Detailed Needs Assessment of Priority Areas

FINAL REPORT ON TASK 4 OF THE INTEGRATED WATER RESOURCES MANAGEMENT PROGRAM

TOWN OF COLCHESTER, VERMONT

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1. INTRODUCTION

Using the planning level data compiled in the town-wide needs assessment, "priority areas" were identified where additional on-site field investigation was warranted to better understand and characterize the condition of on-site wastewater treatment systems. The information obtained in the field inspections was analyzed and then used to rank each "priority area" based on environmental factors to identify where the greatest needs for management strategies and/or wastewater treatment and disposal system improvements are justified to better protect the public health and surrounding natural resources. The findings will be used to help guide strategies for town-wide management programs for distributed infrastructure.

Where a field investigation was conducted, a detailed assessment of the characteristics of that specific property to support an on-site wastewater treatment and disposal system was completed. Where possible, a representative sample of parcels was investigated in each priority area to allow us to characterize the entire area. We also compared our "in the field" findings to the characterization of the area in the town-wide needs assessment to gage the accuracy of a "desk-top" analysis to a detailed field investigation.

Similar to the town-wide needs assessment, the Vermont Environmental Protection Rules, Chapter 1: Wastewater System and Potable Water Supply Rules (the "Environmental Protection Rules") were used to establish the environmental factors that each parcel was evaluated against. A summary of the Environmental Protection Rules, as they pertain to this investigation can be found in **Appendix A**.

We also looked at watershed boundaries and results of the microbial source tracking study as part of the overall assessment for each priority area to connect known information about environmental conditions and water quality.

Based on both the field investigations and the conclusions of the town-wide needs assessment, priority areas were evaluated on how well they complied with the five most critical environmental factors:

- Area Limitations
- Distance to Surface Waters
- Soils Suitability
- Depth to Groundwater
- Depth to Bedrock

Each of the five criteria was rated on a scale of 0-4 for each priority area. A weighting factor was then applied to area limitations, distance to surface waters and depth to bedrock as it was concluded that these constraints were the most difficult to overcome. A total weighted score for each priority area was then compiled for ranking purposes. The weighted score was used to rank each area as “high concern”, “medium concern” or “low concern” allowing us to identify those areas where there is the greatest need for improved wastewater treatment and management.

Where a need for improved wastewater treatment and management was identified, an alternatives analysis of methods to better address the wastewater needs was conducted to assess what can be done, as well as what should be done.

2. METHODS

The method used to select priority areas, identify parcels for detailed on-site investigation and the on-site investigation method is described below.

2.1. Selection of Parcels for Details Assessment

Two methodologies were used to identify parcels that would be considered for a more detailed on-site assessment.

- All parcels within 300’ of the shoreline of Lake Champlain (Mallets Bay and the broad lake) were selected.
- Several inland parcels were identified in the town-wide needs assessment as “non-conforming”. Neighborhood areas with clusters of “non-conforming” parcels were also selected.

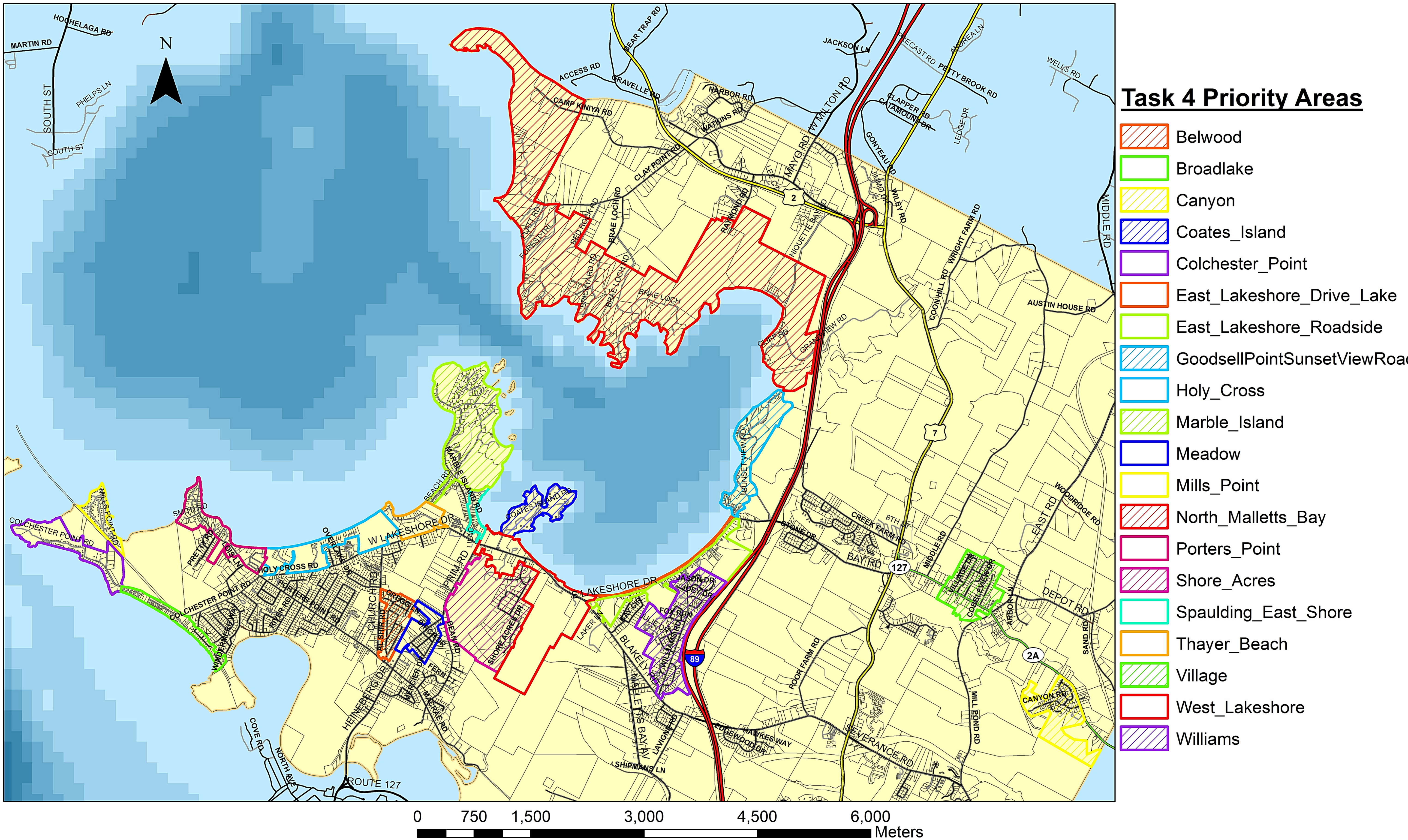
Individual parcels were then grouped into priority areas that generally followed geographic and neighborhood boundaries.

All the parcels within a given priority area are contiguous, generally have similar site characteristics and share a common watershed. Areas were also kept relatively small to enhance the accuracy of the characterization of the given area and overall assessment (comparison) of all the priority areas.

Table 2.1 provides a summary of the priority areas and the rationale for its inclusion in the detailed assessment. Figure No. 1 shows the locations of each priority area within the town.

Table 2.1
Recommended Priority Areas for Site Specific Assessments

Area Name	Rationale by Work Plan		
	Task 1 Infrastructure Inventory	Task 2 Water Resource Mapping & Assessment	Task3 Wastewater Needs Assessment
Lake Champlain			
Inner Mallets Bay ▪ North Mallets Bay/Niquette Bay ▪ Goodsell Point/Sunset View Road ▪ East Lakeshore Drive ▪ Spaulding East Shore ▪ Coates Island **Outer Mallets Bay** ▪ Beach Road/Marble Island ▪ Thayer Beach ▪ Holy Cross ▪ Porter's Point ▪ Mills Point **Broad Lake** ▪ Broad Lake Shore ▪ Colchester Point		Phosphorous TMDL on Lake Champlain; long-standing concerns with bacterial contamination at public beaches	Severe limitations in some portions of lake shore (area, bedrock and/or groundwater limitations)
Inland			
▪ Bellwood			Most parcels are area limited
▪ Meadow Drive		History of seasonal high groundwater issues	Most parcels are area limited
▪ Shore Acres	Wastewater permit history suggests challenging conditions		Majority of parcels have groundwater, bedrock and/or area limitations
▪ Williams Road	Potential wastewater contribution to storm drain noted		Majority of parcels in the northern portion are area limited
▪ Village Drive	Potential wastewater contribution to storm drain noted	Elevated ammonia, E. coli, phosphorus in Pond Brook	Northern portion is area and/or groundwater limited
▪ Canyon Estates			Majority of parcels are area limited
▪ Westbury Trailer Park	Permit history limited	Close proximity to Sunderland Brook	


N
Task 4 Priority Areas
Belwood
Broadlake
Canyon
Coates_Island
Colchester_Point
East_Lakeshore_Drive_Lake
East_Lakeshore_Roadside
GoodsellPointSunsetViewRoad
Holy_Cross
Marble_Island
Meadow
Mills_Point
North_Malletts_Bay
Porters_Point
Shore_Acres
Spaulding_East_Shore
Thayer_Beach
Village
West_Lakeshore
Williams
0 750 1,500 3,000 4,500 6,000
Meters

2.2. Right-of-Entry

Prior to performing any field investigation, we needed permission from each property owner, to enter his or her property to conduct the detailed investigation.

Using the GIS database, a list of property owner's names and addresses was developed for all properties located within each priority area. An **Informational Letter** and a **Right-of-Entry (ROE) Form** (see **Appendix B**) were prepared and mailed to the property owners. The letter and form summarized the project goals and objectives and requested permission from the property owner to enter private property to perform the assessments.

A total of 1,613 right-of-entry requests were mailed to property owners. We received 581 responses (a 36% response rate). Once the majority of the responses were received and logged in a database, the location of each response within a given priority area was identified on a map.

The properties chosen for on-site assessment from the 581 responses were selected to provide a representative sample of parcels in the specific priority area (to the extent practical), as it was deemed not practical or necessary to visit all 581 parcels where responses were received. Out of the 581 ROE responses, assessments were completed on 176 properties.

Respondents from those parcels selected for a further field assessment were then contacted to schedule the inspection. Respondents were given the option to be present during the field assessment, though it was not a requirement as the field assessment was minimally intrusive and didn't require the property owner's presence to gain access.

Table 2.2 provides a summary of the number of ROE forms mailed, responses and property assessments performed for each priority subarea.

Table 2.2
Right-of-Entry (ROE) Responses by Area

Subarea Name	Number ROE Distributed	Number ROE Responses	Number Properties Assessed
Lake Champlain			
Inner Mallets Bay			
▪ North Mallets Bay/Niquette Bay	125	43	13
▪ Goodsell Point/Sunset View Road	64	22	13
▪ East Lakeshore Drive	164	35	14
▪ West Lakeshore Drive	51	23	14
▪ Spaulding East Shore	62	20	6
▪ Coates Island	36	19	7
Outer Mallets Bay			
▪ Beach Road/Marble Island	101	37	5
▪ Thayer Beach	19	8	4
▪ Holy Cross	31	13	
▪ Porter's Point	93	28	10
▪ Mills Point	85	28	14
Broad Lake			
▪ Broad Lake Shore	157	59	11
▪ Colchester Point	61	25	6
Inland			
▪ Bellwood	99	36	8
▪ Meadow Drive	82	26	10
▪ Shore Acres	74	32	10
▪ Williams Road	75	35	16
▪ Village Drive	144	59	7
▪ Canyon Estates	90	27	4
▪ Westbury Trailer Park	1	0	0
Totals	**1,613**	**581**	**176**

2.3. Detailed on-site field assessments

The detailed on-site assessments were performed on specific representative properties within a given priority area to obtain a more detailed understanding of the characterization of the environmental features and constraints (if any) on wastewater treatment and subsurface wastewater disposal in the area.

With this field data, we can assess the ability of the existing systems to provide proper wastewater treatment and disposal based on current conditions and at full build-out. If the area is considered substandard, we can assess how much additional on-site and off-site wastewater treatment is required to protect public health and the environment. Detailed summaries of the inspection results for each area can be found in **Appendix D**.

Data Collected

An **On-Site Wastewater Inspection Form** (see **Appendix C**) was developed to collect a standard set of on-site wastewater information, soil and site conditions. The following data was collected on the On-Site Wastewater Inspection Form during the on-site field assessments:

Property Information

- Property owner names, physical address and mailing address
- Parcel Number
- GPS location
- Seasonal or Year-Round (residential parcels)
- Number of bedrooms (residential parcels)
- Non-residential use (if a non-residential parcel)
- Wastewater design flow
- Home and work telephone numbers
- Email address

Water System Information

- Type of system (e.g. shallow dug well, spring, bedrock well or municipal)
- If municipal, list the entity
- Is the system shared?
- Is the system on or off site?
- The location of the source and service lines on the site sketch (if known)

Wastewater Treatment Information

- Type of system (e.g. cesspool, septic tank, or advanced treatment)
- If advanced treatment, describe
- Materials of construction (concrete, steel, block, fiberglass, plastic, or other)
- The approximate volume
- Does the system have accessible lids or an effluent filter?
- The pumping frequency and when the system was last pumped
- Is there a separate gray water system? (If yes, describe)
- Approximate isolation distances to environmental features
- Overall condition
- Any relevant comments

Wastewater Disposal Information

- Type of system (e.g. holding tank, dry well, absorption bed, at-grade, mound or other)
- Approximate age
- Is the system on-site or off-site?
- Approximate isolation distances to environmental features
- Is the system an individual, shared or a community system?
- Is the system a gravity or pressure distribution system?
- Is there a distribution box?
- Is there is a dosing pump station? (If yes, describe the condition)
- Is there any surfacing effluent, odors, wet or spongy areas?
- Is this a "Best Fix" system?
- Is the disposal area free of obstructions? (e.g. cars, structures, parking lots etc)
- Is there a designated replacement area?
- Is there potential room for a replacement area?
- Is there potential room for a cluster system?

Site Sketch

- Site (including buildings and other structures)
- Water system (location)
- Wastewater treatment and disposal systems (location)
- Environmental features

Soil Conditions

Hand auger soil probes (to a maximum depth of 48" below ground surface) were taken to determine site soil conditions. Information was records on a **Soil Boring Log Form** (see **Appendix C**). The following soils data was collected:

- Classification of the soils in accordance with the <u>Field Book for Describing and Sampling Soils</u>, Latest Edition, National Soil Survey Center, Natural Resources Conservation Service, U.S. Department of Agriculture.
- The depth and thickness of soil layers
- Matrix soil color (hue, value and chroma) utilizing a <u>Munsell Soil Color Chart</u>
- If redoximorphic features are present, determine the RMF color, abundance, size, contrast
- Estimate the soil's sand, silt and clay content by hand and then determine the soil texture using the <u>USDA-NRCS Soil Textural Classification Triangle</u>
- The soil's structure including grade, shape and size
- The soil's moisture and consistence
- The soil layers boundary change and pattern
- The estimated seasonal high water table based on redoximorphic features
- Groundwater level at time of boring (if any)
- Depth to bedrock (if any)

Design Flows

For each parcel, the design flow was determined to allow us to evaluate area limitations, which are based on design flows, soil characteristics and separation from other environmental features. In accordance with the Environmental Protection Rules, design flows for residential parcels are determined based on the number of bedrooms, as follows:

- 2 bedrooms…………280 gpd
- 3 bedrooms…………420 gpd
- 4+ bedrooms………..420 gpd + 70 gpd for each bedroom over 3 bedrooms

Commercial and industrial flow rates are determined in a similar manner using other criteria as listed in the Environmental Protection Rules (Tables 2 and 3 in Section §1-808 found in **Appendix A**).

3. ASSESSMENT PARAMETERS

The On-Site Needs Assessment Analysis was performed using the data collected in the field to assess site conditions and any site constraints for each priority area. With this information, the suitability of the area's geologic features to adequately treat the wastewater flows, based on the area's developed uses and at full build-out was evaluated. The following components are involved in the needs assessment analysis:

- Area limitation analysis
- Distance to surface waters assessment
- Soils limitation analysis
- Groundwater limitation analysis
- Bedrock limitation analysis

The data collected for each property is compared to the requirements of the Environmental Protection Rules to judge whether the existing system is in conformance with the requirements.

Some key requirements of the Environmental Protection Rules that affect the analysis are the following:

- Isolation distance to potable water (horizontal separation)
- Isolation distance to other environmental features (horizontal separation)
- Minimum separation to groundwater (vertical separation)
- Minimum separation to bedrock (vertical separation)
- Septic system sizing requirements
- Available suitable land area

3.1. Area Limitation Analysis

The first step in assessing the suitability of the parcel to support a wastewater treatment and disposal system was to determine the available area for a replacement system. The following areas were subtracted from the total area to determine the area available for a replacement system:

- Areas within horizontal set-back limits
- Existing septic system areas [1]
- Prohibited areas (surface waters, wetlands etc.)
- Buildings, driveways or other permanent features
- Areas where soils are not suitable for on-site systems

(1) Except mounds as the Environmental Protection Rules allow mounds to be re-built in place.

Table 3.1 provides a summary of the horizontal setbacks from features regulated in the Environmental Protection Rules and used in the analysis.

Table 3.1

Horizontal Setback Requirements

Constraint	Septic Tanks or Advanced Treatment Systems	Wastewater Disposal Systems
Surface Waters	25’	50’
Drainage Swales, Roadway Ditches	---	25’
Top of slope greater than 30%	10’	25’
Property Lines	10’	25’
Water Service	25’	25’
Water Main	50’	50’
Bedrock Well	50 ‘	100’ if downhill of well; 200’ uphill of well [1]
Shallow Wells	75’	150’ downhill of well; 500’ uphill of well [1]

(1) Requirements may be greater for larger water and/or wastewater systems

The required area for a replacement system was determined from three sources:

- The soil texture of the most limited (dense) soil from the on-site soil borings
- The estimated percolation rate and leach field loading rate for that soil texture
- The estimated leach field sizing for the wastewater disposal system based on the site constraints (seasonal high water table, depth to bedrock, etc.)

Where suitable soils exist, the on-site system was assumed to be a trench standard leach field design. From the Environmental Protection Rules, the standard long-term application rate (LTAR) was used in the sizing of the leach field. A standard three 3' wide trench with 4' of separation between trenches was used as the typical layout. This results in a range of areas needed for the leach field depending on the design flow rate for the property and the soil's assumed percolation rate. For soils where only mound systems would be feasible, an estimate of the required area for a mound system was calculated using the LTAR values for mounds.

The available area for an on-site system was compared to the required area for each parcel. Parcels are indentified as area constrained if the available area was less than the required area. This methodology was similar to that used in the town-wide needs assessment.

3.2. Distance to Surface Waters Assessment

The Environmental Protection Rules require a horizontal separation of 50' from wastewater disposal components to surface water (lakes, rivers, streams, and wetlands) in order to protect public health and the environmental resource. A property is considered constrained with respect to distance to surface water if the horizontal separation from their wastewater disposal system to surface waters is less than 50'.

3.3. Soils Limitation Analysis

As wastewater effluent passes through a soil-based treatment and disposal system, biological treatment occurs. Microorganisms attached to the stone in the bottom of the absorption layer, create a biomass film that feeds on the organic matter in the effluent, consuming it before the effluent filters through. The permeability of the soil dictates the time of travel through the absorption layer and thus affects the amount of time available for biological treatment.

If soils have low permeability, disposal systems can become over-saturated, slowing or even preventing biological treatment. In extreme cases surface breakouts or system back-ups occur, resulting in a failed system. Conversely, if soils have a very high permeability, wastewater leaving the disposal field can quickly infiltrate through the ground without proper treatment. The inadequately treated filtrate can then reach groundwater or adjacent surface waters, causing a public health and environmental concern.

The Environmental Protection Rules require naturally occurring soils to have a percolation rate of 120 min/inch or less. Soils that typically have a percolation rate of 120 min/inch or more (unsuitable soils) include the following:

- Sandy clay
- Silty Clay
- Clay

Conversely, soils that have a percolation rate of less than 1 min/inch are considered too porous to allow for adequate wastewater treatment. Soils that typically have a percolation rate less than 1 min/inch (unsuitable soils) include the following:

- Coarse gravels
- Soils with large stones or cobbles

A property is considered constrained with respect to soils if the area available for wastewater disposal contains any of the soil types listed above.

3.4. Groundwater Limitation Analysis

Subsurface wastewater treatment works by filtering through the soil beneath the leach field and by microbial treatment through aerobic digestion. Oxygen needs to be present in the soils to support the microbes that perform biological treatment. In order to maintain aerobic digestion processes and remove contaminants effectively, the bottom of the wastewater effluent infiltrative surface must be adequately separated from groundwater in order to maintain unsaturated aerobic conditions for the microbes to live in.

The vertical separation between the bottom of the wastewater effluent infiltrative surface and groundwater is important. Saturated soils (high groundwater) inhibit or prevent the biological treatment process and allow horizontal movement of the effluent, which greatly reduces treatment and carries less treated effluent to surface waters.

Depth to seasonal high groundwater was determined from the soil borings through identification of redoximorphic features (mottles). The Environmental Protection Rules set minimum vertical separation between the bottom of the disposal system infiltrative surface and seasonal high groundwater, as follows:

- For septic tank effluent, a minimum vertical separation of 36”
- For systems that provide additional treatment prior to disposal (filtrate or advanced treatment), a minimum vertical separation of 24”

Using the prescriptive approach, there must be at least 24” of naturally occurring permeable soil above the seasonal high water table. Using the performance-based approach, an above-grade system can be designed that allows the induced groundwater to rise to a point no less than 6” above of the naturally occurring soil at the toe of the mound. Soils with groundwater depths less than 24” below ground surface would most likely require a mound system or a performance based system, and would indicate a significant constraint for operation of a typical on-site wastewater disposal system.

A property is considered constrained with respect to groundwater when there is not adequate area for a conventional disposal system after subtracting the area where the seasonal high groundwater depth is less than 24”. This analysis may over-estimate site limitations regarding depth to groundwater, as it does not account for advanced treatment systems or desktop hydrogeologic analyses that may be used under the Environmental Protection Rules.

3.5. Bedrock Limitation Analysis

Wastewater effluent must be treated properly prior to reaching bedrock since no further treatment occurs after the effluent enters bedrock. Similar to groundwater, bedrock can promote horizontal travel of partially treated wastewater effluent. Treatment needs to occur in the unsaturated soils above the bedrock.

The Environmental Protection Rules set minimum vertical separation between the bottom of the disposal system infiltrative surface and bedrock (for standard subsurface disposal) as follows:

- For septic tank effluent, a minimum vertical separation of 48”
- For systems that provide additional treatment prior to disposal (filtrate or advanced treatment), a minimum vertical separation of 36”

Using the prescriptive approach, there must be at least 24” of naturally occurring, permeable soil above bedrock, as a mound system could be constructed with 24” of suitable soil above the surface. Using the performance-based approach, there must be at least 18” of naturally occurring soil above bedrock.

Soils with depth to bedrock less of than 24” below ground surface would most likely require a mound disposal system with additional fill than normal. This would indicate a significant constraint for successful permitting or operation of a typical on-site wastewater disposal system. Soils with bedrock depths of 18”–24” below ground surface would most likely require an enhanced prescriptive or a performance based system, and significant additional fill to allow an on-site system to function properly.

Using a standard similar to the groundwater standard, a property is considered constrained with respect to bedrock when there is not adequate area for a conventional or mound disposal system after subtracting the area where the depth to bedrock is less than 24".

3.6. Environmental Assessment

Each priority area was assessed for each of the five environmental factors. Table 3.2 provides a summary of which criteria were rated and the constraint for each.

Table 3.2
Criterion Constraint

Criterion	Constraint
Area Limitation	Inadequate area to accommodate a "designated replacement" area
Distance to Surface Water	Disposal System less than 50' from surface water
Soils Suitability	Unsuitable soils for on-site systems
Depth to Groundwater	Depth to seasonal high groundwater less than 24"
Depth to Bedrock	Depth to bedrock less than 24"

These criteria are similar to those used in the town-wide needs assessment, except that soils suitability, depth to groundwater and depth to bedrock are combined in one classification in the town-wide needs assessment. NRCS soils suitability mapping was used to characterize soil constraints in the town-wide needs assessment. These maps combine soils suitability, depth to groundwater and depth to bedrock into a single soils classification, without differentiating between them, as we were able to do in the detailed needs assessment.

When evaluating each of the priority areas, we compared our field results with the findings and conclusions from the town-wide needs assessment to gage the relative accuracy of the town-wide needs assessment to characterize properties for decentralized wastewater treatment solutions. Our field investigations allowed us to refine the assessment to more accurately characterize the area.

Utilizing the above criteria, a rating system was developed to allow for a comparison of the priority areas. Each criterion is rated on a scale of low to severe to classify the extremity of the constraint, with each representing a numerical value of 0 to 4. In general, a score of low for a particular criterion indicates that the area is minimally constrained for that criterion and therefore wastewater disposal systems are not seriously impacted by the criterion. In contrast, a score of severe for a particular criterion indicates that the area is highly constrained for that criterion and that wastewater disposal systems are seriously impacted.

Table 3.2 provides a summary of the rating matrix and their definitions.

Table 3.3
Rating Matrix

Rating	Value	Description
Low	0	Less than 5% of parcels exhibit constraint
Low-Moderate	1	5 % - 10% of parcels exhibit constraint
Moderate	2	10% - 25% of parcels exhibit constraint
Moderate-Severe	3	25% - 50% of parcels exhibit constraint
Severe	4	50% or more of parcels exhibit constraint

During our field assessments, we also checked setbacks to other features regulated by the Environmental Protection Rules, such as distance to water supplies, distance to water lines, and distance to property lines. In our overall assessment, we considered these as secondary concerns that didn't warrant inclusion in our ranking system. We also collected information regarding the water supply types, type of wastewater treatment and disposal system and other relevant information concerning the characterization of the properties we inspected. This information can be found in the detailed summaries for each area included in **Appendix D**.

3.7. Weighted Scoring

During the on-site field investigation, it became apparent that area limitations, distance to surface waters and bedrock limitations are more constraining than soils suitability and depth to groundwater. If the soils on a given parcel are poor, but there is adequate land area, isolation from surface waters and depth to bedrock, a wastewater treatment and disposal system could likely be constructed that complies with the Environmental Protection Rules.

A similar argument can be made for parcels with shallow depth to groundwater. If there is adequate land area, isolation from surface waters and depth to bedrock, a complying wastewater treatment and disposal system can likely be constructed. A parcel that has limited area based on parcel size, proximity to surface waters or shallow bedrock is substantially more limited when considering on-site wastewater treatment and disposal options.

For this reason, a weighting factor of 1.5 was applied to the individual score for area limitations, distance to surface waters and depth to bedrock, to derive a total weighted score for the area. This total weighted score was used to rank each area in comparison to the others and to assign an environmental assessment ranking.

3.8. Environmental Assessment Ranking

Once each of the five environmental factors was rated for each area, the area was ranked "high concern", "medium concern" or "low concern". If an area has a total weighted score higher than 15 it was given a "high concern" ranking. If an area has a total weighted score between 10 and 15 it was given a "medium concern" ranking. All other areas were given a "low concern" ranking.

It is important to keep in mind that each of these areas were selected for further study due to concerns regarding the ability of the parcels to suitably treat and dispose of the wastewater generated by the use of the property. A rank of "low concern" does not mean **no** concern. Management strategies may be appropriate in some of these areas to better manage limitations that were identified.

3.9. Capacity at Build-Out

In the town-wide needs assessment, estimates of actual wastewater flows for each developed parcel were established, based on the current developed use on a given parcel. "Conforming flows" for each parcel were estimated, based on the size of an on-site wastewater treatment system that could be permitted given site constraints.

Using current zoning regulations, the town-wide needs assessment then estimated available flows at full build-out. We were able to break this data down for each priority area to identify "conforming flows at build-out" which could then be compared to "current flows" to estimate the available wastewater capacity for build-out in a given study area. This information is important when evaluating the benefits of improved wastewater infrastructure in a given priority area. Whether there is build-out capacity to help support system improvements may dictate whether the improvements are deemed affordable or not.

3.10. Wastewater Alternatives

In each of the priority areas, where there is a demonstrated need for improvement to protect public health and the environment, alternatives to upgrade wastewater treatment and disposal were evaluated. These alternatives include:

- Individual On-site system (both conventional and Innovative/Alternative)
- Small cluster systems
- Large cluster systems
- Central sewer systems

In a given area, if there is a need for improved wastewater infrastructure, but no viable decentralized wastewater alternative, a centralized municipal sewer system was considered. Different wastewater alternatives available for consideration are described below.

3.10.1 Conventional Systems

Conventional systems typically include a septic tank followed by a subsurface disposal system that could include one the following depending on site conditions:

- Trench subsurface leachfield
- Bed subsurface leachfield
- At-grade raised leachfield
- Mound raised leachfield

Trench and bed subsurface systems can be gravity feed systems or pressurized with a dosing pump station or siphon. At-grade and mound systems are always pressurized systems.

Effluent filters (installed in the effluent end of the septic tank) are required for any new or upgraded systems. Effluent filters can greatly improve system performance and longevity of the wastewater disposal system by improving the filtration of solids in the septic tank so they don't migrate to the disposal field (leach field). Solids that pass through the septic tank and into the leachfield can cause the leachfield to fail over time as the solids build-up prevents effluent from properly percolating through the soils for treatment.

Effluent filters need to be cleaned periodically (typically annually), but are well worth the investment, especially in locations where the system marginally conforms to the Environmental Protection Rules. To maintain an effluent filter, the owner typically only needs to hose the filter down to let build-up fall back into the septic tank. Access at grade is required for maintenance.

3.10.2 Innovative/Alternative (I/A), Advanced Treatment and Filtrate Systems

Innovative/Alternative (I/A), advanced treatment and filtrate systems are treatment systems that allow for a reduction in the final disposal requirements due to the additional treatment of wastewater, typically to a standard of less than 30 mg/l BOD_5 and 30 mg/l TSS, before the effluent reaches the disposal system.

Although they are not commonly used anymore due to their relatively large size and cost compared to the smaller sized and mostly less expensive I/A systems, the Environmental Protection Rules permit the use of the following advanced treatment systems:

- Intermittent sand filters
- Re-circulating sand filters

The Environmental Protection Rules categorize allowable uses for I/A systems into one of three (3) categories:

- Approved for general use
- Pilot projects
- Experimental designs

The application process for approval of Innovative/Alternative systems and products is described in the Environmental Protection Rules (§ 1-1004). Each approval for an Innovative/Alternative system or product contains conditions under which the system or product may be used. Approvals are for a specific length of time and require renewals at the end of the approval period.

3.10.3 Other Systems Approved for Use

The Environmental Protection Rules also allow the following systems in certain circumstances:

- Constructed Wetland Treatment Systems
- Disposal of Wastes from Pump Out Facilities for Marine Sewage Holding Tanks
- Holding Tanks
- Store and Dose Systems
- Composting or Incinerating Toilets and Grey Water Systems
- Subsurface Drip Distribution Systems

We describe each of these alternatives below for reference and informational purposes, but haven't considered them in our alternatives analysis as the conditions in the field either weren't conducive or there was a more viable alternative to consider for addressing wastewater needs.

3.10.3.1 Constructed Wetland

A constructed wetland treatment system may be proposed on a case-by-case basis. Systems determined by the State to be capable of meeting the 30 mg/l BOD_5 and 30 mg/l TSS requirement for filtrate effluent disposal systems can be approved for discharge to a complying constructed wetland.

3.10.3.2 Disposal of Wastes from Pump-Out Facilities

Disposal of wastes from Pump-Out Facilities is allowed in certain circumstances. A holding tank receives and stores raw sewage for pump-out by a certified septage hauler and disposal at a certified facility. Several of the marinas use holding tanks to handle marine waste during the summer season.

3.10.3.3 Holding Tanks

The use of a sewage holding and pump-out tank is permitted when it has been determined that the following conditions are met:

- The existing or proposed building(s) or structure(s) to be served by the sewage holding tank are publicly owned
- The plan for construction and operation of the sewage holding tank will not result in a public health hazard or environmental damage
- A designer demonstrates than an economically feasible means of meeting current standards is significantly more costly than sewage holding and pump out tanks, based on a twenty year life of the project
- The design flows do not exceed 600 gallons per day

3.10.3.4 Storage and Dose Systems

Systems that store effluent during periods when the groundwater level is near the surface and then dose the effluent into a wastewater disposal system when the groundwater is low may be approved provided:

- The system shall be designed so that the effluent will at all times remain at least 6” below the surface of the ground;
- The system incorporates a two-year time of travel management zone; and
- The design flows do not exceed 700 gallons per day.

3.10.3.5 Composting or Incinerating Toilets and Grey Water Systems

Composting or incinerating toilets may be used in place of conventional water carried toilets. Use of these toilets in buildings other than a single-family residence on their own individual lot is subject to review relative to the adequacy of the particular unit for the proposed use. All waste removed from a composting toilet is considered pathogenic by the State of Vermont. The waste must be disposed of in a certified landfill or by shallow burial in a location approved by the State that meets the minimum site conditions for a wastewater disposal system.

Use of a composting or incinerating toilet does not change the requirements for potable water supply and interior plumbing. If there is any interior plumbing, a grey water disposal system must be installed. A grey water disposal system must comply with all of the design criteria for wastewater disposal systems in the Environmental Protection Rules, except that a 25% reduction in the size of the disposal system is granted for residential systems.

3.10.3.6 Subsurface Drip Distribution

Subsurface Drip Distribution (SSD) is a pressurized wastewater distribution system that delivers small, precise doses of effluent to shallow subsurface disposal fields. SDD distribution piping is small diameter, flexible polyethylene tubing (drip-line) with small in-line emitters (orifices that can discharge effluent at slow, controlled rates) into narrow, shallow trenches or plowed directly into the soil and backfilled without gravel. The typical installation is between 6”- 8” below the surface.

3.10.4 Small Cluster Systems

Small cluster systems are systems that are less than 6,500 gpd and are regulated by the Environmental Protection Rules. Small cluster systems can serve as few as two properties sharing a system or a small community with multiple users. Small cluster systems may utilize many of the on-site treatment and disposal technologies identified previously including I/A systems. Small cluster systems tend to resemble individual on-site systems; but are larger in size.

3.10.5 Large Cluster Systems

Large cluster systems are systems greater than 6,500 gpd with a collection, treatment and subsurface disposal system that is regulated by the Indirect Discharge Rules. Large cluster systems can range in size from 6,500 gpd to over 50,000 gpd and serve large community areas. Large cluster systems tend to resemble centralized sewer systems for sewer collection, but then have a treatment and subsurface disposal component.

3.10.6 Central Sewer Systems

Central sewer systems are typically public sewer systems that convey raw sewage by gravity or low-pressure sewer force main to a wastewater pump station or directly to a municipal wastewater treatment facility for treatment. Portions of Colchester already have centralized sewer collection systems including:

- Fort Ethan Allen area connected to the Essex Junction WWTF.
- Breezy Acres Mobile Home Park, Severance Corners, Exit 16 and St. Michaels College (Route 15) areas connected to the South Burlington WWTF.

3.11. Typical System Costs

System costs vary widely based on the type and size of the system and site specific conditions that influence the design and permitting. A range of costs for common system replacements is outlined below.

3.11.1. Individual System Types

Table 3.4 provides a summary of typical costs for individual on-site systems based on system type.

Table 3.4
Typical On-site System Construction Costs

System Type	Estimated Cost Range
Upgrade septic tank with effluent filter and accessible riser and covers to grade	$1,500 - $3,000
Replace septic tank	$2,000 - $3,000
Replacement system including septic tank/conventional gravity disposal system	$7,500 - $10,000
Replacement system including septic tank/pump station/pressurized in-ground or at-grade disposal	$12,000 - $15,000
Replacement system including septic tank/pump station/mound disposal	$18,000 - $30,000
Replacement system including septic tank/filtrate system/pump station/pressurized in-ground or at-grade disposal	$20,000 - $30,000
Replacement system including septic tank/filtrate system/pump station/mound disposal	$25,000 - $40,000

3.11.2. Small Cluster Systems

The costs of small cluster systems are site condition dependent. They are typically used when one property doesn't have suitable room for an individual system and a shared system makes sense. Small cluster systems typically cost as much or more than the aggregate cost of individual systems serving each property.

3.11.3. Large Cluster Systems

The costs of large cluster systems are dependent on the flows, site conditions, and type of treatment required. Large cluster systems are typically used when a number of the connected users have no reasonable means of economically meeting their wastewater needs with an individual or small cluster system. Based on past experience, large cluster systems will typically cost between $30,000-$40,000/connection.

3.11.4. Central Sewer Systems

Central sewer systems are typically public sewer systems that convey raw sewage by gravity, low-pressure sewer or force main to a municipal wastewater treatment facility for treatment. Colchester completed a preliminary engineering study in 1998 to provide the Mallets Bay area with centralized sewer system that would discharge to the Burlington North Wastewater Treatment Facility. Ultimately, the public didn't support the project and it wasn't pursued further. Colchester Fire District No. 2 (that serves water to the majority of the Town's original Mallets Bay sewer study area) recently completed a sewer study for their district. This study recommended a core sewer service area serving Heineberg Drive, Porter's Point Road to the Porter's Point School, Prim Road, West Lakeshore Drive, Spaulding East Shore, and Mallets Bay Avenue to the public schools with a discharge to the Burlington North WWTF. The estimated construction cost for the core area sewer serving West Lakeshore Drive is approximately $6,900,000 with an estimated total project cost of $10,200,000.

While Aldrich + Elliott, PC (formerly Forcier Aldrich & Associates) conducted both studies, they were conducted independently of this study. Where the more recent study is referenced in this report, it is intended to provide context for the estimated costs of centralized sewers for comparative purposes only. The information is not intended to confuse the purpose of this study, which is to research decentralized wastewater options.

3.12. Importance of O&M

Environmental factors dictate the suitability of an on-site wastewater treatment and disposal system to adequately treat wastewater without adverse harm to public health and the environment. However, a system properly sited and constructed will still be a threat to public health and the surrounding environment if it isn't properly operated and maintained.

Especially in environmentally sensitive areas where the environmental factors that support wastewater treatment and disposal are marginal, proper operation and maintenance are critical. We will evaluate management strategies to regulate the common operation and maintenance procedures later in the study. Some of these common factors are as follows:

3.12.1 Overloading the System

On-site wastewater treatment and disposal systems are designed for a specific maximum daily flow rate, based on the permitted use of the property. It is important that property owners do not exceed the permitted design flow as both the wastewater treatment and disposal systems are designed for the prescribed flow. Exceeding the flow rate can overwhelm the treatment system sending inadequately filtered effluent to the disposal system. Solids pass to the leachfield clogging the treatment bed and inhibiting proper biological treatment of wastewater, resulting in a system failure that that causes a public health and environmental hazard.

3.12.2 Periodic Cleaning of the Septic Tank

As described above, the septic tank settles out solids which accumulate in the bottom of the tank. The tank requires routine cleaning (typically every 2-5 years depending on use) as solids build-up over time. If solids are allowed to fill the tank, it can no longer settle out solids which then pass solids on to the disposal field, which can quickly cause a system failure. To maintain a septic tank, the property owner must make sure there is adequate access to the tank openings for pump-out and effluent filter cleaning. Immovable objects and structures should not be placed over the access points making maintenance impractical if not impossible. Property owners should recognize the critical importance of maintaining their septic tank (if they have one) as maintenance is substantially less costly than system replacement.

3.12.3 Maintenance of Disposal Fields

Disposal fields are designed to provide biological treatment of wastewater effluent by aerobic digestion. Disposal fields should be left intact and undisturbed once constructed. Structures and other impervious obstructions should not be placed over a disposal field (pavement, patios, etc.) as they can inhibit proper airflow through the system. No digging over or adjacent to the disposal field should be allowed as it is quite easy to disturb the construction of the absorption trenches. Disposal fields should be maintained as designed and periodically inspected for soggy areas or surfacing effluent, which could signal a problem or system failure.

3.12.4 Advanced Treatment Systems

Advanced treatment (I/A) system technologies (including mound systems and other pressurized systems as well as innovative/alternative technologies) are typically used only when site conditions are not conducive to allow for a conventional subsurface treatment system. Each of these systems has operation and maintenance requirements unique to the specific system.
It is essential that property owners follow the operation and maintenance requirements of the system to assure that the components function as designed. Failure of one component due to poor operation and maintenance can quickly result is a serious failure of the entire system.

3.13. Alternatives Analysis

Once the risk assessment ranking is established for each area, an alternatives analysis is conducted to evaluate first whether action is required and if so, what steps should be taken to better protect public health and the environment. The alternatives analysis is primarily driven by the environmental assessment ranking (low, medium or high) for the area. A Decision Process Flow Diagram (Figure 2) graphically depicts the process used to make recommendations for each priority needs area.

3.13.1 "Low Risk" Area Alternatives Analysis

If an area is ranked "low risk", the recommendation is to maintain status quo unless there is a system failure, at which point the system would be replaced meeting the Environmental Protection Rules. If the system replacement can conform to the Environmental Protection Rules, no further action by Colchester is required. If the limitations of the parcel require an innovative/alternative (I/A) replacement system as either conforming or "best fix", it is recommended that Colchester establish an operation & maintenance (O&M) permit with the landowner to monitor and assure proper operation and maintenance and routine inspection of the system.

3.13.2 "Medium Risk" Area Alternatives Analysis

If an area is ranked "medium risk", the recommendation is to inspect each system at a routine interval (every five years) to identify failed systems in need of replacement and marginal systems where the property owner should be encouraged to upgrade their system. Similar to the low risk areas, if a failed system is replaced conforming to the Environmental Protection Rules no further action would be required until the next inspection. If the limitations of the parcel require an innovative/alternative (I/A) replacement system as either conforming or "best fix", it is recommended that Colchester establish an O&M permit with the landowner to monitor and assure proper operation and maintenance and routine inspection of the system.

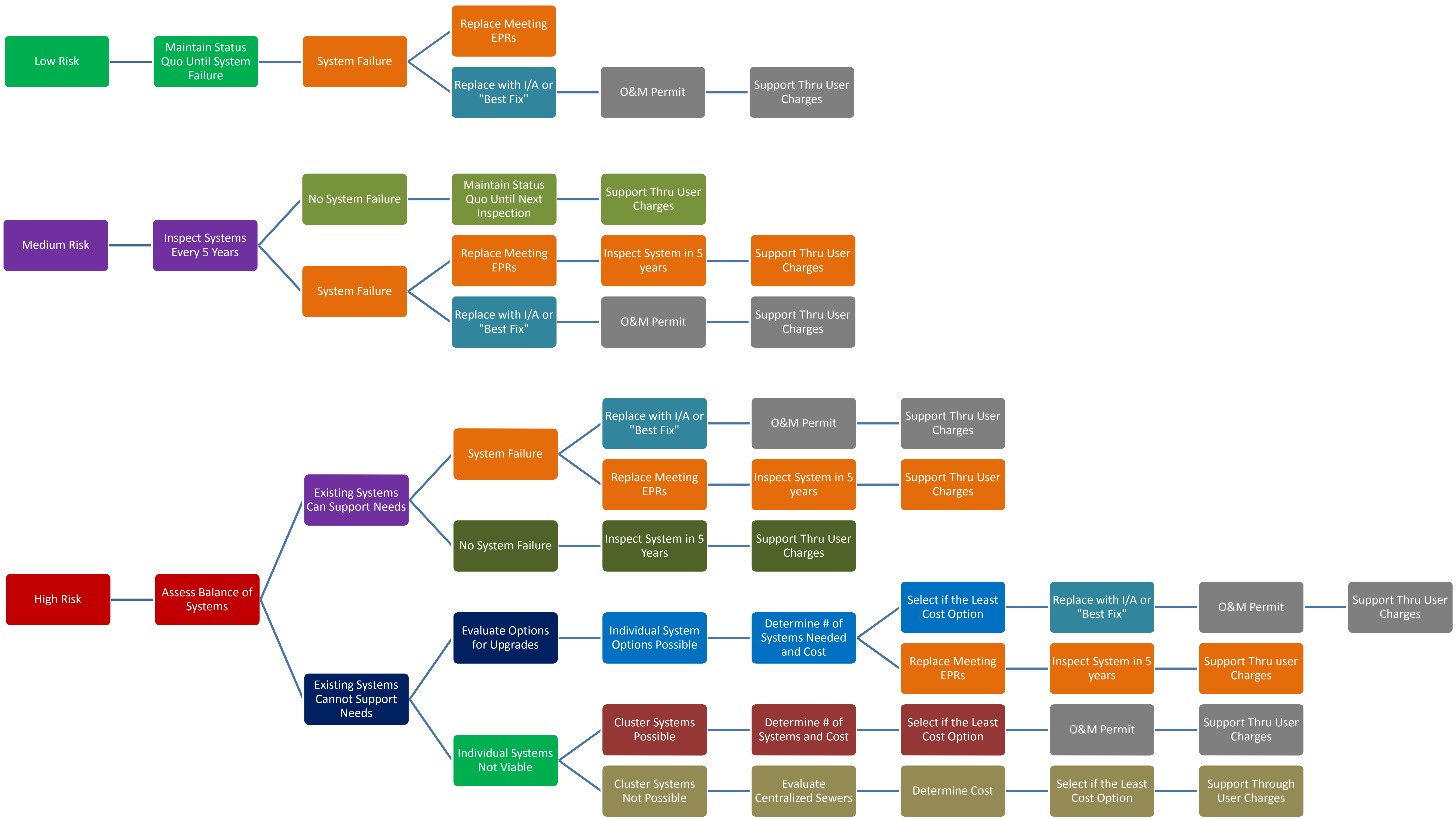
3.13.3 "High Risk" Area Alternatives Analysis

If an area is ranked "high risk", the assessment of alternatives is more rigorous to determine the appropriate method for addressing wastewater needs (individual on-site systems, small or large cluster systems or central sewers). If individual on-site systems (maintaining status quo or upgrading systems) is a viable solution it is typically the least cost and preferred option. If the limitations of the parcel require an innovative/alternative (I/A) replacement system as either conforming or "best fix", it is recommended that Colchester establish an O&M permit with the landowner to monitor for proper operation and maintenance and routine inspection of the system.

If individual on-site systems are not a viable alternative then small and large cluster system options are considered as they are likely to be the next least cost option, if viable. Central sewers are only considered when individual or cluster systems can't adequately address wastewater needs and protect public health and the environment under current and full build-out scenarios.

This decision process is used to derive the conclusions and recommendations for each priority area described in **Section 4 – Assessment Findings**.

Figure 2
Decision Process Flow Diagram (Based on Risk Level)



3.14. O&M Permits

If an individual on-site wastewater treatment and disposal system is constructed using innovative/alternative (I/A) technologies, it is almost always because a more conventional system cannot meet the requirements of the Environmental Protection Rules. I/A systems are substantially more complex than conventional systems and typically require more routine maintenance and inspection to assure that the system is functioning properly. Failure to follow the routine maintenance and inspection requirements can quickly result in a failed system that threatens public health and the environment. For that reason, we conclude that this routine maintenance and inspection should be regulated (monitored) by Colchester to make sure that it is being performed properly and as scheduled.

If an individual on-site wastewater treatment and disposal system is permitted as a “best fix” under the Environmental Protection Rules, the system cannot meet the requirements of the rules, but it is concluded that the proposed system is the best and most reasonable alternative given the constraints of the site. “Best fix” systems are only allowed if there is no reasonable alternative that would fully comply with the rules. Since “best fix” systems are marginal by definition, they also require more routine maintenance and inspection to make sure the system doesn’t get overwhelmed and/or fail. We conclude that this routine maintenance and inspection should be regulated (monitored) by Colchester to make sure that it is being performed properly and as scheduled.

While O&M permits make sense, it is unclear whether Colchester has the authority to issue such permits under Vermont statute. Colchester has delegated authority from the state of Vermont to issue water supply & wastewater disposal permits on behalf of the Vermont Department of Environmental Conservation, it is not clear whether Colchester can place constraints on such permits that are more onerous than the standard permit conditions (e.g. regulate specific maintenance and inspection requirements). Further, it is reasonably clear that Colchester does not have statutory authority to impose a permit on existing wastewater systems within their community.

If Colchester chooses to pursue O&M permits, state statute and local regulations will need to be drafted and adopted.