

Memorandum

To Abigail Vladeck, Program Director, Real Estate Assets at Office of Governor Charlie Baker
Joel Andres Barrera, Deputy Chief of Staff, Cabinet Relations at Office of Governor Charlie Baker

CC Alan McClennen, Chairmen of Board of Selectmen
David Dunford, Board of Selectmen
John Kelly, Town Administrator
George Meservey, Director of Planning & Community Development
Michael Domenica, PE, Program Manager
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Subject **Town of Orleans, MA
Water Quality and Wastewater Planning
Disposal Site Evaluations - Route 6 Exit 12 Cloverleaf Site**

Project Number 60476644

From Thomas Parece, P.E., AECOM Project Manager

Date 03/02/16

1. Introduction/Background

- A. The Town of Orleans is undertaking a Water Quality and Wastewater Planning Project to reduce excessive nitrogen discharges to the Town's ponds, estuaries and embayments. The Project represents the first effort to implement a "Hybrid" approach under the Cape Cod 208 Water Quality Plan, recently approved by both USEPA and MassDEP. The Project consists of conceptual and preliminary design to update the Comprehensive Wastewater Management Plan (CWMP) completed by the Town in 2011 to reflect the Consensus Plan (Water Quality Management Plan) developed by the Town in 2015. The Project goal is to minimize the proposed sewer footprint (area of Town and number of properties to be sewer) to the greatest extent possible by maximizing the use of several the non-traditional technologies (Coastal Habitat Restoration, Aquaculture, Floating Constructed Wetlands, and Permeable Reactive Barriers).
- B. The Project includes two areas for sewers: (1) about 350 parcels encompassing Downtown Orleans and representing approximately 250,000 gpd of flow, to be treated at a new wastewater treatment facility and groundwater effluent disposal area; and (2) about 380 parcels within the Meetinghouse Pond sub-watershed representing approximately 100,000 gpd of flow, to be treated at a new satellite treatment facility and groundwater effluent disposal area. A variety of collection, treatment, and disposal system alternatives are being evaluated.

- C. The project also includes the development of concept design detail for three non-traditional demonstration projects, such as aquaculture, to be implemented in 2016 to determine the feasibility of full scale installation (siting, engineering design, initial permitting, cost estimating and development of monitoring plans). The monitoring plans will be incorporated into an overall Adaptive Management Plan which will be implemented to evaluate the impacts of the technologies on reducing nitrogen. The Town is working closely with the regulatory agencies including the Cape Cod Commission and MassDEP, as the Adaptive Management Plan is critical to obtaining one of the first watershed permits granted by MassDEP.

2. History of Effluent Disposal Investigations

- A. The Town of Orleans has been and is currently investigating potential locations for discharge of fully treated effluent. This effort dates back to the completion of the CWMP in 2010. Other sites were eliminated due to size of the parcel, environmental resources (e.g, wetlands, etc.), groundwater and/or geologic conditions, sensitive adjacent uses, access limitations, abutter objections and other factors (Refer to the attached Figure 1 and Table 1).
- B. The Route 6, Exit 12 cloverleaf site is one of only two sites that have survived previous site screening evaluations and remains the only potentially viable site for disposal of treated effluent from the new wastewater treatment facility. To fully determine if the Exit 12 site is feasible for groundwater discharge, certain additional field investigations are needed to verify soil and groundwater characteristics.
- C. The Town has, unsuccessfully to date, requested that the MassDOT grant access to the southeast section (lobe) of the Exit 12 interchange on Route 6 in Orleans to conduct testing of the soils and geology at the site. The purpose of the testing is to determine potential suitability of this site for groundwater disposal of treated wastewater from the Town's proposed new wastewater treatment facility.

3. Types of Effluent Disposal Methods

- A. All effluent disposal methods require certain favorable hydrogeologic conditions relative to subsurface conditions and depths to water tables.
- B. Three methods of effluent disposal are being evaluated: Infiltration Basin, Subsurface and Wick. The area required for Infiltration Basin effluent discharge is dependent upon the amount of discharge. Using an average daily flow of 250,000 gpd for the Downtown Area of Orleans, the estimated land area for each of the effluent disposal methods can be calculated.

1) Infiltration Basin Method

- a) An infiltration basin is an unlined basin or bed located at the ground surface. The effluent is discharged to the bed where it percolates through a bed of soil/sand, until it enters and recharges the groundwater. The system is not climate dependent, allowing the system to function year-round. Multiple basins are normally installed to allow resting between applications, especially during wet seasons.

The site selection for an infiltration basin is largely dependent upon the type of soils and the depth to groundwater. The best soil type consist of small particle grains of sand as compared to a coarse sand or large gravel that allows discharged wastewater to move too fast through the soil and prevents the natural biological and chemical breakdown of nutrients and pathogens from taking place. Typically the depth to groundwater from the bottom of the basin during loading conditions should be at least four feet. This allows for the proper filtering of the wastewater discharged

and avoids flooding of the infiltration basins. In addition, in order to ensure overall effectiveness, it is better that the infiltration basins be constructed at near level topography.

b) Estimated Area Required

- Clearing for Access Road: 25 feet x 250 feet = 6,250 sq.ft.
 Clearing for Discharge: 250,000 gpd x 4.0 gal/sq.ft. = 62,500 sq.ft.
 Total Estimate Area: 6,250 + 62,500 = 68,750 sq.ft. (1.6 acres)
- As per MassDEP, the proposed open bed effluent discharge would not be required to have a reserve area.

2) Subsurface Method

a) A Subsurface Effluent Disposal system can take the form of leaching trenches, leaching fields, leaching chambers and leaching pits. The leach field is a network of perforated pipes that are laid in underground gravel-filled trenches to dissipate the effluent. After the effluent has passed into the soil, most of it percolates downward and outward, eventually entering the groundwater while a small portion of the effluent is used by plants through their roots or evaporates from the soil. For larger systems, the system can be installed below ball fields, parks, and open space areas.

b) Estimated Area Required

- Clearing for Access Road: 25 feet x 250 feet = 6,250 sq.ft.
 Clearing for Discharge: 250,000 gpd x 2.75 gal/sq.ft. = 91,000 sq.ft.
 Total Estimate Area: 6,250 + 91,000 = 97,250 sq.ft. (2.2 acres)
- As per MassDEP, the proposed subsurface effluent discharge would require to identify a discharge reserve area which can be located between the leaching trenches or located at another site. Setting aside a discharge reserve area between the leaching trenches at the same location would result in a total area of about 142,750 sq.ft. (3.28 acres). This reserve area would not require the development of Contract Documents (drawings and specifications) nor require site clearing. The above is an estimate without the reserve discharge area.

3) Wick Discharge Method

a) A wick is a vertical subsurface structure constructed for the purpose of transporting highly treated effluent to groundwater. A wick is basically a large diameter (normally 2 to 4 feet) borehole filled with pea stone or gravel. The highly treated effluent is discharged into the wick just below the ground surface, allowing the wastewater to flow over the stone to the underlying groundwater. Typically, a minimum depth of 20 to 30 feet to the water table is required.

The concept of a wick is similar to conventional effluent disposal systems where the wick applies the discharge vertically instead of horizontally. The component that is common to both is the receiving groundwater system, which must be capable of receiving and transporting the effluent that is applied to it. The wick is merely the means of transporting the highly treated effluent from the surface and dispersing it into the groundwater.

A wick is installed in much the same way as a well. A borehole is excavated and casing is installed to the entire depth of the proposed wick. Once the total depth of the wick has been excavated, the borehole is backfilled with pea stone. The casing is then pulled back to expose the stone to the surrounding formation. The entire top of the wick is to be enclosed in a precast concrete structure to protect it from the elements. At this time, it is anticipated that a total of three to five wicks would be installed within the primary discharge area at the site.

Wicks have been installed, tested, and used at Linden Ponds Retirement Community in Hingham, Massachusetts following approval of MassDEP. These wicks have been in use for approximately 12 years. These wicks have performed well and remain in use today.

b) Estimated Area Required

- Clearing for Access Road: 25 feet x 500 feet = 12,500 sq.ft.
Clearing for Wick Wells: 50 feet x 275 feet = 13,750 sq.ft.
Total Estimated Primary Area: 12,500 + 13,750 = 26,250 sq.ft. (0.6 acres)
- Setting aside an area for additional wicks for reserve, as necessary, of 13,750 sq.ft. at the Route 6, Exit 12 Cloverleaf Site would result in a total area of about 40,000 sq.ft. (0.9 acres).
- As per MassDEP, the proposed effluent wick discharge would require identification of a traditional discharge reserve area. The reserve discharge area would not require the development of Contract Documents (drawings and specifications) nor require site clearing.

4. Route 6 Exit 12 Cloverleaf Effluent Disposal Site

- A. The use of Wick Effluent Disposal is preferred since it results in a reduced project cost as well as less surface area disturbance (Refer to the attached Figure 1 and Figure 2). As noted above, the Total Estimated Primary Area required for the Wick Wells is estimated at 26,250 sq.ft. (0.6 acres). Setting aside an area for additional wicks, as necessary, of 13,750 sq.ft. would result in a total area of about 40,000 sq.ft. (0.9 acres).
- B. To determine if a site is feasible for groundwater discharge, a certain amount of field investigation is needed to verify soil and groundwater characteristics. The request for access to the Route 6 Exit 12 Cloverleaf site, which has a total area inside cloverleaf of about 381,000 sq.ft. (8.75 acres), is solely to conduct limited field investigations (soil borings/monitoring wells for groundwater monitoring and test pits).
- 1) The field investigations will involve minimal disturbance of the site and no underground piping or above grade buildings being installed.
 - 2) To the best of our knowledge, no wetlands, vernal pools or other environmental features exist at the Exit 12 Cloverleaf site.
 - 3) The temporary access to the proposed soil borings/monitoring wells and proposed test pits will be located in order to minimize vegetation impacts.
 - 4) The six proposed test pits will be approximately 10-foot square and about 15-foot deep. The test pits will be backfilled with the excavated materials.

- 5) The three proposed monitoring wells will be approximately 2-inches in diameter and drilled to a depth of above 20 feet below groundwater level which is estimated about 100-feet below existing grade. The top of the proposed monitoring wells will be about 2 feet above existing grade and will be installed with a locking cover.
 - 6) The proposed soil borings/monitoring wells and proposed test pits will be surveyed to obtain their installed location and elevations, as applicable.
 - 7) The time to conduct the field investigations is estimated at about two weeks.
- C. The can be restored easily if future plans by MassDOT cannot accommodate the monitoring wells.
- D. Should the analysis reveal that the site would indeed be favorable for a groundwater discharge; the Town would coordinate with MassDOT, as well as MassDEP, for approval for long-term use of a portion of the site.

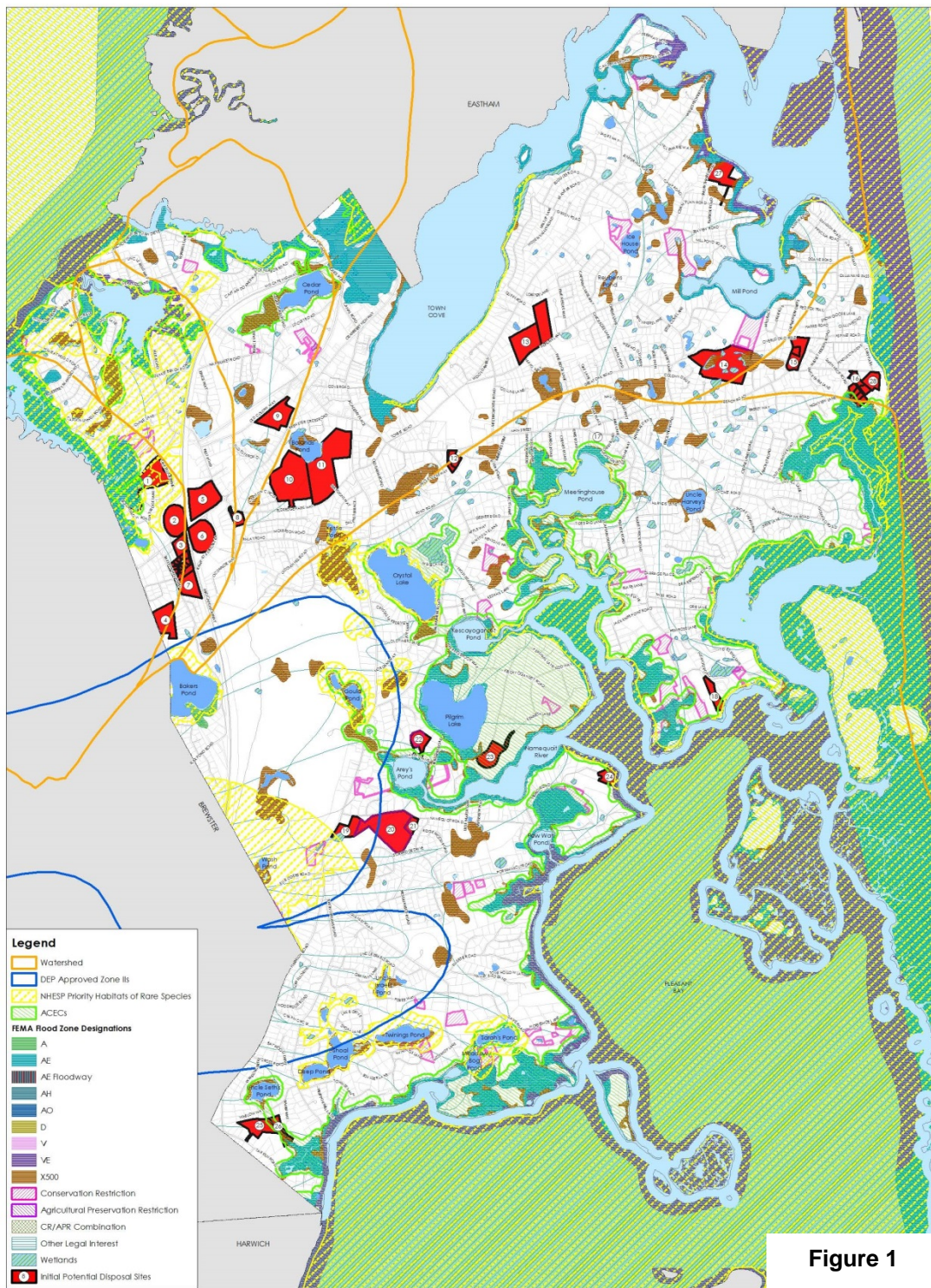


Figure 1

	<p>ORLEANS INITIAL POTENTIAL DISPOSAL SITES</p> <p>TOWN OF ORLEANS MASSACHUSETTS</p>	
<p>OCTOBER, 2014</p>		

Table 1 –Potential Disposal/Treatment Sites

Site ID	General Site Information							Initial Site Screening				Further Site Investigation						
	Map/Parcel	Street Address	Owner	Name	Total Acres	Development Status	Residential/Commercial	Watershed	Sub-watershed	Within the following: Flood Zone, ACEC, Water Supply Zone II, NHESP, Conservation Land	Investigate Further?	Ownership	Topography	Distance to Wetlands	Soil Conditions	Depth to Groundwater	Private wells nearby	Max Disposal Flow (gpd)
1	39 - 6	29 Oak Ridge Lane	Town of Orleans	Tri-Town	26.4	Dev-utility	Commercial	Namskaket Creek	Namskaket Main	NHESP Priority Habitat of Rare Species, ACEC, 100 yr Flood zone	No - due to Namskaket watershed and within sensitive areas							
2		Route 6A	MassDOT	exit 12 cloverleaf	5.5	Hwy ROW	Commercial	Namskaket Creek		No	No - due to Namskaket watershed							
3	46 - 16	17 Nell Way	Joseph Carter	U'ground Mall	3.7	Dev-comm	Commercial	Namskaket Creek / Little Namskaket Creek	Namskaket Stream / Little Namskaket	No	No - due to Namskaket watershed							
4	53 - 1	40 Baker's Pond Road	Seth Wilkinson	Wilkinson	8.5	Dev-res/ag.	Commercial	Namskaket Creek / Little Namskaket Creek	Namskaket Stream / Little Namskaket	No	No - due to Namskaket watershed							
5	40 - 7	9 West Road	TRT Orleans LLC	Skaket Corner	12.1	Dev-comm	Commercial	Little Namskaket Creek	Little Namskaket	No	Yes	Private	Flat	> 500 ft.	Carver-Hinesburg loamy coarse sands, undulating & rolling. Plymouth loamy coarse sand, 3 to 8 percent, very stony, Eastchop loamy fine sand, 0 to 3 percent slopes		No	225,000
6		Route 6A	MassDOT	exit 12 cloverleaf	5.5	Hwy ROW	Commercial	Little Namskaket Creek		No	Yes	Public	Very Hilly	>500 ft.	Carver-Hinesburg loamy coarse sands, Carver-Hinesburg loamy coarse sands, undulating		No	480,000
7	46 - 20	29 Baker's Pond Road	NSTAR Electric Co.	Nstar-I	6.2	Dev-utility	Commercial	Little Namskaket Creek/Namskaket	Little Namskaket	No	Yes	Private	Flat	> 500 ft.	Carver coarse sands, undulating and 8 to 1.5 percent slopes		No	225,000
8	40 - 84	9 Lots Hollow Road	NSTAR Electric Co.	Nstar-II	2.5	Dev-utility	Commercial	Nauset	Rock Harbor Main / Cedar Pond	No	No - due to Rock Harbor watershed							
9	33 - 57	140 Route 6A	Orleans Marketplace LLC	O' Workshop	9.4	Dev-comm	Commercial	Rock Harbor	Cedar Pond	No	No - due to Rock Harbor watershed							
10	40 - 65	46 Eldredge Park Way	Town of Orleans	Bern School	23.8	School	Commercial	Nauset	Boland Pond	No	Not for site disposal. Look into for water reuse potential for irrigation							
11	34 - 85	70 So. Orleans Road	Eastham-Orleans-Wellfleet	Middle School	27.9	School	Commercial	Nauset	Town Cove	No	Not for site disposal. Look into for water reuse potential for irrigation							

Table 1 –Potential Disposal/Treatment Sites (cont.)




Site ID	General Site Information							Initial Site Screening				Further Site Investigation						
	Map/Parcel	Street Address	Owner	Name	Total Acres	Development Status	Residential/Commercial	Watershed	Sub-watershed	Within the following: Flood Zone, ACEC, Water Supply Zone II, NHESP, Conservation Land	Investigate Further?	Ownership	Topography	Distance to Wetlands	Soil Conditions	Depth to Groundwater	Private wells near-by	Max Disposal Flow (gpd)
12	35 - 120	139 Main Street	Town of Orleans	Am. Legion	2.2	Parking	Commercial	Pleasant Bay	Town Cove	No	No - due to Town Cove watershed							
13	27 - 60	54 Hopkins Lane	Town of Orleans	Comm. Gardens	11.0	Gardens	Commercial	Nauset	Town Cove	No	No - due to Town Cove watershed							
14	29 - 3	100 Dunluvin Lane	Nancy Johnson	Nstar-II	24.5	Dev-res.	Commercial	Nauset	Mill Pond	Flood zone, conservation land, wetlands throughout the site	No - due to flood zone and wetlands on site							
15	29 - 83	178 Beach Road	Walter Mayo	Mayo	6.7	Dev-res.	Residential	Atlantic Ocean		No	Yes	Private	Steep slopes throughout site	> 500 ft.	Mapunit Name Nantucket sandy loam, 3 to 15 percent slopes, Carver-Hinesburg loamy coarse sands, undulating		No	150,000
16	38-16 et al	223 Beach Road	Town of Orleans	Hubler motel	5.6	Dev-comm	Commercial	Atlantic Ocean		Near 100 yr flood zone, ACEC on portion of site	Yes	Public	Flat	Wetlands located in adjacent parcel. A number of lots to provide 100 ft. buffer	Mapunit Name Ipswich, Pawcatuck, and Matunuck peats, 0 to 1 percent slopes, Carver coarse sand, 8 to 15 percent slopes, Carver-Hinesburg loamy coarse sands, undulating		No	50,000
17	36 - 140	7 Barley Neck Road	Philip Deschamps	Nauset Marine	1.5	Parking	Commercial	Pleasant Bay	Meetinghouse Pond LT 10	Near 100 yr flood zone, ACEC	No - due to Meetinghouse Pond watershed							
18	64 - 14	59 Fernwood	Richard Walton	Walton	9.1	Dev-res.	Residential	Pleasant Bay	Pleasant Bay LT 10	Along shore line, ACEC	No - due to along shoreline and ACEC							
19	68 - 8	353 So. Orleans Road	Kenrick Sparrow	Sparrow-I	6.6	Dev-res.	Residential	Pleasant Bay	Arey's Pond LT 10	ACEC, within zone II public water supply	No - due to ACEC, within zone II public water supply							
20	69-75	35 Namequoit Road	Town of Orleans		19.4	Conservation land		Pleasant Bay	Namequoit River LT 10	Conservation land, within zone II public water supply	No - due to ACEC, within zone II public water supply							
21	69 - 75-1	61 Namequoit Road	Kenrick Sparrow	Sparrow-II	2.0	Vacant	Residential	Pleasant Bay	Namequoit River LT 10	No	Yes	Private	Gradual site slope	250 ft.	Carver coarse sand, 3 to 15 percent slopes		no	60,000
22	62 - 67	44 Arey's Lane	Anthony Davis	AP Boatyard	4.5	Dev-res.	Commercial	Pleasant Bay	Pilgrim Lake LT 10	Conservation restriction on 2 acre portion of site, portion of site ACEC	No - due to conservation restriction and ACEC							
23	63 - 10	95 Arey's Lane	Louise Thayer	Thayre Lane	6.8	Vacant-recr.	Residential	Pleasant Bay	Namequoit River LT 10	ACEC	No - entire site within ACEC							

Table 1 –Potential Disposal/Treatment Sites (cont.)

Site ID	General Site Information							Initial Site Screening				Further Site Investigation						
	Map/Parcel	Street Address	Owner	Name	Total Acres	Development Status	Residential/Commercial	Watershed	Sub-watershed	Within the following: Flood Zone, ACEC, Water Supply Zone II, NHESP, Conservation Land	Investigate Further?	Ownership	Topography	Distance to Wetlands	Soil Conditions	Depth to Groundwater	Private wells near-by	Max Disposal Flow (gpd)
24	70 - 31	75 Viking Road	Thomas J. Russell	Viking Pt.	1.9	Vacant	Residential	Pleasant Bay	Lower River LT 10	Along shore line, ACEC, 100 yr flood zone, NHESP	No - due to along shore line, ACEC, flood zone and NHESP							
25	91 - 14	46 Tar Kiln Road	Jeffrey Norgeot	Norgeot	8.2	Dev-res/ag.	Commercial	Pleasant Bay	Tar Kiln Stream LT 10 / Pleasant Bay LT 10	Portion within ACEC	Yes	Private	Gradual site slope	On Site	Carver coarse sand, 3 to 35 percent slopes		No	75,000
26	91 - 14	48 Tar Kiln Road	San Giovanni Rebecca Ann		2.1	Dev-res/ag.	Commercial	Pleasant Bay	Tar Kiln Stream LT 10 / Pleasant Bay LT 10	Within 100 yr. flood zone, ACEC	No - due to entire site within flood zone, ACEC							
27	13 - 19	33 Snow Shore Road	George Thompson, II	Seal lane	9.2	Dev-res.	Residential	Nauset	Nauset Marsh	Along shoreline, 100 yr. flood zone, conservation	No - due to along shoreline, flood zone and conservation							
28	30-64	237 Beach Road	Benz Corporation		3.9	Dev-comm	Commercial	Atlantic Ocean		National Park	No - due to National Park							



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-  Potential Monitoring Well
-  Potential Access Road
-  Potential Wick Location

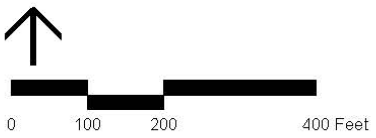


Figure 2
Locus Map

Water Quality and Wastewater Planning
Route 6 (Interchange 12) Cloverleaf
Wick Discharge



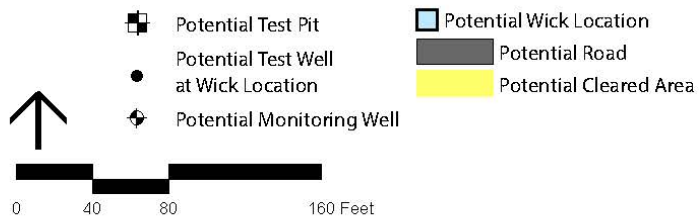


Figure 3
Monitoring Wells and Test Pit Locations
Water Quality and Wastewater Planning
Route 6 (Interchange 12) Cloverleaf
Wick Discharge

