Branchville TOD Community System Feasability

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COPY:

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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 μm/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 μm/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