, marketing and design). There are two dance schools in the Village which fall under the category of Education. Refer to table below for distribution of retail-service based businesses in the Branchville Village.

**Branchville Business Mix**

| Branchville Business Sectors | # of Businesses | % Share |
|---|---|---|
| Wholesale | 1 | 1.5% |
| Constuction | 2 | 2.9% |
| Retail Trade | 20 | 29.4% |
| Motor Vehicle & Parts | 1 | |
| Furniture | 0 | |
| Building Material & Supplies | 6 | |
| Food & Beverage Stores | 3 | |
| Health & Personal Care stores | 1 | |
| Gasoline Stations | 1 | |
| Sporting Goods & Hobby | 2 | |
| Miscellaneous | 6 | |
| Finance & Insurance | 1 | 1.5% |
| Real Estate | 2 | 2.9% |
| Leasing & Rental | 2 | 2.9% |
| Professional Services | 3 | 4.4% |
| Admin-Business Services | 2 | 2.9% |
| Education | 2 | 2.9% |
| Health & Social Services | 2 | 2.9% |
| Recreaton-Fitness | 2 | 2.9% |
| Food Services-Dining | 6 | 8.8% |
| Auto Services | 3 | 4.4% |
| Other Services | 11 | 16.2% |
| **Total** | **59** | **100%** |

Source: Business databases, Internet, AMS Consulting

# Ridgefield Housing Market

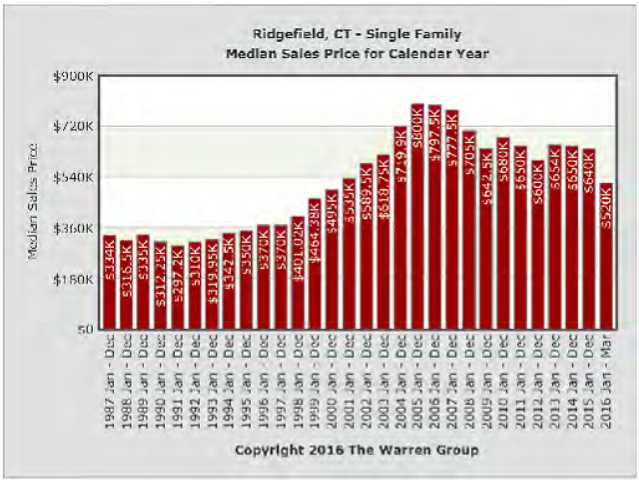
The Ridgefield housing market is over 80% single family, but in the last 15 years the town has seen an increase in the number of multi-family housing proposals targeting both condo and rental housing. Much of the rental housing that has come before the town has been in the form of applications under the state affordable housing statue 80-3g which shifts the burden of proof for denial on the town, and only in cases of health and safety. In response to the flurry of proposals, Ridgefield was successful in gaining a moratorium from the state on affordable housing proposals via 80-3g for a period of 4 years through 2018.

Price support for new housing in Ridgefield is strong though in terms of ownership the market has yet to fully recover from the housing collapse of 2007. Resales on recently constructed condos, however, have hit as high a $700,000 – though most fall within the $550,000+ range. Meanwhile, rents in new Ridgefield apartments range from $1850 to $2975/month (net). Nationally, new rental housing has been on a five year boom, though in Connecticut most of the development has been relegated to its economically stronger cities of Stamford, Danbury, Norwalk and New Haven. In Ridgefield, most rental housing that has come before the town for approval is modest in size ranging from 8 to 20 units.

## Ridgefield Ownership Housing Trends

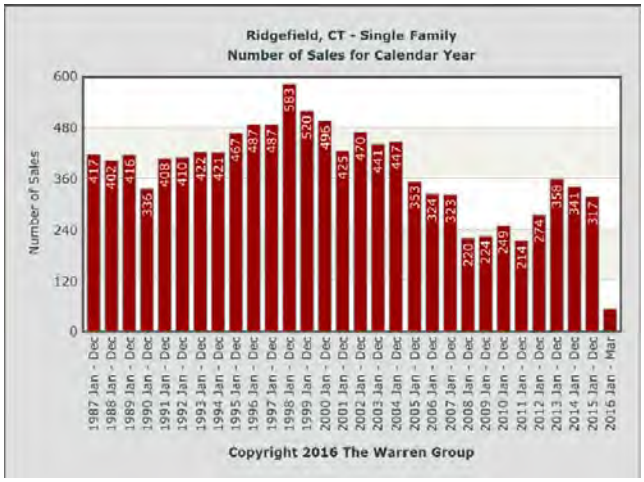
*Single Family Market- Pricing Trends*

While home values in Ridgefield fell less on a percentage basis than most area towns in the after math of the housing collapse, they have yet to recover to pre-recession levels. In 2015, median sales price for a single family home in Ridgefield was $640,000, 20% below peak value attained in 2005. On the plus side, home values in town appear to have stabilized since 2012, though price appreciation has been minimal in recent years.



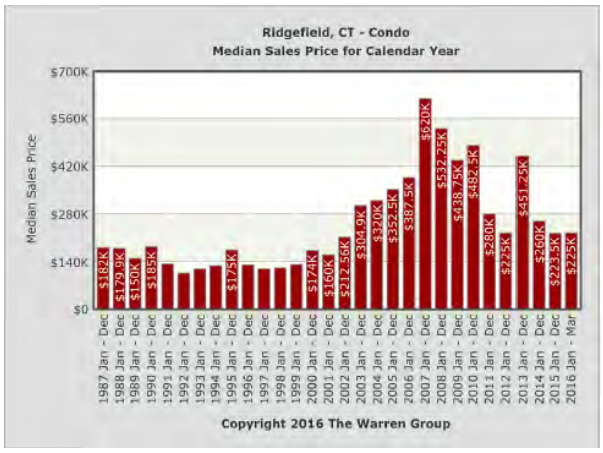

*Single Family Market- Sales Volume Trends*

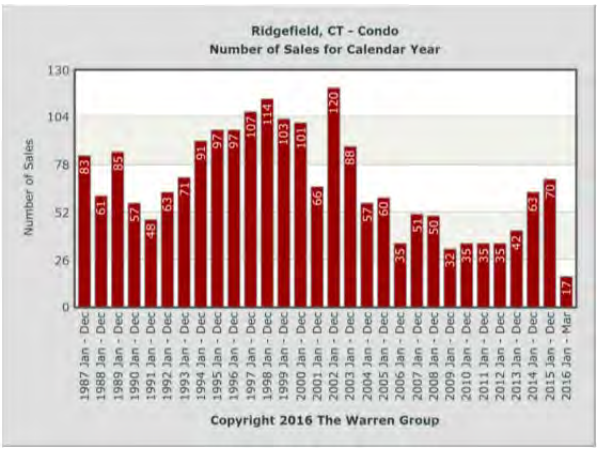
Single Family Sales volume in Ridgefield hit bottom in 2008, though from an historical perspective, sales have been dropping steadily since 1998. Meanwhile, signs of a rebound in sales emerged in 2012-2014 that eclipsed pre-recession levels, only to be followed by two years of decline. Even at its height in 2013, sales volume was still well below annual sales totals achieved 1987- 2004.



*Condo Market-Pricing Trends*

Median condo price in Ridgefield for 2015 was surprisingly low at $223,500, but is largely shaped by resales from two older condominiums in town of 1970's vintage, *Fox Hill Village* and *Casagmo*, which together account for more than 600 units. In contrast, the newly built 73-unit *Regency in Ridgefield* townhomes (2008) on Danbury Road is recording resales exceeding $700,000[5].




*Condo Market-Sales Volume Trends*

Meanwhile, condo sales volume has picked up in Ridgefield with 70 units in 2015, well above the pre-recession level of 51 units in 2007 and the most since 2003.

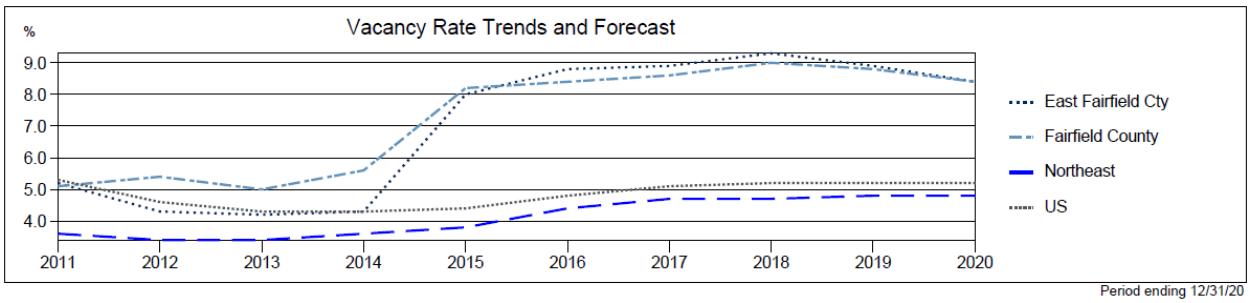
## Regional Rental Housing Trends

In order to obtain a broader understanding of the market dynamics affecting the rental housing market in Ridgefield, rental housing data was collected among towns/cities in the following Eastern Fairfield County submarket region.

*Vacancy Rates-Region:* Year to date vacancy in the region for 2015 stood at 7.5% compared to 7.7% for Fairfield County. Prior to 2015, vacancy averaged closer to 5%. According to forecasts, vacancy will continue to be elevated through much of the remaining decade. (Refer to chart on following page for vacancy trends since 2011).


Regional Rental Market

[5] Not surprisingly, sales absorption at the age restricted Regency at Ridgefield condo was somewhat sluggish given its opening in 2008 which coincided with the housing collapse/financial crisis.

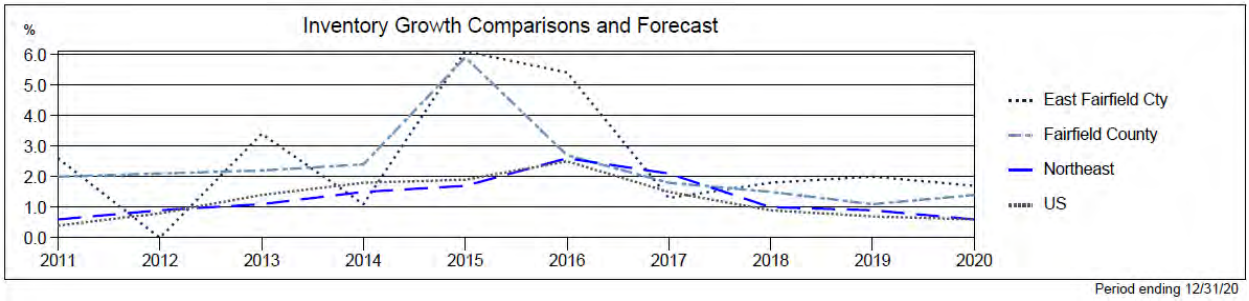



Source: REIS data

*Rent Growth-Region:* Eastern Fairfield County experienced a strong 5.6% rent growth in 2015, double the rate of growth achieved over the past three years (2.6% annually). Much of the growth is associated with new rental housing coming on line. Projections for Eastern Fairfield County call for rent hikes to drift down to 2.0% annual by 2018.

*Asking Rents-Region:* Asking rents for a two bedroom unit averaged $1,645/m in the Eastern Fairfield County market area. This compares to $2,281/month for same bedroom type in Fairfield County overall.

*Inventory Growth-Region:* Rental housing inventory expanded by 6.1% in the region in 2015 reflecting a surge in new construction of apartments that occurred in the region. Over the last three years a more modest growth rate of 3.5% annually has been the norm. It is expected that the inventory growth will moderate even further over the next five years to 2.4% annually as potential over-supply in high end rentals becomes a factor.




Source: REIS data

## Local Rental Housing Trends

- **Ridgefield's Rental Market is Small, but Expanding:** Ridgefield's rental market consists of 18% of total occupied housing, or 1,605 units (2015). Although small, the rental base has been expanding rising from 1,235 units in 2000 to its present base, a 29% increase. Projections for 2020, however, indicate flat growth for rental in large part due to impact of a 4-year moratorium the town received from the state on 80-3g affordable housing proposals.

- **Ridgefield's Rental Profile Weighted towards Single Family:** Ridgefield's private non-subsidized rental market is varied in product type though most rentals in town are associated with single family homes (32%) reflective of the corporate executive-base

market that resides in town. The balance of the rental market is distributed between condo rentals (26%), professionally managed rental apartments (12%), and multi-family homes (14%). Much of the managed apartment supply is new with a sizeable share built in last 10 years. Governmental-assisted housing accounts for nearly 16% of Ridgefield's rental market, a sizeable share for a wealthy suburban community. Not included in the rental breakout below is privately owned and managed Ridgefield Crossing, a senior housing community with 123 units. (*Refer to table below*)

**Ridgefield Rental Housing by Type**

| Rental Housing Type | Share |
|---|---|
| **Market Rate Rental** | **83.9%** |
| Managed Apartments | 11.8% |
| Multi-family | 13.9% |
| Condo | 25.8% |
| Single Family | 32.4% |
| **Gov't Assisted Housing** | **16.1%** |
| | **100%** |

Source: CT MLS, Internet, RE Brokers, Prop. Mngers

- **Rental Market in Ridgefield Tight at 1.2% Vacancy:** According to US Census/ACS survey, rental vacancy in town is tight reflecting near full occupancy at a rate of 1.3%. Fairfield County is nearly double, but also low at 2.4% for 2015. Typically in such tight markets, rent rate growth begins to rise which previously averaged 2.5% annually in last four years.

- **Rental Housing Development in Ridgefield High Recently; Most under 80-3g Affordable Housing Act:** Ridgefield has seen a number of rental housing projects that have come on line in the last decade under Connecticut's 80-3g Affordable Housing legislation. These include Terraces at Ridgefield (now named Ridgefield 619) at 619 Danbury Road with 50 units, 593 Main Street (16 units), 159 Danbury Road Apartments (12 units) -part of a mixed-use residential-commercial property, and Governor House at 76 Governor St (16 units). The town, however, recently applied to the state for a moratorium on 80-3g proposals which was granted. The moratorium will run through 2018.

- **Proposed Housing for 306 Units Moving Forward**: Ridgefield's largest proposed housing project is the Eureka V development calling for 306 units off Bennett's Farm Road and Route 7. The project dates back to 2002 and has been part of a long running lawsuit between developer and town over eminent domain and density issues. The town has approved a concept plan for the project as an affordable housing development under 80-3g. At this point it is not known if units will be rental or ownership. Developer is presently in process of gaining access to sewer and water capacity for its project.

- **2.7% of Ridgefield Housing Base is Defined Affordable**: According to State DECD as of 2015, Ridgefield has a total of 256 affordable units which count towards the threshold for the Affordable Housing Appeals Act. Nearly 70% of the units tabulated are designated as governmental-assisted units, with the remainder associated with rental assistance (3), low interest government mortgages (15), or deed-restricted units (59).

- **Survey of Rents in Study Area Reveal Strong Price Support**: A survey of rental housing in the Ridgefield Area that includes Ridgefield, Wilton and the Rt 7 region of Norwalk reveals strong rent support for new construction rental with one and two bedroom units averaging $1,759/month and $2,522/month respectively. Average rents in Ridgefield among surveyed complexes are somewhat below Wilton and Norwalk, but reflect in large part older product – specifically associated with condo rental. Two bedroom rents at newer apartments in Ridgefield average $1875/m at *Ridgefield* 619, $2,162/m at *Island Hills Apartments* and $3,260/m at *85 Governor House* (rent includes H and HW). *Below are tables providing summary of rental housing survey in study area Rentals of single family homes were not included as part of the MLS survey.*

## Local Rental Housing – Summary of Rental Market Survey

- A survey of professionally managed market rate apartments in the 4-town trade area identified 27 apartment complexes. Thirteen properties were identified in Ridgefield.

- In Ridgefield, two bedroom rents in managed apartments averaged $2,425/month, with rents ranging from $1850 at Woodgate on Danbury Road to $3450/m (includes H&HW) at 86 Governor, a new 20-unit rental complex targeted for occupancy July 2016. Condo rentals averaged $2375/m for a two bedroom unit, while two bedroom rents in multi-family homes averaged $1686/month.

- Overall in the 4–town competitive trade area, apartment rents for two bedrooms average $2,450/month, with averages ranging from $1719/month in Danbury to $3297/m in Wilton. As noted above, two bedroom rents in complexes surveyed in Wallingford averaged $2,375/month.

- All four markets in the trade area have witnessed the construction of new market rate rental housing in last decade that include six in Ridgefield (includes one mix-use), three in Danbury, one in Wilton and four in Norwalk-Route 7 submarket.

- As expected, the more affordable rental product in the region was found in multi-family units, principally in Danbury which averaged $1,101/m and $1375/m respectively, for a one and two bedroom unit. Overall in the region, averages calculated to $1263/m (1 BR) and $1659/m (2BR).

| | | One BR | | | Two BR | | |
|---|---|---|---|---|---|---|---|
| Town | # of Complexes | Avg Rent | Avg Size (SF) | $/Sf | Avg Rent | Avg Size (SF) | $/SF |
| Ridgefield | 13 | $1,527 | 816 | $1.92 | $2,425 | 1,174 | $2.03 |
| Danbury | 6 | $1,470 | 898 | $1.64 | $1,719 | 1,157 | $1.49 |
| Wilton | 3 | $2,043 | 886 | $2.48 | $3,297 | 1,415 | $2.32 |
| Norwalk-Rt 7 | 5 | $1,965 | 852 | $2.45 | $2,357 | 1,159 | $2.15 |
| 4-Town Avg | 27 | $1,751 | 863 | $2.12 | $2,450 | 1,226 | $2.00 |

Source: Internet, Property Managers, Real Estate Ads & Journals, Craigslist

| Multi-Family Housing Rental Summary - Ridgefield Trade Area | | | | | |
|---|---|---|---|---|---|
| | | One BR | | Two BR | |
| Town | # of Units | Avg Rent | Avg Size (SF) | Avg Rent | Avg Size (SF) |
| **Ridgefield** | **17** | **$1,366** | **700** | **$1,686** | **995** |
| Danbury | 61 | $1,101 | 739 | $1,375 | 1,166 |
| Norwalk | 124 | $1,322 | 730 | $1,799 | 1,187 |
| Wilton | 2 | N/A | N/A | $1,775 | 1,200 |
| **4-Town Avg** | | **$1,263** | **723** | **$1,659** | **1,137** |
| Source: CT MLS | Note: Multi-family primarily refers to privately owned 2-4 unit home | | | | |

| Condo Rental Housing Rental Summary - Ridgefield Trade Area | | | | | |
|---|---|---|---|---|---|
| | | One BR | | Two BR | |
| Town | # of Units | Avg Rent | Avg Size (SF) | Avg Rent | Avg Size (SF) |
| **Ridgefield** | **35** | **$1,591** | **900** | **$2,375** | **1,478** |
| Danbury | 114 | $1,137 | 719 | $1,675 | 1,346 |
| Norwalk | 170 | $1,606 | 777 | $2,056 | 1,226 |
| Wilton | 28 | $1,588 | 698 | $2,531 | 1,311 |
| **4-Town Avg** | | **$1,481** | **774** | **$2,159** | **1,340** |
| Source: CT MLS | | | | | |

## Proposed Housing

While a number of smaller housing projects have been identified in Ridgefield aea that are in the proposal stage or recently constructed, there are two large scale developments that if built, could have a marked impact on the local housing market. Both have been stalled for years – one due to litigation, the other a victim of the housing market collapse and financial crisis. The status of both projects is described below.

### Bennett Pond Development (Ridgefield)

The Bennett Pond Development dates back to 1998 when Eureka V LLC, a subsidiary of Milstein Properties based in NY, purchased 660 acres (611 in Ridgefield) from IBM for $8 million. At the time, Eureka envisioned a mix-use plan development on the site consisting of 700 unit/homes, corporate offices, hotel and golf course. The site is located off Route 7 in North Ridgefield bordering Danbury. In 2001, the town purchased 458 acres of the site through eminent domain for $11.5 million. It later transferred the property to

the state which turned it into Bennett's Pond State Park.

Eureka V LLC maintained ownership of the southern of the site consisting of 153 acres and ultimately obtained town approval for 306 units under the state's affordable housing statue 80-3g[6]. Concurrently developer filled several lawsuits against Ridgefield and Planning and Zoning Commission beginning in 2002 pertaining to issues related to future use of eminent domain and permissible housing density on the site. By 2014, Eureka V had reached its limits on federal appeals on lawsuits filed against Ridgefield concerning eminent domain that mostly ruled in favor of town. Lawsuits, however, were still ongoing at the time at the state level over housing density questions.

At present, there has been very little activity on part of developer to move ahead with project which still lacks sewer or water line connection to site though the property has frontage on Route 7 which abuts the sewer line.

**Gilbert & Benning Redevelopment (Georgetown)**

The Gilbert and Benning redevelopment is located in Georgetown at 1 North Main St in the town of Redding on a 55-acre site that formerly housed the Gilbert and Benning Manufacturing Co. facility which functioned as a wire mill facility on site for nearly 130 years. Operations at the facility ceased in 1989, followed by bankruptcy in 1998. In October 2002, Georgetown Land Development Corp (GLDC) purchased the tax liens on former manufacturing property with intent to redevelop the site as New Urbanism mix-use community.

Following a massive outreach effort, GLDC formulated plans for the site consisting of 400+ units, 115,000 square feet of office space, 110,000 sf of retail space and assorted community space including a performing arts center. A transit oriented development component was also added with the prospect of adding a train station in Georgetown nearby the G&B project.

In order to help underwrite development costs, a special taxing district was created in 2005 comprising a single member representing the property owner. As a special district, it was able to issue bonds totaling $14 million for project cost that included building demolition and restoration of part of Norwalk River. The district also entered into a loan for $5 million US Dept. of Agriculture to build a new sewer treatment plant near the site. In addition, GLDC received $875,000 in grants for brownfield remediation.

With the onset of the housing collapse/financial crisis, plans for the Gilbert & Bennett redevelopment came to an abrupt halt. After 11 years of no activity, the town of

[6] Prior to granting concept approvals to Eureka V, Ridgefield considered using eminent domain to purchase the remaining 153 acres for use as a corporate park but dropped plans when office market went soft in aftermath of dot.com recession.

Redding has since filed a tax foreclosure notice against property owner totaling more than $3 million that continues to accrue at $340,000 per year. In addition, the town is paying a portion of the cost of the sewer plant construction ($24,000/month) that was the obligation of the Special District before it defaulted that was specific to cost of excess capacity in treatment plant tied to G&B project[7]. The Special District has also defaulted on its $14 million general obligation bond issuance which has allowed bondholders to gain control of tax liens further complicating resolution of tax and debt on property.

According to public officials in Redding there is still strong support for redevelopment of G&B site into a mixed use development. Reportedly, a court hearing scheduled for later in summer will clarify standing of various debt and lien holders on site that will offer a clear path for all parties on a negotiated settlement. Irrespective of the outcome of hearing, most parties agree that it will take considerable time before a full resolution is achieved between all stakeholders on debt and liens that would pave the way for jumpstarting project. Even when that happens, one stakeholder noted the need to reevaluate the overall concept plan in light of new market conditions before any further investments are made to start-up project. From the town of Redding's perspective, the one irrevocable requirement is that the project continues to represent a mix of uses as opposed to being just all housing.

593 Main Apartments (Ridgefield) – 16 units/Built 2013

[7] As of November 2014, Georgetown Special Taxing District owed $1.5 million to Redding Water Pollution Control Authority.

# Locational Factors

## Branchville Metro-North Station

The Branchville Metro-North station is located in Branchville (Ridgefield) off Route 7 and is the only train station located in Ridgefield. This rapid transit linkage presents a strong locational advantage for any redevelopment considered for the area. It is part of the New Haven Line which includes three branches, one of which is the Danbury Line that includes Branchville. The Danbury Line serves seven stations and terminates at New Haven Metro-North's main line in South Norwalk.


Boardings at the Branchville station are modest – but reflective of household densities in area. According to several recent regional planning studies, an estimated 170 to 190 commuters board the train at Branchville per weekday, or approximately 40,000 to 45,000 a year[8]. But signs point to growing usage on the Danbury Line and Branchville Station. According to Connecticut Commuter Rail, ridership in 2015 on the Danbury Line increased the highest of all the three branches on Metro-North with a 4.5% increase over 2014. This rate of growth even exceeded growth on the main New Haven Commuter line where ridership rose by 1.9%.

Current service on the Danbury line consists of 11 trains per day in each direction – with four thru trains terminating in Grand Central. Future plans call for increasing service to 14 trains per day with seven thru trains to Grand Central. Average travel time from Branchville to Grand Central Station (via thru trains) is 1 hour and 40 minutes.

A survey conducted in 2009 on mode of transportation to stations on Danbury line indicated 72% drove and parked at the station, 15.4% were dropped off, 7.2% waked and the balance (5%) was a mix of carpool, bike and bus. If broadly applied to Branchville demographic profile, roughly 120-140 boarders park on site, and as much as 35 to 45 are dropped off – with only a small percentage (2-5%) using other modes – including car pooling and walking/biking.

A number of capital improvement projects have been recommended for Branchville station including improving vehicular access to and from facility, replacing bridges over Norwalk River, and exploring options for acquiring additional property next to station across river for improved access, short term parking and drop off area[9].

[8] Data on was estimated from two reports: Greater Danbury Rail Parking Plan (HVCEO 2012) and Danbury Line Improvement Program EIS study (SWRPA 2013)
[9] "Branchville Train Station Visual Inspection Report" CDOT January 2007

## Access

Branchville is located on Route 7, a heavily traveled south-north regional arterial road stretching from Norwalk to the Massachusetts border (and beyond). Traffic volume is relatively heavy in Branchville area ranging from 17,900 to 21,300 ADT, levels that are generally attractive for most retail-commercial businesses when considering site locations. Traffic congestion, however, is an issue particularly during commuter times and mostly at the Route 7 and Branchville Road intersection. Feedback from interviews noted numerous complaints of long wait times by patrons trying to enter Route 7 after leaving Branchville businesses.

## Parking

There is no designated public parking in Branchville. All commercial parking in Branchville is private surface parking serving adjoining commercial property. There are 150 parking spots in the Branchville train station of which 140 are assigned annual permits to commuters, with the remaining ten spots reserved for daily fee. Prior to 2010, there was no fee system for parking in the Branchville train station lot. According to various recent surveys, the train station parking lot typically operates at 80% to 85% occupancy.

## Infrastructure

Presently there is no public sewer service in the Branchville study area. Moreover, there are no formal plans to extend service to Branchville from either of the two existing waste treatment plants in Ridgefield, although planning has started on Ridgefield's South Street plan that could potentially expand capacity that would allow for adding Branchville. However, costs for extending lines to Branchville range as high as $6.3 million.

Longer term Branchville might benefit from the redevelopment of Gilbert & Benning which would entail expansion of Georgetown's plant. Reportedly there is excess capacity in Georgetown's system but that is being reserved for G&B redevelopment. Assuming intergovernmental agreements could be secured, the distance for connection would be short and cost potentially reasonable between Georgetown and Branchville. As an alternative to tapping into an existing treatment plants, it is understood that more localized community septic treatment systems could potentially be considered for Branchville.

From a development standpoint, the lack of sewer, or community alternative to public sewer, is a major constraint that would need to be addressed to exploit full development potential in Branchville as a Transit Oriented Development.

## Lifestyle Attributes & Appearance

Lifestyle attributes are limited in Branchville district (outside of proximity to train station) but does include a highly popular full serve restaurant (Little Pub), coffee shops ect that would be appealing to prospective households. Contextually however, while Branchville is often referred to as a village, the presence of Route 7 makes area largely inhospitable for pedestrians where few sidewalks or safely designed crossings exist. Nor is the village visually or physically cohesive, either historically, architecturally, or by any central feature, with even the train station tucked away from view. Although functional

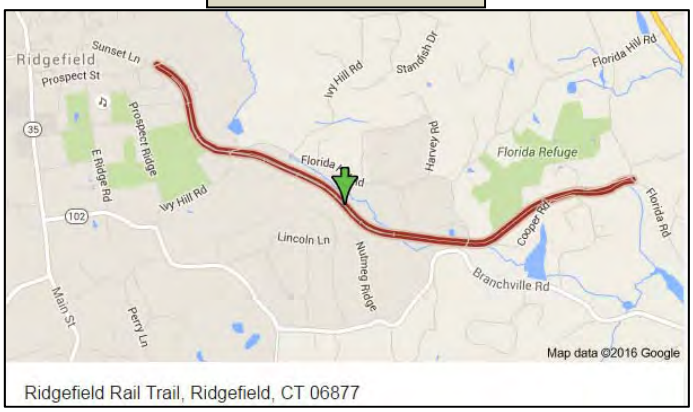
as a small business district, as a village center and major gateway into Ridgefield, its curb appeal is somewhat compromised which could impact first impressions of prospective households or businesses looking to live or invest in area, particularly in the district area.

The village, however, does support a small core of healthy businesses ranging from food outlets and dining, wine and liquor store, a pharmacy to car repair shops and a hardware store, all considered desirable to have nearby by any prospective household considering a move to the area. Business activity in the village is also strong, an important factor for any prospective business.

Moreover, additional retail, commercial and dining options are located closeby including the well regarded Caraluzzi's Food Market situated just south of Branchville on Route 7 in Wilton and an emerging dining district located in Georgetown Village (Redding), all highly supportive of new residential growth in the TOD area. For expanded retail-commercial options, Ridgefield Center with roughly 800,000 sf of space is 4 miles distance from Branchville.

## Community Amenities

Ridgefield Rail Trail



Ridgefield Rail Trail, Ridgefield, CT 06877

Community amenities are minimal in the immediate area of Branchville district – however Ridgefield Rail Trail is a short distance from the village center accessible off Florida Road representing a 2.5 mile walkway (no bikes) terminating in Ridgefield downtown.

The highly regarded Weir Farm National Historic Site is also nearby which commemorates the life and work of impressionist painter J. Alden Weir and other artists who resided at farm including John Singer Sargeant. Weir Farm is one of two sites in the National Park Service devoted to the visual arts. In addition to the house and farm, the site has a number of walking trails that traverse the 60 acre site.

Branchville also contains a small baseball field located off Playground Road with a restroom and a concession stand.

## Schools

For families, Ridgefield's reputation for quality public education is likely to be a strong attraction. The Branchville Elementary School (BES) is located in the village located at 40 Florida Road. BES is a K-5 school, one of six in town. Data for 2014 on school enrollment at BES indicate a size nearly 400 students with low teacher to student ratio. Moreover, according to Ridgefield Board of Education data, CMT scores at the school have trended high in recent years with scores averaging 94.2 on a scale of 100.

# Conclusions on TOD Market Opportunity

## Office Market TOD Potential

Market data collected to date on the Office Market suggests very little potential for development within the Branchville TOD study area. While, vacancy levels regionally and locally have dropped since peaks during recession they still remain elevated. Moreover, there appears to be little investment appetite for new office and virtually none for speculative space, with the possible exception of medical office.

In terms of Branchville TOD opportunity, much of what is marketed or used as office tends to be service-base and would fit easily into a retail building format. It was observed, however, that there is a notable lack of representation in conventional office sectors supporting legal, real estate, and accounting-finance in Branchville to the extent these sectors service a more service-oriented market – i.e. households or other businesses.

While service based office is in abundance in Ridgefield Center – and noted further south on Route 7 in Wilton, these businesses if located in Branchville offer potential for meeting more localized niche requirements, while at same time being close to rapid transit if needed. However, as it is highly unlikely that any conventional office would be developed in Branchville over a 5-7 year timeframe to accommodate such use – the inclusion of such businesses, would likely rely on vacancies in existing commercial space or possibly conversion of an existing property.

### *Office Market Opportunity- Branchville*

Based on factors related to competition and tepid market environment, we anticipate only minor office growth potential in the Branchville TOD area totaling no more than 1,000 to 2,250 sf. It is expected that office demand in Branchville will principally be tied to businesses in independent-based legal, financial, real estate, and medical/allied health related sectors linked to local demand. All of these sectors are commonly found in commercial districts and could be accommodated in Branchville. They are also underrepresented or absent in the business mix of the village.

With the current market environment ill-suited for supporting investment in new construction[10] for office in Branchville, it is further expected that any office growth that emerges in the village will be absorbed in vacant space or as component of a property conversion or as part of a new mix-use project.

## Retail Market TOD Potential

A stronger case can be made for retail growth within the TOD area given tight vacancies locally and high household income base in the trade area. However, a number of market and locational factors are likely to constrain opportunity for retail in Branchville.

[10] The one exception is the medical office market which has seen steady growth in last 10 years despite a dour economy for most of that period.

Heading the list is low population density in a 1-2 mile radius, coupled with low population growth, though drive-by traffic from residents and non-residents alike are providing support of local businesses in Branchville according to local anecdotal data. Area competition is also a factor with Ridgefield Center-Danbury Rd - 4 miles distance - containing nearly 800,000 sf of retail, while Rt 7 south to Cannondale adds another 200,000 sf.

Lack of buildable sites with direct frontage to Route 7 appears to be another constraint – with essentially no viable locations on east side of Route 7 in the TOD area and only small infill options on the west side. Expanded options are noted on a number of side streets, but most retailers considering Branchville would want the visibility from Route 7[11].

On the other hand, capacity for parcel assemblage appears favorable with land ownership among commercial properties in the hands of a few owners. Strong traffic counts in the Branchville area are also supportive of retail growth. Meanwhile, a survey of the business district reveals low vacancy with only one vacant ground floor commercial space identified located at 37 Ethan Allen Highway. This space formerly housed the *La Piazza and Wine Bar* which closed in 2014.

One area of opportunity for growth in Branchville was identified in fast and prepared food and casual dining options in the village which would benefit both from local demand and connection to rapid transit, as well as its location along a highly traveled corridor. Additional opportunity for retail-commercial is identified among businesses catering to convenience based goods and services based on retail gap data reflecting additional capacity for growth in the district.

### *Retail Market Opportunity – Branchville*

Based on the research undertaken of the retail/service/commercial market in Ridgefield and more specifically the Branchville trade area, it is estimated that from 2,500 to 7,500 additional sf could be supported in the Branchville district over a five-six year period depending on configuration (freestanding, infill or mixed use). As noted previously, much of this would likely be in the form of convenience based retail and services (some niche oriented), and would include full and limited service dining and take-out designed to serve a local-based and drive-by market.

As a side note, we also observed the presence of a market niche in the Branchville area that could represent an expansion opportunity oriented towards the building trades and home improvement market that included a hardware store, equipment rental, stone and marble wholesaler, specialty glass, and cabinetry. This sector is also well represented in fair numbers further north on Ethan Allen Highway outside of village.

While demand data indicates support for additional retail in Branchville, growth in retail supply in Branchville is likely to be constrained by investment reticence in new construction unless anchored by a high grade credit tenant. High commercial rents in the area – though Branchville is more competitive than other nearby districts – could also become an impediment to growth with only businesses capable of achieving high sales per square feet likely to be interested in space.

[11] One of the most clearly articulated retail redevelopment opportunity in the broader ½ mile TOD area is actually located just outside of Branchville in Georgetown at 1039 Danbury Road, representing a vacant auto dealership on a 2-acre site, though potential flood issues from nearby Norwalk River is a possible constraint.

## Housing Market TOD Potential

Probably as no surprise, the strongest market opportunity for development in the Branchville TOD area is linked with housing. This is the case for both ownership and rental, though latent demand is deepest for rental.

*Condo Housing Market*

Market factors in support of condo development include lack of new product in town which is dominated by two complexes built in the early 1970s comprising nearly 600 units – many rented. Most of these units, many one bedrooms, resale in the $250,000 range, while median sales price for a condo in Ridgefield for 2015 was $223,500 according to Warren Group.

However, a better test of price support for condos was noted in sales at *Regency at Ridgefield* built in 2008 – all townhouses- which sold at prices $550,000+ with recent listings topping $700,000. Condo opportunity is also enhanced by Ridgefield's high ranking as a residential location. Additionally, condo demand in town is benefiting from growth in the 55+ household market which is expected to expand by 43% between 2010–2020 in Ridgefield. As this market ages, senior households will be looking for opportunities in town to downsize.

While demographics, solid price support, dearth of newer product, and a desirable town location suggests an opportunity for condo housing in Branchville, a number of constraints impact on development potential in the village.

One such issue is that regionally-locally the condo market is still on the mend following the housing collapse of 2007 and subsequent financial crisis. Sales volume has started to pick up in Ridgefield but sales prices have yet to revive to post recession levels with price levels still down by 42% since 2006. Again part of this impacted by lack of new product, but nevertheless reflects continued weakness.

Branchville is also not perceived as a competitive location for condo, with areas closer to Ridgefield Center deemed more favorable and marketable for ownership housing. Areas closer to the center have the additional benefit of access to public sewer that simplifies development.

*Rental Housing Market*

A more persuasive argument can be made for rental housing in the TOD area where proximity to the train station represents a stronger market advantage over condo and should help with rent support. Even without the connection to the train station, data on housing rents in the area appears quite strong locally with two bedrooms ranging from $1875 to $2900/m (net)[12]. Anecdotal data on lease-ups in a number of newer properties in town also suggest strong demand. Demographics also favor rental housing with highest growth rates projected among young adults 20-35 years over the next five years in Ridgefield.

[12] Two BR Rents at new apartment complex in Ridgefield *86 Governor* are even higher averaging $3500/m, but include H&HW.

Regionally the data on rental housing continues to be favorable, as it has been for almost the past eight years. Rent rate growth lifted to 5.6% in 2015 following three years at 2.5%. New inventory has also begun to hit the regional marketplace expanding by 6.1% in 2015. One cautionary note is this inventory growth has led to an increase in vacancy that is projected to remain above 5% through the end of the decade.

Overall vacancy in Ridgefield for rental continues to remain very low at under 2% despite the spate of rental housing projects in recent years-most under the state's affordable housing act 80-3g. An estimated 100 rental units have been approved and built under the regulation, the largest represented by Terraces at Ridgefield (now Ridgefield 619), but most sized between 8 to 16 units. Another 30+ units have been built as 100% market rate.

One other very sizeable housing project approved under 80 3g, but unbuilt, is the conceptually approved 306-unit Eureka Development located in north Ridgefield, which has been mired in a lawsuit with the town for over a decade. Given legal and infrastructure issues (no public sewer or water), it is not known when and if this project will move forward, or to what degree it will include rental, if any.

In terms of Branchville, household growth town-wide point to potential demand of as much as 250 units by end of decade of which 50 to 75 units would represent demand for rental housing. Regional latent demand for rental housing and shifts in household tenure could push that figure as high as 150 units. Key market groups for new rental in Ridgefield include both empty nesters and a burgeoning 20-34 age group that is showing up in local demographics, the later a likely prime candidate for any rental housing that might be proposed in Branchville.

### *Housing Market Opportunity – Branchville*

Rental housing represents the strongest development opportunity for Branchville, both in terms of market and location. While depth of market and absorption potential would largely be defined by the target market, based on results of a market penetration analysis covering a broad market base it is estimated that up to 20 to 50 units could be envisioned for the target Branchville TOD area in a 5-6 year period, assuming issues related to sewer or septic capacity are resolved.

## Summary of Development Potential

Of the three market sectors analyzed, the most conservative development scenario is projected for office given subdued condition of the market and constraints in future demand for the foreseeable future due to economy, though select options for small-scale legal, finance, real estate, heath care related businesses is possible given how underrepresented they are in the district.

Development opportunities for Retail/Service/Dining in the target area appear to be moderately positive. However, scale of such development will be affected by level of economic growth locally and regionally, as well as success in identifying latent demand for goods and services in an area presently underserved. It is expected that much of the retail-commercial will be in the form of convenience-based services and food services – though it was also observed the village has formed a market niche in building trades and home improvement which may represent an opportunity for further expansion.

Rental housing represents the most viable real estate sector for development in the TOD area based on market strength and advantages inherent with proximity to train station. This sector is also seeing the strongest investment interest from local and regional developers most likely to consider Branchville. New housing in Branchville TOD could take the form of infill, rehab conversion or new construction and be either stand alone or mixed use. Moreover, both market-rate and mixed income scenarios could be envisioned. In either case, property visibility or signage on Route 7 would immeasurably enhance marketability.

Below is a summary chart of development potential over a five year period targeted for Branchville TOD area (Branchville Village District) based on the forgoing analysis of market conditions and market depth within select market sectors in the region, town and targeted TOD area.

**ESTIMATE of TOD DEVELOPMENT POTENTIAL**
***BRANCHVILLE VILLAGE TOD AREA***

| Market Sector | Development Potential |
|---|---|
| Office | 1,000 - 2,250 sf |
| Retail-Services-Food | 2,500 - 7,500 sf |
| Housing (Rental) | 20 - 50 units |

# Branchville TOD Stormwater Management Standards

**TO:** Francisco Gomes

**FROM:** Joe Canas

**COPY:** File, 15-0429

**DATE:** October 31, 2016

# Introduction

The following stormwater management standards are recommended to establish minimum stormwater management criteria for new development and redevelopment activities in the Branchville TOD area. Projects should be required to meet these minimum standards, and comply with specific criteria for the site planning process, groundwater recharge, water quality, channel protection, and peak flow control requirements. The standards are consistent with the stormwater management approaches and design guidance contained in the Connecticut Department of Energy and Environmental Protection's Connecticut Stormwater Quality Manual, the Connecticut Department of Transportation Drainage Manual, and the Town of Ridgefield.

The proposed minimum standards assist in the protection of the water and habitat quality of receiving waters from the negative impacts of stormwater runoff. This is achieved by using a combination of both structural controls and non-structural practices (such as Low Impact Development (LID)) as part of an effective stormwater management system.

# 1 Existing Stormwater Infrastructure

The stormwater within the development area is handled with standard curb-and-gutter systems that direct stormwater runoff into existing catch basins along the curb line. In general, the Town storm drains west of Route 7 flow easterly, discharging into the Connecticut Department of Transportation's Route 7 drainage system. There are multiple outlets from the CTDOT system into the Norwalk River. None of the outlets have additional stormwater treatment systems, such as gross particle separators.

We have inquired to the State and the Town regarding observed capacity issues, and none were reported. As the designs progress, a more detailed analysis of the existing stormwater infrastructure will be required.

# 2 Town of Ridgefield Stormwater Management Requirements

Section 7.14 of the Ridgefield Zoning Regulations identify the Town's requirements for stormwater management. The overall requirement is that the post-development site runoff must be equal to or less than the runoff from the site in its pre-development condition. The 2004 Connecticut Stormwater Quality Manual is incorporated by reference.

Section 7.14.F of the regulations identifies the following requirements:

1. All proposed developments shall include an analysis performed in accordance with the Connecticut Stormwater Quality Manual, including analysis of the upstream tributary drainage area and downstream impact, providing a comparison of the pre-development conditions with the proposed post-development conditions. As the designs progress for the development sites, this analysis would be included as part of the formal site plan application.

2. Proposed developments shall attenuate the post-development peak runoff rate. The stormwater management strategy outlined further in this memorandum anticipates that infiltration will be used as a primary means of attenuating the post-development peak runoff rate.

3. All drainage/conveyance systems, whether structural or non-structural, shall be analyzed, designed and constructed to accommodate existing upstream off-site runoff and developed on-site runoff (post-development). As more detailed plans are developed for the proposed development sites, this analysis would be performed as part of the formal site plan application.

4. Proposed developments shall include provisions for the treatment of surface runoff in order to minimize the discharge of pollutants into existing conveyance systems, watercourses, water bodies and wetlands. Proposed developments will treat surface runoff as required by the 2004 Stormwater Quality Manual and the upcoming 2017 General Permit for the Discharge of Stormwater from Small Municipal Storm Sewer Systems. More specific treatment methods would be developed as designs progress, however, we anticipate the use of infiltration and pretreatment structures, such as gross particle separators

5. The Commission may require post-development pollutant renovation analysis for commercial site development, where warranted by the proposed use and potential for pollutant runoff. Site stormwater treatment trains will be developed to reduce the total suspended solids load from the site to meet the 80 percent goal established by the Town.

6. The Commission may require attenuation of runoff volume through the use of infiltration or other methods, when warranted to decrease water volume impacts on downstream properties. Infiltration is anticipated as a stormwater management strategy for most development blocks to the maximum extent practicable.

7. All proposed developments shall include measures to control soil erosion and sedimentation during construction and post-development in accordance with Section 7.6 of the Zoning Regulations. All development sites will have detailed sediment and erosion control plans as part of the site-specific site plan applications.

8. Maintenance of all proposed drainage systems/facilities not dedicated to the Town shall be the sole responsibility of the property owner or property association. The maintenance of each system, whether it be individual or other private entity will be identified as the site-specific plans are developed.

# 3 Stormwater Management Standards

The following stormwater management standards describe how the Town's stormwater management regulations will be implemented throughout the development area, as well as complying with the standards established in the upcoming 2017 MS4 permit.

## 3.1 Standard 1: Low Impact Development

Low Impact Development (LID) site planning and design strategies must be used to the maximum extent practicable in order to reduce stormwater runoff volume for both new and redevelopment projects. The objective of the LID Site Planning and Design Strategies standard is to provide a process by which LID is considered at an early stage in the planning process such that stormwater impacts are prevented rather than mitigated for later.

Instead of rapidly and efficiently draining the site, low-impact development relies on various planning tools and control practices to preserve the natural hydrologic functions of the site, and typically involves controlling stormwater at its source instead of a centralized management system. Natural hydrologic functions such as interception, depression storage, and infiltration are evenly distributed throughout an undeveloped site. Trying to control or restore these functions using an end-of-pipe stormwater management approach is difficult, if not impossible.

Low Impact Design strategies include the following approaches:

### 3.1.1 Reduce/Minimize Total Impervious Areas

After, or concurrent with, the mapping of the development envelope, develop the traffic pattern and road layout and preliminary lot layout. The entire traffic distribution network, (roadways, sidewalks, driveways, and parking areas), are the greatest source of site imperviousness, these changes in the impervious area alter runoff and recharge values and site hydrology. Strategies include:

- Utilize as narrow a road section as possible
- Limit sidewalks to one side of the road where feasible
- Minimize on-street parking to the minimum necessary
- Provide parking beneath buildings
- Favor vertical over horizontal construction where possible
- Share driveways where possible
- Minimize setbacks where possible to minimize driveway length

### 3.1.2 Minimize Directly Connected Impervious Area

Disconnecting the unavoidable impervious areas as much as possible will reduce the amounts of pollutants transported by the runoff. Strategies for accomplishing this include

- Disconnecting roof drains and directing flows to vegetated areas
- Directing flows from paved areas such as driveways to stabilized vegetated areas
- Breaking up flow directions from large paved surfaces.
- Encouraging sheet flow through vegetated areas.

### 3.1.3 Increase Drainage Flow Paths

The time of concentration, in conjunction with the hydrologic site conditions, factors into the peak discharge rate for a storm event. Site and infrastructure components that affect the time of concentration include

- Travel distance (flow path)
- Slope of the ground surface and/or water surface
- Surface roughness
- Channel shape, pattern, and material components

Techniques that can affect and control the time of concentration may be incorporated into the LID concept by managing flow and conveyance systems within the development site af follows:

- Maximize overland sheet flow length
- Increase and lengthen flow paths.
- Lengthen and flatten site and lot slopes.
- Maximize use of open swale systems.
- Increase and augment site and lot vegetation.

## 3.2 Standard 2: Runoff Volume Reduction and Groundwater Recharge

Stormwater must be recharged within the same subwatershed to maintain baseflow at pre-development recharge levels to the maximum extent practicable. The objective of the groundwater recharge standard is to protect water table levels, stream baseflow, wetlands, and soil moisture levels. Infiltrating stormwater may also provide significant water quality benefits such as reduction of bacteria, nutrients, and metals when infiltrated into the soil profile.

Maintaining pre-development groundwater recharge conditions may also be used to reduce the volume requirements dictated by other sizing criteria (i.e., water quality, channel protection, and overbank flood control). Recharge must occur in a manner that protects groundwater quality. Recharge practices may include both structural stormwater controls and nonstructural practices, and are dependent upon the underlying soil profile.

In addition, infiltration practices should not be used where subsurface contamination is present from prior land use due to the increased threat of pollutant migration associated with increased hydraulic loading from infiltration systems, unless the contamination is removed and the site has been remediated, or if approved by CTDEEP on a case-by-case basis.

Runoff Volume Reduction and Groundwater Recharge strategies include the following:

### 3.2.1 Infiltration Trenches

An infiltration trench is an excavated trench that has been back-filled with stone to form a subsurface basin. Stormwater runoff is diverted into the trench and is stored until it can be infiltrated into the soil, for a maximum storage period of three days. Infiltration trenches are very adaptable and can be configured in numerous layouts to make them ideal for small urban drainage areas. Their service life is maximized when some form of pretreatment is included in their design.

Infiltration trenches can be used around the perimeters of parking lots, along parking lot medians.

### 3.2.2 Underground Infiltration Chambers

Similar to the infiltration trench, and underground infiltration chamber consists of a perforated plastic or concrete chamber surrounded by crushed stone. Stormwater runoff is diverted into the chamber system and is stored within the stone and chamber until it can be infiltrated into the soil, for a maximum storage period of three days. Underground infiltration chambers are very adaptable and can be configured in numerous layouts to make them ideal for small urban drainage areas. Their service life is maximized when some form of pretreatment is included in their design. Drywells also fall into this category.

Underground infiltration chambers are suitable to accept runoff from buildings and parking lots, provided that there are not high levels of pollutants associated with stormwater “hot spots”.

### 3.2.3 Rain Garden and Bioretention

A rain garden is a garden which takes advantage of rainfall and stormwater runoff in its design and plant selection. Usually, it is a small garden which is designed to withstand the extremes of moisture and concentrations of nutrients, particularly Nitrogen and Phosphorus, that are found in stormwater runoff. rain gardens are sited ideally close to the source of the runoff and serve to provide an area for the intercepted runoff to pond and drain through the soil, where pollutants are removed by both infiltration and biological uptake.

### 3.2.4 Permeable Pavement

Permeable pavement is designed to allow infiltration of stormwater through void spaces in the pavement section and into the soil below where the water is naturally filtered and pollutants are removed. Typical pavement, which has no void space for water to move through, resulting in significantly increased runoff. There are numerous permeable pavement products on the market, including pervious concrete, pervious asphalt, and permeable pavers. Availability of pervious concrete and asphalt in smaller quantities may be limited.

## 3.3 Standard 3: Water Quality Pollutant Reduction

Stormwater runoff must be treated before discharge. The amount that must be treated from each rainfall event is known as the required water quality volume (WQV) and is the portion of runoff containing the majority of the pollutants. The WQV is generally the first inch of runoff from the storm, which contains the highest pollutant loads as it washes off accumulated sediments and pollutants.

Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). In order to provide adequate treatment of stormwater, the WQV must be treated by at least one of the structural BMPs listed in the Connecticut Department of Energy and Environmental Protection's Connecticut Stormwater Quality Manual at each location where a discharge of stormwater will occur. Structural BMPs are generally required to achieve the required pollutant removal efficiencies. Potential strategies include the following:

### 3.3.1 Infiltration Practices

Infiltration practices, in addition to recharging groundwater and reducing stormwater volume also can reduce pollutants, by encouraging adsoprption of nutrients and metals to the soil matrix below, immobilizing them and preventing their discharge to wetlands and watercourses.

### 3.3.2 Wet Ponds

Wet ponds typically consist of two general components, a forebay and a permanent wet pool. The forebay provides pretreatment by capturing coarse sediment particles in order to minimize the need to remove the sediments from the primary wet pool. The wet pool serves as the primary treatment mechanism and where much of the retention capacity exists. Wet ponds can be sized for a wide range of watershed sizes, however, their application may be restricted by the size of the site. For example, a variation on the conventional wet pond, sometimes referred to as a "pocket pond", is intended to serve relatively small drainage areas (between one and five acres). Because of these smaller drainage areas and the resulting lower hydraulic loads of pocket ponds, outlet structures can be simplified and often do not have safety features such as emergency spillways and low level drains. In any event, the hydraulic design of the pond must be viewed in the context of the hydrology of the watershed, because over detaining storms can exacerbate flooding conditions. In Branchville, there is a small potential for this to happen because the site is in the upper reaches of the Norwalk River watershed.

### 3.3.3 Micropool Extended Detention Basins

Micropool extended detention basins are primarily used for peak runoff control and utilize a smaller permanent pool than conventional wet ponds. While micropool extended detention ponds are not as efficient as wet ponds for the removal of pollutants, they should be considered when a large open pool might be undesirable or unacceptable. Micropool extended detention ponds are also efficient as a stormwater retrofit to improve the treatment performance of existing detention basins.

### 3.3.4 Stormwater Filtration Practices

Stormwater filtering practices are commonly used to treat runoff from small sites such as parking lots and small developments; areas with high pollution potential such as industrial sites; or in highly urbanized areas where space is limited. A number of surface and underground stormwater filter design variations have been developed for these types of applications. Underground filters can be placed under parking lots and are well suited to highly urbanized areas or space-limited sites since they consume no surface space. As such, stormwater filters are often suitable for retrofit applications where space is typically limited. Stormwater filtration systems that do not discharge to the soil (i.e., are contained in a structure or equipped with an impermeable liner) are also suitable options for treating

runoff from industrial areas and other land uses with high pollutant potential since the water is not allowed to infiltrate into the soil and potentially contaminate groundwater. These systems tend to be maintenance intensive.

#### 3.3.4.1 Surface Sand Filter

The surface sand filter consisting of a filter bed and sedimentation chamber that are aboveground. Surface sand filters can consist of excavated, earthen basins or aboveground concrete chambers.

**Bioretention:** Bioretention systems are shallow landscaped depressions designed to manage and treat stormwater runoff. Bioretention systems are a variation of a surface sand filter, where the sand filtration media is replaced with a planted soil bed designed to remove pollutants through physical and biological processes Stormwater flows into the bioretention area, ponds on the surface, and gradually infiltrates into the soil bed. Treated water is allowed to infiltrate into the surrounding soils or is collected by an underdrain system and discharged to the storm sewer system or receiving waters. Rain gardens are a form of small-scale bioretention applications (i.e., residential yards, median strips, parking lot islands), which may be more appropriate for the sizes of the parcels in the TOD study area.

#### 3.3.4.2 Subsurface Sand Filters

Subsurface sand filters work on the same concept as the surface filtration practices, but instead use underground chambers, and as a result may be more suitable for sites with limited area. Due to their underground nature, operational inefficiencies may not be readily visible, and therefore require frequent observation to ensure that they are operating as intended.

### 3.3.5 Water Quality Swales

Water quality swales provide significantly higher pollutant removal than traditional grass drainage channels, which are designed for conveyance rather than water quality treatment. They come in two basic formats: dry swales and wet swales. Since these treatment practices require little room, they can be considered for areas where there is a moderate amount of impervious cover and enough perimeter land space to incorporate them.

#### 3.3.5.1 Dry Swales

Dry swales are designed to temporarily hold the water quality volume of a storm in a pool or series of pools created by permanent check dams at culverts or driveway crossings. The soil bed consists of native soils or highly permeable fill material, underlain by an underdrain system. Pollutants are removed through sedimentation, adsorption, nutrient uptake, and infiltration.

#### 3.3.5.2 Wet Swales

Wet swales also temporarily store and treat the entire water quality volume. However, unlike dry swales, wet swales are constructed directly within existing soils and are not underlain by a soil filter bed or underdrain system. Wet swales store the water quality volume within a series of cells within the channel, which may be formed by berms or check dams and may contain wetland vegetation \ The pollutant removal mechanisms in wet swales are similar to those of stormwater wetlands, which rely on sedimentation,

adsorption, and microbial breakdown. Water quality swales can be used in place of curbs, gutters, and storm drain systems on residential and commercial sites to enhance pollutant removal and provide limited groundwater recharge, flood control, and channel protection benefits.

## 3.4 Standard 4: Conveyance and Natural Channel Protection

Open drainage and pipe conveyance systems must be designed to provide adequate passage for flows leading to, from, and through stormwater management facilities for at least the peak flow from the 10-year, 24-hour Type III design storm event. Protection for natural channels downstream must be supplied by providing 24-hour extended detention of the one-year, 24-hour Type III design storm event runoff volume.

Control the post-development peak flow rates to the corresponding pre-development peak flow rates. Size the emergency outlet to safely pass the post-development peak runoff from large storms in a controlled manner without eroding the outlet works, downstream drainage systems, and property more than would occur during a similar event under pre-development conditions.

Numerous strategies and combinations of strategies may be used to achieve the required protection levels, especially wet pond and underground infiltration practices.

## 3.5 Standard 5: Redevelopment

Redevelopment is defined as any construction, alteration, or improvement that disturbs disturbs the ground surface or increases the impervious area where the existing land use is commercial, industrial, institutional, governmental, recreational, or multifamily residential. Redevelopment of previously developed sites must meet the standards to the maximum extent practicable for the portion of the site undergoing redevelopment.

Where sites that are currently developed with an effective impervious cover of forty percent or more, the site shall be designed in such a manner as to retain on-half the water quality volume for the site and provide additional stormwater treatment without retention for discharges up to the full water quality volume for sediment, floatables and nutrients to the maximum extent achievable using control measures that are technologically available and economically practicable and achievable in light of best industry practice.

In cases where it is not possible to retain half the water quality volume, the design of the redevelopment shall retain runoff volume to the maximum extent achievable using control measures that are technologically available and economically practicable and achievable in light of best industry practice. In such cases, additional stormwater treatment up to the full water quality volume is still required. Any such treatment shall be designed, installed and maintained in accordance with the Stormwater Quality Manual. If retention of half the water quality volume is not achieved, a report shall be prepared describing: the measures taken to maximize runoff reduction practices on the site; the reasons why those practices constitute the maximum extent achievable; the alternative retention volume; and a description of the measures used to provide additional stormwater treatment above the alternate volume up to the water quality volume.

## 3.6 Standard 6: Land Uses with Higher Potential Pollutant Loads

Stormwater discharges from land uses with higher potential pollutant loads require the use of specific source control and pollution prevention measures and the specific stormwater BMPs approved for such use. Stormwater runoff from land uses with higher potential pollutant loads shall not be recharged to groundwater, unless it has been adequately treated for the pollutant of concern as determined by the approving agency. The recharge prohibition applies only to stormwater discharges that come into contact with the area or activity on the site that may generate the higher potential pollutant load. In these areas where infiltration is not appropriate, other LID practices can be used, as long as they are lined (e.g., lined bioretention areas). The intent of this standard is to prevent, to the maximum extent practicable, pollution from entering water resources.

## 3.7 Standard 7: Illicit Discharges

All illicit discharges to stormwater management systems are prohibited, including discharges from on-site wastewater treatment systems, sub-drains and French drains near on-site wastewater treatment systems. The stormwater management system is the system for conveying, treating, and infiltrating stormwater on site, including stormwater best management practices and any pipes intended to transport stormwater to ground water, surface water, or municipal separate storm sewer system (MS4). Illicit discharges to the stormwater management system, i.e., illicit connections , are discharges not entirely comprised of stormwater that are not specifically authorized by a National Pollutant Discharge Elimination System (NPDES) permit. The objective of this standard is to prevent pollutants from being discharged into MS4s and Waters of the State, and to safeguard the environment and public health, safety, and welfare.

## 3.8 Standard 8: Construction Erosion and Sedimentation Control

Erosion and sedimentation control (ESC) practices must be utilized during the construction phase as well as during any land disturbing activities. ESC practices must meet the requirements of the CTDEEP General Permit for the Discharge of Stormwater and Dewatering Wastewaters from Construction Activities for CTDEEP-regulated activities. ESC practices must be designed according to the guidelines in the most recent edition of the Connecticut Guidelines for Soil Erosion and Sediment Control (as amended) The objective of this standard is to prevent erosion and sedimentation from construction site runoff.

All development, regardless of the area of disturbance, must implement erosion and sedimentation controls prior to and during construction. Additionally, temporary controls shall be removed from a site and disposed of properly after the site has been stabilized.

# 4 Stormwater Management Strategies for Development Scenarios

## 4.1 Development Block 1

Development Block 1 is located in an area where the underlying soils are in Hydrologic Soil Group A and B, which makes the site conducive for infiltration practices. At a minimum, the

rooftop runoff from the proposed commercial building should be infiltrated. The space in the front yard between the proposed building and the Route 7 right of way may be of sufficient size for the construction of a rain garden that could treat low flow from the proposed parking areas, and since the front yard is the lowest point of the site topographically, using the area as a rain garden would mimic existing drainage patterns, and help remove nutrients.

## 4.2 Development Block 2

Development Block 2 consists of 4,000 square feet of existing commercial development and 7,000 square feet of proposed commercial development. The underlying soils are favorable for infiltration, belonging to Hydrologic Soil Group A and B soils. At a minimum, the rooftop runoff from the proposed commercial building should be infiltrated. The space in the front yard between the proposed building and the Route 7 right of way may be of sufficient size for the construction of a rain garden that could treat low flow from the proposed parking areas, and since the front yard is the lowest point of the site topographically, using the area as a rain garden would mimic existing drainage patterns, and help remove nutrients.

## 4.3 Development Block 3

Development Block 3 consists of 3,000 square feet of existing commercial development and 3,000 square feet of proposed commercial development. The underlying soils are favorable for infiltration, belonging to Hydrologic Soil Group A and B soils. At a minimum, the rooftop runoff from the proposed commercial building should be infiltrated. Due to space constraints, beyond the proposed buildings and parking areas, a large rain garden system may not feasible, but other infiltration practices, such as underground infiltration chambers beneath the proposed parking to the northwest may be appropriate depending upon depth to ledge, groundwater, and topography.

## 4.4 Development Block 4

Development Block 4 consists of 2,000 square feet of existing commercial development and 3,000 square feet of proposed commercial development. The underlying soils are favorable for infiltration, belonging to Hydrologic Soil Group A and B soils. At a minimum, the rooftop runoff from the proposed commercial building should be infiltrated. Due to space constraints, beyond the proposed buildings and parking areas, a large rain garden system may not feasible, but other infiltration practices, such as underground infiltration chambers beneath the proposed parking to the northwest may be appropriate depending upon depth to ledge, groundwater, and topography.

## 4.5 Development Block 5

Development Block 5 consists of 25 proposed apartment units with 68 proposed parking spaces at grade. The parking area could be designed to provide vegetated strips and filters along the perimeter, and inside parking islands. The soils in this area have moderate infiltration rates, and therefore infiltration of the roof and parking lot runoff is possible, depending on site-specific soil testing results.

## 4.6 Development Block 6

Development Block 6 consists of 48 proposed apartment units in two buildings with 97 proposed parking spaces at grade. The parking area could be designed to provide vegetated strips and filters along the perimeter, and inside parking islands. The soils in area have low to moderate infiltration rates, and therefore infiltration of the roof and parking lot runoff may be possible, depending on site-specific soil testing results, though depth to restrictive layers may be a concern based upon the soil type of the area.

## 4.7 Development Blocks 7, 8 and 9

Development Blocks 7, 8 and 9 consist of a total of 22 townhouses, with the slope gradually becoming less steep from west to east. The soils in this area require further testing, but preliminary soil survey data indicates the soils have low to moderate permeability. There is space between the units, and it may be possible to locate a small wet pond on Development Block 9, between the backs of the proposed townhouses to accept runoff from Blocks 7 through 9. Development block 9 is the lowest of the three blocks in elevation. Infiltration of rooftop runoff using drywells is also a potential stormwater management strategy.

## 4.8 Development Block 10

Development Block 10 consists of 30 proposed apartment units in a single building and 55 at-grade parking spaces. Potential stormwater management strategies include the use of vegetative strips and filters on the proposed parking north of the village green, and infiltration of stormwater from the development block, also located beneath the parking lot of the village green area, since it is the topographically lowest area of the development block, and also the area with the best soil as described in the NRCS Soil Survey.

## 4.9 Development Block 11

Development Block 11 is located along the frontage of U.S. Route 7, and consists of 5,000 square feet of existing commercial development, 12,000 square feet fo proposed commercial development, and 44 at-grade parking spaces to be located south of the proposed village green. The parking area south of the village green is a good candidate for vegetative swales, and the runoff from the parking lot should be infiltrated here to take advantage of the suitable soils. Leaders from the buildings fronting Route 7 could be infiltrated through drywells.

## 4.10 Development Block 12

Development Block 12 consists of 6,000 square feet of proposed commercial space and 35 parking spots. The parking will be located to the west of the commercial building. Vegetative strips may be of value here, though there is less green space on the margins of the parking area. Runoff from the parking lot can also be infiltrated, while roof top runoff from the proposed buildings may be infiltrated due to the favorable soils based upon the NRCS survey.

## 4.11 Development Block 13

Development Block 13 consists of 30 apartment units in a single building and 32 proposed parking spaces. The development block is located in an area with low to moderately

permeable soils, therefor, additional soil testing will be required to determine if infiltration is possible. Underground detention will likely be necessary for peak flow attenuation since there is not enough surface area available for surface detention ponds.

## 4.12 Development Block 14

Development Block 14 lies in an area of low to moderate soil permeability, therefore additional soil testing will be necessary to confirm soil infiltration capacities. The development block consists of a mixture of townhouse buildings. The roof areas may be small enough to allow for infiltration of the roof area through drywells, and a vegetated swale may be incorporated between the lowest row of townhouses and the townhouses just upslope to help convey runoff from the upper area and provide additional stormwater treatment.

## 4.13 Development Block 15

Development Block 15 consists of 30,000 square feet of proposed commercial space and 98 parking spaces. The soils in this development block have moderate infiltrative capacity. Vegetative filter strips can be employed inside and along the perimeter of the parking area, and infiltration chambers could be placed beneath the parking area, subject to the potentially restrictive depth of groundwater.

## 4.14 Development Blocks 16 and 17

Development Blocks 16 and 17 are situated on a steep slope with moderate soil permeability. The proposed development for these two blocks are townhouses. There is a potential to place a long, linear wet pond system between the backs of units of the southern end of the development blocks. Due to the slope steepness in the upper portion of the development block, infiltration opportunities may be limited.

## 4.15 Development Blocks 18, 19, 22, 23, 27 and 28

These development blocks consist of townhouses located on the highest part of the slope within the TOD area east of the Norwalk River. Due to the steepness of the slopes and position above over development blocks, infiltration opportunities are limited. Localized improvements, such as permeable paver driveways and vegetated swales may provide stormwater management quality treatment opportunities.

## 4.16 Development Blocks 20, 21, 24, 25, and 29 – 31

These development blocks consist of townhouses on a steep slope below other development blocks. Soils have moderate infiltrative capacity based on the NRCS Soil Survey. Infiltration of rooftop runoff and the use of permeable paver driveway may be appropriate stormwater management strategies for these blocks.

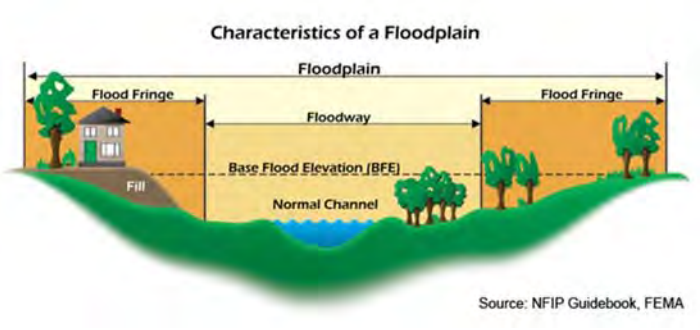
## 4.17 Development Block 32

This development consists of 84 apartment units in a two buildings with 150 parking spaces on moderately sloping land. The development block is underlain by soils of moderate permeability. The parking areas provide opportunities for vegetated filter strips around the

perimeters and areas to place underground infiltration chambers. There appears to be little room for surface detention ponds.

# 5 Floodplain Management

Portions of the TOD area are within areas mapped by the Federal Emergency Management Agency as a special flood hazard area. FEMA establishes the minimum standards for the National Flood Insurance Program (NFIP) while the Connecticut Department of Energy and Environmental Protection (CTDEEP) and Town of Ridgefield can establish additional requirements.




There are two components to special flood hazard areas: the floodway and the flood fringe, together, they are collectively referred to as the floodplain. The floodway is the portion of the floodplain most critical for the conveyance of flood flows, and also contains the highest velocities. Development in the floodway is more tightly regulated than anywhere else in the floodplain. The flood fringe is the portion of the floodplain between the floodway and the floodplain limit. This area is subject to restrictions, but not to the same extent as the floodway.

## 5.1 Flood Fringe Requirements

Under the National Flood Insurance Program (NFIP), the following requirements apply within the flood fringe:

- Construction must withstand impact loads, uplift, and other forces associated with flooding
- Must use flood resistant materials
- Utility equipment must be located above the base flood elevation, or floodproofed
- Utility lines must be designed to minimize/eliminate infiltration of flood waters
- No increase in base flood elevation
- Lowest floor of residential construction must be elevated to or above the base flood elevation
- Non-residential construction has the option of flood-proofing to 1 foot above the base flood elevation, although typically it is beneficial to raise above the base flood elevation to reduce flood insurance rates.

Section 11 of the Town of Ridgefield Zoning Regulations also includes additional standards that are more stringent than those of the NFIP. These include:

- Equal Conveyance
- Compensatory Storage
- The bottom of the lowest floor, including basement, must be raised to the level of the base flood elevation or higher.

## 5.2 Floodway Development Requirements

All flood fringe development requirements apply, and it must also be demonstrated that there will be no increase (0.00 feet) in the base flood elevation

## 5.3 State Funding Requirements

If state funding is involved in the site-specific construction of the proposed development blocks, a CTDEEP Floodplain Management Certification is required. Additionally, if the funding covers housing components, the housing must be constructed above the 500-year flood elevation, and must also include dry access to contiguous dry land above the 100-year flood elevation.

## 5.4 Applicability of Floodplain Management Requirements to Proposed Development Area

The floodplain of the Norwalk River is generally parallel to Route 7. Development has been located such that non-residential structures are located within the floodplain, and can therefore be floodproofed, or if residential uses are within these buildings, said residential units will be on the upper floors, with non-residential uses or parking below.

Document2

## Branchville TOD Community System Feasability

**TO:** Francisco Gomes

**FROM:** Joe Canas

**COPY:**

**DATE:** April 1, 2016

# Community System Design Components

## 1.1 Flow Rate

Based upon the February 9, 2016 Branchville TOD Build-Out study, the total flow generated from retail and residential development will be approximately 130,000 gpd.

## 1.2 Ground Slope

Slopes less than 15% are preferred for leaching system installation.

## 1.3 Soils

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 January, February, March, April, May, November, 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.

## 1.4 Pretreatment of Wastewater Required

A wastewater pretreatment system will be required in order to remove nitrogen due to the volume of wastewater discharged. We assumed a septic tank effluent total nitrogen concentration of 39 mg/L for mixed use development without pretreatment, and that the unpaved surface area to dilute the nitrogen present in the wastewater to the maximum 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 CTEEP requires ultraviolet disinfection.

## 1.5 Leaching System

### 1.5.1 Long Term Acceptance Rate

The long term acceptance rate (LTAR) of wastewater that CTDEEP permits to be discharges into a soil depends on the permeability of the soil. Therefore, a less permeable soil will require more effective leaching area. Based upon the Hinckley soils assumed permeability rate, the leaching area required is 108,333 square feet.

Assuming that the effective leaching area would be 80 percent of the footprint, the result would be a disposal area of 135,416 square feet, or 3.10 acres for full build out, not including a 75-foot buffer around the leaching area. Including the 75 foot buffer, the required land area is 268,324 square feet, or 6.15 acres.

It should be noted that the existing baseball field, off Playground Road, is only 72,000 square feet, and therefore is insufficient for the required leaching area.

### 1.5.2 System Size

The leaching system sized for installation would need to consist of 5,417 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 501 feet, which is more than what is available at the site. Constraining the width to 270 feet results in a 42.9 foot high wastewater mound. Therefore, the Little League field is too constrained, and a longer width is needed.

### 1.5.3 Nitrogen Conentration

A wastewater pre-treatment system will be required to remove the nitrogen from the wastewater prior to discharge to a leaching system. 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. Therefore, if the pretreatement system produces an effluent with total nitrogen concentrations of less than 10 mg/L, then the CTDEEP requirement will be satisfied.

### 1.5.4 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 elementary school and Little League fields do not provide sufficient travel time.

# Conclusions

Based upon the proposed development program, and assumed soil infiltration rates, we offer the following conclusions:

1. Pretreatment of the wastewater will be required.

2. The Little League baseball field by itself is not large enough to support the necessary leaching area. Additional leaching area will be required.

3. Use of the baseball field at the elementary school as supplemental leaching field will not work because it is too close to the Norwalk River, and the travel time would be significantly less than the 21 day minimum.

4. A site with length parallel to the Norwalk River would be more desirable. The Little League field is too constrained at only 270 feet wide, resulting in a groundwater mound 42.9 feet high.

5. It is not clear that a parcel of sufficient size is available within the study area and the area of suitable soils to host the leaching field for the proposed full build-out scenario. However, if the sewage from the full build-out scenario from only the west side of the river was considered, based upon our soil assumptions, the Little League field could contain a leaching field of suitable size to meet the bacteria travel time limitation.

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**Community System Feasibility**
**Branchville TOD**
**Full Build-Out Scenario**
April 1, 2016

**Permeability of Soils**

| | |
|---|---|
| Hinckley Soils, Permeability (ft/day) | 28.4 ft/day (100 $\mu$m/s) |
| | 0.01972 ft/min |

**Design**

| | |
|---|---|
| Design flow = | 130,000 gpd |

**Long Term Acceptance Rate (LTAR)**

LTAR = 5 x k – (1.2/log k), k in ft/min

LTAR = 5(0.01972) – (1.2/log 0.01972)
0.09861 – (1.2/-1.7050)
0.09861 – (-0.7038)
0.09861 + 0.7038
0.802 gal/sf-day

- Use 1.20 for LTAR, use of pre-treated wastewater allows for 50% increase in LTAR value to a maximum value of 1.2

**Leaching Facilities to be Provided**

Leaching area required = design flow / LTAR

| | |
|---|---|
| Leaching area required | 108,333 sf |

Use 20' wide beds with low-pressure perforated distribution pipe. Beds to be placed 5' edge-to-edge

| | |
|---|---|
| Effective area (sf/lf) | 20 |
| L = Area required/effective area | 5,417 lf |

Assume length of row is 270 feet. If 80% of required leaching area contains effective leaching area:

| | |
|---|---|
| Area required (sf) = (108,333/0.80) | 135,416 |

| | |
|---|---|
| Length (ft) | 270 |
| Width (ft) = 135,416/270 | 501 |

Note: Baseball field measures 270' x 270', and therefore is insufficiently sized for full build-out

**Nitrogen Dilution:**

| | |
|---|---|
| Estimate N concentration in wastewater (mg/L) = | 65 |
| Assume 40% removal in septic tank (mg/L) | 39 |
| | |
| Estimate precipitation recharge area | |
| (pervious area only) | 26.51 acres |
| | |
| Average Daily Recharge Depth from Rainfall | |
| Average rainfall (ft/day) | 0.01 |
| Rainfall infiltration (%) | 60 |
| Average daily recharge (ft/day) | 0.006 |
| | |
| Daily Recharge Volume | |
| Volume/day = Recharge Area x Daily Recharge | |
| Recharge volume | 6,928 cf/day |
| | 51,826 gal/day |
| | 196,421 L/day |
| | |
| Daily Effluent Flow | |
| 130,000 gpd x 3.79 L/gal | 492,700 L/day |
| | |
| Daily Effluent Nitrogen | |
| 492,700 L/day x 39 mg/L | 19,215,300 mg |
| | |
| Concentration | |
| 19,215,300 mg / 196,421 L | 97.82 mg/L |

Nitrogen concentration too high, pretreatment required

**Hydraulic Mounding Analysis**

| | |
|---|---|
| Q = discharge rate | 17,380 cf/day |
| i = hydraulic gradient | 0.05 (estimated) |
| K = saturated horizontal conductivity (ft/day) | 30 ft/day |
| L (ft) | 270 ft |

| | |
|---|---|
| Depth of Flow, d (ft) = Q/K(i)(L) | 42.9 ft |
| | |
| Required unsaturated separation (ft) | 2.0 |
| Wastewater mound height (ft) | 42.9 |
| Trench height (ft) | 1.0 |
| | |
| Separation from Seasonal High groundwater to top of trench (ft) | 45.9 |

**Bacterial Travel Time for Design Flow**

Vertical Travel Time (Unsaturated Zone)

| | |
|---|---|
| K(unsat) = | max application rate (gal/day-sf)x(cf/7.48 gal) |
| | 1.2/7.48 |
| | 0.160 ft/day |
| i = | 1 (assumed) |
| n (effective) = | V(water)/V(air)+V(solids)+V(water) |
| | 0.18 assumed |
| V(unsat) = | K(unsat)/n(effective) |
| | 0.160 / 0.18 |
| | 0.89 |

| | |
|---|---|
| Maximum vertical unsaturated depth (ft) = | 2.0 |
| Vertical travel time (days) = | 2.2 |

Horizontal Travel Time (Saturated Zone)

| | |
|---|---|
| K(sat) = | 30 ft/day |
| i = | 5 ft drop + 42.9 ft mound in 80 ft |
| | 0.598 |
| n = | 0.3 (assumed) |
| v (groundwater) = | K(saturated) x i / n |
| = | 59.8 ft/day |

| | |
|---|---|
| Minimum horizontal distance to wetlands (ft) = | 100 ft |
| | |
| Horizontal travel time (days) = | 1.67 < 21, TOO SHORT |

**Community System Feasibility**
**Branchville TOD**
**West Side Sewage Only**
April 1, 2016

**Permeability of Soils**

| | |
|---|---|
| Hinckley Soils, Permeability (ft/day) | 28.4 ft/day (100 $\mu$m/s) |
| | 0.01972 ft/min |

**Design**

| | |
|---|---|
| Design flow = | 55,000 gpd |

**Long Term Acceptance Rate (LTAR)**

LTAR = 5 x k – (1.2/log k), k in ft/min

LTAR = 5(0.01972) – (1.2/log 0.01972)
0.09861 – (1.2/-1.7050)
0.09861 – (-0.7038)
0.09861 + 0.7038
0.802 gal/sf-day

- Use 1.20 for LTAR, use of pre-treated wastewater allows for 50% increase in LTAR value to a maximum value of 1.2

**Leaching Facilities to be Provided**

Leaching area required = design flow / LTAR
Leaching area required 45,833 sf

Use 20' wide beds with low-pressure perforated distribution pipe. Beds to be placed 5' edge-to-edge

| | |
|---|---|
| Effective area (sf/lf) | 20 |
| L = Area required/effective area | 2,292 lf |

Assume length of row is 270 feet. If 80% of required leaching area contains effective leaching area:

| | |
|---|---|
| Area required (sf) = (45,833/0.80) | 57,292 |
| Length (ft) | 270 |
| Width (ft) = 57,292/270 | 212 |

Note: Baseball field measures 270' x 270', area okay

**Nitrogen Dilution:**

| | |
|---|---|
| Estimate N concentration in wastewater (mg/L) = | 65 |
| Assume 40% removal in septic tank (mg/L) | 39 |
| | |
| Estimate precipitation recharge area | |
| (pervious area only) | 26.51 acres |
| | |
| Average Daily Recharge Depth from Rainfall | |
| Average rainfall (ft/day) | 0.01 |
| Rainfall infiltration (%) | 60 |
| Average daily recharge (ft/day) | 0.006 |
| | |
| Daily Recharge Volume | |
| Volume/day = Recharge Area x Daily Recharge | |
| Recharge volume | 6,928 cf/day |
| | 51,826 gal/day |
| | 196,421 L/day |
| | |
| Daily Effluent Flow | |
| 55,000 gpd x 3.79 L/gal | 208,450 L/day |
| | |
| Daily Effluent Nitrogen | |
| 208,450 L/day x 39 mg/L | 8,129,550 mg |
| | |
| Concentration | |
| 8,129,550 mg / 196,421 L | 41.38 mg/L |

Nitrogen concentration too high, pretreatment required

**Hydraulic Mounding Analysis**

| | |
|---|---|
| Q = discharge rate | 7,352 cf/day |
| i = hydraulic gradient | 0.05 (estimated) |
| K = saturated horizontal conductivity (ft/day) | 30 ft/day |
| L (ft) | 270 ft |

| | |
|---|---|
| Depth of Flow, d (ft) = Q/K(i)(L) | 18.1 ft |
| | |
| Required unsaturated separation (ft) | 2.0 |
| Wastewater mound height (ft) | 18.1 |
| Trench height (ft) | 1.0 |
| | |
| Separation from Seasonal High groundwater to top of trench (ft) | 21.1 |

**Bacterial Travel Time for Design Flow**

Vertical Travel Time (Unsaturated Zone)

| | |
|---|---|
| K(unsat) = | max application rate (gal/day-sf)x(cf/7.48 gal) |
| | 1.2/7.48 |
| | 0.160 ft/day |
| i = | 1 (assumed) |
| n (effective) = | V(water)/V(air)+V(solids)+V(water) |
| | 0.18 assumed |
| V(unsat) = | K(unsat)/n(effective) |
| | 0.160 / 0.18 |
| | 0.89 |

| | |
|---|---|
| Maximum vertical unsaturated depth (ft) = | 2.0 |
| Vertical travel time (days) = | 2.2 |

Horizontal Travel Time (Saturated Zone)

| | |
|---|---|
| K(sat) = | 30 ft/day |
| i = | 15 ft drop + 18.1 ft mound in 720 ft |
| | 0.046 |
| n = | 0.3 (assumed) |
| v (groundwater) = | K(saturated) x i / n |
| = | 4.6 ft/day |

| | |
|---|---|
| Minimum horizontal distance to wetlands (ft) = | 720 ft |
| | |
| Horizontal travel time (days) = | 156.52, OK |

MEMORANDUM **Tighe&Bond**

# Branchville IHZ Study

## Summary of Wastewater Collection Treatment Facility and Infrastructure Analysis

**TO:** Charles Fisher, P.E., L.S.

**FROM:** John W. Block, Joseph Canas, Lori Carriero **DRAFT**

**DATE:** May 13, 2016

## 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 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.

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 services proposal 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

## 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 sanitary sewer flow is 61,085 gpd.

**TABLE 1**
Sewage Generation Rates

| Source | Number | Generation Rate (gpd) | Estimated Flow (gpd) |
|---|---|---|---|
| Commercial (Retail/Office) | 82,500 sf | 0.1 gpd/sf | 8,250 |
| 1-bedroom | 108 | 65 gpd | 7,020 |
| 2-bedroom | 232 | 110 gpd | 25,520 |
| 3-bedroom | 123 | 165 gpd | 20,295 |
| TOTAL | | | 61,085 |

## 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 2 summarizes the water flow rates as follows:

**TABLE 2**
Estimated Water Flows

| Demand Type | Estimated Flows (gpd) |
|---|---|
| Domestic Water | 61,085 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.

## 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.

**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.

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.

### 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. Therefore, the facility cannot accept any new flows unless the plant is expanded or existing flow capacity reallocated to the Branchville area. 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.

**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.

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

## Sewer Connection Cost Development

Cost estimates 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 pavement was assumed to be a trench repair in Town roads. Final paving in state roadways is assumed to include milling and final overlay of ½ the roadway in addition to the final paving cost.

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 was added to Alternative 1A (connection to Quail Ridge) for possible capacity increases which may be required at the Quail Ridge pump station to accept additional flows

9. An allowance of $20,000 was added for pipe crossings of the Metro-North railroad tracks.

10. Flushing/air release manholes were assumed to be required for approximately every 2,000 LF of pipe.

11. 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 3. An itemized breakdown is included in Appendix B.

**TABLE 3**
Estimated Connection Costs*

| Connection Alternative | Estimated Cost |
|---|---|
| 1A | $4,400,000 |
| 1B | $6,300,000 |
| 2 | $7,300,000 |
| 3 | $2,500,000 |

* 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.

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 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.

Potential Additional Pretreatment Requirements: 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 Systems: 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 wastewater flow generated from retail and residential development is approximately 61,085 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. 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 78,680 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 98,350 square feet, or 2.26 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 216,300 square feet, or 4.96 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 3,934 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 365 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 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 wastewater flows with this scenario are 19,185 gpd. 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 flow that can be treated and disposed of at the Little League Field using an on-site system is 7,000 gpd.

## 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 estimated sewage flow will be 61,085 gpd.
2. Estimated water flows are 86,000 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

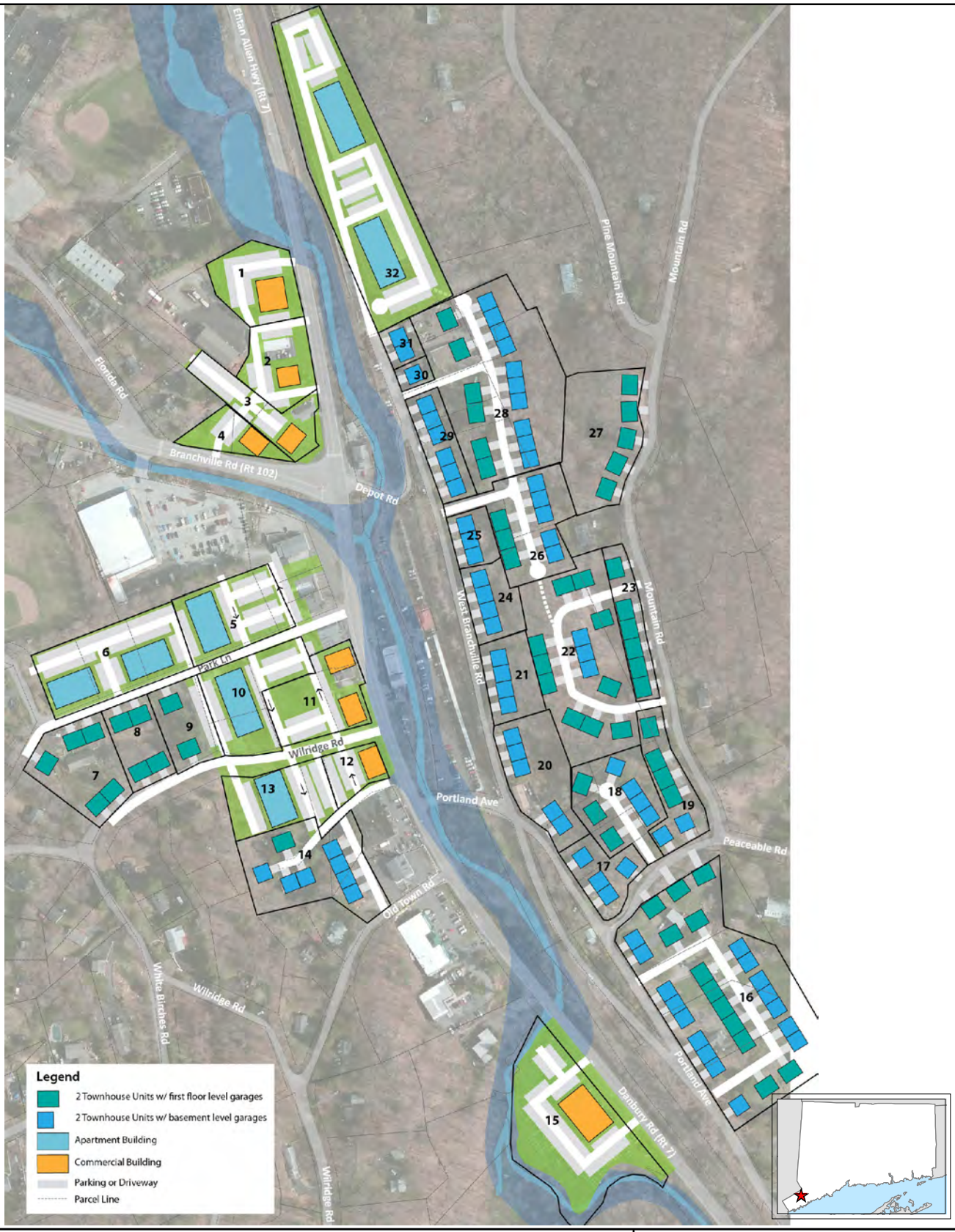


FIGURE 1
PREFERRED DEVELOPMENT SCENARIO
BRANCHVILLE TOD STUDY

Branchville Transit Oriented Development Study

Ridgefield, Connecticut

May 2016

Tighe&Bond
Engineers | Environmental Specialists

Data source: CT DEEP and Town GIS data

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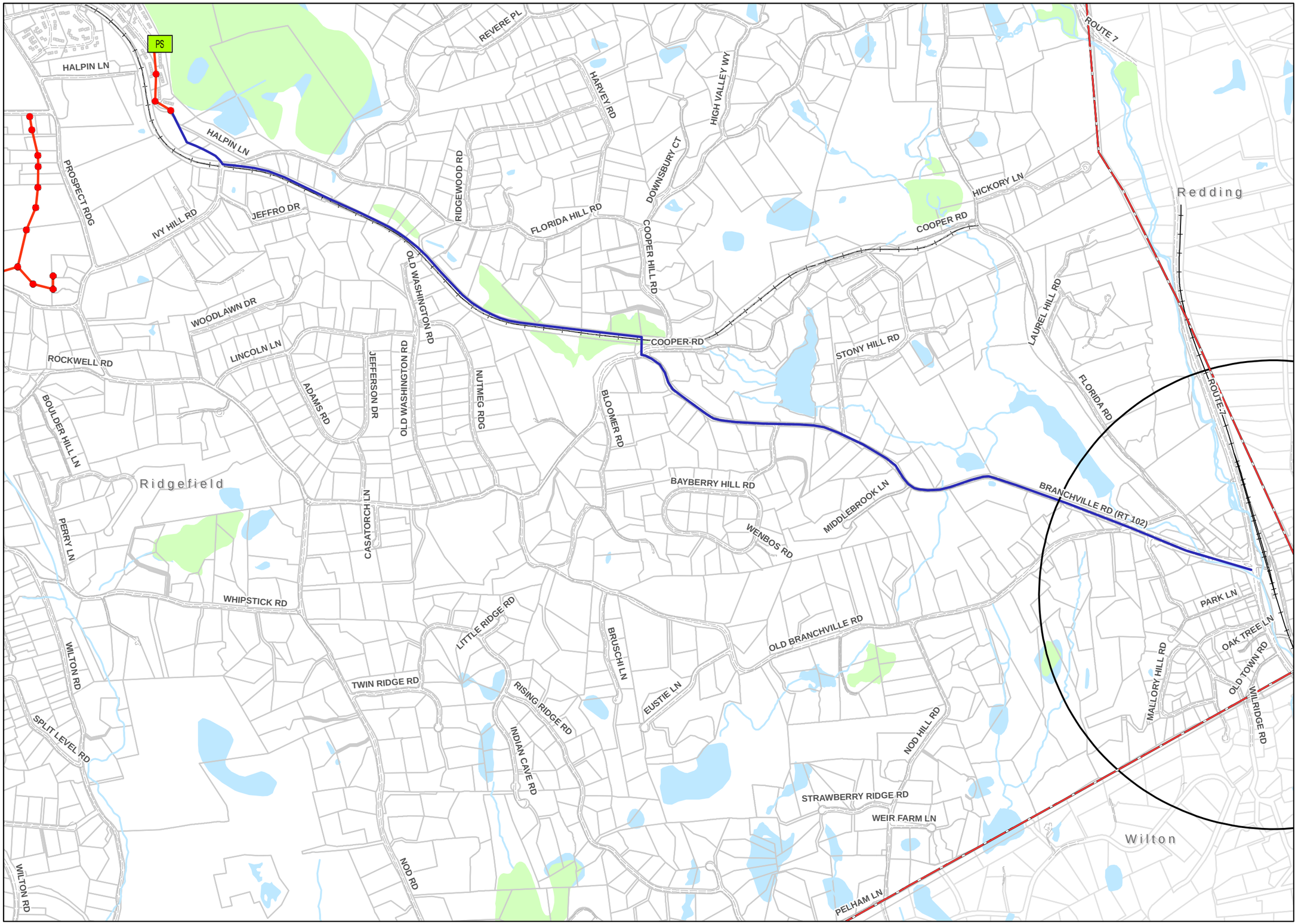
R-0306

# 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
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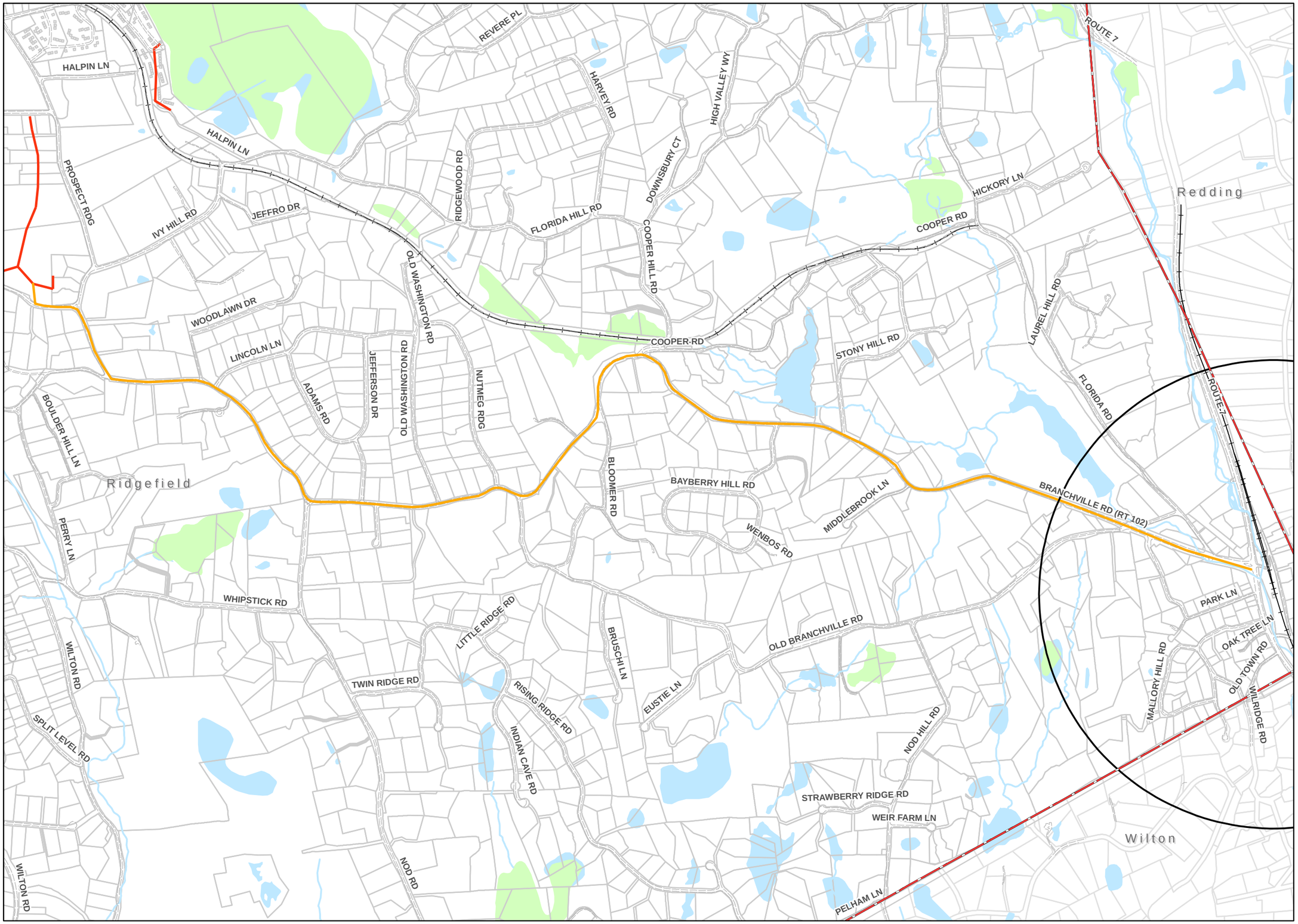
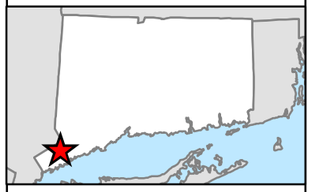



# SEWER CONNECTION ALTERNATIVE 1B

## LEGEND

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

## LOCUS MAP



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Feet

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## NOTES

Data source: CT DEEP and Town GIS data

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Ridgefield, Connecticut

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Figure 3

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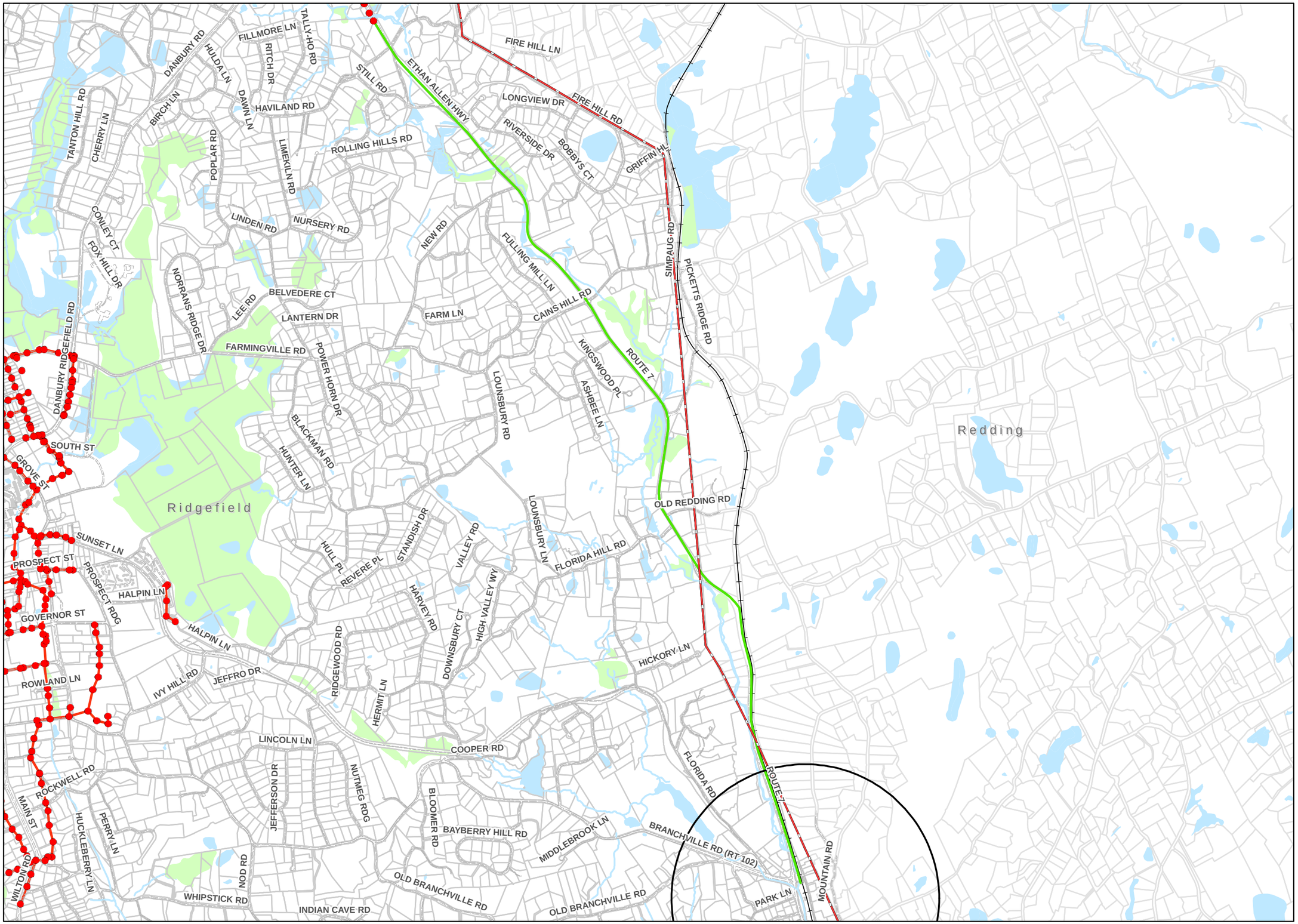


# SEWER CONNECTION ALTERNATIVE 2

## 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

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Figure 4

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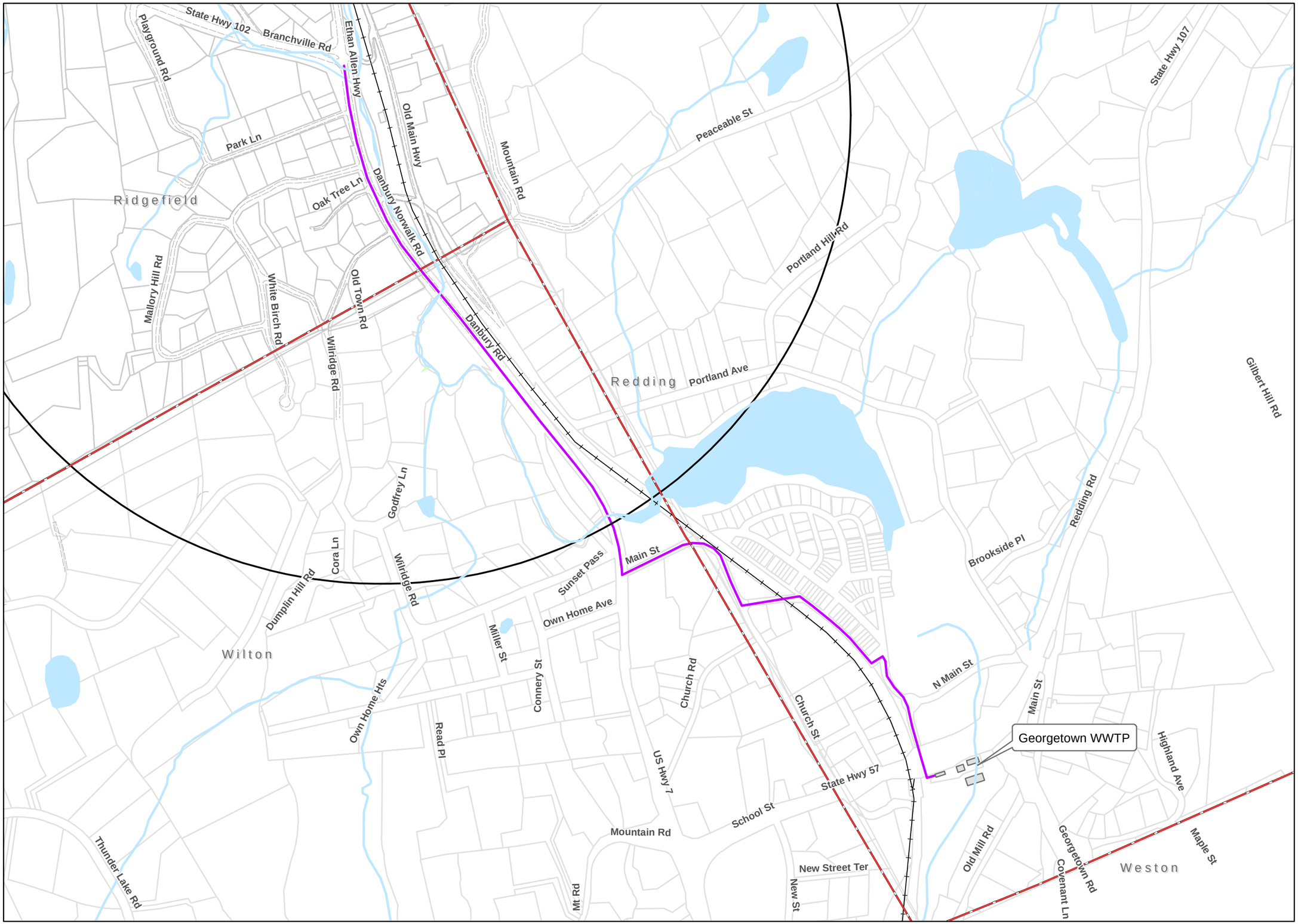


SEWER CONNECTION ALTERNATIVE 3

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
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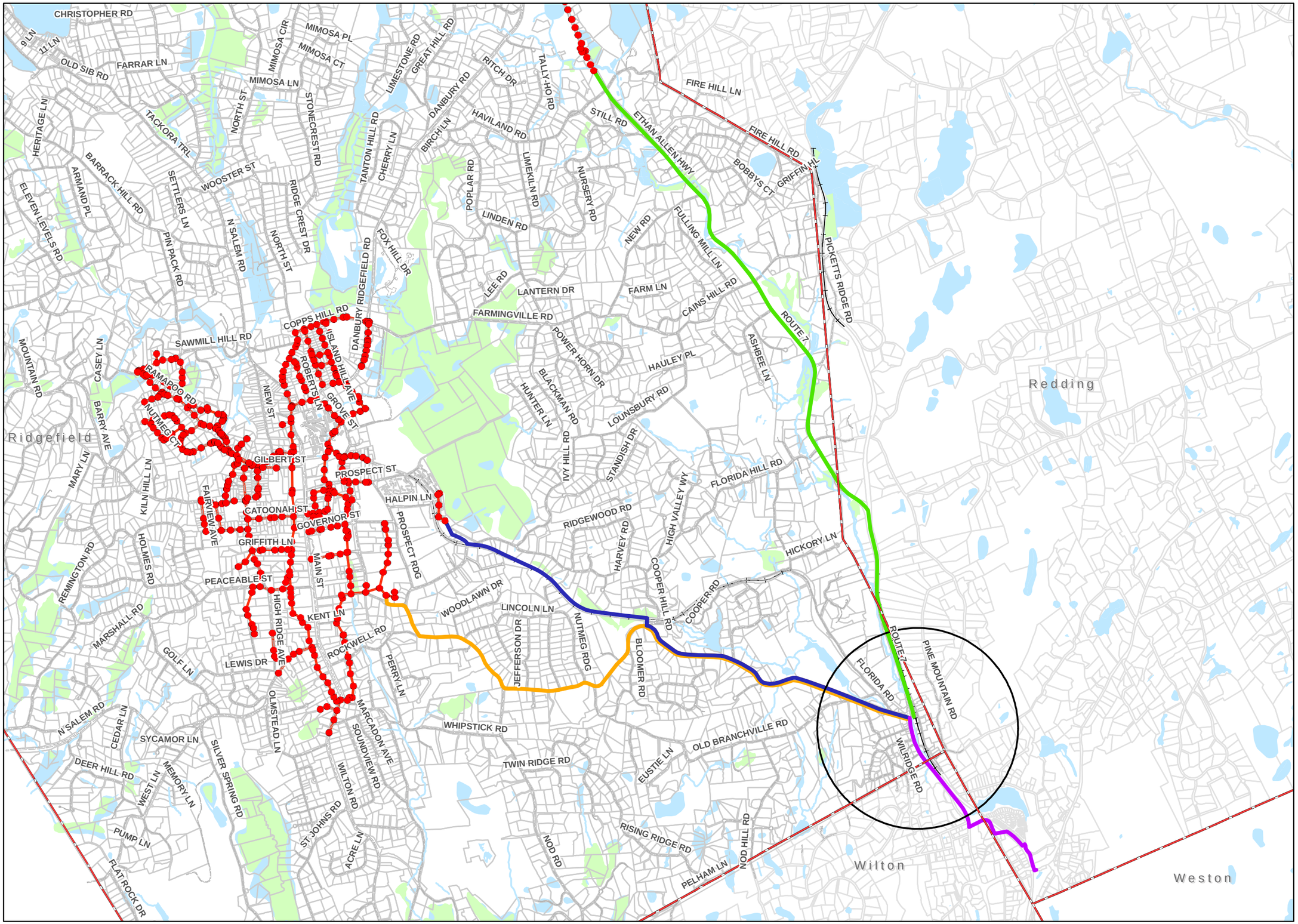
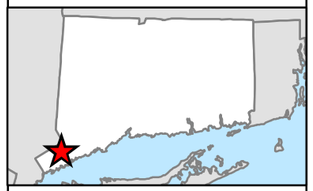
# SEWER CONNECTION ALTERNATIVE OVERVIEW




## LEGEND

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

## LOCUS MAP



N

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Feet

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## NOTES

Data source: CT DEEP and Town GIS data

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Ridgefield, Connecticut

May 2016

Figure 6

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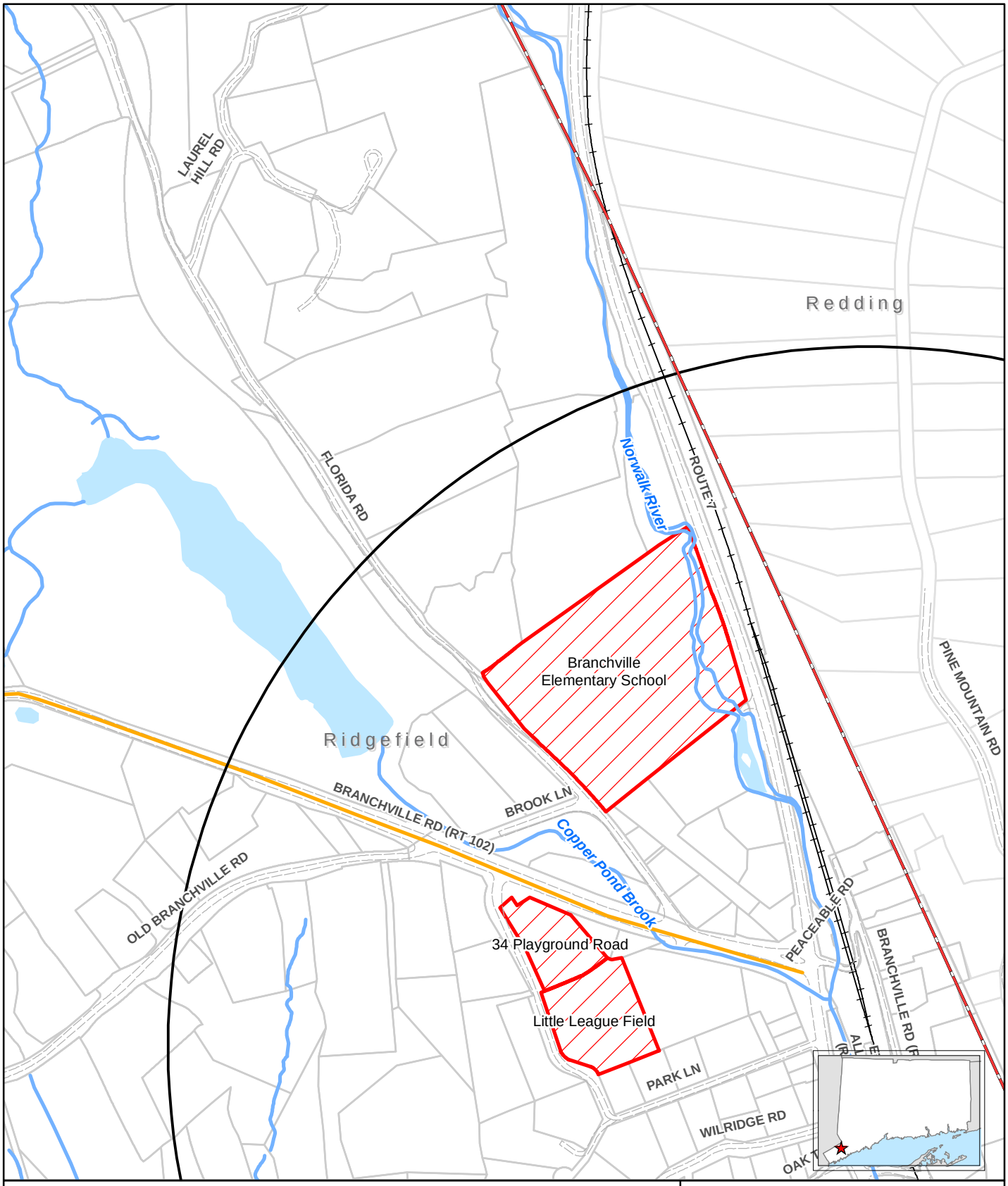


Proposed Sewer
Existing Sewer
Project Area
Feasible Parcels for Initial Consideration
ParcelPolygon
Streams
Swamps
Waterbodies
Town Boundary

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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R-0306

Branchville IHZ
Opinion of Probable Cost
Sewer Connection Alternatives

| Bid Item No. | Bid Item Description | Alternative 1A: Connection to Quail Ridge PS | | | | Alternative 1B: Connection to East Ridge | | | | Alternative 2: Connection to Route 7 WWTP | | | | Alternative 3: Connection to Georgetown WWTP | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Quantity | Unit | Estimated Unit Cost | Extended Total | Quantity | Unit | Estimated Unit Cost | Extended Total | Quantity | Unit | Estimated Unit Cost | Extended Total | Quantity | Unit | Estimated Unit Cost | Extended Total |
| 1 | Mobilization/Demobilization (5%) | 1 | LS | $122,500.00 | $122,500.00 | 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 | 7,500 | LF | $10.00 | $75,000.00 | 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 | 13,750 | LF | $5.00 | $68,750.00 | 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 | 516 | CY | $100.00 | $51,562.50 | 619 | CY | $100.00 | $61,875.00 | 731 | CY | $100.00 | $73,125.00 | 221 | CY | $100.00 | $22,125.00 |
| 5 | Borrow Material | 516 | CY | $10.00 | $5,156.25 | 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 | 13,750 | LF | $80.00 | $1,100,000.00 | 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 | 6 | EA | $5,000.00 | $30,000.00 | 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 | 13,750 | LF | $2.00 | $27,500.00 | 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 | 1,700 | CY | $20.00 | $34,000.00 | 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 | 5,000 | SY | $40.00 | $200,000.00 | 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 | 6,700 | SY | $20.00 | $134,000.00 | 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 | 16,700 | SY | $3.00 | $50,100.00 | 36,700 | SY | $3.00 | $110,100.00 | 43,500 | SY | $3.00 | $130,500.00 | 7,400 | SY | $3.00 | $22,200.00 |
| 13 | Paving Overlay | 16,700 | SY | $12.00 | $200,400.00 | 36,700 | SY | $12.00 | $440,400.00 | 43,500 | SY | $12.00 | $522,000.00 | 7,400 | SY | $12.00 | $88,800.00 |
| 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 | 1 | LS | $300,000.00 | $300,000.00 |
| 15 | Pump Station Capacity Increase | | | | $50,000.00 | | | | $0.00 | | | | $0.00 | | | | $0.00 |
| 16 | RR Crossing | | | | $0.00 | | | | $0.00 | | | | $0.00 | | | | $20,000.00 |
| | | | | Total: | $2,448,968.75 | Total: | | | $3,544,312.50 | Total: | | | $4,103,437.50 | Total: | | | $1,399,237.50 |
| | | 10% Markup/Installation | | | $244,896.88 | 10% Markup/Installation | | | $354,431.25 | 10% Markup/Installation | | | $410,343.75 | 10% Markup/Installation | | | $139,923.75 |
| | | 15% General Conditions | | | $404,079.84 | 15% General Conditions | | | $584,811.56 | 15% General Conditions | | | $677,067.19 | 15% General Conditions | | | $230,874.19 |
| | | 40% Engineering/Contingency | | | $1,239,178.19 | 40% Engineering/Contingency | | | $1,793,422.13 | 40% Engineering/Contingency | | | $2,076,339.38 | 40% Engineering/Contingency | | | $708,014.18 |
| | | Subtotal: | | | $4,337,123.66 | Subtotal: | | | $6,276,977.44 | Subtotal: | | | $7,267,187.81 | Subtotal: | | | $2,478,049.61 |

| | |
|---|---|
| Depth of Flow, d (ft) = Q/K(i)(L) | 18.1 ft |
| | |
| Required unsaturated separation (ft) | 2.0 |
| Wastewater mound height (ft) | 18.1 |
| Trench height (ft) | 1.0 |
| | |
| Separation from Seasonal High groundwater to top of trench (ft) | 21.1 |

**Bacterial Travel Time for Design Flow**

Vertical Travel Time (Unsaturated Zone)

| | |
|---|---|
| K(unsat) = | max application rate (gal/day-sf)x(cf/7.48 gal) |
| | 1.2/7.48 |
| | 0.160 ft/day |
| i = | 1 (assumed) |
| n (effective) = | V(water)/V(air)+V(solids)+V(water) |
| | 0.18 assumed |
| V(unsat) = | K(unsat)/n(effective) |
| | 0.160 / 0.18 |
| | 0.89 |

| | |
|---|---|
| Maximum vertical unsaturated depth (ft) = | 2.0 |
| Vertical travel time (days) = | 2.2 |

Horizontal Travel Time (Saturated Zone)

| | |
|---|---|
| K(sat) = | 30 ft/day |
| i = | 15 ft drop + 18.1 ft mound in 720 ft |
| | 0.046 |
| n = | 0.3 (assumed) |
| v (groundwater) = | K(saturated) x i / n |
| = | 4.6 ft/day |

| | |
|---|---|
| Minimum horizontal distance to wetlands (ft) = | 720 ft |
| | |
| Horizontal travel time (days) = | 156.52, OK |