Town of Moretown

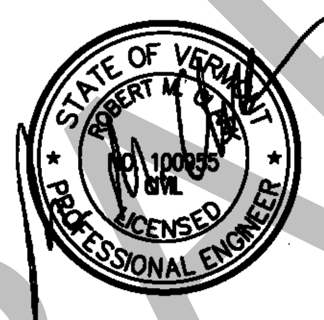
Community Wastewater Feasibility Study

Moretown, Vermont

2022

TOWN OF MORETOWN

COMMUNITY WASTEWATER
FEASIBILITY STUDY



MORETOWN, VERMONT

2022

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COMMUNITY WASTEWATER FEASIBILITY STUDY

MORETOWN, VERMONT
Winter, 2022

Table of Contents

1.0 PROJECT PLANNING

The Town of Moretown, Vermont (Town) is a rural town in Washington County, Vermont with a densely developed village center. The Town received a forgivable loan from the Vermont Department of Environmental Conservation (DEC) to conduct a wastewater feasibility study for Moretown Village, which currently possesses no community based wastewater solution. Otter Creek Engineering, Inc. (OCE) has collaborated with the Town's Wastewater Committee to conduct this study.

1.1 Location, Study Area, and Potential Service Area

The project is located in the Town of Moretown, Vermont. The Study Area, the Potential Service Area, and other notable features and landmarks for easy reference are depicted on **Figure No. 1**. The focus area generally includes the Village Center which has already been developed along Vermont Route 100B between Pony Farm Road and Dickerson Road.

The "Potential Service Area" is defined as the area the Town will focus on providing opportunities for wastewater solutions. Primarily, the Potential Service Area is the Village Designation limits shown on **Figure No. 1**, and as identified in the Town Planning and Zoning maps. Moretown Village contains some unique physical and topographical features which further define the service area.

This study includes the review of a public community water supply as a potential alternative to address community wastewater issues. The Study Area was chosen to include land within approximately 1 mile from the center of Moretown Village, which is generally considered the maximum distance for new water supply sources, beyond which the length of transmission piping would not be cost effective. This radius is generally considered feasible for wastewater system investigation.

1.2 Goals of the Study

The existing Town Plan indicates the following broad based goals regarding water and wastewater disposal:

1. Under the topic of water supply, wastewater disposal, and stormwater,
   a. Consider creating one or more municipal water systems (fire district) for the Town.
   b. Reduce the environmental impact from stormwater runoff and wastewater disposal systems, especially those systems in densely settled and environmentally sensitive areas.
2. Under the topic of economic development, the Town Plan aims to encourage economic development, with a focus on creating job opportunities while maintaining high environmental standards.

Encompassing both of these points, the town plan stated "The floodplain is the most significant natural constraint to development within the Moretown Village area. The lack of community water or wastewater infrastructure is the other major constraint on more intensive use of existing properties or further growth at a density that would extend the historic settlement pattern."

The specific objectives of this study are to:

- Review readily available information and identify areas where construction of new onsite or offsite systems are needed, or would be necessary if new development occurs;
- Identify potential wastewater disposal sites;
- Review the potential for providing off-site water supplies as an alternative to off-site wastewater solutions;
- Develop and analyze system and/or management alternatives;
- Prepare preliminary conceptual plans and cost opinions for meeting the immediate needs of the Town;
- Present preliminary funding options and the potential range of user fees that may be needed to support the preliminary concepts;
- Offer concepts to consider for future planning efforts if the Town wants or needs to provide off-site water and wastewater solutions to portions of or the entire Village Center in the future.
- Convey information in a format that would be suitable to be considered a Preliminary Engineering Report if the Town chooses to pursue one of the reasonable alternatives recommended in this study.

There is evidence that providing community water and wastewater infrastructure, either with physical systems or with support and guidance on management of on-site systems, will help the Town provide opportunities for environmentally responsible economic development, consistent with the Town Plan.

1.3 Planning Analysis

The town zoning bylaws and zoning map can be found in **Appendix A**. Moretown has a fairly simple breakdown of zoning districts, with only 4 different zones existing. These zones are; Agricultural-Residential district which mostly encompasses the main roads and valley areas of the town, the commercial district which lies to the north and follows the south bank of the Winooski River and the portion of VT Route 2 which goes through the town, the Preserve district which is the forested and steeper terrain, and the Village District which is the highest density of development along Route 100B and the Mad River.

The village district has standards that which are the most conducive to growth and buildout when it comes to required setbacks and permitted and conditional uses. The stated purpose of the village district is "…to encourage a concentration of residential, commercial, and civic activities within and immediately adjacent to Moretown Village in a manner that respects the Village's small scale, historic character, and residential uses."

1.4 Environmental Resources Present

The study area was reviewed using the State of Vermont Agency of Natural Resources online interactive database and mapping tool. **Appendix B** includes ANR Resource Atlas Maps depicting known natural and environmental resources within the project area. Mapped resources that are shown include:

- Surface water (lakes, ponds, and streams);
- Wetlands and Vernal Pools;

- Primary Agricultural Soils;
- Hazardous waste sites, hazardous waste site generators
- Rare, Threatened and Endangered Species;
- Significant natural communities and Deer wintering areas;
- Floodways, Floodplains, and River Corridors;
- Groundwater Source Protection Areas; and

The following information provides a discussion of the environmental resources of note.

Surface Waters

The most major surface water in the village is the Mad River. Moretown sits at the end of its run before it reaches the Winooski River. The watershed of the Mad River at Moretown Village is 131 square miles and its extents are shown in **Figure No. 2**.

The Mad River offers a wide array of recreational activities, economic benefits, and ecological functions to the Mad River Valley towns, including Moretown. According to the 2016 Mad River Report (attached as **Appendix C**), the Mad River and its tributaries are used extensively for boating, swimming, fishing, nature-viewing, and other recreational activities. There are 19 swimming holes along the main stem and three tributaries, with one of the more popular ones being Kenneth Ward Park, which is in Moretown just north of the village.

According to the Online Resource Atlas, there are no impaired water bodies in the Study Area. The Town Plan, dated January 4, 2016, had a section on impaired waters which stated that a 6-mile segment of the Mad River was on the impaired list due to elevated levels of E. Coli. In consultation with Town officials, the elevated levels of E. Coli within this stretch are anticipated to be related to failed wastewater systems.

To the northeast of the village there is a stressed river in the Winooski River, and further upstream is its watershed, which is on the 303(d) list.

Wetlands

There is only one area of mapped Class II wetlands that's been identified within the village designated area. Otherwise, wetlands are not close enough to have potential impacts to any potential water or wastewater infrastructure.

It's reasonable to presume that unmapped wetlands may exist on some properties within the project boundaries. Development within the wetlands will not be permitted, but temporary impacts to those wetlands or their associated buffers may be required and considered permittable when they are deemed necessary to complete the installation of utility infrastructure. The overall goal of any infrastructure project will be to utilize the techniques of avoidance and minimization to limit wetland impacts.

In general, mapped wetlands and hydric soils are not suitable locations for wastewater disposal.

Primary Agricultural Soils

In addition to the surrounding farm lands, the Village Center does contain soils which are classified as primary agricultural soils by the State of Vermont. The designation is important for development projects which would require an Act 250 permit, as impacts to the lands ability to be used for agriculture must be minimized. In general, designated growth centers with pre-existing development are less of a concern, especially for buried utility infrastructure projects.

There is another area of prime agricultural soils just outside the village center but this area may not be considered for wastewater disposal due to its proximity to an existing waterbody.

Hazardous Waste Sites

Six hazardous waste sites have been listed by the State of Vermont in the Study Area. All of the sites are clustered in the Village Center, and a summary of the sites can be found below in **Table 1**. In general, impacts from these sites would be limited to construction of potential piping infrastructure (water or sewer). Should a project move forward, considerations would be made to make a contaminated soils plan for the possibility of running in to contaminated soils during construction.

Table 1 Summary of Hazardous Sites

Hazardous Site	Site Number	Contaminant	Source of Contamination	Priority	Project Status	Site Closure Date
Town of Moretown Garage	962118	Gasoline	UST-Gasoline	SMAC	N/A	6/30/2009
Moretown General Store	900588	Gasoline	UST-Gasoline	Medium	Investigation shows potential risk to homes and impacts to water supplies and Mad River	N/A
Moretown Post Office	20043207	Gasoline, MTBE	UST-Gasoline	SMAC	N/A	10/1/2019
Schultz Residence	20164680	Heating Oil	UST-Heating Oil	Medium	Groundwater imacted with prescense of NAPL, continued groundwater monitoring required	N/A
Moretown Clerk's Office	20053377	Heating Oil	UST-Heating Oil	SMAC	N/A	2/3/2006
Zschau Residence	20134402	Gasoline, Heating Oil	Unknown	Medium	Three 1,000-gallon USTs removed, semi-annual groundwater monitoring required	N/A

Floodplains, River Corridor and Floodways

The Mad River runs right through the village center. The surrounding floodplain contains land which is mapped on the Federal Emergency Management Agency (FEMA) Flood Hazard Area Maps. The land is mapped Zone A, Zone AE, and Zone X.

The mapped river corridor roughly follows the FEMA floodplain areas and is shown on the River Corridor layer. No disposal area projects are proposed in FEMA floodplain areas or the river corridor. A stream in the east of the Study Area has narrow corridor, but it is not to have significant impacts to any potential projects.

Rare Threatened and Endangered Species
No rare, threatened or endangered species have been identified within the Study Area.

Significant natural communities and Deer wintering areas
There are no known significant natural communities within the study area. Deer Wintering Areas are mapped in the forested area on the outskirts of the Village and may have to be considered when choosing potential wastewater disposal location.

1.5 Historical Resources Present

1.6 Population Trends

According to the 2020 U.S. Census, Moretown has a population of 1,753. This represents an increase of 95 residents from the 2010 Census population of 1,658.

In general, Moretown's growth has outpaced both Washington County's and the State of Vermont's growth. Refer to the population by State, County and Town data presented in **Table 2** below. This is indicative that Moretown is a community in Vermont where people desire to live.

Table 2 – Population Trends

	Moretown	Washington County	Vermont
2000	1,653	58,039	608,827
2010	1,658	59,534	625,741
2020	1,753	59,807	643,077
% Change	6.05	3.05	5.63

In 2020, according to the U.S. Census American Community Survey, the Town had 854 total housing units. Of those units, 722 were occupied and 132 were vacant. According to the Vermont Department of Labor, in 2019 Moretown had 33 private businesses employing 276 people.

1.7 Regulatory Requirements

The Vermont Department of Environmental Conservation (DEC) Drinking Water and Groundwater Protection Division (DWGPD) regulates most of the water and wastewater systems throughout the State. **Table 3** presents a summary of the different categories of systems that may be considered for the Town in developing water and wastewater solutions for the Village.

Table 3 Town of Moretown Community Wastewater Feasibility Study Regulatory Summary			
Category of System	**Regulatory Authority**	**Description**	**Applicability to Highgate Community WW Study**
Wastewater			
Small-Scale	EPR, Ch. 1, WW Rules	For soil-based systems with capacities less than 6,500 gpd	
Indirect Discharge	EPR, Ch. 14, IDR	For soil-based systems with capacities at or greater than 6,500 gpd	If soil conditions allow for larger systems, these system
Direct Discharge	Title 40 CFR, Section 122, NPDES	For systems with point source discharges to waterways	Not applicable
Water Supply			
Non-Public	EPR, Ch. 1, WW Rules	Covers all water systems that are not considered "Public" including single family residences with private wells, to 9 lot developments with a shared water system	
Public Transient Non-Community (TNC)	EPR, Ch. 21 (WSR)		
Public Non-Transient Non-Community (NTNC)	EPR, Ch. 21 (WSR)		
Public Community (PCWS)	EPR, Ch. 21 (WSR)	For systems serving at least 10 residential connections or 25 year-round residential population	Would provide safe, reliable water to all properties

Abbreviations:
EPR = Enviornmental Protection Rules
WW Rules = Wastewater System and Potable Water Supply Rules
IDR = Indirect Discharge Rules
WSR = Water Supply Rule
CFR = Code of Federal Regulations (Title 40 is "Protection of Environment")
NPDES = U.S. Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System

Wastewater

In Vermont, sanitary wastewater disposal systems are regulated under two sets of rules, depending on the design capacity. Systems which are less than 6,500 gallons per day are considered “small scale“ wastewater systems, and subject to Chapter 1 of the Vermont Environmental Protection Rules (EPRs), also known as the Vermont Wastewater and Potable Water Supply Rules (WW Rules). Chapter 1 of the EPRs are administered through the DWGPD Regional Offices and provide regulation, requirements and guidance for the design, construction, replacement, modification, operation and maintenance of small-scale soil-based wastewater disposal systems with the primary goal of protecting public health and the environment. The WW Rules are applicable from single family residential septic systems up to shared community systems equivalent to the size of a development of approximately 25 homes.

Soil-based wastewater systems with capacities of 6,500 gallons per day or greater are considered “indirect discharges” of sewage and are subject to Chapter 14 of the EPRs, the Indirect Discharge Rules (IDRs). The requirements to obtain an Indirect Discharge Permit are significantly more substantial than for systems that are regulated under the WW Rules, and as a result there are many building developments around the State with capacity of 6,499 gpd or less.

For larger scale systems above 30,000 gpd (or approximately 120 homes), the system is required to provide secondary wastewater treatment (such as an aerated lagoon) prior to discharge. At this size, the IDRs also allow for “spray disposal,” which is similar to an irrigation system, where treated wastewater effluent is spread over a protected area and allowed to percolate into the ground. These required systems are typically used in the ski areas and other locations where subsurface disposal is not practical.

Systems larger than 40,000 gpd require tertiary treatment, which requires significantly more expensive capital and operational costs. These types of systems are likely not applicable for Moretown.

Some wastewater systems have treatment facilities which discharge directly to a surface water source such as a lake or river, are regulated under the federal National Pollutant Discharge Elimination System (NPDES) Permit program, administered by the DEC Watershed Management Division.

Water Supply

All new (and modifications to) potable water supply systems in the State are regulated as either non-public (typically for small systems regulated through the WW Rules) or public water systems, which are regulated by Chapter 21 of the EPRs, the Water Supply Rule (WSR).

A public water system is one which serves at least ten (10) service connections and/or serves at least 25 residents (note: the WSR indicates serving at least 15 connections, but practically the DWGPD has acted based on the assumption that only 10 single family homes with an average household size of 2.5 persons per household, will trigger the threshold for serving 25 persons). Public water systems are categorized as follows:

i. Public Community Water Systems (PCWS) regularly serve the at least 25 year-round residents (or 10 single family homes).
ii. Public Non-Transient Non-Community (NTNC) Systems serve at least 25 of the same persons daily for more than six months of the year. Examples of these types of systems are schools and office buildings.
iii. Public Transient Non-Community (TNC) Systems serve transient populations such as restaurants and motels.

Each of the systems are regulated differently because the risk of acute and chronic exposure to contaminants for varying populations is reduced from PCWS to TNC systems, respectively.

1.8 Community Engagement

In 2013, the Town issued a survey requesting feedback on various aspects of the Town's current state and desired future outlook. Included within this was a gauging of public opinion on the potential of developing community based water and wastewater systems for the main village.

Respondents expressed that they did not want to develop either, siting cost as a primary concern.

In 2022, the Moretown Selectboard formed the Moretown Village Wastewater Committee. The Committee consists of ## members, and adopted the following mission statement:

"insert mission statement"

Throughout the study process, the committee will meet bi-weekly to discuss progress and next steps towards a community-based wastewater solution.

Moving forward, community engagement will be completed through public informational meetings and presentations to discuss the study, options and paths forward for the Town, with the goal of gaining valuable feedback from property owners and residents on what is important to them.

A public presentation will be held to present the findings of the study and solicit input when the investigation reaches approximately 90% complete.

2.0 EXISTING CONDITIONS

Moretown Village is moderately developed within the study area and includes a mixed use of residential, commercial, and municipal/institutional properties. The study area includes not only the existing Moretown Village designated area, but also an investigation radius which extends ### feet beyond the limits of the Village Boundary.

The study area encompasses a total area of approximately #### acres, and included ### total parcels.

The following were used to document and evaluate existing water and wastewater facilities:

- Property Survey Information

2.1 Study Area

The overall project study area is depicted on **Figure 1.**

2.2 History

There are no municipal water or wastewater facilities within the study area.

Currently, the residences and commercial properties within the Village obtain water from on-site water supply wells and dispose of wastewater into individual on-site disposal systems. This scenario of having both water supply wells and wastewater disposal systems on the same lot, many which are relatively small, is common but is not desirable since in some cases the isolation distances between wells and disposal systems do not meet current regulations and health hazards exist or can be created. All private water supplies, including both wells and springs are required to meet specific isolation distances under the current rules and regulations. This is presented below in **Table 4.**

Table 4 - Isolation Distances as outlined in the WW Rules

Water Supply Item	Horizontal Distance (Feet)		
	Leachfield	Septic Tank	Sewer Pipe
Drilled Well	100-400	50	50
Gravel Pack Well, Shallow Well or Spring	150-500	75	75
Water Main	50	50	10
Water Service	25	25	10
Water Storage Tank	50	50	50
Suction Water Pipe	100	50	50

Known water and wastewater systems within the project area are depicted on **Figure 3.**

2.3 Existing Water Systems (Project Area)

Although there is not a singular public water system, there are several smaller water systems which are regulated by the State of Vermont Drinking Water and Groundwater Protection Division (DWGPD). These include:

<u>Moretown Elementary School</u> [WSID 6677]– The school's system operates as a NTNC, serving 200 people through 2 service connections. The Maximum Daily Demand (MDD) is 3,000 gallons per day (gpd), which equates to a flow rate of 4.2 gallons per minute (gpm) when the

source well (WL001) is operated for 12 hours. The system's treatment is comprised of cartridge filtration and two ultraviolet light treatment units. The system has no storage or booster pumping stations, so the pressure is set by the pumping of the well. Distribution piping consists of small diameter copper piping.

Moretown General Store [WSID 20971] – The store operates as a NC serving just the Moretown General Store property. It serves a population of 55 through one connection (50 transient, 5 non-transient).

The Commons [WSID 5435]– The common operates as a community water system serving The Common's Owners Association's condominiums complex off Moretown Common Road. It serves a population of 79 through 30 service connections and is served by a single well. The well had a tested yield of 10 gpm.

2.4 Existing Wastewater Systems (Project Area)

Although there is no singular municipal wastewater system, there are a number of permitted wastewater systems within the project area. The State of Vermont maintains a database of permits issued under the "small scale (WW) rules". The records were reviewed as part of this study in an effort to gather information on the age of systems, type of systems constructed, number of failed / replacement systems in the service area, and to begin evaluating design flows.

Included in **Figure 3** are examples of systems that have been replaced in recent years, based on information available on the State permit database. It appears there is a relatively small sampling of properties within the Moretown Village area that have needed to apply for State permits due to a failure of a water supply or wastewater system. However, when these occur there are difficulties with meeting the current standards for systems, and often the property owner is required to apply for variances from State Rules and implement a "best fix" solution. **Table 5** below outlines the documented failed systems between 1987 and 2022.

Table 5 – Village Failed Systems

Address		Date	Gallons Per Day	Notes
1 Moretown Mountain Road	Residence	4/17/1987	130	
918 VT RTE 100B	Residence	2/15/2022	560	
989 VT RTE 100B	Residence	7/1/2018	280	
1128 VT RTE 100B	Moretown Gen Store	9/24/1990		
1128 VT RTE 100B	Moretown Gen Store	4/28/2018	1000	System has failed twice
1049 VT RTE 100B	Fire Department	7/16/2003	200	
1836 VT RTE 100B	Apartments	9/16/2003	560	
1266 VT RTE 100B	Residence	7/10/2007	420	replacement system requiring pretreatment
1284 VT RTE 100B	Residence	1/23/2009	420	
66 Dickerson Road	Residence	10/28/2013	325	

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Table 6 – Existing Village WW Permits

Address		Date	Gallons Per Day	Notes
1 Moretown Mountain Road	Residence	4/17/1987	130	
VT RTE 100B	Town Garage	10/21/2008	75	
918 VT RTE 100B	Residence	1/2/2013	560	
949 VT RTE 100B	Residence	4/12/2019	630	
989 VT RTE 100B	Residence	7/1/2018	280	
1114 VT RTE 100B	Moretown Gen Store	9/24/1990		
1128 VT RTE 100B	Moretown Gen Store	4/28/2018	1000	
1049 VT RTE 100B	Fire Department	7/16/2003	200	
1836 VT RTE 100B	Apartments	9/16/2003	560	
1266 VT RTE 100B	Residence	7/10/2007	420	
1284 VT RTE 100B	Residence	1/23/2009	420	
1326 VT RTE 100B	Residence	9/20/2005	560	
1414 VT RTE 100B	Residence	2/20/2004	420	
Sitka Lane	Multi-Residence	10/25/2011	1300	
88 Dickerson Road	Residence	10/28/2013	325	

The majority of wastewater systems are smaller in-ground disposal systems, with the exception of some pressure based mound disposal systems and unique, best fix designs.

In addition to traditional residential wastewater systems, there are several smaller systems designed to serve more than one single family home, which include:

Moretown Elementary School [WW-#####]– This is the town's most significant in-ground based wastewater system and has a current capacity of 3,000 gallons per day, and it serves the school and the nearby town office. The system is comprised of septic tanks, pump stations, a leachfield pump station, and leachfield mound. The original system for the school was smaller, and when the school proposed to build additions, it was increased and a new (the current) wastewater disposal system was built. This was not an easy undertaking, as studies including tests pits had determined that much of the area around the school was not suitable for the increase they were looking for. See information on the school system in **Appendix D**.

The Commons (IDR####) – The Commons has an Indirect Discharge permit to discharge a design sewage flow of 10,000 gpd to the Mad River. Although outside of the Village, the Commons wastewater system is the largest community based solution in Moretown.

2.5 Design Flows

Design capacity of a wastewater disposal system is a critical component in completing the engineering design and permitting because they not only affect the size of the components, but also dictate which regulatory standard applies. **Table 7** presents a listing of the existing uses within the Designated Village boundary, as well as within the serviceable area.

Additionally, **Table 8** attempts to show the potential future design capacity that may be needed to cover water and/or wastewater needs in areas targeted for development by the Town. Although this was not an exhaustive analysis of existing use and capacity, **Table 8** is intended to provide a general range of capacity needed to provide for existing conditions and estimated potable water supply and wastewater design flows associated with the current and projected future uses. In developing the design flows, Table Nos. 8-1 and 8-2 of Chapter 1 of the EPRs were utilized.

Based on the existing property uses within the service area, wastewater design flows are anticipated to range between 20,000 and 30,000 gallons per day, at full build out and current land uses. Considerations for growth, and an allowance for infiltration and inflow could necessitate a wastewater system which has a design capacity of 40,000 to 50,000 gallons per day at full buildout.

Table 8 – Proposed System Design Flow

Wastewater GPD Origin	GPD	Notes
WW Permits On File	6,880	
Rest of Village Residences (42 @ 420 gpd)	17,640	Assuming each is 3 Bedroom and 140 gpd per bedroom
Total	**24,520**	

2.6 Financial Status of Existing Water and Wastewater Facilities

There are no municipal water or wastewater systems. Currently, all water and wastewater expenses are the responsibility of the individual landowners.

2.7 Water / Energy / Waste Audits

No water, energy or waste audits have been conducted as part of this study

3.0 NEED FOR PROJECT

3.1 Health, Sanitation, and Security

In 2007, the State revised the regulations to eliminate certain exemptions and assumed jurisdiction over all small scale wastewater systems throughout Vermont, including previously exempted systems when they are modified or deemed to have failed. Over time, issues identified during property transfers may help to monitor the risk of overlapping water and wastewater systems in the Moretown Village area.

Properly designed wastewater disposal systems, which are operated and function as designed are critical to maintaining public health and protecting the environment. As noted in section 2.0 of this report, the existing development within the project area limits the overall land area which is available for adequate wastewater disposal. The Village includes a configuration of small lots, combined with both individual on-site water and wastewater disposal systems which likely do not meet current day standards for separation/isolation on their own properties, and also impact the isolation distances for both water and wastewater systems on neighboring properties.

In some communities, this condition has been defined as an “emergent condition” - where there is no obvious public health threat (such as widespread septic system failures or bacterial contamination of water supplies), but the inability to meet current standards acknowledges the risk to public health is real and presumed. Based on information received, at this time there does not appear to be widespread environmental or public health concerns throughout the study area, however there is a documented history of contamination to the Mad River.

Development of a community wastewater system would provide enhancement and protection of water quality in the Mad River, address limitations presented by the density of existing development and reduce / eliminate conflicts with drinking water supplies and disposal fields.

3.2 Aging Infrastructure

Given the limited number of properties in the Moretown Village that have a State permit for their water and wastewater system, and the age of existing homes and buildings within the project study area, it is inferred there are many water and wastewater systems that have been in place for decades.

Depending on the site specific conditions, such as types of soil and depth to groundwater, and the level of maintenance performed, it is unclear what the remaining useful life is of these systems. The typical lifespan for a residential septic system is 40 years or less. Use of pretreatment with septic tank effluent filters, regular pumping of septic tanks, and monitoring what is disposed in household wastewater may help to prolong the life of a septic system, however it appears that many of these systems are at or exceeding the expected useful life.

Development of community water and wastewater solutions would address the aging infrastructure within the Village as a community based solution.

3.3 Reasonable Growth

The Town has made efforts to promote reasonable growth of residential, commercial, and industrial uses throughout the Town by adopting and modifying planning and zoning standards. A goal of this study is to provide options by which the Town can offer basic utility services in an effort to retain existing development in the village while providing allowances for future growth and infill development in the village center, and reducing the potential for sprawl development.

Vermont Agency of Natural Resources
Vermont Agency of Natural Resources

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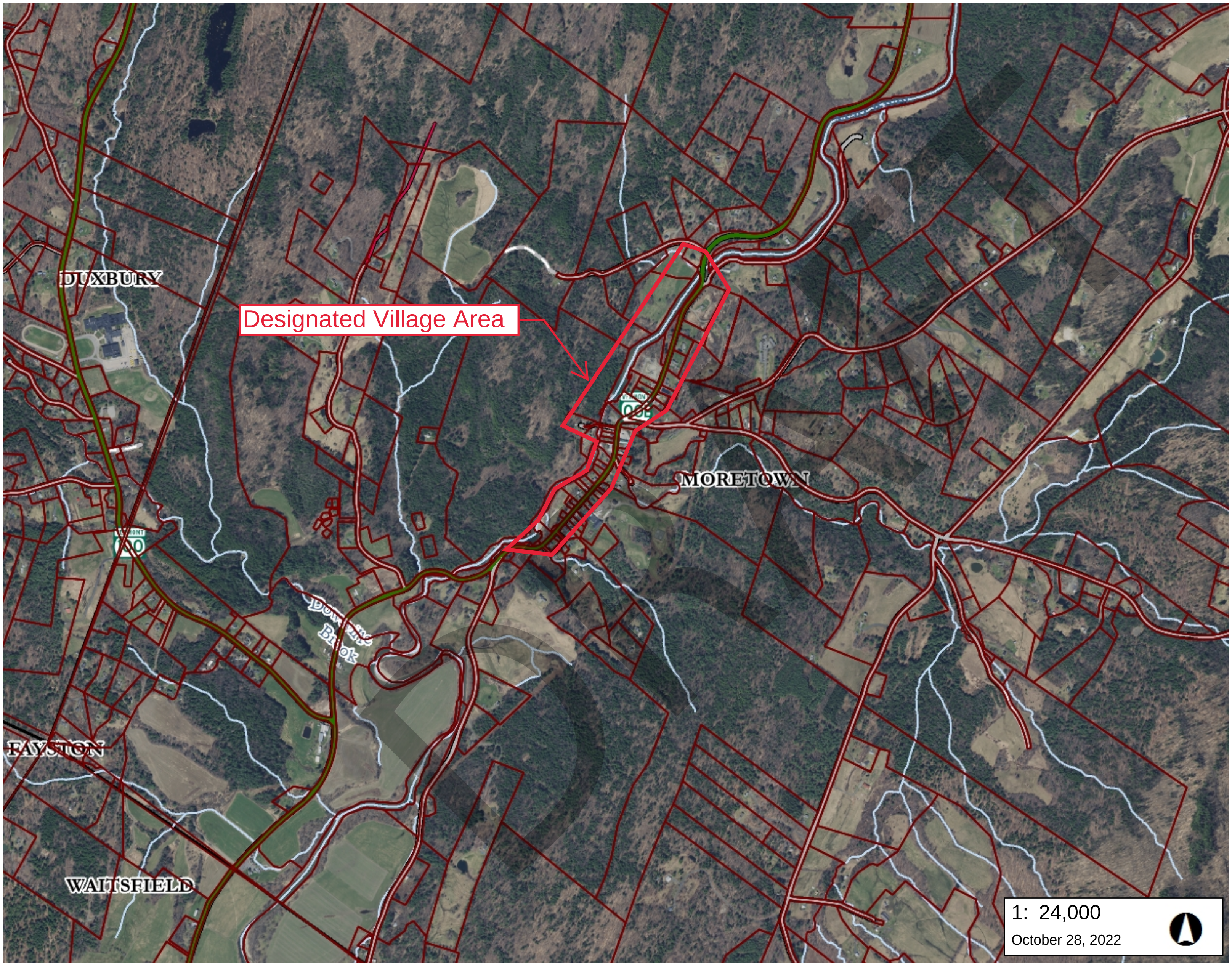


1: 24,000
October 28, 2022

LEGEND

- Parcels (standardized)
- Roads
  - Interstate
  - US Highway; 1
  - State Highway
  - Town Highway (Class 1)
  - Town Highway (Class 2,3)
  - Town Highway (Class 4)
  - State Forest Trail
  - National Forest Trail
  - Legal Trail
  - Private Road/Driveway
  - Proposed Roads
- Stream/River
  - Stream
  - Intermittent Stream
- Town Boundary

4,000.0 0 2,000.00 4,000.0 Feet

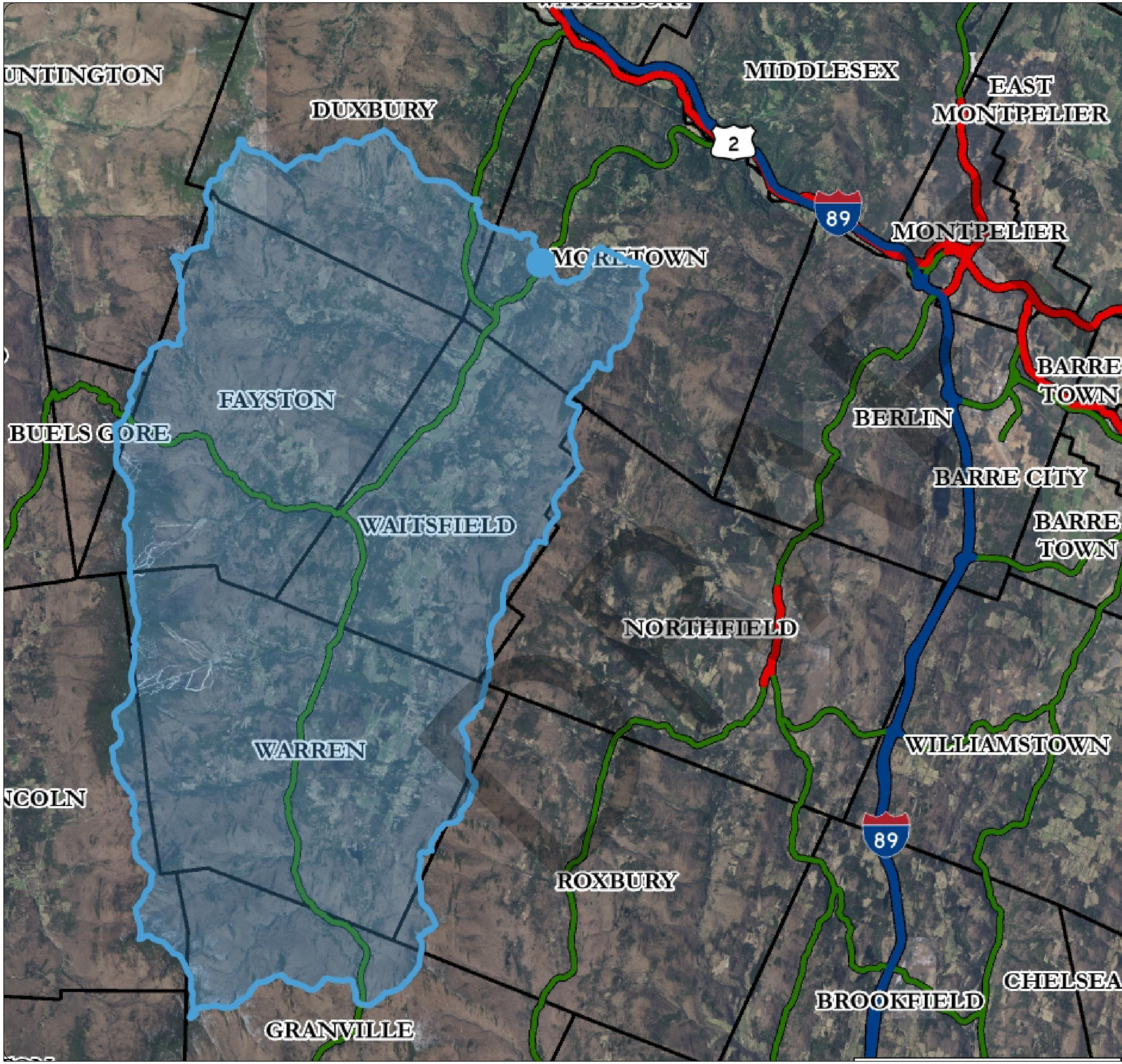
WGS_1984_Web_Mercator_Auxiliary_Sphere 1" = 2000 Ft. 1cm = 240 Meters

THIS MAP IS NOT TO BE USED FOR NAVIGATION

DISCLAIMER: This map is for general reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable. ANR and the State of Vermont make no representations of any kind, including but not limited to, the warranties of merchantability, or fitness for a particular use, nor are any such warranties to be implied with respect to the data on this map.

NOTES

Map created using ANR's Natural Resources Atlas



LEGEND

Roads

- Interstate
- US Highway; 1
- State Highway
- Town Highway (Class 1)
- Town Highway (Class 2,3)
- Town Highway (Class 4)
- State Forest Trail
- National Forest Trail
- Legal Trail
- Private Road/Driveway
- Proposed Roads

Town Boundary

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404 East Main Street
P.O. Box 712
East Middlebury, VT 05740
Telephone: 802 382-8522
Fax: 802 382-8640
~
110 Merchants Row
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Rutland, VT 05701
Telephone: 802 747-3080
Fax: 802 747-4820
~
93 South Main Street
Suite 203a
West Lebanon, NH 03784
Telephone: 603 696-3075
~
E-mail: info@ottercrk.com

STAMP AND SIGNATURE:

DESIGN ENGINEER

GRID NORTH

TOWN OF MORETOWN
VILLAGE WASTEWATER
MORETOWN, VERMONT

REVIEW

DATE ISSUED:	9/13/2022
REVISIONS:	
DRAWN BY:	BB
CHECKED BY:	RC
SCALE:	1"=300'
PROJECT NO.:	1174.001
CADD FILE:	1174-001

TITLE:
MAD RIVER WATERSHED

DRAWING NO.

Vermont Agency of Natural Resources

Vermont Agency of Natural Resources

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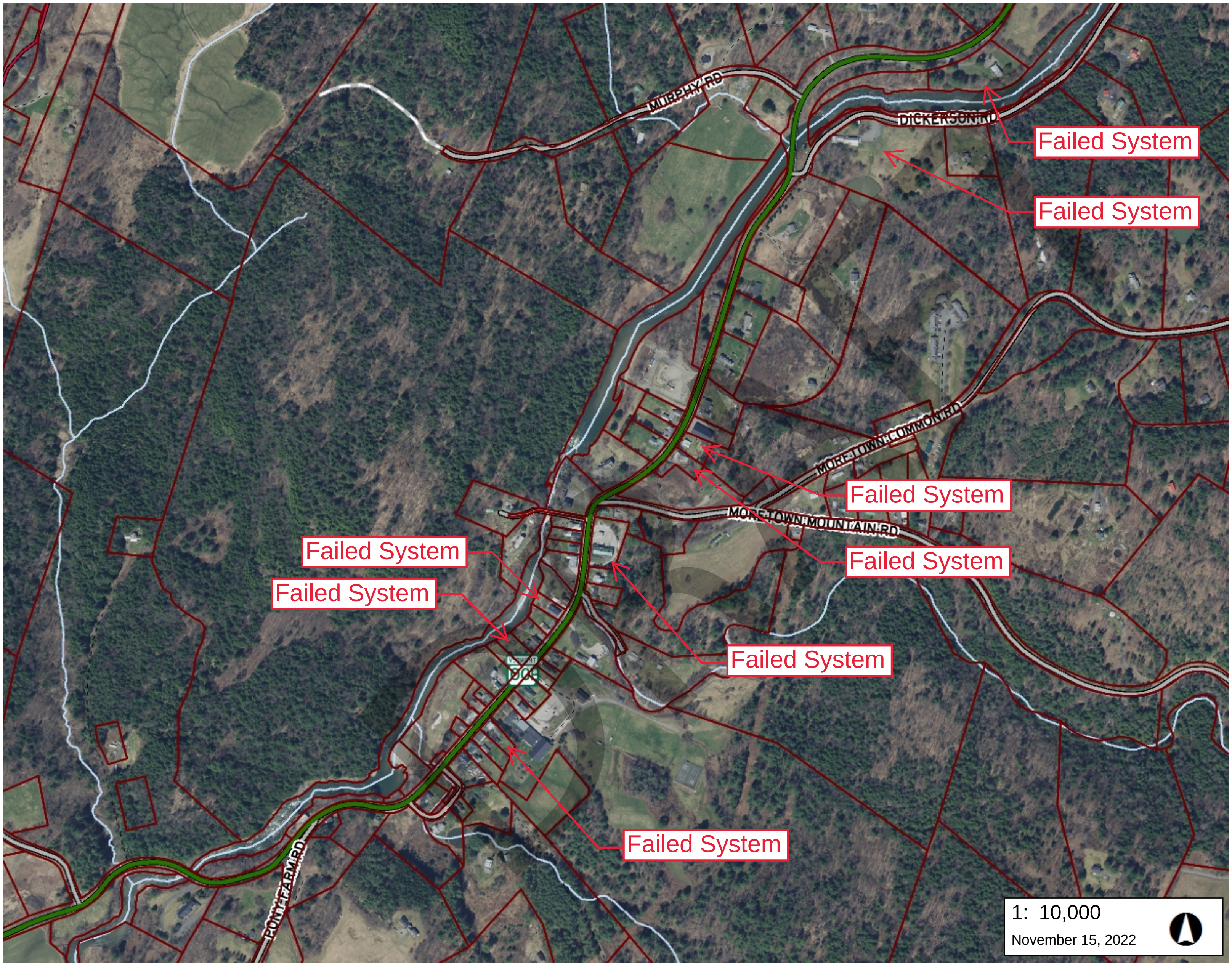


LEGEND

Parcels (standardized)

Roads
- Interstate
- US Highway; 1
- State Highway
- Town Highway (Class 1)
- Town Highway (Class 2,3)
- Town Highway (Class 4)
- State Forest Trail
- National Forest Trail
- Legal Trail
- Private Road/Driveway
- Proposed Roads

Stream/River
- Stream
- Intermittent Stream

Town Boundary

1,667.0 0 834.00 1,667.0 Feet

WGS_1984_Web_Mercator_Auxiliary_Sphere 1" = 833 Ft. 1cm = 100 Meters

THIS MAP IS NOT TO BE USED FOR NAVIGATION

DISCLAIMER: This map is for general reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable. ANR and the State of Vermont make no representations of any kind, including but not limited to, the warranties of merchantability, or fitness for a particular use, nor are any such warranties to be implied with respect to the data on this map.

NOTES

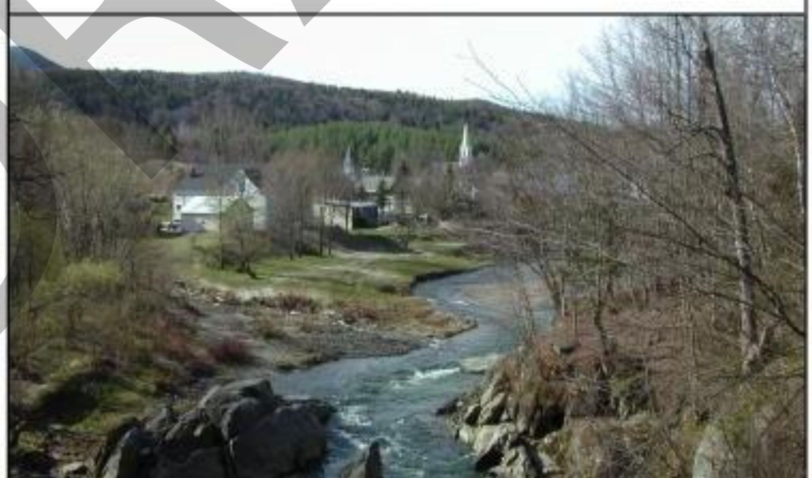
Map created using ANR's Natural Resources Atlas

Zoning Regulations

for the Town of

MORETOWN

VERMONT



March 2, 2021

Town of Moretown, Vermont
ZONING REGULATIONS

Adoption History

Moretown's Zoning Regulations were first adopted on September 14, 1976. Subsequent amendments to the 1976 regulations include:

September 12, 1978	(Flood Hazard Regulations)
March 6, 1984	(Signs)
November 8, 1988	(Flood Hazard Revisions)
March 6, 1990	(Light Industry)
March 7, 2000	(Zoning Regulations Revisions)
September 11, 2000	(Traffic Ordinance)*
September 17, 2001	(Animal Control Ordinance)*
March 3, 2003	(Sewage Ordinance)*6/7
July 21, 2003	(Wireless Telecommunications Facilities Interim Bylaw)**
July 21, 2003	(Access and Frontage Requirements Interim Bylaw)**
August 2, 2004	(Quarry Interim Bylaw)**
February 6, 2006	(Zoning Regulations Revisions including Section 3.14 - Telecommunications Facilities)
September 12, 2006	(Revisions to Section 3.5 – Extraction of Earth Resources)
March 4, 2008	(Zoning Regulations Revisions to address NFIP requirements)
March 3, 2009	(Minor revisions to Section 5.2b and Section 7.2 Definitions)
March 2, 2010	(Wind Turbine Regulations- Section 3.16)
August 9, 2016	(Special Events, Setback Waivers, Erosion Control, Riparian Buffers)
March 3, 2020	(Subdivision Review Standards, Section 6)
March 2, 2021	(Minor updates to comply with state law and address other technical issues)

* Ordinance does not appear in these regulations
** These Interim Bylaws have expired

Moretown Select Board

Thomas Martin, Chair
John Hoogenboom
Callie Streeter
Rae Washburn
Don Wexler

Moretown Planning Commission

Jonathan Siegal, Chair
Deb Carroll
Karen Horn
John Schmeltzer
David Stapleton

TABLE OF CONTENTS

ARTICLE I AUTHORITY & PURPOSE

Section 1.1 Enactment

These regulations are established in accordance with the Vermont Municipal and Regional Planning and Development Act, 24 V.S.A., Chapter 117 (the "Act") and shall be known as the "Town of Moretown Zoning Regulations".

To effect the purposes of 10 V.S.A. Chapter 32, and in accordance with 24 V.S.A. § 4424, there is hereby established an ordinance for areas of special flood hazard (special flood hazard area) in the Town of Moretown, Vermont.

Section 1.2 Purpose

The purpose of these regulations is to further the purposes established in the Act [§4302] and to implement the Moretown Town Plan by providing for the preservation of the Town's rural character and significant natural areas; to promote commercial activities in appropriate locations; to encourage the productive use of agricultural and forested lands; to preserve natural and scenic resources; and, to support flexible and creative development which protects the health, safety, welfare, and quality of life of Moretown residents.

Section 1.3 Application & Interpretation

(A) The application of these regulations is subject to the provisions of all subchapters of the Act as most recently amended. No land development shall commence within the Town except in compliance with the provisions of these regulations. A zoning permit issued by the Zoning Administrator shall be required for all land development as defined herein. Such permit may be issued only in conformance with these regulations and other Town ordinances. Land development shall not include customary maintenance activities.

Land Development: the division of a parcel into two or more parcels, the construction, reconstruction, conversion, structural alteration, relocation or enlargement of any building or other structure, or of any mining, excavation, or landfill, and any change in the use of any building or other structure, or land or extension of use of land. [24 V.S.A., §4303(10)].

(B) The adoption of these regulations shall not repeal or limit any permit previously issued. Where these regulations impose a greater restriction upon use of a structure or land than is required by any other statute, ordinance, rule, regulation, permit, easement, or agreement, then these regulations shall control.

Section 1.4 Adoption, Effective Date and Amendments

These regulations shall take effect immediately after adoption at a regular or special town meeting, in accordance with the Act [§4442]. These regulations may be amended according to the requirements and procedures established in the Act [§4441 and §4442]; any mandatory changes enacted by the state shall automatically become part of these regulations.

Section 1.5 Severability

If any portion of this ordinance is held unconstitutional or invalid by a competent court, the remainder of this ordinance shall not be affected.

ARTICLE II
ESTABLISHMENT OF ZONING DISTRICTS AND DISTRICT STANDARDS

Section 2.1 Establishment of Zoning Districts and Zoning Map

(A) The Town of Moretown is hereby divided into the following zoning districts:

(1) Village District
(2) Commercial District
(3) Agricultural-Residential District
(4) Preserve District
(5) Flood Hazard Overlay

(B) The location and boundaries of zoning districts are established as shown on the official "Town of Moretown Zoning Map", which is made part of these regulations. The locations and boundaries of the Flood Hazard Overlay district are shown on the FEMA FIRM (Flood Insurance Rate Map). The official zoning map and FEMA FIRM shall be located in the Town Clerk's office and shall be the final authority as to the current zoning status of land and waters in the town.

(C) The official zoning map and FEMA FIRM shall be identified by the signatures of the Select Board, as attested to by the Town Clerk. No changes of any nature shall be made on the official map or overlays except in conformance with zoning amendment procedures and requirements set forth in the Act [§4441, §4442].

(D) The flood hazard regulations shall apply to all areas identified as areas of special flood hazard in and on the most current flood insurance studies and maps (FEMA FIRM maps) published by the Department of Homeland Security (DHS), Federal Emergency Management Agency (FEMA), National Flood Insurance Program (NFIP), as provided by the Secretary of the Agency of Natural Resources pursuant to 10 V.S.A. § 753, which are hereby adopted by reference and declared to be part of these regulations.

Section 2.2 Interpretation of Boundaries

(A) Where uncertainty exists as to the location of district boundaries shown on the official zoning map and overlay, the following rules shall apply:

(1) Boundaries indicated as following elevation contours shall be construed to follow such contours.

(2) Boundaries indicated as approximately following the center lines of streams, roads, transportation and utility rights-of-way shall be construed to follow such centerlines.

(3) Boundaries indicated as approximately following property boundaries or platted lot lines shall be construed to follow such lot lines.

(4) Boundaries indicated as parallel to or extensions of features under subsections (1) and (2)

shall be so construed. Boundaries indicated as lines perpendicular to lines or features described in subsections (2) and (3) shall be construed to proceed at right angles from such lines or features. Distances not specifically indicated shall be determined by the scale of the map.

(5) The abandonment or relocation of a right-of-way or roadway, or the change in a line or feature which references a district boundary line, after the effective date of these regulations, shall not affect the location of such boundary line.

(B) When the Zoning Administrator cannot definitely determine the location of a district boundary by the scale or dimensions given on the official zoning map and associated overlays or by the above rules, the Development Review Board shall determine said location. A determination by the Zoning Administrator regarding the location of a district boundary may be appealed to the Development Review Board under Section 6.6.

(C) Where a district boundary line divides a lot in single ownership on or after the effective date of these regulations or of amendments thereto, the Development Review Board may permit, as a conditional use, the extension of the regulations for either portion of the lot not to exceed 50 feet beyond the district line into the remaining portion of the lot.

(D) Areas of Special Flood Hazard (Flood Hazard Overlay): This ordinance does not imply that land outside of the areas of special flood hazard or land use permitted within such districts will be free from flooding or flood damages. This ordinance shall not create liability on the part of the Town of Moretown or any town official or employee thereof for any flood damages that result from reliance on this ordinance or any administrative decision lawfully made there under.

Section 2.3 Application of District Standards

(A) The standards for each district apply uniformly to each class of use and/or structure, unless otherwise specified in these regulations. All uses and structures must comply with all prescribed standards for the district in which they are located as set forth in Tables 2.1 - 2.5, unless otherwise permitted under Planned Residential Development (PRD) or Planned Unit Development (PUD) pursuant to Section 5.3. Nonconforming uses and noncomplying structures shall be regulated in accordance with Section 4.8.

(B) Flood Hazard Overlay District standards shall be applied concurrently with the standards for underlying districts. Where an overlay district imposes more restrictive standards on the use of a structure or land, the standards of the overlay district shall apply.

(C) Additional Overlay Districts, which may be adopted through amendment to these regulations, shall be applied concurrently with the standards for underlying districts. Where overlay districts impose more restrictive standards on the use of a structure or land, the standards of the overlay district shall apply.

(D) Prescribed uses for each district are classified as **"permitted,"** to be reviewed in accordance with Section 6.2, or "**conditional**" to be reviewed in accordance with Section 5.2.

(E) Any use not permitted by these regulations, unless specifically exempted under Section 6.3, shall be deemed to be prohibited.

Section 2.4 Zoning District Objectives, Uses and Specific Standards

Tables 2.1-2.5 set forth the stated purpose, allowable uses and specific standards for each zoning district.

Table 2.1 VILLAGE DISTRICT (VLG)

(1) Purpose: The purpose of the Village District is to encourage a concentration of residential, commercial and civic activities within and immediately adjacent to Moretown Village in a manner that respects the Village's small scale, historic character and residential uses.

(2) Permitted Uses:	**(3) Conditional Uses (see Section 5.2):**
1. Accessory Use/Structure (to a permitted use) 2. Agriculture 3. Cemetery 4. Child Care Facility (6 children or fewer - see Section 3.4) 5. Home Occupation (see Section 3.7) 6. Place of Worship 7. School 8. Single Family Dwelling 9. Accessory Dwelling Unit (see Section 3.1) 10. Camp 11. Telecommunication Facility (enclosed inside existing structure, substantially not visible – see Section 3.15 D) 12. Subdivisions (see Section 3.14)	1. Accessory Use/Structure (to a conditional use) 2. Bank 3. Bed & Breakfast 4. Child Care Facility (greater than 6 children – see Section 3.4) 5. Outdoor or Indoor Recreation Facility 6. Community Center 7. Cottage Industry (see Section 3.7) 8. Gasoline Station (see Section 3.6) 9. Health Clinic 10. Light Industry (see Section 3.8) 11. Mixed Use Building (see Section 3.10) 12. Multi-Family Dwelling 13. Nursing Home 14. Professional/Business Office 15. Public Facilities/Services 16. Public Assembly Facility 17. Restaurant 18. Retail Store 19. Telecommunication Facility (on existing structure – see Section 3.15 C)

(4) Dimensional Standards (unless otherwise specified by use type):

Lot Area Minimum:	.5 acre		
Minimum Building Setback:	20 feet	Minimum Lot Frontage:	80 feet
Minimum Rear Yard Setback:	20 feet	Minimum Lot Depth:	80 feet
Minimum Side Yard Setback:	20 feet	Maximum Building Coverage:	25%
Maximum Building Height:	45 feet	Maximum Lot Coverage:	50%

Table 2.2 COMMERCIAL (Mixed Use) DISTRICT (COM)

(1) Purpose: The purpose of the Moretown Commercial District is to allow for the location and expansion of commercial uses in appropriate locations in a manner that is compatible with residential uses and the Town's rural character.

(2) Permitted Uses:

1. Accessory Use/Structure (to a permitted use)
2. Agriculture
3. Child Care Facility (6 children or fewer - see Section 3.4)
4. Forestry
5. Home Occupation (see Section 3.7)
6. Private Club
7. Place of Worship
8. School
9. Single Family Dwelling
10. Accessory Dwelling Unit (see Section 3.1)
11. Camp
12. Telecommunication Facility (enclosed inside existing structure, substantially not visible – see Section 3.15 D)
13. Subdivisions (see Section 3.14)

(3) Conditional Uses (see Section 5.2):

1. Accessory Use/Structure (to a conditional use)
2. Automobile Sales & Service
3. Bank
4. Bed & Breakfast
5. Child Care Facility (greater than 6 children - see Section 3.4)
6. Community Center
7. Cottage Industry (see Section 3.7)
8. Enclosed Storage & Warehousing
9. Extraction of Earth Resources (Section 3.5)
10. Gasoline Station (see Section 3.6)
11. Health Center
12. Hotel/Motel
13. Indoor Recreation Facility
14. Light Industry (see Section 3.8)
15. Mixed Use Building
16. Mobile Home Park (see Section 3.11)
17. Multi-Family Dwelling
18. Nursing Home
19. Outdoor Recreation Facility
20. Professional/Business Office
21. Public Facilities/Services
22. Public Assembly Facility
23. Restaurant
24. Retail Store
25. Sanitary Landfill (see Section 4.6)
26. Telecommunication Facility (new tower or on existing structure – see Section 3.15 A, B, & C)

(4) Dimensional Standards (unless otherwise specified by use type):

Lot Area Minimum:	1 acre	Lot Dimension: Each lot must have a point from which a circle can be inscribed with a diameter of at least 150 feet.	
Minimum Rear Yard Setback:	25 feet		
Minimum Front Yard Setback:	45 feet		
Minimum Side Yard Setback:	25 feet		
Maximum Building Height:	35 feet	Maximum Building Coverage:	25%
Minimum Lot Frontage:	80 feet	Maximum Lot Coverage:	50%

Table 2.3 AGRICULTURAL-RESIDENTIAL DISTRICT (AG-RES)

(1) Purpose: The purpose of the Agricultural-Residential District is to provide for medium density residential development, to permit the continuance of agricultural operations, to encourage clustered housing units, to preserve open space, and to preserve the significant resources of this District.

(2) Permitted Uses:

1. Accessory Use/Structure (to a permitted use)
2. Agriculture
3. Cemetery
4. Child Care Facility (6 children or fewer -see Section 3.4)
5. Forestry
6. Home Occupation (see Section 3.7(A) – (C))
7. Private Club
8. Single Family Dwelling
9. Wildlife Refuge
10. Accessory Dwelling Unit (see Section 3.1)
11. Camp
12. Telecommunication Facility (enclosed inside existing structure, substantially not visible – see Section 3.15 D)
13. Subdivisions (see Section 3.14)

(3) Conditional Uses (see Section 5.2):

1. Accessory Use/Structure (to a conditional use)
2. Adaptive Re-use of Historic Barns (see Section 3.2)
3. Bed & Breakfast
4. Child Care Facility (greater than 6 children - see Section 3.4)
5. Outdoor Recreation Facility
6. Cottage Industry (see Section 3.7 (E))
7. Extraction of Earth Resources (see Section 3.5)
8. Light Industry (see Section 3.8)
9. Mobile Home Park (see Section 3.11)
10. Multi-Family Dwelling
11. Place of Worship
12. Public Facilities/Service
13. Sawmill
14. School
15. Telecommunication Facility (on existing structure – see Section 3.15 C)

(4) Dimensional Standards (unless otherwise specified by use type):

Minimum Front Yard Setback:	65 feet	Lot Area Minimum: 1 acre	
Minimum Rear Yard Setback:	25 feet	Lot Dimension: Each lot must have a point from which a circle can be inscribed with a diameter of at least 150 feet	
Minimum Side Yard Setback:	25 feet		
Maximum Building Height:	35 feet	Maximum Building Coverage:	25%
Minimum Lot Frontage:	80 feet	Maximum Lot Coverage:	50%

Table 2.4 PRESERVE DISTRICT (PRES)

(1) Purpose: The purpose of the Preserve District is to protect significant forest resources and water supply watersheds at higher elevations and to limit development in areas with steep slopes, shallow soils, unique or fragile resources, and poor access to Town roads and community facilities and services.

(2) Permitted Uses:

1. Accessory Use/Structure (to a permitted use)
2. Agriculture
3. Child Care Facility (6 children or fewer - see Section 3.4)
4. Forestry
5. Home Occupation (see Section 3.7(A)-(C))
6. Single Family Dwelling
7. Wildlife Refuge
8. Accessory Dwelling Unit (see Section 3.1)
9. Camp
10. Telecommunication Facility (enclosed inside existing structure, substantially not visible – see Section 3.15 D)
11. Subdivisions (see Section 3.14)

(3) Conditional Uses (see Section 5.2):

1. Accessory Use/Structure (to a conditional use)
2. Cemetery
3. Child Care Facility (greater than 6 children - see Section 3.4])
4. Extraction of Earth Resources (see Section 3.5])
5. Outdoor Recreation Facility
6. Cottage Industry (see Section 3.7 (E))
7. Sawmill
8. Telecommunications Facility (on existing structure or new tower – see Section 3.15 A, B, & C)

(4) Dimensional Standards (unless otherwise specified by use type):

Lot Area Minimum:	5 acres
Minimum Front Yard Setback:	65 feet
Minimum Rear Yard Setback:	25 feet
Minimum Side Yard Setback:	100 feet
Maximum Building Height:	35 feet
Minimum Lot Frontage:	80 feet

Lot Dimension: Each lot must have a point from which a circle can be inscribed with a diameter of at least 200 feet.

Maximum Building Coverage:	3%
Maximum Lot Coverage:	6%

Table 2.5 FLOOD HAZARD AREA OVERLAY DISTRICT (FLD)

(1) Purpose: The purpose of the Flood Hazard Area Overlay District is to promote public health, safety and welfare by preventing or minimizing hazards to life or property due to flooding. It is also the intent to the Town of Moretown to regulate development within identified flood hazard areas in accordance with state and federal law in order to ensure that private property owners are eligible for flood insurance through the National Flood Insurance Program (NFIP) (**see also Article V**).

(2) Permitted Uses (see Section 503):	**(3) Conditional Uses (see Section 5.2):**
1. Accessory Uses (see Section 5.2 (E)) 2. Agriculture (see Section 4.10) 3. Forestry (see Section 4.10) 4. Outdoor Recreation (no structures)	All other permitted or conditional uses listed for the underlying district, unless otherwise specifically excluded under Section 5.2 (E).

(4) Dimensional Standards

Standards as set forth for the underlying district unless otherwise specified under Article III and/or Article V.

(5) Flood Hazard Standards:

(A) Uses permitted within the Flood Hazard Area Overlay specifically include agriculture and forestry, unimproved open space, recreational and educational uses, and those uses generally permitted within existing single-family dwellings (i.e., day care facilities and group homes as defined, and home occupations). All other uses and structures, including but not limited to new or expanded single family dwellings, shall be subject to conditional use review under Section 5.2, as well as all other applicable municipal and state regulations.

(B) Mandatory state [§4424] and federal [44 CFR 60.3 and 60.6] requirements for continued eligibility in the National Flood Insurance Program – including but not limited to associated structural standards, definitions, administrative and variance requirements – are hereby adopted by reference and shall be applied to all development in this district. Accordingly:

(1) Applications for development within the Flood Hazard Area Overlay District shall be submitted in accordance with the provisions of Sections 5.1 and 6.2, and are subject to state and federal agency referral requirements in accordance with Section 6.4.

(2) Development in the Flood Hazard Area Overlay District shall be subject to conditional use review under Section 5.2, including criteria under Section 5.2 (E) specific to development within designated flood hazard areas, as well as applicable requirements of the underlying zoning district. Where this overlay imposes more restrictive standards on the construction and use of structures or land, the most restrictive standards shall apply.

(3) Requests for variances for development within the Flood Hazard Area Overlay District shall be subject to review under Section 6.7, including but not limited to variance criteria

under Section 6.7 (C) specific to variances with designated flood hazard areas.

(4) Permits, certifications and variance actions for development within the Flood Hazard Area Overlay District shall be recorded by the Zoning Administrator in accordance with the provisions of Section 6.9(B).

ARTICLE III
SPECIFIC USE PROVISIONS

Section 3.0 Applicability

The following standards shall apply to the designated use in all zoning districts in which the respective uses are allowed. Such uses may be subject to conditional use review in accordance with Section 5.2. Variances from these standards shall not be granted by the Development Review Board. If there is a conflict between a standard in this section and a standard in another section of these regulations, the more restrictive standard shall apply.

Section 3.1 Accessory Dwelling Units

(A) There shall be only one principal structure per residential lot. However, in accordance with 24 V.S.A. § 4412(1)(E), one accessory dwelling unit shall be permitted that is located within, detached, or attached to a single-family dwelling. An accessory dwelling unit shall be defined as a dwelling, located within, detached, or attached to a single-family dwelling, that is clearly subordinate to a single-family dwelling, and has facilities and provisions for independent living, including sleeping, food preparation, and sanitation, provided there is compliance with all the following:

(1) The property has sufficient wastewater capacity to accommodate the accessory unit;
(2) The unit does not exceed 1050 square feet; and,
(3) Applicable setback, coverage, and parking requirements specified in the bylaws are met.

(B) Notwithstanding the provisions above, the creation of an accessory dwelling unit will require conditional use approval under Section 5.2 when one or more of the following is involved:

(1) An increase in the height or floor area of the existing single family dwelling; or,
(2) An increase in the dimensions of the parking areas.

Section 3.2 Adaptive Re-Use of Historic Barns

(A) To encourage the economic viability of maintaining and restoring historic barns which are no longer associated with a viable agricultural enterprise, the following standards shall apply to all barns listed on the Vermont Historic Sites and Structures Survey as being eligible for listing on the National Register of Historic Places.

(B) Notwithstanding the permitted and conditional uses allowed in each district, historic barns may, with the approval of the Development Review Board in accordance with Section 5.2, be converted to the following uses:

(1) Cultural facilities, including religious institutions, performance space, community centers or museums;

(2) Warehouse and storage facilities;

(3) Multi-family housing (not to exceed four units);
(4) Light industry (excluding outdoor storage or display).

(C) In approving applications for the adaptive re-use of historic barns, the Development Review Board shall ensure that the proposed use complies with all general and/or specific use regulations set forth in these regulations.

Section 3.3 Campers

(A) Campers (travel trailer, recreation vehicle, etc.) may be parked on any public or private property in conformance with the following regulations:

(1) No permit shall be required to park campers in approved campgrounds and, for temporary periods, on construction sites (subject to Section 3.15).
(2) No permit shall be required to park a camper(s) on the premises of a principal dwelling or an undeveloped lot provided that it is not occupied for dwelling purposes for more than sixty (60) days per calendar year; and is not hooked up to residential water or wastewater systems.
(3) Any camper used for living quarters for more than 30 days per calendar year, or is sited so as not to be readily moveable, is deemed a dwelling or accessory dwelling and shall be subject to all zoning regulations.

Section 3.4 Child Care Facilities

(A) In accordance with 24 V.S.A. § 4412(5), a "family child care home or facility" means a home or facility where the owner or operator is to be licensed or registered by the state for child care. A family child care home serving six or fewer children shall be considered to constitute a permitted single family residential use of property. A family child care home serving no more than six full-time children and four part-time children, as defined in 33 V.S.A. § 4902(3)(A), shall be considered to constitute a permitted use of property but requires a zoning permit issued by the Zoning Administrator. Such a permit shall be issued only after the applicant for the family child care facility:

(1) submits proof that the facility is properly registered or licensed by the state;
(2) meets all zoning district requirements pertaining to single family dwellings; and,
(3) fulfills the application requirements of Section 6.2 of these regulations.

(B) A family child care facility serving more than six full-time and four part-time children shall be reviewed as a conditional use in accordance with Section 5.2.

(C) Child care facilities that are exempt from state licensure and registration through 33 V.S.A. § 3502(b) are not regulated under these provisions but may be regulated in other sections of this bylaw. Such exemptions include:

- Persons providing care for children of not more than two families;
- Hospitals or establishments holding a license issued by the Department of Health, or a person operating a program primarily for recreation or therapeutic purposes;
- Day care facilities operated by religious organizations for the care and supervision of

children during or in connection with religious services or church sponsored activities;
- Nursery schools or other preschool establishments, attended by children of less than compulsory school age, which are subject to regulation by the Department of Education (33 V.S.A. § 3502(b)(1-4)).

(D) Such uses that meet the above requirements shall not require a permit issued by the Zoning Administrator but the applicant shall notify the Zoning Administrator in writing of intent to establish use.

(E) A state registered or licensed family child care home operating in a dwelling other than a single family dwelling (e.g. duplex, multi-family housing) shall be treated as a permitted use and therefore must receive a zoning permit.

Section 3.5 Extraction of Earth Resources

3.5.1 Definitions

"Character of the area" refers to the distinctive traits, qualities or attributes, appearance and essential nature, pattern of uses, sense of community, and the factors which give it identity within the same area or nearby, including but not limited to the area within sight and/or sound.

"Commercial" means a use or activity whose byproducts are available for sale to the public and is carried on for profit by the owner, lessee.

"Earth extraction, Major" means the commercial or non-commercial extraction and processing of earth resources such as topsoil, sand, and gravel, which may include some on-site preparation activities such as screening and crushing.

"Earth extraction, Minor" means the infrequent, low-impact removal of topsoil, sand, or gravel from a site that requires no on-site preparation or processing. For the purposes of this ordinance, minor earth extraction shall be limited to no more than 45 cubic yards per day and no more than 3 truck trips per day.

"Extension" means continuation of a preexisting operation onto an adjacent parcel of land, or any substantial increase in the rate of extraction, or substantial change in the type of operation, or of traffic or equipment associated with a preexisting operation. A substantial change is one that could have an adverse effect on the character of the area, natural resource values, or infrastructure.

"Heavy Industry" is a use engaged in the basic processing and manufacturing of materials or products predominately from extracted or raw materials, or a use engaged in storage of, or manufacturing processes using flammable, explosive, and radioactive materials, pesticides and herbicides, or storage or manufacturing processes that potentially involve hazardous or commonly recognized offensive conditions. Examples of heavy industry include quarrying or mining operations.

"Nuisance" is a legal term referring to any land use whose associated activities are incompatible with surrounding land uses and the character of the area, or an activity that annoys or seriously disturbs other property owners making it discomforting and unpleasant to use their own property, or may devalue that property monetarily.

"Quarrying, Major" means the systematic, long-term excavation from an open pit or mine for commercial purposes from which rock or minerals are extracted by digging, cutting or blasting. Facilities such as offices, heavy equipment, machinery and stockpiles of materials are kept on site. Major Quarrying is not permitted within the Town of Moretown.

"Quarrying, Minor" means the excavation of rock or minerals by digging, cutting or blasting. For the purposes of this ordinance, minor quarry shall imply a limited time frame of 12 consecutive months in a 10-year time period for the quarrying activity. Minor quarrying shall also be limited to no more than cubic 45 yards per day and no more than 3 truck trips per day.

"Undue adverse impact" is an unfavorable, opposed, or hostile consequence for the physical, natural, social, or economic environment, which is more than necessary – exceeding what is appropriate or normal.

3.5.2 Exemptions

(A) Blasting which is customarily incidental to a permitted or conditional construction activity and does not exceed 4 weeks in duration.
(B) Earth extraction which is customarily incidental to permitted or conditional construction activity.
(C) Municipal road maintenance activities.
(D) Earth Extraction that is incidental to the waste management business of the Moretown Landfill, Inc. is exempt under this bylaw.

3.5.3 Minor Earth Extraction

Any new or extended minor earth extraction operation shall be permitted in all zoning districts except the Village District, subject to conditional use review in accordance with Section 5.2 and findings that the proposed activity meets the following definitions, standards and conditions.

1. Application Requirements

In addition to application requirements under Section 6.2 and 5.1, the applicant shall submit two (2) copies of an acceptable erosion control and site restoration plan to ensure that upon completion of the excavation operations the abandoned site will be left in a safe, attractive, and useful condition. Plans shall include the following information:

a. Existing grades, drainage and depth to water table;
b. The extent and magnitude of the proposed operation, including hours of operation, routes of transportation, amount of material to be removed, and a timetable for completion of the operation;
c. Finished grades and proposed vegetation and trees at the conclusion of the operation.
d. Plans shall be in accordance with other applicable local or state provisions or requirements (i.e. wetlands).

2. Standards

In granting approval, the Development Review Board shall consider and impose conditions with respect to the following standards:

a. In any new operation, the area excavated at any one time shall not exceed 1 acre (43,560 square feet). Smaller areas may be designated if necessary to protect the character of the area where the operation is located.

b. The days and hours of operation shall be limited to 8am – 5pm Monday through Friday so as to ensure reasonable quiet and compatibility with other uses in the area.

c. The removal of all material shall be conducted so as to result in the improvement of the land, having due regard to the contours in the vicinity, such as leveling slopes and removing hills. The digging or creating of pits or steep slopes shall not be permitted, unless provision is made to regrade such pit and reduce such slopes

d. No stockpile shall exceed 20 feet in height. No excavation, alteration or removal of vegetation shall be made within 50 feet of the property line of the subject parcel, 200 feet from an existing dwelling and 100 feet from an existing public right-of-way, except at the conclusion of operations if required in order to improve the overall grading or restoration. In all cases an undisturbed buffer shall be maintained around all property lines. With regard to property line setbacks only, the DRB has the discretion to reduce setback distances if it determines that such a reduction in distance will not have an undue adverse affect on abutting landowners and on the character of the area.

e. Removal shall not result in a cover of less than three feet of native, undisturbed material over any water table, such water table elevation to be established at a seasonally high level.

f. All surface drainage affected by removal operation shall be controlled by the owner to prevent erosion debris and other loose material from filling any drainage course, street, or private property, and shall not result in any changes or increased impacts to off site conditions.

g. The restoration plan shall assure the following:

i. As much as practical during the active earth extraction operation, and within one year of the stoppage of active earth extraction, the site shall be reclaimed.

ii. The removal operation site shall be graded smooth and restored to a "natural" or prior landform configuration. Cut slopes and soil banks shall not be allowed to remain.

iii. The entire area shall be covered with not less than four (4) inches of good, arable topsoil, and shall have a minimum of ten (10) percent organic material except that no greater depth of topsoil or percentage of organic material shall be required than that originally existed on the property prior to commencement of operations.

iv. The operation shall establish on the regraded areas, and all other lands affected, a diverse, effective, and permanent vegetative cover of the same seasonal variety native to the area of the land to be affected and capable of self-regeneration and plant succession at least equal in extent of cover to the natural vegetation of the area; except, that introduced species may be used in the revegetation process where desirable and necessary to achieve the post- mining land use and to prevent erosion. Numbers and sizes of plantings should be included in the overall submission.

v. Upon failure of the permit holder, or the permit holder's successors or assigns, to complete the reclamation of the site as required above, the Town may take such actions as may be necessary to complete the work, and may enter onto the property for such purposes. The Town's reasonable cost of completing these requirements shall be a lien on the property and may be foreclosed by the Town in the same manner as provided for the foreclosure of mortgages.

h. All operations shall be conducted in a safe manner, especially with respect to hazards to persons, damage to adjacent lands or improvements and wells, and damage to any street by slides, sinking or collapse of supporting soil adjacent to an excavation.

i. Access ways and on-site roads shall be maintained in a dust-free condition. The owner or operator shall take adequate measures within the site to ensure that trucks, exiting the site on roadways, shall not discharge earth materials or debris on public roadways.

j. The proposed activity shall not have an undue adverse impact on neighboring properties or the character of the area by reason of noise, dust, vibration, traffic hazards, scenic values or natural beauty of the area, historic sites or irreplaceable resources, or creation of a nuisance.

k. The premises shall be neat and orderly, free from junk, trash or unnecessary debris.

l. Additional conditions shall be imposed by the Development Review Board as appropriate for the specific site.

3. Surety Requirement
A performance bond, escrow account, or other surety acceptable to the Select Board, may be required to ensure site reclamation upon completion of minor excavation projects.

3.5.4 Major Earth Extraction

Any new or extended major earth extraction operation shall be permitted in all zoning districts, except the Village District, subject to conditional use review in accordance with Section 5.2 and findings that the proposed activity meets the following definitions, standards and conditions.

1. Application Requirements

In addition to application requirements under Section 6.2 and 5.1, the applicant shall submit two (2) copies of an acceptable erosion control and site restoration plan to ensure that upon completion of the extraction operations the abandoned site will be left in a safe, attractive, and useful condition. Plans shall also include the following information:

a. Existing grades and drainage, stockpiles and berms (including typical cross-sections);

b. Structures, roadways, equipment, materials, fuel storage, water supply, sewage disposal, trees, landscaping, and screening;

c. Area maps showing the general project location in the Town and the following features within 2,500 feet of the proposed operation: roads (including class 4 roads and legal trails), land uses and principal structures including public resources, designated scenic areas, and historic sites, surface waters, soils, and the location and depth of all water supplies.

d. Project description, including details of:

   i. each phase of excavation, stockpiling and the volumes involved, as applicable;
   ii. operations, including the nature, location and times of extraction, screening, crushing, and trucking: operation of other major equipment on the site, safety measures, dust, sedimentation and erosion controls, water table monitoring and site dewatering, truck routes to be used, as applicable;
   iii. the anticipated cost of site rehabilitation in accordance with these regulations.

The Development Review Board may reasonably require such additional information as it deems necessary to determine whether the new or extended excavation operation will be located and performed in accordance with these regulations.

2. Standards

In granting approval, the Development Review Board shall consider and impose conditions with respect to the following standards:

a. The days and hours of operation shall be limited to 8am – 5pm Monday through Friday so as to ensure reasonable quiet and compatibility with other uses in the area.

b. Isolation Distances and Setbacks

   i. No part of any extraction area shall be within 300 feet of any of the following uses existing or approved: Any dwelling, private or public water supply or water line, public building, park, or other community or institutional facility.

   ii. No part of any extraction area shall be within 150 feet of the property lines, or within 150 feet of any natural stream or pond.

   iii. Stockpiling of excavated material shall not exceed 35 feet and shall not be within 150 feet of the property lines, or within 150 feet of any natural stream or pond.

   iv. No truck access road to the property shall be within 50 feet of the property lines, except at the connection to the public road.

   v. No stationary processing machinery shall be located within 300 feet of any property line.

   vi. With regard to property line setbacks only, the DRB has the discretion to reduce setback distances if it determines that such a reduction in distance will not have an undue adverse affect on abutting landowners and on the character of the area.

b. Maintenance Buffer

i. The land within 100 feet of the property line shall be maintained as a buffer or conservation area by the permit holder.

ii. There shall be no land development on this buffer except for truck access roads.

c. Dust Control

i. The owner/operator shall implement positive and effective dust control measures, which will meet the requirements in the State of Vermont Air Quality Regulations. This shall apply to all on-site operations as well as to all vehicular traffic leaving the site.

d. Traffic and Noise

i. The days and hours of operation shall be 8am – 5pm Monday through Friday so as to ensure reasonable quiet and compatibility with other uses in the area.

ii. No noise shall be permitted which is excessive at the property line or is incompatible with the reasonable use of the surrounding area. Excessive noise shall be considered a sound pressure level that exceeds 65 decibels at the property line on a regular or reoccurring basis.

iii The property shall be limited to one truck access to any public right-of- way and shall have a grade of 5% or less. An emergency or second limited use access may be provided.

iv. Access ways and on-site roads shall be maintained in a dust-free condition. The owner or operator shall take adequate measures within the site to ensure that trucks, exiting the site on roadways, shall not discharge earth materials or debris on public roadways.

v. The proposed transport for the operation shall not exceed the carrying capacity of the roadways and any damage to such roadways shall be repaired at the expense of the owner/operator.

vi. The proposed schedule and gross vehicle weight of transport vehicles shall be appropriate for the season of the year, the character of the area where the operation is located, and the neighborhood through which vehicles must pass.

e. Landscaping, Screening and Signs

i. Natural screening shall be provided and maintained so that no stockpiles of excavated material shall be visible from any existing or approved dwelling or public right-of-way within 300 feet as of the filing of the earth extraction application. No stockpile shall exceed 35 feet in height.

ii. The property's access road shall be hidden from view from existing or approved dwellings and public roads by natural topography, vegetated berm or evergreen trees, either existing or to be planted, at least every 10 feet on both sides of the road.

iii. An earthen berm of not less than six (6) feet in height and/or farm fence of not less than fifty-four (54) inches in height shall be maintained around potentially hazardous areas, including but not limited to the excavation site, storage and waste piles and fuel storage areas. Berms that will remain in place for one (1) year or longer shall be planted with grass, shrubs and trees and maintained as a visual and acoustical screen. They shall be designed so that they do not erode into the road or highway right-of-way or onto adjoining property. This provision can be waived if the applicant demonstrates adequate safety and buffering can be accomplished by other means or with conditions present on site.

iv. Signs shall be posted and maintained at frequent intervals around the site indicating danger and presence of the excavation site.

f. Terracing and Contouring

Terracing or contouring shall be used, as appropriate, so as to minimize hazards. In no case shall the slope exceed 20% (meaning 20 feet of vertical rise for every 100 feet of horizontal distance). No vertical face shall exceed in height that permitted by the U.S. Bureau of Mines.

g. Closing-Out the Operation

i. As much as practical during the active earth extraction operation, and within one year of the stoppage of active earth extraction, the site shall be reclaimed.

ii. The removal operation site shall be graded smooth and restored to a"natural" or prior landform configuration. Cut slopes and soil banks shall not be allowed to remain. Provisions for restoring the "approximate original contour" of the land shall be made. Approximate original contour means that surface configuration achieved by backfilling and grading of the excavated area so that the reclaimed area, including any terracing or access roads, closely resembles the general surface configuration of the land prior to excavation and blends into and complements the drainage pattern of the surrounding terrain, with all highwalls and spoil piles eliminated.

iii. The entire area shall be covered with not less than four (4) inches of good, arable topsoil, and shall have a minimum of ten (10) percent organic material except that no greater depth of topsoil or percentage of organic material shall be required than that originally existed on the property prior to commencement of operations. The operation shall establish on the regraded areas, and all other lands affected, a diverse, effective, and permanent vegetative cover of the same seasonal variety native to the area of the land to be affected and capable of self-regeneration and plant succession at least equal in extent of cover to the natural vegetation of the area; except, that introduced species may be used in the revegetation process where desirable and necessary to achieve the post- mining land use and to prevent erosion. Numbers and sizes of plantings shall be included in the overall submission.

iv. The reclamation of the site shall be completed so that the land will be left in a safe, attractive and readily usable condition for the types of land uses allowable in the district.

v. When earth extraction operations have been completed, then all buildings (other than those shown on the restoration plan), structures (except fences) and equipment shall be entirely removed from the property within one (1) year from the expiration date of the conditional use.

vi. Upon failure of the permit holder, or the permit holder's successors or assigns, to complete the reclamation of the site as required above, the Town may take such actions as may be necessary to complete the work, and may enter onto the property for such purposes. The Town's reasonable cost of completing these requirements shall be a lien on the property, including the buffer, and may be foreclosed by the Town in the same manner as provided for the foreclosure of mortgages.

h. Surface and ground water

i. The proposed operation shall not have an undue adverse impact on surface and ground water.

ii. At all times, the owner or operator shall take adequate measures to ensure that contaminated surface water run-off shall not enter ponds or other areas of open standing water.

iii. As necessary, ground water quality shall be monitored and maintained on a regular basis in accordance with acceptable monitoring practices.

iv. If the extraction is wholly or partly from a streambed, it shall be carried out in such a manner that there shall be no obstruction or substantial change in normal flow, and at the conclusion of work in any section, there shall be no increase in erosion or flood hazards.

v. Removal shall not result in a cover of less than three feet of native, undisturbed material over any water table, such water table elevation to be established at a seasonally high level.

i. Premise and on-site facilities

At all times the premises shall be neat and orderly, free from junk, trash or unnecessary debris. Buildings shall be maintained in a sound condition, in good repair and appearance. Salvageable equipment stored in a non- operating condition shall be suitably screened or garaged.

j. General

i. In any new operation, the area excavated at any one time shall not exceed five (5) acres (or 217,800 square feet). Smaller areas may be designated if necessary to protect the character of the area where the operation is located.

ii. All operations shall be conducted in a safe manner, especially with respect to hazards to persons, damage to adjacent lands or improvements and wells, and damage to any street by slides, sinking or collapse of supporting soil adjacent to an excavation.

iii. The proposed activity shall not have an undue adverse impact on neighboring properties or the character of the area with regard to the following standards:
1. noise, dust, vibration, as defined in Section 3.5.4.2.c. and 3.5.4.2.d. above
2. traffic, traffic safety impacts, as defined in Section 3.5.4.2.d. above.
3. scenic values, visual impact, Visually sensitive areas include but are not limited to ridgelines, mountain tops, vistas, steep slopes, shorelines or riverbanks, large open areas, public resources, or scenic road corridors. In addition, unique areas such as wetlands, waterfalls, and historic areas may be sensitive to aesthetic change. In such cases, visibility studies may be required by the Development Review Board to determine impact on visibility and aesthetic resources.
4. ecological function, natural resources, or
5. creation of a nuisance.

iv. Additional conditions may be imposed by the Development Review Board as appropriate for the specific site.

3. Escrow Agreement

a. The owner/operator, prior to commencing excavation, shall designate a bank having an office in the State of Vermont, as escrow agent for the Town and the permit holder, to receive funds on account of the anticipated cost of complying with subsection 3.5.4.2.g of this Section, after the volume of material approved for excavation is removed. Such amount shall be paid over at least semi-annually, commencing six months from the date of the first excavation, based upon the amount of material removed in the preceding six- month period.

b. The Escrow agreement shall provide:

i. That the fund shall be invested in a savings account or certificate of deposit, at the owner/operator's option.

ii. That all interest shall be payable to the owner/operator.

iii. That the escrow agent shall account quarterly to the Town, and at such other more frequent intervals as the Town may require.

iv. That the fund shall be available to the owner/operator to reimburse it for the cost of complying with subsection 3.5.4.2.g of this Section, or upon failure of the permit holder to so comply the fund shall be available to the Town to reimburse it for any costs it incurs in closing out the operation.

v. That any remaining amount shall be paid over to the owner/operator

c. If the owner/operator fails to make a payment into the escrow fund, as required herein, and such failure continues for thirty days from due date, then there shall be no excavation of materials until such default is cured. The applicant shall make available to the Town such records as the Town may reasonably request in order for it to determine compliance with this paragraph.

d. The Development Review Board shall re-evaluate, at their discretion, the anticipated cost of compliance with subsection 3.5.4.2.g of this Section, after public hearing, and the payment to the escrow funds shall be adjusted accordingly.

e. At any time the owner/operator may withdraw any amount which is in the escrow account, upon filing with the Town a bond, issued by a good and sufficient bonding or surety company authorized to do business in Vermont, for the benefit of the Town, in an amount sufficient to cover the cost of implementing Section 3.5.4.2.g, but not for more than the amount then in the escrow account, and being withdrawn. Similarly, in lieu of any deposit in the escrow account, the owner/operator may file a similar bond in the amount required to be deposited. If a bonding company should become insolvent, go out of business, or lose its right to do business in Vermont, that shall be deemed a default under c. above and shall be remedied by a new bond or deposit before excavation is continued.

3.5.5 Minor Quarrying

Any new or extended minor quarry operation shall be permitted in all zoning districts, except the Village District, subject to conditional use review in accordance with Section 5.2 and findings that the proposed activity meets the following definitions, standards and conditions.

1. Application Requirements
In addition to application requirements under Section 6.2 and 5.1, the applicant shall submit two (2) copies of an acceptable erosion control and site restoration plan to ensure that upon completion of the quarry operation the abandoned site will be left in a safe, attractive, and useful condition. Plans shall also include the following information:

a. Existing grades and drainage, stockpiles and berms (including typical cross-sections);

Structures, roadways, equipment, materials, fuel storage, water supply, sewage disposal, trees, landscaping, and screening;

b. Area maps showing the general project location in the Town and the following features within 2,500 feet of the proposed operation: roads (including class 4 roads and legal trails), land uses and principal structures including public resources, designated scenic areas, and historic sites, surface waters, soils, and the location and depth of all water supplies.

c. Project description, including details of:

   i. each phase of mining, stockpiling and the volumes involved, as applicable;

   ii. operations, including the nature, location and times of: blasting, drilling, crushing and operation of other major equipment on the site, safety measures, dust, sedimentation and erosion controls, water table monitoring and site dewatering, truck routes to be used, as applicable;

   iii. the anticipated cost of site rehabilitation in accordance with these regulations.

The Development Review Board may reasonably require such additional information as it deems necessary to determine whether the new or extended quarry operation will be located and performed in accordance with these regulations.

2. Standards

In granting approval, the Development Review Board shall consider and impose conditions with respect to the following standards:

a. The days and hours of operation shall be limited to 8am – 5pm Monday through Friday so as to ensure reasonable quiet and compatibility with other uses in the area.

b. Isolation Distances and Setbacks

i. No part of any extraction area shall be within 300 feet of any of the following uses existing or approved: Any dwelling, private or public water supply or water line, public building, park, or other community or institutional facility.

ii. No part of any extraction area shall be within 150 feet of the property lines, or within 150 feet of any natural stream or pond.

iii. Stockpiling of excavated material shall not exceed 35 feet and shall not be within 150 feet of the property lines, or within 150 feet of any natural stream or pond.

iv. No truck access road to the property shall be within 50 feet of the property lines, except at the connection to the public road.

v. No stationary processing machinery shall be located within 300 feet of any property line.

vi. With regard to property line setbacks only, the DRB has the discretion to reduce setback distances if it determines that such a reduction in distance will not have an undue adverse affect on abutting landowners and on the character of the area.

c. Maintenance Buffer

i. The land within 100 feet of the property line shall be maintained as a buffer or conservation area by the permit holder.

ii. There shall be no land development on this buffer except for truck access roads.

d. Vibration and Dust Control

i. The owner/operator shall implement positive and effective dust control measures, which will meet the requirements in the State of Vermont Air Quality Regulations. This shall apply to all on-site operations as well as to all vehicular traffic leaving the site.

e. Traffic and Noise

i. The days and hours of operation shall be 8am – 5pm Monday through Friday so as to ensure reasonable quiet and compatibility with other uses in the area.

ii. No noise shall be permitted which is excessive at the property line or is incompatible with the reasonable use of the surrounding area. Excessive noise shall be considered a sound pressure level that exceeds 65 decibels at the property line on a regular or reoccurring basis.

iii. The property shall be limited to one truck access to any public right-of- way and shall have a grade of 5% or less. An emergency or second limited use access may be provided.

iv. Access ways and on-site roads shall be maintained in a dust-free condition. The owner or operator shall take adequate measures within the site to ensure that trucks, exiting the site on roadways, shall not discharge earth materials or debris on public roadways.

v. The proposed transport for the operation shall not exceed the carrying capacity of the roadways and any damage to such roadways shall be repaired at the expense of the owner/operator.

vi. The proposed schedule and gross vehicle weight of transport vehicles shall be appropriate for the season of the year, the character of the area where the operation is located, and the neighborhood through which vehicles must pass.

f. Landscaping, Screening and Signs

i. Natural screening shall be provided and maintained so that no stockpiles of excavated material shall be visible from any existing or approved dwelling or public right-of-way within 300 feet as of the filing of the earth extraction application. No stockpile shall exceed 35 feet in height.

ii. The property's access road shall be hidden from view from existing or approved dwellings and public roads by natural topography, vegetated berm or evergreen trees, either existing or to be planted, at least every 10 feet on both sides of the road.

iii. An earthen berm of not less than six (6) feet in height and/or farm fence of not less than fifty-four (54) inches in height shall be maintained around potentially hazardous areas, including but not limited to the excavation site, storage and waste piles and fuel storage areas. Berms that will remain in place for one (1) year or longer shall be planted with grass, shrubs and trees and maintained as a visual and acoustical screen. They shall be designed so that they do not erode into the road or highway right-of-way or onto adjoining property. This provision can be waived if the applicant demonstrates adequate safety and buffering can be accomplished by other means or with conditions present on site.

iv. Signs shall be posted and maintained at frequent intervals around the site indicating danger and presence of the excavation site.

g. Terracing and Contouring

Terracing or contouring shall be used, as appropriate, so as to minimize hazards. In no case shall the slope exceed 20% (meaning 20 feet of vertical rise for every 100 feet of horizontal distance). No vertical face shall exceed in height that permitted by the U.S. Bureau of Mines.

h. Closing-Out the Operation

i. As much as practical during the active earth extraction operation, and within one year of the stoppage of active earth extraction, the site shall be reclaimed.

ii. The removal operation site shall be graded smooth and restored to a"natural" or prior landform configuration. Cut slopes and soil banks shall not be allowed to remain. Provisions for restoring the "approximate original contour" of the land shall be made. Approximate original contour means that surface configuration achieved by backfilling and grading of the excavated area so that the reclaimed area, including any terracing or access roads, closely resembles the general surface configuration of the land prior to excavation and blends into and complements the drainage pattern of the surrounding terrain, with all highwalls and spoil piles eliminated.

iii. The entire area shall be covered with not less than four (4) inches of good, arable topsoil, and shall have a minimum of ten (10) percent organic material except that no greater depth of topsoil or percentage of organic material shall be required than that originally existed on the property prior to commencement of operations.

iv. The operation shall establish on the regraded areas, and all other lands affected, a diverse, effective, and permanent vegetative cover of the same seasonal variety native to the area of the land to be affected and capable of self-regeneration and plant succession at least equal in extent of cover to the natural vegetation of the area; except, that introduced species may be used in the revegetation process where desirable and necessary to achieve the post- mining land use and to prevent erosion. Numbers and sizes of plantings shall be included in the overall submission.

v. The reclamation of the site shall be completed so that the land will be left in a safe, attractive and readily usable condition for the types of land uses allowable in the district.

vi. When earth extraction operations have been completed, then all buildings (other than those shown on the restoration plan), structures (except fences) and equipment shall be entirely removed from the property within one (1) year from the expiration date of the conditional use.

vii. Upon failure of the permit holder, or the permit holder's successors or assigns, to complete the reclamation of the site as required above, the Town may take such actions as may be necessary to complete the work, and may enter onto the property for such purposes. The Town's reasonable cost of completing these requirements shall be a lien on the property, including the buffer, and may be foreclosed by the Town in the same manner as provided for the foreclosure of mortgages.

i. Surface and ground water

i. The proposed operation shall not have an undue adverse impact on surface and ground water.

ii. At all times, the owner or operator shall take adequate measures to ensure that contaminated surface water run-off shall not enter ponds or other areas of open standing water.

iii. As necessary, ground water quality shall be monitored and maintained on a regular basis in accordance with acceptable monitoring practices.

iv. If the extraction is wholly or partly from a streambed, it shall be carried out in such a manner that there shall be no obstruction or substantial change in normal flow, and at the conclusion of work in any section, there shall be no increase in erosion or flood hazards.

v. Removal shall not result in a cover of less than three feet of native, undisturbed material over any water table, such water table elevation to be established at a seasonally high level.

j. Premise and on-site facilities

At all times the premises shall be neat and orderly, free from junk, trash or unnecessary debris. Buildings shall be maintained in a sound condition, in good repair and appearance. Salvageable equipment stored in a non- operating condition shall be suitably screened or garaged.

k. General

i. In any new operation, the area excavated at any one time shall not exceed five (5) acres (or 217,800 square feet). Smaller areas may be designated if necessary to protect the character of the area where the operation is located.

ii. All operations shall be conducted in a safe manner, especially with respect to hazards to persons, damage to adjacent lands or improvements and wells, and damage to any street by slides, sinking or collapse of supporting soil adjacent to an excavation.

iii. The proposed activity shall not have an undue adverse impact on neighboring properties or the character of the area with regard to the following standards:

1. noise, dust, vibration, as defined in Section 3.5.4.2.c. and 3.5.4.2.d. above
2. traffic, traffic safety impacts, as defined in Section 3.5.4.2.d. above.
3. scenic values, visual impact. Visually sensitive areas include but are not limited to ridgelines, mountain tops, vistas, steep slopes, shorelines or riverbanks, large open areas, public resources, or scenic road corridors. In addition, unique areas such as wetlands, waterfalls, and historic areas may be sensitive to aesthetic change. In such cases, visibility studies may be required by the Development Review Board to determine impact on visibility and aesthetic resources.
4. ecological function, natural resources, or
5. creation of a nuisance.

iv. Additional conditions may be imposed by the Development Review Board as appropriate for the specific site.

3. Escrow Agreement

a. The owner/operator, prior to commencing excavation, shall designate a bank having an office in the State of Vermont, as escrow agent for the Town and the permit holder, to receive funds on account of the anticipated cost of complying with subsection E.2.h of this Section, after the volume of material approved for excavation is removed. Such amount shall be paid over at least semi-annually, commencing six months from the date of the first excavation, based upon the amount of material removed in the preceding six- month period.

b. The Escrow agreement shall provide:

   i. That the fund shall be invested in a savings account or certificate of deposit, at the owner/operator's option.

   ii. That all interest shall be payable to the owner/operator.

   iii. That the escrow agent shall account quarterly to the Town, and at such other more frequent intervals as the Town may require.

   iv. That the fund shall be available to the owner/operator to reimburse it for the cost of complying with subsection 3.5.52.h of this Section, or upon failure of the permit holder to so comply the fund shall be available to the Town to reimburse it for any costs it incurs in closing out the operation.

   v. That any remaining amount shall be paid over to the owner/operator

c. If the owner/operator fails to make a payment into the escrow fund, as required herein, and such failure continues for thirty days from due date, then there shall be no excavation of materials until such default is cured. The applicant shall make available to the Town such records as the Town may reasonably request in order for it to determine compliance with this paragraph.

d. If applicable, the anticipated cost of compliance with subsection E. 2.h of this Section shall be re-evaluated by the Development Review Board, after public hearing, and the payment to the escrow funds shall be adjusted accordingly.

e. At any time the owner/operator may withdraw any amount which is in the escrow account, upon filing with the Town a bond, issued by a good and sufficient bonding or surety company authorized to do business in Vermont, for the benefit of the Town, in an amount sufficient to cover the cost of implementing Section E. 2.h, but not for more than the amount then in the escrow account, and being withdrawn. Similarly, in lieu of any deposit in the escrow account, the owner/operator may file a similar bond in the amount required to be deposited. If a bonding company should become insolvent, go out of business, or lose it's right to do business in Vermont, that shall be deemed a default under c. above and shall be remedied by a new bond or deposit before excavation is continued.

Section 3.6 Gasoline Stations

(A) Gasoline or motor vehicle service stations may be permitted in designated zoning districts subject to conditional use review under Section 5.2 and the following additional provisions:

(1) Service station siting, design and layout shall be compatible with the character of the neighborhood. A landscaped area shall be maintained at least ten (10) feet in depth along all road frontage, excluding designated access areas or curb cuts. Additional curbing, landscaping and screening, and pedestrian walkways may be required as appropriate.
(2) Pumps, lubricating, and other outdoor service equipment shall be located to meet minimum setback distances for the applicable district.
(3) All stored fuel and oil, including underground tanks, shall meet all state fire codes and regulations, and shall be stored at least 35 feet from any property lines.
(4) All automobile parts and dismantled vehicles shall be stored within an enclosed building or suitably screened area.
(5) There shall be no more than 2 access driveways from the street. The maximum width of an access driveway or curb cut shall be 40 feet, with the minimum width to be 20 feet.
(6) Pump canopies shall be limited to the area required to cover the pump island and pump-apron, and shall be the minimum height necessary to satisfy applicable state and federal safety requirements. In no case shall canopies exceed 24' in width or 36' in length. Canopy design, including materials and roof pitch, shall be compatible with surrounding buildings; and the sides (fascias) of canopies shall not be used for advertising.
(7) Lighting levels on station aprons, under canopies and in associated parking areas shall be the minimum required for intended activities. The lighting of such areas shall not be used for advertising or to attract attention to the business. Lights shall not be mounted on the top or sides of canopies; and the sides of canopies (fascias) shall not be illuminated. Light fixtures mounted on canopies shall either be recessed so that the lens cover is flush with the bottom surface (ceiling) of the canopy; or for indirect lighting, mounted and shielded so that direct illumination is focused exclusively on the underside of the canopy. Outdoor lighting shall also meet applicable lighting standards under Section 410.
(8) Signs shall meet all requirements of Section 4.12. Gasoline service stations, in addition to the signs allowed for businesses, are allowed to have either one pricing sign which does not exceed 12 square feet in area, or pump-top pricing signs, each not to exceed 2 square feet in area. Signs must meet all setback requirements.
(9) Automobile service stations which include retail sales unrelated to motor vehicle service, maintenance or repair (e.g., food, convenience items) shall be reviewed as a mixed use, and as such is required to meet all zoning provisions pertaining to retail uses for the district in which they are located, including but not limited to additional sign, lot size and/or parking requirements.

Section 3.7 Home Based Businesses

(A) **Home Occupations**. In accordance with the Act [§4412(4)], no provision of these regulations shall infringe upon the right of a resident to use a minor portion of a dwelling for an occupation which is customary in residential areas and which does not have an undue adverse effect upon the residential area in which the dwelling is located. Home occupations, as distinguished from cottage industries under this Section, are permitted as an accessory use in all districts where residential uses are permitted. The home occupation shall be carried on by residents of the dwelling unit. One additional employee who is not a resident of the dwelling unit is permitted. Home occupations are:

(1) Accessory uses to residential properties, which are clearly incidental and secondary to the residential use.
(2) Conducted wholly within the principal structure and occupy less than 25% of the entire

floor area of such structures. Home occupations in accessory buildings may be permitted by the Development Review Board in accordance with conditional use review under Section 5.2.

(3) Not retail in nature.

(B) In order to ensure that a home occupation will not have an undue adverse effect upon the residential area in which the dwelling is located, the owner must demonstrate that it will comply with all of the following standards:

(1) All business activities or transactions associated with the home occupation shall be carried on entirely within the dwelling unit; no outside storage shall be permitted.
(2) No traffic shall be generated which would be uncharacteristic of the neighborhood.
(3) New parking required for the home occupation shall be provided off-street.
(4) No objectionable vibration, odor, smoke, dust, electrical disturbance, heat, or glare shall be produced by the home occupation.
(5) Exterior displays other than those normally permitted in the district shall be prohibited excepting signs, which do not conflict with applicable ordinances.
(6) Retail sales shall be limited to the sale of goods or products produced on premises and/or the sale of goods and products that are associated with and clearly incidental to the primary operation of the home occupation.

Where it is determined by the Zoning Administrator that the proposal does not meet the definitions or standards of home occupations in A and B above, the applicant may apply for a permit under the broader regulations (commercial, industrial, etc.) as determined by the district in which the parcel is located.

(C) A zoning permit for a home occupation does not follow the land. Therefore, the permit expires when the individual who was granted the permit no longer resides in the dwelling. If another individual wishes to continue a particular home occupation, he or she shall apply to the Zoning Administrator for a permit.

(D) **Exemptions.** The ordinary use of a small room (study), or part of a larger room, with such equipment as a file (cupboard), desk (table), and a phone which one uses for personal use and/or paperwork for business activity carried on elsewhere, is not considered a Home Occupation and shall not require a zoning permit from the Zoning Administrator.

(E) **Cottage Industry.** Cottage industries (as distinguished from Home Occupations) may be permitted in designated zoning districts subject to conditional use review in accordance with Section 5.2 and the following additional provisions:

(1) The business owner shall reside on the lot.
(2) The business shall be carried on within the principal dwelling unit and/or accessory structure(s), and shall occupy less than 50% of the combined floor area of all structures on the lot. However, the Development Review Board may permit the use of floor space in excess of 50% of the combined floor area of all structures on the lot providing such space is limited to the storage of goods and materials associated with the operation of the Cottage Industry and that such storage occurs in an accessory structure.
(3) The cottage industry shall be carried on by residents of the dwelling. Up to eight employees who are not residents may be permitted.
(4) The business shall not necessitate any change in the outward appearance of the dwelling unit or accessory structures on the lot. Exterior signs other than those normally permitted

in the district are prohibited. Any outdoor storage of materials, including building or construction materials, unregistered vehicles or heavy equipment, or lumber, must be completely screened year-round from the road and from neighboring properties.

(5) The business shall not generate traffic, including but not limited to delivery truck traffic, in excess of volumes characteristic of the neighborhood.

(6) Adequate off-street parking shall be provided for all residents, employees and customers in accordance with Section 4.9.

(7) There shall be no storage of hazardous waste or materials; fuel storage shall be limited to that needed for heating, and operation of equipment and vehicles associated with the business.

(8) Retail sales shall be limited to the sale of goods or products produced on premises and/or the sale of goods and products that are associated with and clearly incidental to the primary operation of the cottage industry.

(9) The business shall not result in hazards to public safety and welfare or to neighboring properties, and shall be subject to applicable performance standards included under Section 4.10. Conditions may be placed on the hours of operation as appropriate.

(10) The permit for a cottage industry shall clearly state that the industry is a home-based business which is accessory to the principal residential use, and to be retained in common ownership and management. A cottage industry may be subdivided and/or converted for sale or use apart from the residential use only if it meets all current municipal and state regulations and bylaws pertaining to such use, including all density, dimensional, and other requirements for the district in which it is located. Separate permits shall be required as appropriate prior to subdivision, sale and/or conversion.

Section 3.8 Light Industry

(A) Light industry (as distinguished from cottage industries under Section 3.7) may be permitted in designated zoning districts subject to conditional use review in accordance with Section 5.2 and the following provisions:

(1) The industry shall not result in hazards to public safety and welfare or to neighboring properties, and shall be subject to applicable performance standards included under Section 4.10. Conditions may be placed on the hours of operation and/or intensity of use as appropriate.

(2) Sufficient landscaping and screening shall be provided along parcel boundaries and within the project site to protect adjacent properties from objectionable visual impacts.

(3) Total square footage of all buildings and outdoor storage areas shall not exceed 20,000 square feet.

(4) For any light industry in the Agricultural-Residential District, no more than thirty (30) employees may be employed on site at any one time.

Section 3.9 Special Events

Special events may be allowed in any district subject to the following:

(A) A maximum of two special events in any calendar year, lasting a maximum of 2 consecutive days, with no more than 150 attendees, and associated with a single parcel of land, are exempt from this provision and shall not require a zoning permit.

(B) Special events (e.g., weddings and receptions; concerts, festivals, fairs and other cultural events; conferences, trade and antique shows) are permitted as a principal or accessory use of any parcel providing that such use occurs for no more than 10 days within any calendar year. Churches and other religious institutions, funeral homes, schools, and municipal properties are specifically exempted from this definition. Any single event involving more than 200 participants requires conditional use approval from the Moretown Development Review Board.

(C) The use of any parcel for hosting special events for more than 10 days within any calendar year may be permitted as an accessory use to another principal use with the approval of the DRB in accordance with Article 5. Prior to any grant of approval, the applicant shall demonstrate that adequate provision has been made for temporary wastewater disposal, solid waste disposal, and noise, traffic and crowd control as appropriate. The DRB may impose conditions regarding the number of participants, hours of operation, and other limitations related to scale and intensity as deemed appropriate.

(D) All special events must be maintained in accordance with the Performance Standards set forth in Section 4.10.

Section 3.10 Mixed Uses

(A) In designated districts, more than one use may be permitted within a single building or on a single property subject to conditional use review in accordance with section 5.2 and providing those uses meet the following:

(1) Each of the proposed uses is otherwise allowed as permitted or conditional uses in the district in which the mixed use is proposed.
(2) The combined uses meet all applicable standards for the district in which the mixed use is proposed, including minimum setbacks and frontage, maximum lot coverage and minimum lot size.
(3) The combined uses meet all applicable dimensional standards set forth in Articles II, and all applicable general provisions contained in Article IV, including parking requirements under Section 4.9 based on the cumulative parking demand for the various proposed uses.

Section 3.11 Mobile Home Parks

(A) In accordance with 24 V.S.A. § 4412(1)(C), mobile homes are permitted in approved mobile home parks subject to the requirements of this section and state law. Mobile home parks where permitted as a conditional use in the specific zoning district are subject to review under section 5.2 of these bylaws. New mobile home parks and any addition or alteration to an existing mobile home park, requires conditional use approval by the Development Review Board. Mobile home parks shall be developed in accordance with the following:

(1) The mobile home park shall be located in a district specifically permitting mobile home parks and shall comply with all applicable provisions of these regulations.
(2) The requirements of 10 VSA Chapter 153 shall be met.
(3) All applicable State and local laws, ordinances and regulations relating to water supply and

waste treatment shall be complied with.

(B) Prospective owners of mobile home parks are encouraged to employ the planned residential or clustering concept in design of mobile home parks and to create a pleasant and healthful living environment for occupants.

Section 3.12 Ponds

(A) The creation of ponds and other impoundments may be permitted as an accessory use upon application and receipt of a zoning permit in accordance with Section 6.2. In issuing a zoning permit, the Zoning Administrator shall find that:

(1) Any pond that will impound, or be capable of impounding, in excess of 500,000 cubic feet of water has received a permit from the Vermont Department of Environmental Conservation in accordance with 10 VSA Chapter 43.
(2) Any pond involving the alteration of a stream has received a stream alteration permit from the Vermont Department of Environmental Conservation in accordance with 10 VSA Chapter 41.
(3) Any pond involving the impoundment of water through the creation of an embankment, berm or other structure that exceeds the natural grade of the site shall be subject to conditional use review in accordance with Section 5.2. In granting approval, the Development Review Board shall find that the proposed pond poses no danger to neighboring properties or Town roads and bridges. To this end, the applicant shall provide certification regarding the safety of the pond design by a Vermont licensed professional engineer.

Section 3.13 Public Utility Substations

(A) Public utility substations and similar utility structures shall comply with the following:

(1) The facility shall be surrounded by a fence which shall be set back from the property lines in conformance with the district regulations for front, side, and rear yards.
(2) A landscaped area at least twenty-five feet wide shall be maintained in front, side and rear yards.

Section 3.14 Subdivision of Land

Definitions

For the purposes of this section, all definitions in Article 7, Definitions shall apply.
Subdivision: Division of any parcel of land for the purposes of conveyance, transfer of ownership, lease, improvement, building, development or sale which results in a total of two or more lots, blocks or parcels are created. The term subdivision includes re-subdivision.

3.14.1 Application of Standards

(A) Whenever any subdivision of land is proposed, the subdivider shall apply for and secure approval of such proposed subdivision in accordance with the procedures set forth in these regulations prior to:

(1) Commencing any construction or land development (excluding forestry or agricultural activities);
(2) The issuance of any municipal permit for any land development involving land to be subdivided;
(3) The sale or lease of any subdivided portion of a property; or
(4) Filing a subdivision plat in the land records of the Town.

Such approval shall be granted by the Zoning Administrator or the Development Review Board in accordance with the procedures and standards set forth below.

(B) Exemptions. The following are specifically exempted from subdivision review under this article:

(1) Parcels leased for agricultural or forestry purposes where no permanent roads or structures are established;
(2) Rights-of-way or easements which do not result in the subdivision of land, and
(3) Boundary adjustments between existing parcels which do not create new or non-conforming lots.

(C) Classification of Minor and Major Subdivisions. For the purposes of these regulations, the following two categories of subdivisions are established:

(1) **Minor Subdivisions**, to be reviewed by the Zoning Administrator under Section 3.14.2 include:

(a) the subdivision of land which results in a total of three (3) or fewer lots within any five-year period; or

(b) an amendment to an approved subdivision which does not substantially alter the subdivision, nor result in the creation of a major subdivision.

(2) **Major Subdivisions**, to be reviewed by the Development Review Board under Section 3.14.2 include:

(a) the subdivision of land which results in a total of four or more
lots within any five-year period or involves the construction of a new road;
(b) an amendment to an approved subdivision which substantially alters the subdivision or conditions of approval, or which results in the creation of a major subdivision or a new road; or
(c) a planned unit development.

(D) Coordination with Planned Unit Development Review. Applications for Planned Unit Developments (PUDs) shall be reviewed concurrently by the Development Review Board as subdivisions in accordance with Section 3.14.2 and under Section 5.3.

3.14.2 Subdivision Review

(A) Subdivision Approval Requirement. The Zoning Administrator or Development Review Board shall review all subdivisions in accordance with the Act [§ 4418] and these regulations.

(B) Waiver Authority. Pursuant to the Act [24 V.S.A. § 4418], the Development Review Board may waive application requirements as specified in Table 3.1, or subdivision standards under Section 3.14.3 which, in their judgment:
(1) are not requisite in the interest of public health, safety and general welfare;
(2) are inappropriate due to the inadequacy or lack of connecting facilities adjacent to or in proximity to the subdivision.

The request for a waiver shall be submitted in writing by the applicant with the subdivision application. It shall be the responsibility of the applicant to provide sufficient information to justify the waiver, and enable the Development Review Board to reach a decision. In granting waivers, the Development Review Board may require such conditions that will, in their judgment, substantially meet the objectives of the requirements so waived. No such waiver may be granted if it would have the effect of nullifying the intent and purpose of these regulations or other municipal ordinances or regulations currently in effect.

(C) Application Requirements. An application for subdivision approval, including applicable fees, shall be made on forms provided by and filed with the Zoning Administrator.

(D) Sketch Plan Review. Prior to the submission of an application for a major subdivision review, the applicant may submit a sketch plan to the Zoning Administrator for consideration by the Development Review Board at a regularly scheduled Development Review Board meeting.

(1) **Purpose**. The purpose of sketch plan review is to acquaint the Development Review Board with the proposed subdivision at an early stage in the design process, prior to the applicant incurring significant expense.

(2) **Submission Requirements**. One original and two copies of the sketch plan, to include information specified in Table 3.1, should be submitted to the Development Review Board at least 15 days prior to a regularly scheduled meeting.

(3) **Effect**. The Development Review Board may offer comments and recommendations at the meeting or, within the thirty (30) days of the date of the meeting, provide comments and recommendations to the applicant in writing. Such comments are advisory and as such shall not constitute an appealable decision or action of the Development Review Board, and shall not be binding on subsequent major subdivision review.

(E) Minor Subdivision Review. The application for minor subdivision review shall include one original of the information for subdivision plan approval specified in Table 3.1, and any required fees. The application must also include, in writing, any requested waivers to be considered under subsection (B) and the reason for such waivers. The Zoning Administrator shall consider the application in accordance with his or her review for a Zoning permit without the need for a public hearing, but may in his or her judgment forward any application to the Development Review Board for its review following a public hearing. **(F) Major Subdivision Review**. The application for major subdivision review shall include one original and six copies of the information for subdivision plan approval specified in Table 3.1, and any required fees. The application must also include, in writing, any requested waivers to be considered under subsection (B) and the reason for such waivers. The Development Review Board shall consider the application in accordance with the following:

(1) **Public Hearing**. As required by the Act [§ 4464], upon submission of a complete application the Development Review Board shall schedule a public hearing on the application, warned in accordance with subsection 6.5 and the Act [§ 4464]. After the hearing is convened, the Development Review Board may continue the hearing as needed to request and allow for the submission of additional information or studies to determine conformance with these regulations.

(2) **Final Approval**. The Development Review Board shall act to approve, approve with conditions, or deny an application for subdivision approval within forty-five (45) days of adjournment of the final public hearing, and issue a written decision. The written decision shall include a statement of the factual bases on which the Development Review Board made its conclusions, a statement of those conclusions, any conditions, and shall specify the period of time within which the decision may be appealed to the Environmental Court. Failure to act within the forty-five (45) day period shall be deemed approval. The decision shall be mailed, via certified mail, to the applicant within the forty-five (45) day period. Copies of the decision shall also be mailed to every person or body appearing and having been heard at the hearing, and a copy of the decision shall be recorded in accordance with Subsection 3.14.2.G .

(3) **Performance Bonding**. For any subdivision that includes the construction of roads or other physical improvements, the Development Review Board may require the subdivider to post a performance bond or other comparable surety to ensure completion of the improvements in accordance with the approved specifications. In accordance with the Act [§ 4464], the term of the performance bond shall be fixed by the Development Review Board for a period not to exceed three years, unless with the consent of the owner it is extended for an additional period not to exceed three years. If any required improvements have not been installed or maintained as provided, the bond shall be forfeited to the municipality which shall then use the proceeds to install and maintain covered improvements.

(4) **Effect**. Approval of the Development Review Board of a subdivision shall not be construed to constitute acceptance by the town of any street, easement, utility, park, recreation area or other open space shown on the final plat. Such acceptance may be accomplished only by an act of the Moretown Selectboard, in accordance with state law for the laying out of public rights-of-way.

(4) **Deferral of Subdivision Standard(s)**. The Zoning Administrator may, at the request of the applicant under subsection 3.14.1 (B), defer review of a proposed minor subdivision's compliance with the standards set forth in Section 3.14.1 in the event the proposed subdivision involves the creation of a lot(s) that is solely intended for forestry, agriculture or other use not involving land development. Both the Zoning Administrator's decision and the plat recorded in the Town Land records shall clearly indicate the intended use of the lot(s), and shall require that any change in the use of the deferred lot be approved by the Development Review Board only upon a

determination that the proposed use and associated development complies with the standards set forth in Section 3.14.4. All lots, however, shall meet the minimum lot size for the district in which the parcel is located, including any density requirement related to the creation of new lots set forth in subsection 6.4(D

TABLE 3.1 SUBDIVISION APPLICATION REQUIREMENTS
(A) Application Form (one copy)
General description of proposed development plans, including number and size of lots, intended use, general timing of development
Waiver request, in writing [if being requested]
Names, addresses of all adjoining property owners
One copy of a sketch plan, drawn on paper at an appropriate scale, to accurately depict: • Scale, Date, North Arrow, Legend; • Project boundaries and property lines; • Existing and proposed lot lines, dimensions; • Adjoining land uses, roads and drainage; • Zoning district designations and boundaries; and • A general indication of the location of natural and physical features located on the site including buildings; roads, driveways and parking areas; fences and walls; watercourses; wetlands; areas of slope in excess of 25%; and a general Indication of land cover, including forested areas and land in agricultural production.
(B) Plan/Plat Mapping Requirements [required for major subdivision approval]
Application Form (one copy)
Application Fee
Name, address of applicant [landowner or agent]
General description of proposed development plans, including number and size of lots, intended use, general timing of development
Waiver request, in writing [if being requested]
A survey, drawn on mylar at scale of not less than 1"=100', and two paper copies, to include: • Scale, Date, North Arrow, Legend; • Preparer Information, Certifications; • Project boundaries and property lines; • Existing and proposed lot lines, dimensions; • Adjoining land uses, roads and drainage; • Zoning district designations and boundaries; and • An indication of the location of natural and physical features located on the site including buildings; roads, driveways and parking areas: fences and walls; watercourses; wetlands; areas of slope in excess of 25%; and a general indication of land cover, including forested areas and land in agricultural production; • Existing and proposed roads, paths, common or shared parking areas, associated rights-of-way or easements; • Proposed utilities, water and wastewater systems
Monument locations
Site location map showing proposed subdivision In relation to major roads, drainage ways, and adjoining properties
Statement of compliance with town plan and applicable local regulations
Engineering reports (water and wastewater systems)
Proposed covenants and/or deed restrictions, off-site easements (e.g., for water, wastewater, access), or proposed homeowner or tenant association or agreements (if any)

(5)

(G) Recording and Amendment Requirements.

(1) In accordance with the Act [24 V.S.A §4463], within 180 days of the date of receipt of final subdivision approval under Subsection (F)(2), the subdivider shall file three copies of the plan and final plat (one Mylar, two paper), signed by an authorized representative of the DRB, for recording in the land records of the town in conformance with the requirements of 27 V.S.A. Chapter 17. The Approval of subdivision plats not filed within 180 days shall expire. The Zoning Administrator may, however, grant one 90-day extension for plat filing in the event the applicant documents that other required local and/or state permits are still pending.

(2) The municipality shall meet all recording requirements for subdivision approvals as specified for municipal land use permits under Section 3.9.

(3) No changes, modifications, or other revisions that alter the final plat or the conditions attached to subdivision approval shall be made unless the proposed revisions are first submitted for review by the Zoning Administrator pursuant to section 3.14.1 (C)(1) (b) or the Development Review Board under Section 3.14.1 (C) (2) (b) as a subdivision amendment. In the event that revisions are recorded without complying with this requirement, the revisions shall constitute a violation of these regulations, and be considered null and void.

3.14.3 Roads and Access (Minor and Major Subdivision)

(A) **Access**. Access to the subdivision and to individual lots shall be provided in accordance with Section 4.1. All access onto town highways shall be subject to the approval of the Moretown Selectboard, or for state routes, the Vermont Agency of Transportation. Such approval shall be required prior to final subdivision plan approval. To better manage traffic flow and safety, to avoid congestion, and to preserve the capacity of local roads, the Development Review Board may also:

(1) limit the number of access points onto public highways;
(2) require shared access, driveways, and/or roads to serve multiple lots; and/or
(3) require access from secondary roads, if a proposed subdivision has frontage on both primary and secondary roads.

3.14.4 Application of Subdivision Standards (Major Subdivision)

(A) The Development Review Board shall evaluate subdivisions under the standards set forth in this article. Development Review Board, to assist in evaluation, may require:

(1) an independent technical review of the proposed subdivision under one or more standards, prepared by a qualified professional and paid for by the subdivider; provided such technical review is commensurate with the scale and scope of the proposed subdivision, and

(2) the phasing of development, and/or additional measures to avoid or mitigate any adverse impacts likely to result from the proposed subdivision.

3.14.5 General Regulations (Major Subdivision)

(A) **Stormwater Management and Erosion Control**. Subdivisions shall incorporate temporary and permanent stormwater management and erosion control practices appropriate for the type and density of proposed development (See Section 4.15).

(B) **Landscaping and Screening**. Subdivisions shall incorporate landscaping and screening measures appropriate to the type and density of the proposed development. These measures should include measures to address:

(1) critical wildlife habitat areas (as defined by the Vermont Agency of Natural Resources – Natural Resources Atlas);
(2) water quality; and
(3) screening to increase privacy, reduce noise or glare, or to establish a barrier between incompatible land uses.

3.14.6 Facilities and Utilities (Major Subdivision)

(A) **Public Facilities**. The proposed subdivision shall not create an undue burden on existing and planned public facilities. The Development Review Board should consult with appropriate municipal and school officials to determine whether adequate capacity exists to serve the subdivision.

3.14.7 Legal Requirements (Major Subdivision)

(A) Land reserved for the protection of significant natural, cultural or scenic features, or other open space areas, may be held in common, or in separate ownership from contiguous parcels. Such land may be dedicated, either in fee or through a conservation easement approved by the Development Review Board, to the municipality, an owners' association comprised of all present or future owners of subdivided lots, and/or a nonprofit conservation organization. At minimum, land designated for protection shall be indicated with appropriate notation on the final subdivision plat.

(B) The subdivider shall provide documentation and assurances that all required improvements, associated rights-of-way and easements, and other common lands or facilities will be maintained either by the subdivider, an owners' association, or through other legal means acceptable to the Development Review Board. Such documentation, as approved by the Development Review Board, shall be filed in the Moretown land records.

Section 3.15 Telecommunications Facilities

(A) New or expanded telecommunication facilities, including but not limited to towers and accessory structures may be permitted in designated zoning districts subject to conditional use review under Section 5.2 and the following provisions:

(1) A proposal for a new tower shall not be permitted unless it is determined by the Development Review Board that the equipment planned for the proposed tower cannot be accommodated on an existing approved tower not on or in an existing building or other structure. New towers

will be allowed only in the Preserve and Commercial Districts.

(2) All new towers shall be designed to accommodate both the applicant's antennas and comparable antennas for at least one additional user if the tower is less than or equal to 75 feet in height, and two additional users if it exceeds 75 feet in height. Towers must be designed to allow future rearrangement of antennas, and to accept antennas mounted at varying heights.

(3) All towers, including antennae, shall not be more than 25 feet higher than surrounding forest canopy as measured from the lowest grade at ground level to the top of the highest structure or component. Forest canopy shall be defined as the average height of the five(5) tallest trees within 50 feet of the tower.

(4) No telecommunication facility shall be located within 500 feet of an existing residence.

(5) Towers shall be set back from all property lines and public rights of way for a distance equaling their total height, including attached antennas, unless otherwise permitted by the Development Review Board:

a. If tower design and construction guarantees that it will collapse inwardly upon itself, and no liability or risk to adjoining or public property shall be assumed by the municipality; or

b. To allow for the integration of a telecommunication facility into an existing or proposed structure such as a church steeple, light standard, utility pole, or similar structure, to the extent that no hazard to public health, safety or welfare results.

(6) Telecommunication Facilities shall meet all state and federal requirements, including but not limited to Federal Communication Commission requirements for transmissions, emissions and interference. No telecommunication facility shall be located or operated in such a manner that it poses a potential threat to public health or safety.

(7) New telecommunications facilities shall be located to minimize their visibility. No telecommunications facility shall be located on a ridge line or hill top, and shall be sited so that the highest point of the facility does not exceed the highest point of land in the immediate vicinity of the tower. New or modified telecommunication facilities shall be designed to blend into the surrounding environment to the greatest extend feasible, through the use of vegetation, landscaping and screening, the use of compatible materials and colors, or other camouflaging techniques. Towers shall be of a monopole design unless it is determined by the Board that an alternative design would better blend into the surrounding environment.

(8) Telecommunication Facilities shall be designed to avoid having an undue adverse aesthetic impact on prominent ridgelines and hilltops. In determining whether a telecommunication facilities' aesthetic impact would be undue and adverse, the Development Review Board will consider:

a. The period of time during which the proposed tower would be viewed by the traveling public on a public highway;
b. The frequency of the view experienced by the traveling public;
c. Background features in the line of sight to the proposed telecommunication facility that obscure the facility or make it more conspicuous;
d. The sensitivity or unique value of a particular view affected by the proposed telecommunication facility;
e. Significant disruption of a view shed that provides context to a historic or scenic resource.

(9) Towers shall be enclosed by security fencing at least 6 feet in height, and shall be equipped with appropriate anti-climbing devices.

(10) Telecommunications facilities shall not be illuminated by artificial means and shall not display

strobe lights unless the Federal Aviation Administration or other federal or state authority for a particular tower specifically requires such lighting.

(11) The use of any portion of a telecommunications facility for signs other than warning or equipment information signs is prohibited.

(12) Access roads, and all utility buildings and structures accessory to a telecommunications facility shall be designed to aesthetically blend in with the surrounding environment and meet all other minimum requirements for the district in which they are located. Ground-mounted equipment shall be screened from view. Setback, landscaping and screening requirements may be increased as appropriate to site conditions, and to protect neighboring properties and uses. All utilities proposed to serve a telecommunications site shall be installed under ground.

(13) All abandoned or unused towers and associated facilities shall be removed within 12 months of the cessation of operations at the site, and the site shall be restored to its original appearance. A copy of the relevant portions of any signed lease that requires the applicant to remove the tower and associated facilities shall be submitted at the time of application. A bond or other acceptable form of surety may be required to ensure tower removal and site reclamation.

(B) In addition to the site development plan required under Section 5.1, applications for new telecommunications facilities shall also include:

(1) A report from a qualified and Vermont licensed professional engineer which describes telecommunication facility height, construction design and capacity, including cross-sections, elevations, potential mounding locations, and fall zones;

(2) Information regarding the availability of existing telecommunications facilities located within the site search ring for the proposed site, including written documentation from other telecommunications facility owners within the search ring that no suitable sites are available;

(3) A letter of intent committing the telecommunication facility owner and his/her successors to allow the shared use of the telecommunication facility if an additional user agrees in writing to meet reasonable terms and conditions for shared use;

(4) Written documentation that the proposed telecommunication facility shall comply with all requirements of the Federal Communication Commission, and the Federal Aviation Administration; and,

(5) Any additional information needed to determine compliance with the provisions of these regulations.

(C) Telecommunications equipment mounted on existing structures may be permitted in all zoning districts subject to conditional use review under Section 5.2 and the following provisions:

(1) No changes are made to the height or appearance of such structure except as required for mounting;

(2) The height of the antenna as mounted is not more than 10 feet higher than the structure and does not exceed height requirements under Section 4.5;

(3) No panel antenna shall exceed 72 inches in height or 24 inches in width;

(4) No dish antenna shall exceed 3 feet in diameter;

(5) Any accompanying equipment shall be screened from view;

(6) Antenna placement and installation shall adhere to (A) 6 criteria; and,

(7) The telecommunication facility shall be located to minimize visibility and designed to blend into the surrounding environment to the greatest extend feasible through the use of vegetation, landscaping and screening, the use of compatible materials and colors or other camouflaging techniques.

(D) Telecommunications facilities to be installed within existing structures may be permitted by the Zoning Administrator in all zoning districts, without conditional use approval provided that:

(1) Facilities are enclosed inside existing structures (e.g. silos, steeples, cupolas) and are substantially not visible.

(E) The following are specifically exempted from the provisions of these regulations:

(1) A single ground or building mounted radio or television antenna or satellite dish not exceeding 72 inches in diameter which is intended solely for residential use, and does not, as mounted, exceed 35 feet in height above the lowest grade at ground level;
(2) All citizens band radio antenna or antenna operated by a federally licensed amateur radio operator which do not exceed a height of 50 feet above the grade level, whether free standing or mounted, and which meet all setback requirements for the district in which they are located.

Section 3.16 Temporary Uses & Structures

(A) Temporary permits may be issued by the Zoning Administrator for certain non-conforming uses, described below, for a period not to exceed two (2) years, conditioned upon written agreement by the owner to remove the structure and/or discontinue the use upon expiration of the permit. Such permits may be renewed by the Zoning Administrator upon application for an additional period not exceeding one year. Any further renewal of temporary permits is contingent upon the review and approval by the Development Review Board in accordance with Section 5.2.

(B) Permits for temporary structures and/or uses may be issued for non-conforming uses, excluding residential uses, or non-complying structures which are:

(1) incidental to a construction project; or,
(2) associated with the road-side sale of agricultural products produced on the premises; or,
(3) is accessory to transportation services, such as a school bus shelter.

(C) Temporary uses and/or structures may be exempt from the area, yard, and general regulations if their placement is not found to be hazardous to pedestrian and traffic movement. Where applicable, adequate off street parking is required.

(D) Any trailer used for storage or other accessory use for a period exceeding thirty (30) days shall be considered a structure subject to all of the terms and conditions of this bylaw.

Section 3.17 Wind Turbines

A) No Conditional Use Permit Required

(1) **Applicants with a Certificate of Public Good (CPG):** Applicants who have received a Certificate of Public Good (CPG) from the Vermont Public Service Board (allowing them to net-meter their wind turbine) DO NOT need a Moretown zoning permit, however, they must certify that they have received a CPG. The applicant must submit a "Moretown Wind Turbine CPG Certification Form" to the zoning administrator with all necessary documentation. The zoning administrator will confirm the validity of the CPG, and send confirmation to the applicant.

(2) **Small turbines on existing structures:** Wind turbines can be installed on existing structures. The mounting structure (pole) shall not extend more than 15 feet above the highest point on the structure. The turbine blades must be less than or equal to 10 feet in diameter. The applicant must submit a "Moretown Existing-Structure Wind Turbine Permit Form" to the zoning administrator with all necessary documentation. The zoning administrator will approve or deny the permit in accordance with these regulations.

B) **Conditional Permit Required - Applicants without a Certificate of Public Good (CPG):** Wind turbines may be permitted in zoning districts subject to conditional use review under Section 5.2 and the following provisions:

(1) All turbines shall not be more than 40 feet higher than the surrounding forest canopy as measured from the lowest grade at ground level to the top of the highest structure or component (usually top of the blade). Forest canopy shall be defined as the average height of the five (5) tallest trees within 50 feet of the tower. The maximum height of any wind turbine is 150 feet.

(2) Wind turbines shall be set back from all property lines, buildings, and public rights of way for a distance equaling their total height, including blades, unless otherwise permitted by the Development Review Board.

(3) No wind turbine shall be located or operated in such a manner that it poses a potential threat to public health or safety.

(4) Wind turbines shall be designed to avoid having an undue adverse aesthetic impact on prominent ridgelines and hilltops. In determining whether a wind turbines' aesthetic impact would be undue and adverse, the Development Review Board will consider:
   a. The period of time during which the proposed turbine would be viewed by the traveling public on a public highway;
   b. The frequency of the view experienced by the traveling public;
   c. Background features in the line of sight to the proposed wind turbine that obscure the facility or make it more conspicuous;
   d. The sensitivity or unique value of a particular view affected by the proposed wind turbine;
   e. Significant disruption of a view shed that provides context to a historic or scenic resource.

(5) Wind turbines shall not be illuminated by artificial means and shall not display strobe lights unless the Federal Aviation Administration or other federal or state authority specifically requires such lighting.

(6) The use of any portion of a wind turbine for signs other than warning or equipment

information signs is prohibited.

(7) Access roads, and all utility buildings and structures accessory to a wind turbine shall be designed to aesthetically blend in with the surrounding environment and meet all other minimum requirements for the district in which they are located.

(8) All abandoned or unused wind turbines and associated facilities shall be removed within 5 years of the cessation of operations at the site, and the site shall be restored to its original appearance.

ARTICLE IV
GENERAL REGULATIONS

Section 4.0 Applicability

The following general standards, including provisions required under the Act [§4412, §4413], apply to all uses and structures as specified within these regulations.

Section 4.1 Access and Frontage Requirements

(A) In accordance with the Act [§4412(3)], no land development may be permitted on lots including those in existence prior to the effective date of these regulations which do not have either frontage on a Town Class I, II, III, or State highway or public waters, or with the approval of the Development Review Board, access to such a road or waters by a permanent easement or right-of-way at least twenty (20) feet in width. The Board will consider intended use, safety, traffic, lot configuration and road and site conditions in granting or denying approval, and impose conditions as appropriate.

(1) ***Exception***: If development has been previously approved on a lot (i.e. where the property owner already has a permitted residence or camp), the zoning administrator has the authority to review and approve proposed additions to an existing structure, or accessory structures, so long as the application otherwise complies with all applicable provisions of these regulations.

(B) No lot shall be served by more than one (1) access road or driveway unless otherwise permitted under conditional use review in accordance with Section 5.2. Accesses (curb cuts) are to be installed in accordance with municipal and/or state regulations, and shall be of a designated width and not extend along the length of road frontage.

(C) Driveways are to be located one hundred (100) feet from a street or highway intersection for all uses, except one-and two-family residential uses, which shall be at lease fifty (50) feet from the same unless otherwise approved by the Development Review Board in accordance with Section 5.2.

(D) Driveways are to be located at least five (5) feet from side property lines. The Development Review Board may, pursuant to Section 5.2, approve a driveway within five (5) feet of a property line in instances involving shared access or where traffic safety would be enhanced and both adjacent property owners approve of such location.

(E) Bridges that provide vehicular access must be approved by the Development Review Board in accordance with Section 5.2. In granting approval, the Board shall find the proposed bridge is accessible for emergency response vehicles. To this end, the applicant shall provide certification of the bridge design by a Vermont licensed professional engineer.

Section 4.2 Conversions and Changes of Use

A conversion or change of use from a permitted to a conditional use, or from a conditional use to another conditional use, requires conditional use approval. Changes or conversions involving nonconforming uses and/or noncomplying structures also are subject to the provisions of Section 4.8.

Section 4.3 Equal Treatment of Housing

Pursuant to the Act [§4412(1)], a mobile home shall be considered a single family dwelling, and shall meet the same zoning requirements applicable to single family dwellings, except when allowed as a temporary structure under Section 3.15 of these regulations. No provision of this bylaw may have the effect of excluding from the municipality housing to meet the needs of the population as determined in accordance with 24 V.S.A. § 4382(c). No provision of these regulations shall have the effect of excluding mobile homes, modular housing, or other forms of prefabricated housing from the municipality except upon the same terms and conditions as conventional housing is excluded.

Section 4.4 Existing Small Lots

(A) In accordance with the Act [§4412(2)], any lot that is legally subdivided, is in individual and separate and nonaffiliated ownership from surrounding properties, and is in existence on the date of enactment of any bylaw, including an interim bylaw, may be developed for the purpose permitted in the district in which it is located, if such lot is at least one-eighth (1/8) of an acre in area with a minimum width or depth of forty (40) feet, even though the small lot no longer conforms to minimum lot size requirements of the new bylaw or interim bylaw. Development of the existing lot shall be subject to all other applicable requirements.

(B) Existing small lots in affiliated or common ownership or such lots, which subsequently come under common ownership with one or more contiguous lots, shall be deemed merged with the contiguous lots for the purpose of these regulations. However, such lots shall not be deemed merged, and may be separately conveyed, if in accordance with the Act *all* of the following requirements are met:

(1) the lots are conveyed in their pre-existing, nonconforming configuration; and
(2) on the effective date of any bylaw, each lot had been developed with a water supply and wastewater disposal system; and
(3) at the time of transfer, each water supply and wastewater system is functioning in an acceptable manner; and,
(4) the deeds of conveyance create appropriate easements on both lots for replacement of one or more wastewater systems, potable water systems, or both, in case a wastewater system fails, pursuant to the Act [§4412(2)(B)(iv)].

Section 4.5 Height and Setback Requirements

(A) The maximum height of structures in all districts shall be three (3) stories or thirty-five feet (forty-five feet in the Village District), whichever is less, as measured from the median grade, except as permitted under Subsection (B), or for the following which are specifically exempted from the height requirements:

(1) agricultural structures in accordance with the Act [§4413];
(2) church steeples, spires and belfries;
(3) accessory structures associated with residential use which are less than 50 feet in height above

the lowest grade at ground level, including antennas, flag poles, ornamental cupolas, chimneys, wind generators with blades less than 20 feet in diameter, and rooftop solar collectors.

(B) The Development Review Board may permit structures in excess of thirty-five (35) feet subject to conditional use review under Section 5.2, provided that:

(1) the structure does not constitute a hazard to public safety, or to adjoining properties;
(2) the structure is not to be used for advertising purposes;
(3) lighting, if deemed necessary by the Board in accordance with state and federal regulations, shall be restricted to the minimum required for security and safe operation; and,
(4) the proposed building height and scale is consistent with the character of the immediate surroundings.

(C) Notwithstanding the minimum setback standards for front yards (setback from centerline of road) and side and rear yards (setback from parcel boundaries) for various zoning districts set forth in Article 2, Section 2.4, Tables 2.1 through 2.5, the DRB may allow the modification of building setbacks as a conditional use reviewed in accordance with Article 5 and subject to the following provisions:

(1) The DRB may allow for a reduction of the front setbacks: from sixty-five (65) feet to not less than forty-five (45) feet (Agricultural-Residential District and Preserve District); from forty-five (45) feet to not less than thirty-five (35) feet (Commercial District); side/rear setback reduction from twenty-five (25) to not less than ten (10) feet (Agricultural- Residential District and Commercial District) from the side or rear property line; and in the Preserve District rear setback reduction from twenty-five (25) to not less than ten (10) feet and side setback reduction from one-hundred (100) feet to not less than sixty-five (65) feet, if the reduction:

a. accomplishes the preservation of a scenic feature (s) not otherwise protected by the required setback; or
b. is necessitated by building constraints caused by geologic, topographic, or hydrologic conditions.

(2) Any reduction of setback standards beyond the allowance described in subsection (1) above may only be granted in accordance with variance standards under Section 6.7.

(3) This section does not apply to setbacks from surface waters set forth in Section 4.11. This section also does not apply to setbacks within the Village District.

[Statutory references. 24 VSA Chapter 117 §§4412(6), 4413 and 4414(8)]

Section 4.6 Landfill

Except for solid waste landfills certified under 10 V.S.A. Chapter 159, the dumping of refuse and waste material is prohibited. Topsoil, rock, stone, gravel, sand and other earth materials may be used for site grading and related site preparation activities associated with permitted land development.

Section 4.7 Lot and Yard Requirements

(A) There shall be only one principal structure or use per lot, unless otherwise specifically approved as part of a PUD under Section 5.2, or as a mixed use under Article III. In each district, a lot size minimum is specified.

(B) An accessory use or structure must conform to all lot setback, coverage and other dimensional requirements for the district in which it is located.

(C) Front, side and rear yard setbacks shall be measured as the horizontal distance from the nearest point of a building or structure to the related front, side or rear property line. Where a lot fronts an existing public right-of way, the front yard setback shall be measured from the street centerline to the point on building closest to the street. Setbacks shall apply only to buildings and other above ground structures and do not, unless expressly set forth in these regulations, apply to wells, sewage disposal systems, driveways and parking areas.

(D) Any yard adjoining a street shall be considered a front yard. A corner lot shall be considered to have only front and side yards.

(E) For any lot lacking road frontage, all setbacks from adjacent parcel boundaries shall be considered side setbacks.

Section 4.8 Nonconformities

(A) Any lawful structure or any lawful use of any structure or land existing at the time of the enactment of these regulations may be continued, although such structure or use does not conform with the provisions of these regulations, provided the conditions in this section are met.

(1) The nonconforming use of a structure may be continued provided that such structure shall not be enlarged or extended unless the use therein is changed to a conforming use.
(2) A nonconforming structure that is devoted to a conforming use may be reconstructed, structurally altered, restored or repaired, in whole or in part, with the provision that the degree of the nonconformance shall not be increased.
(3) A nonconforming structure, or part thereof, shall be maintained, repaired, or restored to a safe condition as required by the zoning administrator.
(4) A nonconforming structure shall not have its degree of non-compliance increased.
(5) A nonconforming use shall not be extended or enlarged, nor shall it be extended to displace a conforming use, nor shall it be changed to another nonconforming use, nor shall it, if changed to a conforming use, thereafter be changed back to a nonconforming use.

(B) A conforming structure used by a nonconforming use shall not be reconstructed, structurally altered, restored or repaired to an extent exceeding 100 percent of the gross floor area of such structure unless the use of such structure is changed to a conforming use.

(C) Any nonconforming building or structure may be altered, including additions to the building or structure, provided such alteration does not exceed in aggregate cost 35 percent for residential properties and 25 percent for industrial and commercial property of the current assessed value as determined by the town assessor. If an addition or an expansion to a building or structure is proposed, the addition or expansion itself must comply with the provisions of these regulations (e.g. setback requirements).

(D) Any nonconforming structure damaged by any means to an extent greater than 50 percent of its current assessed value shall be permitted to be reconstructed only if the future use of the structure and the land on which it is located is in conformity with these regulations. Any nonconforming structure damaged by any means to an extent less than 50 percent of its current assessed value, the use of which is not in conformance with these regulations, may be rebuilt provided that:

(1) The resumption of any nonconforming use (if any) takes place within one year of the time of its interruption.
(2) The cost of such reconstruction or structural alteration is less than 50 percent of said assessed value.
(3) The reconstruction or structural alteration is commenced within six months of the date of interruption and completed within 2 years of the date of interruption.
(4) Where such reconstruction or structural alteration can reasonably be accomplished so as to result in greater compliance with these regulations, then the reconstruction or structural alteration shall be so done.
(5) No later than six months after a permanent or temporary structure has been damaged, made uninhabitable, or has been abandoned, all scrap, debris, damaged or unsafe materials shall be removed from the site and any remaining excavation, foundation or cellar hole shall be covered over or filled to the existing grade by the property owner. Upon application by the property owner, the Development Review Board may enlarge the time to undertake such remedial work as a conditional use.

(E) No nonconforming use may be resumed if such use has been abandoned for a period of 1 year or more. A nonconforming use shall be considered abandoned when any of the following conditions exist:

(1) when it is replaced by any other use,
(2) when the intent of the owner to discontinue the use is apparent. Any one of the following may constitute prima facie evidence of a property owner's intent to abandon a use voluntarily
   i. failure to take necessary steps within one year to resume the nonconforming use with reasonable dispatch in any circumstances, including without limitation failing to advertise the property for sale, rent, lease, or use.
   ii. Discontinuance of the use for one consecutive year, or for a total of 18 months during any three-year period, or
   iii. In the case where the nonconforming use is of land only, discontinuance of the use for more than one (1) year.

(3) when the characteristic equipment and furnishings have been removed from the premises and have not been replaced by similar equipment and furnishings within one (1) year, except in the event that the structure is damaged.

Section 4.9 Parking and Loading Requirements

(A) **Parking**. For every structure or use requiring conditional use approval of the Development review Board in accordance with Section 5.2, off-street parking spaces shall be provided as set forth below:

(1) All required parking spaces shall have a minimum width of nine (9) feet, a minimum length of twenty (20) feet, and unobstructed access.
(2) Parking areas intended for commercial and/or public use which are adjacent to residential uses shall be set back at least ten (10) feet from the nearest property line unless otherwise permitted by the Development Review Board.
(3) All non-residential parking areas shall be located to the side or rear of buildings unless otherwise approved by the Development Review Board, and screened or otherwise visually hidden as viewed from public highways and from adjoining residential areas.
(4) A minimum number of parking spaces as provided in accordance with the requirements listed in Table 4.1.
(5) In addition to the requirements listed in Table 4.1, all commercial developments must provide adequate, clearly marked handicapped parking spaces in accordance with state and federal requirements.

(B) **Loading and Service Areas.** Where a proposed development will require the frequent or regular loading or unloading of goods, sufficient on-site service areas shall be provided. Service areas may also be required for emergency vehicles, waste disposal and collection, and other purposes as may be necessitated by the use. All loading and service areas shall be clearly marked and located in such a manner that parked vehicles will not block or obstruct sight visibility at intersections or to or from any internal road or access.

(C) **Waivers**. On-site parking, loading and/or service area requirements may be reduced or waived by the Development Review Board based on the Board's determination that due to circumstances unique to the development, the strict application of these standards is unnecessary.

Table 4.1
Minimum Off-Street Parking Requirements

Use	Parking Spaces
Accessory Apartment	1 per dwelling unit
Bed and Breakfast	2 per dwelling unit, and 1 per lodging room
Home Occupation/Home-Based Business	2 per dwelling unit, and 1 per additional employee
Mixed Use	total required per each individual use
Multi-Family Dwelling	1.5 per dwelling unit
Professional Office	1 space plus one for every 300 sq. ft. of office space
Religious Institution	1 per 4 seats or 200 sq. ft. of gross floor area, whichever is greater
Retail Store	1 per 250 sq. ft. of retail floor area
School or Day Care (6 or more children)	3 spaces per 10 children enrolled at the facility
Unspecified	As determined by the Development Review Board

Section 4.10 Performance Standards

(A) No land or structure in any zoning district shall be used or occupied in any manner so as to create dangerous, injurious or noxious conditions that adversely affect the reasonable use of adjoining or nearby properties.

(B) The following specific standards apply to all uses, with the exception of agriculture and forestry, in all districts. The burden of proof that the following standards are met shall fall on the applicant and/or all successors and assigns.

(1) No noise shall be permitted which is excessive at the property line or is incompatible with the reasonable use of the surrounding area. Excessive noise shall be considered a sound pressure level that exceeds 65 decibels at the property line on a regular or reoccurring basis.
(2) No glare, lights, or reflection shall be permitted which could impair the vision of a driver of any motor vehicle or which are detrimental to public health, safety, and welfare. Outdoor lighting shall be cut-off fixtures; wall mounted fixtures shall be shielded and down-cast. Such fixtures shall be directed so as not to cause glare on adjacent roadways, cause excessive levels of illumination, or result in direct illumination of neighboring properties.
(3) No fire, explosive or safety hazard shall be permitted which significantly endangers other property owners or which results in a significantly increased burden on municipal facilities.
(4) No smoke, dust, dirt or noxious gases which endanger or adversely affect the health, comfort, psafety, or welfare of the public or neighboring property owners, or which causes damage to property, business, or vegetation shall be permitted.
(5) There shall be no discharge of sewage, septage, or other harmful wastes into any public water, wetland, aquifer.

(C) Agricultural operations shall at minimum observe Accepted Agricultural Practices (AAPs) as defined and administered by the Vermont Department of Agriculture.

(D) Forestry operations shall at minimum observe Acceptable Management Practices (AMPs) as defined and administered by the Vermont Department of Forests, Parks and Recreation.

Section 4.11 Protection of Streams, Streambanks and Wetlands

(A) No alteration of the natural course of any stream shall be allowed unless a stream alteration permit has been issued by the Vermont Department of Environmental Conservation in accordance with 10 VSA Chapter 41.

(B) To prevent soil erosion, protect wildlife habitat and maintain water quality, land development shall be setback a minimum of fifty (50) feet from all streams and rivers to create a buffer strip. The 50' buffer strip shall be measured from the top of the bank or, where a clear bank is not discernible, from the mean water mark. No development, excavation, landfill or grading shall occur within the buffer strip, and vegetation shall be left in an undisturbed state, with the exception of clearing and associated site development necessary to accommodate the following:

(1) Road, driveway and utility crossings.
(2) Streambank stabilization and restoration projects, in accordance with all applicable State and Federal regulations.
(3) Unpaved bicycle and pedestrian paths and trails.
(4) Landscaping associated with residential uses.
(5) Public recreation facilities and improved river/lake accesses.

(C) The expansion or enlargement of any structure in existence prior to the effective date of this ordinance and not in compliance with subsection 4.11 (B), above, is permitted with the approval of the Development Review Board in accordance with Section 4.8.

(D) For development subject to conditional use review, minimum required setback and/or undisturbed buffer strip distances may be increased as appropriate based on site, slope or soil conditions and the nature of the proposed use.

(E) A naturally vegetated buffer strip shall be maintained, of at least seventy-five (75) feet in uniform width, for Class Two wetlands, and one hundred (100) feet in uniform width, for Class One wetlands. No development, dredging, ditching or manipulation of vegetation will be permitted within neither the buffer strip nor within the wetland, unless in conformance with the Vermont Wetlands Rules. (For conformance requirements, contact the Agency of Natural Resources, Department of Environmental Conservation).

Section 4.12 Signs

(A) The purpose of this Section is to promote and protect the public health, safety and welfare by regulating existing and proposed signs in the Town of Moretown. It is further intended hereby to control and reduce the proliferation of signs in order to protect the economic and scenic value of the Town, and in order to prevent hazards to users of the roads in the Town.

(B) Any signs beside or within the State right-of-way must comply with State regulations.

(C) No sign shall be permitted except as hereinafter provided.
- (1) No signs shall be erected or substantially altered without a zoning permit being issued except for those signs exempt under subsection 8, below.
- (2) All signs must be well constructed and maintained in good repair and stable condition.
- (3) Advertising billboard signs shall not be permitted in any zoning district.
- (4) In the Village, Agricultural/Residential, and Preserve Districts, the following signs are permitted:
  - a. One home-based business sign in the Village not exceeding four (4) square feet;
  - b. Residence signs not exceeding two (2) square feet;
  - c. One sign identifying an industrial structure or use, not exceeding a total of sixteen (16) square feet;
  - d. One sign identifying any non-residential structure or use permitted in the Agricultural/Residential or Preserve Districts, not exceeding a total of sixteen (16) square feet;
- (5) In the Commercial District, the following signs are permitted:
  - a. All signs which are allowed in the Village, Agricultural/Residential, and Preserve Districts;
  - b. One individual business identification sign attached to or free standing from the premises not to exceed sixteen (16) square feet.
- (6) All signs shall comply with the following restrictions:
  - a. No permanent or commercial sign shall be permitted within or over a public right-of-way.
  - b. No sign shall be permitted which appears to direct the movement of traffic or which interferes with, imitates or resembles any official traffic, directional or route sign, signal or device.
  - c. No sign shall be permitted which prevents a clear and unobstructed view of official signs or approaching or merging traffic.
  - d. No lighting of signs shall be permitted unless such lighting is mounted to the top or

side of the sign structure, directed so that the lighting illuminates only the surface area of the sign and is effectively shielded to prevent hazardous beams or rays of light from being directed at any portion of the main traveled way of a public road. The internal illumination of signs may only be permitted with the approval of the Development Review Board in accordance with Section 5.2.

e. No sign shall contain any moving parts.
f. No sign shall be erected, attached or maintained upon trees, or drawn or painted on rocks or other natural features, or upon utility poles.
g. No sign shall be allowed which is not on the premises of the activity served by the sign.
h. No free standing sign may be more than sixteen (16) feet high nor less than thirty (30) feet from any street center line nor nearer than ten (10) feet to any other lot line.
i. No sign ,which is attached to a structure, may extend above the eaves of that part and side of the structure to which the sign is attached.
j. No sign shall contain any fluorescent paint.

(7) The following additional signs may be permitted upon the granting of a conditional use approval by the Development Review Board as hereinafter provided:

a. One free-standing or attached sign if it identifies two or more businesses located on the same premises upon a finding by the Development Review Board that the sign does not exceed twenty-four (24) square feet in area, meets the requirements set forth in subsection 5, ābove.
b. Up to two free-standing or attached signs if they identify ten or more businesses located on the same premises upon a finding by the Development Review Board that each sign does not exceed thirty-six (36) square feet in area, meets the requirements set forth in subsection 5, above.

(8) The following shall be exempt from the sign requirements:

a. Signs erected or administered by the Town or the State of Vermont under Title 10, VSA 21, whether maintained at private or public expense.
b. Small signs without advertising displayed for the direction, instruction or convenience of the public, including signs which identify rest rooms, freight entrances, "open/closed", posted areas or the like, with an area not exceeding two (2) square feet, provided such signs are on the premises of the activity served by the sign.
c. Signs to be maintained for not more than forty-five (45) days in any calendar year erected by fairs or expositions or signs announcing an auction, or a campaign drive, or event of a civic, political, philanthropic service, or religious organization.
d. Signs not exceeding sixteen (16) square feet, which are not visible in any substantial degree from premises other than that on which the sign is located.
e. Temporary real estate signs not exceeding six (6) square feet, offering for sale the premises on which such sign is situated.
f. Signs required by the street naming and addressing ordinance of the Town of Moretown to identify the physical address of a property.

Section 4.13 Storage of Flammable Commodities

The storage of any highly flammable liquid or gas in tanks above ground, excluding tanks for residential purposes, with unit capacity greater than two thousand (2,000) gallons shall be prohibited, unless such tanks up to and including ten thousand (10,000) gallon capacity are placed not less than eighty (80) feet from all property lines, and unless all such tanks of more than ten thousand (10,000) gallon capacity are placed not less than two hundred (200) feet from all property lines.

All tanks (containing flammable liquids) having a capacity greater than two thousand (2,000) gallons shall be properly retained with dikes having a capacity not less than one and one-half (1.5) times the capacity of the tanks surrounded.

Section 4.14 Storage of Motor Vehicles

In all districts, any motor vehicle, which is not State inspected, must be stored in an enclosed building or placed in a rear or side yard and screened from view from any public road. Unregistered motor vehicles used for on-site property maintenance, such as snow plowing or agricultural purposes, and up to two (2) motor vehicles are exempted from this provision.

Section 4.15 Erosion and Sediment Control and Stormwater Management

Applicability. To promote erosion control and stormwater management practices that maintain pre-development erosion rates and hydrology, all development requiring a conditional use permit is subject to the provisions of these regulations as follows.

(A) **Exemptions.** Any development that requires a state stormwater permit is exempt from the approval requirements of Article 6, Section 6.4. However, it is suggested that the Low Impact Development Standards described in this Section be incorporated in the overall project design of State permitted projects as well.

(B) **Application Requirements.** The following information shall be presented on a plan or plans drawn to scale with supporting documents and technical details. The DRB or Zoning Administrator may require that the application materials be prepared by a qualified professional. For further explanation on how to develop this information see The Low Risk Site Handbook and the Erosion Prevention and Sediment Control Field Guide at the Vermont Department of Environmental Conservation's Stormwater Management website at http://www.vtwaterquality.org/stormwater.htm or check with Moretown's Zoning Administrator.

(1) An existing condition site assessment providing baseline information on features including slope profiles showing existing gradients, soil types, tree canopy and other vegetation, natural waterbodies, wetlands and site features that aid in stormwater management including natural drainage ways and forested and vegetated lands located on stream and wetland buffers;

(2) An erosion and sediment control plan that incorporates accepted management practices as recommended by the state in the most recent editions of the Low Risk Handbook for Erosion Prevention and Sediment Control or The Vermont Standards and Specifications for Erosion Prevention and Sediment Control, or the most recent Agency of Natural Resources standards as determined by the DRB.

(C) **Sediment and Erosion Control Standards.** All development is subject to the following pre-development and construction site standards to ensure that all sources of soil erosion and sediment on the construction site are adequately controlled, and that existing site features that naturally aid in stormwater management are protected to the maximum extent practical. Standards are statements that express the development and design intentions of this article. The guidelines suggest a variety of means by which the applicant might comply with the standards. The guidelines are intended to aid the applicant in the design process and the Administrative Officer and the DRB when reviewing applications. Options for compliance with the standards are not limited to the guidelines listed.

(1) **Minimize land disturbance.** Development of a lot or site shall require the least amount of vegetation clearing, soil disturbance, duration of exposure, soil compaction and topography changes as possible.

a. To the extent feasible, soils best suited for infiltration shall be retained and natural areas consisting of tree canopy and other vegetation shall be preserved, preferably in contiguous blocks or linear corridors.
b. The time the soil is left disturbed shall be minimized. The Administrative Officer or DRB may require project phasing to minimize the extent of soil disturbance and erosion during each phase of site development.
c. There shall be no soil compaction except in the construction disturbance area, which shall be identified and delineated in the field with appropriate safety or landscape fencing. In areas outside the disturbance area there shall also be no storage of construction vehicles, construction materials, or fill, nor shall these areas be used for circulation.
d. Development on steep slopes equal to or in excess of 15%, or which results in such slopes, shall be subject to conditional use review in accordance with Article 5.

(2) **Preserve natural areas.** Development shall not result in an undue adverse impact on fragile environments, including wetlands, wildlife habitats, streams, lakes, steep slopes, floodplains and vegetated riparian buffers.

a. Open space or natural resource protection areas shall be retained preferably in contiguous blocks or linear corridors where feasible, for the protection of the best stormwater management features identified in the site assessment as required in Section 3.4(C)(1).
b. Forested lands located on stream and wetland buffers and steep slopes are priority areas and are subject to regulations in Section 4.11.
c. Lot coverage and building footprints shall be minimized and where feasible, development clustered to minimize site disturbance and preserve large areas of undisturbed space. Environmentally sensitive areas, such as steep slopes shall be a priority for preservation and open space.

(3) **Manage water, prevent erosion and control sediment during construction.** Applicants shall maintain compliance with the accepted erosion prevention and sediment control plan as required by Section 3.4(B) (2).

a. Runoff from above the construction site must be intercepted and directed around the disturbed area.
b. On the site itself, water must be controlled, and kept at low velocities, to reduce erosion in drainage channels.
c. The amount of sediment produced from areas of disturbed soils shall be minimized by utilizing control measures such as vegetated strips, diversion dikes and swales, sediment traps and basins, check dams, stabilized construction entrances, dust control, and silt fences.
d. Immediate seeding and mulching or the application of sod shall be completed at the

conclusion of each phase of construction, or at the conclusion of construction if not phased.

e. The applicant shall follow the erosion prevention and sediment control practices for construction that occurs from October 15th to May 15th found in Section 3.2 Winter Construction Limitations as outlined in The Vermont Standards and Specifications for Erosion Prevention and Sediment Control, or the most recent Agency of Natural Resources standards for winter construction.

(D) **Low Impact Development (LID) Standards and Guidelines for Stormwater Management.** All applications for development are subject to the following post construction stormwater management standards and guidelines to ensure that stormwater management approaches that maintain natural drainage patterns and infiltrate precipitation are utilized to the maximum extent practical.

The use of LID design approaches shall be implemented to the maximum extent practical given the site's soil characteristics, slope, and other relevant factors. To the extent that LID design approaches are not proposed in the stormwater management plan, as required in Section 3.4(C), the applicant shall provide a full justification and demonstrate why the use of LID approaches is not possible before proposing to use conventional structural stormwater management measures which channel stormwater away from the development site.

Standards are statements that express the development and design intentions of this article. The guidelines suggest a variety of means by which the applicant might comply with the standards.

(1) Standard (1): **Vegetation and Landscaping.** Vegetative and landscaping controls that intercept the path of surface runoff shall be considered as a component of the comprehensive stormwater management plan.

a. Guideline (a): Design parking lot landscaping to function as part of the development's stormwater management system utilizing vegetated islands with bioretention functions.
b. Guideline (b): Incorporate existing natural drainage ways and vegetated channels, rather than the standard concrete curb and gutter configuration to decrease flow velocity and allow for stormwater infiltration.
c. Guideline (c): Divert water from downspouts away from driveway surfaces and into bioretention areas or rain gardens to capture, store, and infiltrate stormwater on-site.
d. Guideline (d): Consider construction of vegetative LID stormwater controls (bioretention, swales, filter strips, buffers) on land held in common.

(2) Standard (2): **Reduce Impervious Surfaces.** Stormwater shall be managed through land development strategies that emphasize the reduction of impervious surface areas such as streets, sidewalks, driveway and parking areas and roofs.

a. Guideline (a): Evaluate the minimum widths of all streets and driveways to demonstrate that the proposed width is the narrowest possible necessary to conform to safety and traffic concerns and requirements
b. Guideline (b): Reduce the total length of residential streets by examining alternative street layouts to determine the best option for increasing the number of homes per unit length.
c. Guideline (c): Reduce driveway lengths by minimizing setback distances. Encourage

common driveways.

d. Guideline (d): Use permeable pavement for parking stalls and spillover parking, sidewalks, driveways and bike trails.

(3) Standard (3): **Low Impact Integrated Management Practices (IMPs).** Stormwater shall be managed through the use of small-scale controls to capture, store and infiltrate stormwater close to its source.

a. Guideline (a): Create vegetated depressions, commonly known as bioretention areas or rain gardens that collect runoff and allow for short-term ponding and slow infiltration. Raingardens consist of a relatively small depressed or bowl- shaped planting bed that treats runoff from storms of one inch or less.
b. Guideline (b): Locate dry wells consisting of gravel or stone-filled pits to catch water from roof downspouts or paved areas.
c. Guideline (c): Use filter strips or bands of dense vegetation planted immediately downstream of a runoff source to filter runoff before it enters a receiving structure or water body. Natural or man-made vegetated riparian buffers adjacent to waterbodies provide erosion control, sediment filtering and habitat.
d. Guideline (d): Utilize shallow grass-lined channels to convey and store runoff.
e. Guideline (e): When paving, use permeable paving and sidewalk construction materials that allow stormwater to seep through into the ground.
f. Guideline (f): Consider other LID techniques such as rooftop gardens and/or rain barrels and cisterns of various sizes that store runoff conveyed through building downspouts. Rain barrels are generally smaller structures, located above ground. Cisterns are larger, often buried underground, and may be connected to the building's plumbing or irrigation system.
g. Guideline (g): Add minerals and organic materials to soils to increase its capacity for absorbing moisture and sustaining vegetation.

(E) **Development on Steep Slopes.** The intent of these regulations is to protect areas of steep slope within the Town of Moretown from the adverse effects of site disturbance and development as necessary to:

- Prevent landslides,
- prevent soil erosion, including the loss of topsoil,
- minimize stormwater runoff and prevent flooding,
- control sedimentation and prevent water quality degradation, and
- provide safe, stable building sites.

(1) Applicability

a. **Steep slopes (15 + %).** Development involving the site disturbance, excavation, filling, or regarding of 1000 or more square feet of land with a gradient of 15% or more, and driveways on land that exceeds an average gradient of 12% or more over any 50-foot section, as determined from mapped contour intervals or site inspection, shall be subject to conditional use review and approval from by the Development Review Board under Article 5 and the requirements of the Subsections below.

b. **Very Steep Slopes (25 + %).** No site disturbance of development shall take place on very steep slopes with natural gradients of 25% or more, with the exception of the following, which are subject to conditional use review and approval by the Development Review Board under Article 5, and the requirements of the Subsections below.

i. limited site improvements necessary to facilitate development on contiguous land with a slope of less than 25% gradient

c. **Exemptions.** The following are specifically exempted from the requirements of this section:

i. Hiking, rock climbing and back country skiing trails.
ii. Agricultural and forestry operations that incorporate accepted management practices established by the State of Vermont.
iii. Sand, gravel, quarrying, and other extraction operations regulated under Section 4.13 of these Regulations.
iv. Sanitary landfills regulated by the State of Vermont as public facilities (see Section 4.12).

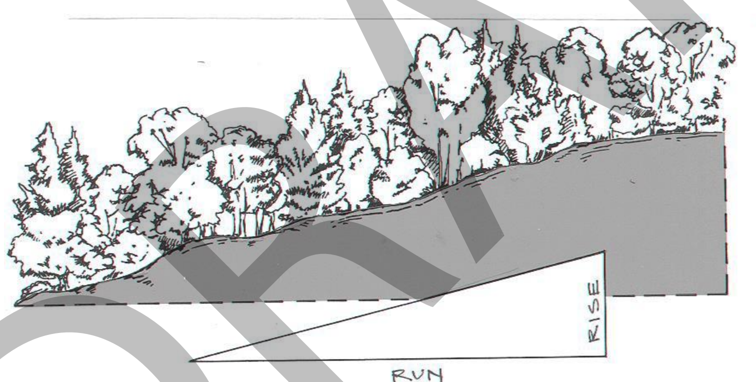
(2) **Application Requirements.** In addition to application requirements under Section 5.2, conditional use approval for development on steep and very steep slopes shall be contingent upon the submission and Board approval of the following, as prepared by a qualified professional engineer licensed by the State of Vermont:

a. A grading plan drawn at scale which indicates existing and proposed grades with contour lines at five (5) foot intervals within any area of proposed activity, site disturbance or construction, including access routes. The grading plan shall depict slope classes of 0-14.9%, 15-24.9% and 25% or more, based on five (5) foot contours analyzed on a ten foot (10') horizontal interval.

(3) **Review.** The Board may require an independent technical review of grading and erosion prevention and sedimentation control plans by a qualified engineer, in accordance with Section 6.5(A). Based upon information submitted, the Board shall find that:

a. Development, including building envelopes or footprints, driveways, parking areas and septic systems, will be sited to avoid areas of steep and very steep slope in order to minimize the need for site clearing, grading, cut, and fill.
b. House sites, subsurface sewage systems and parking areas are located on the flattest portion of the site.
c. Existing drainage patterns and vegetation will be retained and protected to avoid altering or relocating natural drainage ways, and to avoid increases in the amount of stormwater runoff being discharged into drainage ways as a result of site compaction, the unnecessary removal of vegetative cover, or re-contouring of land surface. Any proposed regarding will blend in with the natural contours and undulations of the land.
d. Terracing for building sites will be minimized, and structures will be designed to fit into rather than alter the slope, by employing methods such as reduced footprints, stilt and step-down building designs, and by minimizing grading outside the building footprint.

e. Driveways and roads will follow the natural contours of the land, and shall not exceed an average finished grade of 12% over any 50-foot section [see also Section 3.1].
f. The topsoil removed from all disturbed areas will be stockpiled and stabilized in a manner that minimizes erosion and sedimentation and allows for replacement elsewhere on the site at the time of final regarding. Topsoil shall not be stockpiled on slopes of greater than 10 percent (10%).
g. Cut and fill slopes will be rounded off to eliminate any sharp angles at the tops, bottoms and sides of regarded slopes, and shall not exceed a slope of one vertical to two horizontal (1:2), except where retaining walls, structural stabilization or other accepted engineering methods are proposed. Structures will be set back from the tops and bottoms of such slopes an adequate distance (generally six (6) feet plus one- half the height of the cut or fill) to ensure structural safety in the event of slope collapse.
h. Clean fill shall be used and compacted sufficiently to support proposed structures and uses.
i. Rock outcrops will be avoided or, where determined by the Board to be a hazard, will be removed or stabilized. Explosives shall be used only in accordance with accepted practices and applicable state regulations; the Board, as a condition of approval, may require notification of adjoining property owners prior to blasting.
j. Permanent vegetation will be re-established and maintained on undeveloped disturbed slopes in accordance with an approved landscaping plan for the site.



Slope, or gradient, is measured as the increase in rise over run. In this example, the rise increases (climbs) 15 feet over a distance (run) of 100 feet, which results in a 15% slope.

ARTICLE V
DEVELOPMENT REVIEW

Section 5.0 Applicability

(A) **Conditional Use Review** approval by the Development Review Board is required for the establishment of any land use designated as a conditional use in Article II, or as otherwise specified under Article IV, or any land development associated with such a use. Applications for conditional use review shall be reviewed in accordance with Section 5.2.

(B) **Flood Hazard Area Review** approval by the Development Review Board is required for construction of new buildings or the substantial improvement of existing buildings within the Flood Hazard Area Overlay District. Applications for flood hazard review shall be reviewed in accordance with Section 5.2.

(C) **Planned Unit Development (PUD)** standards may be applied by the Development Review Board at the request of the applicant for any parcel which meets the minimum lot size for the district within which it is located, in accordance with Section 5.3.

Section 5.1 Application Requirements

(A) An applicant for Conditional Use or PUD review shall submit, in addition to zoning permit application requirements under Section 6.1, eight (8) complete copies of a site development plan to include the following:

(1) The names and addresses of the property owner(s) of record, the applicant if different from the property owners, and the person(s) or firm preparing the application and plan.

(2) Proof that all adjoining property owners, as determined from the current Moretown Grand List, have been notified that the application is being submitted and a brief description of the nature of the application. This requirement may be satisfied by the submission of a list of property owners and addresses together with proof of mailing from the U.S. Postal Service or a certificate of service or comparable affidavit signed by the applicant.

(3) A site development plan, drawn to scale, which shows the following:

a. north arrow, scale and application date;
b. existing and proposed property boundaries, easements and rights-of-way;
c. zoning district boundaries;
d. existing features, including prominent topographic features and areas of steep slope (15% or greater); surface waters, wetlands and associated buffers; designated floodplain and source protection areas; land cover; and critical habitat areas and historic sites;
e. existing and proposed structures, including building footprints, building elevations depicting general design features, walls and fence lines, utilities, roads, driveways, parking and loading areas;
f. existing and proposed traffic and pedestrian circulation patterns, including accesses onto

or connections with adjoining properties, public roads and public waters, and associated sidewalks, pathways or trails serving the proposed development;

g. water supply and wastewater disposal system locations;

h. proposed grading, drainage, landscaping, screening, signage, and/or lighting details; and,

(4) Any additional information required by the Development Review Board to determine project conformance with the provisions of this bylaw (e.g., site plan prepared by licensed engineer or surveyor; erosion control, stormwater management or site reclamation plans; traffic, fiscal or visual impact analyses).

(5) For development in the flood hazard area overlay district, the elevation, in relation to mean sea level, of the lowest floor, including basement, of all new or substantially improved buildings; the elevation, in relation to mean sea level, to which buildings will be floodproofed; proposed floodproofing measures; and any comments received from the Vermont Department of Environmental Conservation following their review of the application.

(B) The application will not be considered complete until all required forms, information and fees have been submitted. The Development Review Board may waive one or more application requirements if they determine the information is unnecessary for the comprehensive review of the application. Such waiver will be made at the time the application is accepted and deemed complete.

Section 5.2 Conditional Use Review

(A) Any use or structure requiring conditional use approval, including projects located within the Flood Hazard Overlay District, shall not be issued a zoning permit by the Administrative Officer until the Development Review Board grants such approval in accordance with the Act [§ 4414(3)], and the following standards and procedures.

(B) In accordance with the Act [§4464], the Development Review Board shall schedule a public hearing, warned in accordance with Section 6.5, not less than 15 days prior to the date of the public hearing. The Board may recess the convened hearing to require the submission of additional information from the applicant, or to allow for the submission of information from other parties. The Board shall act to approve, approve with conditions, or disapprove an application for conditional use review, within forty five (45) days of the date of the final public hearing; and shall issue a written decision to include findings, any conditions deemed necessary to ensure compliance with the standards set forth below, and provisions for appeal. Failure to act within the forty five (45) day period shall be deemed approval.

(C) Conditional use approval shall be granted by the Development Review Board upon finding that the proposed conditional use shall not result in an undue adverse effect on any of the following:

(1) **The capacity of existing or planned community services or facilities**. The Board shall consider the demand for community services and facilities resulting from the proposed development in relation to the available capacity of such services and facilities including, but not limited to, schools, emergency services and road maintenance.

(2) **The character of the area affected**. The Board shall consider the location, scale, type, density and intensity of use associated with the proposed development in relation to the character of the area likely to be affected, as defined by the Board based on the Moretown Town Plan, applicable zoning district purposes and standards, submitted materials, and

testimony presented at public hearing.

(3) **Traffic on roads and highways in the vicinity**. The Board shall consider the potential impact of projected traffic resulting from the proposed development in relation to the condition, capacity, safety, and function of roads and associated infrastructure (e.g., bridges, culverts) potentially affected by the proposed development.

(4) **Bylaws in effect**. The Board shall consider whether the proposed development complies with all bylaws in effect at the time of application, including other applicable provisions of this zoning bylaw, and other prior municipal permits and/or approvals.

(5) **The utilization of renewable energy resources**. The Board shall consider whether the proposed development will interfere with the sustainable use of renewable energy resources, including access to, direct use or future availability of such resources.

(D) **Specific Standards.** In addition to the General Standards set forth above, the Development Review Board may impose specific conditions or require project modifications to ensure the following:

(1) **Location of Structures**. The design and location of structures will be compatible with their proposed setting and context, as determined in relation to zoning district objectives and requirements, existing site conditions and features, and adjoining structures and uses. Conditions may be imposed with regard to siting, density, setbacks, height, scale and/or orientation, to ensure compatibility.

(2) **Traffic and Pedestrian Circulation.** A coordinated, safe and efficient system for vehicular and pedestrian circulation will be provided on and off-site in accordance with all applicable municipal and state standards. Conditions may be imposed with regard to intersections, pedestrian paths and crossings, and the number and size of curb cuts, including the reduction, consolidation or elimination of noncomplying curb cuts, and/or provisions for shared access with adjoining parcels.

(3) **Parking and Service Areas**. Parking and service areas will be provided in accordance with the requirements of Section 4.9, and be designed to minimize off-site visibility and stormwater runoff. Nonresidential parking and service areas shall be located to the side or rear of buildings, unless otherwise approved by the Board in relation to existing site limitations. Conditions may be imposed with regard to the extent, siting, landscaping, screening, paving, curbing and/or sharing of parking and service areas with adjoining parcels.

(4) **Outdoor Storage & Display.** The storage or display of outside materials, goods, supplies, vehicles, machinery or other materials shall be prohibited unless specifically approved by the Board. Secured, covered areas shall be provided for the collection and on-site storage of trash and recyclables generated by the proposed development. In approving such outdoor display or storage, the Board may place conditions on the area and location of such storage or display, and may require appropriate screening.

(5) **Stormwater Management.** Stormwater runoff will be managed to ensure that such runoff will not result in adverse impacts to neighboring properties, town roads, or water quality. A stormwater management and/or erosion control plan may be required and incorporated as a condition to approval. Please refer to requirements of Section 4.15.

(6) **Lighting**. Lighting associated with the proposed development will be the minimum required for safety and security, and will not adversely affect neighboring properties and uses or the quality of the night sky; exterior lighting shall generally be limited to cut-off fixtures. Such fixtures shall be directed so as not to cause glare on adjacent roadways, cause excessive levels of illumination, or result in direct illumination of neighboring properties. The Board may restrict the maximum level of illumination on all or a portion of the property. A lighting plan may be required and incorporated as a conditions to approval.

(7) **Landscaping & Screening**. Proposed landscaping and screening (which may include but not be limited to shade and street trees, shrubs, planting beds, buffers, and ground covers) will preserve and incorporate existing vegetation; be suited to existing site conditions; enhance features unique to the site; and not obstruct scenic views or road visibility. Conditions may be imposed as appropriate with regard to the amount, type, size, and location of landscaping and screening materials. A three (3) year landscaping plan, and/or bond or other surety to ensure installation and maintenance may be required and incorporated as a condition to approval.

(6) **District and Use Standards.** All development shall comply with all applicable specific use standards set forth in Article III, and all district standards set forth in Article II.

(E) Flood Hazard Area Development Standards.

Base Flood Elevations and Floodway Limits

A. Where available, base flood elevations and floodway limits (or data from which a community can designate regulatory floodway limits) provided by the National Flood Insurance Program in the Flood Insurance Study and accompanying maps shall be used to administer and enforce these regulations.

B. In areas where base flood elevations and floodway limits have not been provided by the National Flood Insurance Program in the Flood Insurance Study and accompanying maps, base flood elevations and floodway data provided by FEMA or available from State or Federal agencies or other sources, shall be obtained and utilized to administer and enforce these regulations.

C. Until a regulatory floodway has been designated, no new construction, substantial improvements, or other development shall be permitted unless it is demonstrated that the cumulative effect of the proposed development, when combined with all other existing development and anticipated development will not increase the water surface elevation of the base flood more than one foot at any point within the community.

In addition to applicable general and specific standards set forth above, the Development Review Board may impose specific conditions or require project modifications for development within the Flood Hazard Area Overlay District in accordance with the following standards:

(1) Development within floodways is prohibited unless a registered professional engineer certifies that the proposed development will not result in any increase in flood levels during the occurrence of the base flood. Junkyards and storage facilities for floatable materials, chemicals, explosives, flammable liquids, or other hazardous or toxic materials, are specifically

prohibited within the floodway.

(2) All development shall be designed to (a) minimize flood damage to the proposed development and to public facilities and utilities; and (b) to provide adequate drainage to reduce exposure to flood hazards.

(3) Structures shall be (a) designed (or modified) and adequately anchored to prevent flotation, collapse, or lateral movement of the structure during the occurrence of the base flood, (b) be constructed with materials resistant to flood damage, (c) be constructed by methods and practices that minimize flood damage, and (d) be constructed with electrical, heating, ventilation, plumbing and air conditioning equipment and other service facilities that are designed and/or located so as to prevent water from entering or accumulating within the components during conditions of flooding.

(4) The flood carrying capacity within any altered or relocated portion of a watercourse shall be maintained.

(5) New and replacement water supply and sanitary sewage systems shall be designed to minimize or eliminate the infiltration of flood waters into the systems and discharges from the systems into flood waters.

(6) On-site waste disposal systems shall be located to avoid impairment to them or contamination from them during flooding.

(7) New and replacement manufactured homes shall be elevated on properly compacted fill such that the top of the fill (the pad) under the entire manufactured home is above the base flood elevation.

(8) The lowest floor, including basement, of all new buildings shall be at or above the base flood elevation,

(9) Existing buildings to be substantially improved for residential purposes shall be modified or elevated to meet the requirements of Subsection (8).

(10) Existing buildings to be substantially improved for nonresidential purposes shall either (a) meet the requirements of subsection 8, or (b) be designed to be watertight below the base flood elevation with walls substantially impermeable and with structural components having the capability of resisting hydrostatic and hydrodynamic loads and effects of buoyancy. A permit for a building proposed to be floodproofed shall not be issued until a registered professional engineer or architect has reviewed the structural design, specifications, and plans, and has certified that the design and proposed methods of construction are in accordance with accepted standards of practice for meeting the provisions of this subsection.

(11) All new construction and substantial improvements with fully enclosed areas below the lowest floor that are subject to flooding shall be designed to automatically equalize hydrostatic flood forces on exterior walls by allowing for the entry and exit of floodwaters. Designs for meeting this requirement must either be certified by a registered professional engineer or architect or meet or exceed the following minimum criteria: a minimum of two openings having a total net area of not less than one square inch for every square foot of

enclosed area subject to flooding shall be provided. The bottom of all openings shall be no higher than one foot above grade. Openings may be equipped with screens, louvers, valves or other cover coverings or devices provided that they permit the automatic entry and exit of floodwaters.

(12) Recreational Vehicles placed on sites within Zones A1-A30, AH and AE shall either (1) be on the site for fewer than 60 days during a year or 3 consecutive weeks, (2) be fully licensed and ready for highway use, or (3) meet all standards of Section 60.3(b)(1) of the National Flood Insurance Program Regulations and the elevation and anchoring requirements for "manufactured homes" of Section 60.3(c)(6).

(F) Determining Undue Adverse Effect.

The following test shall be used by the DRB when the bylaw requires the DRB to determine whether or not an undue adverse effect is being created.

(1) First, the DRB shall determine if a project is creating an adverse effect upon the resource, issue and/or facility in question. The DRB shall determine such by responding to the following question:

a. Does the project have an unfavorable impact upon the resource, issue and/or facility in question?

(2) If it has been determined by the DRB that an adverse effect is being created by a project, the DRB shall then determine if the adverse effect is undue. To determine whether or not an adverse effect is undue, the DRB shall respond to the following two questions:

a. Does the project conflict with a clear, written standard in these Regulations or the Municipal Plan applicable to the resource, issue or facility in question?
b. Can the unfavorable impact be avoided through site or design modifications, on mitigation, or other conditions of approval?

The DRB shall conclude that adverse effect is "undue" if the answer to 2(a) is YES OR the answer to 2(b) is NO.

Section 5.3 Planned Unit Development

(A) **Purpose**. In accordance with the Act [§4417], Planned Unit Developments (PUD's) are permitted in all zoning districts to allow for innovative and flexible design and development that will promote the most appropriate use of land, and specifically achieve one or more of the following objectives:

(1) increase density, reduce lot size and/or facilitate the adequate and economical provision of streets and utilities to provide housing in a cost effective manner;

(2) cluster residential development to preserve and maintain open space, including but not limited to important resource or conservation lands;

(3) protect significant natural, cultural or scenic features as identified in the Moretown Town Plan, or through site investigation; and/or,

(4) allow for creative design and layout of development, an efficient use of land, and to provide for the integrated mix of uses.

(B) **Review Process**. A PUD shall be reviewed in accordance with the procedures for conditional use review set forth in Section 5.2. In addition to a Site Development Plan prepared in accordance with Section 5.1, an application for PUD approval shall include a statement describing all proposed modifications, changes or supplements to existing bylaw requirements. Modifications of this bylaw approved by the Development Review Board shall be noted in writing and appended to a plat depicting the project to be filed in the Moretown Land Records. All other provisions of this bylaw not specifically modified shall remain in effect and be applicable to the project.

(C) **Coordination with Conditional Use Review** Approval granted for a PUD involving the development of one or more uses subject to conditional use review shall not exempt the proposed development from subsequent Development Review Board review in accordance with Section 5.2 unless the Development Review Board specifically grants conditional use review at the time of PUD approval.

(D) **General Standards**. The modification of zoning regulations by the Development Review Board may be permitted in accordance with the following standards:

(1) The PUD shall meet all applicable standards set forth in Section 5.2, and shall be consistent with the Moretown Town Plan and all other applicable municipal regulations and ordinances currently in effect. The PUD shall also meet all local and state regulations for sewage disposal and the protection of water quality.

(2) The PUD shall represent an effective and unified treatment of the development site, including provisions as appropriate for the preservation or protection of surface andground waters; wetland, stream bank, floodplain and lake shore areas; significant topographic features, including hilltops and ridgelines; areas of steep slope or shallow soil; significantresource lands, including agricultural and forest land; historic or archaeological sites and structures; natural and critical habitat areas; and open spaces, including scenic views and vistas.

(3) The Development Review Board may allow for a greater concentration or intensity of development within some section(s) of the development than in others, on individual lots which are smaller than the minimum lot size for the district within which the PUD is located, provided that there is an offset by a lesser concentration in other sections, including the reservation of no less than 50% of the remaining land as open space.

(4) The minimum front, side and rear yard setbacks at the periphery of the PUD shall be as dictated for the particular district unless otherwise specified by the Development Review Board. The Board may allow other setback standards, such as zero lot lines, as part of PUD approval.

(5) Provision shall be made for the preservation of open space. Preserved open space shall be dedicated, either in fee or through a conservation easement to the Town, a community association comprising all of the present and future owners of lots or dwellings in the project, or a non-profit land conservation organization. Such easement shall be approved by the

Development Review Board. Land held in common shall be subject to appropriate deed restrictions stipulating the permitted and restricted use of such lot, and establishing the person or entity responsible for maintenance and long term stewardship. The location, size and shape of lands set aside to be preserved for open space shall be approved by the Board, in accordance with the following:

a. Open space land shall provide for the protection of identified resources, including farmland, productive forest, wildlife habitat, natural areas, aquifer protection areas, surface waters, stream banks, historic and archaeological sites, and scenic views and vistas;
b. Designated open space may include the portion of a single lot which is characterized by one or more of the above referenced features, or may encompass the contiguous boundaries of the above referenced feature located on multiple lots;
c. The location, shape, size and character of the open space shall be suitable for its intended use. Generally, open space shall be at least 50% of the total area for projects involving a parcel(s) of twenty-five (25) acres or more. For smaller parcels, open space should be in proportion to the size and scope of the project, and its intended use;
d. Open space shall be suitably improved and/or maintained for its intended use, except for open space containing natural or cultural resources worthy of preservation, which may be required to be left unimproved. Provisions shall be made to enable lands designated for agriculture and forestry to be used for these purposes. Management plans for forests and/or wildlife habitat may be required by the Board as appropriate. Areas preserved for agricultural use should be of a size that retains their eligibility for state and town tax abatement programs;
e. Open space land shall be located so as to conform with and extend existing and potential open space lands on adjacent parcels; and
f. Sewage disposal areas and utility and road rights-of-way or easements, access and parking areas shall not be counted as open space areas, except where the applicant can prove, to the satisfaction of the Board, that they will in no way disrupt or detract from the values for which the open space is to be protected.

(6) Where a district boundary line divides a parcel, the Development Review Board may allow the development of a single PUD with a total density based on the combined allowable density of each district.

(7) Two (2) or more contiguous parcels under the ownership or control of the applicant may be combined for review as a PUD. The permitted density on one parcel may be increased as long as the overall density for the combined parcels does not exceed that which could be permitted, in the Development Review Board's judgement, if the land were subdivided into lots in conformance with district regulations.

(F) **Specific Standards**. In addition to the general standards under subsection (D), PUD's shall also meet the following specific standards:

(1) The total number of residential units and/or commercial or industrial space within the PUD shall not exceed the number, which would be permitted in the Development Review Board's judgement if the parcel were subdivided into buildable lots in conformance with the zoning regulation for the district in which the project is located. The number of units allowed in a

PUD may, at the discretion of the Development Review Board, be increased by up to 25% of the number, which the Board determines could be provided on the site in conformance with zoning district requirements. Density bonuses shall also be granted for PUD's in which 50% or more of the total land area is to be set aside as open space, or for the provision of affordable or elderly housing.

(2) A PUD may include any permitted or conditional uses allowed in the district in which it is located. Multiple principle structures and/or uses on a lot, or multiple ownership of a single structure may be permitted.

(3) Principal buildings and mixed uses shall be arranged to be compatible, and buffered as appropriate to ensure visual and acoustical privacy for the residents of the development and for adjacent properties.

f.

ARTICLE VI
ADMINISTRATION AND ENFORCEMENT

Section 6.1 Appointments and Duties

6.1.1 Zoning Administrator

(A) **Appointment**. In accordance with the Act [§ 4448], the Planning Commission, with the approval of the Select Board, shall appoint a Zoning Administrator for a term of three years. The Select Board in consultation with the Planning Commission may remove a Zoning Administrator for cause at any time. The planning commission may nominate and the legislative body may appoint an acting zoning administrator who shall have the same duties and responsibilities as the zoning administrator in the zoning administrator's absence. If an acting zoning administrator or assistant zoning administrator position is established, there shall be clear policies regarding the authority of the zoning administrator in relation to the acting or assistant administrator.

(B) **Duties.** The Zoning Administrator shall administer these regulations literally, and shall only permit land development that is in conformance with these regulations and any other Town ordinance. The Zoning Administrator may make reasonable inspections to determine compliance, and shall maintain accurate records of all applications and fees received, permits issued and denied, and notice of violations. These records shall be available to the public. The Zoning Administrator shall perform all other necessary functions to carry out the provisions contained herein.

6.1.2 Development Review Board

(A) **Appointment**. A Development Review Board shall be appointed by the Select Board in accordance with the Act [§ 4460(c)]. The Select Board shall determine the Board's members as well as their number and term of office. Any member of the Development Review Board may be removed for cause by a majority vote of the Select Board upon notification of written charges and after a public hearing.

(B) **Duties***.* To the extent authorized by the Act, the Development Review Board shall consider and act upon:

1. appeals of the Zoning Administrator's acts or decisions;
2. requests for variances; and
3. applications for conditional use (Section 5.2) and PUDs (Section 5.3).

(C) **Procedures.** The Development Review Board may prepare and adopt rules of procedure to guide the Board's official conduct. Said rules shall be prepared in accordance with all applicable provisions of the Act [§ 4461] and Vermont's Open Meeting Law [1 V.S.A. § 310-314].6.1.3 Planning Commission

(A) **Appointment.** A Planning Commission shall be appointed by the Select Board in accordance with the Act [§ 4321]. The Select Board shall determine the Board's members as well as their number and term of office. The Select Board may remove any member of the Planning Commission with a unanimous vote of the Board.

(B) **Duties.** As authorized by the Act [§4325] the Planning Commission shall have the following duties:

a. Prepare and update the Town Plan every five years and prepare amendments to the Plan as necessary;
b. Prepare bylaws and amendments to such bylaws;
c. Undertake studies and make recommendations on matters related to land development, transportation, economic and social development, historic and scenic preservation, natural resource protection and related areas;
d. Assist Selectboard to prepare a five-year capital budget and program;
e. Undertake comprehensive planning, including related preliminary planning and engineering studies; and
f. Perform other acts or functions as it may deem necessary or appropriate to fulfill the intent and purposes of the Act.

(C) **Procedures.** The Planning Commission may prepare and adopt rules of procedure to guide the Commission's official conduct. Said rules shall be prepared in accordance with all applicable provisions of the Act [§4321-§4328] and Vermont's Open Meeting Law [1 V.S.A. §310-314].

Section 6.2 Permits and Applications

(A) **Zoning Permit.** In accordance with the Act [§4449], no development may be commenced and no structure erected, substantially improved, moved, or changed in use without a zoning permit issued by the Zoning Administrator, unless specifically exempted under Section 6.3.

(B) **Application Requirements.** All applications shall be submitted to the Zoning Administrator on forms provided by the Town with application fees as established by the Select Board. In addition, the following applicable items will be required:

(1) **Permitted Uses.** Application for a permitted use shall be accompanied by one (1) copy of a sketch plan, no smaller than 8.5" x 11", drawn to an appropriate scale to accurately depict and include:

a. the dimensions of the lot including existing and proposed property boundaries;
b. the location, footprint and height of the existing and proposed structure and additions;
c. setbacks from property boundaries, rights-of-way, surface water and wetlands;
d. the location of existing and proposed easements, rights-of-way, and utilities;
e. the existing or intended use of all structures on the lot; and
f. other information as may be necessary to determine conformance with these regulations.

(2) **Uses Requiring Conditional Use or PUD Approval.** Uses that require approval under conditional use, flood hazard area, or planned unit development review shall include a development review application and site development plan prepared and submitted in

accordance with Section 5.1 of these regulations.

(3) **Uses Subject to State Agency Referrals**. For any permit application subject to state agency referral requirements, a brief report describing the proposed use and location, as well as an evaluation of the effects of such use on municipal and regional plans currently in effect, shall be attached for submission by the Zoning Administrator to the state.

(4) **Flood Hazard Areas.** Any application for development within the Flood Hazard Overlay District shall include copies of application information as required for referral to the Vermont Agency of Natural Resources, the Federal Insurance Administrator, and adjacent municipalities in accordance with the Act [§4424(D)] and Section 2.4.

(C) Issuance of Permits.

(1) **Required Approvals.** The Zoning Administrator shall not issue a zoning permit unless an application, fee and any approvals required by these regulations have been received. If the proposed land development or land use requires approval by the Development Review Board, the application shall be deemed incomplete until such time as the DRB conducts its review and renders a decision.

(2) **Action by the Zoning Administrator.** The Zoning Administrator shall within 30 days of submission of a complete application either issue or deny a zoning permit in writing, or refer the application to the Development Review Board and/or state for consideration, in accordance with the Act [§4449, §4465]. The permit shall contain a written statement of the period of time within which an appeal may be taken. If the Zoning Administrator fails to act within 30 days of receiving a complete application, a permit shall be deemed issued on the 31st day, in accordance with the Act [§§4448, 4449].

(3) **Permits in the Flood Hazard Area**. Permits issued for land development in the flood hazard area shall contain a notation that such land development is located in regulated flood hazard area.

A. Prior to issuing a permit a copy of the application and supporting information shall be submitted by the administrative officer to the State National Floodplain Insurance Program Coordinator at the Vermont Agency of Natural Resources, Department of Environmental Conservation, River Management Section in accordance with 24 V.S.A. § 4424. A permit may be issued only following receipt of comments from the Agency or the expiration of 30 days from the date the application was mailed to the Agency, whichever is sooner.

B. Adjacent communities and the Stream Alteration Engineer at the Vermont Agency of Natural Resources, Department of Environmental Conservation, River Management Section shall be notified at least 30 days prior to issuing any permit for the alteration or relocation of a watercourse and copies of such notification shall be submitted to the Administrator of the National Flood Insurance Program. Any permit issued shall assure that the flood carrying capacity within the altered or relocated portion of any watercourse is maintained.

C. Proposed development shall be reviewed by the administrative officer or the appropriate municipal panel to assure that all necessary permits have been received from those government agencies from which approval is required by Federal, State or Municipal law.

(4) **Amendment to the Zoning Regulations.** Pursuant to the Act [§4449(d)], if a public notice is issued with respect to the adoption or amendment of these regulations, or an amendment to an ordinance adopted under prior enabling laws, the Zoning Administrator, for a period of 150 days following that notice, shall review any new application filed after the date of the notice under the proposed regulation or amendment and applicable existing regulations and ordinances. If the new regulation or amendment has not been adopted by the conclusion of the 150-day period or if the proposed regulation or amendment is rejected, the permit shall be reviewed under existing regulations and ordinances. An application that has been denied under a proposed regulation or amendment that has been rejected or that has not been adopted within the 150-day period shall be reviewed again, at no cost, under the existing regulations and ordinances, upon request of the applicant. Any determination by the zoning administrator under this section shall be subject to appeal as provided in §4465 of the Act.

(D) Effective Date of Permit and Appeal Period.

(1) **Effective Date.** Within three days following the issuance of a Zoning Permit:

a. The Zoning Administrator shall deliver a copy of the permit to the Moretown Board of Listers;
b. The Zoning Administrator shall post a copy of the permit in at least one public place in the municipality for a period of 15 days from the date of issuance.
c. The applicant, property owner, or applicant's/owner's agent must post a permit notice, on a form prescribed by the Town of Moretown within view of the public right-of-way most nearly adjacent to the subject property until the time for appeals has passed. The notice shall contain a statement of the appeal period and information as to where a full description of the project and approval can be found.

(2) **Appeal Period.** No zoning permit shall take effect until the time for appeal has passed (see Section 6.6), or in the event that a notice of appeal is filed properly, such permit shall not take effect until final adjudication of said appeal.

(E) **Expiration and Renewal of Permit.** A zoning permit shall remain valid for two (2) years from the date it is issued. If before that time expires, the applicant files a renewal application and has made substantial progress of the land development described in the permit, the Zoning Administrator shall issue not more than two consecutive 12-month permit renewals without fee. If a zoning permit expires without substantial land development the permit shall become null and void.

(F) **Permit Fees.** The Select Board shall establish application fees to be charged in administering these regulations, with the intent of covering the Town's administrative costs. The application fees may be revised periodically.

Section 6.3 Exemptions

(A) No zoning permit shall be required for the following: (NOTE: Several of the exemptions listed here may not apply in the Special Flood Hazard Area)

1. Any use commenced prior to the adoption of these regulations provided such use was in accordance with all applicable local regulations in effect at the time of commencement, or any building for which construction has begun prior to the adoption of these regulations, provided such construction is in accordance with all applicable local regulations in effect at the time construction was initiated and is providing the construction is completed within one year from the date of such adoption.

2. Accepted Management Practices (AMPs) for silviculture (forestry) as defined by the Commissioner of Forests, Parks and Recreation, pursuant to the Act [§4413(d)].

3. Accepted Agricultural Practices (AAPs) including farm structures, as defined by the Secretary of Agriculture, Food and Markets in accordance with the Act [§4413(d)]; however written notification including a sketch plan of the structure showing setback distances from road, rights-of-way, property lines, special flood hazard areas and floodway boundaries, and surface waters shall be made to the Zoning Administrator prior to any construction as required by the Act [§4413(d)].

4. Any residential fence or wall that is less than six and half (6.5) feet in height and which does not extend into or obstruct public rights-of-way, or interfere with corner visibility or site distances for vehicular traffic.

5. Any shed, tree house, doghouse, a child's play house, or similar structure with a floor area of not more than one hundred fifty (150) square feet and a height of not more than twelve (12) feet, which is located at least 10 feet from all property lines.

6. Any sign erected by the Town or State for directional, informational or traffic control purposes and other signs exempt under Section 4.12 (8) of this ordinance.

7. Garage sales, yard sales, auctions or similar types of sale for a period of not exceeding three consecutive days, nor more than eight days per calendar year, which are managed so as not to cause unsafe traffic conditions, parking problems, or other nuisances to neighbors.

8. The ordinary use of a small room of a dwelling for personal office use and/or paperwork for business activity. Interior alteration of a structure that does not result in a change of use of the structure or any expansion in the total area of the structure.

9. Placement or grading of less than 200 cubic yards of gravel, sand, topsoil, rock, or similar material per calendar year if the placement or grading involves:

    a. Town Road maintenance and improvement where fill is placed on private property,
    b. Driveway maintenance or construction (including culvert repair and resurfacing)
    c. Property and Yard improvements associated with customary residential or agricultural uses to principal structures (contouring yards, establishing garden and landscape areas)
    d. Placement of fill on unimproved lots, or
    e. Landfill associated with other permitted activities (see Section 4.6).

These exemptions do not apply to placement of fill in streams, within required stream setbacks, or within wetlands or the floodplain/floodway, which are prohibited or require special permits from state agencies. Section 4.11; table 2.5 and section 5.2 (e).

10. The placement above or below ground of any fuel storage tank designed and intended for residential use, provided said tank is located at least 10 feet from all property lines.

11. The drilling of a well for residential use.

12. Hunting, fishing, and trapping as specified under 24 V.S.A. §2295 on private or public land. This does not include facilities supporting such activities, such as firing ranges or rod and gun clubs, which for the purposes of these regulations are defined as outdoor recreational facilities.

Section 6.4 Referral to State Agencies

The Zoning Administrator shall advise applicants to contact the Agency of Natural Resources regional permit specialist to determine whether any state permits are required [§4448(d)]. For permit applications that must be referred to a state agency for review, no zoning permit shall be issued until a response has been received from the state, or the expiration of 30 days following the submission of the application to the state.

Section 6.5 Notice Requirements

(A) **Notice Procedures.** All development review applications before the Development Review Board under procedures set forth in §4464 of the Act shall require notice as follows:

(1) A warned public hearing shall be required for conditional use review, variances, zoning administrator appeals, and final plat review for subdivisions. Any public notice required for a warned public hearing under these regulations shall be given not less than 15 days prior to the date of the public hearing by all of the following:

a. Publication of the date, place, and purpose of the hearing in a newspaper of general circulation in the Town.
b. Posting of such notice in three or more public places within the Town in conformance with location requirements of 1 V.S.A. §312(c)(2), including posting within view from the public right-of-way most nearly adjacent to the property for which an application is made..
c. The notice shall include the date, place and purpose of such a hearing, and shall be sent by mail to the applicant.
d. In accordance with Section 5.1, the applicant shall provide abutting property owners with a notice of application for a permit which shall include a description of proposed structures or uses, the property location, the name of the landowner and applicant, and notice that a public hearing will be scheduled and that they can contact the Town for the date of said. Abutting properties shall include those which are across public or private roads, providing they are within 200 feet of the subject parcel.

(2) Public notice for hearings of all other types of development review, including site plan review, shall be given not less than seven days prior to the date of the public hearing, and shall include at a minimum all of the following:

a. Posting of the date, place and purpose of the hearing in three or more public places within the municipality in conformance with the time and location requirements of 1 V.S.A §312(c)(2).
b. The notice shall include the date, place and purpose of such a hearing, and shall be sent by mail to the applicant. In accordance with Section 5.1, the applicant shall provide abutting property owners with a notice of application for a permit which shall include a description of proposed structures or uses, the property location, the name of the landowner and applicant, and notice that a public hearing will be scheduled and that they can contact the Town for the date of said. Abutting properties shall include those which are across public or private roads, providing they are within 200 feet of the subject parcel.

(B) **Invalid Posting or Notice.** In accordance with §4464(a)(5), no defect in the form or substance of any requirements in Section 6.5 (A) shall invalidate the action of the Development Review Board where reasonable efforts are made to provide adequate posting and notice. However, the action shall be invalid when the defective posting or notice was materially misleading in content. If action is ruled to be invalid by the environmental court or by the applicable municipal panel itself, the action shall be remanded to the applicable municipal panel to provide new posting and notice, hold a new hearing, and take a new action.

Section 6.6 Appeals

(A) **Appeal of a Decision or Action by the Zoning Administrator**. In accordance with the Act [§4465] any **interested person** may appeal a decision or act taken by the Zoning Administrator by filing a notice of appeal with the Development Review Board's Secretary or the Town Clerk if no Secretary has been elected, within fifteen (15) days of the date of such decision or act.

(B) **Appeal of a Development Review Board Decision.** Any **interested person** may appeal a decision of the Development Review Board within thirty (30) days of such decision to the Vermont Environmental Court, in accordance with the Act [§§4471 and 4472]. Notice of appeal shall be sent to every hearing participant.

(C) Appeal Procedures.

(1) **Notice of Appeal.** A notice of appeal shall be in writing and shall include:

a. the name and address of the appellant;
b. a brief description of the property with respect to which the appeal is taken;
c. a reference to the applicable regulatory provisions;
d. the relief requested by the appellant, including any request for a variance from one or more provisions of these regulations;
e. the alleged grounds why such relief is believed proper under the circumstances; and
f. any applicant for a variance shall submit, in addition to zoning permit application requirements, under Section 6.2, two complete copies of a Site Development Plan, meeting the criteria set forth in Section 5.1 (A), including evidence of notice to all adjoining property owners.

(2) **Hearing.** Pursuant to the Act [§4468], the Development Review Board shall set a date and place for a public hearing on an appeal, which shall be within 60 days of the filing of the notice of appeal. Any hearing held under this section may be adjourned by the DRB from time to time, provided, however, that the date and place of the adjourned hearing shall be announced at the hearing. For an appeal for the variance within a floodplain area, the Board shall give notice of the date and place of the hearing to the Vermont Agency of Natural Resources. Where it is alleged that an error has been committed in any order, requirement, decision or determination made by the Zoning Administrator in the connection with the enforcement of these regulations, the Board shall consider available evidence and testimony and decide whether such error has been committed.

(3) **Decisions on Appeal.** A decision on appeal, to include written findings of fact, shall be rendered within forty-five (45) days after hearing completion. The Development Review Board may reject an appeal without hearing, and render a decision within ten (10) days of the filing of a notice of appeal, if the Board determines that the issues raised by the appellant have been decided in an earlier appeal, or are based on substantially or materially the same facts, by or on behalf of the appellant, in accordance with § 4470. Copies of the decision shall be mailed to the appellant and hearing participants, and filed with the Zoning Administrator in accordance with the Act. Failure of the Board to issue a decision within the 45-day period shall be deemed approval and shall be effective on the 46th day.

Section 6.7 Variances

(A) Variance Request. The Development Review Board shall hear and decide upon requests for variance pursuant to the Act [§4469] and appeal procedures set forth in Section 6.6 of these regulations. **The Board may grant a variance, and render a decision in favor of the appellant, only if *all* of the following facts are found and the findings are specified in its decision:**

(1) That there are unique physical circumstances or conditions, including irregularity, narrowness, or shallowness of lot size or shape, or exceptional topographical or other physical conditions peculiar to the particular property, and that unnecessary hardship is due to such conditions and not the circumstances or conditions generally created by the zoning regulations in the district in which the property is located;

(2) That because of such physical circumstances and conditions, there is no possibility that the property can be developed in strict conformity with the provisions of the zoning regulation and that the authorization of a variance is necessary to enable the reasonable use of the property;

(3) That such unnecessary hardship has not been created by the appellant;

(4) That the variance, if authorized, will not alter the essential character of the neighborhood or district in which the property is located, substantially or permanently impair the appropriate use or development of adjacent property, reduce access to renewable energy resources, nor be detrimental to the public welfare; and

(5) That the variance, if authorized, will represent the minimum that will afford relief and will represent the least deviation possible from the zoning regulations and the Town Plan.

(B) **Renewable Energy Resource Structure Variance Request.** On an appeal for a variance from the provisions of these regulations that is requested for a structure that is primarily a renewable energy resource structure, the Board may grant such variance only if it finds that all of the following facts are found in the affirmative and specified in its decision:

(1) It is unusually difficult or unduly expensive for the appellant to build a suitable renewable energy resource structure in conformance with these regulations.

(2) The hardship was not created by the appellant.

(3) The variance, if authorized, will not alter the essential character of the neighborhood or district in which the property is located, substantially or permanently impair the appropriate use or development of adjacent property, reduce access to renewable energy resources, or be detrimental to the public welfare.

(4) The variance, if authorized, will represent the minimum variance that will afford relief and well represent the least deviation possible from these regulations and from the Town Plan.

(C) **Variance Request in the Floodplain District.** In addition to requirements under subsection (A), variances for development within the Floodplain District shall be granted by the Development Review Board only:

(1) In accordance with the Act [§4469 and 4424] and the criteria for granting variances found in CFR, Section 60.6 of the National Flood Insurance Program;

(2) Upon determination that during the base flood discharge the variance will not result in increased flood levels; and

For variances for development within the Floodplain District, the Zoning Administrator shall notify the applicant in writing that (i) the issuance of a variance to construct a structure below the base flood level will result in increased premium rates for flood insurance up to amounts as high as $25 for $100 of insurance coverage and (ii) such construction below the base flood level increases risks to life and property. Such notification shall be maintained with a record of all variance actions.

(D) In **granting a variance**, the Development Review Board may impose conditions that it deems necessary and appropriate under the circumstances to implement the purposes of this chapter and the Town Plan currently in effect. In no case shall the Development Review Board grant a variance for a use, which is not permitted or conditionally permitted within the applicable district nor shall the Board grant a variance, which results in an increase in allowable density.

Section 6.8 Violations and Enforcement

(A) **General Provisions.** The commencement or continuation of any land development, subdivision or land use that is not in conformance with any provision of these regulations shall constitute a violation. All such violations shall be prosecuted in accordance with the Act [§4451 and §4452]. Each day that a violation continues shall constitute a separate offense. The Zoning Administrator shall institute, in the name of the Town of Moretown, any appropriate action, injunction or other proceeding to enforce the provisions of these regulations. All fines imposed and collected shall be paid over to the municipality.

(B) **Notice of Violation.** No action may be brought under this section unless the alleged offender has had at least seven (7) days notice by certified mail that a violation exists. The seven-day warning notice shall state:

(1) That a violation exists;

(2) That the alleged offender has an opportunity to cure the violation within the seven days; and,

(3) That the alleged offender will not be entitled to an additional warning notice for a violation occurring after the seven days.

An action may be brought without the seven-day notice and opportunity to cure if the alleged offender repeats the violation of the regulations or ordinance after the seven-day notice period and within the next succeeding twelve (12) months.

(C) **Limitations on Enforcement.** An action, injunction or other enforcement proceeding relating to the failure to obtain or comply with the terms and conditions of any required or duly recorded municipal land use permit may be instituted against the alleged offender if the action, injunction or other enforcement proceeding is instituted within 15 years from the date the alleged violation first occurred, and not thereafter, in accordance with the Act [§4454]. The burden of proving the date the alleged violation first occurred shall be on the person against whom the enforcement action is instituted. No enforcement proceeding may be instituted to enforce an alleged violation of a municipal land use permit unless the permit or a notice of the permit has been recorded in the land records under Section 6.9.

(D) **Penalties.** Any person who violates any provision of this bylaw shall be fined the highest permissible fine allowed under the Act. In default of payment of the fine, such person, the members of any partnership, or the principal officers of such corporation shall each pay double amount of any such fine. Each day that a violation is continued shall constitute a separate offense. All fines collected for the violation of bylaws shall be paid over to the municipality whose bylaw has been violated.

If the structure is still noncompliant after the opportunity to cure has passed, the Administrator Officer shall submit a declaration to the Administrator of the National Flood Insurance Program (NFIP) requesting a denial of flood insurance. Section 1316 of the National Flood Insurance Act of 1968, as amended, authorizes FEMA to deny flood insurance to a property declared by a community to be in violation of their flood hazard area regulations. The declaration shall consist of: (a) the name of the property owner and address or legal description of the property sufficient to confirm its identity or location, (b) a clear and unequivocal declaration that the property is in violation of a cited State or local law, regulation, or ordinance, (c) a clear statement that the public body making the declaration has authority to do so and a citation to that authority, (d) evidence that the property owner has been provided notice of the violation and the prospective denial of insurance, and (e) a clear statement that the declaration is being submitted pursuant to Section 1316 of the National Flood Insurance Act of 1968, as amended.

(E) **Remedies.** If any structure or land is or is proposed to be erected, constructed, reconstructed, altered, converted, maintained or used in violation of any bylaw adopted under this chapter the Zoning Administrator shall institute proceeding to prevent, restrain, correct or abate such construction or use, or to prevent, in or about such premises, any act, conduct, business or use constituting a violation.

Section 6.9 Recording Requirements

(A) Pursuant to the Act [§4449], within thirty (30) days after a municipal land use permit including but not limited to a zoning permit and associated conditional use, PUD and/or variance approvals, and certificate of compliance, has become final, or within thirty (30) days of the issuance of a notice of violation, the Zoning Administrator shall deliver the notice of violation, or memorandum or notice of recording, to the Town Clerk for recording as provided in 24 V. S. A. subsections 1154(a) and (b). The applicant may be charged for the cost of recording fees.

(B) For development within the Floodplain District, the Zoning Administrator shall also maintain a record of:

(1) All permits issued for development in areas of special flood hazard;

(2) The elevation, in relation to mean sea level, of the lowest floor, including basement, or all new or substantially improved buildings;

(3) The elevation, in relation to mean sea level, to which buildings have been floodproofed;

(4) All floodproofing certifications required under this regulation; and,

(5) All variance actions, including the justification for their issuance. The Zoning Administrator shall notify the applicant in writing that (i) the issuance of a variance to construct a structure below the base flood level will result in increased premium rates for flood insurance up to amounts as high as $25 for $100 of insurance coverage and (ii) such construction below the base flood level increases risks to life and property. Such notification shall be maintained with a record of all variance actions.

ARTICLE VII
DEFINITIONS

Section 7.1 Terms and Usage

(A) Unless otherwise specifically provided, or unless otherwise clearly required by the context, the words and phrases defined in Article VII shall have the meanings indicated below.

(B) Words, phrases, and terms defined herein or elsewhere in these bylaws shall have their usual and customary meanings except where the context clearly indicates a different meaning.

(C) The words and terms used, defined, interpreted or further described in Article VII shall be construed as follows:

(1) The particular controls the general.
(2) The present tense includes the future tense.
(3) Words used in the singular number include the plural, and words used in the plural number include the singular, unless the context clearly indicates the contrary.
(4) The phrase "used for" includes "arranged for," "designed for," "intended for," "maintained for," and "occupied for."
(5) The word "shall" is mandatory; the word "may" is discretionary; the term "generally shall" is mandatory unless the Development Review Board or other applicable body deems otherwise in accordance with these regulations.
(6) The word "person" includes a firm, association, organization, partnership, trust, company or corporation, as well as an individual.
(7) The word "lot" includes "parcel" and "plot."

Doubt as to the precise meaning of any word used in this bylaw shall be clarified by the Development Review Board.

Section 7.2 Definitions

ACCESSORY DWELLING UNIT: A dwelling unit located within, attached, or detached to a single-family dwelling, that is clearly subordinate to a single-family dwelling, and has facilities and provisions for independent living, including sleeping, food preparation, and sanitation, provided there is compliance with all the following:

- The owner occupies either the primary dwelling or accessory dwelling
- The property has sufficient wastewater capacity
- The unit does not exceed 1050 square feet
- Applicable setback, coverage, and parking requirements specified in the bylaws are met. 24 V.S.A. §4412(1)E) [Refer to Section 3.1]

ACCESSORY STRUCTURE: A structure, the use of which is incidental and subordinate to the principal use or structure and is located on the same lot. Examples of accessory structures include patios, permanent swimming pools, porches, garages, tool sheds, workshops, decks and gazebos, boathouses, and docks. See also Accessory Dwelling Unit, Accessory Use.

ACCESSORY USE: A use that is incidental and subordinate to a principal use located on the same lot. Accessory uses may include home occupations, day care centers or group homes within single-family residences. See also Accessory Use, Accessory Dwelling Unit.

ADAPTIVE REUSE: The development of a new use for an older building or for the conversion to another use of a building originally designed for a special or specific purpose. [Refer to Section 3.2]

AGRICULTURE: Land (containing at least two acres) which is used for raising livestock, or agricultural or forest products, including farm structures and the storage of agricultural products raised on the property. The disposal, processing or application of human sludge is not an agricultural use.

ALLOWABLE DENSITY: The maximum number of units (e.g., dwelling units, principal uses) allowed on a particular lot, based upon the minimum lot size for the zoning district within which the lot is located.

AUTOMOBILE SALES AND SERVICE: Land or structures used for either or both the sale of new or used vehicles, and the maintenance, servicing, and repairing of vehicles.

BANK: An institution where money is deposited, kept, lent or exchanged.

BASE FLOOD: The flood having a one percent chance of being equaled or exceeded in any given year.

BASE FLOOD ELEVATION: Base Flood Elevation (BFE) the height of the base flood, usually in feet, in relation to the National Geodetic Vertical Datum of 1929, the North American Vertical Datum of 1988, or other datum referenced in the Flood Insurance Study report, or average depth of the base flood, usually in feet, above the ground surface.

BED AND BREAKFAST A single-family dwelling in which not more than ten (10) rooms are offered for rent to transient guests on a nightly basis, in addition to the principal occupants who shall reside on premise. Central dining and food preparation facilities may be provided sufficient to serve registered guests; cooking facilities shall not be provided in individual guest rooms.

BRIDGE: A structure, designed to convey vehicles and/or pedestrians, spanning a watercourse, public or private right-of-way or depression.

BUILDING: A structure having a roof, supported by columns or walls, and intended for shelter or enclosure of persons, chattel, animals, equipment, goods, or materials of any kind or nature.

BUSINESS OFFICE: **[See Professional/Business Office]**

CAMP: A private hunting, fishing or other recreational camp, consisting of a building or a tent not suitable for use as a full-time dwelling, but used no more than 60 days during the course of year and no more than 3 weeks consecutively, for temporary shelter in connection with a recreational activity, provided that such camp is located on a separate parcel not less than the lot size of the district and that only chemical incinerator or privy type toilet facilities are used.

CHILD DAY CARE FACILITY A place operated as a business or a service on a regular basis, whose primary function is protection, care and supervision of children outside their homes for periods less than twenty-four (24) hours a day by a person other than a child's own parent or guardian. [Refer to Section 3.4]

COMMUNITY CENTER: A place, structure, area or other facility used for recreational, social, education and cultural activities usually owned and operated by a public or nonprofit group or agency.

CONDITIONAL USE: A use of land which is not permitted as a right under these regulations, but which can be allowed by the Development Review Board, after public notice and a determination of whether the use complies with standards contained in these regulations and upon which the Development Review Board may attach reasonable conditions.

COTTAGE INDUSTRY: A home-based business that meets the specific standards set out in Section 3.7 of this bylaw.

DEVELOPMENT: Any man-made change to improved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations or storage of equipment or materials. Also includes all activities as defined under "LAND DEVELOPMENT". Development shall not include customary property maintenance activities.

DEVELOPMENT ENVELOPE: A specific area of a lot, delineated on a subdivision plat or site development plan, within which structures, parking and loading areas shall be located, and outside of which no structures, parking or loading areas shall be located. A building envelope shall be defined by required minimum setback and height distances, unless otherwise specified in these regulations. This also may be referred to as the "buildable area" of a lot.

DRIVEWAY: A vehicular access, easement or right-of way serving a maximum of two (2) parcels.

DWELLING UNIT: One or more rooms designed, occupied or intended for occupancy as separate living quarters with cooking, sleeping and sanitary facilities provided within the dwelling unit for the exclusive use of a single family maintaining a household. The term "dwelling unit" shall not include a hotel, motel, boarding house or similar structure. A Single Family home is equal to one dwelling unit.

DWELLING, MULTIPLE-FAMILY: A building containing two or more dwelling units, excluding ACCESSORY DWELLINGS UNITS.

ENCLOSED STORAGE: A building, the whole or major parts of which may be rented out to persons wishing to store belongings for a period of time.

EXISTING MANAFACTURED HOME PARK OR SUBDIVISION: For the purpose of floodplain management, means a manufactured home park or subdivision for which the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including, at a minimum, the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads) is completed before the effective date of the floodplain management regulations adopted by a community.

EXPANSION TO AN EXISTING MANAFACTURED HOME PARK OR SUBDIVISION: The preparation of additional sites by the construction of facilities for servicing the lots on which the manufacturing homes are to be affixed (including the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads).

FIA: Federal Insurance Administration

FAMILY: One or more persons living, sleeping, cooking and eating on the same premises as a single housekeeping unit.

FAMILY DAY CARE HOME OR FACILITY: A facility that provides for care on a regular basis in the caregiver's own residence for not more than ten children at any one time. Of this number, up to six children may be provided care on a full-time basis and the remainder on a part-time basis. For the purpose of this regulation, care of a child on a part-time basis shall mean care of a school-age child for not more than four hours a day. These limits shall not include children who reside in the residence of the caregiver; except:

(a) these part-time school-age children may be cared for on a full-day basis during school closing days, snow days and vacation days which occur during the school year; and,
(b) during the school summer vacation, up to 12 children may be cared for provided that at least six of these children are school age and a second staff person is present and on duty when the number of children in attendance exceeds six. These limits shall not include children who are required by law to attend school (age 7 and older) and who reside in the residence of the caregiver. 33 V.S.A. § 4902(3)

FLOOD HAZARD AREA: Land subject to one percent or greater chance of flooding in any given year. The area is designated as Zone A on the Flood Hazard Boundary Map. For purposes of these regulations, the term "flood hazard area" is synonymous in meaning with the phrase "area of special flood hazard" and "special flood hazard area".

FLOOD HAZARD BOUNDARY MAP (FHBM): An official map of a community, issued by the Federal Insurance Administrator, where the boundaries of the flood, mudslide (i.e., mudflow) and related erosion areas having special hazards have been designated as zones A, M and/or E.

FLOOD INSURANCE RATE MAP (FIRM): An official map of a community issued by the Federal Insurance Administrator on which both special hazard areas and risk premium zones applicable to the community have been delineated.

FLOOD INSURANCE STUDY: An examination, evaluation and determination of flood hazards and, if appropriate, corresponding water surface elevations or an examination, evaluation and determination of mudslide (i.e., mudflow) and /or flood related erosion hazards.

FLOODPROOFING: Any combination of structural and non-structural additions, changes, or adjustments to structures which reduce or eliminate flood damage to real estate or to improved real property, water and sanitary facilities, structures and their contents.

FLOODWAY: The channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than one foot.

FORESTRY: The developing, caring for or cultivating of forests, or the management and harvesting of timber.

GASOLINE STATION: Any premise where gasoline, petroleum and other fuel products are sold and/or vehicular maintenance activities are conducted. Specific standards are set out in Section 3.6

HEALTH CLINIC: A facility or institution, whether private or public, principally engaged in providing services for health maintenance and for the diagnosis and treatment of human ailments.

HEAVY INDUSTRY: A use engaged in the basic processing and manufacturing of materials or products predominantly from extracted or raw materials, or a use engaged in storage of or manufacturing processes using flammable or explosive materials, or storage or manufacturing processes that potentially involve hazardous or commonly recognized offensive conditions.

HISTORIC STRUCTURE: For the purpose of floodplain management, means any structure that is: (a) Listed individually in the National Register of Historic Places (a listing maintained by the Department of the Interior) or preliminarily determined by the Secretary of the Interior as meeting the requirements for individual listing on the National Register; (b) Certified or preliminarily determined by the Secretary of the Interior as contributing to the historical significance of a registered historic district or a district preliminarily determined by the Secretary to qualify as a registered historic district; (c) Individually listed on a state inventory of historic places in states with historic preservation programs which have been approved by the Secretary of the Interior; or (d) Individually listed on a local inventory of historic places in communities with historic preservation programs that have been certified either: (i) By an approved state program as determined by the Secretary of the Interior or (ii) Directly by the Secretary of the Interior in states without approved programs.

HOME OCCUPATION: An occupation, carried on within a principal or accessory residential structure, which is clearly incidental and secondary to the use of the premises for dwelling purposes, and which does not have an undue adverse effect upon the character of the residential area in which the premises is located and meets the specific standards set out in Section 3.7.

HOTEL/MOTEL: A building containing bedrooms and other facilities for occupancy and use by transients on a short term basis of less than one month average, and having a management entity operating the building(s) and providing such services as maid service, a central switchboard, or dining facilities to occupants of the lodging facility.

INTERESTED PERSON: In accordance with the Act [§4465(b)], the definition of an interested person shall include the following:

1. The applicant;
2. The municipality of Moretown or an adjoining municipality;
3. A person owning or occupying property in the immediate neighborhood of a property which is the subject of a decision or act taken under these regulations, who alleges that the decision or act, if confirmed, will not be in accord with the policies, purposes or terms of the plan or regulations of the Town;
4. Any 10 persons owning real property within the Town who, by signed petition to the Development Review Board, allege that any relief requested by a person under this section, if granted, will not be in compliance with the plan or bylaw of the Town;
5. Any department or administrative subdivision of the State owning property or any interest

therein within the Town or adjoining municipality, and the Vermont Agency of Commerce and Community Development.

LAND DEVELOPMENT: The division of a parcel of land into two (2) or more parcels; construction, reconstruction, structural alteration, conversion, relocation or enlargement of any building or other structure, or of any mining, excavation or landfill, and any change in the use of any building or other structure, or land, or extension of use of land. Also includes all activities as defined under "DEVELOPMENT". Land Development shall not include customary property maintenance activities.

LIGHT INDUSTRY: A use providing for the manufacturing predominately from previously prepared materials of finished products or parts, including processing, fabrication, assembly, treatment, packaging, incidental storage, sales and distribution of such products or components, but excludes basic industrial processing; and meets the specific standards in Section 3.8. Light industry is capable of operation in such a manner as to control the external effects of the manufacturing process, such as smoke, noise, soot, dirt, vibration, odor, etc.

LOT: Land used or occupied or to be used or occupied by a building and its accessory buildings, having not less than a minimum area and dimensions required for a lot in the district in which such land is situated.

LOT COVERAGE: The percentage of lot area which is covered by buildings, structures, and other impervious surfaces, including driveways and parking areas.

LOWEST FLOOR: For the purpose of floodplain management, means the lowest floor of the lowest enclosed area, including basement. An unfinished or flood resistant enclosure, usable solely for parking of vehicles, building access or storage in an area other than a basement area is not considered a building's lowest floor; Provided, that such enclosure is not built so as to render the structure in violation of the applicable non-elevation design requirements.

MANUFACTURED HOME: See Mobile Home

MIXED-USE BUILDING: A single structure containing more than one type of land use (i.e., residential and commercial), planned as a unified complementary whole, and functionally integrated to use shared access, parking areas, etc.

MOBILE HOME: A structure or type of manufactured home that is built on a permanent chassis and is designed to be used as a dwelling with or without a permanent foundation, includes plumbing, heating, cooling, and electrical systems, and is:

- Transportable in one or more sections; and
- At least eight feet wide or 40 feet long or when erected has at least 320 square feet or if the structure was constructed prior to June 15, 1976, at least eight feet wide or 32 feet long; or
- Any structure that meets all the requirements of these regulations except for size and for which the manufacturer voluntarily files a certification required by the U.S. Department of Housing and Urban Development and complies with the standards established under Title 42 of the U.S. Code 10 V.S.A. § 6201(1).

For floodplain management purposes, the term "mobile or manufactured home" also includes park trailers, travel trailers, and other similar vehicles placed on a site for greater than 180 consecutive days. For insurance purposes, the term "mobile or manufactured home" does not include park trailers, travel trailers, and other similar vehicles.

MOBILE HOME PARK: Any parcel of land under single or common ownership or control which contains, or is designed, laid out or adapted to accommodate, two or more mobile homes. Nothing herein shall be construed to apply to premises used solely for storage or display of mobile homes. Mobile home park does not mean any parcel of land under the ownership of agricultural employer who may provide up to four mobile homes used by full-time workers or employees of the agricultural employer as a benefit or condition of employment or any parcel of land used solely on a seasonal basis for vacation or recreational mobile homes. 10 V.S.A. § 6201(2).

MODULAR (or Prefabricated) HOUSING: A dwelling unit constructed on-site and composed of components substantially assembled in a manufacturing plant and transported to the building site for final assembly on a permanent foundation.

MOTOR VEHICLE: Includes all motor vehicles capable of being registered for legal operation of Vermont highways. Specifically excluded from this definition are all terrain vehicles (ATVs), boats and associated trailers, snow-machines and construction and excavation equipment.

MUNICIPAL LAND USE PERMIT: Includes any zoning, subdivision, site plan or building permit or approval, any of which relate to land development as defined in statute, which has received final approval from the applicable board, commission or officer of the municipality [24 V.S.A. §4303(11)].

MULTI-FAMILY DWELLING: Includes

NONCONFORMING LOTS OR PARCELS: Lots or parcels that do not conform to the present bylaws covering dimensional requirements but were in conformance with all applicable laws, ordinances, and regulations prior to the enactment of the present bylaws, including a lot or parcel improperly authorized as a result of error by the administrative officer.

NEW CONSTRUCTION: Means, for the purposes of determining flood insurance rates, structures for which the "start of construction" commenced on or after the effective date of an initial FIRM or after December 31, 1974, whichever is later, and includes any subsequent improvements to such structures. For floodplain management purposes, new construction means structures for which the start of construction commenced on or after the effective date of the floodplain management regulation adopted by a community and includes any subsequent improvements to such structures.

NEW MANAFACTURED HOME PARK OR SUBDIVISION: For the purpose of floodplain management, means a manufactured home park or subdivision for which the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including at a minimum, the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads) is completed on or after the effective date of the floodplain management regulations adopted by a community.

NONCONFORMING STRUCTURE: A structure or part thereof not in conformance with the present zoning regulations covering building bulk, dimensions, height, area, yards, density of off-street parking or loading requirements, where such structure conformed to all applicable laws, ordinances and regulations prior to the enactment of such zoning regulations, including a structure improperly authorized as a result of error by the administrative officer. [See Section 4. 8]

NONCONFORMING USE: A use of land or a structure which does not comply with present zoning regulations where such use conformed to all applicable laws, ordinances and regulations prior to the enactment of such regulations, including a use improperly authorized as a result of error by the administrative officer.[See Section 4.8]

NURSING HOME/EXTENDED CARE FACILITY: An extended or intermediate care facility licensed or approved to provide a full-time convalescent or chronic care to individuals who, by reason of advanced age, chronic illness or infirmity, are unable to care for themselves.

PARKING SPACE: Off-street space used for the temporary location of one licensed motor vehicle, which is at least nine feet wide and twenty-feet long, not including access driveway, and having direct access to a street or alley. [See Section 4.10]

PLACE OF WORSHIP: A church, synagogue, temple, mosque or other facility used for conducting formal religious ceremonies or services on a regular basis.

PLANNED RESIDENTIAL DEVELOPMENT (PRD): An area of land to be developed as a single entity for a number dwelling units; the plan for which does not correspond in lot size, bulk, or type of dwelling, density, lot coverage, and required opens space under these regulations except as a planned unit development (see also **PLANNED UNIT DEVELOPMENT**).

PLANNED UNIT DEVELOPMENT (PUD): One or more lots, tracts, or parcels of land to be developed as a single entity, the plan for which may propose any authorized combination of density or intensity transfers or increases, as well as the mixing of land uses. This plan, as authorized, may deviate from bylaw requirements that are otherwise applicable to the area in which it is located with respect to lot size, bulk, or type of dwelling or building use, density, intensity, lot coverage, parking, required common open space, or other standards.

PRIVATE CLUB: Buildings or facilities owned or operated by a corporation, association, or persons for a social, educational, or recreational purpose; but not primarily for profit or to render a service that is customarily carried on as a business.

PROFESSIONAL/BUSINESS OFFICE: A room or group of rooms wherein services are performed involving predominately administrative, clerical or professional operations.

PUBLIC ASSEMBLY FACILITY: A facility owned, operated, and/or maintained by a municipal, state, federal or community non-profit agency or service organization for use or access by the general public, including but not limited to office, meeting, assembly, cultural, and social facilities. A post office operated by the U.S. Postal Service is included in this definition. Educational and recreation facilities, defined elsewhere, are specifically are excluded from this definition.

PUBLIC FACILITY/SERVICE: Services and associated facilities maintained by municipal, state or federal government, community non-profit agencies or regulated utilities which serve but are typically not open to the general public, including but not limited to ambulance and fire stations, garages and equipment sheds, water and wastewater facilities, solid waste management facilities, and other institutional facilities where public access is prohibited, limited or controlled. Community facilities, electric utilities and telecommunications facilities, defined elsewhere, are specifically excluded from this definition.

RECREATION FACILITY, INDOOR: Includes indoor bowling alley, theater, table tennis and pool hall, skating rink, gymnasium, swimming pool, hobby workshop, and similar places of indoor commercial recreation.

RECREATION FACILITY, OUTDOOR: Any facility for outdoor recreation, including but not limited to tennis courts, golf courses, athletic fields, shooting and archery ranges, swimming pools or beaches, and trails for hiking, horseback riding, bicycling, snowmobiling and cross-country skiing, with the exception of facilities that are accessory to a residential dwelling. Such facilities may be improved or unimproved.

RECREATIONAL VEHICLE: A vehicle which is: (a) Built on a single chassis; (b) 400 square feet or less when measured at the largest horizontal projection; (c) Designed to be self-propelled or permanently towable by a light duty truck; and (d) Designed primarily not for use as a permanent dwelling but as a temporary living quarters for recreational, camping, travel, or seasonal use.

RESTAURANT: A structure for public eating in which the primary business is the preparation and serving of food for consumption on the premises.

RETAIL STORE: Establishment where goods or merchandise are offered for retail sale or short term rental to the general public for personal, business or household consumption and services incidental to the sale of such goods are provided. Retail Store shall exclude any drive-up service, free-standing retail stand, gasoline service and motor vehicle repair service, new and used car sales and service, trailer and mobile home sales and service.

ROAD: Any road, highway, avenue, street, land or other way between right-of-way lines, commonly used for vehicular traffic and serving three or more lots.

ROAD FRONTAGE: Lot lines which abut a public road.

SIGNIFICANT WILDLIFE HABITAT: Those natural features that contribute to the survival and/or reproduction of the native wildlife of Moretown. This shall include, but is not limited to, (1) deer wintering areas (i.e. deeryards); (2) habitat for rare, threatened and endangered species (state or federally listed); (3) concentrated black bear feeding habitat (mast stands); (4) riparian areas and surface waters; (5) wetlands and vernal pools; (6) wildlife travel corridors; (7) high elevation bird habitat (8) ledge, talus and cliff habitat; and (9) habitat identified by the Vermont Department of Fish and Wildlife as either significant wildlife habitat or necessary wildlife habitat in accordance with 10 V.S.A. § 6086(a)(8)(A).

SIGNS: A structure, or device used for visual communication, which is used for the purpose of bringing the subject thereof to the attention of the public or to display, identify and publicize the name, product, or service of any person.

SLOPE: The topographical gradient of any area of land, whether or not located on a single lot, as determined by the ratio of the vertical distance (rise) to horizontal distance (run) which, for purposes of these regulations, is expressed as a percentage. A **steep slope** is a slope with a topographical gradient equal to or greater than fifteen percent (15%) but less than twenty-five percent (25%). A

very steep slope is a slope with a topographical gradient equal to or greater than twenty-five percent (25%).

SPECIAL FLOOD HAZARD AREA: The land in the floodplain within a community subject to a 1 percent or greater chance of flooding in any given year. The area may be designated a Zone A on the Flood Hazard Boundary Map (FHBM). After detailed ratemaking has been completed in preparation for publication of the Flood Insurance Rate Map (FIRM), Zone A usually is refined into Zones A, AO, AH, A1-30, AE, A99, AR, AR/AI-30, AR/AE, AR/AO, AR/AH, AR/A, VO or V1-30, VE, or V. For purposes of these regulations, the term "special flood hazard area" is synonymous in meaning with the phrase "area of special flood hazard" and "flood hazard area"

STABLE: A structure in which livestock is kept for private use, remuneration, hire, or sale.

START OF CONSTRUCTION: For the purpose of floodplain management, includes substantial improvement, and means the date the building permit was issued, provided the actual start of construction, repair, reconstruction, rehabilitation, addition placement, or other improvement was within 180 days of the permit date. The actual start means either the first placement of permanent construction of a structure on a site, such as the pouring of slab or footings, the installation of piles, the construction of columns, or any work beyond the stage of excavation; or the placement of a manufactured home on a foundation. Permanent construction does not include land preparation, such as clearing, grading and filling; nor does it include the installation of streets and/or walkways; nor does it include excavation for a basement, footing, piers, or foundations or the erection of temporary forms; nor does it include the installation on the property of accessory buildings, such as garages or sheds not occupied as dwelling units or not part of the main structure. For a substantial improvement, the actual start of construction means the first alteration of any wall, ceiling, floor, or other structural part of a building, regardless whether that alteration affects the external dimensions of the building.

STREAM: All surface waters as depicted on 1:24,000 (7.5 minute) U.S. Geological Survey (USGS) maps covering the Town of Moretown. The following USGS 7.5 minute quadrangles cover Moretown: Middlesex, Waterbury, Waitsfield, and Northfield. These quadrangles are available at the Town Clerk's Office.

STRUCTURE: An assembly of materials for occupancy or use including, but not limited to, a building, mobile home or trailer, or swimming pool. Walls and fences are exempt (See BUILDING). Structure means, for floodplain management purposes, a walled and roofed building, including a gas or liquid storage tank, that is principally above ground, as well as a manufactured home. Structure, for insurance purposes, means: (a) A building with two or more outside rigid walls and a fully secured roof, that is affixed to a permanent site; (b) A manufactured home ("a manufactured home," also known as a mobile home, is a structure: built on a permanent chassis, transported to its site in one or more sections, and affixed to a permanent foundation); or (c) A travel trailer without wheels, built on a chassis and affixed to a permanent foundation, that is regulated under the community's floodplain management and building ordinances or laws. For the latter purpose, "structure" does not mean a recreational vehicle or a park trailer or other similar vehicle, except as described in (c) of this definition, or a gas or liquid storage tank.

SUBDIVISION: Division of any parcel of land for the purposes of conveyance, transfer of ownership, lease, improvement, building, development or sale, whereby two (2) or more lots, blocks or parcels are created. The term "subdivision" includes resubdivision.

SUBSTANTIAL DAMAGE: Damage of any origin sustained by a structure whereby the cost of restoring the structure to its before damaged conditions would equal or exceed 50 percent of the market value of the structure before the damage occurred.

SUBSTANTIAL IMPROVEMENT: Any repair, reconstruction or improvement of a structure the cost of which equals or exceeds 50 percent of the market value of the structure either: a) before the improvement or repair is started; or b) if the structure has been damaged, and is being restored, before the damage occurred. The term does not, however, include either (1) any project for improvement of a structure to comply with existing State or local health, sanitary or safety code specifications which are solely necessary to assure safe living conditions or (2) any alteration of a structure listed on the National Register of Historic Places or a State Inventory of Historic Sites.

TELECOMMUNICATIONS FACILITY: A facility which is primarily for commercial, industrial or public communication or broadcasting purposes, to include towers or other supporting structures which extend vertically twenty (20) feet or more, equipment, buildings and parking areas, and other ancillary development (see Section 3.15).

TEMPORARY STRUCTURE: A structure designed for limited use with no foundation or footings, which is easily relocated and which is removed when the designated time period, activity, or use for which the temporary structure was erected has ceased.

UNDUE ADVERSE EFFECT: A condition that creates, imposes, aggravates, or leads to inadequate, impractical, unsafe, or unhealthy conditions on a site proposed for development or on off-tract property or facilities. Adverse effects can relate to circulation, drainage, erosion, potable water, sewage collection and treatment, as well as lighting and glare, aesthetics, quality of life, and impact on the environment. (See Section 5.2 (F) for determining *undue adverse effect*).

VIOLATION OF FLOODPLAIN MANAGEMENT REGULATIONS: Means the failure of a structure or other development to be fully compliant with the community's floodplain management regulations. A structure or other development without the elevation certificate, other certifications, or other evidence of compliance required in 44 CFR 60.3 is presumed to be in violation until such time as that documentation is provided.

WETLANDS: Those areas of the state that are inundated by surface or groundwater with a frequency sufficient to support vegetation or aquatic life that depend on saturated or seasonally saturated soil conditions for growth and reproduction. Such areas include, but are not limited to, marshes, swamps, sloughs, potholes, fens, river and lake overflows, mud flats, bogs and ponds, but excluding such areas as grow food or crops in connection with farming activities. Class I and II wetlands are those wetlands that have been identified by the Vermont Agency of Natural Resources as significant. Information regarding whether a wetland has been identified as a Class I or II wetland is available from the Agency's Department of Environmental Conservation.

WILDLIFE REFUGE: An area set aside for the conservation of plants, animals and their habitat. These are noncommercial areas usually without any structures on them. A single parking area and walking trails are characteristic of a wildlife refuge.

YARD: Space on a lot not occupied with a building or structure. Porches, whether enclosed or unenclosed, shall be considered as part of the main building and shall not project into a required yard. The front yard is measured from the street centerline to the point on building closest to the street. Side and rear yards are measured from the lot line to the point of the building closest to the lot line.

ZONING PERMIT: The permit issued by the Zoning Administrator, which authorizes development when such development has been determined to be in accord with these regulations and the applicable fee paid (see Section 6.2).

APPENDICES

Appendix A: Zoning District Descriptions

Appendix B: Zoning Map

Appendix A: Zoning District Descriptions

The location and boundaries of zoning districts are established as shown on the official "Town of Moretown Zoning Map", and the associated overlays, which is made part of these regulations. The official zoning map and overlays shall be located in the Town Clerk's office and shall be the final authority as to the current zoning status of land and waters in the town.

Where uncertainty exists as to the location of district boundaries shown on the official zoning map and overlay, the guidelines included in Section 2.2 of the regulations shall apply. To assist with the application of those guidelines, the following general district descriptions may be used.

VILLAGE DISTRICT includes those areas:

(1) A strip of land running southerly from the cement bridge (#3) by the Fire Station, measured from Route 100B to the Mad River on th west and 200 feet to the east of Route 100B, to the intersection of Route 100B wand the Austin/Pony Farm Road (fown Highway #3); and, a strip 250 feet wide, on both sides of Route 100B, southerly from the intersection of Town Road #3 and Route 100B to the Mad River.

(2) North of the cement bridge (#3) by the Fire Station, to the former Iron Bridge (#4) over the Mad River, extending 500 feet to the east of Route 100B, and to the Mad River on the west of Route 100B;

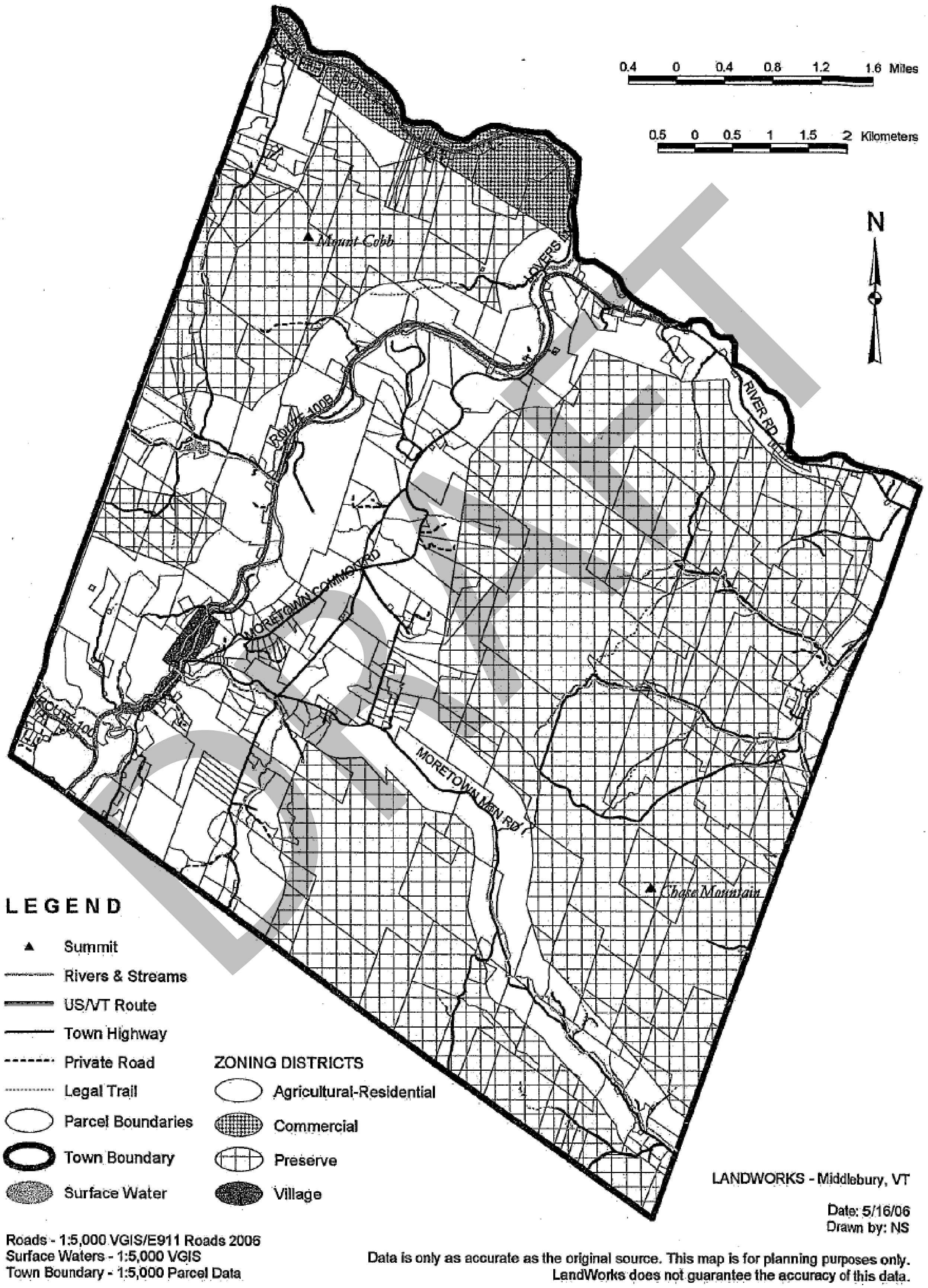
(3) A strip of land measured 250' west from the Mad River, including those parcels west of the Mad River fronting uponTown Road #39, northerly to the Trudy Murphy Road.

COMMERCIAL DISTRICT starts at the lower (northerly) end of Lovers' Lane where VELCO lines cross the Winooski River and road, extending northerly along Route 2 to the Moretown/Duxbury Town line, including all land between Route 2 and the Winooski River; and from Lovers' Lane to the Moretown/Duxbury Town line on the south side of Route 2, the line follows the VELCO transmission line to the Moretown/Duxbury Town line.

AGRICULTURAL-RESIDENTIAL DISTRICT is generally measured as a setback from Town Roads, as scaled from the Official Zoning Map, unless the boundary coincides with the Mad River or other physical feature.

PRESERVE DISTRICT includes all lands not otherwise zoned as Village, Commercial, or Agricultural-Residential.

Appendix B. Moretown Zoning Map

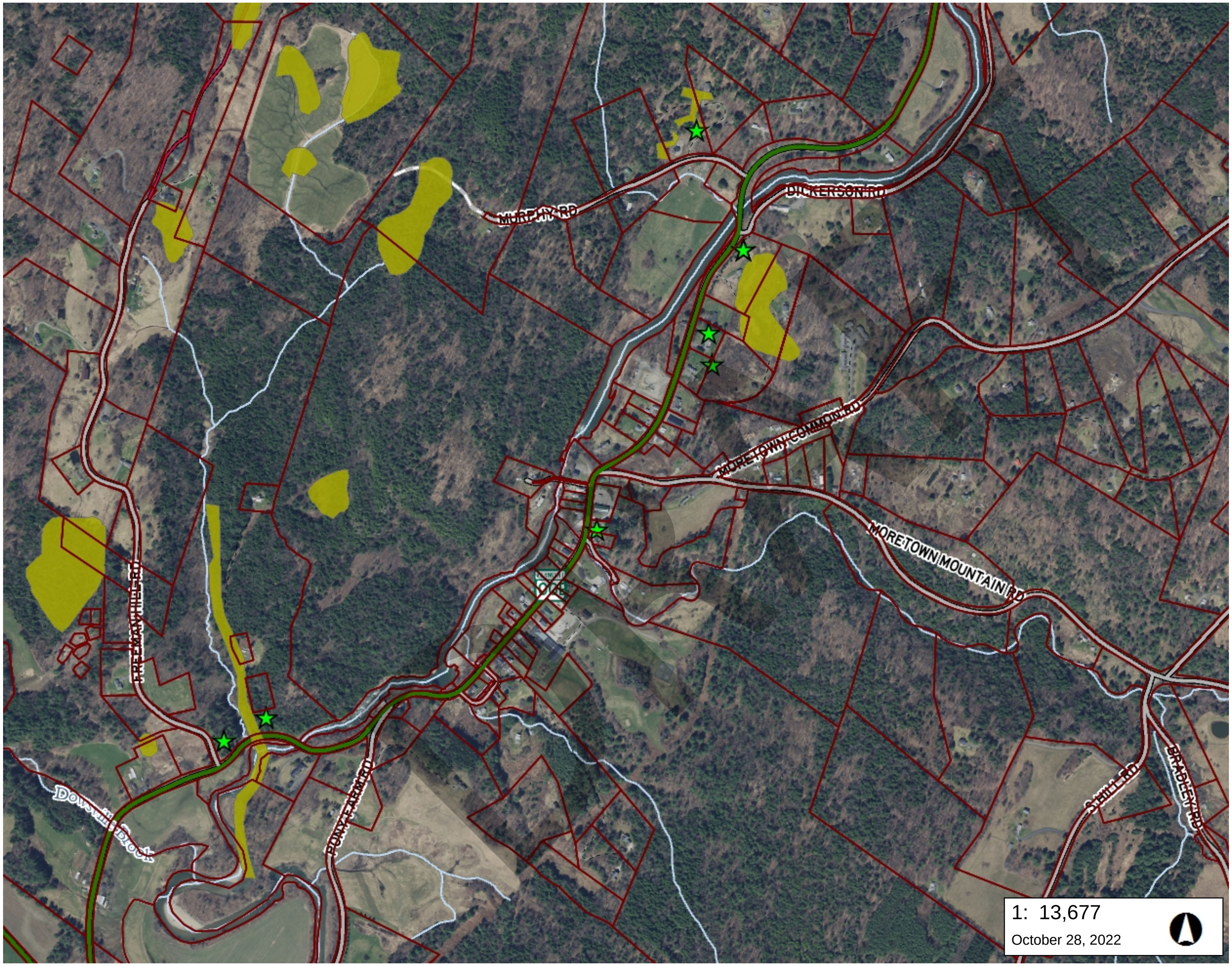


VERMONT

Natural Resources Atlas

Vermont Agency of Natural Resources

vermont.gov



1: 13,677

October 28, 2022

LEGEND

- Wetland Projects
- Wetland - VSWI
  - Class 1 Wetland
  - Class 2 Wetland
  - Buffer
- Wetlands Advisory Layer
- Parcels (standardized)
- Roads
  - Interstate
  - US Highway; 1
  - State Highway
  - Town Highway (Class 1)
  - Town Highway (Class 2,3)
  - Town Highway (Class 4)
  - State Forest Trail
  - National Forest Trail
  - Legal Trail
  - Private Road/Driveway
  - Proposed Roads
- Stream/River
  - Stream
  - Intermittent Stream
- Town Boundary

NOTES

Map created using ANR's Natural Resources Atlas

695.0 0 348.00 695.0 Meters

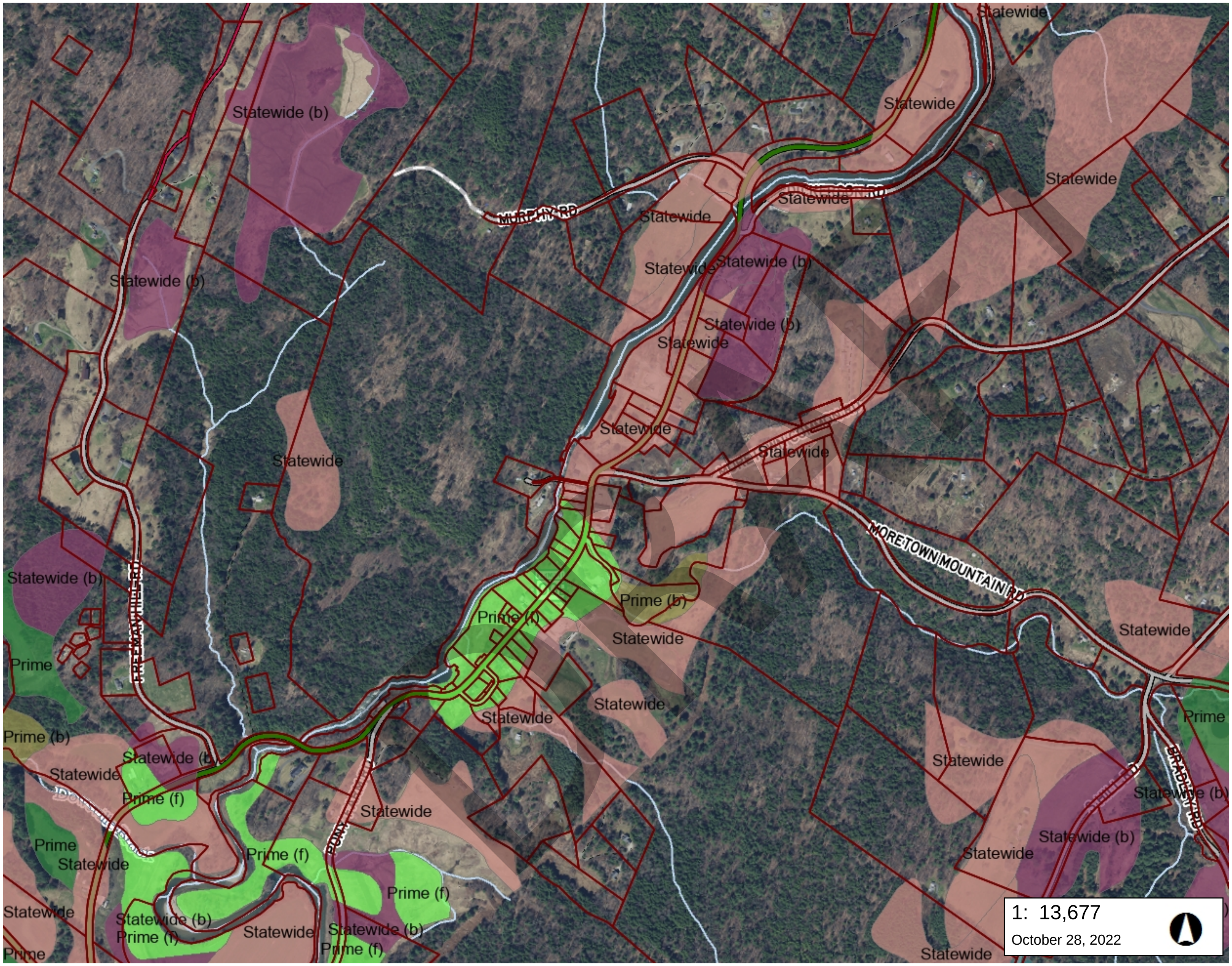
WGS_1984_Web_Mercator_Auxiliary_Sphere 1" = 1140 Ft. 1cm = 137 Meters

THIS MAP IS NOT TO BE USED FOR NAVIGATION

Natural Resources Atlas

Vermont Agency of Natural Resources

vermont.gov



LEGEND

Soils - Prime Agricultural

- Local
- Local (b)
- Not rated
- Prime
- Prime (b)
- Prime (f)
- Statewide
- Statewide (a)
- Statewide (b)
- Statewide (c)

Parcels (standardized)

Roads

- Interstate
- US Highway; 1
- State Highway
- Town Highway (Class 1)
- Town Highway (Class 2,3)
- Town Highway (Class 4)
- State Forest Trail
- National Forest Trail
- Legal Trail
- Private Road/Driveway
- Proposed Roads

Stream/River

- Stream
- Intermittent Stream

695.0   0   348.00   695.0 Meters

WGS_1984_Web_Mercator_Auxiliary_Sphere   1" = 1140 Ft.   1cm = 137 Meters

THIS MAP IS NOT TO BE USED FOR NAVIGATION

DISCLAIMER: This map is for general reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable. ANR and the State of Vermont make no representations of any kind, including but not limited to, the warranties of merchantability, or fitness for a particular use, nor are any such warranties to be implied with respect to the data on this map.

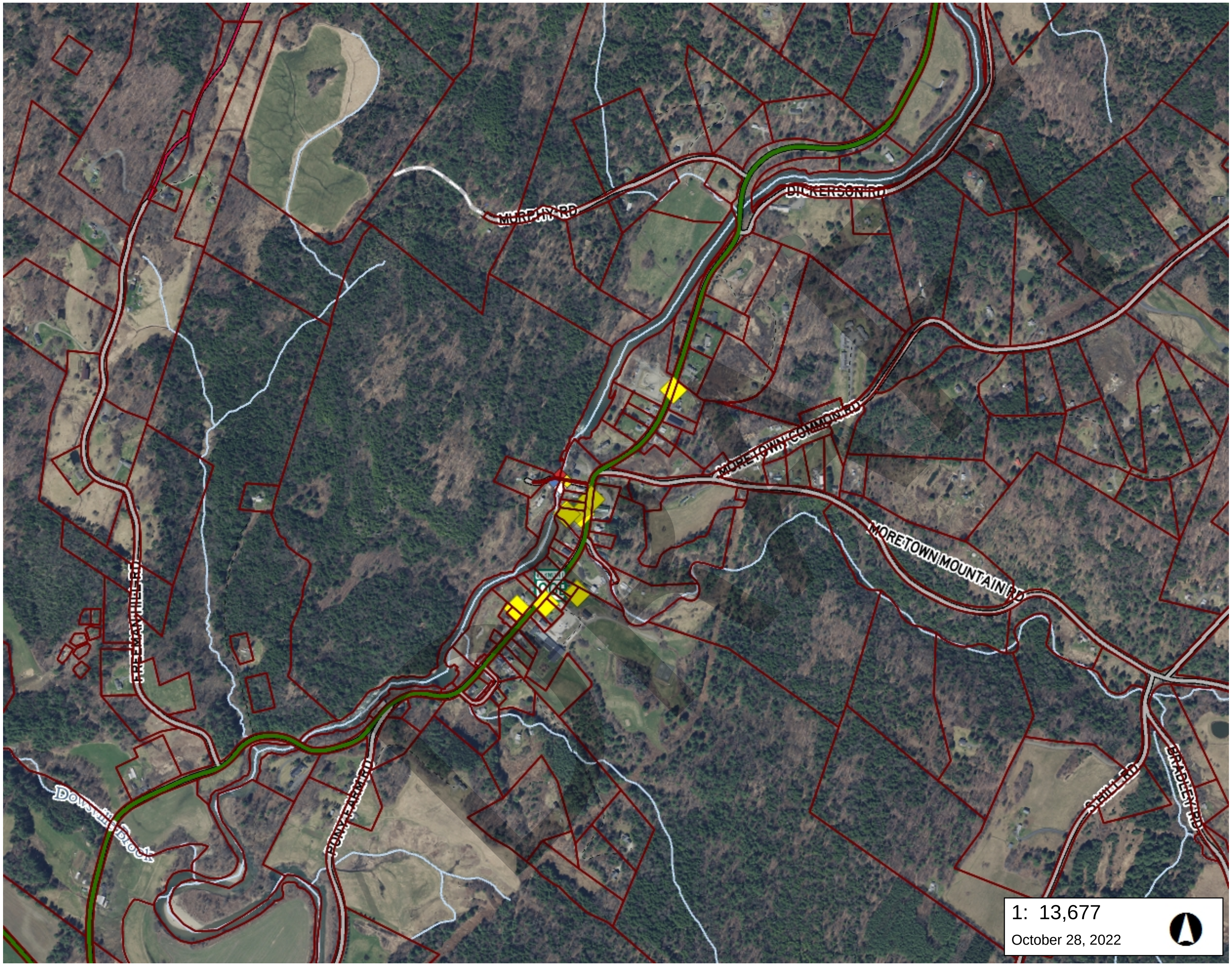
NOTES

Map created using ANR's Natural Resources Atlas

Natural Resources Atlas

Vermont Agency of Natural Resources

vermont.gov



LEGEND

- Hazardous Site
- Hazardous Waste Generators
- Parcels (standardized)
- Roads
  - Interstate
  - US Highway; 1
  - State Highway
  - Town Highway (Class 1)
  - Town Highway (Class 2,3)
  - Town Highway (Class 4)
  - State Forest Trail
  - National Forest Trail
  - Legal Trail
  - Private Road/Driveway
  - Proposed Roads
- Stream/River
  - Stream
  - Intermittent Stream
- Town Boundary

695.0 0 348.00 695.0 Meters

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VERMONT

Natural Resources Atlas

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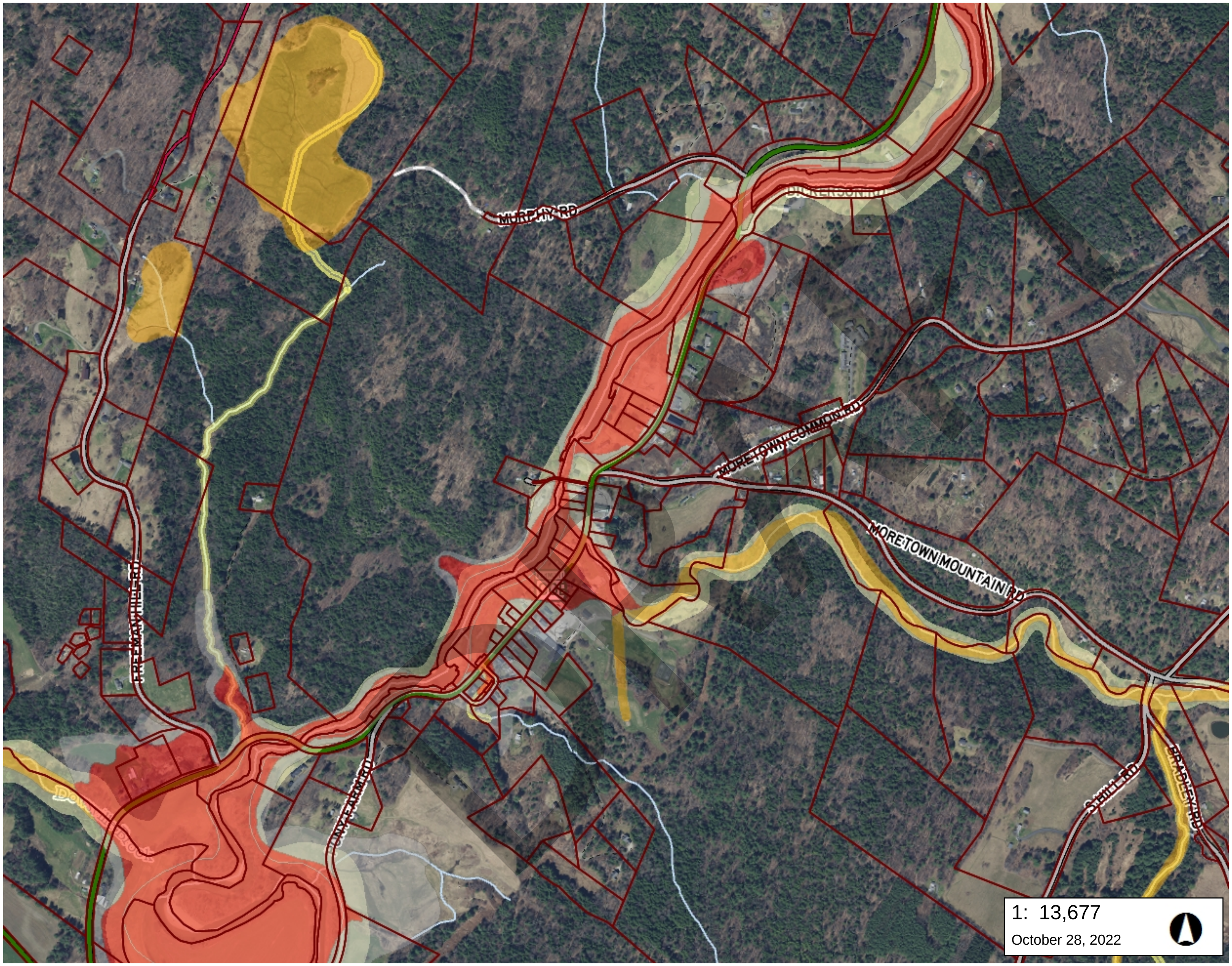
vermont.gov



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October 28, 2022

LEGEND

Flood Hazard Areas (Only FEM

- AE (1-percent annual chance floodp
- A (1-percent annual chance floodpl
- AO (1-percent annual chance zone feet)
- 0.2-percent annual chance flood ha

River Corridors (Aug 27, 2019)

- .5 - 2 sqmi.
- .25-.5 sqmi.

Parcels (standardized)

Roads

- Interstate
- US Highway; 1
- State Highway
- Town Highway (Class 1)
- Town Highway (Class 2,3)
- Town Highway (Class 4)
- State Forest Trail
- National Forest Trail
- Legal Trail
- Private Road/Driveway
- Proposed Roads

Stream/River

- Stream
- Intermittent Stream

Town Boundary

NOTES

Map created using ANR's Natural Resources Atlas

695.0 | 0 | 348.00 | 695.0 Meters

WGS_1984_Web_Mercator_Auxiliary_Sphere

1" = 1140 Ft. 1cm = 137 Meters

THIS MAP IS NOT TO BE USED FOR NAVIGATION

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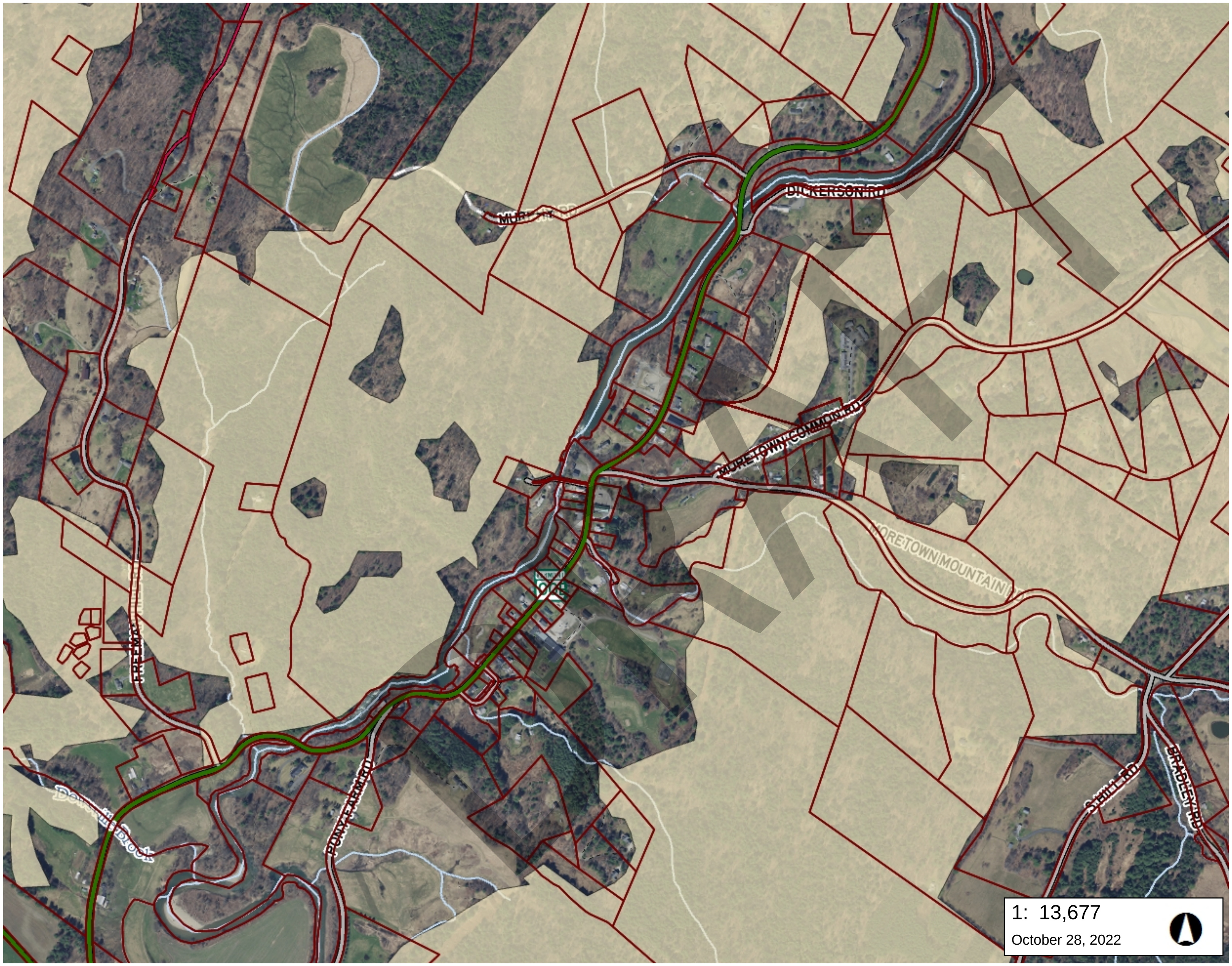
Natural Resources Atlas

Vermont Agency of Natural Resources

vermont.gov



1: 13,677

October 28, 2022

LEGEND

Rare Threatened and Endange

- RTE Animal
- RTE Plant

Deer Wintering Areas

Parcels (standardized)

Roads

- Interstate
- US Highway; 1
- State Highway
- Town Highway (Class 1)
- Town Highway (Class 2,3)
- Town Highway (Class 4)
- State Forest Trail
- National Forest Trail
- Legal Trail
- Private Road/Driveway
- Proposed Roads

Stream/River

- Stream
- Intermittent Stream

Town Boundary

695.0 | 0 | 348.00 | 695.0 Meters

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NOTES

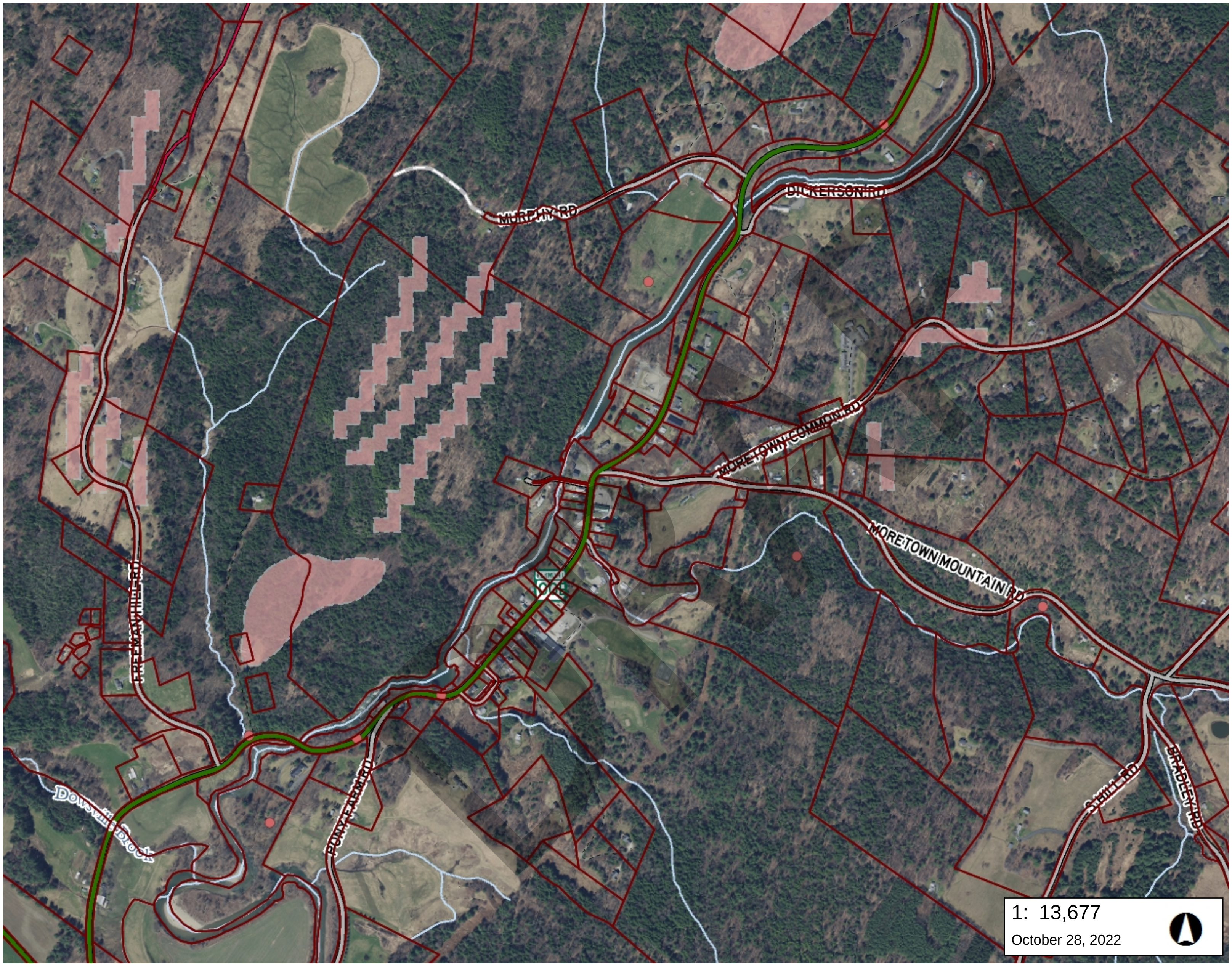
Map created using ANR's Natural Resources Atlas

VERMONT

Natural Resources Atlas

Vermont Agency of Natural Resources

vermont.gov



LEGEND

- Bedrock Outcrops (points)
- Bedrock Outcrops (polygon)
  - 1:24,000
  - 1:62,500
- Parcels (standardized)
- Roads
  - Interstate
  - US Highway; 1
  - State Highway
  - Town Highway (Class 1)
  - Town Highway (Class 2,3)
  - Town Highway (Class 4)
  - State Forest Trail
  - National Forest Trail
  - Legal Trail
  - Private Road/Driveway
  - Proposed Roads
- Stream/River
  - Stream
  - Intermittent Stream
- Town Boundary

1: 13,677

October 28, 2022

695.0 | 0 | 348.00 | 695.0 Meters

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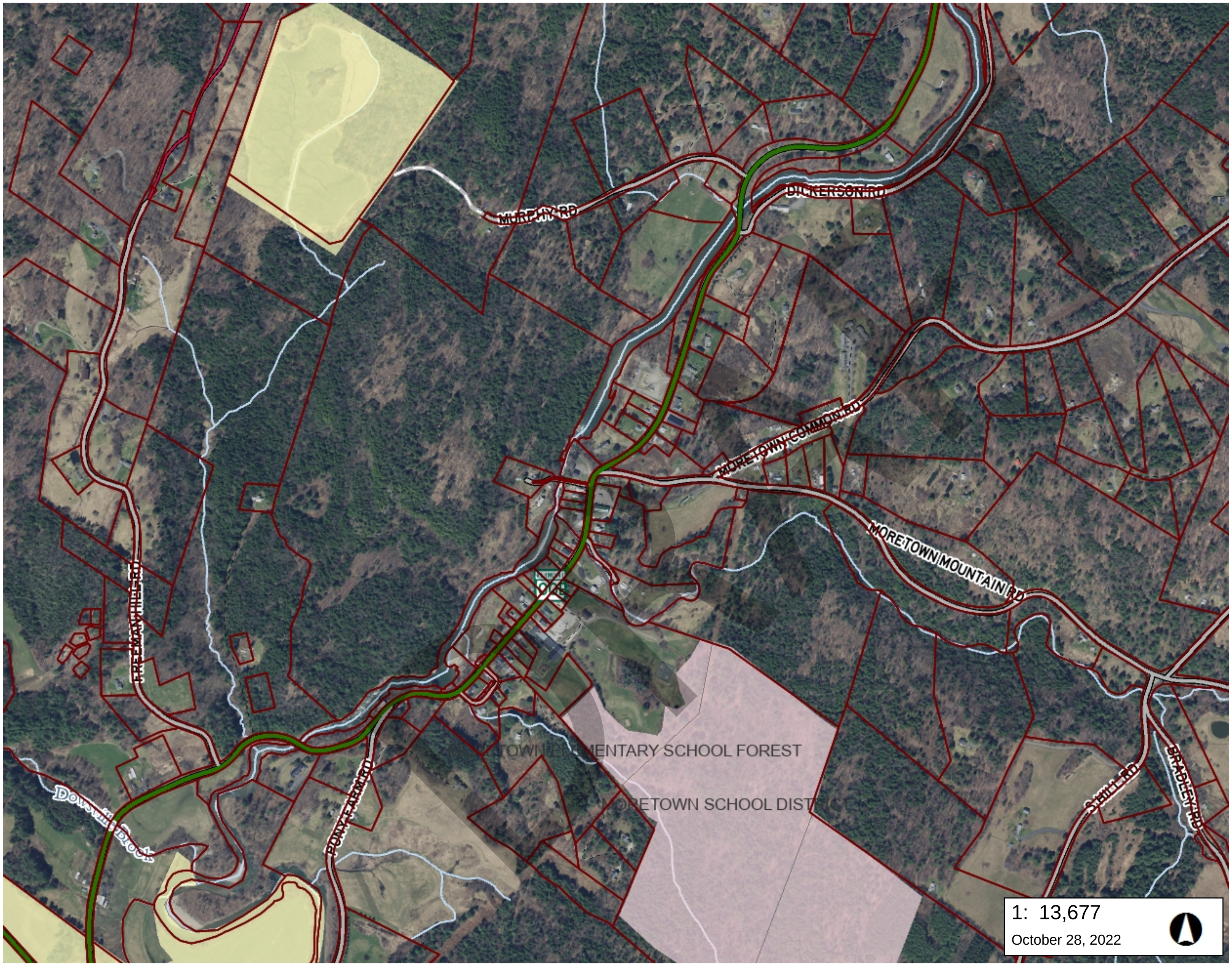
Natural Resources Atlas

Vermont Agency of Natural Resources

vermont.gov



1: 13,677

October 28, 2022

LEGEND

Protected Lands
- Private Organizations
- Vermont Municipalities
- State
- Federal

Parcels (standardized)

Roads
- Interstate
- US Highway; 1
- State Highway
- Town Highway (Class 1)
- Town Highway (Class 2,3)
- Town Highway (Class 4)
- State Forest Trail
- National Forest Trail
- Legal Trail
- Private Road/Driveway
- Proposed Roads

Stream/River
- Stream
- Intermittent Stream

Town Boundary

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695.0 0 348.00 695.0 Meters

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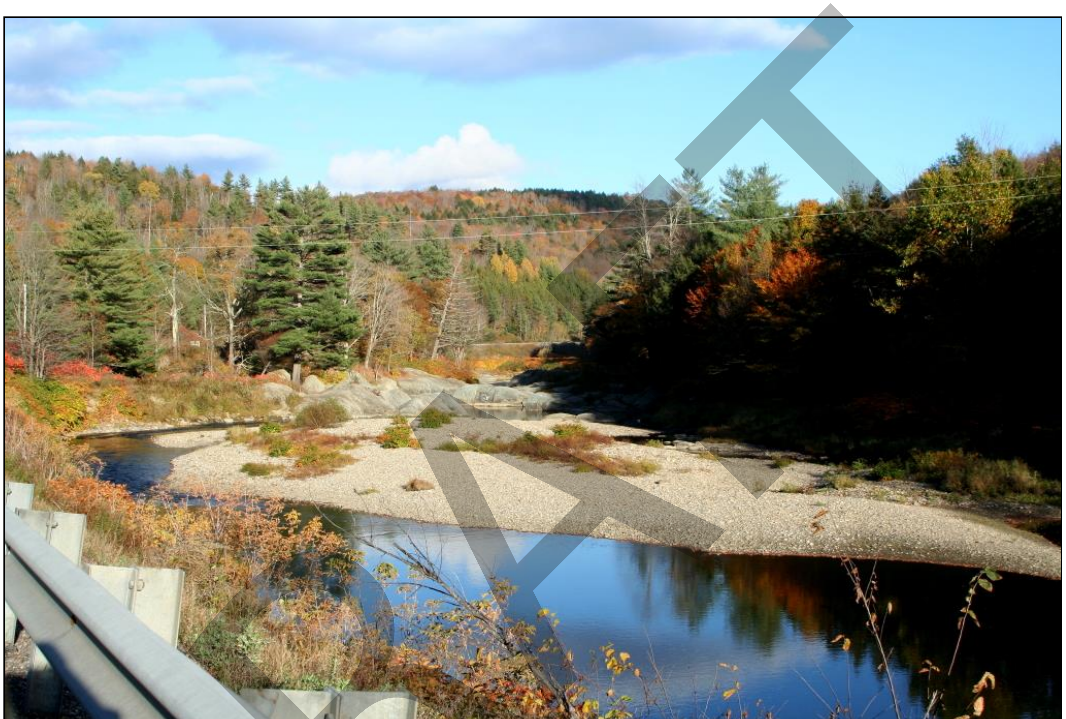
Water Quality Conditions in the Mad River Watershed, Vermont 1985-2015



Prepared for the

Friends of the Mad River

by

Fritz Gerhardt, Ph.D.

31 May 2016

Beck Pond LLC

Beck Pond LLC, a limited liability company founded in 2008, partners with public and private organizations to conduct scientific research that not only increases our understanding of the natural environment but also informs and guides on-the-ground conservation and management. Among other projects, Beck Pond LLC has conducted scientific studies and helped develop conservation projects that assess the impacts of historical land uses on forest plant communities in northern New England; assess the impacts of invasive plants on California grasslands and New England forests; identify, assess, and propose solutions to water quality problems in the Lake Memphremagog, White River, and Missisquoi Bay watersheds; protect and restore floodplain forests and wetlands along the Connecticut River and in the Lake Memphremagog Basin; and identify and protect critical wildlife habitats across northern New England and eastern Canada.

Cover. Looking downstream along the Mad River just downstream of the village of Moretown, Vermont on 15 October 2015. Note the large bedrock outcrops and sand and gravel bars, both characteristic of this dynamic river system. The pools among the distant rock outcrops are one of many popular swimming areas along the Mad River.

Water Quality Conditions in the Mad River Watershed, Vermont 1985-2015

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This project would not have been possible without the support and assistance of many individuals and organizations. Corrie Miller (Friends of the Mad River) spearheaded the development of, obtained funding for, administered, provided valuable insights, and asked probing questions throughout this project. Numerous volunteers with the Mad River Watch provided valuable insights into site locations and sampling protocols (as well as collecting many water samples throughout the years): Michael Ware, Fran Plewak, Chase Fortier, and Paula Baldwin, among others. Neil Kamman (Vermont Department of Environmental Conservation) provided valuable insights into the water quality sampling and water quality issues in the Mad River watershed, especially in relation to *Escherichia coli* (*E. coli*). Steve Fiske (Vermont Department of Environmental Conservation) provided valuable insights into long-term and biological monitoring sites in the Mad River watershed. Jim Kellogg (Vermont Department of Environmental Conservation) provided valuable feedback on the recommendations for updating and upgrading the Mad River Watch water quality monitoring program. Kristen Underwood (University of Vermont) provided additional insights into water quality conditions and future monitoring options in the Mad River watershed. This project was made possible by the generous funding provided by an anonymous donor and a Vermont Watershed Grant from the Vermont Agency of Natural Resources. The assistance and support of all of these individuals and organizations are greatly appreciated.

Table of Contents

List of Tables

List of Figures

List of Figures (continued)

Executive Summary

1. Since 1985, the Friends of the Mad River has monitored water quality conditions throughout the Mad River watershed of Vermont to identify, assess, and correct water quality problems. The resulting water quality data are perhaps unparalleled in Vermont, especially in terms of the length of the record (31 years) and the consistent and repeated sampling of the same sites throughout this time period, and provide an outstanding, long-term record of water quality conditions in the Mad River watershed during 1985-2015. This report provides an overview of the Friends of the Mad River water quality monitoring program, presents the results of the analyses of the biological and chemistry data collected through this program, identifies several areas and issues of concern, and provides recommendations for future monitoring efforts.

2. Starting in 1985 and continuing through 2015, staff and volunteers from the Friends of the Mad River used portable field equipment and an in-house laboratory to quantify various physical, chemical, and biological parameters at a total of 57 sites along the Mad River and its tributaries (only 18-40 sites were sampled in any one year). Starting in 2006, the Friends of the Mad River partnered with the LaRosa Analytical Laboratory of the Vermont Department of Environmental Conservation to measure total phosphorus, turbidity, and *Escherichia coli* (*E. coli*) at a subset of those 57 sites (*E. coli* was only analyzed through this partnership during 2006-2011). In executing this project, staff and volunteers adhered to a rigorous set of quality assurance standards in order to collect the most precise and accurate measures of the physical, chemical, and biological conditions in the Mad River watershed. Review of the quality assurance data and examination of the stream flows sampled indicated that the data were generally collected across a broad but consistent range of stream flows and in a repeatable manner and without contamination.

3. Water temperatures were measured at 52 sites on 143 dates during 1988-2014. Water temperatures along both the main stem and the tributaries were generally high, primarily because these measurements were only recorded during the summer months (June-August). However, water temperatures were highest in the middle and lower reaches of the main stem and were lowest along the upper reaches of the main stem and many of the tributaries. These higher temperatures likely reflected the more open land uses, lack of vegetative cover, and more meandering river channel along the lower reaches of the main stem. Thus, these data did allow us to identify areas that provide suitable habitat for cold-water fish, such as brook trout (*Salvelinus fontinalis*) and other cold-water organisms.

4. pH, which measures the acidity or alkalinity of water, was measured at 51 sites on 1-80 dates during 1988-1995 and 1997-2005 (34-40 sites were sampled in each year). All sites, including those along both the main stem and the tributaries, exhibited generally neutral pHs (mean at each site = 6.7-7.2). Because pH is largely influenced by the underlying

bedrock and surficial geology, pH levels showed no pronounced relationships with stream flow, but they did show an almost universal pattern of change over time. That is, pH levels initially decreased at all sites in the years prior to 1995, but, after 1995, they increased markedly and consistently at all sites, presumably in response to improvements in air quality and decreased acid deposition following implementation of the Clean Air Act and its amendments starting in the mid-1990s.

5. Total phosphorus, which measures the concentration of all forms of phosphorus in the water column and is an important measure of nutrient levels in rivers and streams, was measured at 19 sites on 55 dates during 2006-2015 (18 sites were sampled in all ten years). Total phosphorus concentrations were remarkably low across almost all of the sample sites. The only areas of concern were along two tributaries (High Bridge and Folsom Brooks) and the main stem in the vicinity of Moretown village. At two of these three sites, total phosphorus concentrations have increased over time, and the positive relationships with stream flow suggested that much of the phosphorus at these two sites may be originating from nonpoint sources, such as surface runoff from agricultural and other land uses and from unpaved roads, especially along High Bridge Brook.

6. Turbidity, which measures water clarity, was measured at the same 19 sites on 55 dates during 2006-2015 (18 sites were again sampled in all ten years). Turbidity levels were also remarkably low across all sample sites. Turbidity levels were slightly higher at two sites located along the main stem near the villages of Moretown and Waitsfield, especially during the two most recent years of this study (2014-2015). At a third site along High Bridge Brook, turbidity levels were also slightly higher than elsewhere, and there the turbidity levels had increased markedly, especially during the past five years. Like total phosphorus, turbidity levels at this site increased markedly with stream flow, and this positive relationship again suggested that nonpoint sources, such as surface runoff from agricultural and other land uses and from unpaved roads, may be impacting water quality in this stream.

7. Fecal coliform bacteria and *Escherichia coli* (*E. coli*), which is one type of fecal coliform bacteria, are valuable indicators of the health and safety of surface waters, especially in areas valued for recreational uses such as swimming. Fecal coliform bacteria were measured at 56 sites on 59 dates during 1985-1991 and 2002-2005 (18-39 sites were sampled in any one year), and *Escherichia coli* were measured at 47 sites on 3-83 dates during 2002-2015 (36-39 sites were sampled in any one year). Both fecal coliform and *E. coli* counts were very high at a number of sites along the lower section of the main stem as well as along several tributaries. Both fecal coliform and *E. coli* counts increased consistently from upstream to downstream areas along the main stem and were markedly higher from the village of Waitsfield downstream to the mouth of the Mad River. At several of the downstream sites, *E. coli* counts also showed a disturbing trend towards higher values during the past 10-15 years. The positive relationship between *E. coli* and stream flow at many of these sites suggested that the source(s) of the *E. coli* may be related to stormwater runoff, especially from areas contaminated by manure, leakage or overflows from septic systems, and wastewater.

8. Collectively, these data greatly increased our understanding of water quality problems in the Mad River watershed. In general, water quality conditions in the Mad River and its tributaries were very good to excellent; however, a few areas exhibited total phosphorus concentrations and turbidity and *E. coli* levels that were higher than desirable. In order to maintain this outstanding long-term data set and to further pinpoint and assess the sources of these water quality problems, we recommend that future monitoring efforts include: 1) continued monitoring of *E. coli* and fecal coliform bacteria at selected sites along the main stem and several tributaries, primarily where swimming and other recreational activities are popular; 2) the addition of new sample sites in areas where water quality problems were identified but are not fully understood (e.g. lower reaches of the main stem and Welder, High Bridge, Folsom, and Clay Brooks); and 3) sampling total nitrogen, which will allow us to better pinpoint and identify possible sources of water quality problems, especially in areas where the high *E. coli*, phosphorus, and turbidity levels may have agricultural or wastewater sources. Better understanding these water quality problems will facilitate efforts to identify and develop the appropriate protection and restoration strategies that will most effectively protect and improve water quality throughout the Mad River watershed.

Introduction

Water is essential for human life as well as most other forms of life. Consequently, water quality is important to the health and integrity of both the human and natural communities. Surface waters - such as streams, rivers, lakes, ponds, and wetlands - provide numerous important ecosystem services and functions and support a great diversity of natural communities and organisms. In addition, surface waters provide drinking water, hydroelectric power, and disposal of treated wastewater; support agricultural and industrial production; and serve important flood control and water filtration functions. Furthermore, surface waters provide important opportunities for recreation, including swimming, boating, fishing, hunting, nature-viewing, and other outdoor activities. The quality of surface waters can also greatly affect the prevalence and spread of many diseases that can be harmful to human health (e.g. cholera and malaria). Because water is essential for maintaining both aquatic and terrestrial ecosystems, water quality serves as a valuable indicator of ecosystem health, especially since water quality integrates the impacts of a wide range of stressors in both the terrestrial and aquatic ecosystems.

Water quality faces a number of threats across a broad range of geographic scales. At the regional and global scales, water quality is threatened by climate change (including changes in both temperature and the frequency and intensity of precipitation events), atmospheric deposition (e.g. acid precipitation and sulfur and nitrogen deposition), and invasive species [e.g. Eurasian water milfoil (*Myriophyllum spicatum*) and zebra mussels (*Dreissena polymorpha*)]. At the local and landscape scales, water quality is threatened by these factors as well as chemical and biological toxins; changes in land uses such as forest clearing and conversion, construction and maintenance of paved and unpaved roads, and increased urban and suburban development; poor agricultural and forestry practices; loss of wetlands and shoreline habitats; and in-stream modifications, such as dams and channelization. Collectively, these stressors often result in increased sedimentation and nutrient enrichment, which can cause the eutrophication (or "premature aging and death") of water bodies. When allowed to proceed unchecked, elevated nutrient and sediment levels can cause excessive plant and algal growth, and the subsequent decomposition can deplete oxygen levels to levels that are too low to support most aquatic life. At its extreme, this process can lead to the development of "dead zones", where virtually no aquatic life survives due to oxygen depletion. In addition, excessive nutrients and sediment, especially the combination of high levels of phosphorus, nitrogen, and iron, can lead to increased occurrences of freshwater cyanobacterial (blue-green algal) blooms and marine and estuarine diatom blooms (e.g. "red tides"). Some of these cyanobacteria and diatoms produce toxins that can be harmful or even fatal to humans and wildlife. Finally, these stressors can also eliminate or compromise important aquatic and riverine habitats for fish and wildlife [e.g. warmer water temperatures result in loss of brook trout (*Salvelinus fontinalis*) habitat].

The Mad River is a tributary of the Winooski River (which is itself a tributary of Lake Champlain). The Mad River drains the valley (popularly known as the "Mad River Valley") that separates the main range of the Green Mountains to the west and the Northfield Mountains to the east. The Mad River and its tributaries, nestled in a deep valley between high mountains, give the Mad River Valley its unique sense of place and are highly-valued resources that support a wide array of recreational activities, economic benefits, and ecological functions. The Mad River and its tributaries are used extensively for boating, swimming, fishing, nature-viewing, and other recreational activities (Figure 1). The Mad River hosts nineteen swimming holes along the main stem and three tributaries (Stetson, Lincoln, and Shepard Brooks)(Jenkins et al. 1992). The Mad River is also popular for recreational boating and offers a range of conditions from calm water (Class I) to white water (Class III-IV). The 19 km (12 miles) between Warren and Moretown are a mix of relatively calm Class I and II waters, although there are two areas of more challenging ledges. The 11 km (7 miles) between Moretown Gorge and the Winooski River include a mix of flat water, quick water, a few short Class II rapids, as well as more significant Class III-IV rapids. The Mad River Valley is also popular for its scenic beauty and as home to two popular ski areas (Sugarbush Resort and Mad River Glen). In addition, the Mad River Valley hosts important historic and cultural resources, including several National Historic Districts (Mad River Valley Rural, McLaughlin Farm, Waitsfield Common, Waitsfield Village, and Warren Village) and sites listed on the National Register of Historic Places (the Warren, Great Eddy, and Pine Brook Covered Bridges and the Joslin and McLaughlin Farms). Finally, the Mad River and its tributaries serve as public water supplies, provide hydroelectric power, and support agricultural and industrial production; and the floodplains serve important flood control and water filtration functions.

Figure 1. Swimming is one of several popular recreational activities that occur at many locations along the Mad River, including this area known locally as Ward's Access in Moretown, Vermont viewed on 15 October 2015.

The Mad River Valley also hosts a number of unique and important geologic, hydrologic, and ecological features. There are numerous waterfalls, cascades, and gorges along the Mad River and several of its tributaries (Lincoln, Slide, Stetson, and Mills Brooks), including Moretown Gorge, Mad River Natural Bridge (one of only three in Vermont), and Warren Falls (Jenkins & Zika 1988, State of Vermont 2008). The upper reaches of the Mad River and most of the tributaries are cold-water streams that support native brook trout as well as stocked rainbow trout (*Oncorhynchus mykiss*). The warm-water lower reaches of the main stem support stocked brown trout (*Salmo trutta*) and rainbow trout. Unfortunately, the dams in Warren and Moretown fragment and degrade the aquatic habitats used by these and other fish. Numerous deer wintering areas are located throughout the Mad River watershed, including along the main stem and Dowsville, Shepard, Mill, Folsom, Clay, Lincoln, Stetson, and Mills Brooks. In addition, the surface waters and associated habitats support a number of rare plant and animal species and significant natural communities, which contribute greatly to regional biodiversity. In recognition of these natural features, a number of areas have been conserved to protect public access and the natural heritage of the Mad River watershed, including the Green Mountain National Forest, Camels Hump State Park, and Granville Reservation State Park.

Over the past three decades, there has been considerable interest in protecting and improving water quality and its associated values along the Mad River and its tributaries. This interest has been spurred by concerns that water quality in the Mad River was threatened by rapid development; excessively high levels of nutrients, sediment, and *Escherichia coli* (*E. coli*); and increasing frequency and intensity of flooding. In addition, the State of Vermont has listed a number of locations along the Mad River and its tributaries as impaired or stressed by *Escherichia coli*, sedimentation, stormwater impacts, and insufficient flows due to water withdrawal activities (State of Vermont 2014b, 2014c).

Study Goals

Since 1985, the Friends of the Mad River has been monitoring water quality conditions in the Mad River and its tributaries through its Mad River Watch program, one of the longest-running, volunteer-based water quality monitoring programs in the United States. The overarching goal of this program has been to identify and address water quality problems in order to protect and restore the physical, chemical, and biological integrity of the Mad River and to protect the health and human use of the river. More specifically, the goals of the Mad River Watch program have been 1) to collect baseline information on water quality conditions in the Mad River; 2) to document the impact of point and nonpoint pollution sources on selected physical, chemical, and biological water quality indicators; 3) to document long-term changes in water quality conditions resulting from the implementation of best management practices; 4) to determine whether or not it is safe for humans to use the river; and 5) to determine whether the river meets Vermont Water Quality Standards for bacteria, nutrients, and other indicators. To this end, volunteers have collected water samples every summer since 1985 to document water temperature, pH, total phosphorus, turbidity, fecal coliform bacteria, and *Escherichia coli* at numerous sites along the Mad River and its tributaries. Given this long-term record of water quality conditions, the Friends of the Mad River contracted to have these water quality data compiled, summarized, and analyzed and to recommend options for maintaining and upgrading the Mad River Watch program in future years.

Study Area

One of the largest tributaries of the Winooski River, the Mad River (Waterbody ID VT08-18) extends approximately 42 km (26 miles) and drains an area of approximately 373 km^2 (144 miles^2) in the towns of Moretown, Duxbury, Waitsfield, Fayston, Warren, Lincoln, and Granville in central Vermont (Figure 2). The Mad River drains a narrow valley (popularly known as the "Mad River Valley") that separates the spine of the Green Mountains to the west and the Northfield Mountains to the east. Elevations in the Mad River watershed range between approximately 133 m (435 ft) at the mouth of the Mad River in Moretown to 1,244 m (4,083 ft) atop Mount Ellen in Warren. The Mad River originates in Granville Notch in the town of Granville and flows downstream in a northerly direction through the towns of Warren, Waitsfield, and Moretown before flowing into the Winooski River just downstream of the village of Middlesex. The Mad River is fed by numerous tributary streams, including Lincoln, Freeman, Folsom, Mill, Shepard, and Dowsville Brooks, among others. Blueberry Lake, an artificial impoundment, is the only significant lake in the Mad River watershed and covers an area of 19 ha (48 acres) to a maximum depth of 4.9 m (16 ft). The Mad River is impounded by two dams, the Moretown-8 hydroelectric dam, which has a rated capacity of 920 kW, in Moretown and a second, wooden crib dam in the village of Warren. There are other dams and weirs located along several tributaries of the Mad River, including the earthen dam that impounds Blueberry Lake. The dominant land uses in the Mad River watershed include forestry (86% of the watershed), agriculture (7.3% of the watershed), urban and suburban development in the village centers, and scattered areas of residential development throughout the watershed (all developed lands encompass 4.3% of the watershed)(Stone Environmental 2016).

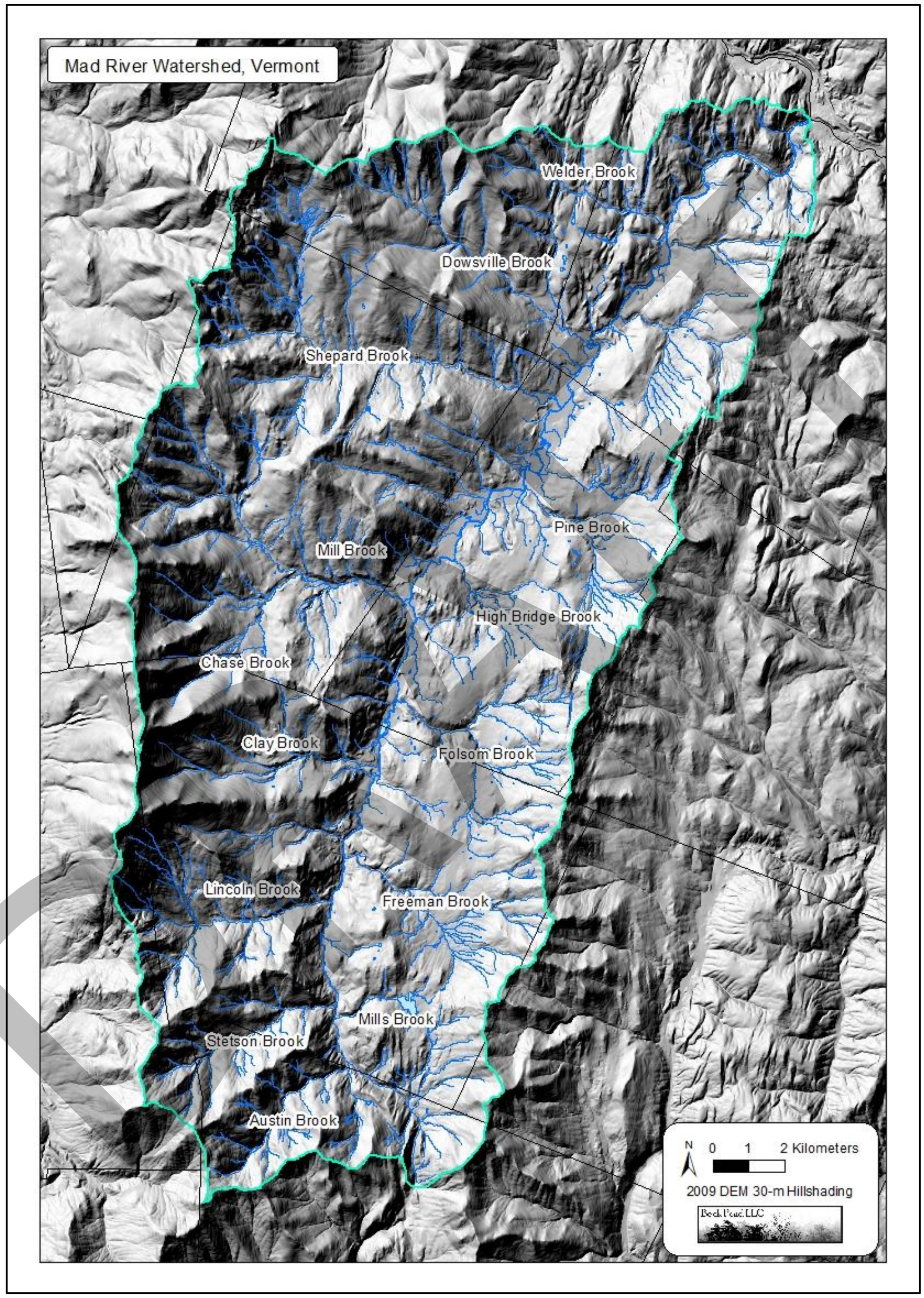

Figure 2. Map of the Mad River watershed (outlined in turquoise) showing the locations of the major tributaries and the topography illustrated by hill-shading.

A number of water quality concerns have been identified in the Mad River watershed, and parts of the Mad River and its tributaries have been listed by the State of Vermont as either impaired or stressed (State of Vermont 2014b, 2014c). The downstream-most 10 km (6.2 miles) of the Mad River from its mouth to Moretown village are already part of an approved Total Maximum Daily Load (TMDL) addressing elevated *Escherichia coli* levels due to possible failing septic systems and other unknown sources (State of Vermont 2011; Part D, State of Vermont 2014b). Clay Brook, from River Mile 1.8 to River Mile 2.3, is impaired and in need of a Total Maximum Daily Load (TMDL) due to increased peak stormwater flows, stormwater runoff, erosion and sedimentation from construction activities and from a gravel parking lot, and iron deposits, all of which are impacting aesthetics and aquatic life support (Part A, State of Vermont 2014b). A 3.4-km (2.1-mile) section of Mill Brook is listed as partially failing to support aquatic life due to artificial and insufficient flows below the Mad River Glen snow-making water withdrawal (Part F, State of Vermont 2014b). Another 1.3 km (0.8 miles) of Slide Brook are listed as failing to support aquatic life due to artificial and insufficient flows below the Mount Ellen snow-making water withdrawal (Part F, State of Vermont 2014b). Finally, a short section of the Mad River from Warren Dam upstream to Vermont Route 100 is listed as stressed due to elevated sediment levels originating from morphological instability and nearby sand and gravel pits, all of which are impacting aesthetics and aquatic life support (State of Vermont 2014c).

In addition, staff from the Biomonitoring and Aquatic Studies Section (BASS) of the Vermont Department of Environmental Conservation (DEC) have monitored the fish and macroinvertebrate communities at numerous sites along the Mad River and its tributaries during 1991-2008 . In general, the macroinvertebrate communities have been ranked as good to excellent at most sites along the main stem, and several tributaries, including Austin, Lockwood, Shepard, Dowsville, and Kewvasseur Brooks. In contrast, during the 1990s, the macroinvertebrate communities in Clay, Rice, Chase, and Slide Brooks, all of which drained parts of the Sugarbush Resort, were ranked as fair or poor due to erosion and sediment transport by stormwater. However, following improvements to the parking areas and other stormwater infrastructure, the macroinvertebrate communities in those streams improved dramatically, and all of these streams, except Clay Brook, were removed from the list of impaired waters (State of Vermont 2008, 2014b). Three other areas of concern include Bradley Brook, where the macroinvertebrate community was ranked as only fair to good in 2006; High Bridge Brook, where there were concerns about the higher water temperatures and excessive sediment on the streambed in an area of pasture; and Welder Brook, where houses, lawns, and a gravel road are encroaching upon the stream (State of Vermont 2008).

Methods

Starting in 1985 and continuing through 2015, staff and volunteers from the Friends of the Mad River have used portable field equipment, an in-house laboratory , and a partnership program through the State of Vermont to quantify various physical, chemical, and biological parameters at 57 sites along the Mad River and its tributaries. Each year during 1985-2015, staff and volunteers from the Friends of the Mad River sampled water quality at 18-40 sites on 2-6 dates during June, July, and August. On each sample date, volunteers collected water samples from each site to be analyzed for total phosphorus, turbidity, fecal coliform bacteria, and/or *E. coli* bacteria. These samples were collected in pre-labeled, sterilized bottles according to protocols established by the Friends of the Mad River and, in the case of those samples being analyzed by the LaRosa Analytical Laboratory, in conjunction with the Vermont DEC (State of Vermont 2006, 2009). At each site, volunteers collected grab samples either directly into the sample bottle or with a dip sampler. In general, water samples were collected 20-30 cm (8-12 in) beneath the water's surface (or mid-way between the surface and the streambed if the water was too shallow) and as far from the streambank and as close to the center of the current as was safely and practically possible. Before collecting the samples, they rinsed the turbidity bottles and, if using one, the dip sampler with sample water three times. All samples were collected in the morning, stored in coolers, and delivered to the Friends of the Mad River office in Waitsfield, Vermont by 10 a.m., and those samples being analyzed by the LaRosa Analytical Laboratory were delivered to the laboratory the same day. This schedule ensured that the laboratories were able to process the samples in a timely manner. While sampling, the volunteers also measured air temperature in the shade, water temperature, and pH and recorded sample date and time, current and previous weather conditions, flow level and category, and general observations about the river or stream and any factors potentially affecting water quality. To avoid spreading invasive species, volunteers disinfected all gear that was touched by water (e.g. boots, sandals, etc.) between sample sites, especially when traveling upstream along the main stem or from the main stem into tributaries.

The fecal coliform and *E. coli* samples were analyzed by Friends of the Mad River staff at their offices in Waitsfield using two different methodologies. During 1992-2002, fecal coliform and *Escherichia coli* samples were processed and counted using a membrane filtration method, in which fecal coliform and *Escherichia coli* samples were collected, processed, and grown on a nutrient medium, so that the numbers of fecal coliform and *E. coli* colonies could be counted by the naked eye. During 2002-2015, fecal coliform and *E. coli* colonies were processed and counted using the Quanti-Tray 2000 system (IDEXX Laboratories, Westbrook, Maine). In this method, fecal coliform and *Escherichia coli* samples were collected, processed, and placed in an incubator within six hours; and the numbers of fecal coliform and *E. coli* colonies were counted after the samples were incubated for 24 hours. This method is widely used, provides very accurate and precise measures of fecal coliform and *E. coli* levels, and is approved by the Environmental Protection Agency as well as other accrediting agencies and organizations.

Quality Assurance

All of the water quality data collected in partnership with the LaRosa Analytical Laboratory during 2006-2015 were collected in accordance with a Quality Assurance Project Plan (QAPP) developed in conjunction with the Vermont DEC and U.S. Environmental Protection Agency. Based on this Quality Assurance Project Plan, the volunteers collected two field blanks and two field duplicates, representing approximately 10% of the number of samples collected on each sample date. Blank sample containers were rinsed and filled only with de-ionized water using the same procedures that were used to collect the field samples and, if done properly, should result in values below the detection limits (5 µg/l for total phosphorus, 0.2 NTU for turbidity, and 1 colony/100 ml for *E. coli*). Field duplicates required collecting a second set of samples at the same time and place as the original samples. When done properly, the mean relative percent difference among all pairs of duplicate samples should be <30% for total phosphorus, <15% for turbidity, and <50% (if >25 colonies/100 ml) or <125% (if <25 colonies/100 ml) for *E. coli*.

Stream Flow

To relate the water quality data to stream flows, we relied on a single source of stream flow data [the U.S. Geologic Survey gage station on the Mad River near Moretown, Vermont (USGS station 04288000)]. The daily stream flow data were downloaded from the USGS website (http://waterdata.usgs.gov/usa/nwis/uv?04288000). Using these data, we calculated the criteria distinguishing four flow levels (low, moderate, high, and flood) based on guidance from the Vermont DEC. Across the entire range of stream flows, low flows were defined as the lowest 25% of all stream flows; moderate flows were defined as the intermediate 50% of all stream flows; high flows were defined as the highest 25% of all stream flows; and flood flows were defined as the top 5% of all stream flows. For the Mad River, these four categories of flow level were calculated using all of the daily stream flow data collected during 1928-2015. In addition, the Friends of the Mad River also qualitatively categorized stream flows based on their field observations and the same stream gage measurements. Their categories included 1) low and steady (LS, when it has not rained in several days and the flow is low), 2) low and rising (LR, when recent rains caused a low-flowing river to rise), 3) low and declining (LD, when rain caused a low-flowing river to rise earlier in the week, but the flow is now dropping), 4) high and steady (HS, when the river has been running higher than normal for several days), 5) high and rising (HR, when recent rains caused a high river to rise even further), and 6) high and declining (HD, after reaching peak flow, a high-flowing river is falling). These qualitative assessments were not used in the quantitative analyses presented in this report but were used to better understand individual data points and water quality conditions at individual sites.

Data Analysis

To accomplish the goals of this study, we undertook the following steps to compile, summarize, and analyze the water quality data collected by the Friends of the Mad River during 1985-2015:

1. First, the Friends of the Mad River provided all of the readily-available data collected by the Mad River Watch program during 1985-2015. In addition, the Vermont DEC provided all of the data housed in their Integrated Watershed Information System (IWIS) database.
2. Second, we downloaded all of the stream flow data from the U.S. Geological Survey (USGS) stream gage located along the Mad River near Moretown, Vermont during 1928-2015.
3. Once downloaded, all of these data were imported into and compiled in electronic spreadsheets (Excel 2007, Microsoft, Redmond, Washington).
4. All of the data were screened to identify any errors or outlying data points, and the available quality assurance (QA) data were analyzed to verify that water samples were collected in a repeatable manner without any contamination.
5. We used the geographic coordinates to map all of the sample sites in a Geographic Information System (ArcGIS 10, ESRI, Redlands, California).
6. We summarized the water quality data for each sample site, and, where data were sufficient, we analyzed the water quality data in relation to stream flow, and year.
7. We compared the results of our analyses to those reported in earlier reports prepared by the Friends of the Mad River and other agencies and organizations.
8. We developed recommendations for updating and upgrading the water quality monitoring program, including identifying new sites and new parameters that would best pinpoint and assess possible sources of water quality problems.
9. We identified locations within the Mad River watershed, where on-the-ground assessments should be conducted by the appropriate agency or organization (e.g. Friends of the Mad River; Vermont DEC; and/or Vermont Agency of Agriculture, Food & Markets) to investigate possible sources of water quality problems.
10. Finally, in July 2016, we will present the results of this study at a public outreach meeting with staff, members, and volunteers from the Friends of the Mad River; staff from the Vermont Agency of Natural Resources and Vermont Agency of Agriculture, Food & Markets; and other interested parties.

Throughout this project, we coordinated our efforts with staff, board members, and volunteers from the Friends of the Mad River and other water quality professionals, including personnel from the Vermont DEC and the University of Vermont. All these stakeholders were targeted with specific questions and concerns and given the opportunity to review and comment on earlier drafts this report and the sampling recommendations.

All data were compiled and maintained in Excel spreadsheets and ArcGIS shapefiles, were archived by the author, and were provided to the Friends of the Mad River.

Results and Discussion

The water quality monitoring completed by the Friends of the Mad River represents an outstanding, long-term record of water quality conditions in the Mad River watershed during 1985-2015 (Table 1). This effort is perhaps unparalleled in the state of Vermont, especially in terms of the length of the record (31 years) and the consistent and repeated sampling of the same sites throughout this time period. Thus, these data provide outstanding baseline monitoring of past and current water quality conditions, identify reference and other outstanding waters, identify and/or confirm the stressors that are impacting these rivers and streams, and assess whether or not water quality conditions are safe for swimming and other recreational activities. On the other hand, these monitoring data were not designed to and were less useful for calculating nutrient and sediment loading into rivers and streams and pinpointing and assessing possible nutrient and sediment sources, although, in the process of collecting water samples, staff and volunteers from the Friends of the Mad River documented possible sources of water quality problems.

During 1985-2015, the Friends of the Mad River sampled water quality at a total of 57 sites distributed throughout the Mad River watershed (Table 2, Figure 3). However, not all sites were sampled in all years. Only 16 sites were sampled in all 31 years during 1985-2015, but another 18 sites were sampled during at least 25 of the 31 years. Of these 34 sites, 16 sites were located along the main stem of the Mad River, and 18 sites were located along tributaries. Largely due to differences in the numbers of years sampled, the 57 sample sites differed dramatically in the numbers of dates on which they were sampled during 1985-2015 (Figure 4). Individual sites were sampled on 1-143 dates over 1-31 years. However, 53% of the sites (30 of the 57 sites) were sampled on at least 105 dates during 1985-2015. In our analyses of the water quality data, we focused primarily on the data collected at those sites that were sampled on the majority of the dates sampled for each parameter.

Table 1. Water quality data collected by the Mad River Watch program of the Friends of the Mad River during 1985-2015. This summary is based solely on the data and documents that were provided to the author in electronic format. Total numbers of dates and sites sampled indicate the total numbers across all sites and all years, but not all sites were sampled on all dates or in all years (those numbers are presented in the discussions of the individual parameters).

Parameter	Year(s) Sampled	Total # Dates Sampled	Total # Sites Sampled	Notes
Parameters Measured In-House by the Friends of the Mad River (1985-2015)				
Air temperature	?	?	?	Data collected but not entered into database
Water temperature	1988-2014	143	52	Data collected in 2015 but not entered into database
pH	1988-1995, 1997-2005	80	51	Data collected in 2006-2015 but not entered into database
Total phosphorus	1993	3	15	Data not analyzed
Turbidity	1988-1990	14	39	Data not analyzed
Fecal coliform	1985-1991, 2002-2005	59	56	Data collected in other years but not entered into database
Escherichia coli (*E. coli*)	1992-2015	83	47	-
Parameters Measured through the LaRosa Partnership Program (2006-2015)				
Total phosphorus	2006-2015	55	19	-
Turbidity	2006-2015	55	19	-
Escherichia coli (*E. coli*)	2006-2011	12	14	Data analyzed for quality assurance purposes only

Table 2. The 57 sites sampled by the Friends of the Mad River during 1985-2015. Sites highlighted in bold were sampled in all years but not necessarily on all dates.

River/Stream	Site #	Site Name	Total # Dates	Year(s) Sampled
Mad River	1	Warren Falls	140	1985-1986, 1988-2015
Lincoln Brook	**2**	**Bobbin Mill**	**140**	**1985-2015**
Mad River	**3**	**Warren Covered Bridge**	**141**	**1985-2015**
Freeman Brook	**4**	**Warren Store**	**140**	**1985-2015**
Freeman Brook	4.5	Freeman Brook	105	1997-2015
Mad River	**5**	**Warren Village North**	**140**	**1985-2015**
Bradley Brook	6	Bradley Brook	136	1985-1986, 1988-2015
Mad River	6.5	Mad River	55	2006-2015
Mad River	**7**	**Riverside Park**	**137**	**1985-2015**
Clay Brook	**8**	**Clay Brook**	**138**	**1985-2015**
Mad River	8.5	-	29	1997-2005
Mad River	9	-	107	1985-2009
Folsom Brook	**10**	**Folsom Brook**	**141**	**1985-2015**
-	10.1	-	5	1985
-	10.2	-	4	1985
-	10.3	-	4	1985
-	10.4	-	1	1985
Folsom Brook	10.5	-	29	1989, 1997-2003, 2005
Folsom Brook	10.6	Folsom Brook	77	1988-1995, 2003-2015
Folsom Brook	10.7	-	36	1988-1995, 1997, 2003-2005
Rice Brook	**11**	**Rice Brook**	**136**	**1985-2015**
Clay Brook	12	Clay Brook	136	1985-1986, 1988-2015
Slide Brook	13	-	65	1985-1986, 1988-2005
Slide Brook	13.1	Slide Brook	77	1988-1995, 1997-2015
Lockwood Brook	14	-	64	1985-1986, 1988-2002, 2012-2014
-	15	-	58	1985, 1988-2002
Chase Brook	16	Chase Brook	137	1985-1986, 1988-2015
Mill Brook	17	Mill Brook German Flats	136	1985-1986, 1988-2015
Mill Brook	17.1	Mill Brook West	75	1988-1995, 1997-2015
Mill Brook	18	-	67	1985-1986, 1988-2005
Mill Brook	18.1	Mill Brook Mouth	76	1988-1995, 1997-2015
Mad River	**19**	**Lareau Swimhole**	**143**	**1985-2015**
Mad River	19.1	-	71	1988-2005
Mad River	19.2	Couples Club	140	1988-2015
-	19.5	-	4	1987

Table 2 (continued).

River/Stream	Site #	Site Name	Total # Dates	Year(s) Sampled
Mad River	**20**	**Waitsfield Covered Br.**	**141**	**1985-2015**
High Bridge Brook	20.1	High Bridge Brook	77	1985, 1988-1995, 1997-2015
Mad River	21	Waitsfield Elem. School	123	1985-1986, 1988-2011
Mad River	21.5	Tremblay Road	25	1991, 2012-2015
Pine Brook	**22**	**Pine Brook**	**142**	**1985-2015**
Mad River	**23**	**Meadow Road Bridge**	**140**	**1985-2015**
Shepard Brook	24	Shepard Brook	140	1985-1986, 1988-2015
Dowsville Brook	25	Dowsville Brook	140	1985-1986, 1988-2015
-	25.1	-	76	1988-1995, 1997-2005
Mad River	**26**	**North Road**	**136**	**1985-2015**
Mad River	**27**	**Moretown Village**	**137**	**1985-2015**
Doctor's Brook	27.1	Doctor's Brook	137	1988-2015
Mad River	**28**	**Moretown**	**137**	**1985-2015**
Welder Brook	28.05	Welder Brook	125	1988-2015
Unnamed Tributary	28.1	-	77	1988-2005
Unnamed Tributary	28.2	-	77	1988-2005
Unnamed Tributary	28.3	-	78	1988-2005
Mad River	28.4	-	78	1988-1995, 1997-2005
Mad River	**29**	**Ward's Access**	**136**	**1985-2015**
Mad River	30	-	79	1985-2005
Mad River	31	Lover's Lane Bridge	123	1985-1986, 1988-2015
Blueberry Lake	BBL	Blueberry Lake	81	1987-1995, 1997-2015

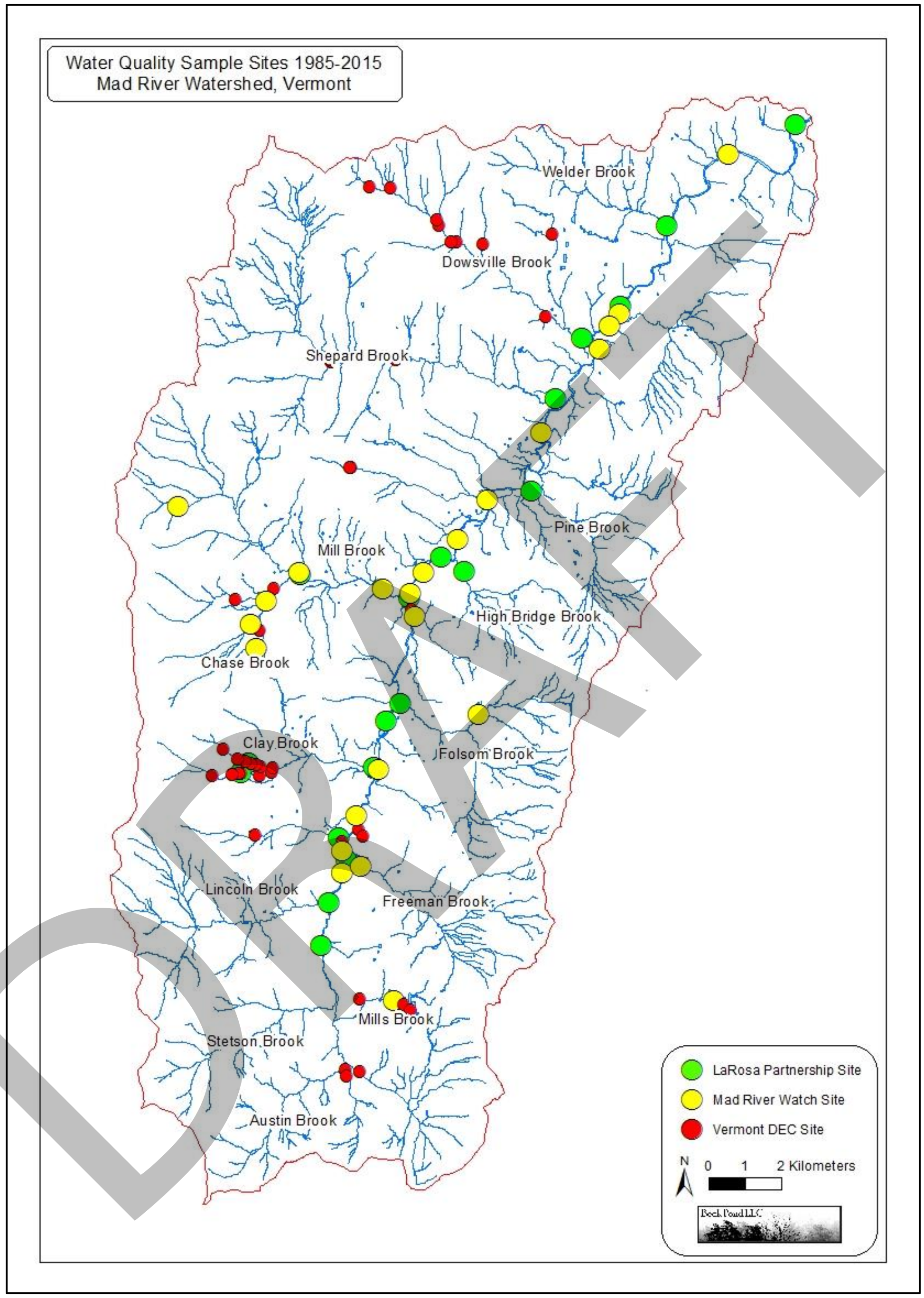

Figure 3. Locations of the 57 sites sampled by the Friends of the Mad River during 1985-2015. Note that not all of these sites were sampled on all dates, in all years, or for all parameters. All of the sites sampled through the LaRosa Partnership Program were also sampled in-house by the Friends of the Mad River. In addition, staff from the Vermont DEC sampled water quality and/or macroinvertebrate and fish communities at another 41 sites.

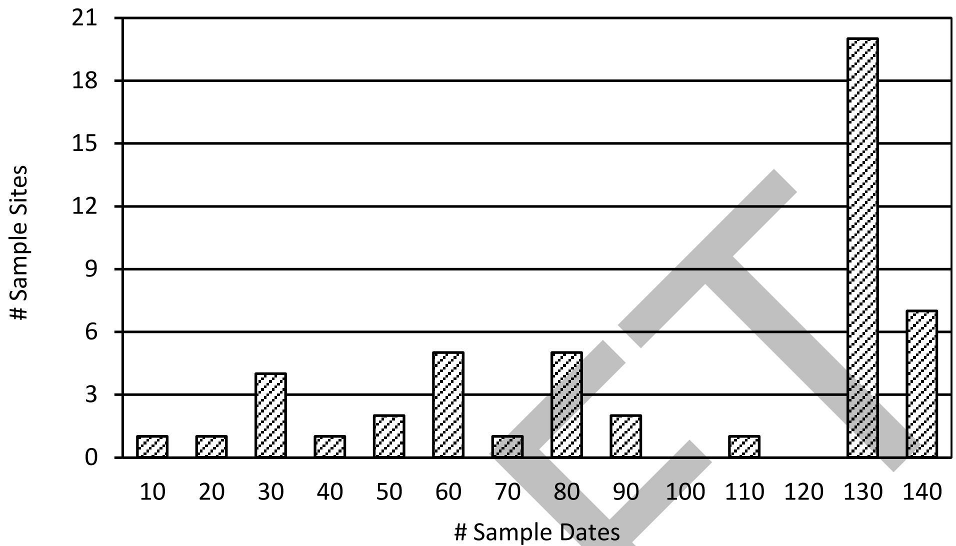

Figure 4. Frequency histogram showing the number of dates on which one or more water quality parameters were sampled at each site in the Mad River watershed during 1985-2015.

Quality Assurance

For the data collected through the LaRosa Partnership Program, this project was conducted in accordance with a Quality Assurance Project Plan (QAPP) developed in conjunction with the Vermont DEC and the U.S. Environmental Protection Agency. The quality assurance data for the Mad River watershed indicated that the sampling program was generally meeting the quality assurance standards for total phosphorus, turbidity, and *E. coli* during 2006-2015. Quality assurance data, at least field duplicates, were also collected for the parameters measured in-house by the Friends of the Mad River; however, these data were not entered into electronic databases, have not been formally analyzed as part of the water quality monitoring program, and were not analyzed as part of this study. The only exception was that duplicate *E. coli* samples were collected and analyzed separately by the Friends of the Mad River and LaRosa Analytical Laboratory at 14 sites on 12 dates during 2006-2011.

Total Phosphorus

The quality assurance samples, including both field blanks and field duplicates, indicated that the total phosphorus samples were generally being collected in a repeatable manner and were generally not being contaminated during collection and processing. Twelve of the 109 field blanks exceeded the detection limit (5 µg/l). However, of these twelve, three were likely mislabeled field duplicates. Two other field blanks (300 and 442 µg/l) greatly exceeded both the detection limit and the values of the regular and duplicate samples collected at those two sites on those two dates. The reason(s) for these extreme values remains unclear. Ignoring these five values, the seven remaining field blanks ranged in value between 5.13-8.13 μg/l, which were relatively minor deviations above the detection limit. Likewise, the mean relative percent difference between duplicate samples (11%) was well below the prescribed relative percent difference (30%). In addition, only twelve of the 109 pairs of total phosphorus samples exceeded the prescribed difference (range = 30-86%).

Turbidity

The quality assurance samples, including both field blanks and field duplicates, indicated that, as has been observed in other water quality monitoring programs, this program encountered difficulties in collecting repeatable and uncontaminated turbidity samples for some unknown reason. Thirteen of the 110 field blanks exceeded the detection limit (0.2 NTU). However, of these 13, four were likely mislabeled field duplicates. Ignoring those four values, the range in values for six of the eight remaining field blanks was 0.26-0.34 NTU, which were relatively minor deviations above the detection limit. The two remaining values (0.80 and 2.19 NTU), however, were relatively high. Similarly, the mean relative percent difference between the duplicate turbidity samples (20%) did exceed the prescribed relative percent difference (15%), and 52 of the 109 pairs of turbidity samples did differ by >15% (range = 16-108%).

Escherichia coli

The quality assurance samples indicated that the *E. coli* samples were generally being collected in a repeatable manner (field blanks, which indicate possible contamination during sampling, were not collected for *E. coli*). We were able to compare field duplicates for *E. coli* in two different ways. First, we compared field duplicates of *E. coli* collected through the LaRosa Partnership Program. The mean relative percent difference between these duplicate samples (49%) was slightly below both of the prescribed differences (<50% if >25 colonies/100 ml and <125% if <25 colonies/100 ml). However, 18 of the 76 pairs of *E. coli* samples exceeded the relevant prescribed difference (range = 50-186%). Second, we compared field duplicates of *E. coli* collected and analyzed independently at the Friends of the Mad River laboratory and the LaRosa Analytical Laboratory. The mean relative percent difference between these duplicate samples (39%) was also below the prescribed relative percent differences (<50% if >25 colonies/100 ml and <125% if <25 colonies/100 ml). However, 17 of the 78 pairs of *E. coli* samples exceeded the appropriate prescribed difference (range = 66-196%). In addition, the correlation between the two sets of values (those measured in-house by the Friends of the Mad River and those measured by the LaRosa Analytical Laboratory) was very good (y=0.78x-0.43, where x = value measured by the LaRosa Analytical Laboratory and y = value measured by the Friends of the Mad River; $R^2 = 0.65$)(Figure 5). Thus, the results of these analyses, which met the quality assurance requirements, all indicated that the *E. coli* data were generally being collected in a repeatable manner.

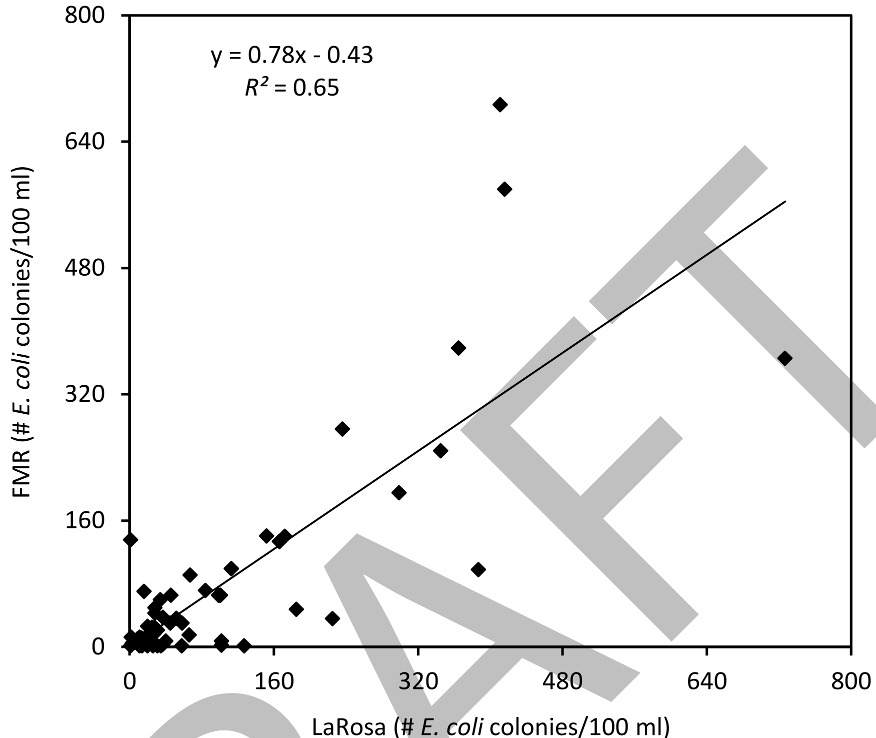

Figure 5. Correlation between the *E. coli* values obtained from paired samples analyzed independently by the Friends of the Mad River laboratory and the LaRosa Analytical Laboratory during 2006-2011. These data represent field duplicates that were collected at the same times and at the same sites but were analyzed in separate laboratories.

Stream Flow

Stream flow measures the volume of water passing a given location per unit of time and is calculated by multiplying the area of the stream cross-section by water velocity. Stream flow affects both water quality and the quality and characteristics of aquatic and riparian habitats. For example, fast-moving streams are more turbulent and better aerated than slow-moving streams. High flows also dilute dissolved and suspended pollutants but, at the same time, typically carry more surface runoff and associated sediments and nutrients. Stream flow is extremely dynamic and changes frequently and sometimes dramatically in response to changes in temperature, precipitation, and season.

To approximate stream flows at the sample sites examined in this study, we used the daily stream flows measured at a stream gage maintained by the U.S. Geological Survey (USGS) on the Mad River near Moretown, Vermont (USGS station 04288000). As is typical in northern New England, stream flows at this gage generally peaked for extended periods of time during the spring and early summer (April-June) following snowmelt, were generally low during the summer and early autumn (July-September), and rose again during late autumn and winter (October-March)(Figure 6). However, extremely high flows also occurred for shorter periods of time following heavy rains and winter thaws throughout the year.

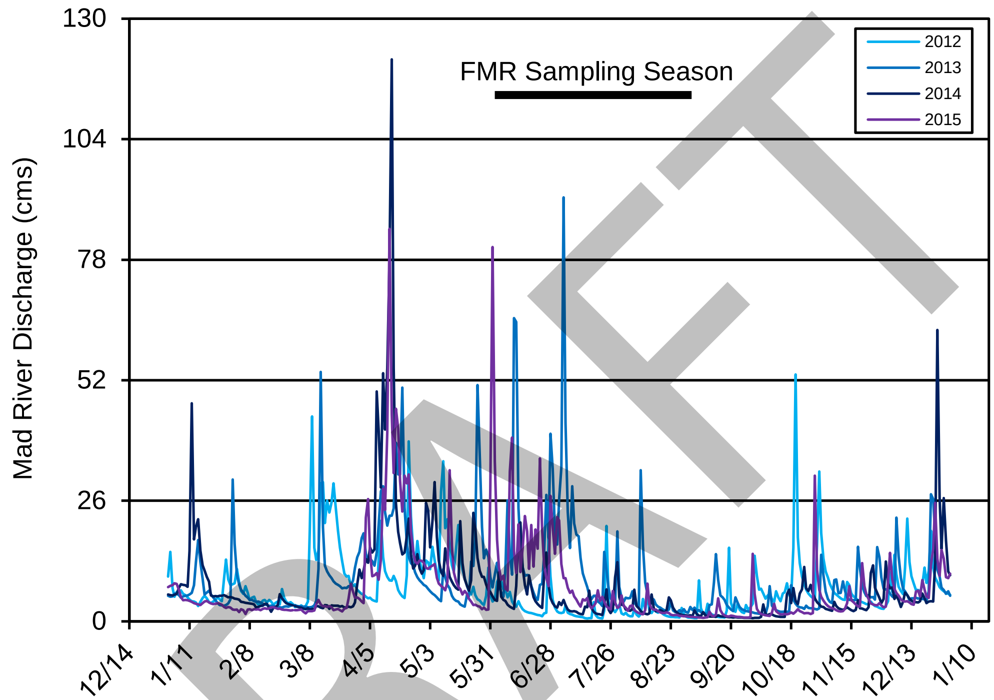

Figure 6. Stream flows along the Mad River near Moretown, Vermont during 2012-2015. Stream flows were measured by the U.S. Geological Survey (USGS station 04288000). The horizontal bar represents the general range of dates sampled by the Friends of the Mad River during 1985-2015.

The water quality sampling conducted by the Friends of the Mad River largely reflected the more limited variation and low to moderate stream flows that typically occurred during June-August when the sampling occurred (Table 3, Figure 7). Despite this more limited variation, the sampling did capture a slightly higher proportion of moderate- and high-flow events. During 2006-2015, 16 of the 55 sample dates (29%) occurred during high flows (that is, when flows were greater than or equal to the highest 25% of all flows), and 30 of the 55 sample dates (55%) occurred during moderate flows (i.e. when flows were within the intermediate 50% of all flows). In contrast, only 9 of the 55 sample dates (16%) occurred during low flows (that is, when flows were less than or equal to the lowest 25% of all flows). In addition, the ranges of stream flows sampled were somewhat similar among years. High flows were sampled on 1-3 dates, representing 17-50% of the sample dates, in nine of the ten years (no high flows were sampled in

2012). Moderate flows were sampled on 1-5 dates, representing 33-83% of the sample dates, across the ten years. However, low flows were only sampled on 1-3 dates during 2011-2015, representing 17-50% of the sample dates (no low flows were sampled during 2006-2010). Given that the water quality standards for certain parameters (State of Vermont 2014a) are referenced to "low median monthly flows" (total phosphorus) or "dry weather base-flow conditions" (turbidity), this small number of samples collected at low flows limited our ability to use these data to evaluate whether or not individual streams or sites were meeting State water quality standards. It should also be noted that localized precipitation events may have affected flows in some but not all areas of the watershed on some dates and that the smaller streams and larger rivers may have responded differently to individual precipitation events. Given these caveats, the stream flows measured at the USGS gage on the Mad River near Moretown may not always provide an accurate representation of stream flows at individual sites on each sample date.

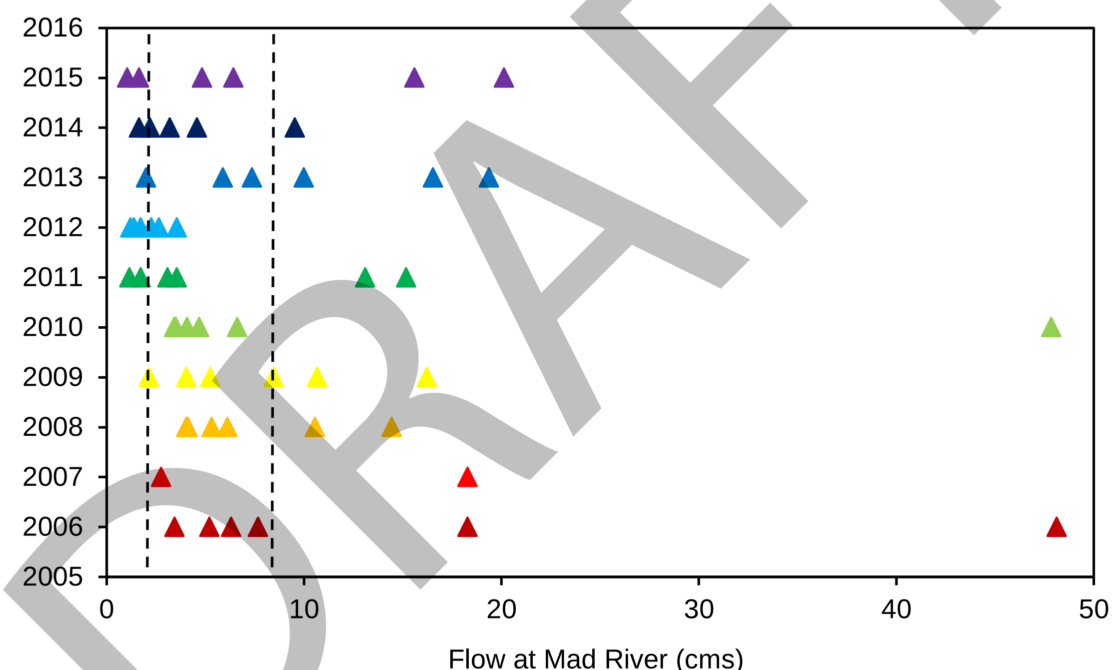

Figure 7. Stream flows measured at the USGS gage on the Mad River near Moretown, Vermont (USGS station 04288000) on each date that water quality samples were collected in the Mad River watershed during 2006-2015. The vertical, dashed lines separate low (left), moderate (center), and high (right) flows.

Table 3. Numbers of low, moderate, and high flows sampled in the Mad River watershed during 2006-2015. The criteria defining low, moderate, and high flows were calculated from the daily stream flows measured at the USGS gage on the Mad River near Moretown, Vermont (USGS station 04288000)(see text for definitions).

Year	Low (<2.1 cms)	Moderate (2.1-8.5 cms)	High (>8.5 cms)	Total	% High Flows
2006	0	4	2	6	33
2007	0	1	1	2	50
2008	0	4	2	6	33
2009	0	4	2	6	33
2010	0	5	1	6	17
2011	2	2	2	6	33
2012	3	3	0	6	0
2013	1	2	3	6	50
2014	1	3	1	5	20
2015	2	2	2	6	33
All ten years	9	30	16	55	29

Because not all sample sites were sampled in all years or on all sample dates, the stream flows represented by the samples collected at each site did differ among sites. Thus, we focused our analyses on those sites that were sampled consistently across most or all of the years for each parameter. By focusing on these sites, we were able to analyze the physical, biological, and chemical data across a consistent and representative set of stream flows and to make meaningful comparisons, especially since nutrient concentrations and sediment loads are often strongly correlated with stream flows. Data collected at low flows were particularly informative for identifying and assessing nutrients originating from point and groundwater sources. In contrast, data collected at high flows were more informative for identifying and assessing nutrients and sediment originating from nonpoint sources, which typically generate the majority of the sediment and nutrient loads being exported into the Lake Champlain Basin (Stone Environmental 2011, Environmental Protection Agency 2015). Thus, analyzing data collected across a range of low, moderate, and high flows allowed us to better identify and evaluate the relationships between water quality parameters and stream flows; to identify and assess possible nutrient and sediment sources, especially point vs. nonpoint sources; and to identify those areas within the Mad River watershed where additional water quality sampling might be most beneficial in pinpointing and assessing possible sources of water quality problems.

Water Temperature

Water temperature regulates many biological and chemical processes, and many aquatic organisms are dependent on specific temperature ranges (Picotte & Boudette 2005). Water temperatures are highly variable in space and time and vary daily, seasonally, annually, and in response to precipitation and other weather events and among sites depending on elevation, stream size, stream type, vegetative cover, groundwater inputs, and a host of other factors. Water temperatures affect the oxygen content of water (e.g. cold water holds more dissolved oxygen), rates of plant and animal growth, and the metabolic rates of many aquatic organisms. In addition, water temperatures directly affect the survival of certain, sensitive aquatic organisms, such as cold-water fish. For example, brook trout cannot survive temperatures exceeding 22ºC for an extended period of time.

Water temperature data were collected by the Friends of the Mad River during 1988-2014 (water temperatures were also apparently measured in 2015, but the data were not provided to the author). During these 27 years, water temperatures were measured at 34-39 sites each year. Across all years, 28 of the 52 sites were sampled on at least 117 of the 143 sample dates and across almost all of the years (two of these 28 sites were not sampled in 3-5 years). The remaining 24 sites were sampled on 1-107 dates, often for only a subset of years. Thus, we used the data from all of the years to calculate the median, geometric mean, 25% and 75% quartiles, and range in water temperatures for each of the 28 sites that were well sampled throughout the full time period (1988-2014). However, because the water temperature data for each site represented only single point in time on each sample date (and only six or fewer dates each year), the presentation and interpretation of these data are somewhat limited in scope.

During 1988-2014, water temperatures at the 28 sites ranged between 8.0-27.8ºC (46.4-82.0ºF), but mean temperatures only ranged between 13.7-19.0ºC (56.7-66.2ºF)(Table 4). It is important to remember, however, that these temperatures were measured in the early morning hours (prior to 10 a.m.) and only during the summer months (June-August). Within this range, the lowest mean temperatures [<16ºC (<60.8ºF)] were measured along the upper reaches of the main stem and along most of the tributaries (Figure 8-9). In contrast, the highest mean temperatures [>17ºC (>62.6ºF)] were measured along the lower reaches of the main stem. Finally, intermediate mean temperatures [16-17ºC (60.8-62.6ºF)] were measured along the middle reaches of the main stem and the downstream section of Mill Brook.

Table 4. Water temperatures (°C) at 28 sites along the Mad River and its tributaries during 1988-2014. Only sites that were sampled on at least 117 of the 143 sample dates are included.

Site #	Site Name	# Dates	Median	Mean	Range
1	Warren Falls	140	14.5	14.2	8-21.1
2	Bobbin Mill	140	14.8	14.3	9-19
3	Warren Covered Bridge	141	15.0	14.9	9-23.9
4	Warren Store	140	15.0	14.6	9-20.6
5	Warren Village North	140	15.5	14.9	9-21.7
6	Bradley Brook	136	15.0	14.3	8-23.3
7	Riverside Park	137	15.6	15.2	10-23.3
8	Clay Brook	138	15.0	14.4	9-21.1
10	Folsom Brook	141	15.5	15.0	10-22.2
11	Rice Brook	136	15.0	14.4	10-22.2
12	Clay Brook	136	14.0	13.7	8.9-22.2
16	Chase Brook	137	15.0	14.7	10-21.1
17	Mill Brook German Flats	136	15.0	15.2	10-23.3
19	Lareau Swimhole	143	16.5	16.3	11.1-23.9
19.2	Couples Club	140	16.5	16.6	11.1-26.7
20	Waitsfield Covered Bridge	141	16.7	16.7	11.1-23.9
21	Waitsfield Elementary School	123	17.0	16.9	11-25.6
22	Pine Brook	142	15.6	15.4	11-20.6
23	Meadow Road Bridge	140	17.0	17.3	11.1-25
24	Shepard Brook	140	16.0	15.7	10-24.4
25	Dowsville Brook	140	15.0	14.7	9-22.8
26	North Road	136	17.8	17.5	10-26.1
27	Moretown Village	137	17.8	17.5	11.1-25.6
27.1	Doctor's Brook	137	16.0	16.0	10.6-22.8
28	Moretown	137	17.8	17.5	11.7-25.6
28.05	Welder Brook	117	16.0	16.0	10.6-21
29	Ward's Access	136	18.5	18.3	12.2-27.8
31	Lover's Lane Bridge	118	19.5	19.0	12.2-26

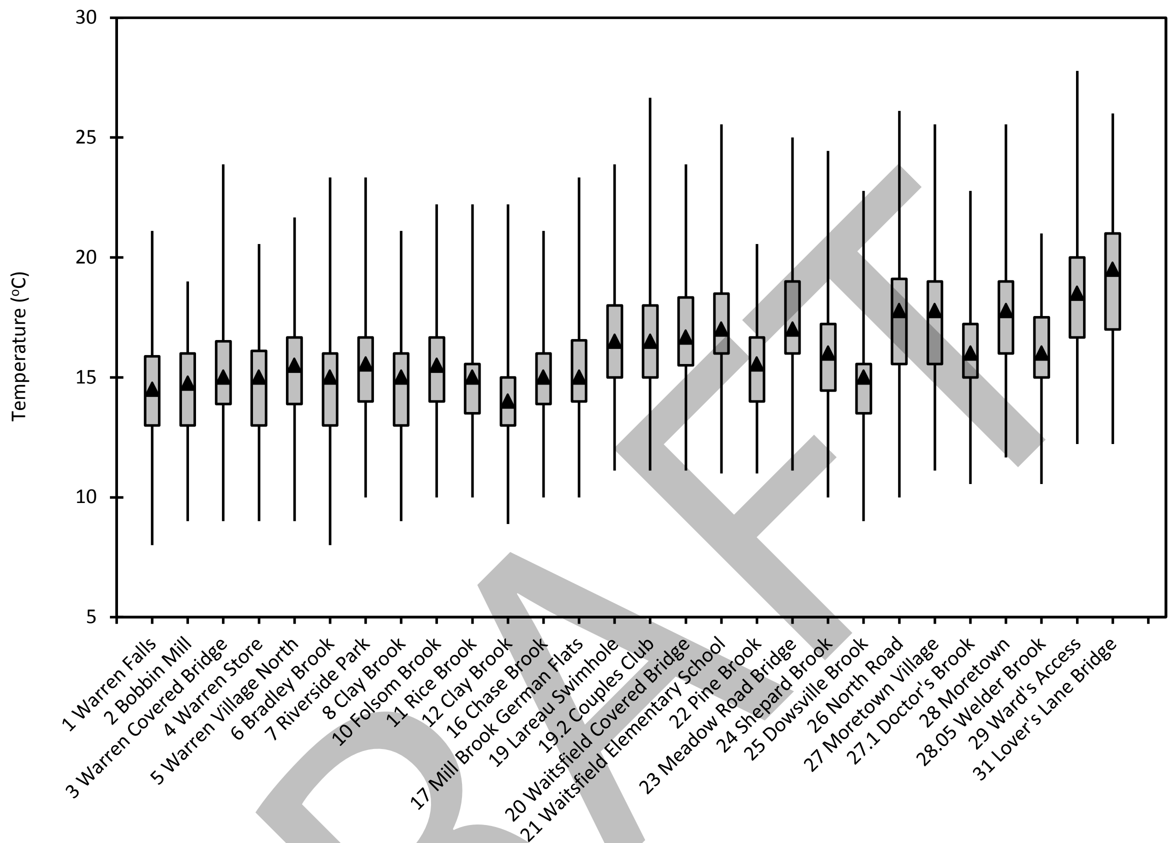

Figure 8. Water temperatures at 28 sites along the Mad River and its tributaries during 1988-2014. Values are the median (triangle), 1st and 3rd quartiles (rectangle), and minimum and maximum (line). Only sites that were sampled on at least 117 of the 143 sample dates are included.

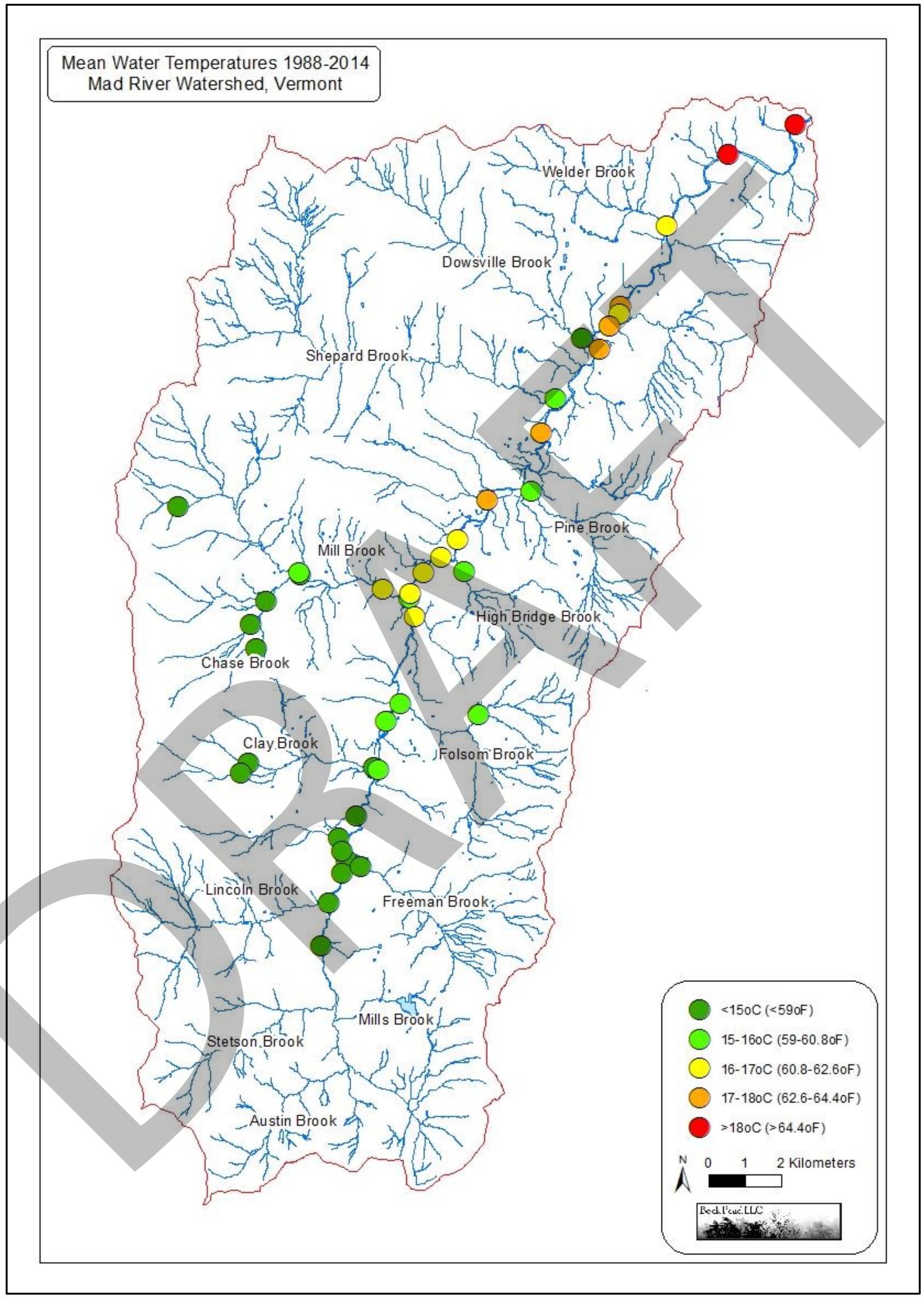

Figure 9. Mean water temperatures (°C) at 52 sites along the Mad River and its tributaries during 1988-2014.

During the last two years (2013-2014), water temperatures showed steady and consistent increases along the length of the main stem of the Mad River from Site #1 (Warren Falls) downstream to Site #31 (Lover's Lane Bridge)(Figure 10). Across the length of the main stem, median temperatures increased by approximately 3.7°C (6.5°F).

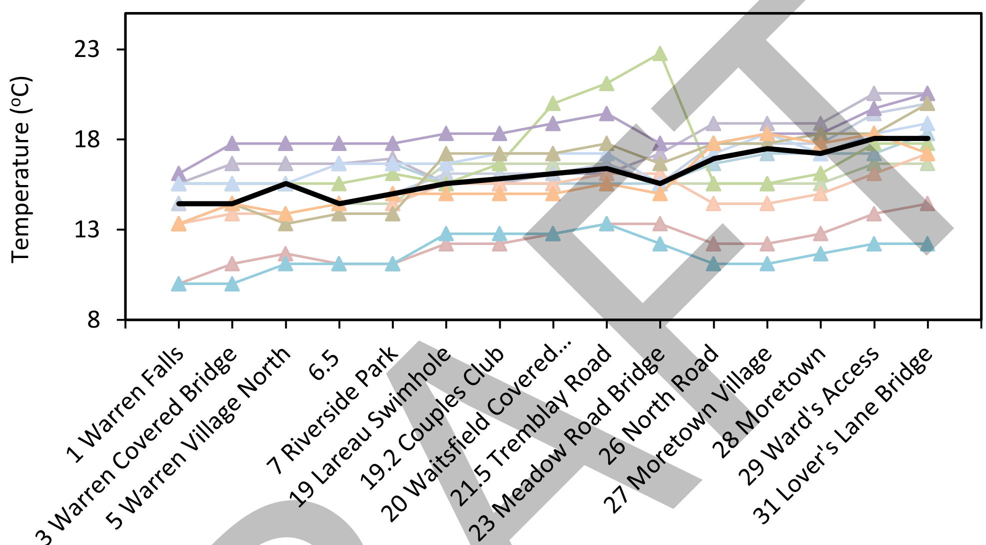

Figure 10. Water temperature "profile" at 15 sites along the main stem of the Mad River from Site #1 (Warren Falls) downstream to Site #31 (Lover's Lane Bridge) during 2013-2014. The light, colored lines show the values measured on each sample date; the bold, black line shows the median values for each site during those two years.

In summary, water temperatures were measured at 52 sites on 143 dates during 1988-2014 (but not all sites were sampled on all dates or in all years). In general, water temperatures along both the main stem and the tributaries were moderately high, as temperatures were only measured during the summer months (June-August). Mean and median water temperatures were highest in the middle and lower reaches of the main stem and were lowest along the upper reaches of the main stem and many of the tributaries. The higher temperatures likely reflected the more open land uses, lack of vegetative cover, and more meandering channel plan of the lower reaches of the main stem. The limited number of temperature measurements recorded at each site in each year (typically 4-6 data points each year) limited the utility of these data. Nevertheless, they did provide some indication of those areas with lower and higher water temperatures during the summer months, the former being important for identifying suitable habitat for cold-water fish, such as brook trout, and other cold-water organisms.

pH

pH, which is typically measured in the field with a hand-held meter, is a measure of the acidity or alkalinity of the water. pH is measured on a logarithmic scale from 0 (most acidic) to 14 (most alkaline) with a pH of 7 considered neutral. pH is an important measure of water chemistry, as pH determines the solubility, biological availability, and toxicity of nutrients (e.g. phosphorus and nitrogen) and heavy metals (e.g. lead, copper, and arsenic). Different organisms have different tolerances for and ranges of pH in which they flourish, but most aquatic organisms prefer a pH between 6.5-8.0. In surface waters, pH is usually relatively stable over time, as it primarily reflects the underlying bedrock and surficial geology. However, changes in pH can be caused by atmospheric deposition (e.g. "acid rain") and wastewater discharges. In Vermont, the Water Quality Standards for pH in Class A(1) Ecological Waters, Class A(2) Public Water Supplies, and all Class B Waters are that the pH shall not exceed 8.5 standard units (State of Vermont 2014a). In the Mad River watershed, all surface waters are classified as Class B Waters, except those located above 762 m (2,500 ft) in elevation, which are classified as Class A(1) Ecological Waters.

pH was measured by the Friends of the Mad River during 1988-1995 and 1997-2005 (pH was also apparently measured during 2006-2015, but these data were not entered into the electronic databases provided to the author). During these 17 years, 34-40 sites were sampled each year. Across all years, 34 of the 51 sites were sampled on at least 48 of the 80 sample dates and across almost all of the years (seven of the 34 sites were not sampled in 1-5 years). The remaining 17 sites were sampled on 1-39 dates, often for only a subset of years (e.g. six sites were only sampled on 15-17 dates during 2003-2005). Thus, we used the data from all of the years to calculate the median, geometric mean, 25% and 75% quartiles, and range in pH levels for each of the 34 sites that were well sampled throughout the full time period (1988-2005).

During 1988-2005, pH levels at the 34 sites ranged between 4.4-8.7, but mean pH levels ranged between 6.7-7.2 (Table 5). Thus, pH levels were generally neutral (generally defined as pH = 6.6-7.3) at all sites in the Mad River watershed, although the full set of 2,429 values did include nine values that were strongly acidic (pH <5.5) and ten values that were strongly alkaline (pH >8.5.). The lowest mean pH levels (pH <6.8) were measured along Chase and Clay Brooks (Figure 11-12). In contrast, the highest mean pH levels (pH >7.2) were measured along the lower reaches of the main stem and several other tributaries (Welder, Doctor's, Mill, Folsom, and Freeman Brooks). Intermediate mean pH levels (pH = 6.8-7.2) were measured throughout the main stem, especially its middle and upper reaches, and along several other tributaries.

Table 5. pH levels at 34 sites along the Mad River and its tributaries during 1988-1995 and 1997-2005. Only sites that were sampled on at least 48 of the 80 sample dates are included.

Site #	Site Name	# Dates	Median	Mean	Range
1	Warren Falls	75	7.0	7.0	5.8-7.9
2	Bobbin Mill	76	7.2	7.1	6-8.7
3	Warren Covered Bridge	77	7.1	7.0	6-8.7
4	Warren Store	77	7.2	7.1	6.2-8.6
5	Warren Village North	77	7.2	7.1	5.3-8.7
6	Bradley Brook	73	7.2	7.1	5.1-8.7
7	Riverside Park	75	7.0	7.0	5-8.6
8	Clay Brook	73	7.1	7.0	5.6-7.9
9	-	74	7.0	7.0	5.6-8.3
10	Folsom Brook	75	7.0	7.0	6.1-8.1
11	Rice Brook	75	6.9	6.7	4.4-8
12	Clay Brook	75	7.1	7.0	5-7.9
13	Slide Brook	59	6.8	6.9	5.8-8.1
14	Lockwood Brook	58	6.8	6.8	5.9-7.9
16	Chase Brook	74	6.9	6.9	5.8-7.9
17	German Flats	76	7.0	6.9	5.9-8
18	-	57	6.9	6.9	5.9-7.8
19	Lareau Swimhole	79	6.9	6.9	6.1-8.6
19.1	-	62	6.9	6.9	6.3-8.7
19.2	Couples Club	78	6.9	6.9	6.1-8.6
20	Waitsfield Covered Bridge	78	6.9	6.9	6.1-8.1
21	Waitsfield Elementary School	79	6.9	6.9	6.1-7.8
22	Pine Brook	80	6.9	6.9	6.1-7.8
23	Meadow Road Bridge	79	6.9	6.9	6.2-7.8
24	Shepard Brook	77	7.0	6.9	5.5-7.9
25	Dowsville Brook	77	6.9	6.8	6.0-7.8
26	North Road	67	7.2	7.1	6.1-7.7
27	Moretown Village	71	7.3	7.1	6.2-7.9
27.1	Doctor's Brook	70	7.3	7.2	6.3-8.2
28	Moretown	70	7.3	7.2	6.3-8.2
28.05	Welder Brook	49	7.3	7.2	6.3-7.8
28.2	-	52	7.1	7.1	6-8.3
29	Ward's Access	76	7.3	7.2	6.0-8.4
31	Lover's Lane Bridge	59	7.2	7.2	6.2-8.5

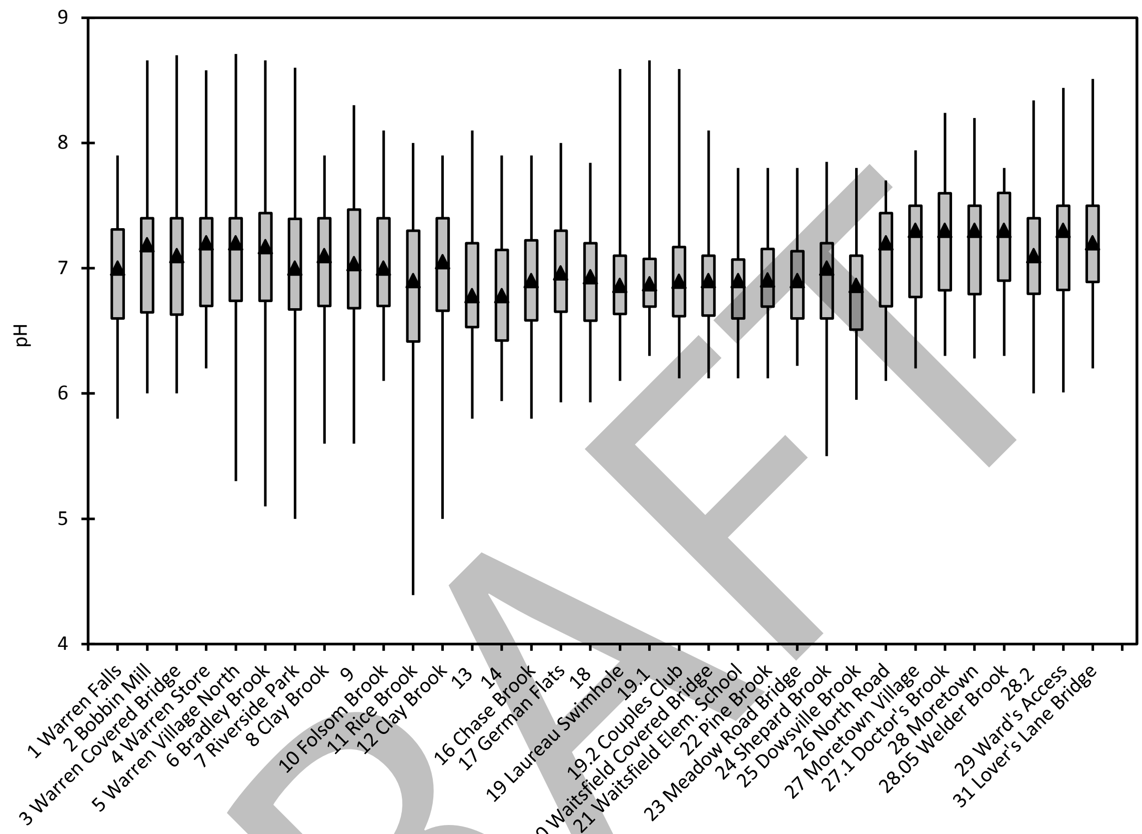

Figure 11. pH levels at the 34 sites at which >49 samples were collected along the Mad River and its tributaries during 1988-2005. Values are the median (triangle), 1st and 3rd quartiles (rectangle), and minimum and maximum (line). Only sites that were sampled on at least 48 of the 80 sample dates are included.

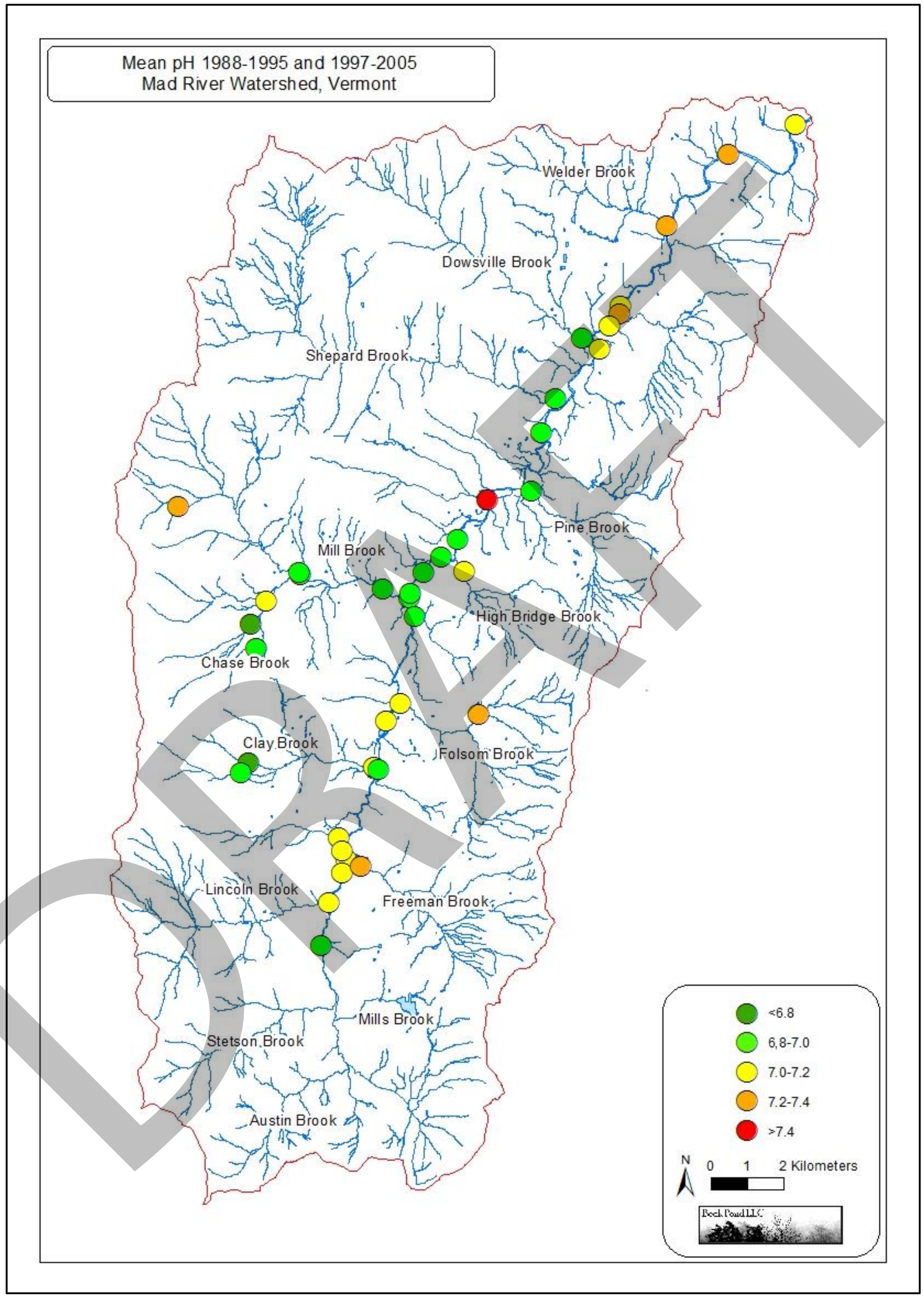

Figure 12. Mean pH levels at 51 sites along the Mad River and its tributaries during 1988-2005.

During 2004-2005 (the two most recent years of data provided to the author), pH levels were generally similar along the length of the main stem of the Mad River (Figure 13). However, on five of the six dates in 2005, pH levels were considerably lower between Site #19 (Lareau Swimhole) and Site #23 (Meadow Road Bridge). The reason(s) for this consistent but temporary decrease in pH were not clear but may reflect either real differences in pH on those dates or problems with the field equipment.

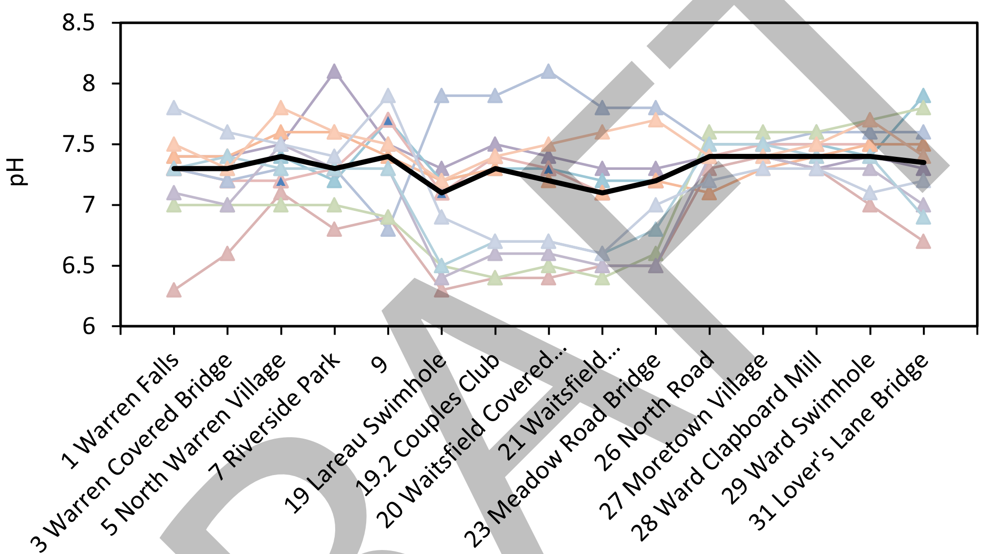

Figure 13. pH "profile" at 15 sites along the main stem of the Mad River from Site #1 (Warren Falls) downstream to Site #31 (Lover's Lane Bridge) during 2004-2005. The light, colored lines show the values measured on each sample date; the bold, black line shows the median values for each site during those two years.

One of the most pronounced patterns in pH levels in the Mad River watershed is the clear and consistent decreases in pH prior to 1995 and the subsequent clear and consistent increases in pH after 1995 (Figure 14). This pattern occurred at all ten sites examined and across the spectrum of sites from those with "average" pH levels to those with either lower and higher mean pH levels [e.g. Site #25 (Dowsville Brook) and Site #27.1 (Doctor's Brook), respectively]. Presumably, this clear and consistent pattern, especially the increases in pH after 1995, reflected the improvements in air quality and reduced acid deposition (e.g. "acid rain") that resulted from the implementation of the Clean Air Act and its amendments beginning in the mid-1990s.

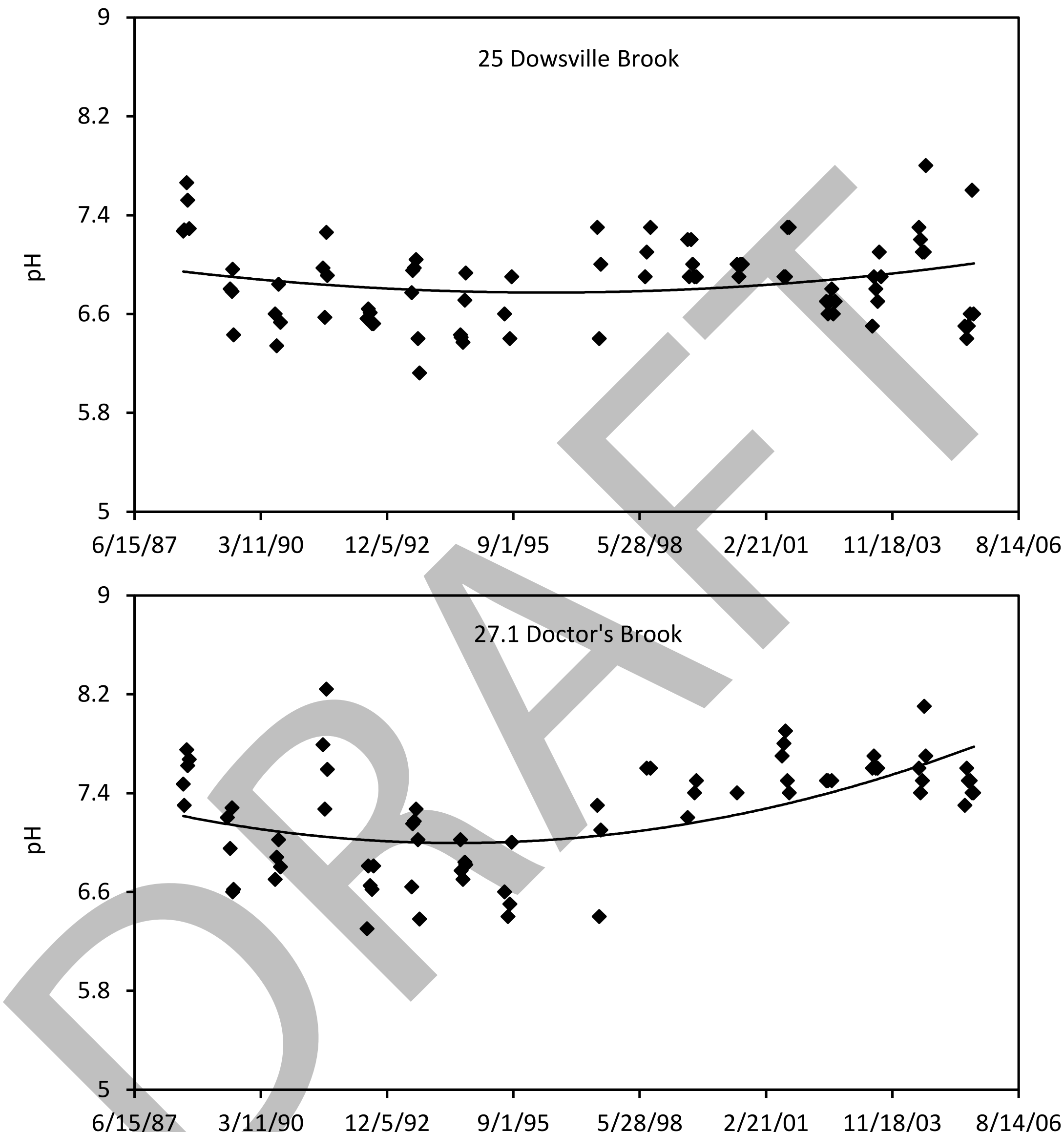

Figure 14. Changes in pH over time at two sites along the Mad River during 1988-2005. Site #25 (Dowsville Brook) represented those sites with lower mean pH levels (mean = 6.8), and Site #27.1 (Doctor's Brook) represented sites with higher mean pH levels (mean = 7.2). The regression lines indicate the polynomial relationships between the two parameters.

Finally, we analyzed pH in relation to the stream flows measured at the USGS gage on the Mad River near Moretown. At the four sites examined, there were no clear or convincing relationships between pH and stream flow, although pH levels might have been slightly lower at the highest stream flows (Figure 15). The lack of clear relationships with stream flow likely reflected the primary importance of bedrock and surficial geology in determining pH and the region-wide decreases in acid deposition over the past 20 years. On the other hand, the slightly lower pH values at the highest flows may reflect the more acidic nature of the precipitation that caused the rivers and streams to rise during these high-flow events.

In summary, the pH data provided a valuable long-term record of improvements in air quality and acid precipitation in the northeastern United States. pH, which measures the acidity or alkalinity of water, was measured at 51 sites on 80 dates during 1988-1995 and 1997-2005 (but not all sites were sampled on all dates or in all years). All of the sites, including those along both the main stem and the tributaries, exhibited generally neutral pH values (mean = 6.7-7.2). Because pH is largely influenced by the underlying bedrock and surficial geology, pH showed no pronounced relationships with stream flow, but they did show an almost universal pattern of change over time. That is, pH levels decreased at all sites in the years prior to 1995 but increased markedly at all sites after 1995, presumably in response to improvements in air quality and decreased acid deposition following implementation of the Clean Air Act and its amendments starting in the mid-1990s.

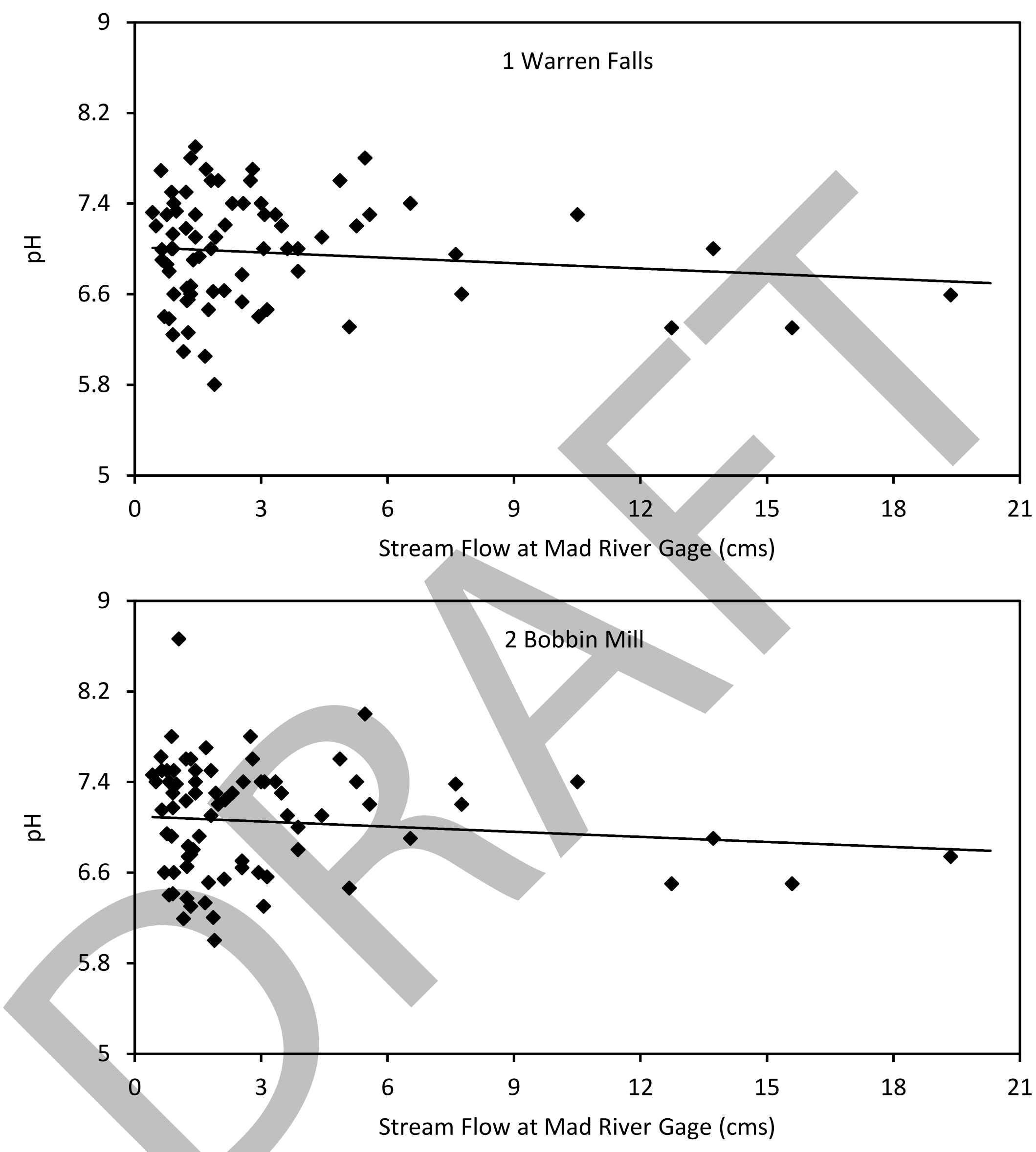

Figure 15. pH in relation to stream flow at two sites [Site #1 (Warren Falls) and Site #2 (Bobbin Mill)] during 1988-2005. Stream flows were measured at the USGS stream gage on the Mad River near Moretown, Vermont (USGS station 04288000). The regression lines indicate the exponential relationships between the two parameters. Note that two extreme high flows were not included in this analysis.

Total Phosphorus

Total phosphorus measures the concentration of all forms of phosphorus in the water column, including dissolved phosphorus, phosphorus attached to suspended sediments, and phosphorus incorporated into organic matter. Phosphorus is an essential nutrient and is typically the limiting nutrient and regulates the amount of aquatic life in northern freshwater ecosystems. Consequently, elevated phosphorus concentrations can lead to eutrophication, in which excessive algal and plant growth and the subsequent decomposition lead to oxygen depletion and increased mortality of aquatic life. In Vermont, most phosphorus originates from soil erosion, wastewater, manure, and synthetic fertilizers applied to lawns and agricultural fields. In Vermont, the Water Quality Standards for phosphorus differ for different types of rivers, streams, lakes, and ponds (Table 6; State of Vermont 2014a).

Table 6. Water Quality Standards for total phosphorus (in µg/l) in Vermont (State of Vermont 2014a). In rivers and streams, these criteria are not to be exceeded at low median monthly flows during June-October in areas representative of well-mixed flows. In lakes and reservoirs, these criteria are not to be exceeded in the photosynthetic (euphotic) zone at a central location in the lake during June-September.

Class of Waters	Small, High-Gradient Streams	Medium, High-Gradient Streams	Warm-Water, Medium-Gradient Streams	Lakes and Reservoirs
Class A(1) Waters	10	9	18	12
Class A(2) Waters	12	15	27	17
Class B Waters	12	15	27	18

Total phosphorus was measured in-house by the Friends of the Mad River on three dates during 1993 and again through the LaRosa Partnership Program during 2006-2015. Because total phosphorus was measured on only three dates during 1993 and because the methods used were not identified, we did not analyze those data but, rather, focused on analyzing those data collected through the LaRosa Partnership Program during 2006-2015. For the 2006-2015 data, all but one of the 19 sites were sampled across the full range of stream flows and on almost all of the 55 sample dates (1-4 of the 55 dates were missed at each of five sites, and Site #9 was only sampled on six dates in 2008). Thus, we used all of the data to calculate the median, geometric mean, 25% and 75% quartiles, and range in total phosphorus concentrations for each of the 19 sites across two time periods (2006-2015 and 2014-2015, the latter better representing the current conditions at each site).

During 2006-2015, total phosphorus concentrations at the 19 sites ranged between 5.0-1,760 µg/l, and mean total phosphorus concentrations ranged between 7.4-22.3 µg/l (Table 7). During these ten years, the highest mean total phosphorus concentrations (>20 µg/l) were measured at two sites, both located along tributaries of the Mad River [Site #20.1 (High Bridge Brook) and Site #10 (Folsom Brook)](Figure 16-17). In contrast, the lowest mean total phosphorus concentrations (<10 µg/l) were measured at several sites along the upper reaches of the main stem, along Mill Brook, and at two upstream sites along Clay Brook. Finally, intermediate mean total phosphorus concentrations (10-20 µg/l) were measured at several sites along the main stem, especially the lower reaches, and several tributaries, including Welder, Dowsville, Clay (downstream site), Bradley, Pine, and Shepard Brooks.

Table 7. Total phosphorus concentrations at 19 sites along the Mad River and its tributaries for two time periods (2006-2015 and 2014-2015).

		#	2006-2015			2014-2015 Only		
Site #	Site Name	Dates	Median	Mean	Range	Median	Mean	Range
1	Warren Falls	55	6.0	7.4	5-55.6	11.9	9.9	5-54
2	Bobbin Mill	55	6.1	8.0	5-195	7.3	7.8	5-18.8
4	Warren Store	54	10.0	12.1	6.1-415	9.9	11.3	6.2-56
6	Bradley Brook	54	9.5	11.6	5.2-645	8.7	9.8	7.2-19.1
8	Clay Brook	54	9.5	12.7	5-305	8.0	11.9	5-117
9	-	6	7.9	7.4	5-10.1	-	-	-
10	Folsom Brook	55	19.0	22.3	11.9-252	16.2	16.8	11.9-30.4
11	Rice Brook	55	6.3	8.1	5-272	6.1	6.1	5-12.7
12	Clay Brook	55	6.3	8.0	5-310	6.3	8.7	5-36.8
16	Chase Brook	55	6.2	8.7	5-1760	6.1	6.8	5-13.2
18.1	Mill Brook Mouth	52	6.9	9.5	5-244	5.9	6.7	5-11.2
20	Covered Bridge	55	8.5	10.7	5-208	8.2	12.9	5-173
20.1	High Bridge Brook	55	16.4	21.3	8.8-196	21.6	24.0	9.8-103
22	Pine Brook	55	9.4	11.5	5.9-136	9.5	12.2	7.3-34.4
24	Shepard Brook	55	8.2	10.3	5-405	7.1	8.0	5-30
25	Dowsville Brook	55	11.1	13.6	5.7-330	10.6	11.4	6.3-67.6
28	Moretown	55	9.3	13.6	5-377.6	9.3	16.4	5.1-377.6
28.05	Welder Brook	55	13.6	16.8	6.6-268	11.8	12.9	8.4-56.9
31	Lover's Lane Bridge	51	11.3	13.9	6.0-510	13.1	13.3	6.7-46.1

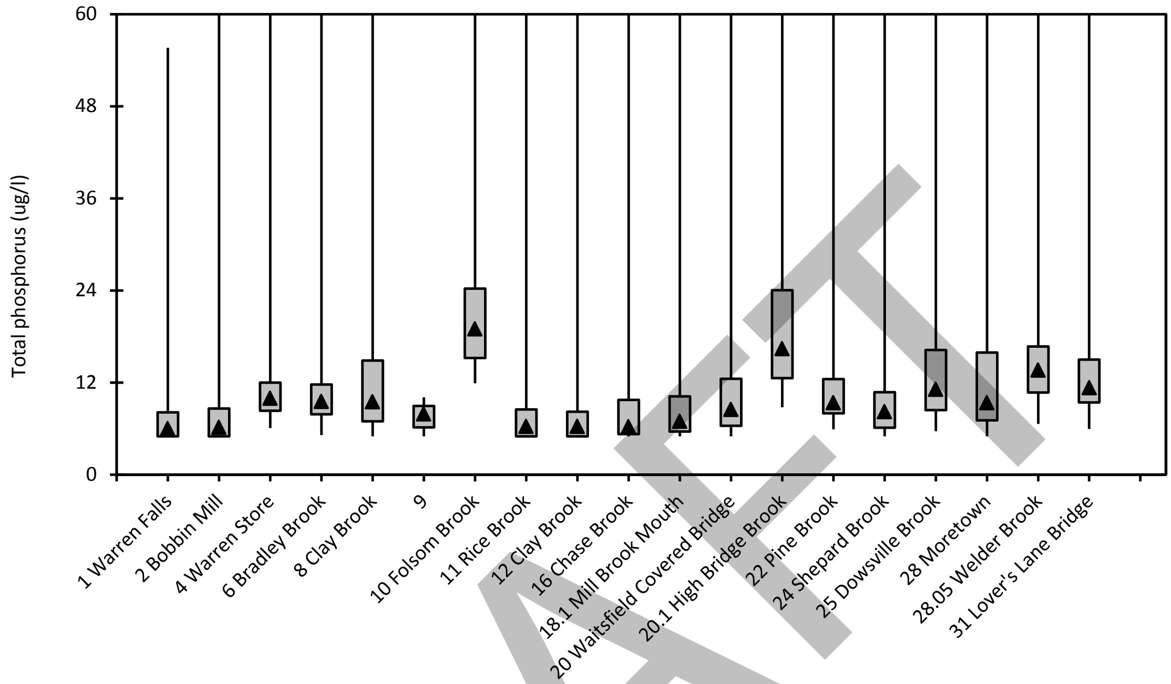

Figure 16. Total phosphorus concentrations at 19 sites along the Mad River and its tributaries during 2006-2015. Values are the median (triangle), 1st and 3rd quartiles (rectangle), and minimum and maximum (line).

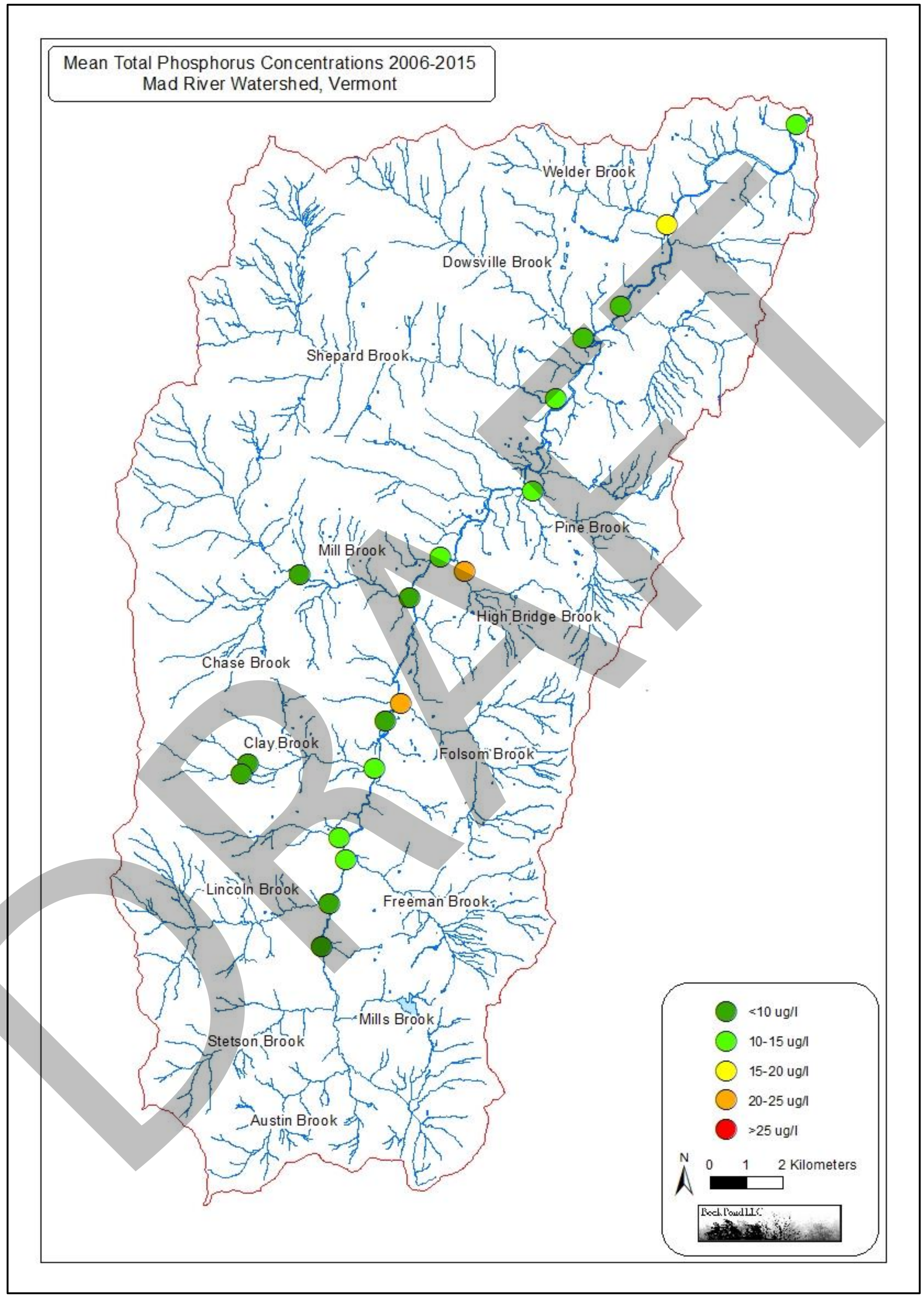

Figure 17. Mean total phosphorus concentrations at 19 sites along the Mad River and its tributaries during 2006-2015.

During 2014-2015, total phosphorus concentrations at the 18 sites (Site #9 was not sampled in these two years) ranged between 5.0-377.6 µg/l, and mean total phosphorus concentrations ranged between 6.1-24.0 µg/l (Table 7). In these two years, the highest mean total phosphorus concentrations (>20 µg/l) were measured at only one site [Site #20.1 (High Bridge Brook)](Figure 18-19). In contrast, lower mean total phosphorus concentrations (<10 µg/l) were measured at numerous sites along both the main stem, especially the upper reaches, and several tributaries, including Mill, Clay, and Shepard Brooks. Finally, intermediate mean total phosphorus concentrations (10-20 µg/l) were measured at several sites along the main stem, especially the lower reaches, and several tributaries, including Welder, Dowsville, and Pine Brooks.

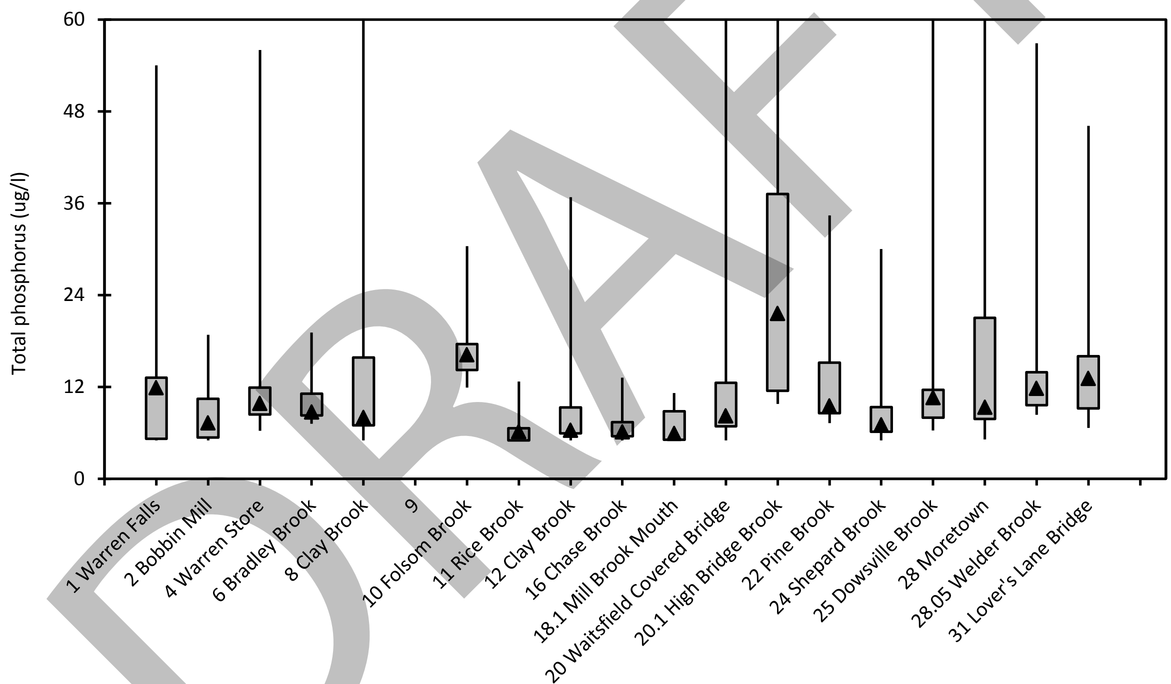

Figure 18. Total phosphorus concentrations at 18 sites along the Mad River and its tributaries during 2014-2015. Values are the median (triangle), 1st and 3rd quartiles (rectangle), and minimum and maximum (line). Site #9 was not sampled in these two years.

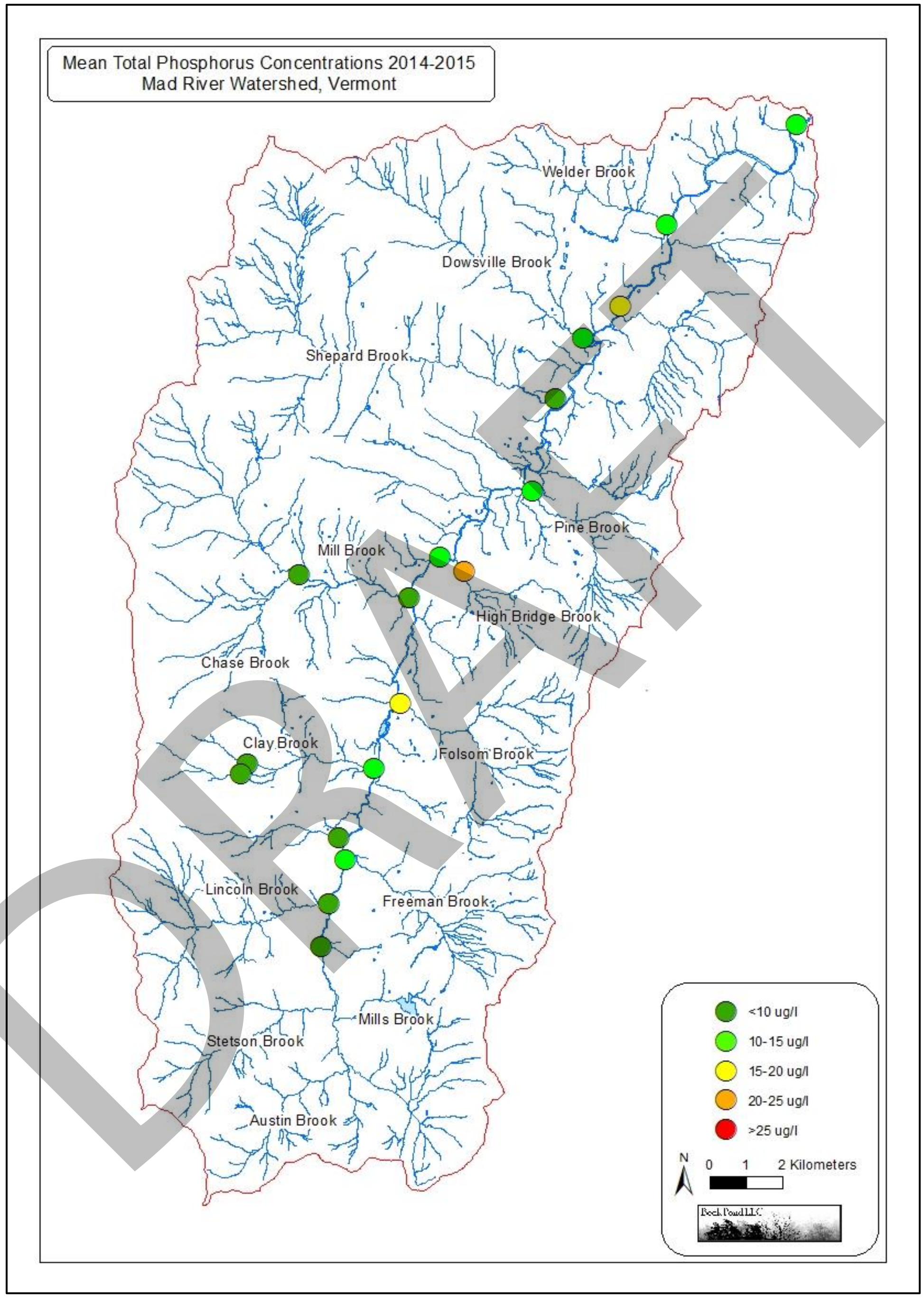

Figure 19. Mean total phosphorus concentrations at 18 sites along the Mad River and its tributaries during 2014-2015.

During 2014-2015, there was no clear or consistent pattern in total phosphorus concentrations along the length of the main stem of the Mad River (Figure 20). Total phosphorus concentrations decreased slightly from Site #1 (Warren Falls) to Site #20 (Waitsfield Covered Bridge) and then increased slightly from there downstream through Site #28 (Moretown) to Site #31 (Lover's Lane Bridge). Thus, total phosphorus concentrations did increase roughly 5 μg/l on average over the course of 21 km (13 miles) from Waitsfield village downstream towards the mouth of the Mad River.

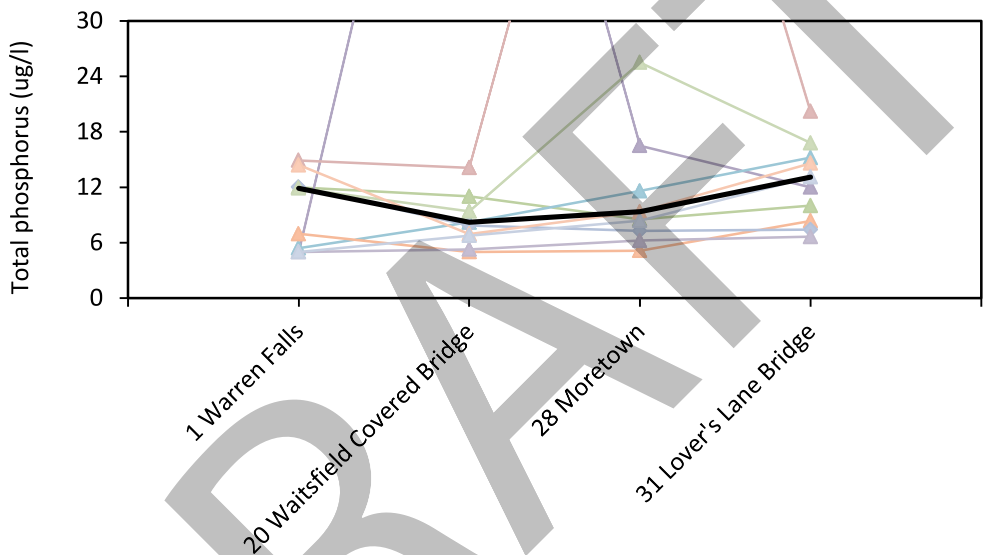

Figure 20. Total phosphorus "profile" at four sites along the main stem of the Mad River from Site #1 (Warren Falls) downstream to Site #31 (Lover's Lane Bridge) during 2014-2015. The light, colored lines show the values measured on each sample date; the bold, black line shows the median values for each site during those two years. Note that some of the values exceed the range of the y-axis.

Total phosphorus concentrations exhibited no consistent change over time, as total phosphorus concentrations increased at some sites and decreased at other sites along both the main stem and tributaries of the Mad River (Figure 21). The sites with the greatest decreases in total phosphorus concentrations during 2006-2015 included Site #8 (Clay Brook), Site #10 (Folsom Brook), and Site #25 (Dowsville Brook). In contrast, total phosphorus concentrations increased markedly at four sites, including Site #1 (Warren Falls), Site #2 (Bobbin Mill), Site #20.1 (High Bridge Brook), and Site #28 (Moretown).

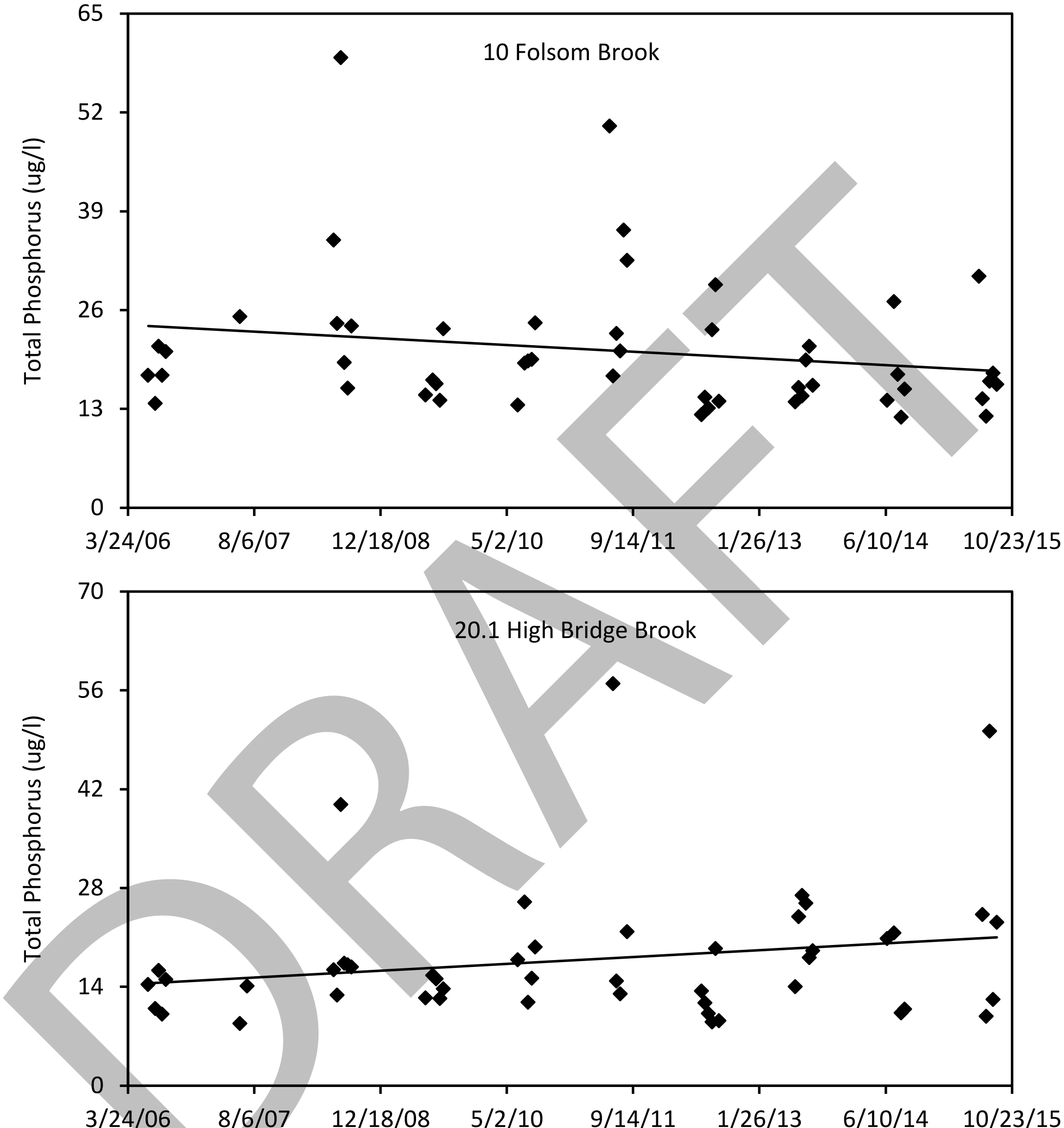

Figure 21. Total phosphorus concentrations over time at two sites [Site #10 (Folsom Brook) and Site #20.1 (High Bridge Brook)] with decreasing and increasing total phosphorus concentrations during 2006-2015. The regression lines indicate the linear relationships between the two parameters. Note that some of the values exceed the range of the y-axis.

At the two sites with the highest median total phosphorus concentrations during 2006-2015, we examined total phosphorus concentrations in relation to the stream flows measured at the USGS gage on the Mad River near Moretown. At both Site #10 (Folsom Brook) and Site

#20.1 (High Bridge Brook), total phosphorus concentrations generally increased with increasing stream flows (Figure 22). However, the patterns differed among the two sites over time. At Site #10 (Folsom Brook), total phosphorus concentrations generally decreased over time, especially at the higher stream flows. In contrast, at Site #20.1 (High Bridge Brook), no consistent change was apparent over time. The generally positive relationships between total phosphorus concentrations and stream flows suggested that the source(s) of these high phosphorus levels were likely to be nonpoint sources, such as surface runoff from agricultural lands, unpaved roads, and other land uses. Both Folsom Brook and High Bridge Brooks pass through agricultural areas, although, on Folsom Brook, the agricultural uses are primarily dairy, whereas, on High Bridge Brook, they are mostly equine. In addition, roads and stream crossings are particularly abundant in the watershed drained by High Bridge Brook (Stone Environmental 2016).

In summary, total phosphorus, which measures the concentration of all forms of phosphorus in the water column and is an important measure of nutrient levels in rivers and streams, was measured at 19 sites on 55 dates during 2006-2015 (although not all sites were sampled on all dates). Total phosphorus concentrations were remarkably low across almost all of the sites. The only areas of concern were along two tributaries (High Bridge Brook and Folsom Brook) and the main stem in the vicinity of Moretown village. At two of these three sites, total phosphorus concentrations have increased over time, and the positive relationships with stream flow suggested that much of the phosphorus at these two sites may be originating from nonpoint sources, such as surface runoff from agricultural and other land uses. Unpaved roads may be another significant source of the high phosphorus levels, especially along High Bridge and Folsom Brooks, where an earlier study estimated that approximately 35% and 11%, respectively, of the phosphorus load may have originated from unpaved roads (Wemple 2013).

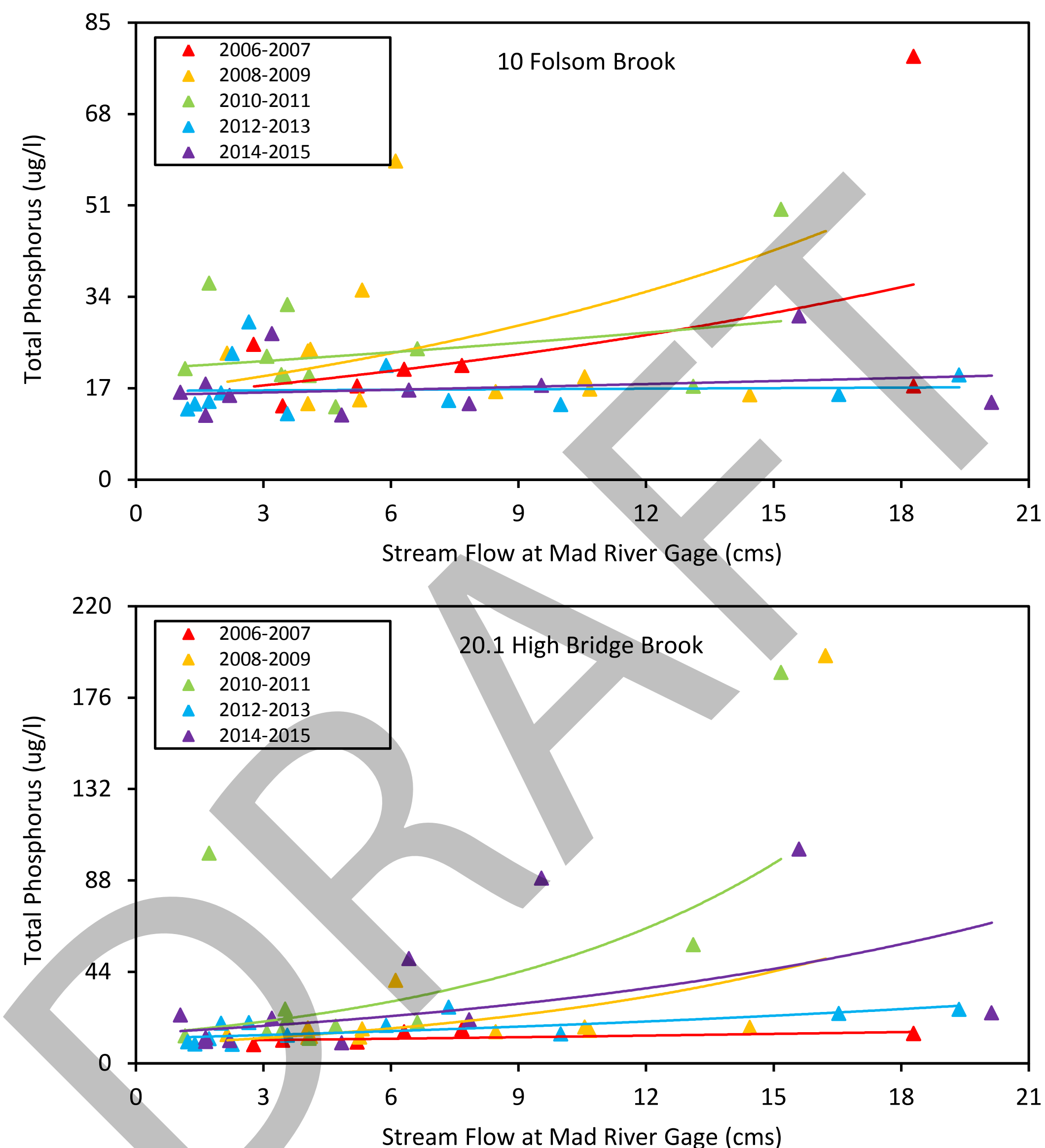

Figure 22. Total phosphorus concentrations in relation to stream flow at two sites [Site #10 (Folsom Brook) and Site #20.1 (High Bridge Brook)] in two-year intervals during 2006-2015. Stream flows were measured at the USGS stream gage on the Mad River near Moretown, Vermont (USGS station 04288000). The regression lines indicate the exponential relationships between the two parameters. Note that two extreme high flows were not included in this analysis.

Turbidity

Turbidity, which is measured in Nephelometric Turbidity Units (NTU), measures the light-scattering properties of all of the dissolved and suspended materials in the water column. Turbidity greatly affects the health of aquatic ecosystems, as more turbid waters allow less light to penetrate into the water column and transport more pollutants, nutrients, and sediment. In addition, sediment and other suspended materials can settle out of the water column and smother aquatic biota and their habitats. Much of the dissolved and suspended material in the water column originates from erosion associated with agriculture, forestry, urban and suburban development, unpaved roads, and stream channel adjustment. However, turbidity is also affected by natural biological and chemical processes and by the presence of chemical pollutants. In Vermont, the Water Quality Standards for turbidity are twofold: 1) 10 NTU as an annual average under dry weather, base-flow conditions in all Class A(1) Ecological Waters, Class A(2) Public Water Supplies, and Cold-Water Class B Waters; and 2) 25 NTU as an annual average under dry weather, base-flow conditions in all Warm-Water Class B Waters (State of Vermont 2014a).

Like total phosphorus, turbidity was measured in-house by the Friends of the Mad River for only a short time period during 1988-1990 and again through the LaRosa Partnership Program during 2006-2015. Because turbidity was measured on only a few dates during 1988-1990 and because the methods used were not identified, we did not analyze those data but, rather, focused on analyzing those data collected through the LaRosa Partnership Program during 2006-2015. For the 2006-2015 data, all but one of the 19 sites were sampled on almost all of the 55 sample dates (1-4 of the 55 dates were missed at each of five sites, and Site #9 was only sampled on six dates in 2008) and across the full range of stream flows. Thus, we used all of the data to calculate the median, geometric mean, 25% and 75% quartiles, and range in turbidity levels for each of the 19 sites across two time periods (2006-2015 and 2014-2015, the latter better representing the current conditions at each site).

During 2006-2015, turbidity levels at the 19 sites ranged between 0.2-472 NTU, but mean turbidity levels only ranged between 0.6-2.9 NTU (Table 8). Thus, turbidity levels were generally relatively low at all sites in the Mad River watershed. During these ten years, the highest mean turbidity levels (>2 NTU) were measured at only five sites, including two sites along the lower reaches of the main stem [Site #31 (Lover's Lane Bridge) and Site #28 (Moretown)] and one site along each of three tributaries [Site #25 (Dowsville Brook), Site #20.1 (High Bridge Brook), and Site #8 (Clay Brook)](Figure 23-24). In contrast, lower mean turbidity levels (<2 NTU) were measured throughout the main stem, especially the upper reaches, and along numerous tributaries of the Mad River.

Table 8. Turbidity levels at 19 sites along the Mad River and its tributaries for two time periods (2006-2015 and 2014-2015).

		#	2006-2015			2014-2015 Only		
Site #	Site Name	Dates	Median	Mean	Range	Median	Mean	Range
1	Warren Falls	55	0.7	0.8	0.2-44.1	0.9	1.6	0.4-44.1
2	Bobbin Mill	55	0.8	1.0	0.2-54	0.8	0.8	0.33-4.73
4	Warren Store	54	1.1	1.3	0.2-166	1.3	1.4	0.41-19.5
6	Bradley Brook	54	1.2	1.8	0.34-187	1.1	1.6	0.52-7.95
8	Clay Brook	54	2.3	2.7	0.29-116	2.9	2.9	0.52-85.6
9	-	6	0.8	0.8	0.39-1.48	-	-	-
10	Folsom Brook	55	0.8	1.1	0.21-56.5	1.2	1.3	0.47-6.28
11	Rice Brook	55	0.6	0.8	0.2-88	0.5	0.5	0.2-1.73
12	Clay Brook	55	0.7	0.8	0.2-59.1	0.7	1.1	0.21-10.1
16	Chase Brook	55	0.4	0.6	0.2-358	0.4	0.5	0.2-1.89
18.1	Mill Brook Mouth	54	0.6	0.9	0.2-88	0.9	0.9	0.23-8.55
20	Covered Bridge	54	1.3	1.6	0.32-173.8	1.7	3.0	0.36-174
20.1	High Bridge Brook	55	2.0	2.9	0.43-217	2.0	3.4	0.96-69.3
22	Pine Brook	55	0.8	0.9	0.2-88.9	1.1	1.0	0.28-12.9
24	Shepard Brook 55		0.7	1.1	0.2-89.7	0.9	0.8	0.2-8.18
25	Dowsville Brook	55	2.0	2.5	0.26-106	1.7	2.5	0.79-40
28	Moretown	55	1.6	2.3	0.54-472	1.6	3.3	0.65-472
28.05	Welder Brook	55	1.7	1.9	0.21-36.3	1.2	1.3	0.55-16.1
31	Lover's Lane Bridge	51	2.0	2.7	0.58-260	2.0	2.9	0.85-15.6

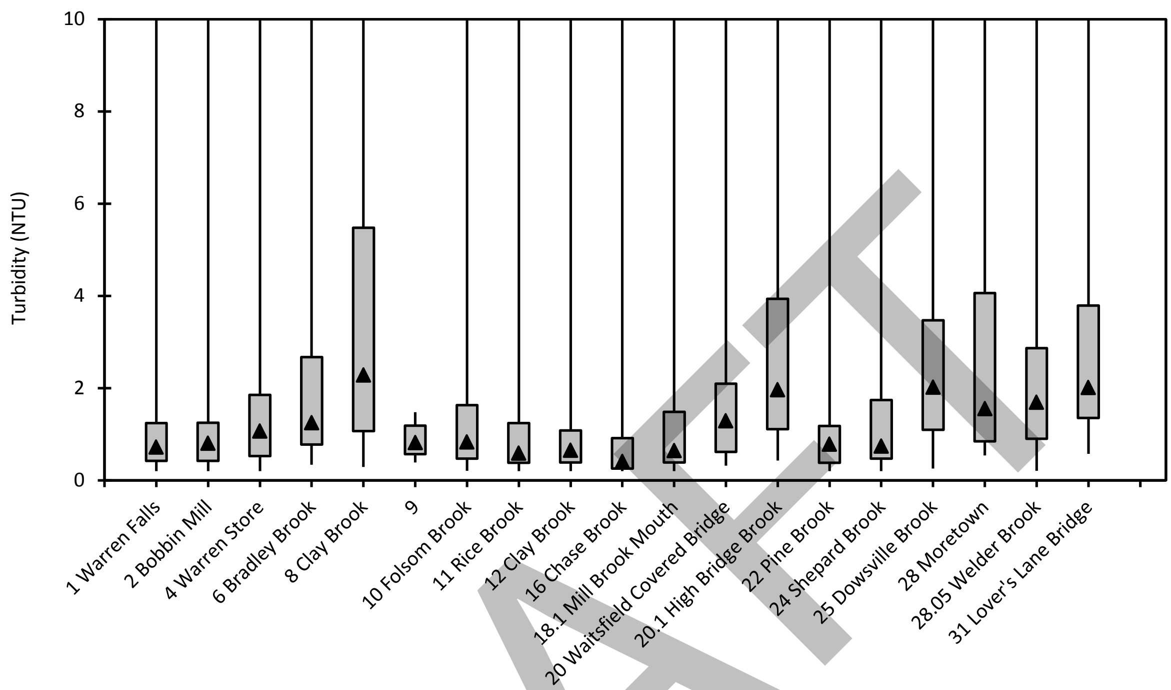

Figure 23. Turbidity levels at 19 sites along the Mad River and its tributaries during 2006-2015. Values are the median (triangle), 1st and 3rd quartiles (rectangle), and minimum and maximum (line).

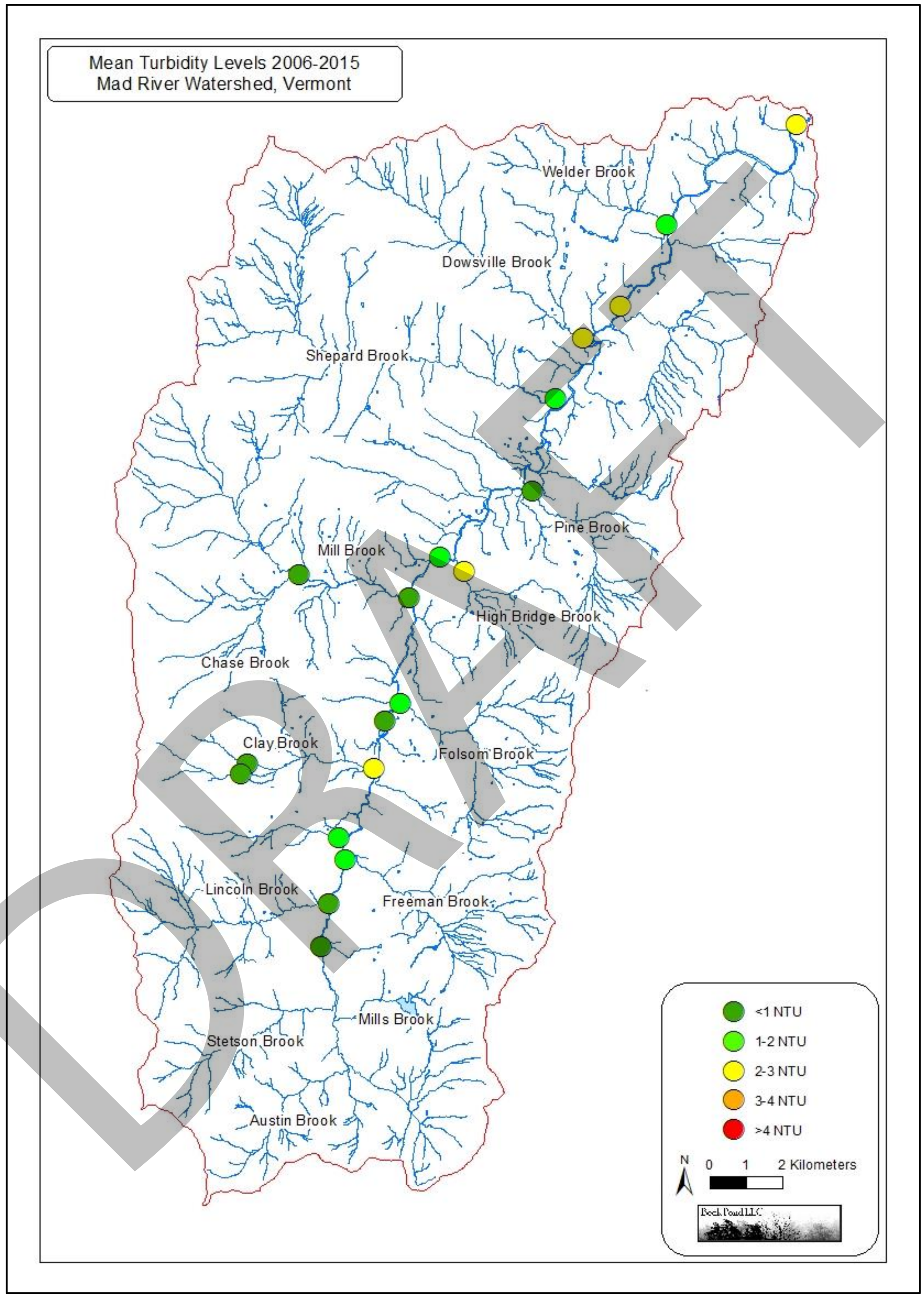

Figure 24. Mean turbidity levels at 19 sites along the Mad River and its tributaries during 2006-2015.

During 2014-2015, turbidity levels at the 18 sites (Site #9 was not sampled in these two years) ranged between 0.2-472 NTU, and mean turbidity levels ranged between 0.5-3.4 NTU (Table 8). In these two years, the highest mean turbidity levels exceeded 3 NTU and were measured at three sites, including two sites along the main stem [Site #28 (Moretown) and Site #20 (Waitsfield Covered Bridge)] and one site along one of the tributaries [Site #20.1 (High Bridge Brook)](Figure 25-26). Unfortunately, all three sites had registered markedly lower mean turbidity levels across the full ten years (2006-2015). In contrast, lower mean turbidity levels (<3 NTU) were measured throughout the main stem, especially the upper reaches, and along most of the tributaries.

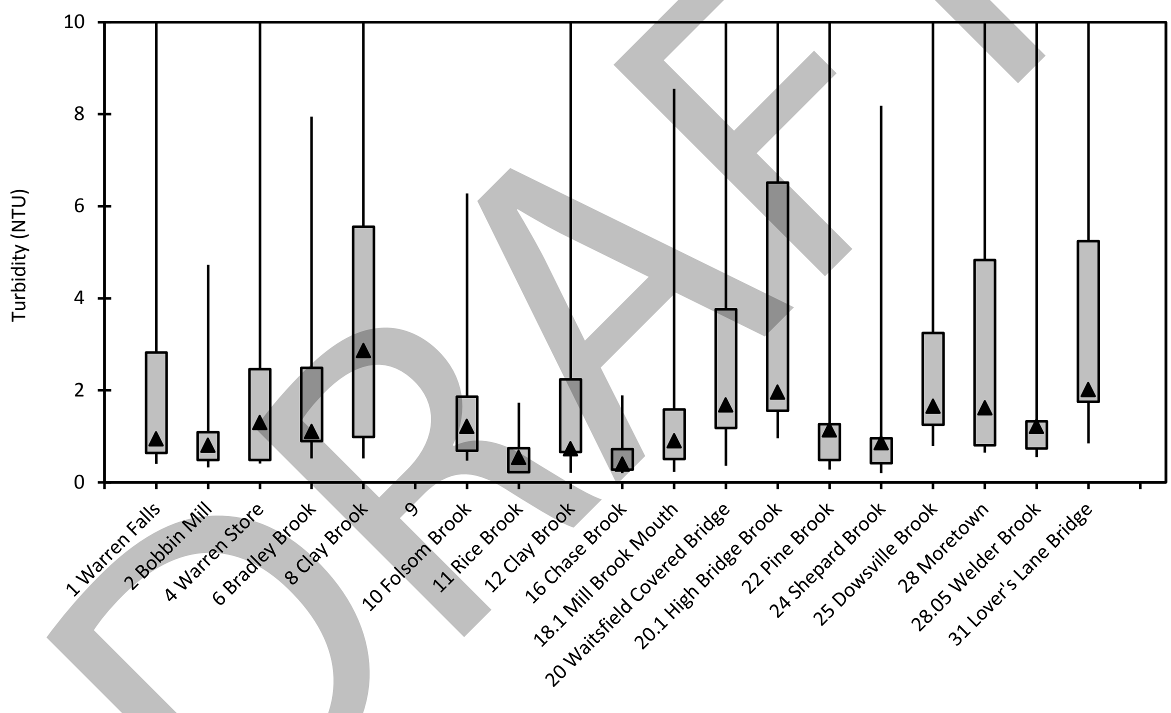

Figure 25. Turbidity levels at 18 sites along the Mad River and its tributaries during 2014-2015. Values are the median (triangle), 1st and 3rd quartiles (rectangle), and minimum and maximum (line). Site #9 was not sampled in these two years.

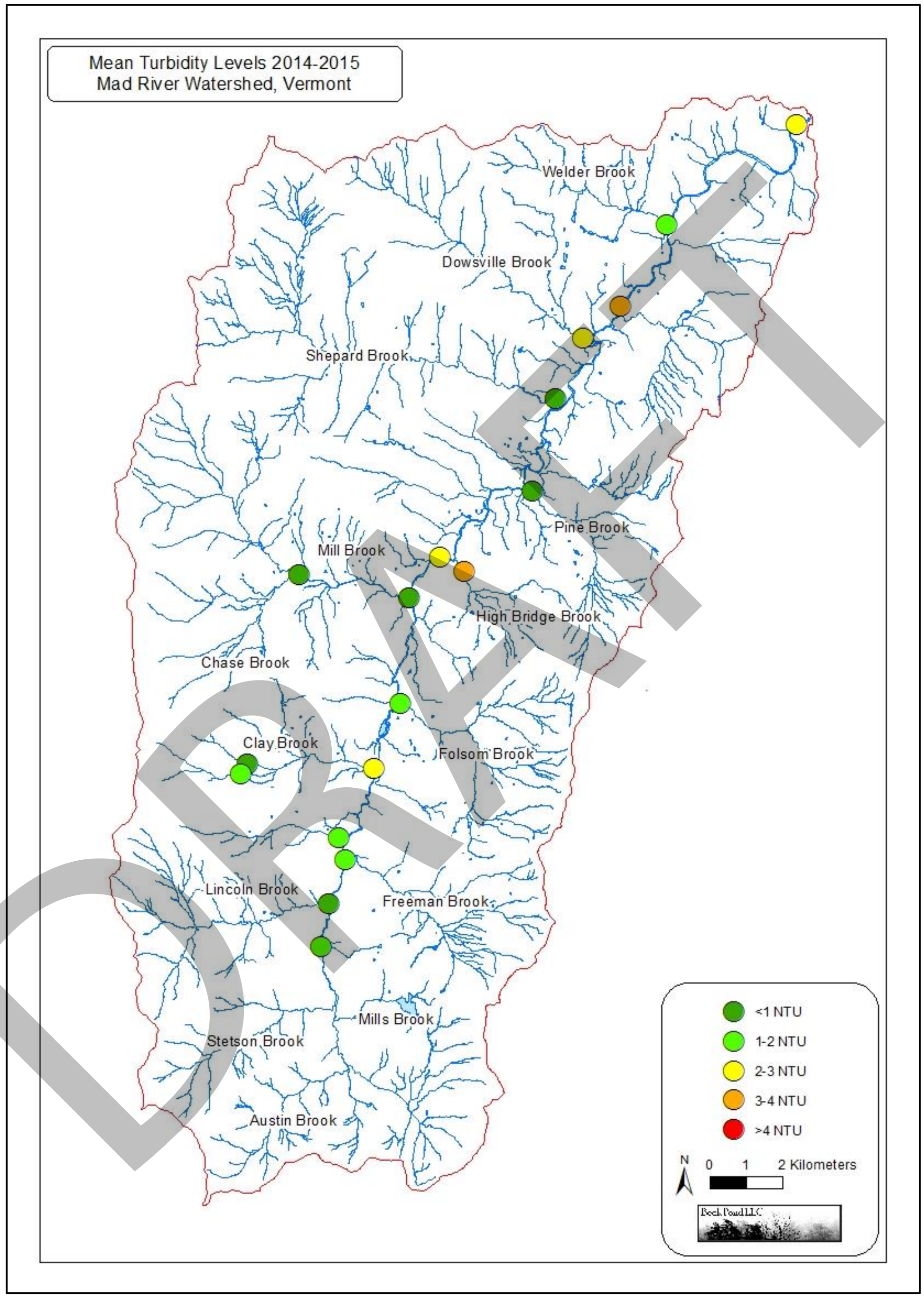

Figure 26. Mean turbidity levels at 18 sites along the Mad River and its tributaries during 2014-2015.

During 2014-2015, turbidity levels consistently increased along the length of the main stem of the Mad River (Figure 27). More specifically, turbidity levels increased most dramatically between Site #1 (Warren Falls) and Site #20 (Waitsfield Covered Bridge) and then leveled off from there downstream through Site #28 (Moretown) to Site #31 (Lover's Lane Bridge). Thus, turbidity levels roughly doubled from <1 NTU to >2 NTU over the course of the 30 km (19 miles) from upstream of Warren village downstream towards the mouth of the Mad River.

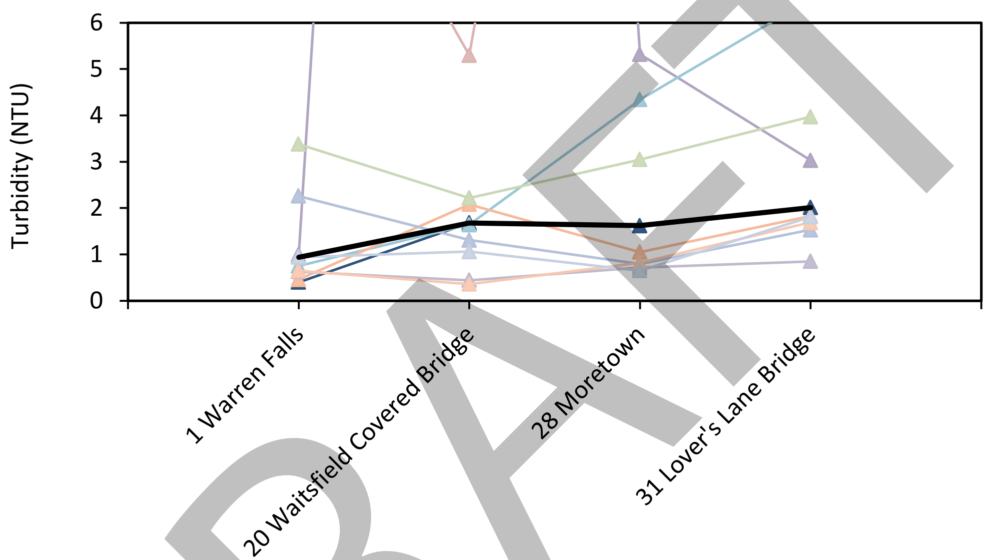

Figure 27. Turbidity "profile" at four sites along the main stem of the Mad River from Site #1 (Warren Falls) downstream to Site #31 (Lover's Lane Bridge) during 2014-2015. The light, colored lines show the values measured on each sample date; the bold, black line shows the median values for each site during those two years. Note that some of the values exceed the range of the y-axis.

Like total phosphorus, turbidity levels showed both increases and decreases over time at different sites along the main stem and tributaries of the Mad River (Figure 28). Six sites exhibited marked decreases in turbidity levels during 2006-2015 [Site #10 (Folsom Brook), Site #11 (Rice Brook), Site #22 (Pine Brook), Site #25 (Dowsville Brook), Site #28 (Moretown), and Site #28.05 (Welder Brook)]. In contrast, turbidity levels only increased markedly at one site [Site #20.1 (High Bridge Brook)] in large part due to a number of very high values measured during 2011-2015. The increase in mean turbidity levels but the overall trend of decreased turbidity values at Site #28 (Moretown) is likely due to a single, extremely high turbidity value measured on 27 July 2015 (472 NTU); for some unknown reason, this value was almost three times the next highest value measured during all of 2006-2015.

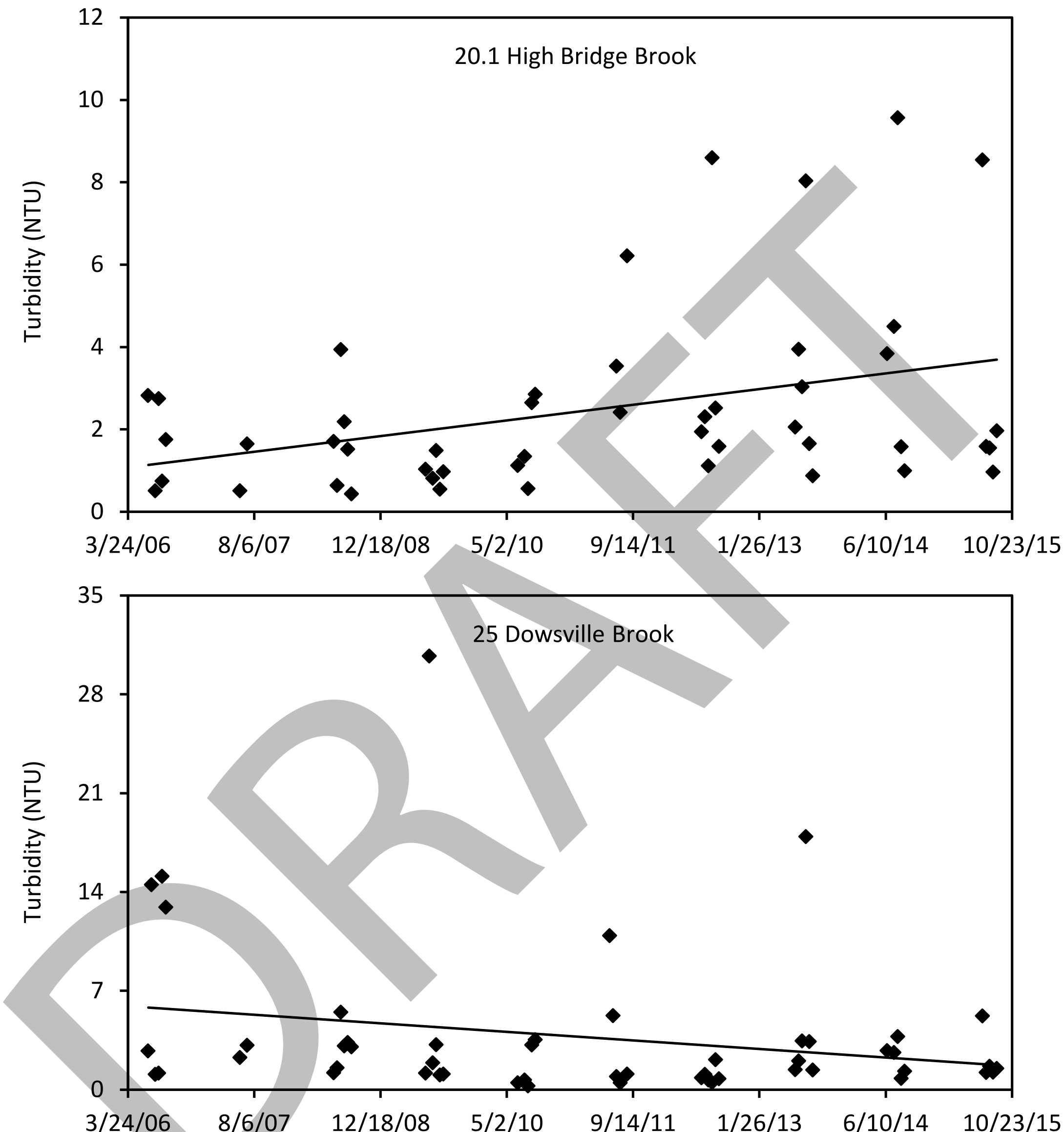

Figure 28. Turbidity levels over time at two sites [Site #20.1 (High Bridge Brook) and Site #25 (Dowsville Brook)] with increasing and decreasing turbidity levels during 2006-2015. The regression lines indicate the linear relationships between the two parameters. Note that some of the values exceed the range of the y-axis.

At the three sites with the highest median turbidity levels during 2014-2015, we analyzed the turbidity levels in relation to the stream flows measured at the USGS gage on the Mad River near Moretown. At all three sites [Site #20 (Waitsfield Covered Bridge), Site #20.1 (High Bridge

Brook), and Site #28 (Moretown)], turbidity levels increased with increasing stream flows (Figure 29). At two of the three sites [Site #20 (Waitsfield Covered Bridge) and especially Site #28 (Moretown)], both of which were located along the main stem, the relationship between stream flow and turbidity became more pronounced over time. These generally positive relationships between turbidity levels and stream flow suggested that the source(s) of the higher turbidity levels were likely to be nonpoint sources, such as surface runoff. High Bridge Brooks passes through an agricultural area that is primarily used for horses but that also has very high densities of unpaved roads and stream crossings (Stone Environmental 2016). The other two sites, on the other hand, are located along the main stem, where there is both more agricultural land but also more suburban and urban development.

In summary, turbidity, which measures water clarity, was measured at the 19 sites on 55 dates during 2006-2015 (although not all sites were sampled on all dates). Turbidity levels were remarkably low across all sites, and, even though they included a mix of low, moderate, and high flows, they were well below the Vermont water quality standards (State of Vermont 2014a). Turbidity levels were slightly higher at two sites located along the main stem near the villages of Moretown and Waitsfield [Site #28 (Moretown) and Site #20 (Waitsfield Covered Bridge)], especially during the two most recent years of this study (2014-2015). At a third site [Site #20.1 (High Bridge Brook)], turbidity levels were also slightly higher than elsewhere, but they had also increased markedly, especially during the past five years. In addition, the positive relationship between turbidity levels and stream flow at this site again suggested that nonpoint sources, such as surface runoff from agricultural and other land uses may be impacting water quality. Unpaved roads may be another significant source of the high turbidity levels, especially along High Bridge Brook, where an earlier study estimated that approximately 11% of the sediment flux may have originated from unpaved roads (Wemple 2013, Stone Environmental 2016).

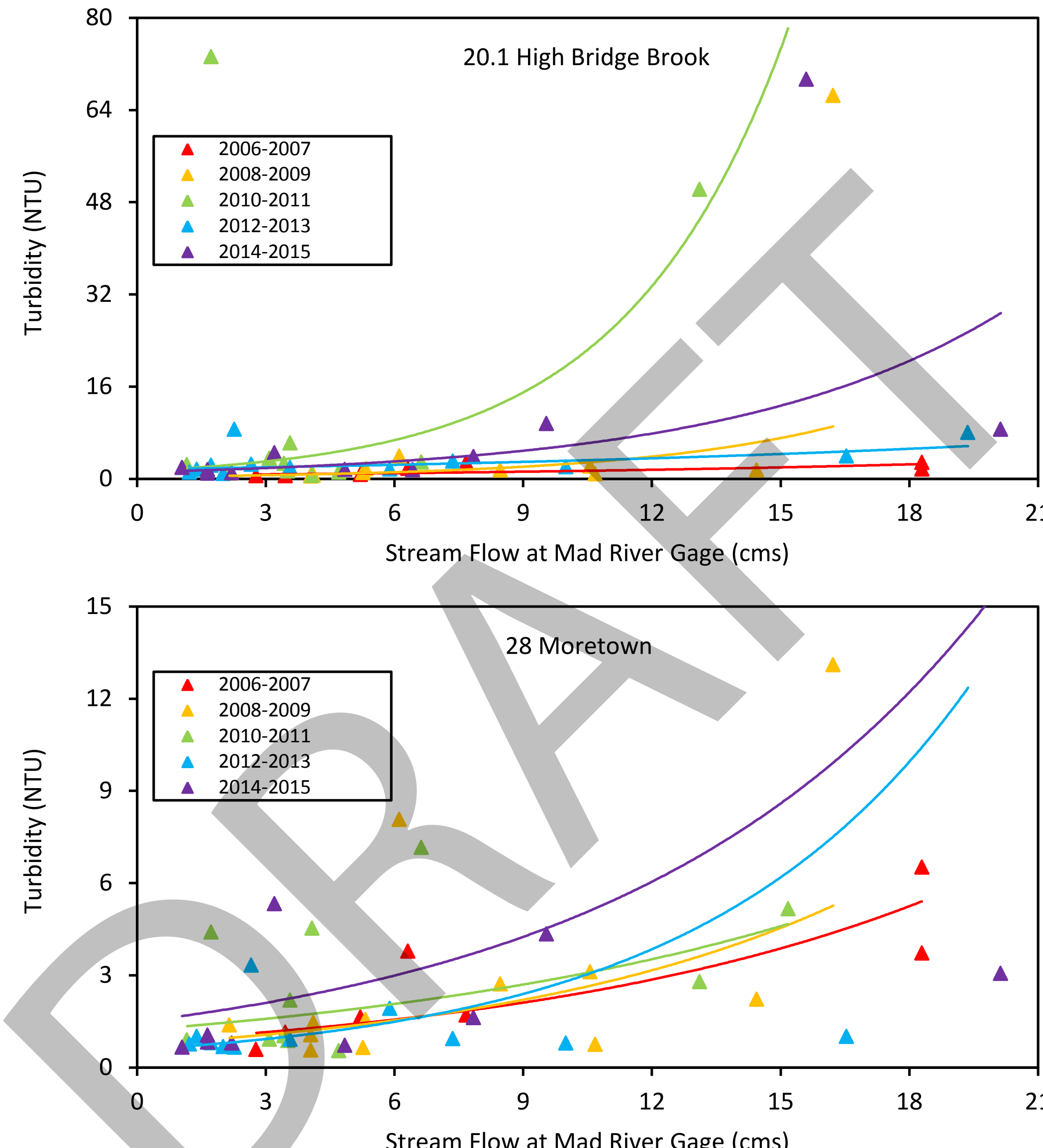

Figure 29. Turbidity levels in relation to stream flow at two sites [Site #20.1 (High Bridge Brook) and Site #28 (Moretown)] at two-year intervals during 2006-2015. Stream flows were measured at the USGS stream gage on the Mad River near Moretown, Vermont (USGS station 04288000). The regression lines indicate the exponential relationships between the two parameters. Note that two extreme high flows were not included in this analysis.

Fecal Coliform Bacteria

Fecal coliform are a generic group of bacteria primarily found in human and animal intestines and wastes and that include both pathogenic and harmless forms (*Escherichia coli* is one species of fecal coliform bacteria). While not necessarily harmful themselves, their presence indicates that other disease-causing organisms may be present and that swimming and other water-based recreation may carry a health risk. Thus, fecal coliform counts provide valuable information that is useful for both protecting public health, especially in areas used for swimming and other recreational activities, and the health of the riverine ecosystem. Potential sources of fecal coliform bacteria include wastewater treatment plants, septic systems, domestic and wild animals, and urban runoff. Fecal coliform are routinely counted as part of the protocol for measuring *E. coli*, and the results are reported as the most probable number (MPN) of colonies per 100 ml.

Fecal coliform bacteria were counted by the Friends of the Mad River during two time periods (1985-1991 and 2002-2005) and were likely counted in all of the intervening and subsequent years, although those data were not entered into the electronic databases used for these analyses. Unlike total phosphorus and turbidity, fecal coliform bacteria were not sampled as consistently across all sites, years, and corresponding stream flows. During the eleven years, 18-39 sites were sampled each year. Only three of the 56 sites were sampled on all 59 sample dates, and another 22 sites were sampled on at least 50 of the 59 sample dates. All 25 of these sites were sampled every year during 1985-1991 and 2002-2005, except eight sites that were not sampled in 1997 for unknown reasons. The remaining 31 sites were sampled on 1-42 dates, often for only a subset of years (e.g. ten sites were only sampled on 1-5 dates in a single year). Thus, we used the data from all the years to calculate the median, geometric mean, 25% and 75% quartiles, and range in fecal coliform counts for each of the 25 sites that were well sampled across the two time periods (1988-1991 and 2002-2005).

Across all eleven years, fecal coliform counts at the 25 sites ranged between <1 and 2,419.2 colonies/100 ml, and mean fecal coliform counts ranged between 18.3-196.4 colonies/100 ml (Table 9). During these eleven years, the highest mean fecal coliform counts (>189 colonies/100 ml) were measured at two sites located along the lower reaches of the main stem [Site #28 (Moretown) and Site #26 (North Road)](Figure 30-31). Intermediate levels of fecal coliform bacteria (126-189 colonies/100 ml) were measured at four sites along the lower reaches of main stem [Site #29 (Ward's Access), Site #27 (Moretown Village), Site #23 (Meadow Road Bridge), and Site #21 (Waitsfield Elementary School)]. Finally, the lowest mean fecal coliform counts (<126 colonies/100 ml) were measured throughout the main stem, especially the middle and upper reaches, and along many of the tributaries, especially Mill, Chase, and Clay Brooks.

Table 9. Fecal coliform counts at 25 sites along the Mad River and its tributaries during 1988-1991 and 2002-2005. Only sites that were sampled on at least 50 of the 59 sample dates are included.

Site #	Site Name	# Dates	Median	Mean	Range
1	Warren Falls	54	29.5	25.1	0.5-1414
2	Bobbin Mill	56	27.0	22.1	0.5-1986
3	Warren Covered Bridge	59	26.0	31.4	0.5-1300
4	Warren Store	58	68.0	82.3	0.5-2420
5	Warren Village North	57	48.0	55.5	1-2420
6	Bradley Brook	52	21.5	31.9	1-2420
7	Riverside Park	58	47.0	54.4	0.5-2420
8	Clay Brook	58	49.0	50.0	0.5-2420
9	-	59	44.3	46.4	0.5-2420
10	Folsom Brook	57	122.4	124.5	0.5-2420
11	Rice Brook	59	24.0	23.8	0.5-1153
12	Clay Brook	54	16.0	18.3	0.5-1203
16	Chase Brook	52	21.5	21.0	0.5-2420
17	German Flats	55	24.0	35.1	0.5-2420
19	Lareau Swimhole	57	94.0	81.7	1-2420
20	Covered Bridge	57	106.0	118.5	1-2420
21	Waitsfield Elem. School	53	107.1	133.1	3.1-2420
22	Pine Brook	56	40.8	51.7	1-2420
23	Meadow Road Bridge	58	156.5	162.4	4.1-2420
24	Shepard Brook	54	53.0	71.6	1-2420
25	Dowsville Brook	51	34.5	54.9	0.5-2419
26	North Road	56	160.5	194.0	1-2420
27	Moretown Village	54	142.5	160.8	1-2420
28	Moretown	53	172.0	196.4	3.1-2420
29	Ward's Access	55	154.0	180.3	2-2420

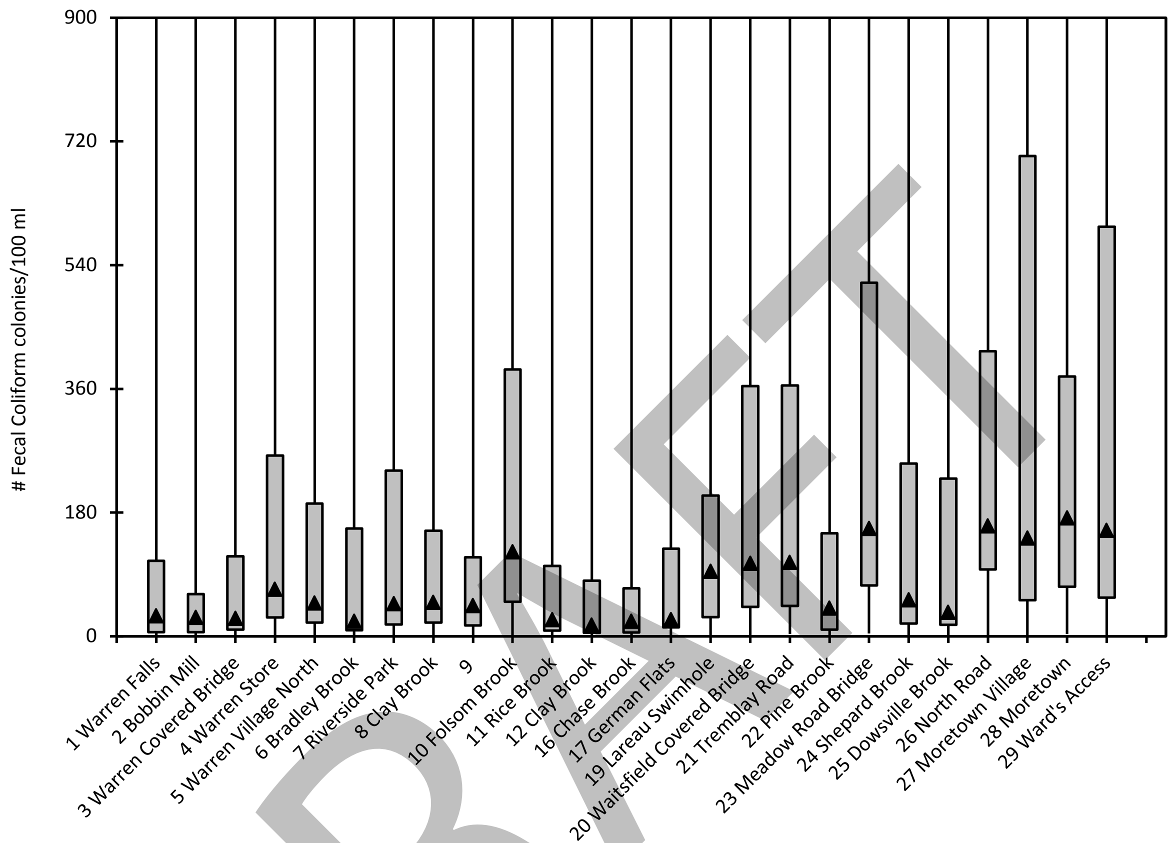

Figure 30. Fecal coliform counts at 25 sites along the Mad River and its tributaries during 1988-1991 and 2002-2005. Values are the median (triangle), 1st and 3rd quartiles (rectangle), and minimum and maximum (line). Only sites that were sampled on at least 50 of the 59 sample dates are included.

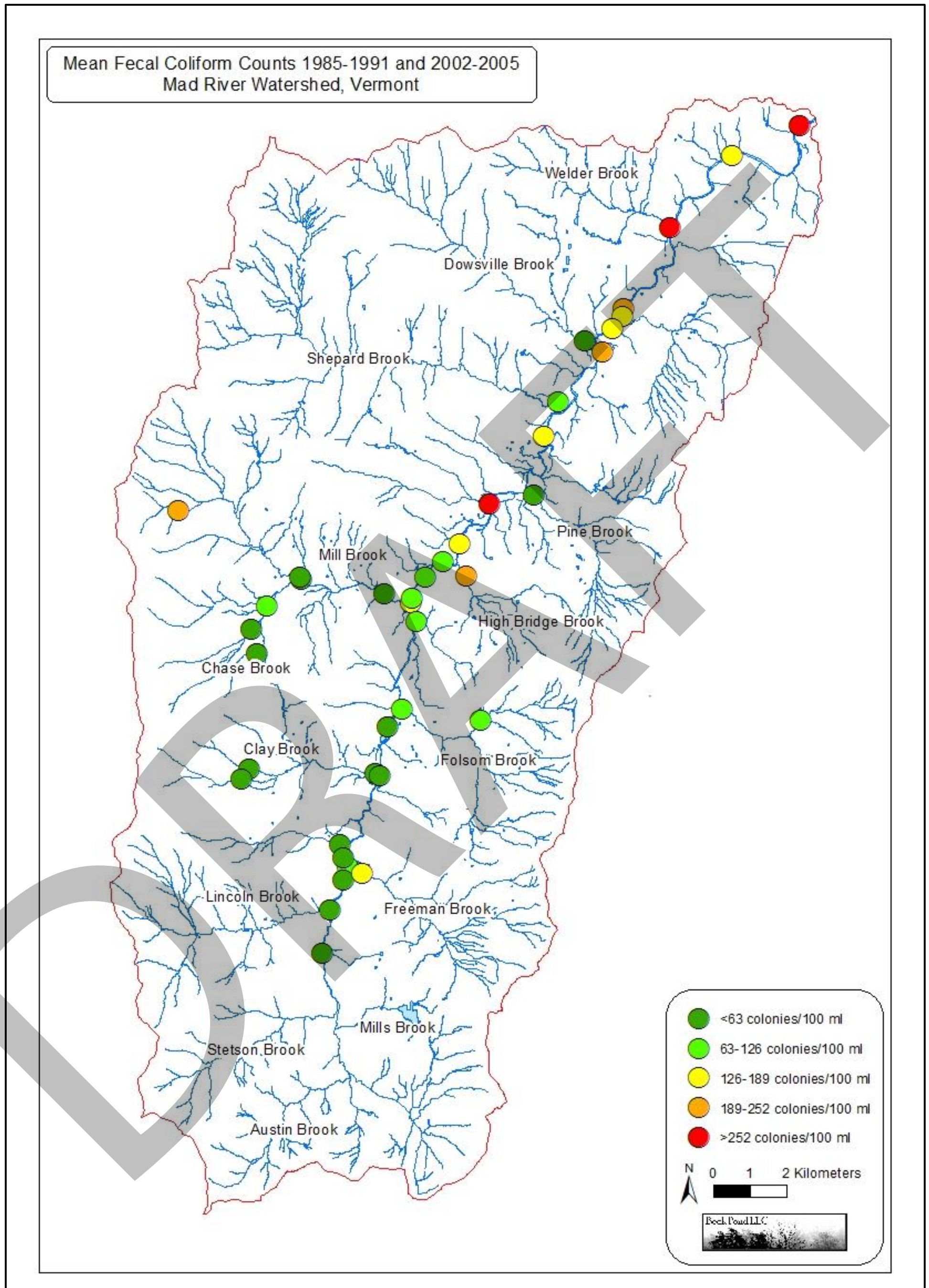

Figure 31. Mean fecal coliform counts at 56 sites along the Mad River and its tributaries during 1988-1991 and 2002-2005.

Fecal coliform counts showed steady and consistent increases along the main stem of the Mad River from Site #1 (Warren Falls) downstream to Site #31 (Lover's Lane Bridge)(Figure 32). The most pronounced increases in fecal coliform counts occurred between Site #26 (North Road) and Site #27 (Moretown Village). In this section of the Mad River, median fecal coliform counts almost doubled from a median of 408 colonies/100 ml at Site #26 (North Road) to a median of 798 colonies/100 ml at Site #27 (Moretown Village).

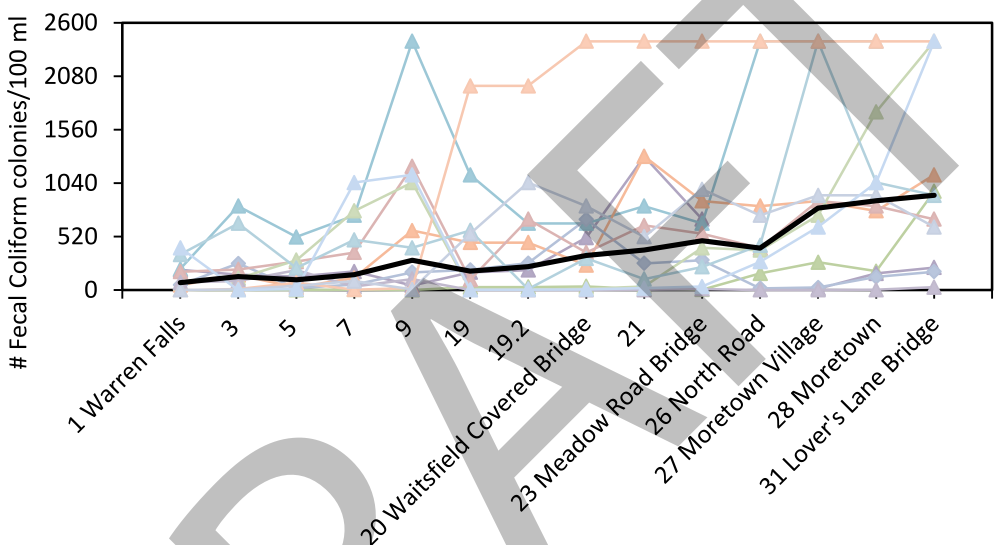

Figure 32. Fecal coliform "profile" at 14 sites along the main stem of the Mad River from Site #1 (Warren Falls) downstream to Site #31 (Lover's Lane Bridge) during 2004-2005. The light, colored lines show the values measured on each sample date; the bold, black line shows the median values for each site during those two years.

In summary, fecal coliform bacteria are valuable indicators of the health and safety of surface waters, especially in areas highly prized for recreational uses such as swimming. Fecal coliform bacteria were measured at 56 sites on 59 dates during 1985-1991 and 2002-2005 (but not all sites were sampled on all dates or in all years). Fecal coliform counts increased consistently from upstream to downstream areas along the main stem and were markedly higher from the village of Waitsfield downstream to the mouth of the Mad River. Fecal coliform counts also were very high at a number of sites along several tributaries of the Mad River. Based on just these analyses, it is difficult to pinpoint and identify likely sources of the high fecal coliform counts measured along the main stem and tributaries; however, a few observations suggested several possibilities. Site #20.1 (High Bridge Brook) is located on a stream that passes through agricultural areas (primarily horse farms), which may be the source of animal wastes that contribute to these higher counts. Along the lower reaches of the main stem, the river passes through agricultural areas as well as village centers and residential areas, which may have failing septic systems and stormwater runoff that carries manure and other organic wastes into the river. Hopefully, future sampling efforts will further pinpoint and assess possible sources of these high fecal coliform counts.

Escherichia coli (E. coli)

As discussed previously, *Escherichia coli* (*E. coli*) is one species of fecal coliform bacteria, which are primarily found in human and animal intestines and wastes. Most strains of *E. coli* are harmless to humans, and some, in fact, are normal residents of the human digestive system, where they aid digestion. A few virulent strains, however, are capable of causing disease in humans and can even be fatal. *Escherichia coli* counts provide valuable information that is useful for both protecting public health, especially in areas used for swimming and other recreational activities, and the health of riverine ecosystems. *Escherichia coli* are widely used as an indicator of fecal contamination and the possible presence of pathogenic (disease-causing) bacteria in surface waters, to ensure that surface waters are safe for swimming and other recreational activities, and to identify possible pollution sources, such as failing septic systems and manure pits. *Escherichia coli* counts [measured as the most probable number (MPN) of colonies/100 ml of water] are typically measured in the laboratory. In Vermont, the Water Quality Standard for *E. coli* in all Class A(1) Ecological Waters, Class A(2) Public Water Supplies, and Class B Waters is that the *E. coli* counts shall not exceed a geometric mean of 126 colonies/100 ml measured over a representative period of 60 days, and no more than 10% of the samples shall exceed 235 colonies/100 ml (State of Vermont 2014a). In addition, none of the *E. coli* should be attributable to the discharge of wastes, and, in all Class B Waters receiving combined sewer overflows (CSO), the representative period is 30 days.

Unfortunately, *E. coli* were not counted or recorded using a consistent methodology during the 24 years sampled (1992-2015). Instead, *E. coli* were counted using a membrane filtration technique during 1992-2001, but the maximum value recorded differed among years (1,001 colonies/100 ml during 1992-1996 but 200 colonies/100 ml during 1997-2001). Beginning in 2002, *E. coli* were counted using the IDEXX Quanti-Tray method. Due to the different methodologies and the differences in the maximum values recorded, we were not able to analyze the data collected during 1992-2001 or to compare those data with data collected after 2001. Nevertheless, the *E. coli* data collected during 2002-2015 provide a valuable, long-term record of *E. coli* levels in the Mad River and its tributaries and are immensely valuable in identifying areas where there may be public health risks for swimming and other recreational activities.

Escherichia coli (*E. coli*) were counted in-house by the Friends of the Mad River using the IDEXX Quanti-Tray method every year during 2002-2015 (14 years). Unlike total phosphorus and turbidity, *E. coli* were not sampled as consistently across all sites, years, and corresponding stream flows. In fact, only five of the 47 sites were sampled on all 83 sample dates during the 14 years. However, 34 of the 47 sites (72%) were sampled on at least 75 dates, and all but six of these 34 sites were sampled every year during 2002-2015 (Figure 33). The remaining 13 sites were sampled on 3-58 dates and often for only a subset of years. Thus, we used the data from all of the years during 2002-2015 to calculate the median, geometric mean, 25% and 75% quartiles, and range in *E. coli* counts for each of the 34 sites that were well sampled throughout 2002-2015.

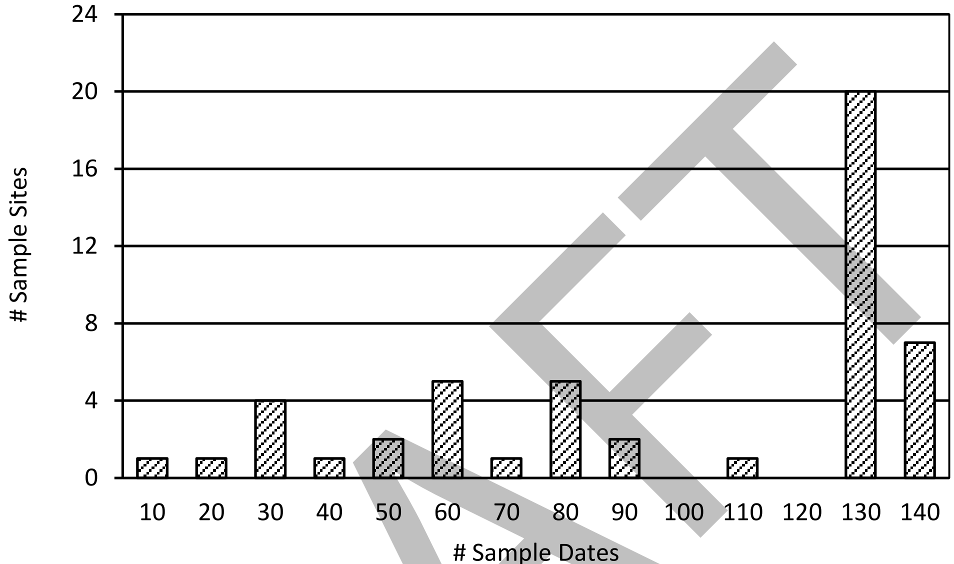

Figure 33. Frequency histogram showing the number of dates on which each site was sampled for *E. coli* in the Mad River watershed during 2002-2015.

During 2002-2015, *E. coli* counts at the 34 sites ranged between <1 and >2,419.2 colonies/100 ml, and mean *E. coli* counts ranged between 9.9-113.2 colonies/100 ml (Table 10). During these 14 years, the highest mean *E. coli* counts (>94.5 colonies/100 ml) were measured at three sites, all located along the lower reaches of the main stem [Site #31 (Lover's Lane Bridge), Site #29 (Ward's Access), and Site #28 (Moretown)](Figure 34-35). Intermediate levels of *E. coli* (63-94.5 colonies/100 ml) were measured at four other sites located along the lower reaches of main stem [Site #27 (Moretown Village) and Site #26 (North Road)] and two tributaries of the Mad River [Site #28.05 (Welder Brook) and Site #28.1]. Finally, lower mean *E. coli* counts were measured throughout the main stem, especially the upper reaches, and along almost all of the tributaries of the Mad River.

Table 10. *E. coli* counts at 34 sites along the Mad River and its tributaries for two time periods (2002-2015 and 2014-2015). The column labeled "%>235" indicates the proportion of counts at each site that exceeded 235 colonies/100 ml during 2014-2015. Only sites that were sampled on at least 75 of the 83 sample dates are included.

		2002-2015			2014-2015 Only			
Site #	# Dates	Median	Mean	Range	Median	Mean	Range	% >235
1	83	16.0	16.9	1-579.4	14.0	18.9	6.3-110	0
2	82	11.0	12.9	1-1413.6	16.3	16.5	5.2-125.9	0
3	82	18.3	20.5	1-2420	14.5	16.8	4.1-160.7	0
4	82	33.8	39.3	1-2420	58.4	38.0	1-461.1	8
4.5	81	22.1	20.0	1-2419.2	27.7	21.9	3.1-1046.2	8
5	81	27.5	30.2	1-640.5	29.9	33.1	5.2-228.2	0
6	80	14.2	15.9	1-1986.3	11.0	15.2	4.1-115.3	0
7	82	25.3	32.5	1-2420	20.9	36.3	11-980.4	8
8	82	17.3	18.4	1-1300	22.1	20.4	1-198.9	0
10	82	27.4	34.3	1-2420	19.4	39.2	5.2-1986.3	17
10.6	77	18.9	23.5	1-2420	21.2	34.4	6.3-920.8	8
11	82	10.9	10.8	1-2420	6.9	10.7	3.1-90.6	0
12	82	4.1	5.5	1-920.8	5.2	7.1	1-143.9	0
13.1	77	11.9	10.5	1-1046.2	11.5	11.9	3-51.2	0
16	82	9.8	10.6	1-2419.2	20.2	17.3	5.2-61.3	0
17	82	17.4	18.6	1-866.4	13.5	15.7	3.1-72.3	0
17.1	75	13.2	13.9	1-1120	14.9	11.3	2-47.5	0
18.1	76	27.0	26.0	1-2419.2	24.7	25.5	6.3-110.6	0
19	83	32.0	24.6	1-2420	41.0	45.2	10.9-770.1	8
19.2	82	30.5	27.2	1-2420	36.5	52.0	12.1-1203.3	8
20	83	35.0	31.3	1-2419.2	25.6	52.3	12-816.4	17
20.1	77	27.8	24.6	1-2420	51.5	79.7	9.8-1553.1	25
22	82	14.8	15.8	1-2420	17.3	16.9	2-547.5	8
23	81	47.9	57.0	1-2420	47.3	66.5	12.2-770.1	8
24	82	29.4	34.7	1-1733	23.3	33.7	10.9-387.3	8
25	81	22.8	25.2	1-2420	19.8	18.5	1-204.6	0
26	81	83.6	84.1	1-2420	100.1	112.4	24.6-866.4	17
27	83	87.0	92.6	1-2420	88.0	110.9	28.7-1413.6	17
27.1	82	38.9	46.9	1-2420	36.2	52.0	14.8-920.8	8
28	82	85.9	103.6	1-2420	90.8	131.3	36.9-1046.2	25
28.05	81	70.0	71.0	1-2420	27.7	61.9	10.7-1299.7	17
29	83	86.0	104.5	7.2-2420	69.4	90.1	27.2-920.8	8
31	77	113.7	113.2	5-2420	68.7	75.9	22.8-770	17
BBL	75	9.7	13.3	1-2420	6.9	7.9	2-69.7	0

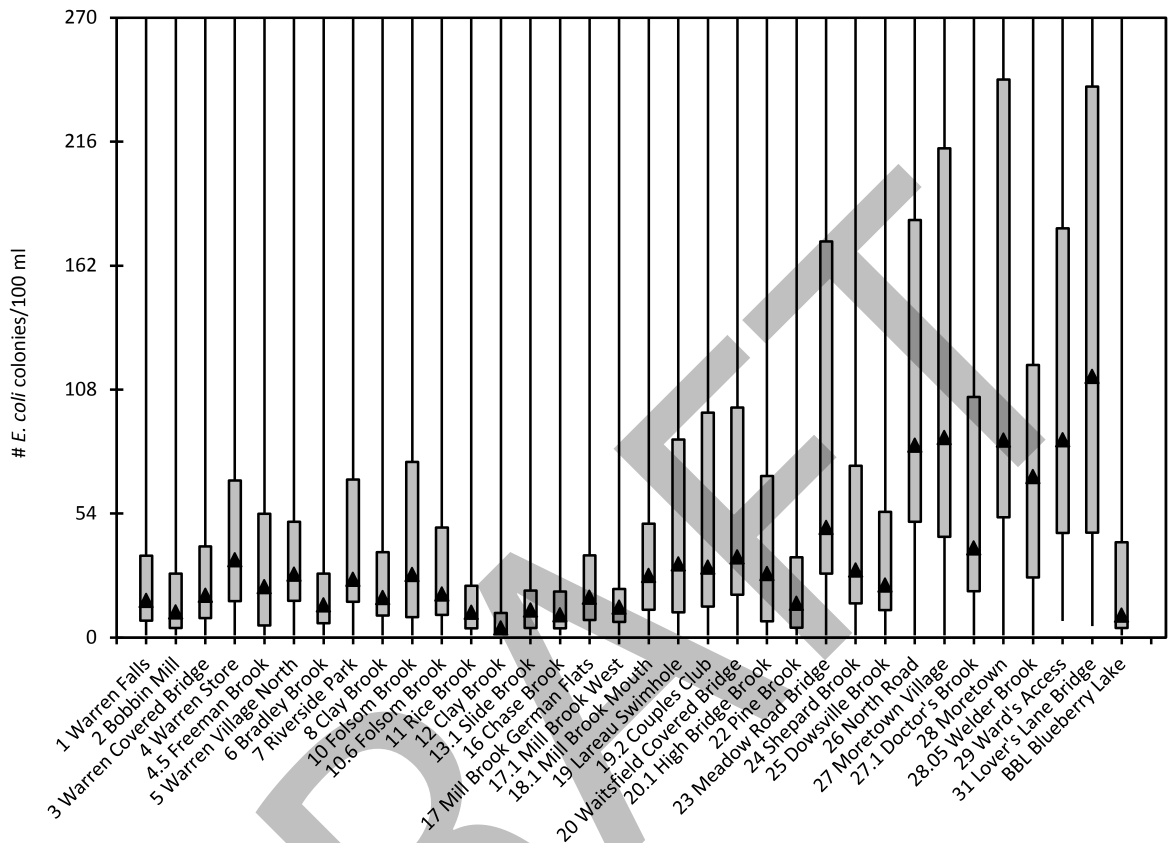

Figure 34. *E. coli* counts at 34 sites along the Mad River and its tributaries during 2002-2015. Values are the median (triangle), 1st and 3rd quartiles (rectangle), and minimum and maximum (line). Only sites that were sampled on at least 75 of the 83 sample dates are included.

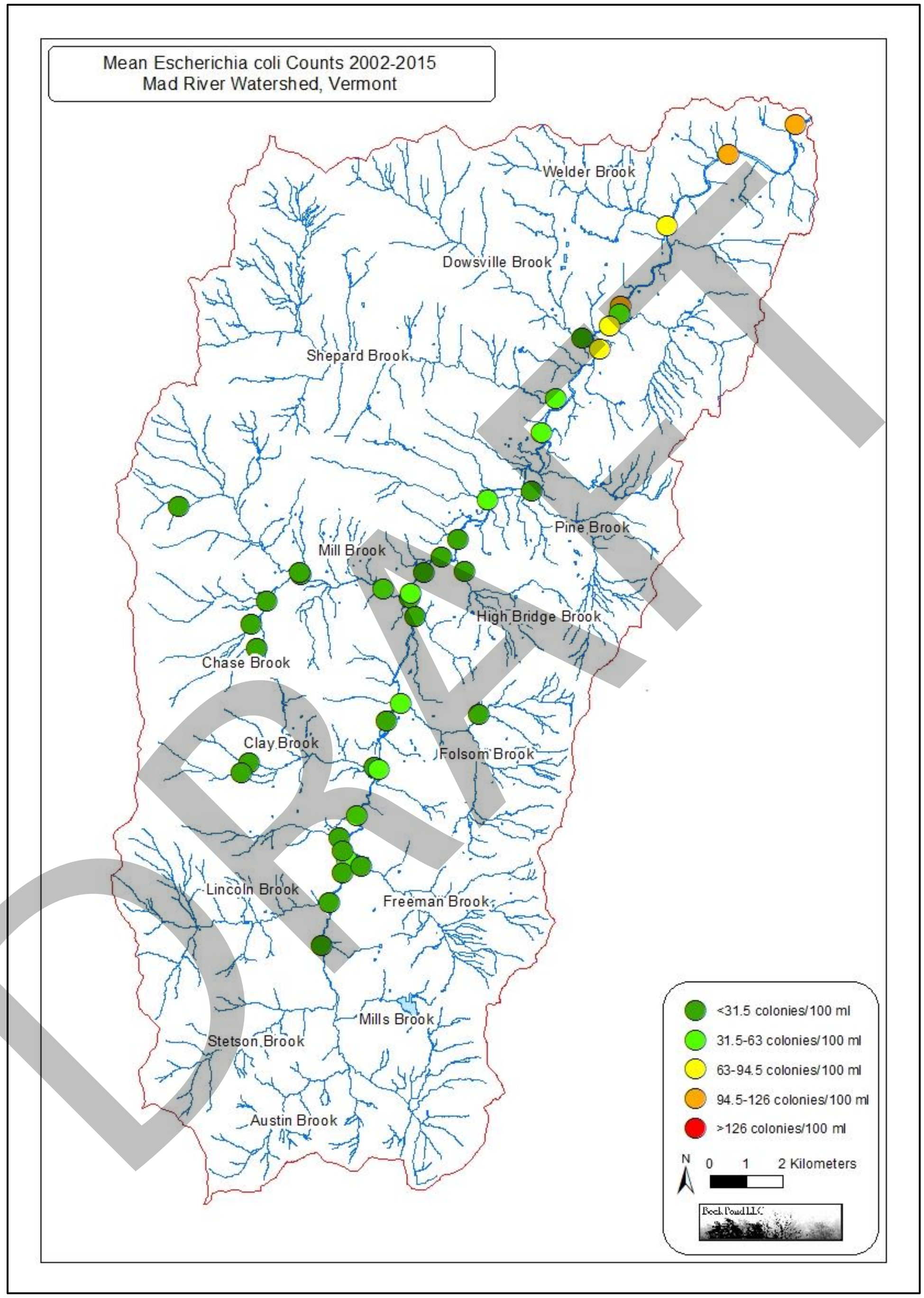

Figure 35. Mean *E. coli* counts at 47 sites along the Mad River and its tributaries during 2002-2015.

During 2014-2015, *E. coli* counts at the 34 sites ranged between 1-1,553.1 colonies/100 ml, and mean *E. coli* counts ranged between 7.9-131.3 colonies/100 ml (Table 10). In these two years, the highest mean *E. coli* counts (>94.5 colonies/100 ml) were measured at three sites, all located along the lower reaches of the main stem in the vicinity of Moretown village [Site #28 (Moretown), Site #26 (North Road), and Site #27 (Moretown Village)](Figure 36-37). Intermediate levels of *E. coli* (63-94.5 colonies/100 ml) were measured at four other sites, including three sites along the lower reaches of the main stem [Site #29 (Ward's Access), Site #31 (Lover's Lane Bridge), and Site #23 (Meadow Road Bridge)] and one site on a tributary [Site #20.1 (High Bridge Brook)]. Finally, lower mean *E. coli* counts (<63 colonies/100 ml) were measured throughout the upper watershed of the Mad River, including the upper reaches of the main stem and many of the tributaries of the Mad River.

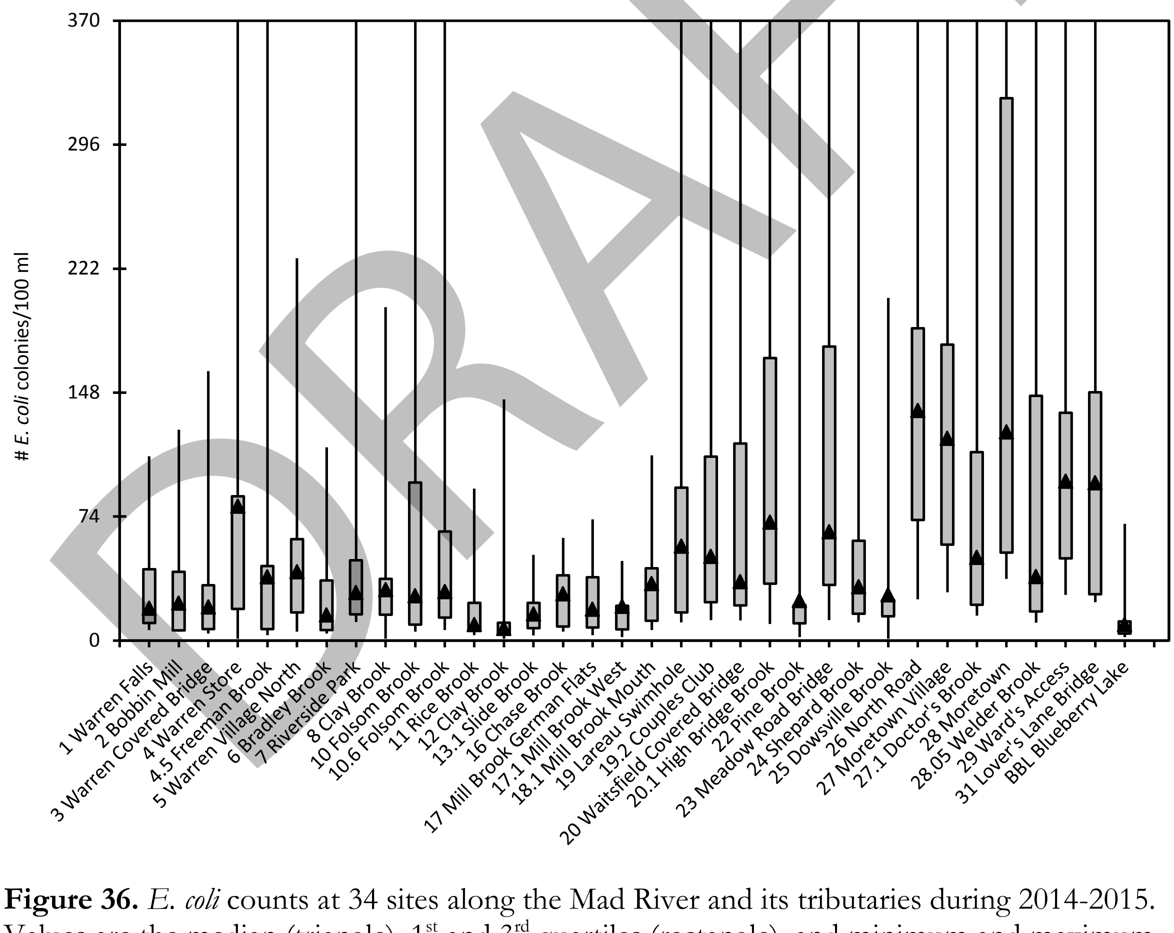

Figure 36. *E. coli* counts at 34 sites along the Mad River and its tributaries during 2014-2015. Values are the median (triangle), 1st and 3rd quartiles (rectangle), and minimum and maximum (line). Only sites that were sampled on at least 75 of the 83 sample dates are included.

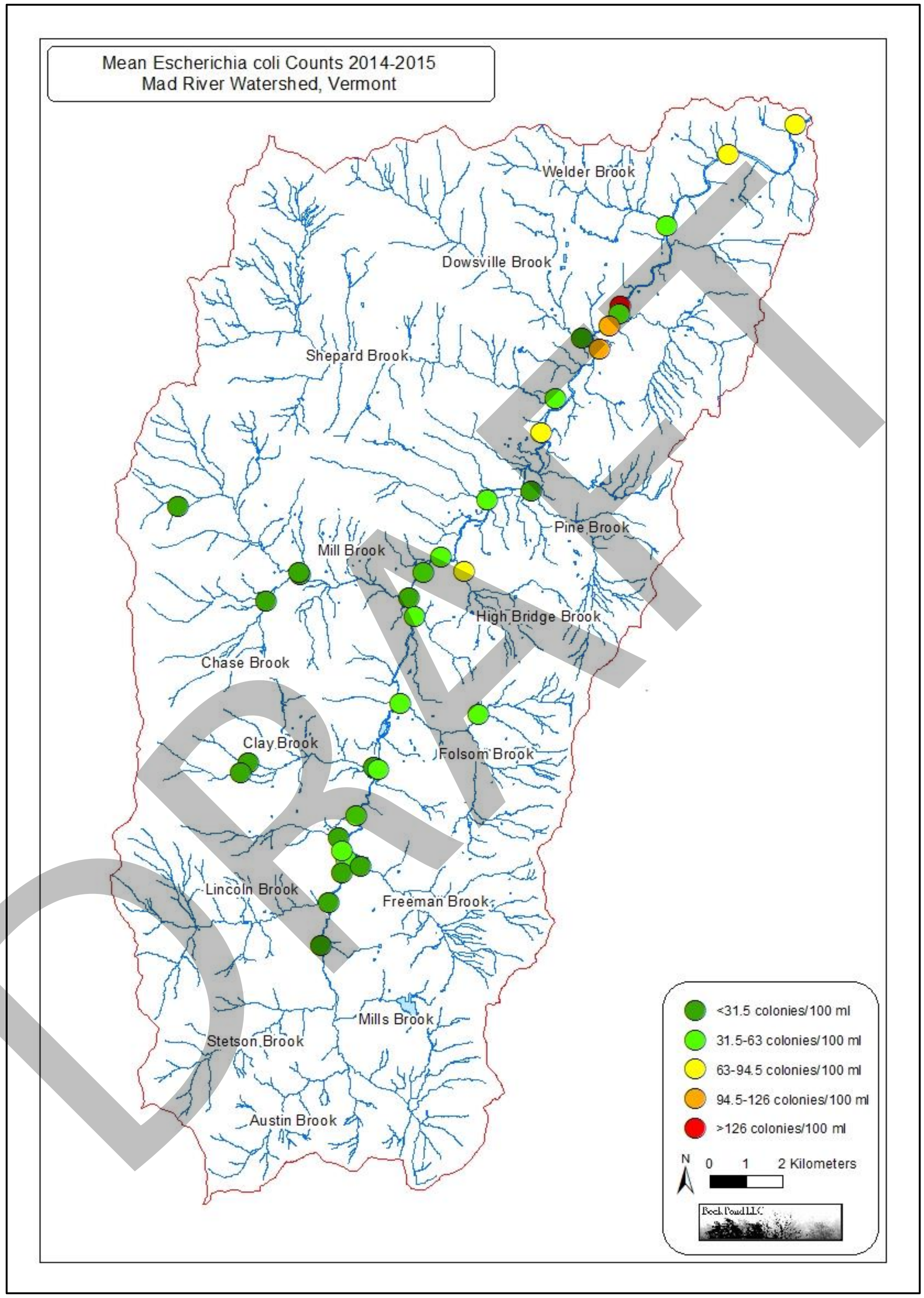

Figure 37. Mean *E. coli* counts at 47 sites along the Mad River and its tributaries during 2014-2015.

During 2014-2015, *E. coli* counts showed steady and consistent increases along the main stem of the Mad River from Site #1 (Warren Falls) downstream to Site #31 (Lover's Lane Bridge)(Figure 38). The most dramatic increases in *E. coli* counts occurred between Site #23 (Meadow Road Bridge) and Site #26 (North Road), and then counts declined somewhat but remained high from there downstream to Site #31 (Lover's Lane Bridge). In this section of the Mad River, median *E. coli* counts more than doubled from a median of 47.3 colonies/100 ml at Site #23 (Meadow Road Bridge) to a median of 100.1 colonies/100 ml at Site #26 (North Road). The steady but slight decline in *E. coli* abundance downstream of Site #26 (North Road) suggested that there may be consistent source of *E. coli* between Site #23 (Meadow Road Bridge) and Site #26 (North Road), and, from there downstream, there is a "decay function" wherein bacteria die-off longitudinally downstream from that source (N. Kamman, personal communication).

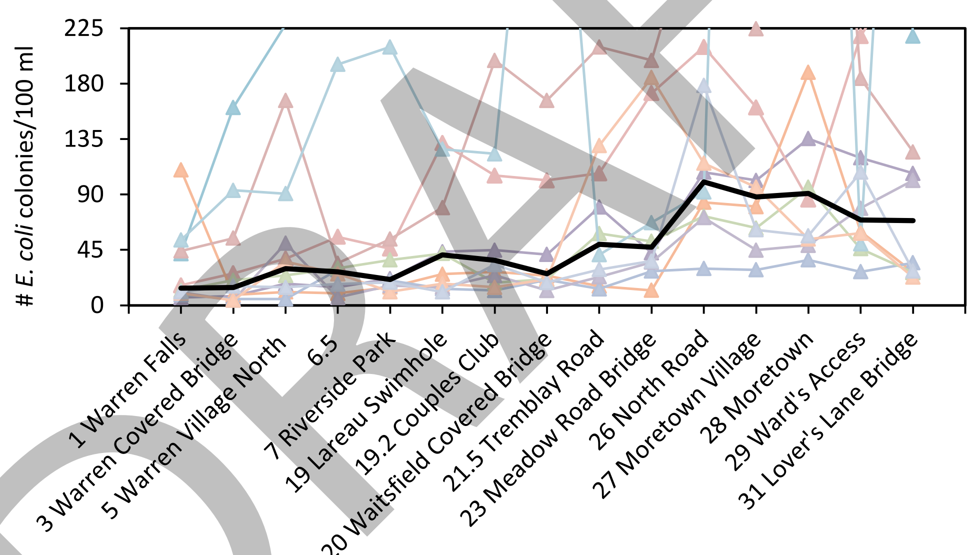

Figure 38. *E. coli* "profile" at 15 sites along the main stem of the Mad River from Site #1 (Warren Falls) downstream to Site #31 (Lover's Lane Bridge) during 2014-2015. The light, colored lines show the values measured on each sample date; the bold, black line shows the median values for each site during those two years. Note that some of the values exceed the range of the y-axis.

For seven of the nine sites with the highest mean *E. coli* counts during 2002-2015 and/or 2014-2015, we examined the *E. coli* counts over time. Only two of these sites showed pronounced changes in *E. coli* counts over time: Both Site #23 (Meadow Road Bridge) and Site #28.05 (Welder Brook) showed marked increases in *E. coli* counts during 2002-2015, primarily due to higher counts (>550 colonies/100 ml) in 2009 and later years (Figure 39). The remaining five sites showed either no changes in *E. coli* counts [Site #26 (North Road) and Site #29 (Ward's Access)] or only slight increases [Site #27 (Moretown Village)] or decreases [Site #28 (Moretown) and Site #31 (Lover's Lane Bridge)].

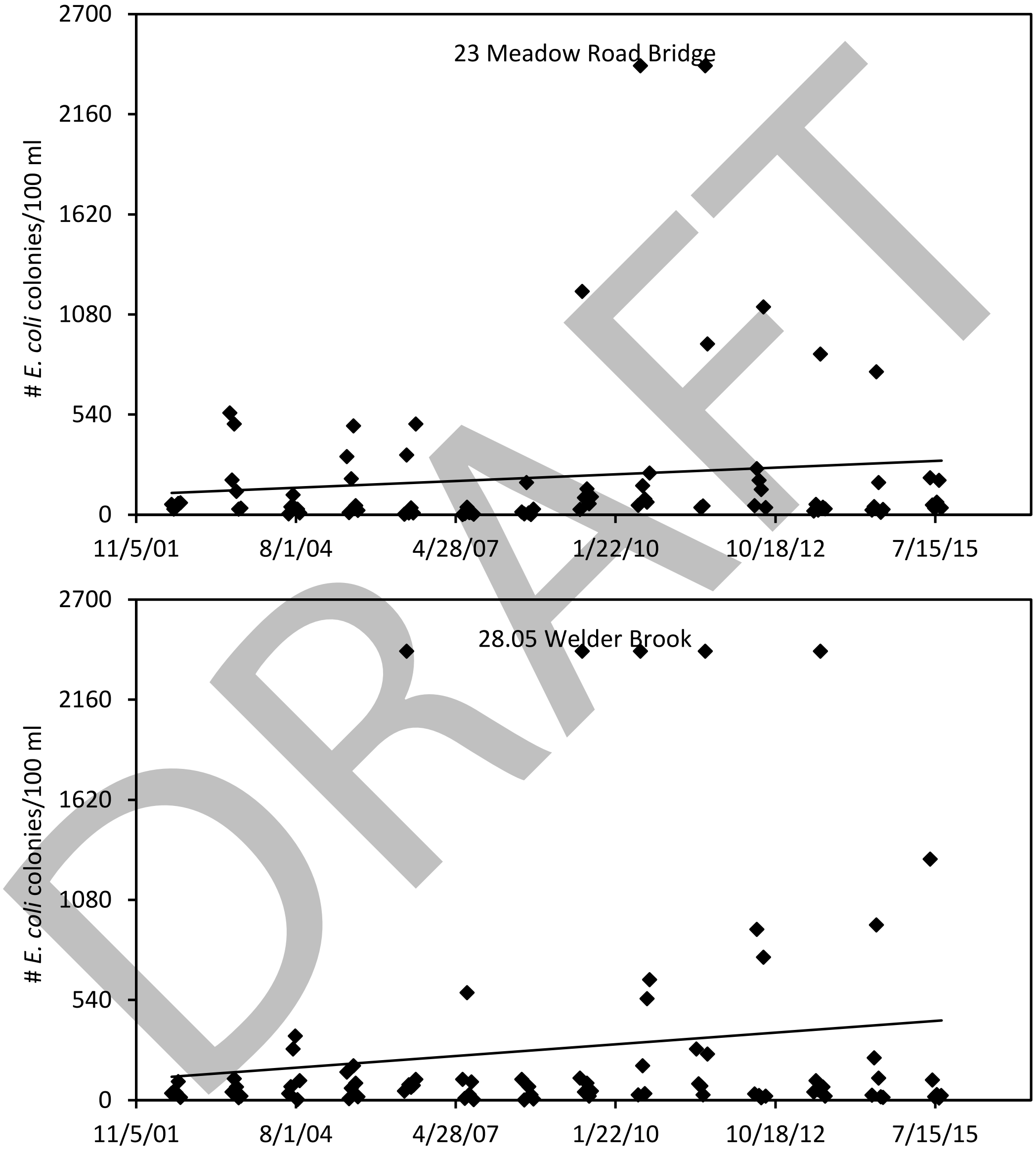

Figure 39. *E. coli* counts over time at two sites [Site #23 (Meadow Road Bridge) and Site #28.05 (Welder Brook)] along the main stem and one tributary of the Mad River during 2002-2015.

For those same seven sites with the highest mean *E. coli* counts during 2002-2015 and/or 2014-2015, we also analyzed the *E. coli* counts in relation to the stream flows measured at the USGS gage on the Mad River near Moretown. At the one site located on a tributary [Site #28.05 (Welder Brook)], *E. coli* counts increased markedly with increasing stream flows (Figure 40). On the other hand, *E. coli* counts showed more modest but consistent increases with increasing stream flows at the six sites located along the main stem [Site #23 (Meadow Road Bridge), Site #26 (North Road), Site #27 (Moretown Village), Site #28 (Moretown), Site #29 (Ward's Access), and Site #31 (Lover's Lane Bridge)].

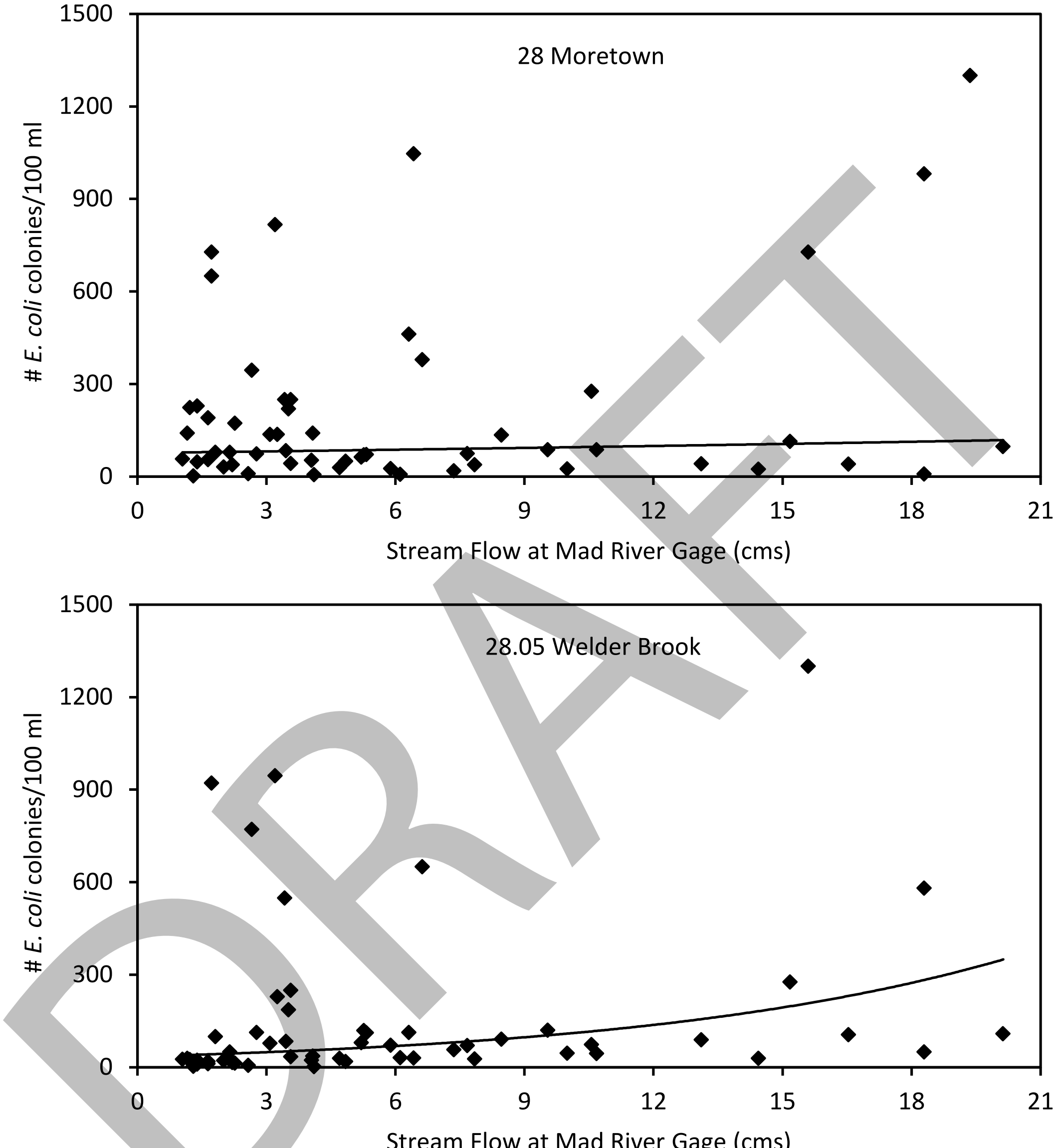

Figure 40. *E. coli* counts in relation to stream flow at two sites [Site #28 (Moretown) and Site #28.05 (Welder Brook)] along the main stem and a tributary of the Mad River during 2006-2015. Stream flow was measured at the USGS stream gage on the Mad River near Moretown, Vermont (USGS station 04288000). The regression lines indicate the exponential relationships between the two parameters. Note that two extreme high flows were not included in this analysis.

Finally, in analyzing these data, we compared the mean and maximum *E. coli* counts from 2014-2015 with the State of Vermont Water Quality Standards for *E. coli* (State of Vermont 2014a). As mentioned previously, the Vermont Water Quality Standards for *E. coli* in all Class A(1) Ecological Waters, Class A(2) Public Water Supplies, and Class B Waters is that the *E. coli* counts shall not exceed a geometric mean of 126 organisms/100 ml measured over a representative period of 60 days, and no more than 10% of the samples shall exceed 235 organisms/100 ml (State of Vermont 2014a). One site [Site #28 (Moretown)] exceeded the geometric mean of 126 organisms/100 ml measured over a representative period of 60 days in 2015 (mean = 148.6 colonies/100 ml) but not in 2014 (mean = 116.0 colonies/100 ml). In addition, 10% of the samples exceeded 235 organisms/100 ml at eight sites during 2014-2015 (Figure 41). These sites included five sites along the main stem [Site #20 (Waitsfield Covered Bridge), Site #26 (North Road), Site #27 (Moretown Village), Site #28 (Moretown), and Site #31 (Lover's Lane Bridge)] and one site along each of three tributaries [Site #10 (Folsom Brook), Site #20.1 (High Bridge Brook), and Site #28.05 (Welder Brook)].

In summary, *E. coli*, which is one species of fecal coliform bacteria, is a valuable indicator of the health and safety of surface waters, especially in areas highly prized for recreational uses such as swimming. *Escherichia coli* were measured at 47 sites on 83 dates during 2002-2015 (but not all sites were sampled on all dates or in all years). *Escherichia coli* counts were high at a number of sites along the lower reaches of the main stem as well as along several tributaries. Along the main stem, *E. coli* counts increased consistently from upstream to downstream areas and were markedly higher from the village of Waitsfield downstream to the mouth of the Mad River. At two sites [Site #23 (Meadow Road Bridge) and Site #28.05 (Welder Brook)], *E. coli* counts showed marked increases over time during the past 14 years. The positive relationship between *E. coli* and stream flow at many of these sites suggested that the source(s) of the *E. coli* may be related to surface and stormwater runoff, especially from areas contaminated by manure, leakage or overflows of septic systems, and wastewater. Based on just these analyses, it is difficult to pinpoint and identify likely sources of the high *E. coli* counts measured along the main stem and tributaries; however, a few observations suggested several possibilities. Site #20.1 (High Bridge Brook) is located on a stream that passes through agricultural areas (primarily horse farms), which may be the source of animal wastes that contribute to these higher counts. Along the lower reaches of the main stem, the Mad River passes through agricultural areas as well as village centers and residential areas, particularly in the vicinity of Moretown village, which may have failing septic systems and stormwater runoff that carries manure and other organic wastes into the river. Hopefully, future sampling efforts will further pinpoint and assess possible sources of these high *E. coli* counts.

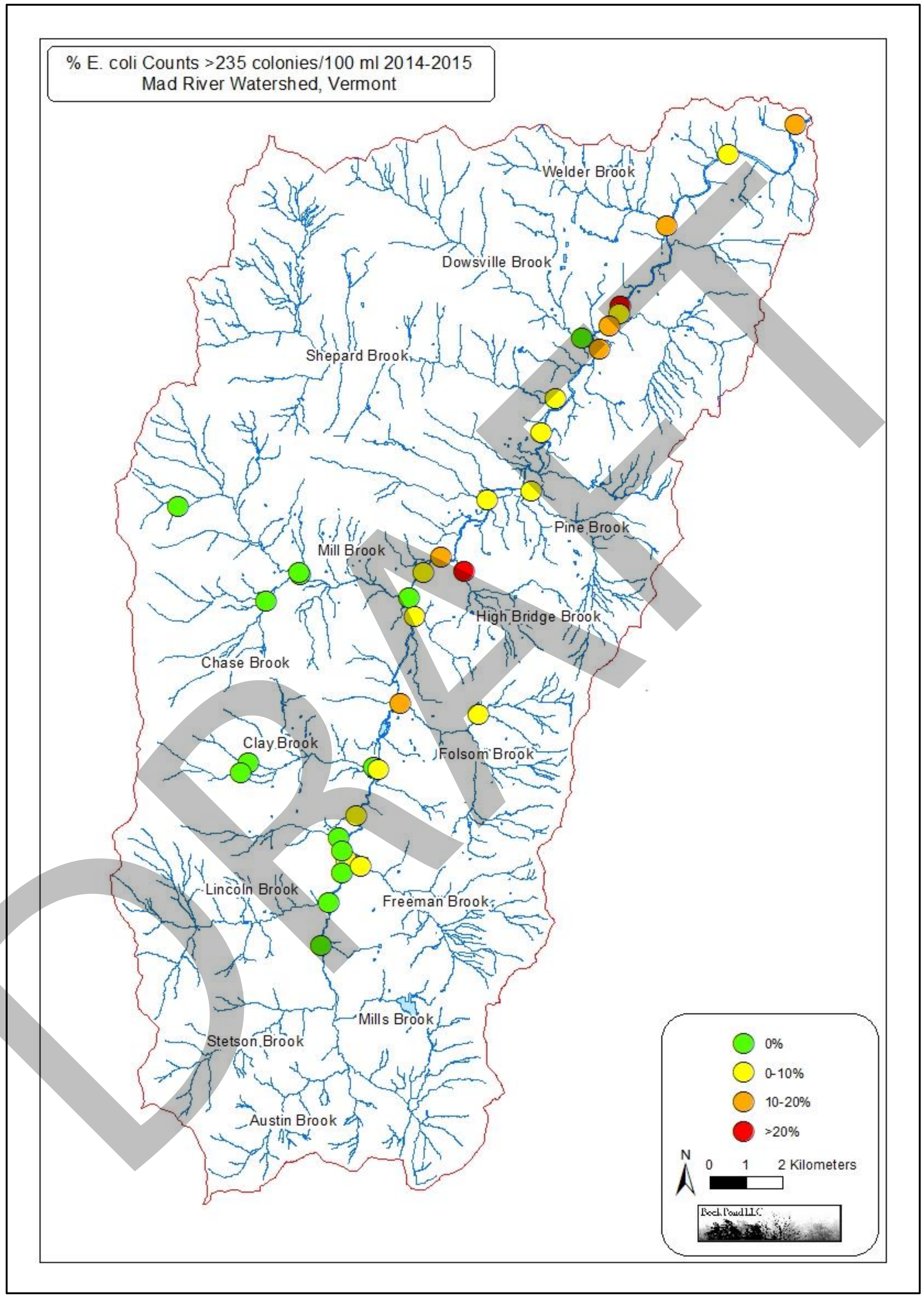

Figure 41. Proportion of *E. coli* counts that exceeded 235 colonies/100 ml at 34 sites in the Mad River watershed during 2014-2015. Only sites that were sampled on at least 100 of the 134 sample dates are included.

Blueberry Lake

Blueberry Lake is the only significant lake in the Mad River watershed (Figure 42). Blueberry Lake is a man-made lake impounded by an earthen dam and covers an area of 19.4 ha (48 acres) to a maximum depth of 4.9 m (16 ft). As part of their spring phosphorus monitoring program, the Lakes and Ponds Section of the Vermont DEC has been monitoring total phosphorus concentrations and Secchi depths at two stations in Blueberry Lake since 1985. Based on these data, mean total phosphorus concentrations equaled 15.8 and 15.4 µg/l, and mean Secchi depths equaled 1.8 m (5.8 ft) and 1.7 m (5.6 ft) at these two stations (Figure 43). During 1985-2011, both total phosphorus concentrations and Secchi depths increased slightly at the two stations. According to the Vermont DEC, Blueberry Lake is classified as mesotrophic, which indicates a lake with an intermediate level of productivity. Such lakes are commonly clear-water lakes with beds of submerged vegetation and moderate levels of nutrients.

Figure 42. Blueberry Lake is the only significant lake in the Mad River watershed. This artificial lake is impounded by an earthen dam and is nestled at the base of the western slopes of the Northfield Mountains in Warren, Vermont as seen on 15 October 2015.

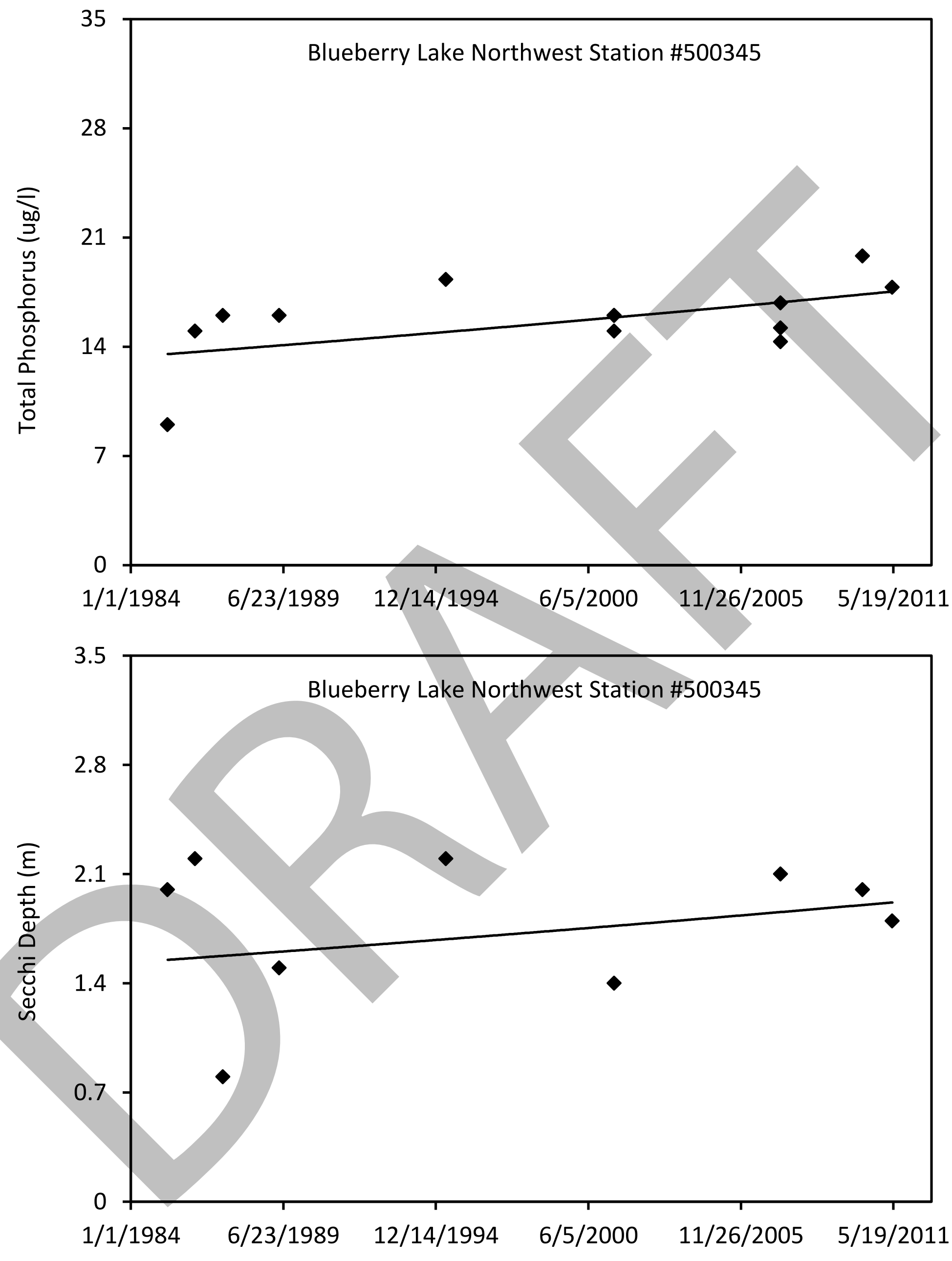

Figure 43. Total phosphorus concentrations and Secchi depths measured as part of Vermont DEC's spring phosphorus sampling at the Northwest Station (Location ID #500345) in Blueberry Lake during 1985-2011. The regression lines indicate the exponential relationships between the two parameters.

Tropical Storm Irene

One final area of discussion is understanding how Tropical Storm Irene might have impacted water quality conditions in the Mad River and its tributaries. On 27-28 August 2011, Tropical Storm Irene deposited greater than 15 cm (6") of rain on several watersheds in the central and south-eastern portions of Vermont. Following these torrential rains, the U.S. Geological Survey reported record discharges [193.7 cms (6,840 cfs)] at the USGS gage station on the Mad River near Moretown, Vermont (USGS station 04288000). These torrential rains and the subsequent flooding caused extensive damage to public and private property, including transportation infrastructure, such as roads, culverts, and bridges. Interestingly, however, we detected no pronounced or obvious impacts on the water quality parameters measured in this study (e.g. total phosphorus, turbidity, and *E. coli*) following this storm and the subsequent floods. More specifically, total phosphorus, turbidity, and *E. coli* levels all showed no consistent increases or decreases between 2011 and 2012 despite the massive and potentially long-lasting impacts that this storm had on the river channels and floodplains of the Mad River and its tributaries. This apparent lack of long-term impacts on these water quality measures may reflect the fact that the 2011 sampling program had ended one week prior to Tropical Storm Irene (22 August 2011) and did not resume until more than nine months later (11 June 2012). However, other studies have shown that Tropical Storm Irene and the subsequent recovery activities were harmful to aquatic habitats and had longer-term impacts on the fish and macroinvertebrate communities. For example, in Slide Brook (a tributary of the Mad River), wild trout populations declined to less than 40% of their pre-storm levels in the year following Tropical Storm Irene (Kirn 2012).

Sampling Recommendations

As part of these efforts to summarize and analyze the water quality data collected by the Friends of the Mad River during 1985-2015, we developed a set of recommendations for updating and upgrading the water quality monitoring programs to 1) more efficiently monitor water quality conditions over time; 2) better identify, pinpoint, and assess the source(s) of specific water quality problems; and 3) maintain and enhance their public health and educational values. In the sections that follow, we describe and present the rationales for these recommendations. It should be understood, however, that any decisions about modifying these monitoring programs ultimately rest with the Friends of the Mad River, not the author of these recommendations.

General Approach

In suggesting revisions and upgrades to the Friends of the Mad River water quality monitoring program, we emphasize maintaining its long-term baseline monitoring, public health, and educational values while adding elements that will allow better identification, pinpointing, and assessment of possible sources of the water quality problems already identified along the Mad River and its tributaries. Based on our analyses and review of these data, we make the following recommendations for updating and upgrading the Friends of the Mad River water quality monitoring program in 2016 and future years.

Parameters

Air Temperature

At several times, we noted that air temperature was measured as part of the water quality monitoring program. However, none of these data were entered into the electronic databases that were provided to the author. Because air temperatures vary greatly from hour to hour, day to day, season to season, and year to year and because they are less "connected" to most measures of water quality, the value of these data for understanding or protecting and improving water quality conditions is minimal. Thus, we recommend discontinuing to measure air temperature as part of the Friends of the Mad River water quality monitoring program.

Water Temperature

Water temperature data were collected during 1988-2014 (and presumably in 2015 as well). Like air temperatures, water temperatures vary daily, seasonally, annually, in response to precipitation and other weather events, and among sites depending on elevation, stream size, stream type, vegetative cover, groundwater inputs, and a host of other factors. Although there are better methods for recording water temperatures over the long term (e.g. water temperature data loggers that provide continuous, long-term records), these instantaneous measures of water temperatures may be useful for understanding the dynamics of certain other water quality parameters (e.g. fecal coliform and *E. coli* counts). Thus, we recommend continuing to measure water temperatures any time and place that fecal coliform and/or *E. coli* samples are collected.

pH

pH is an important measure of water chemistry, as pH determines the solubility, biological availability, and toxicity of nutrients (e.g. phosphorus and nitrogen) and heavy metals (e.g. lead, copper, and arsenic). However, pH is often relatively stable over time, as it is primarily determined by the underlying bedrock and surficial geology of the region. However, pH is also affected by atmospheric deposition (e.g. "acid rain"). Although the long-term record of pH collected by the Friends of the Mad River during 1988-1995 and 1997-2005 (and apparently also during 2006-2015) provides a valuable record of improvements in air quality and reductions in acid deposition in the northeastern United States, these data are less compelling in terms of protecting and improving water quality and freshwater habitats, and they are also more difficult to collect due to the need to calibrate the field equipment. Thus, we recommend discontinuing to measure pH as part of the Friends of the Mad River water quality monitoring program.

Total Phosphorus

Total phosphorus was measured as part of the LaRosa Partnership Program during 2006-2015 and in-house by the Friends of the Mad River on three dates during 1993. Total phosphorus is generally the limiting nutrient in northern freshwater ecosystems and also an important measure of water quality conditions. Because total phosphorus can be more precisely and accurately measured by the LaRosa Analytical Laboratory, we recommend that any future phosphorus measurements be collected through the LaRosa Partnership Program, rather than being measured in-house by the Friends of the Mad River. We do, however, recommend altering the sites sampled for total phosphorus, so that these data can be used to better pinpoint and assess possible sources of nutrients and *E. coli* contamination.

Total Nitrogen

Although typically not the limiting nutrient in northern freshwater ecosystems, high levels of nitrogen can impact both in-lake and in-stream water quality and can exacerbate algal blooms and eutrophication and lead to more frequent and more toxic cyanobacterial blooms. Total nitrogen measures the concentration of all forms of nitrogen in the water column, including nitrogen gas (N_2), nitrite (NO_2), nitrate (NO_3), ammonia (NH_3), ammonium (NH_4), and particulate nitrogen (N). In Vermont, most nitrogen in surface waters originates from wastewater, stormwater, agricultural runoff, and atmospheric deposition. Total nitrogen is a valuable indicator of certain water quality problems, especially those caused by fecal matter (e.g. wastewater effluent, failed septic systems, and manure), and an important nutrient supporting growth of fecal coliform bacteria, including *E. coli*. Thus, we recommend measuring total nitrogen at all sites sampled through the LaRosa Partnership Program in order to better pinpoint and identify possible sources of water quality problems, especially those that may have agricultural or wastewater sources.

Turbidity

Like total phosphorus, turbidity was measured as part of the LaRosa Partnership Program during 2006-2015 but also in-house by the Friends of the Mad River for a short period of time during 1988-1990. Like total phosphorus and total nitrogen, turbidity is an important measure of water quality conditions. Because turbidity can be more precisely and accurately measured by the LaRosa Analytical Laboratory, we recommend that any future turbidity measurements be collected through the LaRosa Partnership Program, rather than being measured in-house by the Friends of the Mad River. We do, however, recommend altering the sites sampled for turbidity, so that these data can be used to better pinpoint and assess possible sources of nutrients and *E. coli* contamination.

Fecal Coliform Bacteria

Fecal coliform are a generic group of bacteria that include both pathogenic and harmless taxa. Fecal coliform bacteria are routinely counted as part of the protocol for measuring *E. coli*. In the Mad River watershed, fecal coliform were measured during two time periods (1985-1991 and 2002-2005) and were likely counted in all of the intervening years, although those data were not entered into the electronic databases provided to the author. Because fecal coliform are routinely counted as part of the *E. coli* sampling, we recommend continuing to count fecal coliform bacteria any time and any place that *E. coli* are measured. In addition, because the fecal coliform data represent the longest record of water quality data collected by the Friends of the Mad River, all of the data from the intervening years should be entered into and made available in the electronic databases.

Escherichia coli

Escherichia coli (*E. coli*) were measured as part of the LaRosa Partnership Program during six years (2006-2011) but also were measured in-house every year during 1992-2015 (24 years) by the Friends of the Mad River. The *E. coli* data provide valuable information that is useful for both protecting public health, especially in areas used for swimming and other recreational activities, and the health of the Mad River ecosystem. Because the in-house protocols used by the Friends of the Mad River to count *E. coli* are widely used and provide precise and accurate counts of *E. coli*, there is no need to sample *E. coli* as part of the LaRosa Partnership Program, except perhaps occasionally as a second set of quality assurance tests for the data collected in-house by the Friends of the Mad River (even then, the Friends of the Mad River should incorporate quality assurance methods, including both field blanks and field duplicates, into their own in-house analyses of *E. coli*). Because of their importance for public health and their value for educating the public about water quality issues, we recommend continuing to measure *E. coli* in those areas regularly used for swimming and other recreational activities. In contrast, those sites located in areas not used for swimming or other recreational activities could be dropped from future sampling efforts. We do, however, recommend that quality assurance procedures (e.g. field blanks and field duplicates like those collected for the parameters analyzed through the LaRosa Partnership Program) be incorporated into future in-house *E. coli* sampling efforts.

Sample Sites

Based on our analyses of the water quality data and discussions with various stakeholders, we recommend a number of changes to the sites sampled by the Friends of the Mad River in 2016 and future years (Table 11, Figure 44):

1) Due to the high *E. coli* and turbidity levels measured there historically, we recommend sampling total phosphorus, total nitrogen, and turbidity to better pinpoint and assess possible source(s) of the high turbidity and *E. coli* levels at five sites along the downstream reaches of the main stem of the Mad River.

2) Due to the high phosphorus and *E. coli* levels measured along High Bridge Brook previously, we recommend retaining the one site and adding three new sites on the three major branches of this tributary to better pinpoint and assess possible source(s) of these high phosphorus and *E. coli* levels.

3) Due to the high *E. coli* levels measured along Folsom Brook previously, we recommend retaining the one site and adding two new sites on the two major branches of this tributary to better pinpoint and assess possible source(s) of these high *E. coli* levels.

4) Due to the higher *E. coli* levels measured along Welder Brook, especially in recent years, we recommend retaining the one site and adding one new site further upstream to better pinpoint and assess possible source(s) of these high *E. coli* levels.

5) Due to the high turbidity levels measured along Clay Brook historically, we recommend retaining the three sites and adding one new site in the middle reach of this tributary to better pinpoint and assess possible source(s) of these high turbidity levels. The ideal location would be immediately upstream of any clay deposits that occur in this section of Clay Brook.

6) Based on stakeholder concerns about runoff from the parking lots at the ski area, we recommend retaining the four sites to further identify and assess possible water quality problems in the Mill Brook watershed.

7) Due to their importance for public health and their educational value, we recommend continuing to monitor *E. coli* levels at twelve sites that are popular for recreation or that otherwise are publicly accessible along the main stem and tributaries of the Mad River.

In summary, we recommend 1) sampling only total phosphorus, total nitrogen, and turbidity through the LaRosa Partnership Program at 20 sites where high *E. coli*, phosphorus, and turbidity levels were measured previously along the main stem of the Mad River and Folsom, High Bridge, Chase, Mill, Clay, and Rice Brooks; 2) sampling only *E. coli* and water temperature in-house for the ten sites located at swimming areas along the main stem of the Mad River and Freeman and Lincoln Brooks; and 3) sampling all five parameters (*E. coli*, water temperature, total phosphorus, total nitrogen, and turbidity) at two sites located at swimming areas where high *E. coli*, turbidity, and/or phosphorus levels were measured previously (Table 11, Figure 44). It should be noted that not all of the sites need to be sampled in the first year. However, if staggering these recommendations over multiple years, it is imperative that all of the sites along a single tributary (e.g. the exploratory sites along Mill Brook) be sampled in the same year in order to most effectively pinpoint and assess possible sources of water quality problems. Depending on the results of the 2016 sampling, these sample sites might be further modified in future years to best accomplish the twin goals of monitoring water quality conditions and pinpointing and assessing possible nutrient and sediment sources. Finally, these 32 sites include 13 sites that have been sampled every year during 1985-2015. Maintaining these 13 sites would maintain the long-term record of the Friends of the Mad River water quality monitoring program.

Finally, we recommend not continuing to sample the outlet stream of Blueberry Lake (Site #BBL) as part these water quality monitoring programs, because sampling the water flowing in the outlet stream is not a very accurate or meaningful measure of water quality in the lake itself. If the Friends of the Mad River is interested in monitoring water quality conditions in the lake itself, then we recommend enrolling Blueberry Lake in the Lay Monitoring Program administered by the Vermont DEC. Participating in this program would provide valuable data on water quality conditions in the lake, including chlorophyll-*a* (a measure of primary productivity), total phosphorus, and Secchi disk transparency. Unfortunately, the Lay Monitoring Program does not measure fecal coliform or *E. coli* bacteria as part of their assessments, so, if these data are useful and meaningful in a lake setting, then the Friends of the Mad River could start sampling *E. coli* in the open waters of the lake while collecting water samples for the Lay Monitoring Program. Staff from the Vermont DEC have already collected nine years of Secchi depth and spring phosphorus data from Blueberry Lake during 1985-2011.

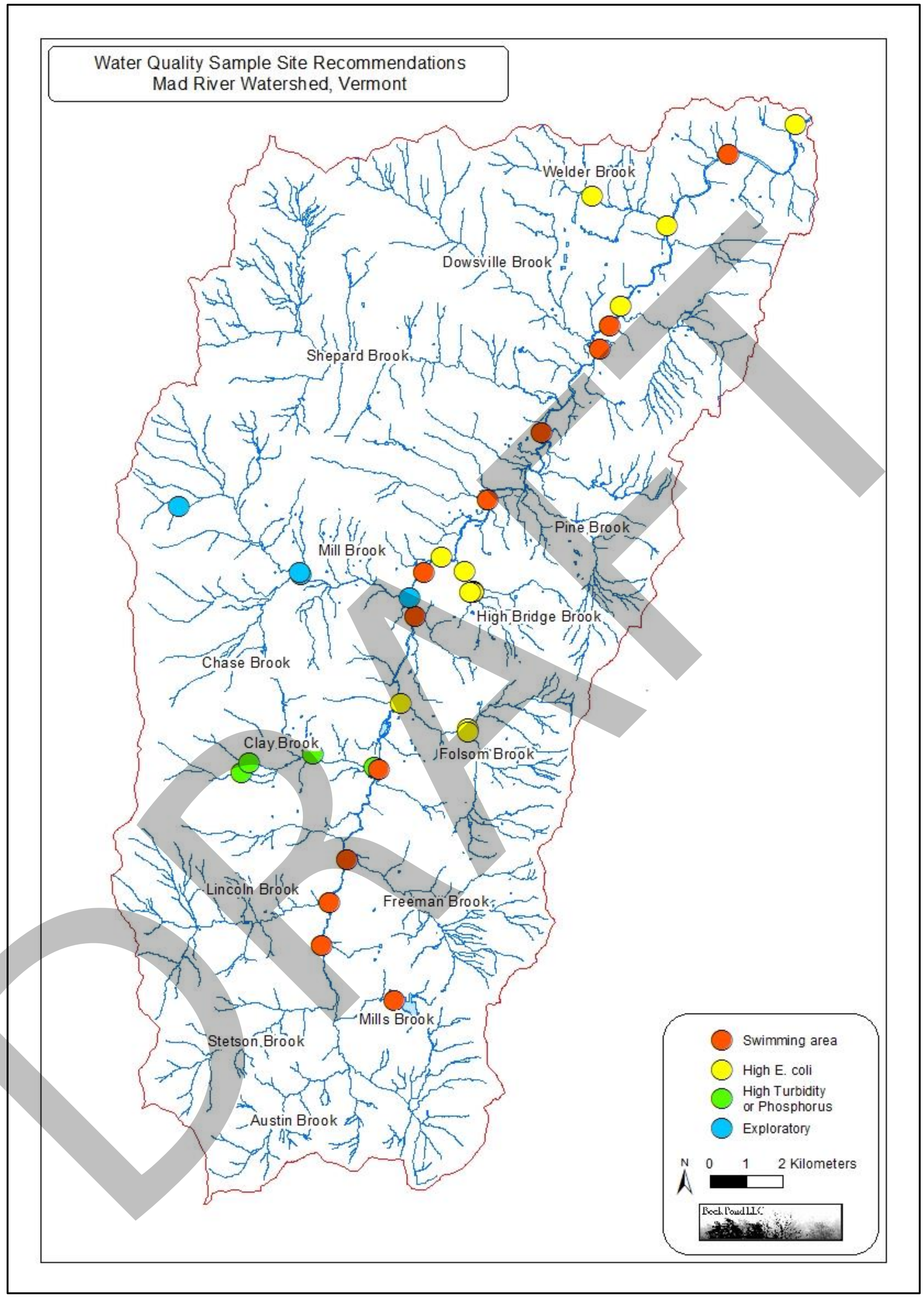

Figure 44. Locations of 32 sites recommended for water quality sampling by the Friends of the Mad River in 2016. Ten of the twelve sites designated as swimming areas would be sampled for *E. coli* and water temperature; the 20 sites designated as high *E. coli*, high turbidity, high phosphorus, or exploratory would be sampled for total phosphorus, total nitrogen, and turbidity; and the two other sites designated as swimming areas would be sampled for all five parameters.

Table 11. List of 32 sites recommended for water quality sampling by the Friends of the Mad River in 2016. The 13 sites highlighted in bold have been sampled every year during 1985-2015 and would maintain the long-term value of the Friends of the Mad River water quality monitoring program.

Site #	Site Name	Rationale	*E. coli*	TP, TN & Turbidity
1	Warren Falls	Swimming	X	-
2	**Bobbin Mill**	**Swimming**	**X**	**-**
4	**Warren Store**	**Swimming**	**X**	**-**
7	**Riverside Park**	**Swimming**	**X**	**-**
8	**Clay Brook**	**High turbidity**	**-**	**X**
10	**Folsom Brook**	**High *E. coli***	**-**	**X**
11	**Rice Brook**	**High turbidity**	**-**	**X**
12	Clay Brook	High turbidity	-	X
16	Chase Brook	Exploratory	-	X
17	Mill Brook German Flats	Exploratory	-	X
17.1	Mill Brook West	Exploratory	-	X
18.1	Mill Brook Mouth	Exploratory	-	X
19	**Lareau Swimhole**	**Swimming**	**X**	**-**
19.2	Couples Club	Swimming	X	-
20	**Waitsfield Covered Bridge**	**High *E. coli*, high turbidity, and swimming**	**X**	**X**
20.1	High Bridge Brook	High *E. coli* and high phosphorus	-	X
21.5	Tremblay Road	Swimming	X	-
23	**Meadow Road Bridge**	**Swimming**	**X**	**-**
26	**North Road**	**High *E. coli* and swimming**	**X**	**X**
27	**Moretown Village**	**High *E. coli* and swimming**	**X**	**X**
28	**Moretown**	**High *E. coli* and high turbidity**	**-**	**X**
28.05	Welder Brook	High *E. coli*	-	X
29	**Ward's Access**	**Swimming**	**X**	**-**
31	Lover's Lane Bridge	High *E. coli*	-	X
0	(New site Blueberry Lake)	Swimming	X	-
0	(New site Clay Brook)	High turbidity	-	X
0	(New site Folsom Brook)	High *E. coli*	-	X
0	(New site Folsom Brook)	High *E. coli*	-	X
0	(New site High Bridge Brook)	High *E. coli* and high phosphorus	-	X
0	(New site High Bridge Brook)	High *E. coli* and high phosphorus	-	X
0	(New site High Bridge Brook)	High *E. coli* and high phosphorus	-	X
0	(New site Welder Brook)	High *E. coli*	-	X

Sampling Schedule

Sampling across a range of stream flows, including rain events and/or high flows, is essential for understanding nutrient and sediment dynamics and possible sources of nutrients and *E. coli* contamination. Because past sampling efforts have adequately sampled a broad range of stream flows, we recommend retaining the current sampling schedule of six sample dates every two weeks during June-August. However, if none of the dates in any one year sample high flows or rain events, then we suggest adding one or two sample rounds to target rain events or high flows to gain the data needed to better understand nutrient and sediment dynamics and *E. coli* contamination. If there is interest, the Friends of the Mad River could also consider sampling earlier in the spring to catch the high flows associated with spring snowmelt and later in the autumn to catch the seasonal rise in water levels as evaporation and transpiration rates decrease. However, as long as the regular sampling schedule continues to capture high-flow and rain events, such an extended season is not essential.

Summary

Based on our analyses of the water quality data collected by the Friends of the Mad River during 1985-2015, we make the following recommendations for maintaining and enhancing the water quality monitoring program undertaken by the Friends of the Mad River:

1) Using the in-house methods, continue to measure *E. coli* levels in those areas where the Mad River is considered impaired or stressed by high *E. coli* levels (e.g. the main stem from Moretown village downstream to the mouth of the Mad River and Welder, High Bridge, and Folsom Brooks) and other sites regularly used for swimming and other recreational activities.

2) Incorporate quality assurance tests, including both field blanks and field duplicates, into future in-house *E. coli* sampling efforts.

3) Continue to measure fecal coliform bacteria and water temperature any place and any time that *E. coli* samples are collected.

4) Continue to measure total phosphorus and turbidity through the LaRosa Partnership Program, but modify the sample sites to better pinpoint and assess possible sources of nutrients and *E. coli* contamination, especially in areas where high levels of *E. coli*, turbidity, and/or total phosphorus have been detected previously (e.g. the main stem from Moretown village downstream to the mouth of the Mad River and Welder, High Bridge, Mill, Clay, and Folsom Brooks).

5) Begin measuring total nitrogen at all sites sampled through the LaRosa Partnership Program to better identify and assess possible sources of nutrients and *E. coli* contamination, especially in areas where high levels of *E. coli* and/or total phosphorus have been detected previously.

6) Discontinue measuring air temperature and pH as part of these monitoring efforts.

7) Retain the current sampling schedule (six dates every two weeks during June-August), unless none of the dates sample high-flow or rain events, in which case, consider targeting one or two rain events or high flows.

8) Enroll Blueberry Lake in the Lay Monitoring Program administered by the Vermont DEC as a better approach for assessing water quality in the lake, rather than in the outlet stream.

Documentation and Data Entry

This study was challenged by three unanticipated problems that made this study more difficult and less complete than desired. First, given the long-term nature of these monitoring programs, it is essential that the methods used to collect, process, and analyze the water samples be completely and thoroughly documented and available to those analyzing or reporting these data. Unfortunately, the documentation that was provided to the author of this study was not always complete. Second, all of the quality assurance data for all of the parameters, both those measured in-house and those measured in through the LaRosa Partnership Program, should be collected and entered into the same databases used to house all of the other data. Having these data would have allowed us to conduct additional quality assurance checks (e.g. field blanks and field duplicates) to ensure that the *E. coli* data were being collected in a repeatable manner and without contamination. Finally, through the process of compiling, analyzing, and reporting these data, we learned that additional data had been collected but had not been entered into the electronic databases. These data are only useful if they are made available for analysis. Having these data would have allowed us to establish and analyze longer records for water temperature [one additional year (2015)], pH [ten additional years (2006-2015)], and fecal coliform bacteria [20 additional years (1992-2001 and 2006-2015)]. Thus, we strongly recommend that all data, including those collected in prior years, be entered into and housed in the electronic databases, so that they can be analyzed along with the existing data in the future. These data and the long-term record that they provide of water quality conditions in the Mad River watershed are exceptional and should be well-documented, quality assured, and readily available for analysis and reporting.

Nutrient Loading

During 1985-2015, the Friends of the Mad River have not collected the water quality data needed to calculate nutrient and sediment loads. Estimating nutrient and sediment loads would allow us to quantify the total amounts of nutrients and sediment entering or being exported from the Mad River, and these estimates might be useful for developing strategies for protecting and improving water quality in the Mad River and downstream surface waters. However, calculating nutrient and sediment loads is not a trivial task and should only be undertaken if the rationale justifies the complexities involved.

Calculating nutrient and sediment loads is not a trivial task. To calculate nutrient and/or sediment loads, many more samples would need to be collected, especially at high flows, when the majority of the nutrient and sediment loading typically occurs. For example, in the Lake Memphremagog Basin, the Watershed Coordinator has calculated phosphorus loads for only four sites, but, to do this, he has had to collect as many as 30 samples per year, primarily at high flows. In the larger rivers (such as the Mad River), samples must be collected with a bomb sampler or some other tool that integrates water samples collected throughout the water column. In smaller streams (e.g. most of the tributaries of the Mad River), such samples could probably be collected using a dip sampler. Given that sampling high flows is essential for accurately estimating loads, safety is an important concern and likely would preclude wading into streams to collect water samples in all but the smallest streams. In addition, stream flows need to be measured or estimated for each site where loads will be calculated. Ideally, measuring stream flows requires a lot of effort and special equipment (e.g. a flow tracker, a sonde or some tool for continuously measuring water depths) and would ideally be done continuously throughout the season(s) in which the nutrient and sediment samples were collected. Alternatively, stream flows could be estimated based on watershed size from the stream flows measured at the existing gage on the main stem of the Mad River, but such estimates would only be approximate and may not accurately measure stream flows at the individual sites.

Given these considerations, a second, more general question also needs to be raised: What would the Friends of the Mad River gain by calculating nutrient and/or sediment loads for one or more sites in the Mad River watershed? Given that water quality is generally good in most areas of the Mad River watershed, it is not clear that calculating loads is necessary or particularly useful for successfully accomplishing the Friends of the Mad River's goal of "protecting, improving and enhancing the ecological, recreational, and community values of the Mad River and its watershed". Although calculating nutrient and sediment loads would identify which tributaries or sections of the main stem are exporting the largest amounts of nutrients and/or sediments, this information is likely already available based on the existing data on nutrient concentrations and turbidity levels and the staff's and volunteers' observations and knowledge of the watershed. Although there certainly is interest in understanding the nutrient and sediment loads entering Lake Champlain, of which the Mad River is one distant tributary, the Mad River is likely to be a relatively low priority for calculating nutrient and sediment loads given the relatively low nutrient concentrations and turbidity levels there. In addition, calculating nutrient and sediment loads for the Mad River would really only make sense as part of a larger effort to calculate loads emanating from the other tributaries of the Winooski River and/or other tributaries of Lake Champlain.

In conclusion, we do not recommend undertaking such a project unless there are clear and concrete reasons for calculating nutrient and sediment loads for the Mad River and its tributaries. Such an effort would face significant challenges, would require considerable effort, and would only be justified if a clear rationale could be articulated clearly and in light of the considerable challenges and complexities involved.

Conclusions

The water quality data collected by the Friends of the Mad River during 1985-2015 represent an outstanding, long-term record of water quality conditions in the Mad River watershed. This effort is perhaps unparalleled in the state of Vermont, especially in terms of the length of the record (31 years) and the consistent and repeated sampling of the same sites throughout this time period. This report provides an overview of the Friends of the Mad River water quality monitoring program, presents the results of the analyses of the biological and chemistry data collected through this program, identifies several areas and issues of concern, and provides recommendations for future monitoring efforts. Based on these data and analyses, it is clear that water quality conditions in the Mad River and its tributaries are generally very good, the major exception being some areas along the lower section of the main stem and several tributaries that exhibited elevated *E. coli* levels, turbidity levels, and/or total phosphorus concentrations.

During 1985-2015, staff and volunteers from the Friends of the Mad River used portable field equipment, an in-house laboratory, and a partnership with the LaRosa Analytical Laboratory to quantify various physical, chemical, and biological parameters at 57 sites along the Mad River and its tributaries. Based on the data obtained, we can make the following conclusions about water quality conditions in the Mad River watershed:

- The quality assurance and stream flow data indicated that the water quality data were generally collected in a repeatable manner, without contamination, and across a broad but fairly consistent range of stream flows.
- pH, which measures the acidity or alkalinity of water, was generally neutral (mean = 6.7-7.2) at the 51 sites sampled during 1988-1995 and 1997-2005, including those along the main stem and the tributaries. Because pH is largely influenced by the underlying bedrock and surficial geology, pH levels showed no pronounced relationships with stream flow, but they did show an almost universal pattern of change over time. That is, pH levels decreased at all sites in the years prior to 1995 but, after 1995, increased markedly at all sites, presumably due to improvements in air quality and decreased acid deposition following implementation of the Clean Air Act and its amendments starting in the mid-1990s.
- Total phosphorus, which measures the concentration of all forms of phosphorus in the water column, is an important measure of nutrient levels in rivers and streams. Total phosphorus concentrations were remarkably low across almost all of the 19 sites sampled during 2006-2015. The only areas of concern were along two tributaries (High Bridge Brook and Folsom Brook) and the main stem in the vicinity of Moretown village. At two of these three sites, total phosphorus concentrations have increased over time, and the positive relationships with stream flow suggested that much of the phosphorus at these two sites may be originating from nonpoint sources, such as surface runoff from agricultural and other land uses, such as unpaved roads.

- Turbidity levels, which measure the clarity of the water, were also remarkably low across the 19 sites sampled during 2006-2015. Turbidity levels were slightly higher at two sites located along the main stem near the villages of Moretown and Waitsfield, especially during the two most recent years of this study (2014-2015). At a third site along High Bridge Brook, turbidity levels were also slightly higher than elsewhere, and, there, the turbidity levels have increased markedly, especially during the past five years. Like total phosphorus, turbidity levels at this site increased with increasing stream flows, and this positive relationship again suggested that nonpoint sources, such as surface runoff from agricultural and other land uses, including unpaved roads, may be impacting water quality.
- Fecal coliform bacteria and *Escherichia coli* (*E. coli*), which is one type of fecal coliform bacteria, are valuable indicators of the health and safety of surface waters, especially in areas highly prized for recreational uses such as swimming. Both fecal coliform and *E. coli* counts were very high at a number of sites along the lower section of the main stem as well as along several tributaries. Fecal coliform and *E. coli* counts increased consistently from upstream to downstream areas along the main stem and were markedly higher from the village of Waitsfield downstream to the mouth of the Mad River. At two sites (one along the main stem and one along Welder Brook), *E. coli* counts also showed marked increases, especially during the last five years. The positive relationship between *E. coli* and stream flow at these sites suggested that the source(s) of the *E. coli* may be related to stormwater runoff, especially from areas contaminated by manure, leakage or overflows of septic systems, and wastewater.

Collectively, these data greatly increased our understanding of water quality problems in the Mad River watershed. In general, water quality conditions in the Mad River and its tributaries were very good to excellent; however, a few areas exhibited total phosphorus concentrations and turbidity and *E. coli* levels that were higher than desirable (Table 12). In order to maintain this outstanding long-term data set and to further pinpoint and assess the sources of these water quality problems, we recommend that future monitoring efforts include: 1) continued monitoring of *E. coli* and fecal coliform bacteria at selected sites along the main stem and several tributaries, especially sites that are popular for swimming; 2) the addition of new sample sites in areas where water quality problems were identified but were not completely understood (e.g. High Bridge Brook, Folsom Brook, and lower reaches of the main stem); and 3) sampling total nitrogen, especially in areas where water quality problems may have agricultural or wastewater sources. Once these water quality problems are better understood, it will be easier to identify and develop the appropriate protection and restoration strategies that will most effectively protect and improve water quality throughout the Mad River watershed.

Table 12. Priority locations for future monitoring and project implementation in the Mad River watershed of Vermont.

River/Stream	Concern(s)	Needs and Opportunities
Mad River (mouth upstream to village of Waitsfield)	High *E. coli* High turbidity	Likely originating from stormwater runoff, especially from areas contaminated by manure, leakage or overflows of septic systems, and wastewater
Folsom Brook (upstream of Vermont route 100)	High *E. coli* High phosphorus	May be originating from stormwater runoff - especially from areas contaminated by manure, leakage or overflows of septic systems, and wastewater nonpoint sources - and surface runoff from agricultural and other land uses, such as unpaved roads
High Bridge Brook (upstream of Joslin Hill Road)	High *E. coli* High phosphorus High turbidity	May be originating from stormwater runoff - especially from areas contaminated by manure, leakage or overflows of septic systems, and wastewater nonpoint sources - and surface runoff from agricultural and other land uses, such as unpaved roads
Welder Brook (upstream of Vermont route 100B)	High *E. coli*	May be originating from stormwater runoff, especially from areas contaminated by manure, leakage or overflows of septic systems, and wastewater
Clay and Rice Brooks (upstream of Vermont route 100)	High turbidity	May have a natural source (e.g. clay deposits in streambed) or an anthropogenic source (e.g. runoff from parking lots and other infrastructure at ski area)

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Appendix A. Glossary [based largely on Picotte and Boudette (2005) and Dyer and Gerhardt (2007)].

Algae – Aquatic organisms that generally are capable of photosynthesis but lack the structural complexity of plants. Algae range from single-celled to multicellular organisms and can grow on the substrate or suspended in the water column (the latter are also known as phytoplankton).

Algal bloom – A population explosion of algae usually in response to high nutrient levels (particularly phosphorus and nitrogen), warm water temperatures, and long periods of sunlight. When these algae die, their decomposition can deplete oxygen to levels that are too low to support most aquatic life.

Basin – A geographic area bounded peripherally by a divide and draining into a particular water body. The relative size of a basin and the human alterations to that basin greatly affect water quality in the water body into which it drains.

Concentration – The quantity of a dissolved substance per unit of volume.

Detection limit – The lowest value of a physical or chemical parameter that can be measured reliably and reported as a value greater than zero by a given method or piece of equipment.

Erosion – The loosening and transport of soil and other particles. Erosion is a natural process but can be accelerated by human activities, such as forest clearance and stream channel alteration.

Eutrophication – The natural aging process of a water body whereby nutrients and sediments increase in a lake over time, increase its productivity, and eventually turn it into a wetland. Human activities often accelerate this process.

Flow – The volume of water moving past a given location per unit of time (usually measured as cubic meters or feet per second).

Geometric mean – A number describing the central tendency of a group of numbers and obtained by calculating the nth root of the product of all of their values (where the nth root is defined by the number of values in the group).

Groundwater – Water that lies beneath the earth's surface in porous layers of clay, sand, gravel, and bedrock.

Limiting nutrient – A nutrient that is scarce relative to demand and that limits plant and animal growth in an ecosystem.

Load – The total amount of a physical or chemical substance, such as sediment or a nutrient, being transported in the water column per unit of time.

Median – A number describing the central tendency of a group of numbers and defined as the value in an ordered set of numbers below and above which there are equal numbers of values.

Nonpoint source pollution – Pollution that originates from many, diffuse sources spread across the landscape (e.g. surface runoff from lawns or agricultural fields).

Nutrient – A chemical required for growth, development, or maintenance of a plant or animal. Nutrients are essential for sustaining life, but too much of any one nutrient can upset the balance of an ecosystem.

Photosynthesis – The biological process by which plants, algae, and some other organisms convert sunlight, carbon dioxide, and water into sugar and oxygen.

Point source pollution – Pollution that originates from a single location or source (e.g. discharge pipes from a wastewater treatment plant or industrial facility).

Quality assurance (QA) – An integrated system of measures designed to ensure that data meet predefined standards of quality with a stated level of confidence.

Quartile – The value at the boundary of the 25th, 50th, or 75th percentiles of an ordered set of numbers divided into four equal parts, each containing one quarter of the numbers.

Surface waters – Water bodies that lie on top of the earth's surface, including lakes, ponds, rivers, streams, and wetlands.

Tributary – A water body, such as a river or stream, that flows into another body of water.

Total Maximum Daily Load (TMDL) – The maximum amount of a pollutant that a water body can receive in order to meet water quality standards.

Watershed – See basin.

Wetland – Land on which water saturation is the dominant factor determining the nature of soil development and the types of plant and animal communities that live there.

Appendix B. Geographic coordinates of the 57 sites sampled by the Friends of the Mad River during 1985-2015. Note that the geographic coordinates for a number of sites are unknown.

Site #	River/Stream	Site Name	Vermont LocationID	Latitude	Longitude
1	Mad River	Warren Falls	501042	44.09274	-72.86403
2	Lincoln Brook	Bobbin Mill	501048	44.10345	-72.86162
3	Mad River	Warren Covered Bridge	-	44.11096	-72.85706
4	Freeman Brook	Warren Store	501057	44.11431	-72.85576
4.5	Freeman Brook	Freeman Brook	-	44.11258	-72.85046
5	Mad River	Warren Village North	-	44.11633	-72.85698
6	Bradley Brook	Bradley Brook	501058	44.11969	-72.85831
6.5	Mad River	-	-	44.12509	-72.85222
7	Mad River	Riverside Park	-	44.13654	-72.84463
8	Clay Brook	Clay Brook	501059	44.13707	-72.84629
8.5	Mad River	-	-	-	-
9	Mad River	-	501060	44.14880	-72.84231
10	Folsom Brook	Folsom Brook	501043	44.15309	-72.83708
10.1	-	-	-	-	-
10.2	-	-	-	-	-
10.3	-	-	-	-	-
10.4	-	-	-	-	-
10.5	Folsom Brook	-	-	-	-
10.6	Folsom Brook	Folsom Brook	-	44.15029	-72.81016
10.7	Folsom Brook	-	-	-	-
11	Rice Brook	Rice Brook	501044	44.13801	-72.88966
12	Clay Brook	Clay Brook	501045	44.13554	-72.89195
13	Slide Brook	-	502076	44.16668	-72.88716
13.1	Slide Brook	Slide Brook	-	44.17842	-72.88359
14	Lockwood Brook	-	-	44.17243	-72.88908
15	-	-	-	-	-
16	Chase Brook	Chase Brook	501046	44.18498	-72.87213
17	Mill Brook	Mill Brook German Flats	-	44.18549	-72.87235
17.1	Mill Brook	Mill Brook West	-	44.20161	-72.9144
18	Mill Brook	-	-	44.18147	-72.84340
18.1	Mill Brook	Mill Brook Mouth	501047	44.17917	-72.83432
19	Mad River	Lareau Swimhole	-	44.17454	-72.83243
19.1	Mad River	-	-	44.18030	-72.83395
19.2	Mad River	Couples Club	-	44.18562	-72.82939
19.5	-	-	-	-	-

Site #	River/Stream	Site Name	Vermont LocationID	Latitude	Longitude
20	Mad River	Waitsfield Covered Bridge	501049	44.18933	-72.82356
20.1	High Bridge Brook	High Bridge Brook	501050	44.18595	-72.81542
21	Mad River	Waitsfield Elem. School	502055	44.19388	-72.81777
21.5	Mad River	Tremblay Road	-	44.20375	-72.80733
22	Pine Brook	Pine Brook	501051	44.20584	-72.79214
23	Mad River	Meadow Road Bridge	-	44.22027	-72.78903
24	Shepard Brook	Shepard Brook	501052	44.22886	-72.78409
25	Dowsville Brook	Dowsville Brook	501053	44.24386	-72.77489
25.1	-	-	-	-	-
26	Mad River	North Road	-	44.24116	-72.76900
27	Mad River	Moretown Village	-	44.24693	-72.7654
27.1	Doctors Brook	Doctor's Brook	-	44.24983	-72.76200
28	Mad River	Moretown	501054	44.25173	-72.76165
28.05	Welder Brook	Welder Brook	501055	44.27186	-72.74608
28.1	Unnamed Tributary	-	-	-	-
28.2	Unnamed Tributary	-	-	-	-
28.3	Unnamed Tributary	-	-	-	-
28.4	Mad River	-	-	-	-
29	Mad River	Ward's Access	-	44.28976	-72.72457
30	Mad River	-	-	-	-
31	Mad River	Lover's Lane Bridge	501056	44.29700	-72.70133
BBL	Blueberry Lake	Blueberry Lake	-	44.07929	-72.83891

Beck Pond LLC

394 Beck Pond Road

Newark, VT 05871

beckpond@gmail.com

WASTEWATER SYSTEM AND POTABLE WATER SUPPLY PERMIT

LAWS/REGULATIONS INVOLVED
10 V.S.A. Chapter 64, Potable Water Supply and Wastewater System Permit
Wastewater System and Potable Water Supply Rules, Effective September 29, 2007
Chapter 21, Water Supply Rules, Effective December 1, 2010

Landowner(s): **Moretown School District**
940 VT Route 100B
Moretown VT 05676

Permit Number: WW-5-0227-3
PIN: BR82-0002

This permit affects property identified as Town Tax Parcel ID # Moretown: 128192-02-020.000 referenced in a deed recorded in Book 28 Page(s) 92 of the Land Records in Moretown, Vermont.

This project, consisting of amending Permit WW-5-0227-1(note error in first page of permit referring to it as WW-5-0227-2) to reallocate water/wastewater flows from Lot #1, now being 4.4± acres, to the Town of Moretown for a new town office building subject to Permit WW-5-6840 located at 940 VT Route 100B in Moretown, Vermont, is hereby approved under the requirements of the regulations named above subject to the following conditions.

1. GENERAL

1.1 The project shall be completed as described in the application prepared by Peter Lazorchak. The project shall not deviate from the approved proposal without prior written approval from the Drinking Water and Groundwater Protection Division.

1.2 This permit does not relieve the landowner from obtaining all other approvals and permits PRIOR to construction including, but not limited to, those that may be required from other State departments and local officials.

1.3 The conditions of this permit shall run with the land and will be binding upon and enforceable against the landowner and all assigns and successors in interest. The landowner shall record and index this permit in the Moretown Land Records within thirty, (30) days of issuance of this permit and prior to the conveyance of any lot subject to the jurisdiction of this permit.

1.4 The landowner shall record and index all required installation certifications and other documents that are required to be filed under these Rules or under a specific permit condition in the Moretown Land Records and ensure that copies of all certifications are sent to the Secretary.

1.5 All conditions set forth in **WW-5-0227-1 dated 06/20/1996** shall remain in effect except as amended or modified herein.

1.6 Lot #1 is approved with the existing elementary school building. No alterations to the existing building other than those indicated in this permit that would change or affect the water supply or wastewater disposal shall be allowed without prior approval by the Drinking Water and Groundwater Protection Division. Construction of additional nonexempt buildings including commercial and residential buildings is not allowed without prior permitting by the Drinking Water and Groundwater Protection Division and such permit may not be granted unless the proposal conforms to the applicable laws and regulations.

1.7 Each purchaser of any portion of the project shall be shown a copy of the Wastewater System and Potable Water Supply Permit and the stamped plan(s), if applicable, prior to conveyance of any portion of the project to that purchaser.

1.8 By acceptance of this permit, the landowner agrees to allow representatives of the State of Vermont access to the property covered by the permit, at reasonable times, for the purpose of ascertaining compliance with the Vermont environmental and health statutes and regulations, and permit conditions.

1.9 Any person aggrieved by this permit may appeal to the Environmental Court within 30 days of the date of issuance of this permit in accordance with 10 V.S.A. Chapter 220 and the Vermont Rules of Environmental Court Proceedings.

2.WATER SUPPLY

2.1 All water supply conditions set forth in **WW-5-0227-1 dated 06/20/1996** shall remain in effect except as amended or modified herein.

2.2 Lot #1 is authorized for a reduction of **162 gallons** per day to the existing **public non-transient non-community** water supply system permitted under **VT0006677**, for a total of **5,238 gallons** per day.

2.3 Lot #1 is subject to an easement onto the lands identified as "Lands of the Town of Moretown". The ownership of this project, or portion thereof, shall not be transferred without water rights to the approved water supply. The water rights shall provide for an uninterrupted supply of water together with the right to enter upon the property for the construction, repair, maintenance and other such reasonable purposes as may arise regarding the potable water supply. No construction on or conveyance of the approved lot(s)/project is allowed until such time as a copy of the executed easement has been recorded in the Moretown land records. Failure to properly execute the easement renders this permit null and void for any lot/the project conveyed without the proper easement. It is recommended that a copy of the executed easement be sent to the Drinking Water and Groundwater Protection Division.

3.WASTEWATER DISPOSAL

3.1 All wastewater disposal conditions set forth in **WW-5-0227-1 dated 06/20/1996** shall remain in effect except as amended or modified herein.

3.2 The wastewater disposal system, which serves Lot #1 is located on lands identified as "Lands of the Town of Moretown". The land deeds that establish and transfer ownership of these parcels shall contain a legal easement which grants the purchaser(s) and any future owner(s) the right to enter upon the property for the construction, repair, maintenance and other such reasonable purposes as may arise regarding the wastewater disposal system. Failure to properly execute the easement renders this permit null and void for any lot/the project conveyed without the proper easement. It is recommended that a copy of the executed easement be sent to the Drinking Water and Groundwater Protection Division.

3.3 Lot #1 is approved for the reduction of **180 gallons** per day to the existing wastewater disposal system, with a maximum design flow of **2,820 gallons** per day. No changes shall be made to the existing wastewater system unless prior approval is obtained from the Drinking Water and Groundwater Protection Division. Should the system fail and not qualify for the minor repair or replacement exemption, the landowner shall engage a qualified Licensed Designer to evaluate the cause of the failure and to submit an application to Drinking Water and Groundwater Protection Division prior to correcting the failure.

David K. Mears, Commissioner
Department of Environmental Conservation

By ______________________________ Dated April 7, 2015

Dana Nagy, Assistant Regional Engineer
Barre Regional Office
Drinking Water and Groundwater Protection Division

cc Moretown Planning Commission
Peter Lazorchak

WW-50227

Also SEE: PB-5-0523

PROJECT DOCKET SHEET

ID# WW-5-0227

DATE	REVIEW ACTION
6/6/90	Info recvd, logged in, 1copy to PS for PR sheet
6.20.90	REVIEWED Project. Contacted C. Grenier's OFFICE - REQUESTED A SITE PLAN SHOWING THE LOCATION OF THE PORTABLE CLASSROOM left message w/ Grenier's SECRETARY.
7-2-90	Notified Grenier of our concern of alternate site of classroom situated too close to leachfield.
7-13-90	RESUB
7-16-90	REVIEW / PERMIT drafted
2/2/93	Spoke w/ Steve Raynes Re failed system expansion, sand filters etc. He'll discuss options w/ school Bd on 2/9 They'll probably monitor 160 Acres

027-1100

Project ID #: WW-5-0227 C = CO Applicant O = Owner S = Seller

APPLICANT	CROSS REFERENCE
Name: Moretown Elementary School	PB-5-0523
Address:	
City, State, Zip: Moretown, VT 05660	

Town of Devt: MORETOWN Road/River: RT 100 B

	DATES
Devt Name:	
Description: add temporary classrooms	Recd at Dist: 6/6/90
	Logged/Rec Ltr: 6/6/90
	Initial Review: 6/20/90
	Comp. Response: 7/13/90
	Final Action: 7/17/90
	Type of Final Action: P
Fee Rec'd: $ EXEMPT-MUN	(See list of Final Action Codes Below)

Consulting Engineer: Charles Grenier, Box 445, Waterbury 05676

Hydrogeologist:

Reg. Review Eng: BLATT

Action Requested: OK

FINAL ACTION CODES

P = Permit
D = Denial
C = Certification of Compliance
N = Cert. of Noncompliance
W = Withdrawn

TO BE COMPLETED AFTER FINAL ACTION

Minor Project (Y/N) N
Type of Water Supply (ON/OFF/MUN/COM/NO):
Type of Sewage Disposal (ON/OFF/MUN/COM/NO):
Date Permit Recorded: ______

Number of Lots Approved: –
Number of Mounds: –
Gals. Sewage Generated: 0

FOR SUBDIVISIONS ONLY:
List deferral number if this permits removes a deferral: ______

FOR DEFERRALS ONLY:
Is parcel retained or conveyed (R/C): ______
Is parcel contiguous or noncontiguous to other lands of buyer (C/N): ______

STREAM ALTERATION PERMITS ONLY:
Purpose: (GR=Gravel Removal, SM=Streambank Mod/Stab, CR=Channel Relocation, DI=Diversion, OT=Other) (GR/SM/CR/DI/OT): ______

STEPHEN REYNES
ATTORNEY AT LAW
16 STATE STREET
P.O. BOX 1254
MONTPELIER, VERMONT 05601-1254

TEL: (802) 229-2766 FAX: (802) 223-3927

RECEIVED
FEB 2 1993
DIVISION OF PROTECTION

DRAFT

February 1, 1993

Mr. Skip Flanders
Chief, Environmental Services Division
Department of Environmental Conservation
Agency of Natural Resources
103 South Main Street
Waterbury, Vermont 05671-0407

Re: Sewage Disposal System for the Moretown Elementary School

Dear Skip:

I am writing you on behalf of the Moretown School Board of Directors, and in follow up to our recent telephone conversation.

I have prepared the enclosed memo to pull together what has been tried and learned over the last five years as the School Board has attempted to locate a sewage disposal system for the proposed addition to the Elementary School. The proposed addition and improvements are much needed, but the project is dead in the water until we can find a feasible and environmentally sound solution to the sewage disposal problem. We appreciate your willingness to review the enclosed and have me meet with you and Donald Wernecke together to discuss the situation, and see what guidance you may have for moving forward.

The School Board is next meeting on February 9 at 6:30 p.m; it would be great if we could meet before then. Whatever will work for you and Mr. Wernecke will probably work for me, whether in Waterbury, Barre, or wherever. If it is more convenient for both of you, we could meet in my office on State Street in Montpelier. I will wait to hear from you.

Best regards.

Sincerely,

Stephen Reynes

cc: Mr. Donald Wernecke, Regional Engineer
Barre Regional Office
324 North Main Street
Barre, Vermont 05641 w/encl.

Diane Girard-di Carlo
Clerk, Moretown School Board
P.O. Box 568
Moretown, Vermont 05660 w 5 copies of the encl.

STEPHEN REYNES
ATTORNEY AT LAW
16 STATE STREET
P.O. BOX 1254
MONTPELIER, VERMONT 05601-1254

TEL: (802) 229-2766 FAX: (802) 223-3927

To: Mr. Skip Flanders, Chief of the Engineering Services Division, DEC
Mr. Donald Wernecke, Regional Engineer, DEC
Moretown School Board of Directors

Re: Septic System for Proposed Addition to the Moretown Elementary School

By: Stephen Reynes

Date: February 1, 1993

I. INTRODUCTION:

The Town of Moretown voted in 1988 to develop plans for building an addition to the Moretown Elementary School. Despite various efforts, the Town has not been able to proceed on that needed addition because of problems in finding an acceptable solution for sewage disposal. The existing septic system is overburdened and polluting the Mad River.

The School Board asked me to review various documents to give an opinion as to whether a variance for a mound system on the 160 acre school property is obtainable. I am an attorney with a practice in the environmental area, but not an engineer or hydrogeologst. After reviewing all of the documents and speaking with several people (including Diane Girard-diCarlo, Clerk of the School Board, and Mr. Skip Flanders, the new Chief of Engineering Services at the Department of Environmental Conservation), we are proceeding as follows:

(1) I have prepared this memorandum which documents the various efforts and data from the last five years, organized under the criteria for granting a variance under the Environmental Protection Rules;

(2) This memo is being sent to Mr. Skip Flanders, Mr. Donald Wernecke (the new Regional Engineer for this District) and of course the School Board; I will then meet jointly with Mr. Flanders and Mr. Wernecke (hopefully before the Feb. 9 School Board meeting) to discuss the situation and for any guidance they may have as to the best course to pursue at this point for reaching a feasible and environmentally sound solution;

(3) I will meet with the School Board at 6:30 p.m. on February 9 to discuss the situation and to pursue a feasible solution.

II. THE CRITERIA FOR GRANTING A VARIANCE FOR A SEPTIC SYSTEM UNDER SECTION 2-03 OF THE EPR:

The review of applications for sewage disposal are governed by the Environmental Protection Rules (EPR), administered by the Department of Environmental Conservation, Agency of Natural Resources. The rules contain a variance provision (section 2-03) under which a proposed system may be approved even though it does not meet all the technical criteria. *Tab 1.* Although it may be possible to achieve a solution without a Section 2-03 variance, I have organized this information under the four criteria for a variance..

The granting of an approval under the variance section must be premised upon finding that four criteria have been met. Those criteria are set out below.

1) <u>The proposed wastewater treatment disposal system is intended to eliminate an existing health hazard, public nuisance, or source of pollution from an existing structure.</u>

(a) The existing school was built to accomodate 130 students; it now has 192 students, plus 22 teachers and other staff; thus, about 215 persons are using the existing system. *See* letter of Nancy McGowan, P.E., dated Feb. 22, 1990, at pg. 2. *Tab 2.* The existing leachfield is close to the school building and operating way over its capacity. *See Tab 2* and Plan by Charles Grenier entitled, "Moretown School/Higgins Site Septic System Alternatives," dated July 9, 1990, *Tab 3.* It is believed that effluent is currently discharging into the Mad River.

(b) Hot lunches are not prepared at the School because it would generate additional wastewater. The cafeteria space is being used for a combined third and fourth grade; the sixth grade and the school library are in a temporary trailer.

(c) The Minutes of the October 13, 1992 meeting of the School Board reflect an ongoing violation of the Public School Approval (PSA) regulations because students must walk through a parking lot to get to their playground. It also appears from the Minutes of several meetings that there are serious problems of traffic congestion associated with the current access.

(d) Plans to address these problems have been on hold, pending resolution of the sewage disposal issue.

2) <u>Site conditions exist which render strict compliance impossible.</u>

(a) The school is located on a site of approximately 160 acres in the Village of Moretown. Nancy McGowan, P.E. of Dufresne-Henry, reported on two test pits east of the existing leachfield in a letter dated June 30, 1988 and fifteen additional test pits in a letter dated January 8, 1990. In light of those test results, she recommended identification of an off-site wastewater disposal area. *See* her letters dated June 30, 1988, December 21, 1989 and January 8, 1990, *Tab 4.*

(b) Nancy McGowan wrote a letter dated February 22, 1990, which summarized the work to date regarding a wastewater disposal system. *See Tab 2.*

(c) Nancy McGowan wrote a letter dated March 23, 1990, which included additional test results from January 26, 1990 (TP16-TP26). *Tab 5.*

(d) The School Board hired Charles Grenier, Consulting Engineer, to get a second opinion on the matter of sewage disposal. Minutes 3/13/90.

(e) The School Board voted to install a water meter at the school to assess usage. Minutes 5/8/90.

(f) Mr. Grenier prepared a letter of second opinion dated April 19, 1990, in which he concluded that "there is no area on the 160 acre Elementary School site suitable for wastewater disposal from an expanded School either by conventional inground or mound systems." He also agreed with Dufresne Henry that it is not feasible to construct a small wastewater treatment plant for the School. *See Tab 6.*

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3) There are no other feasible means of legally treating and disposing of the sewage.

(a) Seven test pits were dug on April 19, 1990 for possible offsite disposal on Lot #3 of the William Moore subdivision. *See Tab 6.* Mr. Grenier recommended in a letter dated April 26, 1990 that there be an engineering and hydrogeologic evaluation of that lot, but also recommended first checking with neighbors whose property would be crossed. *See Tab 6.* Apparently that course proved infeasible.

(b) A 5.3-acre field along the Moretown Mountain Road belonging to Doreen Higgins was investigated for her on April 11 and 12, 1990, to evaluate its potential for gravel and other purposes as set out in a report entitled, "Higgins Site Investigation, Moretown, Vermont," by Wagner, Heindel and Noyes, Inc., dated May 21, 1990. *Tab 7.*

(c) The School Board then asked Mr. Grenier to determine the feasibility of using the Doreen Higgins property for offsite disposal and treatment of the school wastewater. He reviewed the above WH&N soils report and dug ten additional test holes on the Higgins property. Mr. Grenier prepared a report to the School Board dated July 9, 1990, in which he concluded that the Higgins property is well suited for wastewater disposal in terms of soils. He identified four possible routes for a force main to deliver settled wastewater from the school to the Higgins site, ranging from 1450' to 1800', all of which would require property easements. Based on the construction of two leachfields on the Higgins site with a capacity of 5000 gpd[1], new septic tanks, pump station and force mains, Mr. Grenier estimated a cost of $95,000, exclusive of the cost of easements and/or the cost of the possible need to replace any water supplies because of the pipe route or because of their relation to the Higgins disposal site. *See Tab 8 for his letter and Tab 3 for his Site Plan.*

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1 I spoke with Mr. Alan Liptak of the Johnson Company on January 25, 1993, concerning the work of that firm in this matter. In the course of that conversation, he said if there were hot lunches served but no showers, the standard figure to use for the septic system would be 20 gpd for each school person. Currently, there are about 215 school persons, times 20 gpd, equals 4300 gpd. 250 school persons at 20 gpd would be 5000 gpd.

DRAFT

(d) If the School Board chose to pursue a system having a capacity of 6500 gpd or more,[2] the indirect discharge rules would be triggered. 10 V.S.A. sec 1259(e). Mr. Grenier states in that event a hydrogeologist would have to be retained to determine whether there is at least a two year residence (travel) time between the leachfields and any down gradient well or spring and further expense for the replacement of the water supply of any party whose water supply is not adequately protected.

(e) The Minutes of the September 11, 1990 School Board meeting indicate that Doreen Higgins offered to donate land to the school for a septic system as long as she could also use the land for a gravel pit operation and that septic system for a subdivision.[3] The School Board did pursue a possible purchase of that property. However, subsequent letters from Real Estate Broker Alasdair Munro, on behalf of Dorothy Higgins, propose a lease of her subsurface land to the school for sewage disposal at an initial per school person annual rate of $72, with cost of living adjustment. *See footnote 3 and Tab 9.* (That would amount to an initial lease payment of $15,400 for 215 school persons, or $18,000 for 250 school persons, annually, plus CPI adjustments).

(f) The Moretown School Board voted at its May 28, 1991 meeting to enter a contract with the Johnson Company of Montpelier to perform a preliminary assessment of the feasibility of alternative methods of wastewater disposal for the Moretown Elementary School, including sand filtration *(see (g) below)* and effluent spray methods. I spoke with Mr. Alan Liptak of the Johnson Company on January 25, 1993. He told me that the budgeted amount for the contract ($1100) could not include a written report, but they did a site visit, considerable research, spoke with State officials (including the topic of a possible variance) and met with the Board to give a verbal report.

---

2 6500 gpd would be for 325 school persons @ 20 gpd. Ref: fn #1.

3 There are letters dated Jan. 23 and June 7, 1991, to the School Board from Real Estate Broker Alasdair Munro, attached to the Minutes of the June 11, 1991 School Board meeting which summarizes the structure of an agreement proposed on behalf of Doreen Higgins, under which she would lease the subsurface use of her land to the Moretown School Board for the purpose of constructing and operating a subsurface sewage disposal area at the rate of $72 per school person, per year, with annual adjustment. *See Tab 9.*

(g) In speaking with Mr. Liptak about a sand filtration system, he said that it uses standard septic tanks and selected sands, and that the State may bend on the minimum depth to water table if a sand filtration system is used. He also mentioned that such a system was recently permitted for the Calais Elementary School after they had many difficulties in trying to site a disposal system.

I subsequently spoke with Carl Fuller of Dufresne-Henry, who did the engineering work for the above recently approved Calais School sand filtration system, and Craig Heindel of Wagner, Heindel & Noyes, who did the hydrogeologic work for that Calais system. The Calais work was also for a school addition. Mr. Fuller told me that they were allowed to go by metered flow of 10 gpd of wastewater per student and that they did not require a replacement area. He also told me that they had designed and received approval for such a system for Pownal. Mr. Heindel explained to me that the reason the State is not so concerned with a replacement area for a sand filtration system is because the sand filtration gives a higher level of treatment and the sand portion can be fixed. The effluent first goes through a normal septic tank to remove solids, then through the sand filtration system (a concrete vault filled with selected sands, with collection and pipes at the bottom) then to leachfields or mound system.

If a replacement area is not required, that means that an area may be usable which otherwise would be rejected as too small. It also seems that a school has the ability to control and monitor water usage to a greater degree than some other types of development, which may have been a factor in the Calais permit. Although a sand filtration system is more expensive than a standard subsurface or mound system, the cost differential needs to be compared with any avoided costs, such as buying replacement wells, pipelines, pumps, lease or property purchase costs, legal fees and other costs for easements, negotiating, etc. Having control of the system may also save other costs down the road.

I am not qualified to say whether a sand filtration system is approvable on the 160-acre school site. Based on the above, however, it sounds like an avenue that should be explored further.

4) <u>A system can be constructed which will function in a satisfactory manner so as to not create a health hazard, public nuisance, or source of pollution</u>.

It remains to be seen whether a sand filtration/mound system can be approved on the school site. Mr. Fuller thought the Calais permit was done without using the variance section of the EPR. If a variance is necessary, it appears that the situation meets at least the first three criteria for proceeding under the authority of Section 2-03 of the EPR.

III. A FINAL COMMENT:

The current situation, despite much conscientious effort, is undesirable from several perspectives, including environment, safety, health, nutrition, overcrowding and general educational environment. The Moretown School Board appreciates the willingness of Mr. Flanders and Mr. Wernecke to review this material and suggest a good course at this point.

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§2-03. Variances

A. General: Requests for variances shall be accompanied by plans and specifications for the proposed system for which a variance is being requested and a statement of the grounds for the request. The disposition of the variance request shall be in writing and shall state the reasons for a denial or the specifications and conditions of any approval.

Approval of a variance under this section or of an innovative system under §2-04 shall not relieve the applicant of the responsibility of complying with all other applicable State and local laws, rules or ordinances, including Title 10 V.S.A. Chapter 47, Water Pollution Control. In the event that a variance or innovative system may result in a discharge to the waters of the State requiring a permit under 10 V.S.A., Chapter 47 or action by the Board, compliance with Chapter 47 or Board action shall precede issuance of approval by the Division.

B. Grounds for Variances: Variances from the technical requirements of these rules may be granted upon finding that:

1) The proposed wastewater treatment disposal system is intended to eliminate an existing health hazard, public nuisance, or source of pollution from an existing structure;

2) Site conditions exist which render strict compliance impossible;

3) There are no other feasible means of legally treating and disposing of the sewage; and

4) A system can be constructed which will function in a satisfactory manner so as not to create a health hazard, public nuisance, or source of pollution.

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Mr. Mo...

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February 22, 1990

DRAFT

Mr. Dick Moser
Washington West Supervisory District
RR1, Box 1065
Moretown, Vermont 05660

Re: Moretown Elementary School

Dear Dick:

This letter will summarize the work that has been performed to date regarding the wastewater disposal system for the proposed school expansion. The following is a list of the areas tested and the results of testing. High water table means that the separation between the ground surface and seasonal water table is less than 3.5' for a conventional system and 2' for a pressurized mound system. Low percolation soils have been identified as compact till and silt soils.

Area Tested	Limitation
Field adjacent to existing system	High water table Low percolation soils
Field northeast of school	High water table Low percolation soils
Plateau east of school	Impeding layer of low percolation soils
Plateau off South Hill Road	Low percolation soils Saturated soils
Area between plateau and South Hill Road	Saturated soils

The soils testing has been performed on all areas indicated by the Soils Conservation Service (SCS) as having potential for wastewater disposal. Other areas were also tested to ensure all alternatives were investigated. No areas were identified that are suitable for wastewater disposal generally because of the high water table.

Mr. Jack Barnes
Page 2
February 22, 1990

Several off-site areas were identified from the SCS maps. There were sandy soils identified both north and south of the school on Rte. 100B and on the east side of South Hill Road. These areas are owned by Theren Austin (east of the Pony Farm Greenhouse), former gravel pit owned by Bob Gove east of South Hill Road, an area near the power substation and an area between Rte. 100B and the river north of Town. Although the SCS identified these areas as potentially suitable for wastewater disposal, they will need soils field investigation to determine the suitability of the sites. There are limitations to using off-site systems such as obtaining the land or an easement for its use, site access, sewer line construction and pumping requirements.

A rough cost estimate for the construction of an off-site system for the school is as follows:

Wastewater disposal area (5800 sq. ft.)	$	16,500.00
Effluent pumping station		8,000.00
Pressure sewer (1200 l.f.)		11,400.00
Miscellaneous site work		3,000.00
	$	38,900.00

This cost estimate assumes a conventional wastewater disposal system area can be identified.

One of the considerations raised during the Facilities Committee meeting was the possibility of constructing a small wastewater treatment plant for the school. There are no existing municipal discharges on the Mad River upstream from the Town. It is the policy of the Board of Natural Resources that no direct discharges will be permitted on this river. Therefore, regardless of the cost which would be in excess of $400,000, this alternative is not feasible.

The Moretown Elementary School's existing public building permit can be used for wastewater disposal for flows up to it's approved capacity. No Environmental Permit exists for this site. The first addition to the original building occurred in 1959 with a wastewater disposal system of at least 840 sq. ft. This system failed and was renovated by Lloyd Grount in May 1977. The replacement system is the one currently in use and is approximately 1800 sq.ft. (information from Charles Grenier). The public building permit was approved for 130 students. Under current regulations, the capacity of the system is 1950 gpd.

The use of the building can change without significantly affecting the permit. A public building permit will be required for the new use, however, the wastewater disposal system capacity can be grandfathered from the existing permit. If the school building were to be converted to elderly housing with 16 units and a small office building for 8 employees, the wastewater disposal capacity required would by 1200 gpd for the elderly housing and 120 gpd for the office space. These flows are below the existing flows and could be permitted without additional field work.

Charles Grenier's plans show a replacement area for this system.

Please let me know when or whether you will proceed with this project.

Sincerely,

DUFRESNE-HENRY, INC.

Nancy Hoelper McGowan, P.E.

NHM/lcm

cc: Jean Eisele, Principal, Moretown Elementary
Tom Good, BRD
Jack J. Barnes, Moretown Facilities Committee

DH Dufresne-Henry

Dufresne-Henry, Inc.
58 East State Street
Montpelier, Vermont 05602
802-229-0711

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June 30, 1988

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DIVISION OF PROTECTION

Mr. Dick Moser, Superintendent
Washington-West Supervisory District
Rte. 100 A
Moretown, Vermont 05660

Re: Soils investigation at Moretown Elementary School

Dear Dick:

Two test pits were dug in the Moretown School field east of the Piazza and Ward parcels and also east of the existing leachfield. Soils logs for these test pits follow:

TP-1	0" - 6"	Medium brown topsoil
	6" - 16"	Light yellow-brown loam with sand
	16" - 30"	Gray silt, mottled throughout
TP-2	0" - 8"	Medium brown topsoil
	8" - 15"	Light yellow-brown loam with sand
	15" - 17"	Light brown loam, mottled
	17" - 24"	Gray silt, mottled throughout

The soils in this field are inappropriate for a wastewater disposal system design which could be approved under the State Environmental Rules. Please let me know if you would like any additional information or require additional testing.

Sincerely,

DUFRESNE-HENRY, INC.

Nancy J. Hoelper

Nancy J. Hoelper, P.E.

NJH/lm

DRAFT

Dufresne-Henry

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December 21, 1989

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DIVISION OF PROTEC...

Mr. Dick Moser, Superintendent
Washington West Supervisory District
RR1, Box 1065
Moretown, Vermont 05660

Dear Dick:

Enclosed please find a highlighted copy of the soils map from the Soils Conservation Service. I am not certain about the property boundaries. They are estimated in red ink. Highlighted soils are Adams (26) and Colton (39).

There appear to be two areas on site, the plateau area and the field to the north. Both of these areas have been investigated and show high seasonal water table. Further investigation at the toe of slope might be warranted, however, previous field observations indicated these areas might be wet also.

There were no sites in the eastern part of the parcel which showed appropriate soils. Across the road from the eastern road frontage, south of the cemetary, is a field that shows sandy soils in the center of it. Is there any possibility this land owner might be willing to provide a utility easement to the school for wastewater disposal? You will note other areas indicated as 26 or 39 on the map. If any of these areas are available, it may be worthwhile to investigate.

Please feel free to call if you have any questions.

Sincerely,

DUFRESNE-HENRY, INC.

Nancy H M Gowan

Nancy Hoelper McGowan, P.E.

NHM/lcm

cc: Jean Eisele, Principal, Moretown Elementary
Tom Good, BRD

DRAFT

GRICULTURE
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TH
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APPROX. SCALE 1" = 1500'

USDA-SCS FORT WORTH TEXAS

SOIL SURVEY FIELD SHEET
WASHINGTON COUNTY, VERMONT
ADVANCE COPY - SUBJECT TO CHANGE
SURVEY HAS NOT BEEN COMPILED NOR CORRELATED. N
MAY BE CHANGED AND AREAS MAY BE COMBINED.

Dufresne-Henry

Dufresne-Henry, Inc.
58 East State Street
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802-229-0711
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DRAFT

January 8, 1990

Mr. Dick Moser, Superintendent
Washington West Supervisory District
RR1, Box 1065
Moretown, Vermont 05660

Re: Moretown Elementary School

Dear Dick:

Enclosed please find a copy of the complete soils testing for the Moretown School. As noted in a previous letter to you, I indicated the SCS maps indicated two areas of potentially suitable soils. To eliminate any doubt regarding the site potential, several additional test pits were dug today. Investigation at the toe of slope and in the remainder of the plateau area indicated heavy layers of silt which eliminate the use of these areas for wastewater disposal.

Therefore, the identification of an off-site wastewater disposal area is recommended. Please feel free to call if you have any questions.

Sincerely,

DUFRESNE-HENRY, INC.

Nancy H. McGowan

Nancy Hoelper McGowan, P.E.

NHM/lcm

cc: Jean Eisele, Principal, Moretown Elementary
Tom Good, BRD

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Moretown Elementary School
Washington-West Supervisory District
Soils Investigation
August 16, 1989

TP-1	0" - 6"	Medium brown topsoil
	6" - 14"	Medium brown silt loam, friable
	14" - 19"	Brown silt loam, mottled
	19" - 31"	Grey silt, heavily mottled
		NLTD/NWTD
TP-2	0" - 5"	Medium brown topsoil
	5" - 16"	Medium brown sandy silt loam
	16" - 27"	Grey silt, mottled
	27" - 42"	Grey silt, heavy manganese deposits, mottled
	42" - 61"	Red-brown sandy gravel, saturated
		Water at 36"
		NLTD
		Dug up water line
TP-3	0" - 8"	Medium brown topsoil
	8" - 17"	Medium red-brown sandy loam
	17" - 27"	Light brown fine silty sand with stones
	27" - 40"	Brown silty sand
		NLTD/NWTD
		Dug up water line

Soils Investigation
December 14, 1989

TP-4	0" - 8"	Medium brown topsoil
	8" - 19"	Medium red-brown loam with some sand
	19" - 26"	Light brown stony loam
	26" - 45"	Light grey brown silt with fine sand, faint mottling
	45" - 52"	Light brown sandy silt, mottled
	52" - 64"	Light brown fine to medium sand with silt, mottled
	64" - 87"	Grey silt, mottled throughout, dense
		NLTD/NWTD
TP-5	0" - 4"	Medium brown topsoil
	4" - 13"	Medium brown sandy loam
	13" - 46"	Light grey-brown fine sand with stringers of silt, silt is mottled
	46" - 65"	Alternating 4" to 6" layers of brown fine to medium sand and grey-brown silt, mottled
	65" - 76"	Brown very fine sand, moist, mottled
		NLTD/NWTD

TP-6	0" - 10"	Light brown fine sandy loam	
	10" - 19"	Brown sandy silt with 1-1/2" gravel, mottled, soil looks disturbed	
	19" - 72"	Alternating layers of brown fine sand and grey-brown silt, mottled, moist after 70"	
		NLTD/NWTD	
TP-7	0" - 4"	Brown topsoil	
	4" - 28"	Medium brown medium sand with silt	
	28" - 36"	Medium brown medium sand with silt, mottled	
	36" - 46"	Brown medium to coarse sand with silt and gravel, moist	
	46" - 60"	Grey silt, mottled	
		NLTD/NWTD	
TP-8	0" - 4"	Brown topsoil	
	4" - 12"	Medium brown fine sandy loam	
	12" - 33"	Medium brown very fine sandy silt, mottled	
	33" - 42"	Brown sandy silt, mottled	
		Hit water line	
		NLTD/NWTD	
TP-9	0" - 4"	Brown topsoil	
	4" - 16"	Medium brown fine sandy loam	
	16" - 33"	Medium brown very fine sandy silt loam, mottled	
	33" - 40"	Brown sandy silt, mottled	
	40" - 48"	Grey silt, mottled	
		NLTD/NWTD	

Soils Investigation
January 8, 1990

TP-10	0" - 5"	Medium brown topsoil	
	5" - 14"	Dark brown loam	
	14" - 48"	Grey brown silt, mottled	
	48" - 58"	Grey silt, mottled, dense, saturated	
		NLTD/NWTD	
TP-11	0" - 6"	Medium brown topsoil	
	6" - 16"	Dark brown loam	
	16" - 21"	Grey brown silt loam, firm	
	21" - 52"	Grey silt, firm, mottled	
		Water at 52"	
		NLTD	
TP-12	0" - 6"	Dark brown topsoil	
	6" - 16"	Grey brown loam, moist	
	16" - 45"	Grey silt, firm, mottled	
		NLTD/NWTD	

TP-13	0"	-	6"	Medium brown topsoil
	6"	-	14"	Medium brown fine sandy loam with stones
	14"	-	20"	Medium brown fine sandy stony loam with some silt
	20"	-	25"	Medium brown fine sandy stone loam, mottled
	25"	-	42"	Grey silt, mottled
	42"	-	55"	Medium brown fine to medium sand, firm, mottled
	55"	-	75"	Grey silt, firm, mottled
	75"	-	80"	Grey brown fine sand, mottled
				NLTD/NWTD
TP-14	0"	-	4"	Medium brown topsoil
	4"	-	18"	Medium brown sandy stony loam with silt
	18"	-	52"	Grey silt, compact, mottled
	52"	-	70"	Brown clean medium to fine sand, firm, mottled
				NLTD/NWTD
TP-15	0"	-	4"	Medium brown topsoil
	4"	-	16"	Medium brown loam with some stone
	16"	-	36"	Grey brown silt, firm, mottled
	36"	-	55"	Grey silt, dense, mottled
				Saturated at 55"
				NLTD/NWTD

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DUFRESNE-HENRY, INC.

Nancy H. McGowan

Nancy Hoelper McGowan, P.E.

DH Dufresne-Henry

Dufresne-Henry, Inc.
58 East State Street
Montpelier, Vermont 05602
802-229-0711
FAX: 802-229-0891

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March 23, 1990

RECEIVED
FEB 2 1993
DIVISION OF PROTECTION

Mr. Dick Moser
Washington West Supervisory District
RR1, Box 1065
Moretown, Vermont 05660

Re: Moretown Elementary School

Dear Dick:

I was asked to send a copy of the soils reports resulting from my soils investigations to Charlie Grenier. I understand that either Jean Eisele and/or you could not fine a copy of these soils investigations in your files. I'd like to provide you with another copy so you have a complete file.

Please let me know if there is anything else I can do for you.

Sincerely,

DUFRESNE-HENRY, INC.

Nancy H. McGowan

Nancy Hoelper McGowan, P.E.

NHM/lcm

cc: Jean Eisele, Principal, Moretown Elementary, w/encl.
Tom Good, BRD, w/encl.
Charlie Grenier, w/encl.

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Moretown Elementary School
Washington-West Supervisory District
Soils Investigation
August 16, 1989

TP-1	0" - 6"	Medium brown topsoil
	6" - 14"	Medium brown silt loam, friable
	14" - 19"	Brown silt loam, mottled
	19" - 31"	Grey silt, heavily mottled
		NLTD/NWTD
TP-2	0" - 5"	Medium brown topsoil
	5" - 16"	Medium brown sandy silt loam
	16" - 27"	Grey silt, mottled
	27" - 42"	Grey silt, heavy manganese deposits, mottled
	42" - 61"	Red-brown sandy gravel, saturated
		Water at 36"
		NLTD
		Dug up water line
TP-3	0" - 8"	Medium brown topsoil
	8" - 17"	Medium red-brown sandy loam
	17" - 27"	Light brown fine silty sand with stones
	27" - 40"	Brown silty sand
		NLTD/NWTD
		Dug up water line

Soils Investigation
December 14, 1989

TP-4	0" - 8"	Medium brown topsoil
	8" - 19"	Medium red-brown loam with some sand
	19" - 26"	Light brown stony loam
	26" - 45"	Light grey brown silt with fine sand, faint mottling
	45" - 52"	Light brown sandy silt, mottled
	52" - 64"	Light brown fine to medium sand with silt, mottled
	64" - 87"	Grey silt, mottled throughout, dense
		NLTD/NWTD
TP-5	0" - 4"	Medium brown topsoil
	4" - 13"	Medium brown sandy loam
	13" - 46"	Light grey-brown fine sand with stringers of silt, silt is mottled
	46" - 65"	Alternating 4" to 6" layers of brown fine to medium sand and grey-brown silt, mottled
	65" - 76"	Brown very fine sand, moist, mottled
		NLTD/NWTD

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Moretown Elementary School
Soils Investigation

TP-6	0"	-	10"	Light brown fine sandy loam
	10"	-	19"	Brown sandy silt with 1-1/2" gravel, mottled, soil looks disturbed
	19"	-	72"	Alternating layers of brown fine sand and grey-brown silt, mottled, moist after 70"
				NLTD/NWTD
TP-7	0"	-	4"	Brown topsoil
	4"	-	28"	Medium brown medium sand with silt
	28"	-	36"	Medium brown medium sand with silt, mottled
	36"	-	46"	Brown medium to coarse sand with silt and gravel, moist
	46"	-	60"	Grey silt, mottled
				NLTD/NWTD
TP-8	0"	-	4"	Brown topsoil
	4"	-	12"	Medium brown fine sandy loam
	12"	-	33"	Medium brown very fine sandy silt, mottled
	33"	-	42"	Brown sandy silt, mottled
				Hit water line
				NLTD/NWTD
TP-9	0"	-	4"	Brown topsoil
	4"	-	16"	Medium brown fine sandy loam
	16"	-	33"	Medium brown very fine sandy silt loam, mottled
	33"	-	40"	Brown sandy silt, mottled
	40"	-	48"	Grey silt, mottled
				NLTD/NWTD

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Soils Investigation
January 8, 1990

TP-10	0"	-	5"	Medium brown topsoil
	5"	-	14"	Dark brown loam
	14"	-	48"	Grey brown silt, mottled
	48"	-	58"	Grey silt, mottled, dense, saturated
				NLTD/NWTD
TP-11	0"	-	6"	Medium brown topsoil
	6"	-	16"	Dark brown loam
	16"	-	21"	Grey brown silt loam, firm
	21"	-	52"	Grey silt, firm, mottled
				Water at 52"
				NLTD
TP-12	0"	-	6"	Dark brown topsoil
	6"	-	16"	Grey brown loam, moist
	16"	-	45"	Grey silt, firm, mottled
				NLTD/NWTD

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TP-13	0"	-	6"	Medium brown topsoil
	6"	-	14"	Medium brown fine sandy loam with stones
	14"	-	20"	Medium brown fine sandy stony loam with some silt
	20"	-	25"	Medium brown fine sandy stone loam, mottled
	25"	-	42"	Grey silt, mottled
	42"	-	55"	Medium brown fine to medium sand, firm, mottled
	55"	-	75"	Grey silt, firm, mottled
	75"	-	80"	Grey brown fine sand, mottled
				NLTD/NWTD
TP-14	0"	-	4"	Medium brown topsoil
	4"	-	18"	Medium brown sandy stony loam with silt
	18"	-	52"	Grey silt, compact, mottled
	52"	-	70"	Brown clean medium to fine sand, firm, mottled
				NLTD/NWTD
TP-15	0"	-	4"	Medium brown topsoil
	4"	-	16"	Medium brown loam with some stone
	16"	-	36"	Grey brown silt, firm, mottled
	36"	-	55"	Grey silt, dense, mottled
				Saturated at 55"
				NLTD/NWTD

Soils Investigation
January 26, 1990

TP-16	0"	-	8"	Medium brown topsoil
	8"	-	14"	Medium brown loam
	14"	-	28"	Tan loam, moist
	28"	-	54"	Light grey brown till, mottled, saturated
				NWTD
TP-17	0"	-	9"	Dark brown topsoil
	9"	-	15"	Dark red brown sandy loam
	15"	-	30"	Medium yellow brown sandy loam
	30"	-	40"	Yellow brown fine to medium sand with stones, silt stringers, faint color variations
	40"	-	76"	Light brown sandy till, firm, mottled
				NLTD/NWTD
TP-18	0"	-	6"	Medium brown topsoil
	6"	-	14"	Medium brown loam
	14"	-	20"	Grey brown loam, mottled
	20"	-	64"	Till, compact, mottled
				NLTD/NWTD
TP-19	0"	-	11"	Medium brown topsoil
	11"	-	16"	Medium brown loam with some sand
	16"	-	23"	Tan loam, mottled
	23"	-	32"	Medium grey brown till, platey, mottled
	32"	-	58"	Grey brown till, compact, mottled, ledge at 58"
				NWTD

TP-20	0"	-	4"	Medium brown topsoil
	4"	-	14"	Medium yellow brown loam with some sand
	24"	-	36"	Grey brown till, compact, mottled, ledge
				NWTD
TP-21	0"	-	9"	Dark brown topsoil
	9"	-	24"	Medium brown sandy loam
	24"	-	30"	Medium grey brown sandy till, mottled
	30"	-	48"	Grey brown till, compact, mottled, ledge
				NWTD
TP-22	0"	-	11"	Dark brown topsoil
	11"	-	20"	Medium red brown sandy loam
	20"	-	25"	Medium yellow brown loam
	25"	-	80"	Medium grey brown till, mottled
				NLTD/NWTD
TP-23	0"	-	11"	Dark brown topsoil
	11"	-	16"	Medium brown fine sandy loam
	16"	-	22"	Olive brown loam
	22"	-	28"	Olive brown loam, mottled
	28"	-	50"	Medium brown sandy till, firm, mottled
	50"	-	84"	Grey brown till, compact, mottled
				NWTD
TP-24	0"	-	6"	Dark brown topsoil
	6"	-	16"	Medium brown loam
	16"	-	32"	Grey brown till, compact, mottled, ledge
				NWTD
TP-25	0"	-	9"	Dark brown topsoil
	9"	-	22"	Olive brown loam, mottled
	22"	-	50"	Grey brown till, compact, mottled, ledge
				NWTD
TP-26	0"	-	9"	Dark brown topsoil
	9"	-	16"	Olive brown loam, saturated
	16"	-	60"	Grey brown till, saturated
				NLTD

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DUFRESNE-HENRY, INC.

Nancy H. McGowan

Nancy Hoelper McGowan, P.E.

APR 23 1990

CHARLES GRENIER
CONSULTING ENGINEER PC
BOX 445 244-6413
WATERBURY, VT. 05676

April 19, 1990

FILE

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DIVISION OF PROTECTION

Washington West Supervisory Union School District
Attn: Richard Moser, Superintendent
RR#1 Box 1065
Moretown, Vermont 05660

RE: Moretown Elementary School Expansion

Dear Mr. Moser:

At the request of Sam Scofield and David Clemons, members of the Building Committee, we have prepared a second opinion regarding the sewage disposal options for school expansion at Moretown Elementary School. In order to develop an opinion, the following steps were taken.

1. We reviewed the February 22, 1990 letter from Dufresne and Henry, Engineer, Nancy McGowan including the soil test pit logs.

2. We walked a substantial portion of the 160 acre School site in search of other possible soil test areas which Dufresne and Henry might have overlooked. Their soil test pit sites were inspected.

3. We contacted local citizen/excavators, namely Eugene Grandfield and Cedric Reagan to determine whether they knew of areas on the School site where good soil might be discovered.

4. As a result of our site walk and neighborhood inquiries, we dug two test holes on a high pine knoll easterly and directly uphill from the field behind the School. Poor glacial till soils were discovered. We also dug a test hole in the field behind the School to reconfirm the poor wet soil reported by Dufresne and Henry.

5. Through arrangements made by Sam Scofield, test holes were dug on the six acre Lot #3 of the William Moore Subdivision. This parcel is located southerly of the School a distance of 800' ±. Test holes were dug to determine whether this lot could be used for wastewater disposal from the School.

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6. Hoover Austin was contacted to determine if the Austin property was available for use as a sewage disposal area for the School. The Austins are not interested.

7. It is our understanding that the School expansion would be for a population of 200 with hot lunches provided. If hot lunches are prepared on School grounds, 20 gallons per student and staff must be allocated towards sizing a wastewater disposal system. If hot lunches are not prepared at the School, then only 15 gallons per capita is required. Our investigation is directed towards finding an area suitable for wastewater disposal for at least 3000 gallons per day, if not the full 4000 gallons per day with hot lunches provided.

As a result of this investigation, we are sorry to conclude that in our opinion there is "no area on the 160 acre Elementary School site suitable for wastewater disposal from an expanded School either by conventional inground or mound systems". The entire site is either wet, has impermeable soils, or is too steep. The conservative State Environmental regulations for wastewater disposal cannot be met on this site. There is nothing that leads us to believe that we have missed possible wastewater disposal areas on the property. Furthermore, we concur with the conclusions drawn by Dufresne and Henry that "no potential wastewater areas were identified on the site, nor is it feasible to construct a small wastewater treatment plant for the School". It is further our opinion that the only alternative available to the School would be to find an offsite location for wastewater disposal. Lot #3 of the William Moore subdivision might be suitable for that purpose. We will review this letter and address the possibilities for Lot #3 at the scheduled meeting at 6:30 p.m. on Thursday, April 26, 1990.

If any questions arise as a result of this letter, please do not hesitate to contact us.

Respectfully,

Charles J. Grenier

Charles J. Grenier
Consulting Engineer, P.C.

CJG:lar

cc. Sam Scofield
Jean Eisele
David Clemons

CHARLES GRENIER
CONSULTING ENGINEER PC
BOX 445 244-6413
WATERBURY, VT. 05676

TEST PIT LOGS
MORETOWN ELEMENTARY SCHOOL
APRIL 19, 1990

Present: Charles J. Grenier; State Regional Engineer, Eric Blatt; School Building Committee, Sam Scofield and John Moss

<u>Test Pit #G1</u> (on pine ridge above field)

0" - 6"	Dark brown topsoil and roots
6" - 12"	Grey brown sandy loam
12" - 72"	Dense grey basal till, mottled, dry, ledge or big boulder @ 72"±

<u>Test Pit #G2</u> (on pine ridge above field)

0" - 7"	Dark brown topsoil
7" - 11"	Grey brown sandy loam
11" - 60"	Dense grey till, mottled

Stopped Digging

<u>Test Pit #G3</u> (east edge of field, possible School site)

0" - 8"	Dark brown topsoil
8" - 48"	Dense grey silt, mottled throughout
48" -132"	Layers of fine sand, silt, clay, wet, mottled

CHARLES GRENIER
CONSULTING ENGINEER PC
BOX 445 244-6413
WATERBURY, VT. 05676

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TEST PIT LOGS
WILLIAM MOORE SUBDIVISION LOT #3
FOR MORETOWN ELEMENTARY SCHOOL
APRIL 19, 1990

Present: Charles J. Grenier; State Regional Engineer, Eric Blatt; School Building Committee, Sam Scofield and John Moss; William Moore

<u>Test Pit "A"</u>
0" - 5" Brown topsoil
5" -33 1/2" Loose light brown fine sand
33 1/2" - 42" Grey very fine sandy silt, small mottles
42" - 60" Fine grey brown sand, damp 52" - 60"
60" -108" Very fine sands and silt, layered
Water seeping in @ 88"

<u>Test Pit "B"</u>
0" - 34" Light brown sand
34" - 45" Grey firm silt
45" - 58" Light grey brown sand
58" -106" Grey brown sand and silt, some moisture, wet below 80"

<u>Test Pit "C"</u>
0" - 36" Fine light brown sand
36" - 48" Grey silt, firm
30" - 36" Manganese staining
48" - 65" Fine light brown sand
65" -102" Grey silt and very fine sand, mottled, wet

<u>Test Pit "D"</u>
0" - 44" Fine light brown loose sand
44" - 62" Very fine sandy silt, grey, firm, wet
62" - 99" Grey moist very firm sand and silt layers
32" - 36" Firm layer silty sand

<u>Test Pit "E"</u>
0" - 47" Fine light brown sand
37" - 47" Moist
47" - 98" Grey silt and very fine sand

<u>Test Pit "F"</u>
0" - 59" Fine loose light brown sand
46" - 59" Wet silt, water on silt
59" - 96" Grey silt, very fine sand, saturated

<u>Test Pit "G"</u>
0" - 56" Fine loose light brown sand
56" - 96" Grey silt, very fine sand
46" - 56" Wet sand

DRAFT

W H N
Wagner, Heindel, and Noyes, Inc.
285 North Street, Burlington, Vermont 05401 802-658-0820

FILE

HIGGINS SITE INVESTIGATION
MORETOWN, VERMONT

Prepared by:

Samuel R. Haydock
Geologist

Reviewed and Approved by:

Jeffrey E. Noyes
Chief Hydrogeologist

Date: May 21, 1990

H[illegible]GINS SITE INVESTIGATION
MORETOWN, VERMONT

TABLE OF CONTENTS

Wagner, Heindel, and Noyes, Inc.
285 North Street, Burlington, Vermont 05401 802-658-0820

HIGGINS SITE INVESTIGATION
MORETOWN, VERMONT

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

1. A 5.3-acre field located in Moretown, Vermont, belonging to Doreen Higgins, was investigated on April 11 and 12, 1990 to evaluate its potential as a sand and gravel borrow area.

2. The 5.3-acre field is a topographic peninsula, with steep drop-offs on all sides except the northern edge, which is bordered by Moretown Mountain Road. The approximate elevation difference between the field and the toe of slope is approximately 80 to 90 feet. The whole site is open and unwooded. Access to the site is excellent.

3. To establish stratigraphic conditions, a drill rig was used both days of the investigation. A total of 12 holes were drilled, each to a depth of 30 feet, with the exception of hole #5, which was drilled to a depth of 45 feet. Drilling was conducted with solid stem augers. Integrated samples were collected every 5 feet by spinning the augers at high speed and collecting material brought to the surface. Recovery was generally good, with the exception of the larger gravel, cobbles, and boulders.

4. Soil conditions across the site were the same for the first 4 to 8 feet below ground surface, where a sandy gravel was encountered. Below that depth, soil conditions varied depending upon the specific location in the field. In the northern one-third of the field, unsaturated, medium sand and sandy gravel prevailed to depth. In the remainder of the field, a fine sandy silt layer was encountered between 4 to 8 feet below ground surface. This material was encountered to depth, and was usually saturated at approximately 16 to 17 feet below ground surface. Small sand lenses were found at various depths within the sandy silt in some borings.

5. Monitor wells were installed in holes #1, #7, #8, #10, #11 and #12. All wells were installed to a total depth of 15-25 feet bgs, all wells had a 7.0 foot slotted section, and all wells had a 1.0 foot stick-up. Water level measurements recorded at the end of the second day of drilling indicate levels as high as 12.82 feet below top of casing (btc), (hole #10), and as low as 24 feet btc (hole #8). The slope of the water table is to the southeast.

6. Sieve analyses were conducted on five samples recovered from the Higgins site. One sample analyzed represented the shallow gravel layer encountered across the site. The second sample analyzed represented the coarse gravelly sand encountered at depth along the northern third of the site. The remaining three samples analyzed represented the fine sandy silt that was encountered across the remainder of the field.

7. The results of the sieve analysis were compared to the sieve specifications for: mound fill (EPR); mound fill (IDR); granular borrow (AOT); sand, borrow, and cushion (AOT); and fine aggregate for concrete (AOT). The two gravel samples meet the criteria for granular borrow. None of the samples match the criteria for anything else without significant processing.

8. Volumetric estimates have been made for the three soil regimes. We estimate that the shallow gravel layer present across the whole site may yield 51,000 cubic yards. The fine silt layer present below the upper gravel in the southern two-thirds of the field may yield 61,000 cubic yards. The deep gravel and sand present in the northern third of the field may yield 95,000 cubic yards.

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HIGGINS SITE INVESTIGATION
MORETOWN, VERMONT

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1.0 INTRODUCTION

The purpose of this report is to evaluate the potential of a 5.3-acre field in Moretown to support a gravel mining operation. The site is owned by Doreen Higgins, and is located in the center of Moretown, just east and slightly upgradient from Route 100B (see Appendix 1, page 1). Subsurface conditions were investigated with the use of a drill rig, boring 11 holes to a depth of 30 feet, and one hole to a depth of 45 feet (see Appendix 1, page 2 for approximate locations). In each boring, integrated soil samples were collected every 5 feet. In consultation with the project engineer (Olin Potter, P.E.), a select number of samples were then analyzed to determine if they would meet the requirements for:

1. mound fill as specified by the Environmental Protection Rules;
2. mound fill as specified by the Indirect Discharge Rules;
3. sand borrow and cushion as specified by the Agency of Transportation;
4. granular borrow as specified by the Agency of Transportation; and
5. fine aggregate for concrete as specified by the Agency of Transportation.

2.0 SITE CONDITIONS

The site consists of a 5.3-acre open field (Appendix 1, pages 1 and 2) that represents a topographic peninsula, with steep drop-offs on all sides except the northern edge, which is bordered by Moretown Mountain Road. The elevation difference between the test area and the toe of the bank at the base of the field is approximately 80 to 90 feet. Slopes vary from 45% to 85% along the steep banks, and from 0 to 3% in the field proper.

According to the Surficial Geologic Map of Vermont, the 5.3-acre field is part of a glaciolacustrian deposit consisting mostly of pebbly sand. Prior to drilling, a surficial reconnaissance investigation of the entire deposit revealed exposures of sand and clay in stream cuts on the periphery of the site. A thick blue clay layer is present near stream level at the base of the deposit.

At the southwestern end of the bank, a saturated silt layer is exposed in the bank cut approximately 20 feet from the top of bank. Animal burrows lower down on the slope indicate gravel beneath the silt layer. Just down from the animal burrows, seeps with clay are exposed.

The western bank has recently been logged by Ward Lumber Company. At an elevation of approximately 35 feet up from the toe of the bank, the fresh bank cut reveals saturated silty gravel. At an elevation of 45 feet from the toe of bank, the bank cuts are dry. At approximately 55 feet from the toe of bank, and approximately 20 feet down from the field, a saturated silt layer is exposed in a skidder track.

No obvious bank cuts are exposed along the northwestern edge of the bank. The eastern and southeastern banks are steep and dry, showing no exposed seeps. Standing water occurs in old stream meanders at the toe of the bank.

3.0 NEIGHBORING CONCERNS

Two residences are located along the northwestern extremity of the site. A trailer located just along the margin of the field has a drilled well that is clearly visible. A yellow house located 20 feet downgradient along the northwestern bank has no well visible, but must have a well or spring somewhere on the property.

At the northeastern edge of the field, a small portion of land bordered by Moretown Mountain Road, and by the steep eastern bank, is owned by Green Mountain Power Corporation. A small substation presently sits on this property.

A small dug spring is located near the base of the southwestern bank. This spring appears to serve a home located at the bottom of the bank. As indicated by the survey map, this may be the residence of Mr. Frederick Fuller.

The Moretown store and several other buildings are located at the base of the western bank. As there is no municipal water system in Moretown, it is assumed that the store and all of these other buildings are served by individual drilled wells.

Any significant gravel mining operation may have to address adjoining landowner concerns with regard to the protection of their water supplies.

4.0 SOIL CONDITIONS

Soil logs for the 12 borings are located in Appendix 2, pages 1-9. Soil conditions across the site (see Appendix 1, page 3 for schematic cross-section) were the same for the first 4 to 8 feet below ground surface (bgs). In general, this upper layer of soil consisted of a fine sandy gravel. Because the sampling technique consisted of rapidly spinning the augers to recover soil samples, larger cobbles and boulders were not returned to the ground surface. Grinding and screeching of the auger bit indicated cobbles were present in the borehole. Additionally, a hand-dug hole at the location of boring #6 indicated that 20% to 30% of the soil mass may be comprised of cobbles and boulders.

Below the mantle of gravel, soil conditions varied depending on location. In the northern one-third of the field, dry, medium coarse sand and sandy gravel was encountered to depth (30 feet for holes #6 and 9, 45 feet for hole #15). Hole #4 was dry to 30 feet, but consisted of a much finer sandy silt with only a few pebbles scattered throughout.

In the remainder of the field, fine sandy silt was encountered in holes #1, 2, 3, 10, 11, 12, and 8 at the base of the gravel mantle, generally 4 to 8 feet below ground surface, and continued to depth (30 feet for all holes). In all of these borings, the fine sandy silt became saturated between 14 and 19 feet and was saturated to depth. In hole #7, however, the saturated layer was only 3 or 4 feet thick and drier soil conditions were encountered underneath. Sand lenses intermittent with the the fine sandy silt were encountered at various depths in some holes.

It is important to note that in the coarser soils, the samples recovered do not represent 100% of the soil characteristics. Because destructive drilling techniques were used, we were not able to recover the coarser gravel, cobbles, and boulders. As previously stated, the cobbles and boulders may represent upwards of 30% of the soil in the upper layer. In the fine sandy silts, however, the recovered samples give a reasonably accurate picture of the soil conditions at depth.

5.0 SIEVE ANALYSES

Per discussions with the engineer, sieve analyses were conducted on five of the samples collected from the Higgins site. The analysis consisted of an eight tray shaker setup with sieve numbers 5, 10, 18, 35, 40, 60, 120, and 230.

The first sample analyzed (hole #7, depth 0-4') was a sample of the shallow gravel layer present across the site. The second sample analyzed (hole #5, depth 34-39') is representative of the deeper, gravelly sand encountered in the northeastern third of the field. The remaining three samples (hole #6, depth: 19-24'; hole #9, 9-14'; hole #12, 9-14') are representative of the fine sandy silt layer found below the shallow gravel throughout the remainder of the field. The results of each sieve analysis were compared to the sieve specifications for five different materials:

1. mound fill material as specified by the Environmental Protection Rules;
2. mound fill material as specified by the Indirect Discharge Rules;
3. sand borrow and cushion as specified by the Agency of Transportation;
4. granular borrow as specified by the Agency of Transportation; and
5. fine aggregate for concrete as specified by the Agency of Transportation.

The materials listed above have the following specifications (shown in graphical form on pages 4-8 of Appendix 1 and on transparencies in map pocket):

Mound fill material (from EPR):

Sieve (Mesh #)	Size (mm)	Cumulative Percent Passing
10	2.0	85%
40	0.42	30-50%
200	0.075	5-10%

Mound fill material (from IDR):

Sieve (Mesh #)	Size (mm)	Cumulative Percent Passing
10	2.0	85-100%
40	0.42	25-75%
60	0.24	0-30%
100	0.149	0-10%
200	0.075	0- 5%

Sand borrow and cushion (AOT):

Sieve (Mesh #)	Size (mm)	Cumulative Percent Passing
2"	50	100%
1.5"	38	90-100%
.5"	12.75	70-100%
4	4.750	60-100%
100	.150	0-20%
200	0.075	0-8%

Granular Borrow (AOT):

Sieve (Mesh #)	Size (mm)	Cumulative Percent Passing
4	4.76	20-100%
200	0.075	0-12%

Fine Aggregate For Concrete (AOT):

Sieve (Mesh #)	Size (mm)	Cumulative Percent Passing
3/8"	9.5	100%
4	4.76	95-100%
16	1.18	50-80%
30	0.60	25-60%
50	0.30	10-30%
100	0.15	2-10

Listed below is a summary of the results of the sieve analysis for each sample as compared to the sieve specifications for the five materials listed above (see Appendix 1, pages 10-14). A summary table is found on page 9 of Appendix 1.

<u>Hole #7 (depth 0-4')</u>

1. Mound sand (EPR):

   Percent passing sieve #10: 54.46 - out of range.
   Percent passing sieve #40: 39.31% - in range.
   Percent passing sieve #200: 11% - just out of range.

2. Mound fill material (from IDR):

   Percent passing sieve #10: 54.46% - out of range.
   Percent passing sieve #40: 39.31% - in range.
   Percent passing sieve #60: 29.99% - in range.
   Percent passing sieve #100: 20% - out of range.
   Percent passing sieve #200: 11% - out of range.

3. Sand borrow and cushion (AOT):

   Percent passing 2" sieve: unknown.
   Percent passing 1 1/2" sieve: unknown.
   Percent passing 1/2" sieve: unknown.
   Percent passing sieve #4: 66% - in range.
   Percent passing sieve #100: 20% - in range.
   Percent passing sieve #200: 11% - out of range.

4. Granular borrow (AOT):

   Percent passing sieve #4: approximately 66% - in range.
   Percent passing sieve #200: 11% - in range.

5. Fine aggregate for concrete (AOT):

   Percent passing 3/8" sieve: unknown - estimate out of range.
   Percent passing sieve #4: 66% - out of range.
   Percent passing sieve #16: 50% - in range.
   Percent passing sieve #30: 43% - in range.
   Percent passing sieve #50: 33% - out of range.
   Percent passing sieve #100: 20% - out of range.

Hole 5 (depth 34-39')

1. Mound fill material (from EPR):

   Percent passing sieve #10: 61.34% - out of range.
   Percent passing sieve #40: 41.29% - in range.
   Percent passing sieve #200: 9% - in range.

2. Mound fill material (from IDR):

   Percent passing sieve #10: 61.34% - out of range.
   Percent passing sieve #40: 41.29% - in range.
   Percent passing sieve #60: 29.53% - in range.
   Percent passing sieve #100: 16% - out of range.
   Percent passing sieve #200: 9% - out of range.

3. Sand borrow and cushion (AOT)

   Percent passing 2" sieve: unknown.
   Percent passing 1 1/2: sieve: unknown.
   Percent passing 1/2" sieve: unknown.
   Percent passing sieve #4: approximately 78% - in range.
   Percent passing sieve #100: 16% - in range.
   Percent passing sieve #200: 9% - just out of range.

4. Granular borrow (AOT):

   Percent passing sieve #4: 78% - in range.
   Percent passing sieve #200: 9% - in range.

5. Fine aggregate for concrete:

   Percent passing 3/8" sieve: unknown - estimate out of range.
   Percent passing sieve #4: 78% - out of range.
   Percent passing sieve #16: 53% - in range.
   Percent passing sieve #30: 45% - in range.
   Percent passing sieve #50: 33% - out of range.
   Percent passing sieve #100: 16% - out of range.

Hole # 6 (19-24')

1. Mound fill material (from EPR)

   Percent passing sieve #10: 98.54% - out of range.
   Percent passing sieve #40: 92.04% - out of range.
   Percent passing sieve #200: 14% - out of range.

2. Mound fill material (from IDR):

   Percent passing sieve #10: 98.54% - in range.
   Percent passing sieve #40: 92.04% - out of range.
   Percent passing sieve #60: 79.23% - out of range.
   Percent passing sieve #100: 48% - out of range.
   Percent passing sieve #200: 14% - out of range.

3. Sand borrow and cushion (AOT):

   Percent passing 2" sieve: 100% - in range.
   Percent passing 1 1/2" sieve: 100% - in range.
   Percent passing 1/2" sieve: 100% - in range.
   Percent passing sieve #4: 100% - in range.
   Percent passing sieve #100: 48% - out of range.
   Percent passing sieve #200: 14% - out of range.

4. Granular borrow (AOT):

   Percent passing sieve #4: 100% - in range.
   Percent passing sieve #200: 14% - out of range.

5. Fine aggregate for concrete (AOT):

   Percent passing 3/8" sieve: 100% - in range.
   Percent passing sieve #4: 100% - in range.
   Percent passing sieve #16: 97% - out of range.
   Percent passing sieve #30: 95% - out of range.
   Percent passing sieve #50: 83% - out of range.
   Percent passing sieve #100: 48% - out of range.

Hole #9 (9-14')

1. Mound fill material (from EPR):

   Percent passing sieve #10: 95.04% - out of range.
   Percent passing sieve #40: 82.98% - out of range.
   Percent passing sieve #200: 20% - out of range.

2. Mound fill material (from IDR):

   Percent passing sieve #10: 95.04% - in range.
   Percent passing sieve #40: 82.98% - out of range.
   Percent passing sieve #60: 67.51% - out of range.
   Percent passing sieve #100: 46% - out of range.
   Percent passing sieve #200: 20% - out of range.

3. Sand borrow and cushion (AOT)

Percent passing 2" sieve: 100% - in range.
Percent passing 1 1/2" sieve: 100% - in range.
Percent passing 1/2" sieve: 97% - in range.
Percent passing sieve #4: 96% - in range.
Percent passing sieve #100: 46% - out of range.
Percent passing sieve #200: 20% - out of range.

4. Granular borrow (AOT):

Percent passing sieve #4: 96% - in range.
Percent passing sieve #200: 20% - out of range.

5. Fine aggregate for concrete (AOT):

Percent passing 3/8" sieve: 100% - in range.
Percent passing sieve #4: 96% - in range.
Percent passing sieve #16: 93% - out of range.
Percent passing sieve #30: 87% - out of range.
Percent passing sieve #50: 73% - out of range.
Percent passing sieve #100: 46% - out of range.

Hole #12

1. Mound fill material (from EPR):

Percent passing sieve #10: 94.04% - out of range.
Percent passing sieve #40: 82.28% - out of range.
Percent passing sieve #200: 18% - out of range.

2. Mound fill material (from IDR):

Percent passing sieve #10: 94.04% - in range.
Percent passing sieve #40: 82.28% - out of range.
Percent passing sieve #60: 67.56% - out of range.
Percent passing sieve #100: 41% - out of range.
Percent passing sieve #200: 18% - out of range.

3. Sand borrow and cushion (AOT)

Percent passing 2" sieve: 100% - in range.
Percent passing 1 1/2" sieve: 95% - in range.
Percent passing 1/2" sieve: 95% - in range.
Percent passing sieve #4: 95% - in range.
Percent passing sieve #100: 41% - out of range.
Percent passing sieve #200: 18% - out of range.

4. Granular borrow (AOT):

Percent passing sieve #4: 95% - in range.
Percent passing sieve #200: 18% - out of range.

5. Fine aggregate for concrete (AOT):

Percent passing 3/8" sieve: 100% - in range.
Percent passing sieve #4: 96% - in range.
Percent passing sieve #16: 92% - out of range.
Percent passing sieve #30: 86% - out of range.
Percent passing sieve #50: 73% - out of range.
Percent passing sieve #100: 41% - out of range.

The sieve analyses indicate that most of the samples analyzed are unsuitable for any of the five uses we have compared them for, without some type of soil processing. The exceptions are the two gravel samples, which are suitable for granular borrow without any processing.

A. *Mound Fill Material (EPR):*

None of the five samples analyzed meet the specifications for mound fill material as specified by the Environmental Protection Rules. Sample #7, representative of the shallow gravel layer overlying the whole field, contains too high a percentage of coarse material, and also too high a percentage of the very fine material. Only the intermediate material was in the proper range. Sample #5, representing the sandy gravel extracted from the northern portion of the field, is too coarse to meet mound specifications as specified by the EPR. Samples #6, #9, and #12, representing the fine sandy silt, are all too fine to be used for mound fill material. The percent passing for all sieves are out of range.

B. *Mound Fill Material (IDR):*

None of the five samples are suitable for mound fill material as specified by the Indirect Discharge Rules unless a significant amount of processing takes place. The gravel samples (#7 and #5) have both too high a percentage of coarse material and too high a percentage of very fine material. Only the medium textured materials are in the proper range. As with the EPR rules, samples #6, #9, and #12, representing the fine sandy silt, are way of out range with respect to mound specifications. These samples are all too fine to act as mound fill. The amount of material passing sieve #10 for these three samples is in range; however, the amount of material passing all of the other four sieves (40, 60, 100, and 200) are all too high.

C. *Sand, Borrow, and Cushion (AOT):*

We cannot conclude how far out of range the gravel is with respect to meeting the specifications for sand, borrow, and cushion, since the coarser fraction of the soils were not recovered during the drilling process. Therefore, we cannot accurately evaluate the coarse fraction of the sand and gravel samples (#7, #5). With respect to the intermediate and fine fractions of these samples, the intermediate fractions are in range, but there is slightly too much fine material. The fine sandy silts (samples #6, #9, #12) contain too much fine material in order to meet the criteria for sand, borrow, and cushion. The percentage of material passing sieve #100 and #200 is too high for all three of the samples, and this fine fraction would have to be removed in order for the material to meet the specifications.

D. *Granular Borrow (AOT):*

The gravel samples (#7 and #5) meet the criteria for granular borrow. However, it must be kept in mind that our sampling did not recover the coarser cobbles and boulders, and therefore, we cannot truly evaluate whether or not this material would pass the specifications required for granular borrow. The fine sandy silts (samples #6, #9, and #12) are out of range because the percentage of fines passing sieve #200 is too high.

E. *Fine Aggregate For Concrete (AOT):*

For the gravel samples (samples #5 and #7), both the coarse material and the fine material are out of range. Only the intermediate material is in the proper range to meet the specifications for fine aggregate for concrete. For the fine sandy silts (samples #6, #9, and #12), the proper percentage of material passed the coarse sieves (3/8" sieve and sieve #4), but far too much material is passing through the finer sieves (sieve #16, #30, #50, and #100). As with the other four potential uses, this material is too fine.

6.0 ON-SITE PROCESSING

Through on-site processing, the usefulness of the upper gravel mantle and the deeper sandy gravel/gravelly sand may be considerably increased. The fine sandy silt may still be of limited use, even after considerable processing.

If 25% of the fine material were removed from samples #6, #9, and #12, this material would be acceptable for granular borrow but still too fine for mound fill (EPR and IDR), sand borrow and cushion, and fine aggregate for concrete.

If 50% of the fines were removed from samples #6, #9, and #12, it would then be acceptable for granular borrow and sand borrow and cushion, but still too fine for mound fill (EPR and IDR) and fine aggregate for concrete.

At present, the shallow gravel mantle is acceptable for granular borrow. In order to meet the other criteria, the following percentages should be removed:

* Mound fill (EPR): approximately 40% of the coarse material;
* Mound fill (IDR) and fine aggregate for concrete: 40% coarse material and 10% fines;
* Sand borrow and cushion: approximately 30% coarse material and 5%.

At present, the deep sandy gravel/gravelly sand is also acceptable for granular borrow. In order to meet the other criteria, the following percentages should be removed:

* Mound fill (EPR): approximately 20% coarse material;
* Mound fill (IDR): approximately 20% coarse and 10% fines;
* Sand borrow and cushion: approximately 10% coarse material;
* Fine aggregate for concrete: approximately 10% coarse and 10% fines.

Material removed by processing may be used for other purposes. The left over fines may be used for capping landfills, for example, and the left over gravel and cobbles may be used for road fill.

7.0 ESTIMATES OF VOLUME

The following is a rough estimate of the number of cubic yards available for extraction from the Higgins site.

A. *Shallow gravel layer:* The uppermost shallow gravel layer is present across the whole field. Based on the borings, this layer is seen to pinch out anywhere from 4 to 8 feet below ground surface. For the purpose of this estimate, we will assume that this gravel layer ends at 6 feet below ground surface. Using a total usable area of 5.3 acres or 230,868 sq. ft., a total of 51,000 cubic yards may possibly be extracted from the Higgins site.

B. *Deep gravelly sand/sandy gravel layer:* At the northern third of the site (test holes #5, #4, #9, and #6), no perched water table was found. At these test holes, the fine sandy silt layer was also missing (present in #4); with sandy gravel encountered to depth. For this volume estimate, it is assumed that the sandy gravel is present from 6 to 45 feet below ground surface (the total depth of hole #5), and that the total minable area is 66,000 ft^2. Using these parameters, it may be possible to extract as much as 95,000 cubic yards of sandy gravel from the Higgins site.

C. *Fine sandy silt:* For the remaining two-thirds of the field, the overlying shallow gravel layer is underlain by a fine sandy silt layer that is saturated at approximately 16 feet below ground surface. Using a stratigraphic thickness of 10 feet (6 to 16 feet below ground surface for the unsaturated sandy silt) and a total usable area of 164,773 ft^2, it may be possible to mine as much as 61,000 cubic yards of fine sandy silt from the Higgins site.

These estimates do not take into account any setbacks that must be maintained with respect to neighboring landowners and water supplies.

Wagner, Heindel, and Noyes, Inc.
285 North Street, Burlington, Vermont 05401 802-658-0820

APPENDIX 2

HIGGINS GRAVEL PIT INVESTIGATION
MORETOWN, VERMONT
DRILL LOGS

On April 11 and 12, 1990, drilling was conducted at the Higgins site in Moretown, Vermont, in order to evaluate the potential to develop a gravel pit. Over a coarse of a day and a half, twelve holes were drilled across the 5.3-acre site. All holes were drilled to a depth of 30 feet, with the exception of hole #5, which was drilled to a depth of 55 feet below ground surface (bgs). The drilling technique was destructive, and the samples collected represent integrated samples for each 5-foot interval.

Hole #1

0' - 4'	Medium fine silty gravel; dry, larger cobbles at depth, as evidenced by the grinding of the solid stem augers. Gravel recovered consists of .5-inch to 1-inch in diameter pea gravel. The matrix consists mostly of fine silty sands and fine sandy silt.
4' - 9'	Change from the fine silty gravel to a clean, fine, uniform, dry, silty sand at 5'; a little grinding with the solid stem auger between 8' and 9', but no real gravel was recovered.
9' - 14'	Medium brown, clean, dry, fine silty sand/sandy silt. No grinding with the augers, becoming moist between 12' and 13'.
14' - 19'	Same clean, fine, silty, sand, moist and semi-saturated between 17' and 19'; no gravel, no boulders.
19' - 24'	Clean, uniform, saturated, sandy fine silt at 22'; very soupy at 23' to 24'.
24' - 29'	Saturated fine sandy silt, with no boulders or cobbles.

Hole #2

0' - 4'	Pea gravel mixed in fine sandy/silty matrix; cobbles at depth as indicated by grinding on auger.
4' - 9'	Pea gravel mixed with fines until 6.5'; 6.5' to 9' fine silty sand with no cobbles or boulders; smooth drilling and no grinding.
9' - 14'	Medium brown/tan, clean, slightly moist, fine, silty sand.
14' - 19'	Dark brown, fine, sandy silt, clean and uniform, moist/semi-saturated at 18'.
19' - 24'	Medium brown fine sandy silt; coming up in saturated balls at 22.5'.
24' - 29'	Medium to dark brown, fine, sandy silt, moist and semi-saturated, saturated at 25.5' bgs. At 29' bgs, completely saturated with soupy consistency.

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Hole #3

0' - 4'	Medium brown, dry, fine sandy/silty pea gravel, recovered gravel .5" to 1" diameter, grinding and screeching of solid stem auger indicate larger cobbles at depth.
4' - 9'	Sandy, fine gravel until 7'; into fine sand at 7'; back into sandy gravel from 7.5' to 8.5', with sporadic cobbles; silty sand at 9'.
9' - 14'	Silty sand to 11'; coarse to medium, moist sand from 11' to 12'; medium/fine clean, uniform sand with no gravel or cobbles from 12' to 14'.
14' - 19'	Saturated fine silty sand, slightly coarser than what we have seen previously.
19' - 24'	Saturated medium/fine, silty sand.
24' - 29'	Fine, sandy silt, saturated and very soupy.

Hole #4

0' - 4'	Medium brown, sandy gravel/gravelly sand grading into a medium brown/tan, fine sand with lots of silty fines at 3'.
4' - 9'	Medium brown, fine sand with a little gravel present in the upper foot, grading into a medium brown/orange, fine, sandy silt that is dry, uniform, clean, and powdery.
9' - 14'	Moist, clean, uniform, gray/tan silt with fine sand.
14' - 19'	Same fine sandy silt but semi-saturated at 18' bgs.
19' - 24'	Same fine, sandy silt with a little more medium/coarse sand; thin semi-saturated zones alternate with the dry material, but the saturated material as observed in the first three holes has not yet been encountered in this hole.
24' - 29'	Very fine, medium brown, clean, slightly moist, fine sandy silt/silty sand; variations in color observed from medium brown/tan to gray. No saturated zone.

Hole #5

0' - 1'	Black topsoil.
1' - 4'	Fine silty gravel, with gravel sizes ranging from 1/4" to 1-1/2" diameter; lots of auger grinding, suggesting larger cobbles below ground surface.
4' - 9'	Silty gravel grading into silty, fine sand at 6.5'; color change at 7.5' from tan to red-orange.
9' - 14'	Medium coarse, dry, gravelly sand. A little sporadic grinding suggesting a few scattered cobbles at depth.
14' - 19'	Medium coarse sand grading into a gravelly sand at 18', dry and uniform, grinding at 18.5' suggesting cobbles at depth.
19' - 24'	Dry, uniform, coarser sand with little gravel; stones range to 1/4"; grading into a sandy gravel towards 23' to 24'.
24' - 29'	Dry gravelly sand/sandy gravel, color change to dark gray at 28', lots of crunching and grinding suggesting larger cobbles at depth.

Higgins Gravel Pit Investigation
Moretown, Vermont
Drill Logs
Page 3

Hole #5 (cont.)

29' - 34'	Medium brown, dry, uniform, sandy gravel; increasing gravel content with depth.
34' - 39'	Dark gray, moist, sandy gravel, with continued crunching and grinding indicating larger cobbles that are not being recovered.
39' - 45'	Same dark gray sandy gravel grading into a gravelly sand towards 45'.

Hole #6

0' - 4'	Dark gray, fine, sandy/silty gravel; noisy drilling indicating cobbles at depth.
4' - 9'	Alternating fine sandy/silty gravel and medium to coarse gravelly sand, color change at 8.5'.
9' - 14'	Moist, silty fine gravelly sand, 10% to 20% gravel at best in the recovered material; however, grinding and crunching indicates larger cobbles at depth.
14' - 19'	Sandy gravel grading into brown medium fine/fine sand at 15', sand becomes finer and siltier towards 19', color change to medium brown/orange at 18.5'.
19' - 24'	Medium brown, clean, uniform, dry, fine silty sand.
24' - 29'	Fine, silty, sand grading into gravelly fine sand, gravel content increases with depth.

Hole #7

0' - 4'	Medium to dark brown, dry, silty gravel.
4' - 9'	Clean, uniform, medium fine sand; moist but not saturated.
9' - 14'	Medium brown, medium/fine, uniform, dry sand grading into a clean, uniform, dry, fine sandy silt at 12'; color variations between dark gray and medium brown/orange.
14' - 19'	Fine silty sand/sandy silt; saturated from approximately 17' to 19'.
19' - 24'	Gray/brown, fine sandy silt; completely saturated for the first 3' or 4', but grading into a drier material of similar texture.
24' - 30'	Medium brown, fine, silty sand with some small gravel comprising approximately 10%; unsaturated. Appear to have drilled beneath the perched water table.

Hole #8

0' - 5.5'	Medium brown, dry, sandy/silty gravel; crunching and grinding indicating larger cobbles below ground surface that are not being recovered.
5.5' - 9'	Medium brown, dry, fine, sandy silt grading into a moist/saturated fine, sandy silt at 6.5' to 7'; fine, sandy silt grades into a medium/dark brown, medium/coarse sand at 7'.

Hole #8 (cont.)

9' - 14'	Moist, uniform, medium/coarse sand with 10% pebbles grading down into a fine sand towards the bottom of the hole.
14' - 19'	Medium brown, uniform, clean, fine, silty sand that is saturated at approximately 17.5'.
19' - 24'	Clean, uniform, fine, silty sand with no gravel; saturated.
24' - 30'	Same saturated fine, silty sand.

Hole #9

0' - 4'	Medium brown/dark brown, silty, sandy gravel; gravel sizes vary from 1/2" to 1-1/2"; crunching and grinding indicates larger cobbles at depth that do not come up with recovered material.
4' - 9'	Silty/sandy gravel grading into fine, sandy silt with pebbles at approximately 5'; fine, sandy silt with pebbles grading to dark brown, medium fine, pebbly sand towards bottom of the hole.
9' - 14'	Medium brown, fine sand with 5% to 10% silt; several color variations through the 5-foot interval from medium brown/tan to dark gray.
14' - 19'	Medium fine sand with little silt grading into medium brown, fine silty sand/sandy silt at 15.5'.
19' - 24'	Interlayered fine sand and fine silty sand with color changes from black to tan; 5% pebbles towards 23' to 24'.
24' - 30'	Dark gray, coarse, sandy gravel/gravelly sand with 20% to 30% gravel which ranges from 1/4" to 1/2" diameter.

Hole #10

0' - 4'	Medium brown, dry, silty gravel, with crunching and grinding indicating larger cobbles at depth; gravel percentage increases towards 4'.
4' - 9'	Change from gravelly silt to medium brown, clean, fine silty sand at about 7'; semi-saturated at 9'.
9' - 14'	Clean, uniform, medium-fine, moist sand; saturated at about 12' to 14'; does not feel like it has much silt, but it is saturated.
14' - 19'	Clean, medium/coarse sand with some grinding at about 18'; completely saturated at 18.5' to 19'.
19' - 30'	Medium fine, silty sand; completely saturated; crunching and grinding at 29', but no gravel observed in the recovery.

Hole #11

0' - 4'	Medium brown, dry, coarse sandy gravel, with gravel up to 1.5" diameter. Lots of crunching and grinding indicating large cobbles and boulders at depth.
4' - 9'	Coarse, sandy gravel grading into medium brown, fine, silty sand at 6.5'.
9' - 14'	Medium brown, clean, uniform, fine, silty sand; saturated at 13'.

<u>Hole #11</u> (cont.)

14' - 19'	Medium brown, fine, clean, uniform, silty sand; moist to semi-saturated.
19' - 30'	Same fine, silty sand; saturated to bottom of hole.

<u>Hole #12</u>

0' - 4'	Dark brown, moist, loamy gravel; grinding and crunching indicating larger cobbles below ground surface.
4' - 9'	Loamy gravel grading into a gravelly silt at 6.5' to 7'; grading into a fine silty sand at 7.5'; sand is medium to fine.
9' - 14'	Medium brown, dry, pebbly fine, silty sand; pebbles almost all gone by 14'; sand coarsens with depth.
14' - 19'	Medium brown, clean, medium/coarse sand; saturated between 16' and 17'.
19' - 29'	Saturated, clean, uniform, fine sandy silt.

CHARLES GRENIER
CONSULTING ENGINEER PC
BOX 445 244-6413
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FILE

July 9, 1990

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Moretown Elementary School
Jean Eisele, Principal
Moretown, Vermont 05660

Re: Wastewater diposal, Doreen Higgins 5 acre field, Moretown.

Dear Ms. Eisele:

At the request of the Moretown Elementary School Building Committee, our office has prepared this report giving a preliminary opinion as to the wastewater disposal capacity of the Doreen Higgins site. We have reviewed the soils report completed by Wagner, Heindel and Noyes, Inc., Consulting Hydrogeologists. This report was prepared for Doreen Higgins. This preliminary opinion will direct comments toward the following four issues:

1. The type of soil encountered and the wastewater disposal capacity of the site.

2. The impact of wastewater disposal on neighboring wells and springs.

3. The alternatives for delivering wastewater to the site by a new force main and pump station.

4. The State of Vermont "Indirect Discharge Regulations" which are pertinent for flows exceeding 6,500 GPD are proposed.

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Moretown Elementary School
Page 2
July 9, 1990

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ISSUE #1 - SOIL TYPE AND DISPOSAL CAPACITY

1. On June 28, 1990 we dug ten deep test ~~holes with a large~~ back hoe. State Regional Engineer, Eric Blatt was present. These test holes were dug at locations between the 12 deep borings done by Wagner, Heindel, and Noyes, Inc. in April 1990. After analyzing the 22 holes, it is our conclusion that this site is well suited for wastewater disposal from a soil perspective. There is 4 to 8 feet of course sand and gravel over a deep layer of fine to medium sand. The depth to a seasonal groundwater table ranges from 13 to 25 feet from the surface.

2. The applicable State Regulations used in our analysis are for wastewater disposal systems of less than 6,500 GPD. If the building population at the school in ten years is 250 students plus staff and no hot lunches or showers are installed, 15 gallons per person would be used to calculate a total flow of 3,750 GPD. If a new school was constructed and 1,250 GPD was used for the conversion of the existing school to office space, or some other use, 5,000 GPD would be the total design flow. Our site plan shows a layout of twin leachfields with a total capacity of 6,500 GPD. State Regulations require dual alternating leachfields for design flows exceeding 5,000 GPD. When the wastewater design flow reaches 5,000 GPD the second pair of leachfields need to be installed. Given the rate of population increase predicted between 1990 and 1997 it appears prudent to design the leachfields and the pump station system for a flow of at least 6,500 GPD. A 6,500 GPD system gives the school significant expansion capabilities. If the School board chooses not to include the existing building in its' expansion plans, then some surplus capacity would be available to convert the building into offices, a Senior Citizen Center, or some other low flow use.

3. It has come to our attention that the Moretown Store, owned by Robert Dowdell, is experiencing wastewater disposal problems. We have spoken with Robert Dowdell's Engineer, Bernard Chenette, of Montpelier. It is our understanding that approximately 2 years ago Chenette dug testholes on the Doreen Higgins site. The site was suitable for the Store's wastewater disposal needs but Dowdell was unable to purchase the property from Higgins at an acceptable price. We feel that there is enough space in the northwest corner of the field to dispose of wastewater from the Moretown Store. A separate pump station and force main would need to be constructed from the Store to the site. Our site plan shows a likely location for the Store leachfield.

ISSUE #2 - HIGGINS SITE LEACHFIELDS AND THEIR ~~AFFECT UPON~~ NEIGHBORING WATER SUPPLIES

1. Westerly and downhill from the Higgins site are a series of drilled wells owned by Cutler, Moretown Store, Kalantari, Dowdell, and Westerman. These drilled wells average 400' from the proposed leachfield area and probably would not be impacted. Further investigation including a review of the well logs to determine the soil conditions is necessary.

2. Southwesterly of the Higgins site along Route 100B are a series of wells 500' to 1200' away. These wells are owned by Schultz, Booth, Nelson, Dicarlo, Piazza, the Methodist Church parsonage, Tweedie, and Ferris. We expect that it can be proven that these wells would not be impacted by leachfields constructed on the Higgins site.

3. Southwesterly of the site is a shallow spring along Doctor Brook, owned by Robert and Mary Holden. It may be difficult to show that this spring will not be adversely impacted by leachfields 350' away on the Higgins site. State regulations require a two year residence time before wastewater effluent reaches the water supply. Given the 100' elevation difference from the spring to the Higgins site and the sand and gravel soils, it may be difficult to show that the Holden spring will not be impacted. However, if there is a good clay layer protecting this spring, it may be safe. The school district may be required to drill a well for Holden and abandon the spring.

4. Approximately 225' north of the leachfield area is a drilled well owned by Mervin Cutler which serves his mobile home. This well may be adversely impacted by the leachfields. However, it does appear that the flow pattern on the Higgins site is radially in a northerly, westerly, and southerly direction. The leachfields could be constructed on the westerly end of the peninsula shaped site, and it may be possible to prove that the wastewater does not flow toward Cutler's well. It may also be possible to show that the Cutler well is protected by a deep layer of silt or clay. Further information and a review of the well logs is necessary.

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5. In a northeasterly direction a distance of 600'± from the leachfield are springs owned by Eugene Grandfield and Howard Ferris. These springs are along the steep embankment between the Moretown Common Road and Route 100 B. Even though the springs are at an elevation lower than the Higgins field, they may not be down gradient. The flow direction from the Higgins site is likely to be southerly and not directed toward these springs. Further investigation is necessary.

6. In an easterly direction 800'± away at approximately the same elevation as the Higgins site are a group of drilled wells owned by Houghton/Cook, Lamart, formerly Warren White, Elwell, and Eastman. It appears that these wells are not down gradient from the leachfield site and are adequately isolated.

7. In order to receive approval for 6,500 GPD at the Higgins site, a hydrogeologist must be retained to determine the impact on neighboring wells and springs. Calculations are necessary to prove that there is a two year residence time between the leachfields and any down gradient well or spring. Impact on neighboring water supplies is a "significant issue" with the Higgins site. If it cannot be proven that a water supply is adequately protected, the School will be required to replace the water supply of the affected party. It has been our experience that impact on neighboring water supplies is a major stumbling block in receiving State permits.

ISSUE #3 - WASTEWATER FORCE MAIN ROUTES

In order to deliver settled wastewater to the Higgins site from either a new school or an expanded school, new septic tanks and wastewater pumping stations are required. After walking the area and reviewing the tax map, it appears that there are four possible routes for a 3" PVC force main to deliver wastewater to the site. We offer the following comments regarding each route:

1. Route #1 would be the Route 100B/Dowdell route which involves constructing a force main along the driveway between the School and the Methodist Church before proceeding along the easterly edge of Route 100B. The force main would cross Doctor Brook on the up stream side of the bridge before reaching the Moretown Store. At the Store the force main would turn easterly and proceed up the steep bank to the Higgins site. There are many obstacles along this 1800' route, not the least of which are the power poles, the

pavement along Route 100B and the crossing of Doctor Brook. Also, State Regulations require that this force main be 50' from any drilled well and 75' from any spring or point source. A preliminary survey of the wells along this route was completed. The site plan shows many springs and wells along this route. There are also a substantial number of spring lines which cross Route 100B from the steep hillside behind the School. This issue is very similar to the situation which faced the Roxbury School. If wells or springs become obstacles along the route they must be replaced. This route would require an easement from the Moretown Store. It is our understanding that the Store has a failed septic system and we would expect cooperation from Mr. Dowdell regarding this issue.

2. Route #2 would involve the construction of a force main across School property in an easterly direction behind the buildings along Route 100B, then across the Schultz property toward Doctor Brook and the Moretown Store site. This 1700' route would involve significantly less construction along Route 100B in front of all the buildings and would be better isolated from springs and wells. This route would require an easement from both Dowdell and Schultz.

3. It appears possible to construct an 1800' force main in an easterly direction toward the baseball field, before crossing the Calitri property. This Route #3 would involve crossing Doctor Brook and negotiating a steep embankment, but would be in open land with no impact on springs and wells along its' route. The force main would be more cost effective to construct. This route would require an easement from Calitri. It is our understanding that the Calitri parcel is land locked and that an easement from the Town and/or Holden has been pursued.

4. A shorter Route #4 would cross the School property, Doctor Brook, and Holden's field before proceeding up the steep embankment owned by Calitri. This 1450' route involves obtaining an easement from Calitri and Holden in order to save 350' of force main.

5. We prepared a construction cost estimate for new septic tanks, pump station, leachfields, and force mains to deliver the settled wastewater to the Higgins site. We have budgeted for construction of two leachfields with a capacity of 5,000 GPD. We estimate the total cost at $95,000. This estimate does not include the cost of easements and/or replacing water supplies if necessary. The pump station required for this application is more expensive because of the 100' static lift to deliver the wastewater to the Higgins site. We have budgeted two 5 Horsepower grinder pumps which add significant cost to the project.

The Roxbury Elementary School is in the process of constructing a new septic system similar to the Higgins site situation. In Roxbury's case wastewater is pumped 3,000' along a flat gradient to a sandy site. The total cost of this leachfield in Roxbury is near $60,000. In general, the Higgins site application is more difficult, the septic tanks and pump station are more expensive, and the leachfields are larger.

ISSUE #4 - INDIRECT DISCHARGE REGULATIONS

In the event that the School board were to seek approval for more than 6,500 gallons of wastewater disposal on the Higgins site, the new State of Vermont "indirect discharge" rules, adopted on January 15, 1990 would be invoked. In our opinion, these regulations are "extremely conservative" and would have a dramatic effect on leachfield construction and related costs. A brief summary of the impact of the indirect discharge regulations for a septic system of 8,000 GPD follows:

1. The sizing of the leachfields is much more conservative because the wastewater application rate is much lower. Our site plan shows four rectangles which illustrates the space an 8,000 GPD system needs. A dual alternating system must be constructed. We estimate the cost of the four leachfields alone at $50,000.

2. The leachfields must be constructed using pressure distribution. Pressure distribution ensures that the wastewater is spread evenly over the entire system. A pressure system is more difficult to design and results in larger pumps. Given the fact that we have over 100' of static head to overcome, pressure distribution will result in very expensive pumps.

3. These regulations are new and the administration of the regulations is in a state of turmoil. Significantly more hydrogeological studies are required to prove that the wastewater will be adequately treated and not adversely impact ground water and the aquatic biota of the Mad River and Doctor Brook. We spoke with Wagner, Heindel, and Noyes regarding the indirect discharge regulations. They estimate that studies costing from $3,000 to $25,000 are necessary to prove this site adequate for 8,000 GPD without adversely impacting waters of the State and neighboring water supplies. It may be difficult to show that this site can dispose of more than 6,500 gallons of wastewater.

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DIVISION OF PROTECTION

4. It is hoped that these indirect discharge regulations will eventually be relaxed because in their present form they can be easily used to stop development of any site.

FINAL CONCLUSIONS

It is our final conclusion that given the present State of Vermont environmental regulations, the Doreen Higgins site may be the only site near the Moretown Elementary School where 6,500 gallons of wastewater can be disposed. In addition to the cost of the Higgins property, there are considerations as to the cost of easements and the potential of replacing water supplies. We recommend that the School Board proceed with an attempt to purchase the Higgins property contingent upon receipt of all State Permits. Because of the complexity of this project there is a significant amount of engineering and hydrogeological work remaining to obtain the permits. We recommend that the Board allow at least one year for obtaining all required permits and easements.

After you have had a chance to review this preliminary report, please do not hesitate to contact us for further discussion.

Respectfully,

Charles J. Grenier

Charles J. Grenier, P. C.

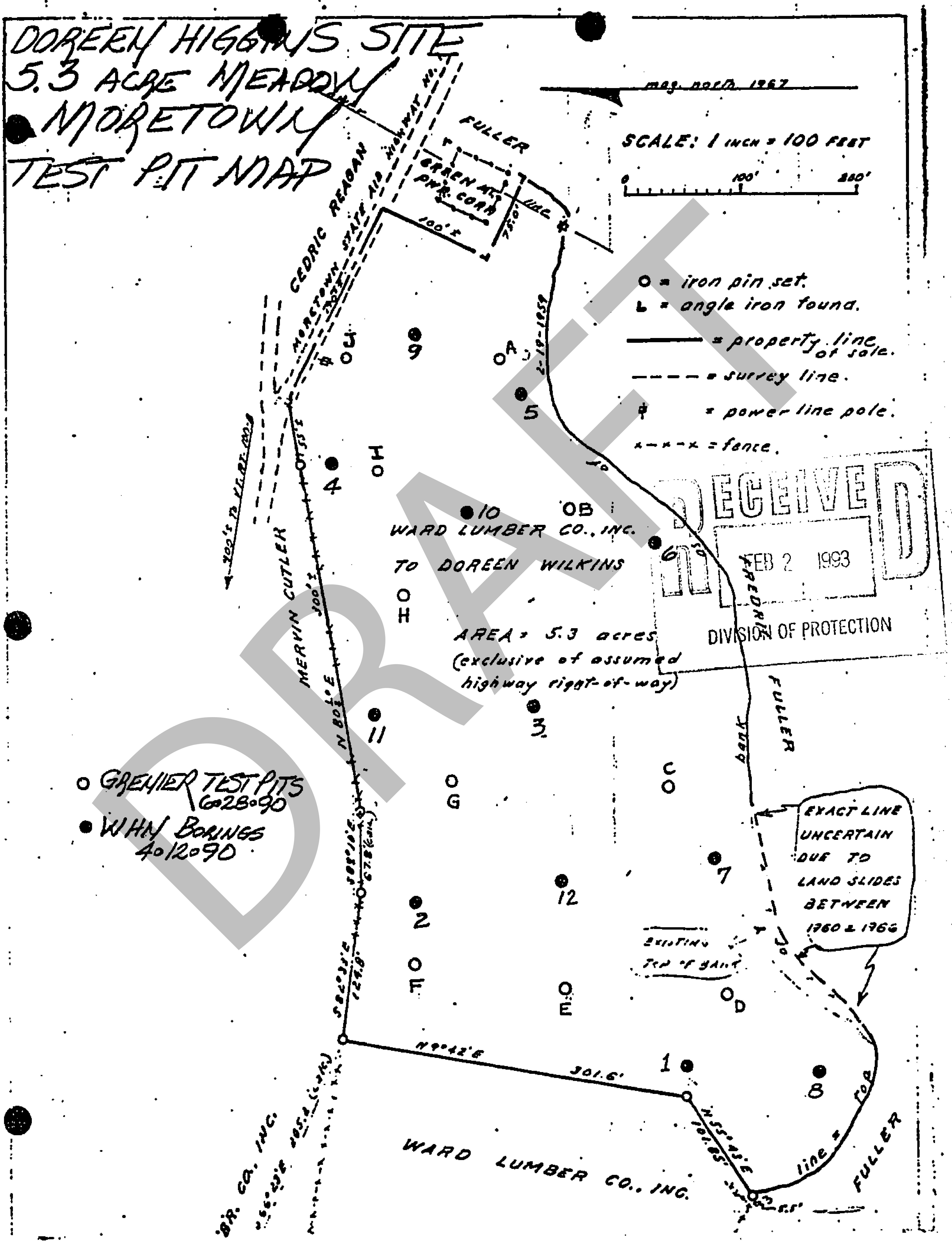
cc: David Clemons
Sam Scofield
Jack Barnes
Superintendent Meaghan
Tom Good

CHARLES GRENIER
CONSULTING ENGINEER PC
BOX 445 244-6413
WATERBURY, VT. 05676

CONSTRUCTION COST ESTIMATE
NEW SEPTIC SYSTEM FOR MORETOWN ELEMENTARY SCHOOL
DOREEN HIGGINS 5 ACRE FIELD SITE
JULY 9, 1990

New Septic Tanks, Pump Station Tanks and Valve Pit.....	$15,000
New Duplex Pump Station: Mechanical Equipment, Control Panel, Piping, Alarm System, Valving and two 5 Horsepower Grinder Pumps..........................	20,000
1800' Route 100B/Dowdell Force Main....................	24,000
*New 5000 GPD Leachfield (2 Trench Systems.............	13,000
SUBTOTAL..........	$72,000
Construction Contingency @ 15% +/-......................	10,000
Engineering, Hydrogeology and Permit Costs.............	13,000
TOTAL COST........	$95,000

*Actual capacity of leachfield is 6500 GPD, but the field will be limited to 5000 GPD to avoid constructing another pair of leachfields.


DOREEN HIGGINS SITE
5.3 ACRE MEADOW
MORETOWN
TEST PIT MAP
mag. north 1967
SCALE: 1 inch = 100 feet
0
100'
200'
FULLER
GREEN MT. PWR. CORP.
100'±
CEDRIC REAGAN
MORETOWN STATE AID HIGHWAY NO. 1
o = iron pin set.
L = angle iron found.
= property line of sale.
= survey line.
= power line pole.
x—x—x = fence.
WARD LUMBER CO., INC.
TO DOREEN WILKINS
AREA = 5.3 acres
(exclusive of assumed highway right-of-way)
MERVIN CUTLER
FREDRIC
FULLER
bank
EXACT LINE UNCERTAIN DUE TO LAND SLIDES BETWEEN 1960 & 1966
Existing Top of Bank
N 9°42' E
301.6'
WARD LUMBER CO., INC.
FULLER
line = Top
o GRENIER TEST PITS 6-28-90
• WHN BORINGS 4-12-90
RECEIVED
FEB 2 1993
DIVISION OF PROTECTION
DRAFT

☐ Districts #1 & #8
RR #2, Box 2161
Pittsford, VT 05763
(802) 483-6022

☐ Districts #2 & #3
RR #1, Box 33
N. Springfield, VT 05150
(802) 886-2215

☐ Districts #4, #6 & #9
111 West Street
Essex Junction, VT 05452
(802) 879-6563

RECEIVED
AUG 17 1990
DIVISION OF PROTECTION

☐ District #5
324 North Main Street
Barre, VT 05641
(802) 479-3621

District #7
180 Portland Street
St. Johnsbury, VT 05819
(802) 748-8787

☐ Environmental Board Office
c/o State Office Building
Montpelier, VT 05602
(802) 828-3309

STATE OF VERMONT
Environmental Board
District Environmental Commission

August 17, 1990

RECEIVED
AUG
DIVISION

Thomas F. Meagher
Superintendent of Schools
Washington West Supervisory Union
RR 1 Box 1065
Moretown, VT 05660

RE: Addition of 64' x 28' Modular Unit at Moretown Elementary School, Town of Moretown

Dear Superintendent Meagher:

I write in response to your letter dated August 13, 1990. Since there is not an existing Act 250 Land Use Permit for the elementary school, no amended permit will be required for the modular unit. Similarly, the facts support a conclusion that the modular unit is not a "substantial change" under Environmental Board Rule 2(G) and, accordingly, a land use permit will not be required for the unit itself as a result of recent legislative changes to Act 250 codified in 10 VSA 6081(c)(3). I am passing your letter on to the Department of Environmental Conservation to have an independent determination made as to whether the Department will require a Wastewater Permit in order to ensure that the school's existing disposal system will be adequate for the anticipated increased flows from the modular unit.

Please call with any questions.

Sincerely,

Ed Stanak

Edward Stanak
District Coordinator

ES:jh
cc: Moretown Planning Commission
Faye Cliche, Permit Specialist
disc 10

REC'D DIST #5 COMM AUG 15 '90

WASHINGTON WEST SUPERVISORY UNION
DUXBURY - FAYSTON - MORETOWN - WAITSFIELD - WARREN
WATERBURY - HARWOOD UNION HIGH SCHOOL

August 13, 1990

RECEIVED
AUG 17 1990
DIVISION OF PROTECTION

Mr. Ed Stanak
Environmental Commission
District #5
324 North Main Street
Barre, Vermont 05641

Dear Ed:

The Moretown School District of Washington West Supervisory Union is interested in moving forward with placing a modular classroom unit adjacent to the Moretown Elementary School. I am interested in obtaining a determination on our need to participate in an Act 250 project review.

The modular unit is 64' x 28' overall with 60' x 28' box for a classroom/library. Water and sewage will not be hooked up in the unit. The project is needed to meet program requirements as opposed to the handling of any significant increase in student enrollment. The unit would be placed on a foundation and be canopied and ramped to the main building.

Foundation and other readiness should begin by mid to late September as the unit will be available early to mid October.

The proposed budget to include all aspects related to the project is $75,000. A special meeting was held in Moretown on July 31, 1990, whereby the residents of Moretown approved the project at the $75,000 level.

Do not hesitate to call us should you require additional information. We look forward to hearing from you regarding our need for review. Thank you.

Sincerely,

Thomas F. Meagher

Thomas F. Meagher
Superintendent of Schools

TFM/lmt
Enclosures (2)

Thomas F. Meagher Superintendent | **Zelda Zeleski** Coordinator of Special Services | **Sandra Gallup** Business Manager

R.R. #1, Box 1065, Moretown, VT 05660 (802) 244-8877 or 496-2272

RECEIVED
AUG 17 1990
DIVISION OF PROTECTION

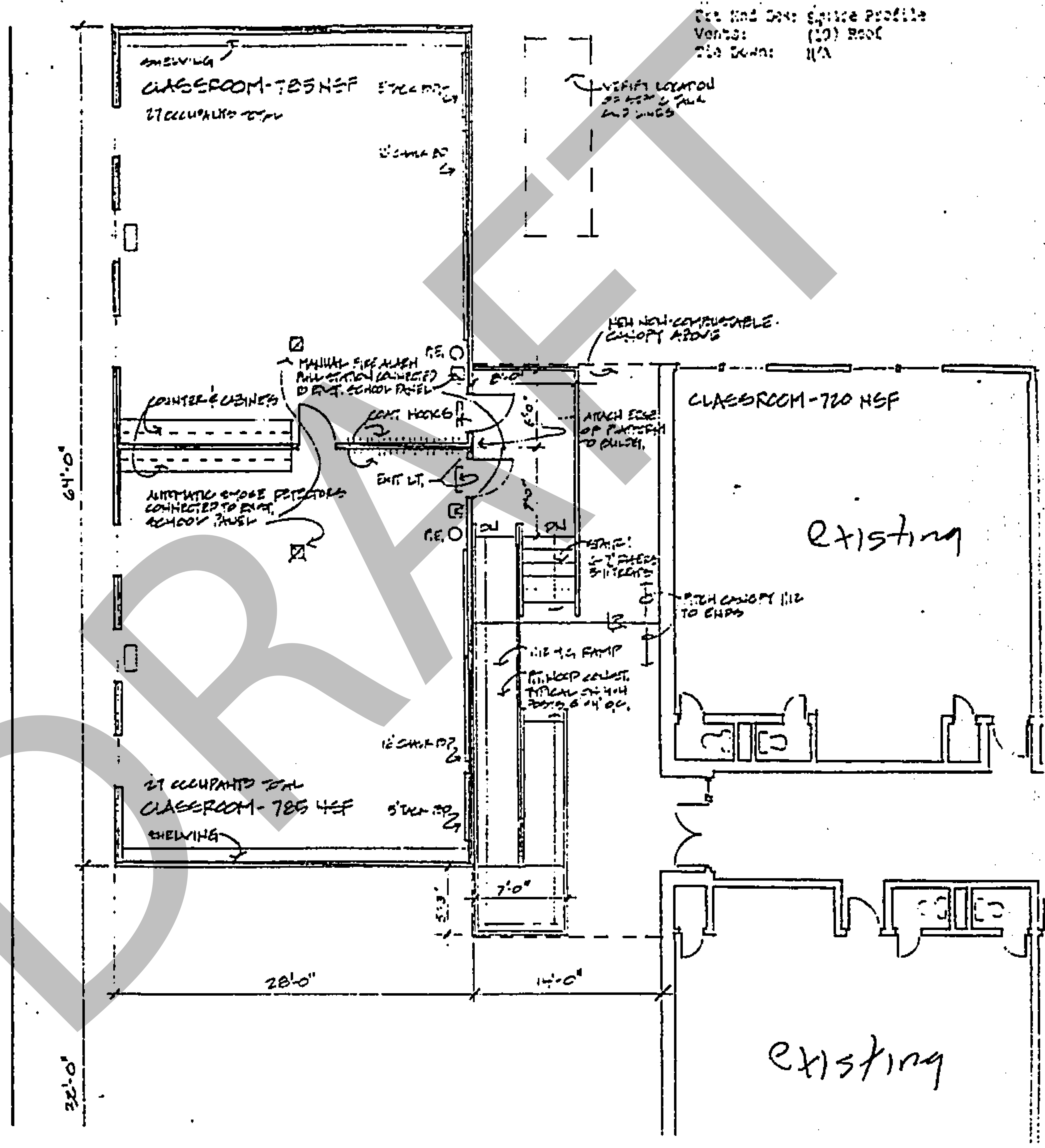
MORETOWN MODULAR UNIT
Time Line

June 19, 1990	Moretown Board of School Directors statement of urgent need.
June 28, 1990	Mailed out invitations to bid for modular unit.
July 11, 1990	Bid opening.
August 14, 1990	Anticipate bid award.
Mid to late September	Site readiness - foundation, etc.
Early to mid October	Placement of modular unit with ramp, etc.

RECEIVED

AUG 17 1990

DIVISION OF [illegible]



WASHINGTON WEST SUPERVISORY UNION
DUXBURY - FAYSTON - MORETOWN - WAITSFIELD - WARREN
WATERBURY - HARWOOD UNION HIGH SCHOOL

August 13, 1990

Mr. Ed Stanak
Environmental Commission
District #5
324 North Main Street
Barre, Vermont 05641

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Sincerely,

Thomas F. Meagher

Thomas F. Meagher
Superintendent of Schools

TFM/lmt
Enclosures (2)

Thomas F. Meagher Superintendent
Zelda Zeleski Coordinator of Special Services
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R.R. #1, Box 1065, Moretown, VT 05660 (802) 244-8877 or 496-2272

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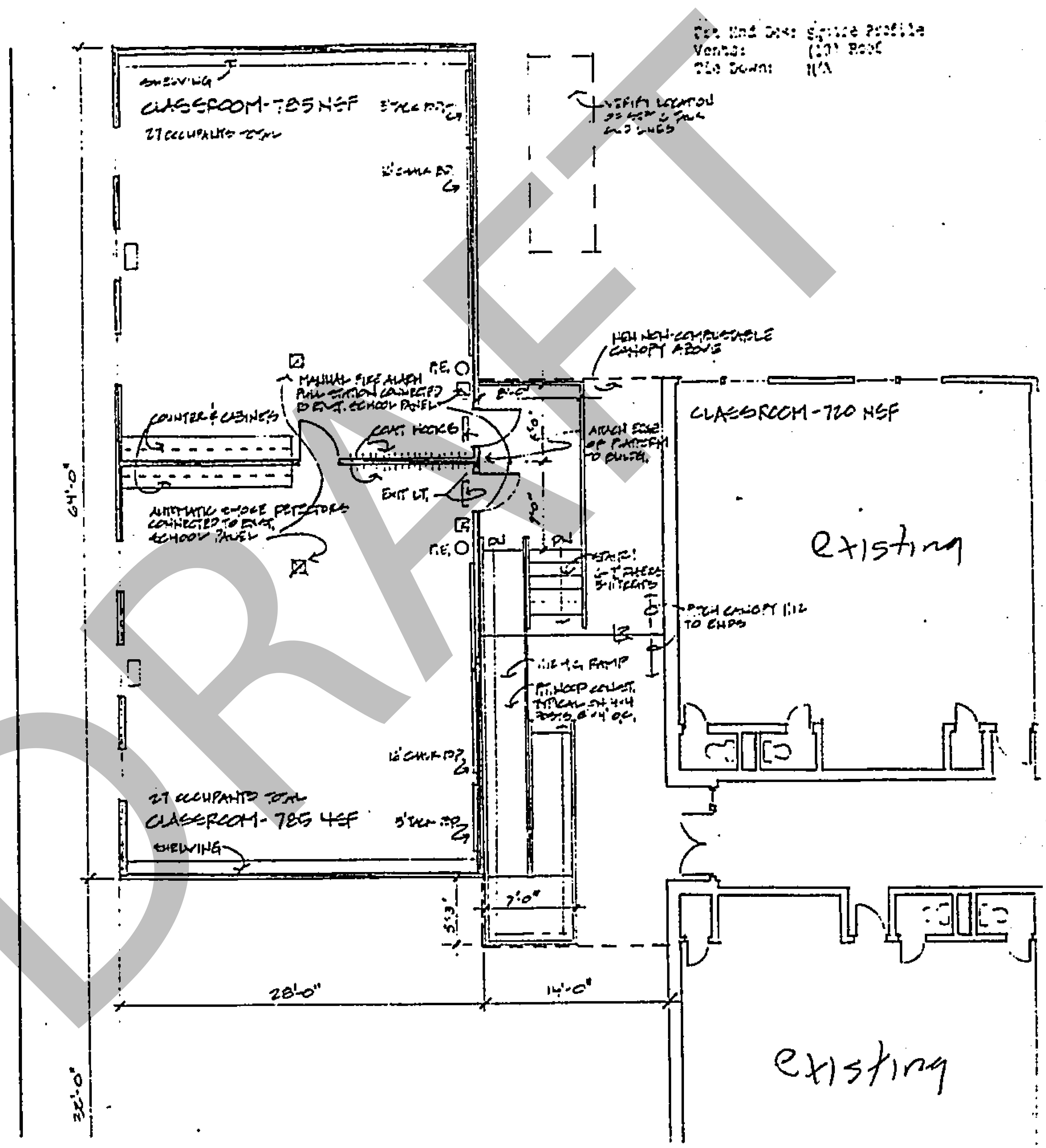


CLASSROOM-785 NSF
27 OCCUPANTS TOTAL
CLASSROOM-785 NSF
SHELVING
COUNTER & CABINETS
COAT HOOKS
EXIT LT.
F.E.
CLASSROOM-720 NSF
existing
existing
28'-0"
14'-0"
64'-0"
32'-0"
7'-0"
DRAFT

AA-PUR 307

STATE OF VERMONT

OFFICE MEMO

Done

TO: Faye

FROM: Eric

DATE: 7/23/90

SUBJECT: Moretown School

- ☐ APPROVAL
- ☐ SIGNATURE
- ☐ COMMENT
- ☐ REVIEW
- ☐ PREPARE REPLY FOR MY SIGNATURE
- ☐ YOUR ACTION REQUESTED BY THIS DATE
- ☐ NOTE AND SEE ME
- ☐ NOTE AND RETURN
- ☐ NOTE AND FILE
- ☐ FOR YOUR INFORMATION
- ☐ PER CONVERSATION
- ☐ AS REQUESTED
- ☐ NECESSARY ACTION
- ☐ GIVE ME THE FACTS
- ☐ SUGGESTIONS REQUESTED

REMARKS:

[Ed Ryan's Replacement]

Please contact Doug Chiapetta @ the Dpt. of Education - Give him a status Report on our preliminary Findings.

- Soil testing on School property has not resulted in any on-site locations
- An off-lot location which has favorable soil conditions may have limitations due to proximity of nearby wells & the land purchase could be "very" expensive.

School board will be meeting w/ consultant & possibly on 7/24/90 Tuesday.

State of Vermont

AGENCY OF NATURAL RESOURCES

WATER SUPPLY AND WASTEWATER DISPOSAL PERMIT

CASE No: WW-5-0227
APPLICANT: Moretown Elementary School
ADDRESS: Moretown, VT 05660

LAWS/REGULATIONS INVOLVED
10 V.S.A. Chapter 61, Water Supply and Wastewater Disposal
Environmental Protection Rules
Chapter 4, Public Buildings

THIS PERMIT DOES NOT CONSTITUTE ACT 250 APPROVAL

This project, consisting of the addition of a relocatable classroom unit to the Moretown Elementary School, located off Route 100B, Moretown, Vermont, is hereby approved under the requirements of the regulations named above, subject to the following conditions:

1. GENERAL CONDITIONS

1.1. The project must be completed as shown on the plans listed as follows:
Site Plan dated 7/11/90, prepared by Black River Design,
and which have been stamped "APPROVED" by the Division of Protection. No alteration of these plans shall be allowed except where written application has been made to the Agency of Environmental Conservation and approval obtained.

1.2. A copy of the approved plans and the Water Supply and Wastewater Disposal Permit shall remain on the project during all phases of construction and, upon request, shall be made available for inspection by State or Local personnel.

1.3. This authorization does not relieve you, as applicant, from obtaining all approvals and permits as may be required from the Act 250 District Environmental Commission, the Department of Labor and Industry (phone 828-2106), the Vermont Department of Education, and local officials PRIOR to construction.

1.4. By acceptance of this permit the permittee agrees to allow representatives of the State of Vermont access to the property covered by the permit, at reasonable times, for the purpose of ascertaining compliance with Vermont environmental and health statutes and regulations and with the permit.

1.5. This permit shall in no way relieve you of the obligations of Title 10, Chapter 48, Subchapter 4, for the protection of groundwater.

1.6. Prior to placement of footings for the relocatable classroom, the location of the existing wastewater disposal field shall be verified by a Vermont registered Professional Engineer. All required isolation distances shall be maintained. The new bus turn-around shall be no closer than 10 feet from the existing wastewater disposal field.

2. WATER CONDITIONS

2.1. This project is approved with an existing on-site water supply system. This water system shall be operated at all times in a manner that keeps the water supply free from contamination. Should the system become contaminated, the permittee must engage a Vermont registered Professional Engineer to evaluate the cause of the contamination and to submit information to this office for repair or replacement of the system.

3. SEWAGE CONDITIONS

3.1. This project is approved with an existing subsurface wastewater disposal system. Should this system ever malfunction, the permittee must engage a Vermont registered Professional Engineer to evaluate the cause of failure and to submit information to this office for repair/replacement of the failing system.

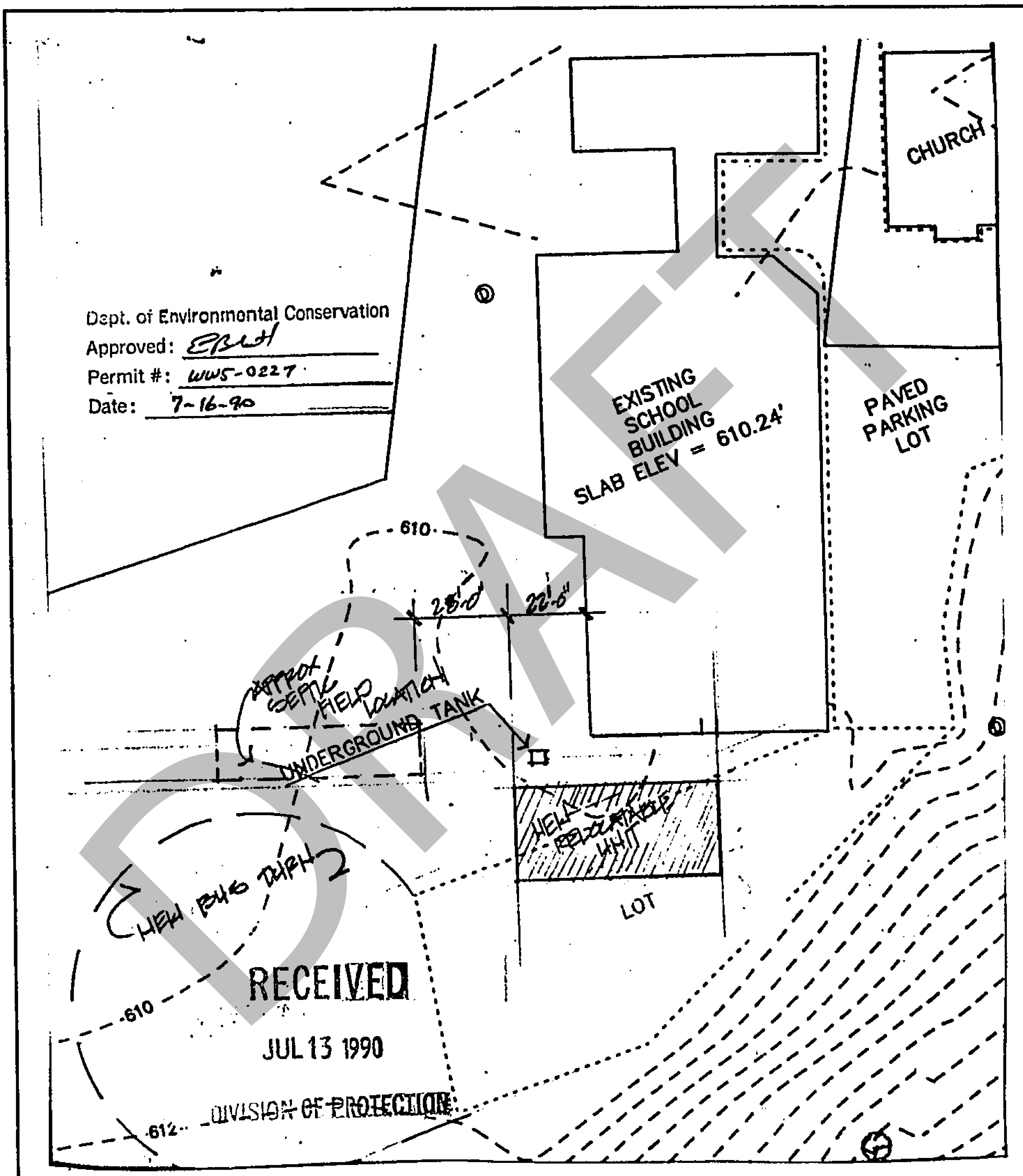
Timothy J. Burke, Commissioner
Department of Environmental Conservation

By EBlatt 7/17/90
Eric Blatt, Regional Engineer

CC Black River Design
VT Dept. of Labor & Industry
VT Dept. of Education
Town Planning Commission
Don Robisky

DRAFT

BLACK RIVER DESIGN 73 MAIN STREET MONTPELIER, VT 05602



MORETOWN SCHOOL	DATE JULY 11, 1990
	SCALE 1"=40'
RELOCATABLE UNIT	REV.

BLACK RIVER DESIGN
ARCHITECTS

RECEIVED
JUL 13 1990
DIVISION OF PROTECTION

DRAFT

July 11, 1990

Eric Blatt, Regional Engineer
District #5 Environmental Office
324 North Main Street
Barre, VT 05641

RE: Moretown School Relocatable Unit

Dear Eric:

On July 10, 1990 Jack Barnes of the School Facilities Committee, Eugene Granfield a town resident, and I meet at the Moretown School to evaluate options for relocating the mobile classroom. Mr. Granfield indicated that the present septic field was not as shown by "approximate area of replacement field constructed in 1977" on our previous site plan of 6/23/81. Mr. Granfield indicated the actual location of the replacement field, which he witnessed being installed. This field is clearly distinguished as a raised up area of earth. I measured the distance from the school building to this field as 50 feet. This location would provide a separation distance to the relocatable unit of at least 28 feet. Please find enclosed an updated partial site plan to reflect this.

Sincerely Yours,

Tom Good

Tom Good

cc:
Moretown School Board
Charles Grenier
Jack Barnes
Eugene Granfield

Enclosure
TEG;teg

HIGGINS SITE INVESTIGATION

MORETOWN, VERMONT

MAY 21, 1990

WAGNER, HEINDEL, AND NOYES, INC.
CONSULTING HYDROGEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

Wagner, Heindel, and Noyes, Inc.
285 North Street, Burlington, Vermont 05401 802-658-0820

HIGGINS SITE INVESTIGATION
MORETOWN, VERMONT

Prepared by:

Samuel R. Haydock
Geologist

Reviewed and Approved by:

Jeffrey E. Noyes
Chief Hydrogeologist

Date: May 21, 1990

HIGGINS SITE INVESTIGATION
MORETOWN, VERMONT

TABLE OF CONTENTS

Wagner, Heindel, and Noyes, Inc.
285 North Street, Burlington, Vermont 05401 802-658-0820

HIGGINS SITE INVESTIGATION
MORETOWN, VERMONT

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

1. A 5.3-acre field located in Moretown, Vermont, belonging to Doreen Higgins, was investigated on April 11 and 12, 1990 to evaluate its potential as a sand and gravel borrow area.

2. The 5.3-acre field is a topographic peninsula, with steep drop-offs on all sides except the northern edge, which is bordered by Moretown Mountain Road. The approximate elevation difference between the field and the toe of slope is approximately 80 to 90 feet. The whole site is open and unwooded. Access to the site is excellent.

3. To establish stratigraphic conditions, a drill rig was used both days of the investigation. A total of 12 holes were drilled, each to a depth of 30 feet, with the exception of hole #5, which was drilled to a depth of 45 feet. Drilling was conducted with solid stem augers. Integrated samples were collected every 5 feet by spinning the augers at high speed and collecting material brought to the surface. Recovery was generally good, with the exception of the larger gravel, cobbles, and boulders.

4. Soil conditions across the site were the same for the first 4 to 8 feet below ground surface, where a sandy gravel was encountered. Below that depth, soil conditions varied depending upon the specific location in the field. In the northern one-third of the field, unsaturated, medium sand and sandy gravel prevailed to depth. In the remainder of the field, a fine sandy silt layer was encountered between 4 to 8 feet below ground surface. This material was encountered to depth, and was usually saturated at approximately 16 to 17 feet below ground surface. Small sand lenses were found at various depths within the sandy silt in some borings.

5. Monitor wells were installed in holes #1, #7, #8, #10, #11 and #12. All wells were installed to a total depth of 15-25 feet bgs, all wells had a 7.0 foot slotted section, and all wells had a 1.0 foot stick-up. Water level measurements recorded at the end of the second day of drilling indicate levels as high as 12.82 feet below top of casing (btc), (hole #10), and as low as 24 feet btc (hole #8). The slope of the water table is to the southeast.

6. Sieve analyses were conducted on five samples recovered from the Higgins site. One sample analyzed represented the shallow gravel layer encountered across the site. The second sample analyzed represented the coarse gravelly sand encountered at depth along the northern third of the site. The remaining three samples analyzed represented the fine sandy silt that was encountered across the remainder of the field.

7. The results of the sieve analysis were compared to the sieve specifications for: mound fill (EPR); mound fill (IDR); granular borrow (AOT); sand, borrow, and cushion (AOT); and fine aggregate for concrete (AOT). The two gravel samples meet the criteria for granular borrow. None of the samples match the criteria for anything else without significant processing.

8. Volumetric estimates have been made for the three soil regimes. We estimate that the shallow gravel layer present across the whole site may yield 51,000 cubic yards. The fine silt layer present below the upper gravel in the southern two-thirds of the field may yield 61,000 cubic yards. The deep gravel and sand present in the northern third of the field may yield 95,000 cubic yards.

HIGGINS SITE INVESTIGATION
MORETOWN, VERMONT

1.0 INTRODUCTION

The purpose of this report is to evaluate the potential of a 5.3-acre field in Moretown to support a gravel mining operation. The site is owned by Doreen Higgins, and is located in the center of Moretown, just east and slightly upgradient from Route 100B (see Appendix 1, page 1). Subsurface conditions were investigated with the use of a drill rig, boring 11 holes to a depth of 30 feet, and one hole to a depth of 45 feet (see Appendix 1, page 2 for approximate locations). In each boring, integrated soil samples were collected every 5 feet. In consultation with the project engineer (Olin Potter, P.E.), a select number of samples were then analyzed to determine if they would meet the requirements for:

1. mound fill as specified by the Environmental Protection Rules;
2. mound fill as specified by the Indirect Discharge Rules;
3. sand borrow and cushion as specified by the Agency of Transportation;
4. granular borrow as specified by the Agency of Transportation; and
5. fine aggregate for concrete as specified by the Agency of Transportation.

2.0 SITE CONDITIONS

The site consists of a 5.3-acre open field (Appendix 1, pages 1 and 2) that represents a topographic peninsula, with steep drop-offs on all sides except the northern edge, which is bordered by Moretown Mountain Road. The elevation difference between the test area and the toe of the bank at the base of the field is approximately 80 to 90 feet. Slopes vary from 45% to 85% along the steep banks, and from 0 to 3% in the field proper.

According to the Surficial Geologic Map of Vermont, the 5.3-acre field is part of a glaciolacustrian deposit consisting mostly of pebbly sand. Prior to drilling, a surficial reconnaissance investigation of the entire deposit revealed exposures of sand and clay in stream cuts on the periphery of the site. A thick blue clay layer is present near stream level at the base of the deposit.

At the southwestern end of the bank, a saturated silt layer is exposed in the bank cut approximately 20 feet from the top of bank. Animal burrows lower down on the slope indicate gravel beneath the silt layer. Just down from the animal burrows, seeps with clay are exposed.

The western bank has recently been logged by Ward Lumber Company. At an elevation of approximately 35 feet up from the toe of the bank, the fresh bank cut reveals saturated silty gravel. At an elevation of 45 feet from the toe of bank, the bank cuts are dry. At approximately 55 feet from the toe of bank, and approximately 20 feet down from the field, a saturated silt layer is exposed in a skidder track.

No obvious bank cuts are exposed along the northwestern edge of the bank. The eastern and southeastern banks are steep and dry, showing no exposed seeps. Standing water occurs in old stream meanders at the toe of the bank.

3.0 NEIGHBORING CONCERNS

Two residences are located along the northwestern extremity of the site. A trailer located just along the margin of the field has a drilled well that is clearly visible. A yellow house located 20 feet downgradient along the northwestern bank has no well visible, but must have a well or spring somewhere on the property.

At the northeastern edge of the field, a small portion of land bordered by Moretown Mountain Road, and by the steep eastern bank, is owned by Green Mountain Power Corporation. A small substation presently sits on this property.

A small dug spring is located near the base of the southwestern bank. This spring appears to serve a home located at the bottom of the bank. As indicated by the survey map, this may be the residence of Mr. Frederick Fuller.

The Moretown store and several other buildings are located at the base of the western bank. As there is no municipal water system in Moretown, it is assumed that the store and all of these other buildings are served by individual drilled wells.

Any significant gravel mining operation may have to address adjoining landowner concerns with regard to the protection of their water supplies.

4.0 SOIL CONDITIONS

Soil logs for the 12 borings are located in Appendix 2, pages 1-9. Soil conditions across the site (see Appendix 1, page 3 for schematic cross-section) were the same for the first 4 to 8 feet below ground surface (bgs). In general, this upper layer of soil consisted of a fine sandy gravel. Because the sampling technique consisted of rapidly spinning the augers to recover soil samples, larger cobbles and boulders were not returned to the ground surface. Grinding and screeching of the auger bit indicated cobbles were present in the borehole. Additionally, a hand-dug hole at the location of boring #6 indicated that 20% to 30% of the soil mass may be comprised of cobbles and boulders.

Below the mantle of gravel, soil conditions varied depending on location. In the northern one-third of the field, dry, medium coarse sand and sandy gravel was encountered to depth (30 feet for holes #6 and 9, 45 feet for hole #15). Hole #4 was dry to 30 feet, but consisted of a much finer sandy silt with only a few pebbles scattered throughout.

In the remainder of the field, fine sandy silt was encountered in holes #1, 2, 3, 10, 11, 12, and 8 at the base of the gravel mantle, generally 4 to 8 feet below ground surface, and continued to depth (30 feet for all holes). In all of these borings, the fine sandy silt became saturated between 14 and 19 feet and was saturated to depth. In hole #7, however, the saturated layer was only 3 or 4 feet thick and drier soil conditions were encountered underneath. Sand lenses intermittent with the the fine sandy silt were encountered at various depths in some holes.

It is important to note that in the coarser soils, the samples recovered do not represent 100% of the soil characteristics. Because destructive drilling techniques were used, we were not able to recover the coarser gravel, cobbles, and boulders. As previously stated, the cobbles and boulders may represent upwards of 30% of the soil in the upper layer. In the fine sandy silts, however, the recovered samples give a reasonably accurate picture of the soil conditions at depth.

5.0 SIEVE ANALYSES

Per discussions with the engineer, sieve analyses were conducted on five of the samples collected from the Higgins site. The analysis consisted of an eight tray shaker setup with sieve numbers 5, 10, 18, 35, 40, 60, 120, and 230.

The first sample analyzed (hole #7, depth 0-4') was a sample of the shallow gravel layer present across the site. The second sample analyzed (hole #5, depth 34-39') is representative of the deeper, gravelly sand encountered in the northeastern third of the field. The remaining three samples (hole #6, depth: 19-24'; hole #9, 9-14'; hole #12, 9-14') are representative of the fine sandy silt layer found below the shallow gravel throughout the remainder of the field. The results of each sieve analysis were compared to the sieve specifications for five different materials:

1. mound fill material as specified by the Environmental Protection Rules;
2. mound fill material as specified by the Indirect Discharge Rules;
3. sand borrow and cushion as specified by the Agency of Transportation;
4. granular borrow as specified by the Agency of Transportation; and
5. fine aggregate for concrete as specified by the Agency of Transportation.

The materials listed above have the following specifications (shown in graphical form on pages 4-8 of Appendix 1 and on transparencies in map pocket):

Mound fill material (from EPR):

Sieve (Mesh #)	Size (mm)	Cumulative Percent Passing
10	2.0	85%
40	0.42	30-50%
200	0.075	5-10%

Mound fill material (from IDR):

Sieve (Mesh #)	Size (mm)	Cumulative Percent Passing
10	2.0	85-100%
40	0.42	25-75%
60	0.24	0-30%
100	0.149	0-10%
200	0.075	0- 5%

Sand borrow and cushion (AOT):

Sieve (Mesh #)	Size (mm)	Cumulative Percent Passing
2"	50	100%
1.5"	38	90-100%
.5"	12.75	70-100%
4	4.750	60-100%
100	.150	0-20%
200	0.075	0-8%

Granular Borrow (AOT):

Sieve (Mesh #)	Size (mm)	Cumulative Percent Passing
4	4.76	20-100%
200	0.075	0-12%

Fine Aggregate For Concrete (AOT):

Sieve (Mesh #)	Size (mm)	Cumulative Percent Passing
3/8"	9.5	100%
4	4.76	95-100%
16	1.18	50-80%
30	0.60	25-60%
50	0.30	10-30%
100	0.15	2-10

Listed below is a summary of the results of the sieve analysis for each sample as compared to the sieve specifications for the five materials listed above (see Appendix 1, pages 10-14). A summary table is found on page 9 of Appendix 1.

<u>Hole #7 (depth 0-4')</u>

1. Mound sand (EPR):

   Percent passing sieve #10: 54.46 - out of range.
   Percent passing sieve #40: 39.31% - in range.
   Percent passing sieve #200: 11% - just out of range.

2. Mound fill material (from IDR):

   Percent passing sieve #10: 54.46% - out of range.
   Percent passing sieve #40: 39.31% - in range.
   Percent passing sieve #60: 29.99% - in range.
   Percent passing sieve #100: 20% - out of range.
   Percent passing sieve #200: 11% - out of range.

3. Sand borrow and cushion (AOT):

   Percent passing 2" sieve: unknown.
   Percent passing 1 1/2" sieve: unknown.
   Percent passing 1/2" sieve: unknown.
   Percent passing sieve #4: 66% - in range.
   Percent passing sieve #100: 20% - in range.
   Percent passing sieve #200: 11% - out of range.

4. Granular borrow (AOT):

   Percent passing sieve #4: approximately 66% - in range.
   Percent passing sieve #200: 11% - in range.

5. Fine aggregate for concrete (AOT):

   Percent passing 3/8" sieve: unknown - estimate out of range.
   Percent passing sieve #4: 66% - out of range.
   Percent passing sieve #16: 50% - in range.
   Percent passing sieve #30: 43% - in range.
   Percent passing sieve #50: 33% - out of range.
   Percent passing sieve #100: 20% - out of range.

Hole 5 (depth 34-39')

1. Mound fill material (from EPR):

   Percent passing sieve #10: 61.34% - out of range.
   Percent passing sieve #40: 41.29% - in range.
   Percent passing sieve #200: 9% - in range.

2. Mound fill material (from IDR):

   Percent passing sieve #10: 61.34% - out of range.
   Percent passing sieve #40: 41.29% - in range.
   Percent passing sieve #60: 29.53% - in range.
   Percent passing sieve #100: 16% - out of range.
   Percent passing sieve #200: 9% - out of range.

3. Sand borrow and cushion (AOT)

   Percent passing 2" sieve: unknown.
   Percent passing 1 1/2: sieve: unknown.
   Percent passing 1/2" sieve: unknown.
   Percent passing sieve #4: approximately 78% - in range.
   Percent passing sieve #100: 16% - in range.
   Percent passing sieve #200: 9% - just out of range.

4. Granular borrow (AOT):

   Percent passing sieve #4: 78% - in range.
   Percent passing sieve #200: 9% - in range.

5. Fine aggregate for concrete:

   Percent passing 3/8" sieve: unknown - estimate out of range.
   Percent passing sieve #4: 78% - out of range.
   Percent passing sieve #16: 53% - in range.
   Percent passing sieve #30: 45% - in range.
   Percent passing sieve #50: 33% - out of range.
   Percent passing sieve #100: 16% - out of range.

<u>Hole # 6 (19-24')</u>

1. Mound fill material (from EPR)

   Percent passing sieve #10: 98.54% - out of range.
   Percent passing sieve #40: 92.04% - out of range.
   Percent passing sieve #200: 14% - out of range.

2. Mound fill material (from IDR):

   Percent passing sieve #10: 98.54% - in range.
   Percent passing sieve #40: 92.04% - out of range.
   Percent passing sieve #60: 79.23% - out of range.
   Percent passing sieve #100: 48% - out of range.
   Percent passing sieve #200: 14% - out of range.

3. Sand borrow and cushion (AOT):

   Percent passing 2" sieve: 100% - in range.
   Percent passing 1 1/2" sieve: 100% - in range.
   Percent passing 1/2" sieve: 100% - in range.
   Percent passing sieve #4: 100% - in range.
   Percent passing sieve #100: 48% - out of range.
   Percent passing sieve #200: 14% - out of range.

4. Granular borrow (AOT):

   Percent passing sieve #4: 100% - in range.
   Percent passing sieve #200: 14% - out of range.

5. Fine aggregate for concrete (AOT):

   Percent passing 3/8" sieve: 100% - in range.
   Percent passing sieve #4: 100% - in range.
   Percent passing sieve #16: 97% - out of range.
   Percent passing sieve #30: 95% - out of range.
   Percent passing sieve #50: 83% - out of range.
   Percent passing sieve #100: 48% - out of range.

<u>Hole #9 (9-14')</u>

1. Mound fill material (from EPR):

   Percent passing sieve #10: 95.04% - out of range.
   Percent passing sieve #40: 82.98% - out of range.
   Percent passing sieve #200: 20% - out of range.

2. Mound fill material (from IDR):

   Percent passing sieve #10: 95.04% - in range.
   Percent passing sieve #40: 82.98% - out of range.
   Percent passing sieve #60: 67.51% - out of range.
   Percent passing sieve #100: 46% - out of range.
   Percent passing sieve #200: 20% - out of range.

3. Sand borrow and cushion (AOT)

Percent passing 2" sieve: 100% - in range.
Percent passing 1 1/2" sieve: 100% - in range.
Percent passing 1/2" sieve: 97% - in range.
Percent passing sieve #4: 96% - in range.
Percent passing sieve #100: 46% - out of range.
Percent passing sieve #200: 20% - out of range.

4. Granular borrow (AOT):

Percent passing sieve #4: 96% - in range.
Percent passing sieve #200: 20% - out of range.

5. Fine aggregate for concrete (AOT):

Percent passing 3/8" sieve: 100% - in range.
Percent passing sieve #4: 96% - in range.
Percent passing sieve #16: 93% - out of range.
Percent passing sieve #30: 87% - out of range.
Percent passing sieve #50: 73% - out of range.
Percent passing sieve #100: 46% - out of range.

<u>Hole #12</u>

1. Mound fill material (from EPR):

Percent passing sieve #10: 94.04% - out of range.
Percent passing sieve #40: 82.28% - out of range.
Percent passing sieve #200: 18% - out of range.

2. Mound fill material (from IDR):

Percent passing sieve #10: 94.04% - in range.
Percent passing sieve #40: 82.28% - out of range.
Percent passing sieve #60: 67.56% - out of range.
Percent passing sieve #100: 41% - out of range.
Percent passing sieve #200: 18% - out of range.

3. Sand borrow and cushion (AOT)

Percent passing 2" sieve: 100% - in range.
Percent passing 1 1/2" sieve: 95% - in range.
Percent passing 1/2" sieve: 95% - in range.
Percent passing sieve #4: 95% - in range.
Percent passing sieve #100: 41% - out of range.
Percent passing sieve #200: 18% - out of range.

4. Granular borrow (AOT):

Percent passing sieve #4: 95% - in range.
Percent passing sieve #200: 18% - out of range.

5. Fine aggregate for concrete (AOT):

Percent passing 3/8" sieve: 100% - in range.
Percent passing sieve #4: 96% - in range.
Percent passing sieve #16: 92% - out of range.
Percent passing sieve #30: 86% - out of range.
Percent passing sieve #50: 73% - out of range.
Percent passing sieve #100: 41% - out of range.

The sieve analyses indicate that most of the samples analyzed are unsuitable for any of the five uses we have compared them for, without some type of soil processing. The exceptions are the two gravel samples, which are suitable for granular borrow without any processing.

A. *Mound Fill Material (EPR):*

None of the five samples analyzed meet the specifications for mound fill material as specified by the Environmental Protection Rules. Sample #7, representative of the shallow gravel layer overlying the whole field, contains too high a percentage of coarse material, and also too high a percentage of the very fine material. Only the intermediate material was in the proper range. Sample #5, representing the sandy gravel extracted from the northern portion of the field, is too coarse to meet mound specifications as specified by the EPR. Samples #6, #9, and #12, representing the fine sandy silt, are all too fine to be used for mound fill material. The percent passing for all sieves are out of range.

B. *Mound Fill Material (IDR):*

None of the five samples are suitable for mound fill material as specified by the Indirect Discharge Rules unless a significant amount of processing takes place. The gravel samples (#7 and #5) have both too high a percentage of coarse material and too high a percentage of very fine material. Only the medium textured materials are in the proper range. As with the EPR rules, samples #6, #9, and #12, representing the fine sandy silt, are way of out range with respect to mound specifications. These samples are all too fine to act as mound fill. The amount of material passing sieve #10 for these three samples is in range; however, the amount of material passing all of the other four sieves (40, 60, 100, and 200) are all too high.

C. Sand, Borrow, and Cushion (AOT):

We cannot conclude how far out of range the gravel is with respect to meeting the specifications for sand, borrow, and cushion, since the coarser fraction of the soils were not recovered during the drilling process. Therefore, we cannot accurately evaluate the coarse fraction of the sand and gravel samples (#7, #5). With respect to the intermediate and fine fractions of these samples, the intermediate fractions are in range, but there is slightly too much fine material. The fine sandy silts (samples #6, #9, #12) contain too much fine material in order to meet the criteria for sand, borrow, and cushion. The percentage of material passing sieve #100 and #200 is too high for all three of the samples, and this fine fraction would have to be removed in order for the material to meet the specifications.

D. Granular Borrow (AOT):

The gravel samples (#7 and #5) meet the criteria for granular borrow. However, it must be kept in mind that our sampling did not recover the coarser cobbles and boulders, and therefore, we cannot truly evaluate whether or not this material would pass the specifications required for granular borrow. The fine sandy silts (samples #6, #9, and #12) are out of range because the percentage of fines passing sieve #200 is too high.

E. Fine Aggregate For Concrete (AOT):

For the gravel samples (samples #5 and #7), both the coarse material and the fine material are out of range. Only the intermediate material is in the proper range to meet the specifications for fine aggregate for concrete. For the fine sandy silts (samples #6, #9, and #12), the proper percentage of material passed the coarse sieves (3/8" sieve and sieve #4), but far too much material is passing through the finer sieves (sieve #16, #30, #50, and #100). As with the other four potential uses, this material is too fine.

6.0 ON-SITE PROCESSING

Through on-site processing, the usefulness of the upper gravel mantle and the deeper sandy gravel/gravelly sand may be considerably increased. The fine sandy silt may still be of limited use, even after considerable processing.

If 25% of the fine material were removed from samples #6, #9, and #12, this material would be acceptable for granular borrow but still too fine for mound fill (EPR and IDR), sand borrow and cushion, and fine aggregate for concrete.

If 50% of the fines were removed from samples #6, #9, and #12, it would then be acceptable for granular borrow and sand borrow and cushion, but still too fine for mound fill (EPR and IDR) and fine aggregate for concrete.

At present, the shallow gravel mantle is acceptable for granular borrow. In order to meet the other criteria, the following percentages should be removed:

* Mound fill (EPR): approximately 40% of the coarse material;
* Mound fill (IDR) and fine aggregate for concrete: 40% coarse material and 10% fines;
* Sand borrow and cushion: approximately 30% coarse material and 5%.

At present, the deep sandy gravel/gravelly sand is also acceptable for granular borrow. In order to meet the other criteria, the following percentages should be removed:

* Mound fill (EPR): approximately 20% coarse material;
* Mound fill (IDR): approximately 20% coarse and 10% fines;
* Sand borrow and cushion: approximately 10% coarse material;
* Fine aggregate for concrete: approximately 10% coarse and 10% fines.

Material removed by processing may be used for other purposes. The left over fines may be used for capping landfills, for example, and the left over gravel and cobbles may be used for road fill.

7.0 ESTIMATES OF VOLUME

The following is a rough estimate of the number of cubic yards available for extraction from the Higgins site.

A. *Shallow gravel layer:* The uppermost shallow gravel layer is present across the whole field. Based on the borings, this layer is seen to pinch out anywhere from 4 to 8 feet below ground surface. For the purpose of this estimate, we will assume that this gravel layer ends at 6 feet below ground surface. Using a total usable area of 5.3 acres or 230,868 sq. ft., a total of 51,000 cubic yards may possibly be extracted from the Higgins site.

B. *Deep gravelly sand/sandy gravel layer:* At the northern third of the site (test holes #5, #4, #9, and #6), no perched water table was found. At these test holes, the fine sandy silt layer was also missing (present in #4); with sandy gravel encountered to depth. For this volume estimate, it is assumed that the sandy gravel is present from 6 to 45 feet below ground surface (the total depth of hole #5), and that the total minable area is 66,000 ft^2. Using these parameters, it may be possible to extract as much as 95,000 cubic yards of sandy gravel from the Higgins site.

C. *Fine sandy silt:* For the remaining two-thirds of the field, the overlying shallow gravel layer is underlain by a fine sandy silt layer that is saturated at approximately 16 feet below ground surface. Using a stratigraphic thickness of 10 feet (6 to 16 feet below ground surface for the unsaturated sandy silt) and a total usable area of 164,773 ft^2, it may be possible to mine as much as 61,000 cubic yards of fine sandy silt from the Higgins site.

These estimates do not take into account any setbacks that must be maintained with respect to neighboring landowners and water supplies.

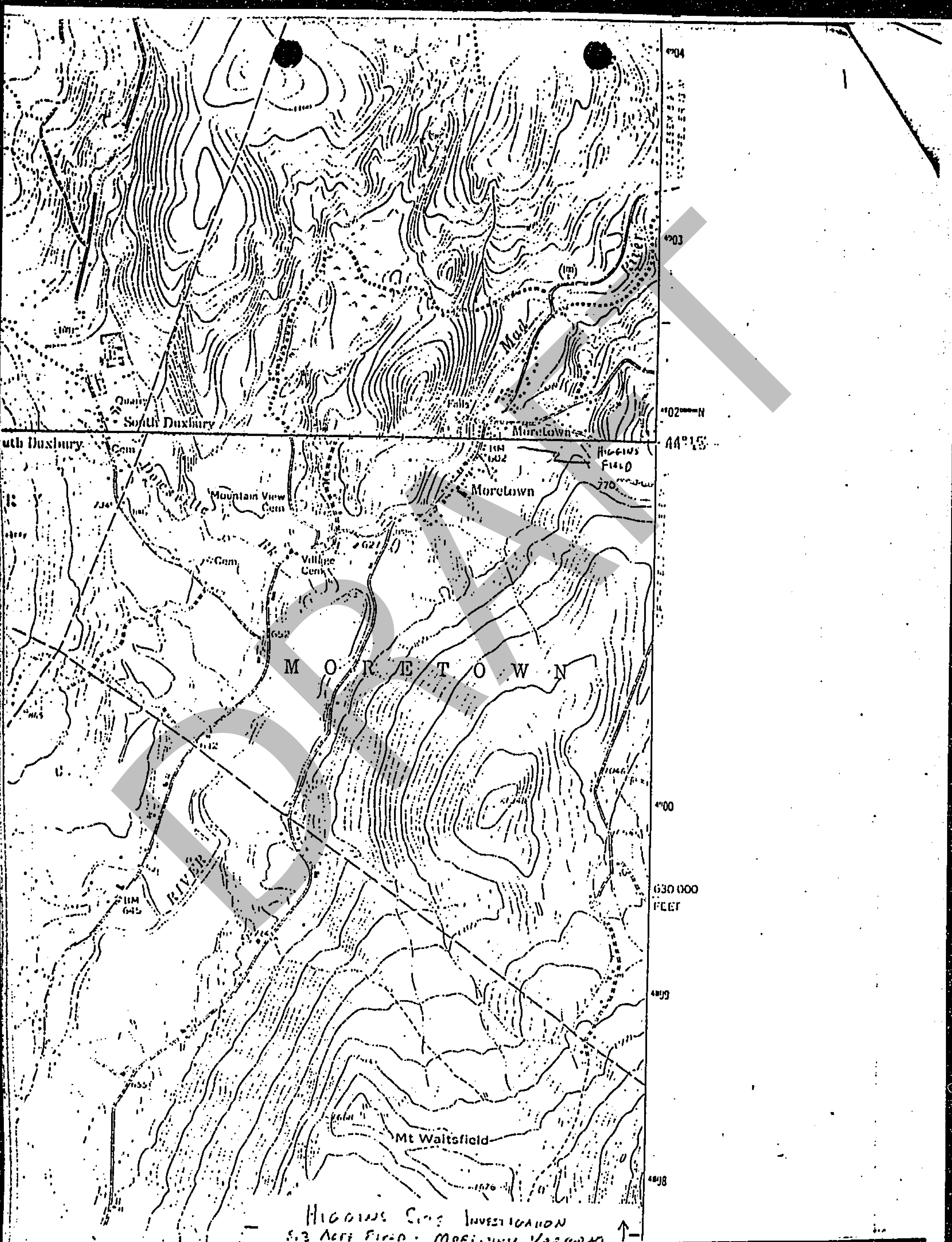
APPENDIX 1

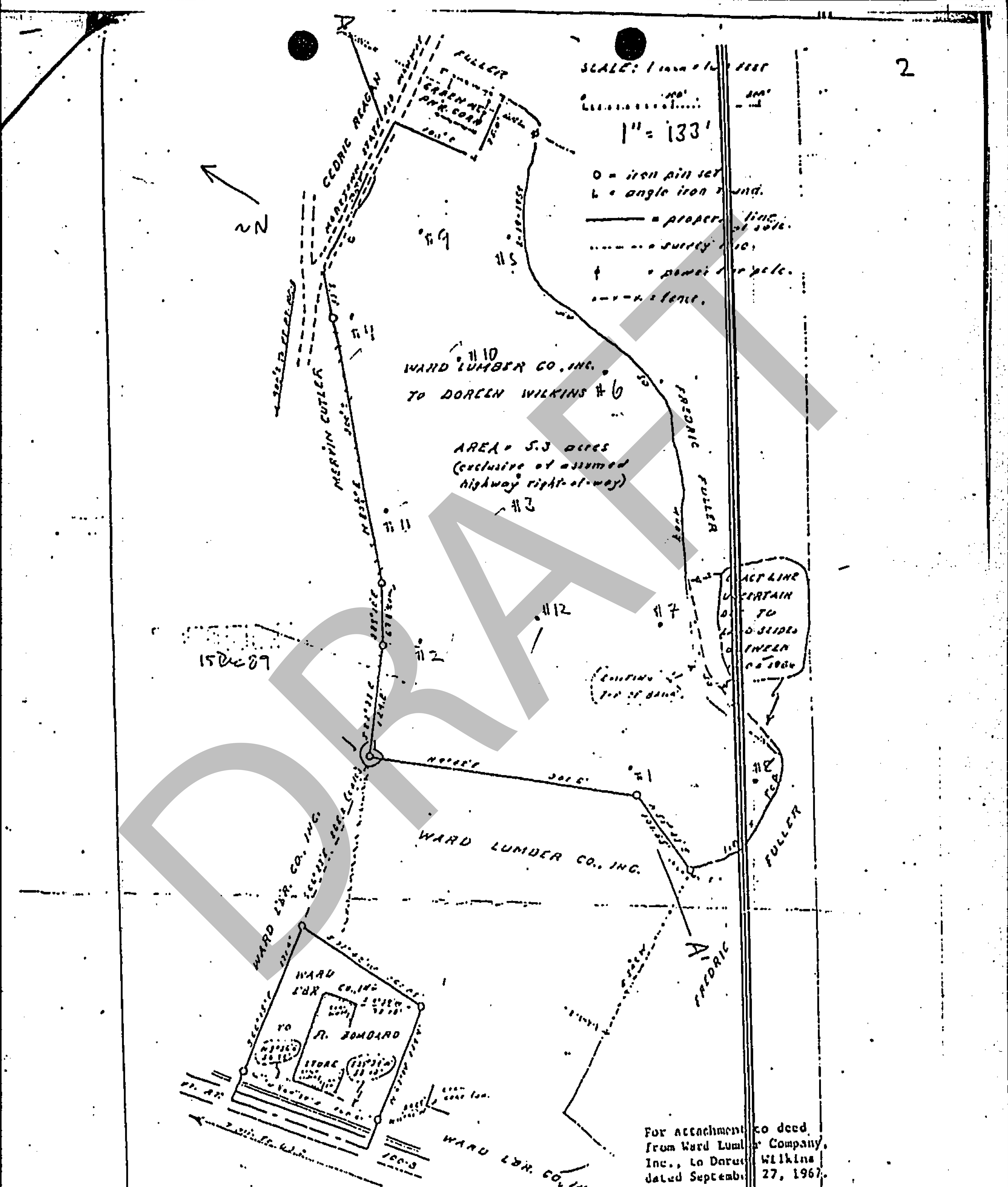
SITE MAPS

SCHEMATIC CROSS SECTION

MATERIALS SPECIFICATION SHEETS

SIEVE ANALYSIS RESULTS


South Duxbury
Quarry
Mountain View Cem
Village Cem
Cem
Falls
Moretown
HIGGINS FIELD
M O R E T O W N
RIVER
Mad
Mt Waitsfield
630 000 FEET
44°15'
HIGGINS SITE INVESTIGATION
5.3 ACRE FIELD - MORETOWN, VERMONT



TO SECURITY TITLE & GUARANTY CO. - I certify that this map is substantially correct and that the sources of title are as shown below. Paul Bigelow, Vt. Reg. Prof. Eng. #139.

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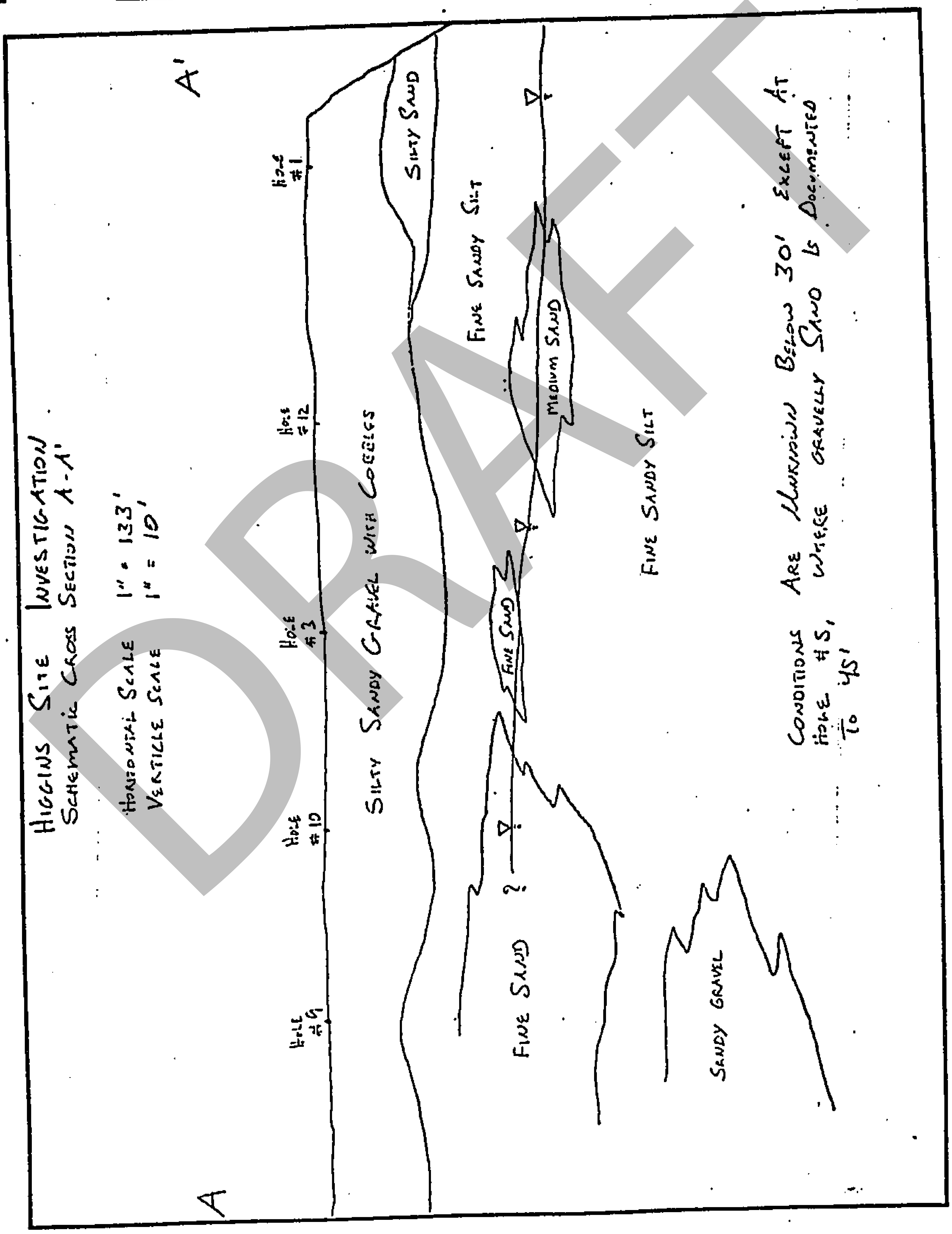
PAGE ____ OF ____

Page No. 3

PROJECT: Higgins Site Investigat

DATE: 5/90



W H N

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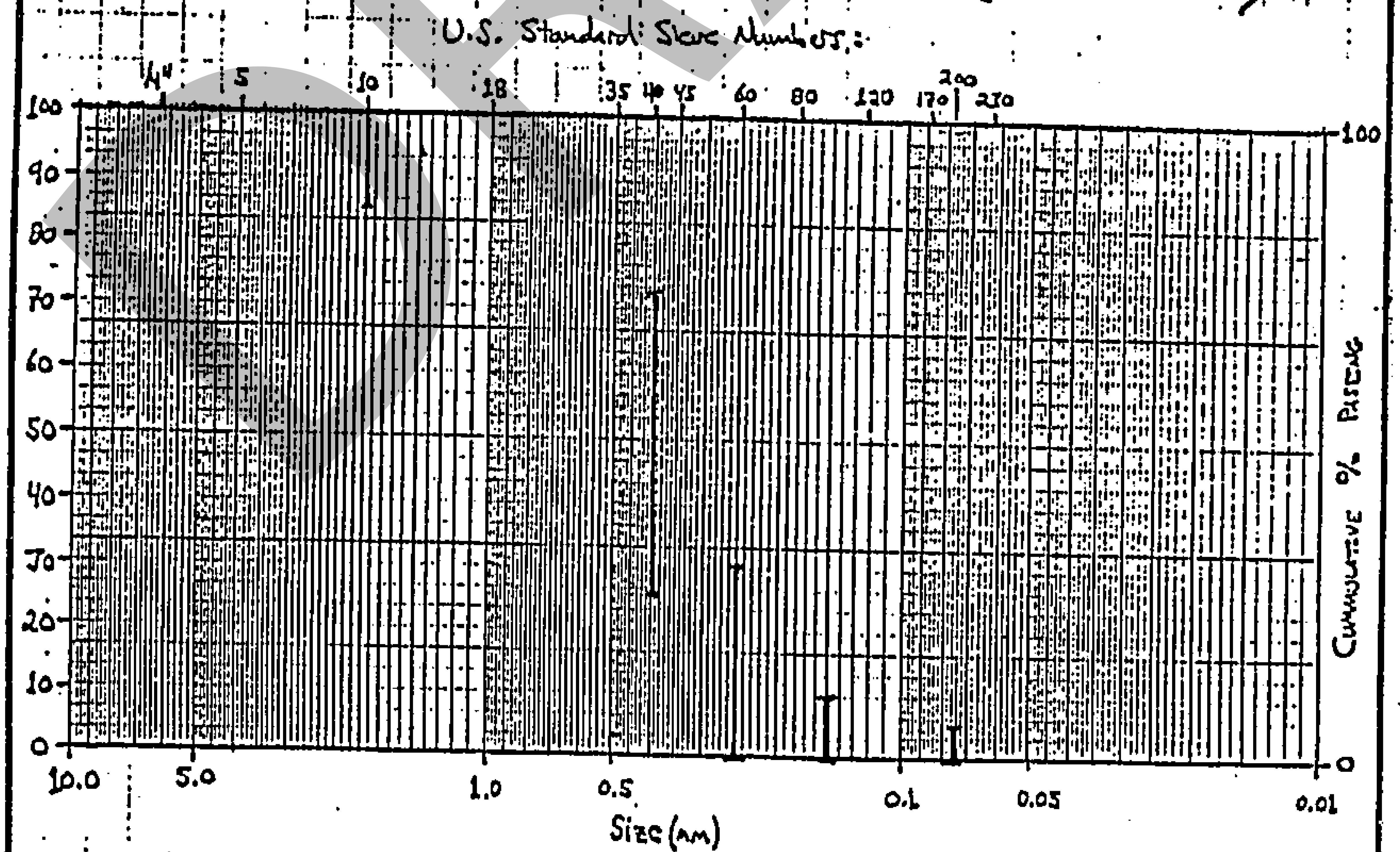
PAGE ____ OF ____ Page No.
PROJECT: ____
DATE: ____

GRAIN SIZE ANALYSIS

SAMPLE ID: ____ SAMPLE WT. = ____

SIEVE (mesh #):	SIZE (mm):	SEDIMENT RETAINED: WT (g):	%:	CUMULATIVE % PASSING:
10	2.0	–	–	85-100
40	0.42	–	–	25-75
60	0.24	–	–	0-30
100	0.149	–	–	0-10
200	0.075	–	–	0-5

LIMITS OF MOUND FILL MATERIAL (FROM IOR)



MEAN SIZE = ____ EFFECTIVE SIZE = — UNIFORMITY COEFF. = —

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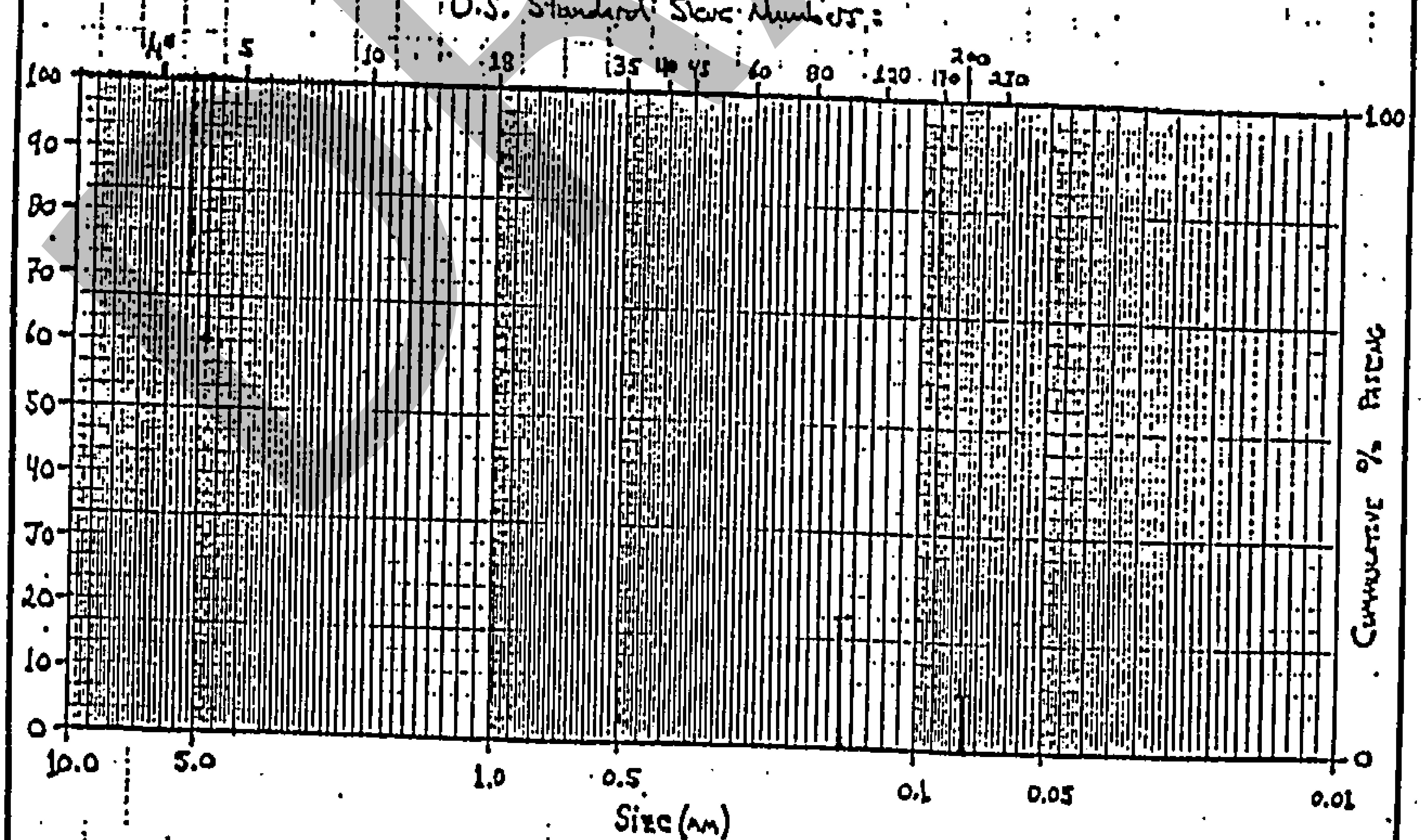
PAGE ____ OF ____ Page No.
PROJECT: ____
DATE: ____

Grain Size Analysis

Sample ID: ________ Sample Wt. = ________

Sieve (mesh #):	Size (mm):	Sediment Retained: Wt (g):	%:	Cumulative % Passing:
2"	150	–	–	100
1½"	38.1	–	–	90-100
¼"	6.3	–	–	70-100
4	4.750	–	–	60-100
100	.150	–	–	0-20
200	.075	–	–	0-8

SAND BORROW AND CUSHION - AOT



Mean Size = ________ Effective Size = — Uniformity Coeff. = —

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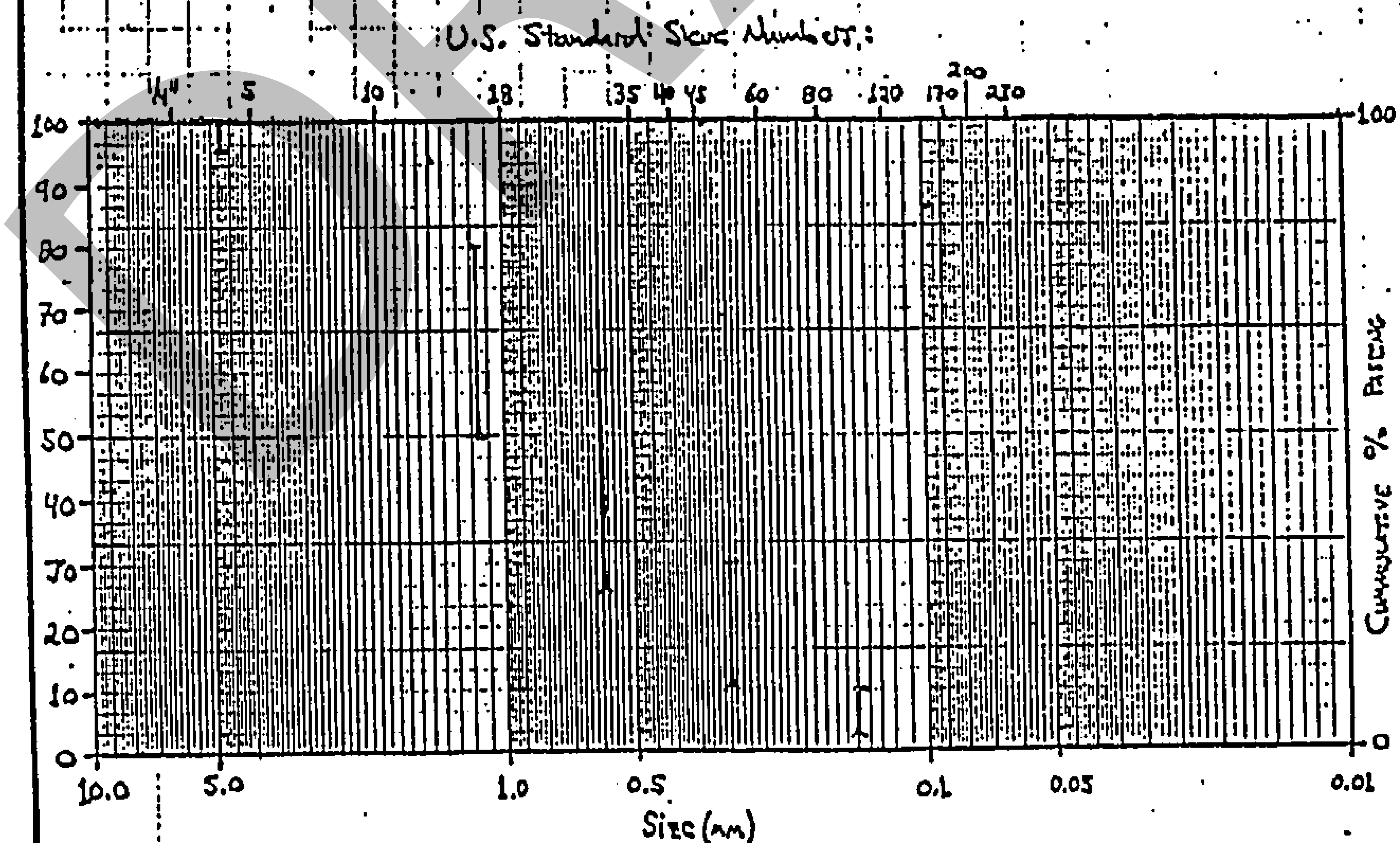
PAGE ___ OF ___
PROJECT: Webb Estates
DATE: June 1987

Grain Size Analysis

Sample ID: ______ Sample Wt. = ______

Sieve (mesh #):	Size (mm):	Sediment Retained: Wt (g):	Sediment Retained: %:	Cummulative % Passing:
3/8 Inch	9.5	-	-	100
4	4.76	-	-	95-100
16	1.18	-	-	50-80
30	.60	-	-	25-60
50	.30	-	-	10-30
100	.15	-	-	2-10

Fine Aggregate for Concrete - AOT



Mean Size = ______ Effective Size = — Uniformity Coeff. = —

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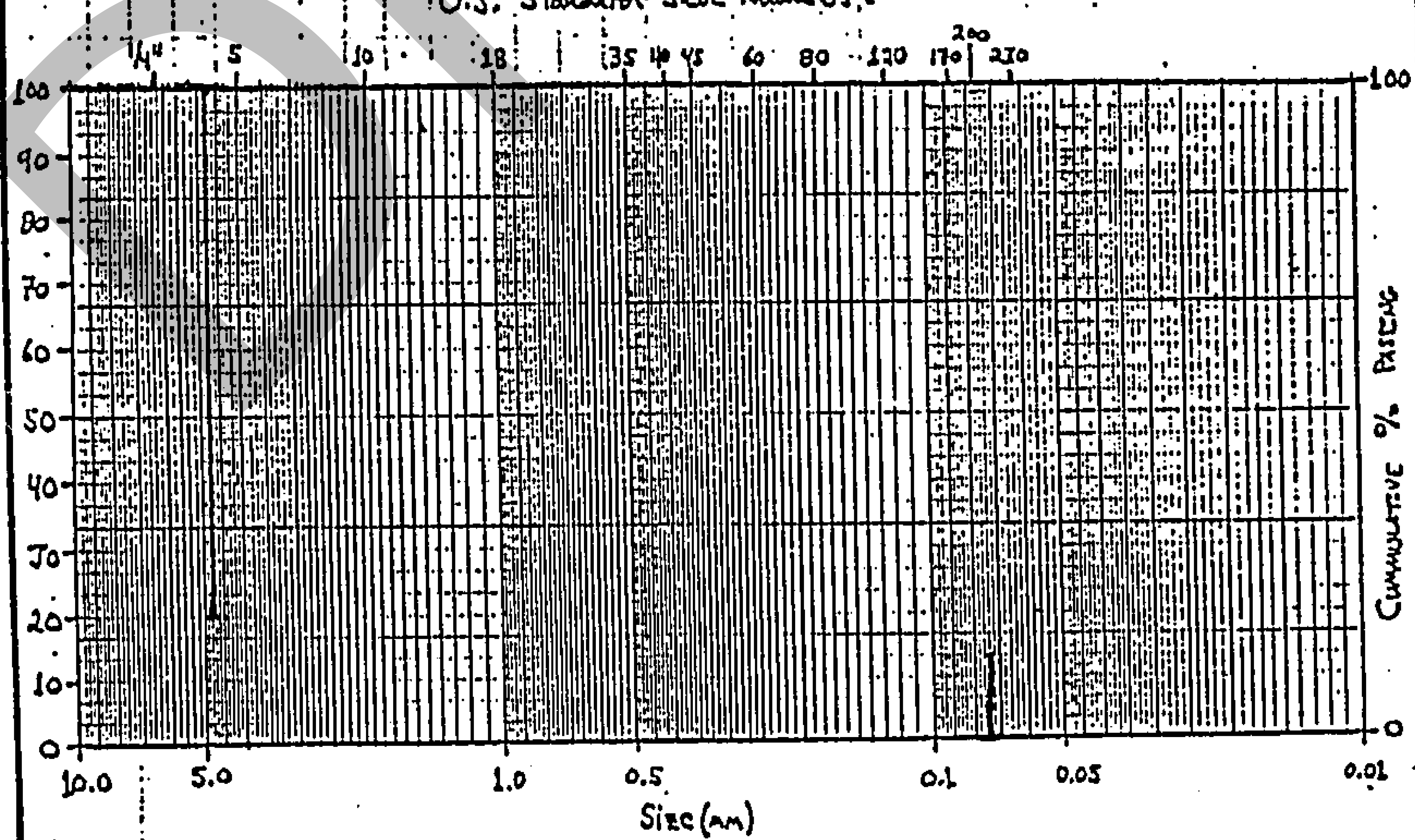
PAGE ____ OF ____
PROJECT: Webb Estates
DATE: June 1987

Grain Size Analysis

Sample ID: ________ Sample Wt. = ________

Sieve (mesh #):	Size (mm):	Sediment Retained: Wt (g):	Sediment Retained: %:	Cummulative % Passing:
4	4.76	–	–	20-100
200	0.074	–	–	0 - 12

GRANULAR BORROW - AOT SPECS



Mean Size = ________ Effective Size = — Uniformity Coeff. = —

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PAGE ____ OF ____ Page No.
PROJECT: ____
DATE: ____

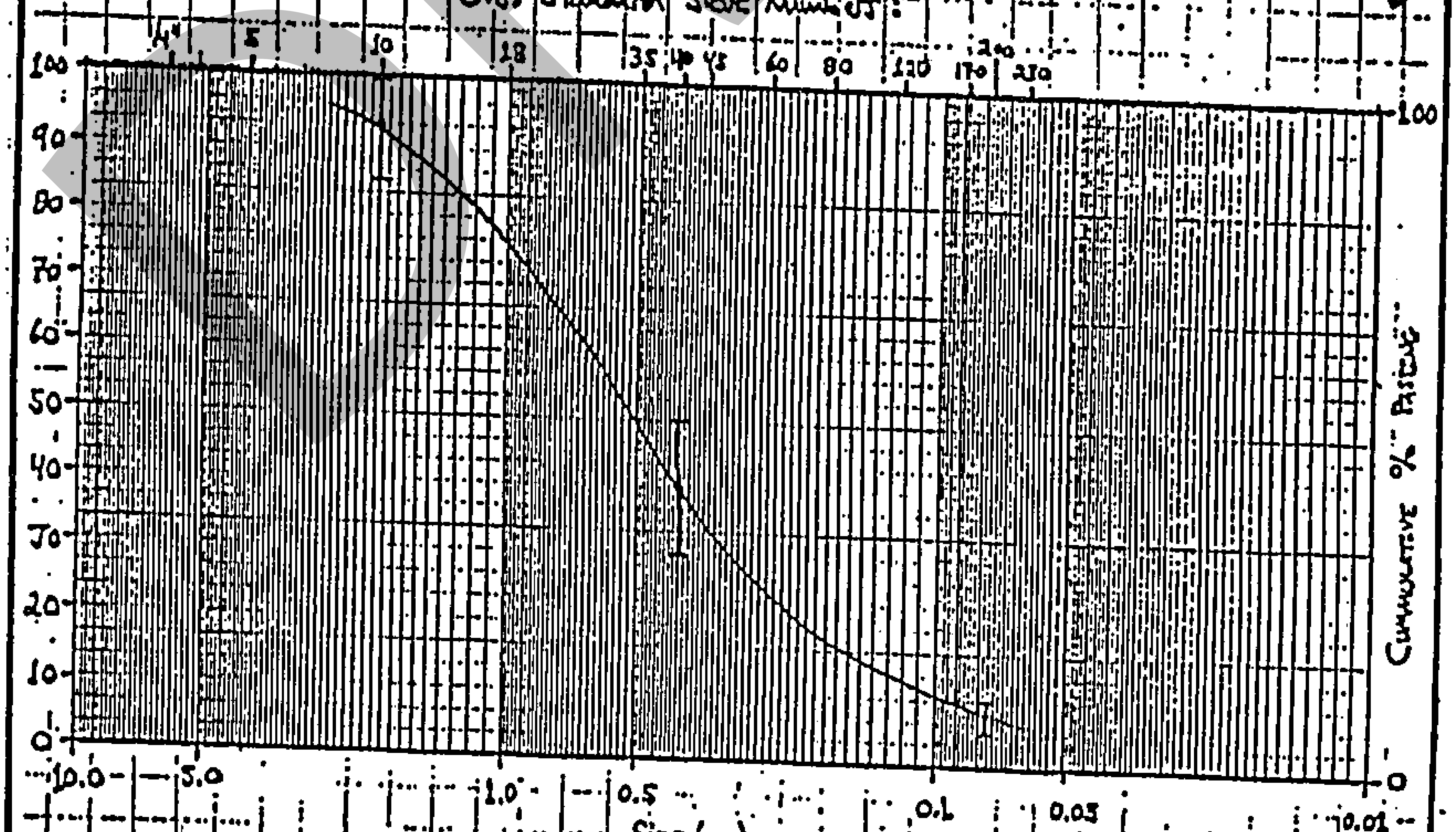
GRAIN SIZE ANALYSIS

SAMPLE ID: ____ SAMPLE WT. = ____

SIEVE (mesh #)	SIZE (mm)	SEDIMENT RETAINED: WT (g)	%	CUMMULATIVE % PASSING
10	2.0	—	—	85%
40	0.42	—	—	30-50%
200	0.075	—	—	5-10%

(as per EPR Chap. 7 - 14-E-3)

LIMITS OF MOUND FILL MATERIAL (From EPR)



MEAN SIZE = ____ EFFECTIVE SIZE = ____ UNIFORMITY COEFF. = ____

H

W N

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PAGE ___ OF ___ 9 Page No.

PROJECT: ___

DATE: ___

Mound Fill Material (EPR)

EPR Specifications Sieve #	Cum. % Passing	Sieve Analyses Results Hole #7	Hole #5	Hole #6	Hole #9	Hole #12
10	85	54.46	61.34	98.34	95.04	94.04
40	30-50	39.31	41.29	92.04	82.98	82.28
200	5-10	~11	~9	~14	~20	~18

Mound Fill Material (IDR)

IDR Specifications Sieve #	Cum. % Passing	Sieve Analyses Results Hole #7	Hole #5	Hole #6	Hole #9	Hole #12
10	85-100	54.46	61.34	98.34	95.04	94.04
40	25-75	39.21	41.29	92.04	82.98	82.28
60	0-30	29.99	29.53	79.23	67.51	67.56
100	0-10	~20	~16	~48	~46	~41
200	0-5	~11	~9	~14	~20	~18

Sand Borrow and Cushion (AOT)

AOT Specifications Sieve #	Cum. % Passing	Sieve Analyses Results Hole #7	Hole #5	Hole #6	Hole #9	Hole #12
2"	100	?	?	~100	~100	~100
1.5"	90-100	?	?	~100	~100	~95
.5"	70-100	?	?	~100	~97	~95
4	60-100	~66	~78	~100	~96	~95
100	0-20	~20	~16	~48	~46	~41
200	0-8	~11	~9	~14	~20	~18

Granular Borrow (AOT)

AOT Specifications Sieve #	Cum. % Passing	Sieve Analyses Results Hole #7	Hole #5	Hole #6	Hole #9	Hole #12
4	20-100	~66	~78	~100	~96	~95
200	0-12	~11	~9	~14	~20	~18

Fine Aggregate for Concrete (AOT)

AOT Specifications Sieve #	Cum. % Passing	Sieve Analyses Results Hole #7	Hole #5	Hole #6	Hole #9	Hole #12
3/8"	100	?	?	~100	~100	~100
4	95-100	~66	~78	~100	~96	~95
16	50-80	~50	~52	~97	~93	~92
30	25-60	~43	~41	~95	~87	~86
50	10-30	~33	~33	~83	~73	~72
100	[illegible]-10	~20	~16	~18	~46	~41

Note: The Approximate Numbers Are Those For Which We Did Not Have The Exact Size Sieve As Specified By EPR, IDR or AOT. These Numbers Are Taken [illegible] considered Approximate

Wagner, Heindel, and Noyes, Inc.
Consulting Geologists — Burlington, Vermont

PROJECT: ______

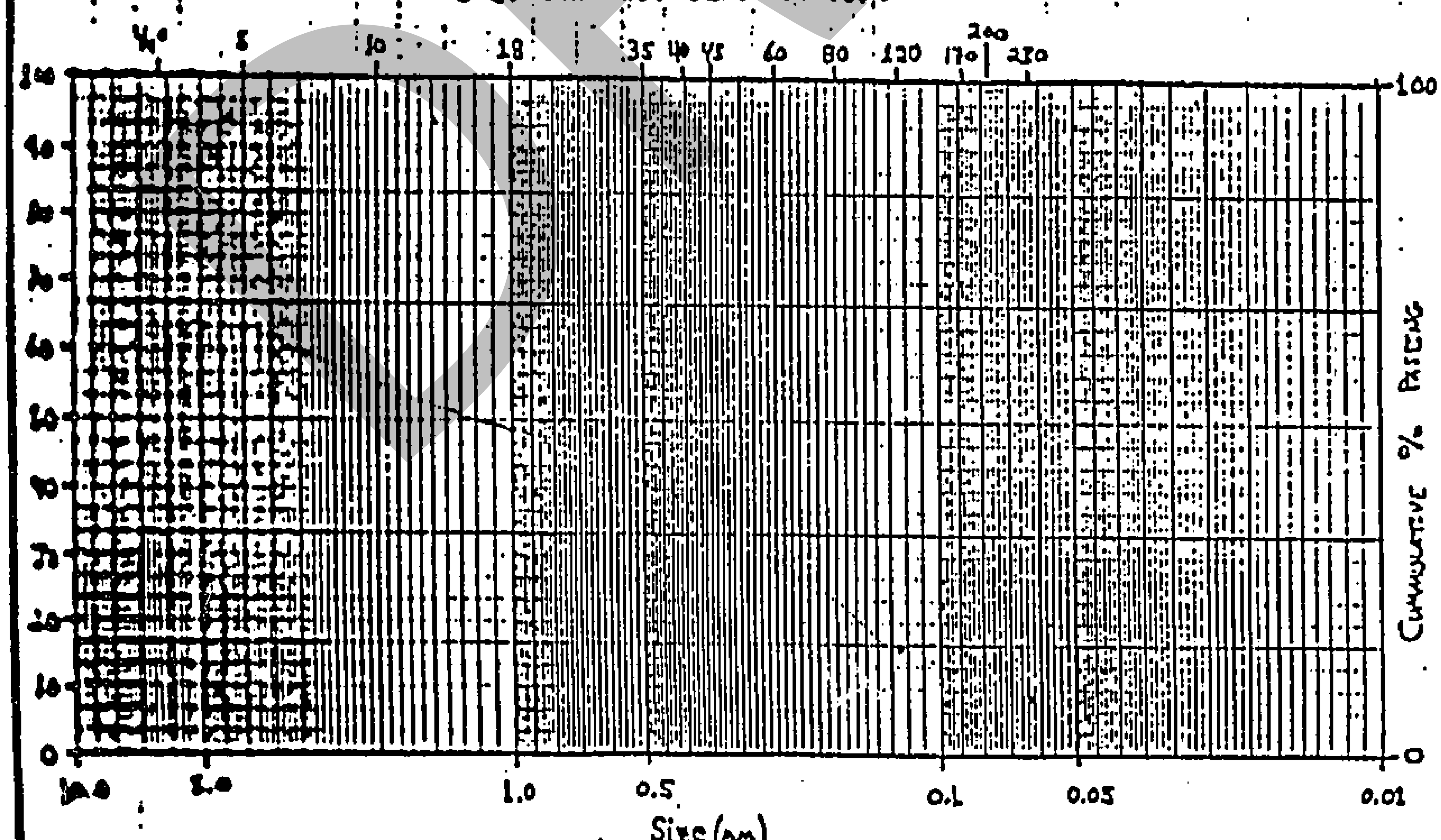
DATE: ______

GRAIN SIZE ANALYSIS

SAMPLE ID: [illegible] 7 (0-4)   SAMPLE WT. = 300.0 grams

SIEVE (mesh #):	SIZE (mm):	SEDIMENT RETAINED: WT (g):	SEDIMENT RETAINED: %:	CUMMULATIVE % PASSING:
#5	4.0	109.16	36.39	63.61
#10	2.0	27.45	9.15	54.46
#18	1.0	16.74	5.58	48.88
#35	.500	22.25	7.42	41.46
#40	.425	6.45	2.15	39.31
#60	.250	27.97	9.32	29.99
#120	.125	40.72	13.57	16.42
#230	.063	20.44	6.81	9.61
	PAN	27.43	9.14	

U.S. Standard Sieve Numbers:



MEAN SIZE = ______ EFFECTIVE SIZE = — UNIFORMITY COEFF. = —

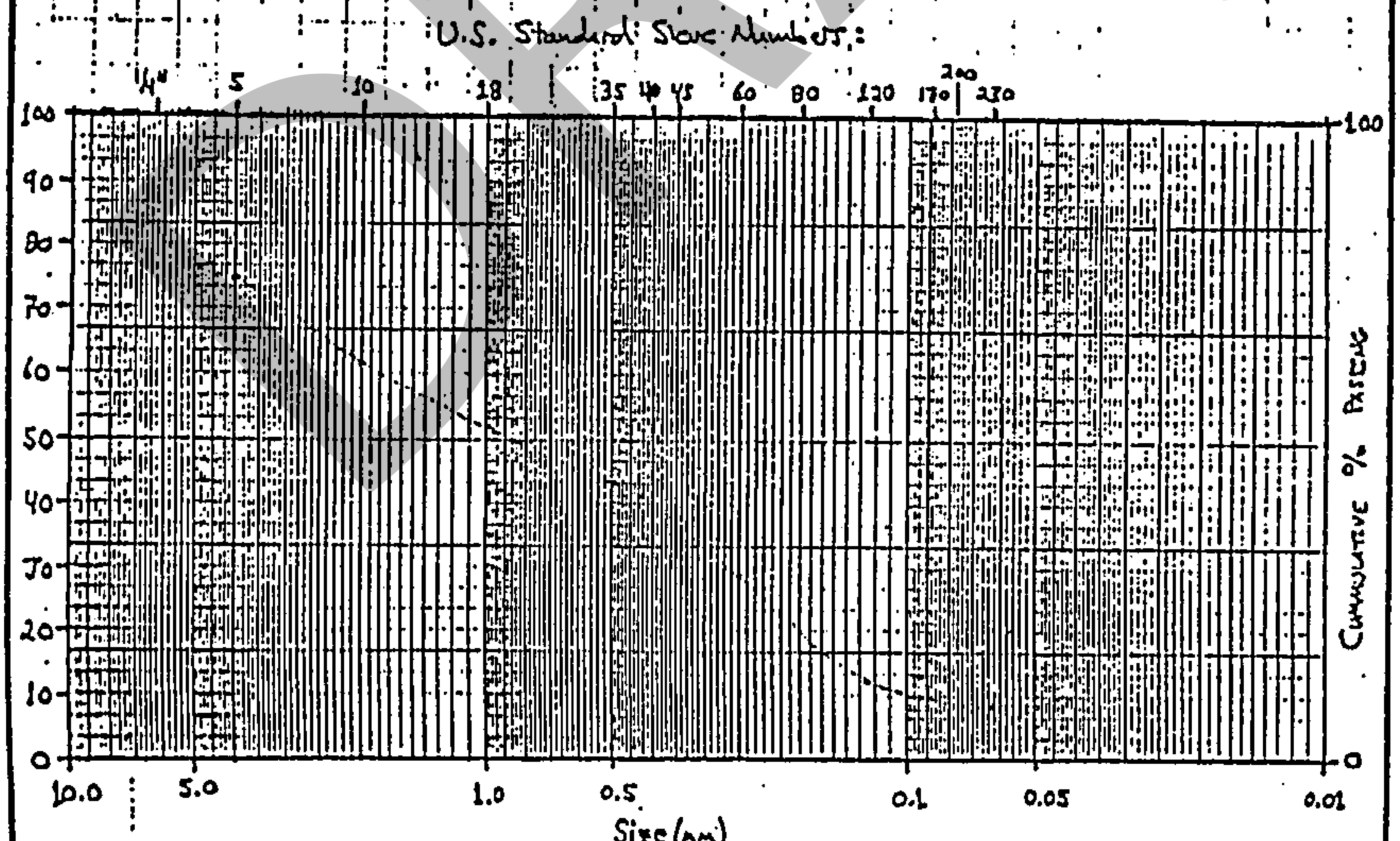
Wagner, Heindel, and Noyes, Inc.
Consulting Geologists Burlington, Vermont

PAGE ____ OF ____
PROJECT: ____
DATE: ____

GRAIN SIZE ANALYSIS

SAMPLE ID: HW5 34-39 SAMPLE WT. = 300.0g

SIEVE (mesh #):	SIZE (mm):	SEDIMENT RETAINED: Wt (g):	SEDIMENT RETAINED: %:	CUMMULATIVE % PASSING:
#5	4.0	74.63	24.88	75.12
#10	2.0	41.34	13.78	61.34
#18	1.0	26.03	8.68	52.66
#35	.500	27.74	9.25	43.41
#40	.425	6.32	2.12	41.29
#60	.250	35.28	11.76	29.53
#120	.125	43.10	14.37	15.16
#230	.063	20.73	6.91	8.25
	PAN	23.83	7.94	



MEAN SIZE = ________ EFFECTIVE SIZE = — UNIFORMITY COEFF. = —

(12)
Page No.

Wagner, Heindel, and Noyes, Inc.
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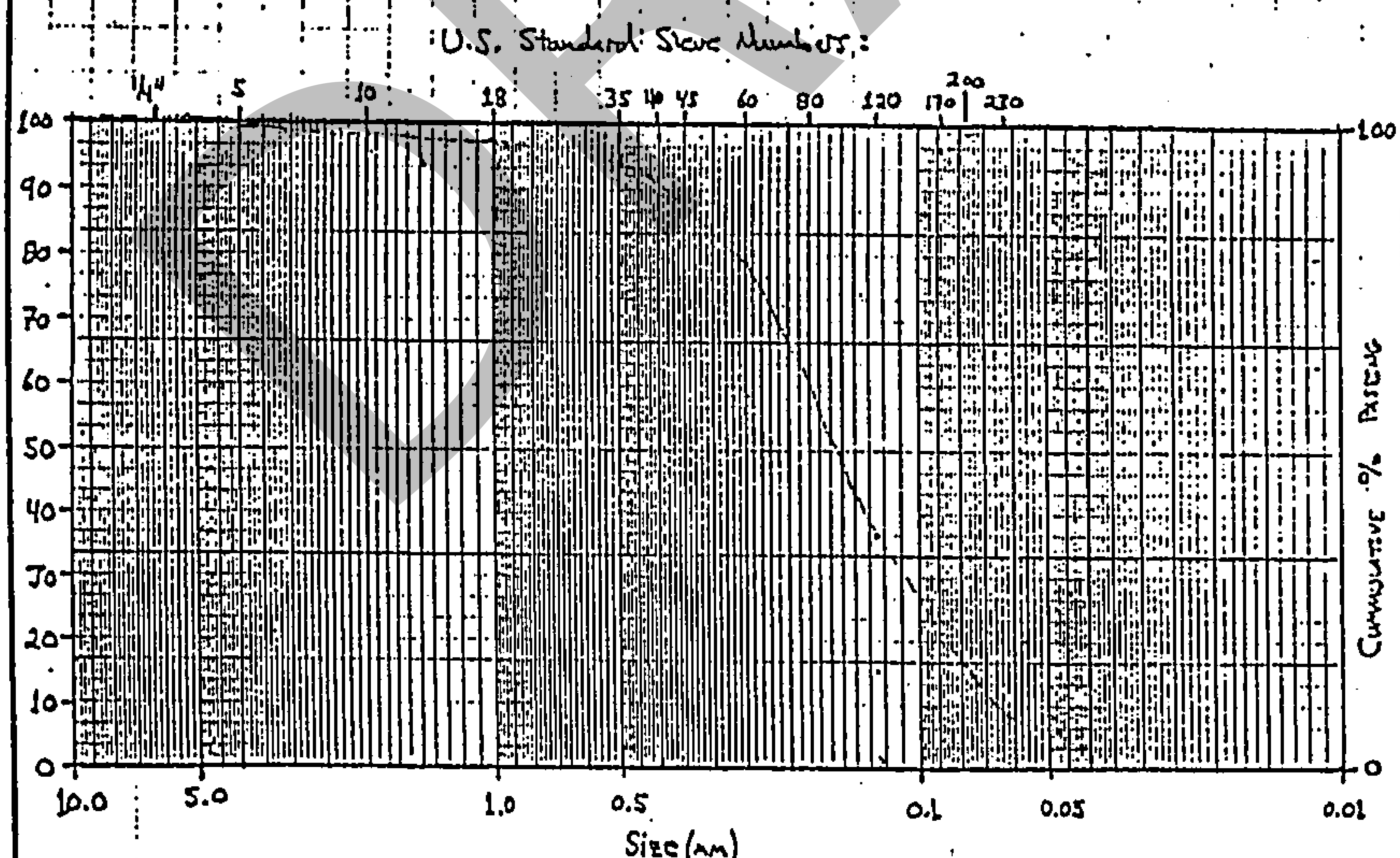
PAGE ____ OF ____
PROJECT: Webb Estates
DATE: June 1987

Grain Size Analysis

SAMPLE ID: Hole #6 19-21'   SAMPLE WT. = 200.0 g

Sieve (mesh #):	Size (mm):	Sediment Retained: Wt (g):	Sediment Retained: %:	Cummulative % Passing:
# 5	4.00	0.84	.42	99.58
# 10	2.00	2.48	1.24	98.34
# 18	1.00	2.94	1.47	96.87
# 35	.500	6.60	3.30	93.57
# 40	.425	3.06	1.53	92.04
# 60	.250	25.62	12.81	79.23
# 120	.125	85.74	42.87	36.36
# 230	.063	55.66	27.83	8.53
	Bottom pan	16.90	8.45	

.02% lost



MEAN SIZE = ________ EFFECTIVE SIZE = — UNIFORMITY COEFF. = —

13
Page No.

Wagner, Heindel, and Noyes, Inc.
Consulting Geologists — Burlington, Vermont

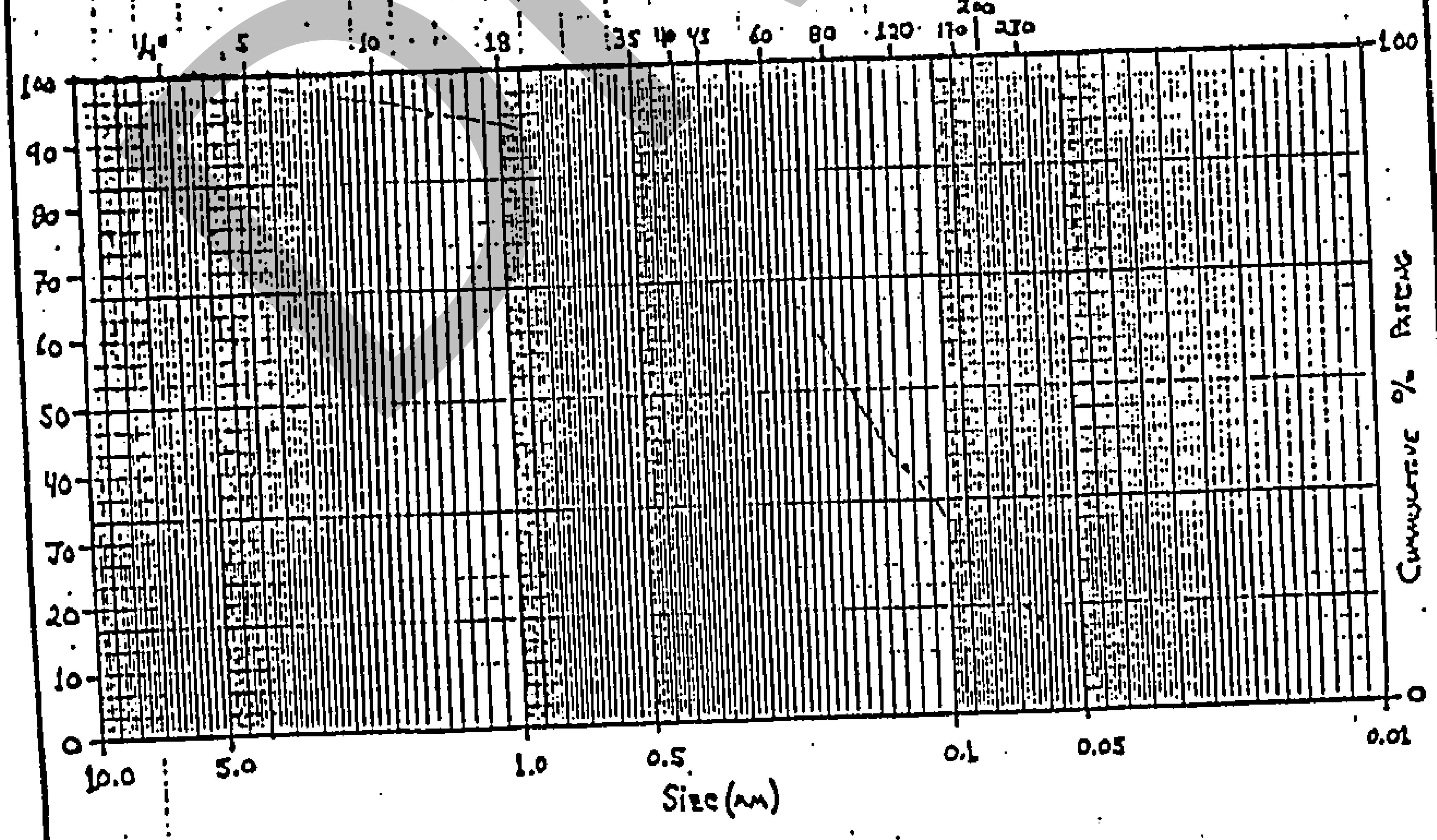
PAGE ____ OF ____
PROJECT: ____
DATE: ____

Grain Size Analysis

Sample ID: H.L. 9 (9-14) Sample Wt. = 300.0 grams

Sieve (mesh #):	Size (mm):	Sediment Retained: Wt (g):	% :	Cummulative % Passing:
# 5	4.0	[illegible]	1.84	98.16
# 10	2.0	9.36	3.12	95.04
# 18	1.0	9.20	3.07	91.97
# 35	.50	19.79	6.60	85.37
# 40	.425	7.18	2.39	82.98
# 60	.250	46.40	15.47	67.51
# 120	.125	91.26	30.42	37.09
# 230	.063	67.21	22.40	14.69
	PAN	13.02	14.36	

U.S. Standard Sieve Numbers:



Mean Size = ______ Effective Size = — Uniformity Coeff. = —

DRAFT

APPENDIX 2

DRILL LOGS

14

Page No.

W H N

Wagner, Heindel, and Noyes, Inc.

Consulting Geologists — Burlington, Vermont

PAGE ____ OF ____

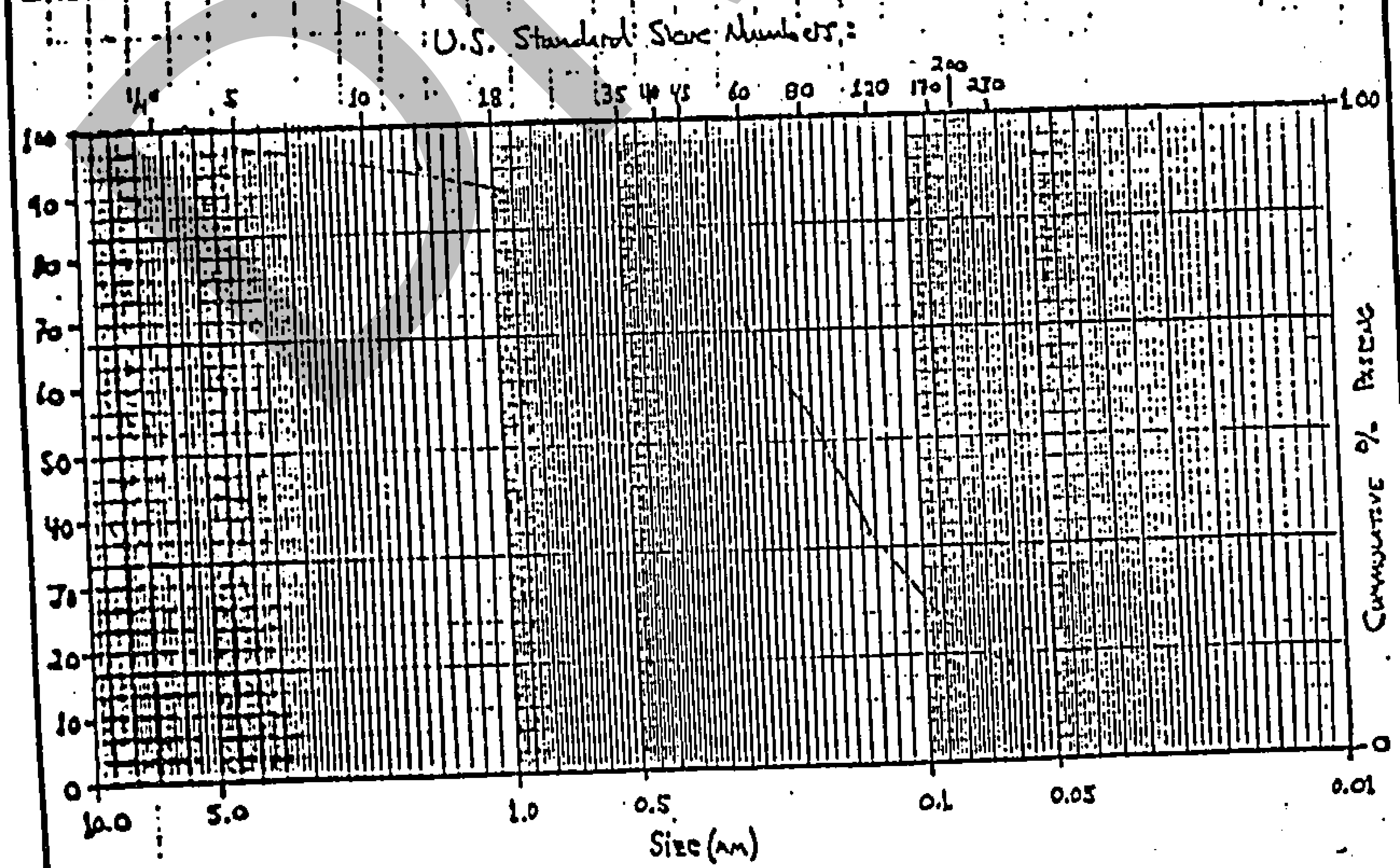
PROJECT: ____

DATE: ____

Grain Size Analysis

Sample ID: Hol-12 (9-14) Sample Wt. = 300.0 grams

Sieve (mesh #):	Size (mm):	Sediment Retained: Wt (g):	Sediment Retained: %:	Cummulative % Passing:
# 5	4.0	6.12	2.04	97.96
# 10	2.0	11.75	3.92	94.04
# 18	1.0	11.14	3.71	90.33
# 35	.50	17.50	5.23	84.5
# 40	.425	6.65	2.22	82.28
# 60	.250	44.15	14.72	67.56
# 120	.125	95.73	31.91	35.65
# 230	.063	60.26	20.09	15.56
	[illegible]	45.[illegible]	15.27	



Mean Size = ________ Effective Size = — Uniformity Coeff. = —

DRAFT

Wagner, Heindel, and Noyes, Inc.
285 North Street, Burlington, Vermont 05401 802-658-0820

APPENDIX 2

HIGGINS GRAVEL PIT INVESTIGATION
MORETOWN, VERMONT
DRILL LOGS

On April 11 and 12, 1990, drilling was conducted at the Higgins site in Moretown, Vermont, in order to evaluate the potential to develop a gravel pit. Over a coarse of a day and a half, twelve holes were drilled across the 5.3-acre site. All holes were drilled to a depth of 30 feet, with the exception of hole #5, which was drilled to a depth of 55 feet below ground surface (bgs). The drilling technique was destructive, and the samples collected represent integrated samples for each 5-foot interval.

Hole #1

0' - 4'	Medium fine silty gravel; dry, larger cobbles at depth, as evidenced by the grinding of the solid stem augers. Gravel recovered consists of .5-inch to 1-inch in diameter pea gravel. The matrix consists mostly of fine silty sands and fine sandy silt.
4' - 9'	Change from the fine silty gravel to a clean, fine, uniform, dry, silty sand at 5'; a little grinding with the solid stem auger between 8' and 9', but no real gravel was recovered.
9' - 14'	Medium brown, clean, dry, fine silty sand/sandy silt. No grinding with the augers, becoming moist between 12' and 13'.
14' - 19'	Same clean, fine, silty, sand, moist and semi-saturated between 17' and 19'; no gravel, no boulders.
19' - 24'	Clean, uniform, saturated, sandy fine silt at 22'; very soupy at 23' to 24'.
24' - 29'	Saturated fine sandy silt, with no boulders or cobbles.

Hole #2

0' - 4'	Pea gravel mixed in fine sandy/silty matrix; cobbles at depth as indicated by grinding on auger.
4' - 9'	Pea gravel mixed with fines until 6.5'; 6.5' to 9' fine silty sand with no cobbles or boulders; smooth drilling and no grinding.
9' - 14'	Medium brown/tan, clean, slightly moist, fine, silty sand.
14' - 19'	Dark brown, fine, sandy silt, clean and uniform, moist/semi-saturated at 18'.
19' - 24'	Medium brown fine sandy silt; coming up in saturated balls at 22.5'.
24' - 29'	Medium to dark brown, fine, sandy silt, moist and semi-saturated, saturated at 25.5' bgs. At 29' bgs, completely saturated with soupy consistency.

Higgins Gravel Pit Investigation
Moretown, Vermont
Drill Logs
Page 2

Hole #3

0' - 4'	Medium brown, dry, fine sandy/silty pea gravel, recovered gravel .5" to 1" diameter, grinding and screeching of solid stem auger indicate larger cobbles at depth.
4' - 9'	Sandy, fine gravel until 7'; into fine sand at 7'; back into sandy gravel from 7.5' to 8.5', with sporadic cobbles; silty sand at 9'.
9' - 14'	Silty sand to 11'; coarse to medium, moist sand from 11' to 12'; medium/fine clean, uniform sand with no gravel or cobbles from 12' to 14'.
14' - 19'	Saturated fine silty sand, slightly coarser than what we have seen previously.
19' - 24'	Saturated medium/fine, silty sand.
24' - 29'	Fine, sandy silt, saturated and very soupy.

Hole #4

0' - 4'	Medium brown, sandy gravel/gravelly sand grading into a medium brown/tan, fine sand with lots of silty fines at 3'.
4' - 9'	Medium brown, fine sand with a little gravel present in the upper foot, grading into a medium brown/orange, fine, sandy silt that is dry, uniform, clean, and powdery.
9' - 14'	Moist, clean, uniform, gray/tan silt with fine sand.
14' - 19'	Same fine sandy silt but semi-saturated at 18' bgs.
19' - 24'	Same fine, sandy silt with a little more medium/coarse sand; thin semi-saturated zones alternate with the dry material, but the saturated material as observed in the first three holes has not yet been encountered in this hole.
24' - 29'	Very fine, medium brown, clean, slightly moist, fine sandy silt/silty sand; variations in color observed from medium brown/tan to gray. No saturated zone.

Hole #5

0' - 1'	Black topsoil.
1' - 4'	Fine silty gravel, with gravel sizes ranging from 1/4" to 1-1/2" diameter; lots of auger grinding, suggesting larger cobbles below ground surface.
4' - 9'	Silty gravel grading into silty, fine sand at 6.5'; color change at 7.5' from tan to red-orange.
9' - 14'	Medium coarse, dry, gravelly sand. A little sporadic grinding suggesting a few scattered cobbles at depth.
14' - 19'	Medium coarse sand grading into a gravelly sand at 18', dry and uniform, grinding at 18.5' suggesting cobbles at depth.
19' - 24'	Dry, uniform, coarser sand with little gravel; stones range to 1/4"; grading into a sandy gravel towards 23' to 24'.
24' - 29'	Dry gravelly sand/sandy gravel, color change to dark gray at 28', lots of crunching and grinding suggesting larger cobbles at depth.

<u>Hole #5</u> (cont.)

29' - 34'	Medium brown, dry, uniform, sandy gravel; increasing gravel content with depth.
34' - 39'	Dark gray, moist, sandy gravel, with continued crunching and grinding indicating larger cobbles that are not being recovered.
39' - 45'	Same dark gray sandy gravel grading into a gravelly sand towards 45'.

<u>Hole #6</u>

0' - 4'	Dark gray, fine, sandy/silty gravel; noisy drilling indicating cobbles at depth.
4' - 9'	Alternating fine sandy/silty gravel and medium to coarse gravelly sand, color change at 8.5'.
9' - 14'	Moist, silty fine gravelly sand, 10% to 20% gravel at best in the recovered material; however, grinding and crunching indicates larger cobbles at depth.
14' - 19'	Sandy gravel grading into brown medium fine/fine sand at 15', sand becomes finer and siltier towards 19', color change to medium brown/orange at 18.5'.
19' - 24'	Medium brown, clean, uniform, dry, fine silty sand.
24' - 29'	Fine, silty, sand grading into gravelly fine sand, gravel content increases with depth.

<u>Hole #7</u>

0' - 4'	Medium to dark brown, dry, silty gravel.
4' - 9'	Clean, uniform, medium fine sand; moist but not saturated.
9' - 14'	Medium brown, medium/fine, uniform, dry sand grading into a clean, uniform, dry, fine sandy silt at 12'; color variations between dark gray and medium brown/orange.
14' - 19'	Fine silty sand/sandy silt; saturated from approximately 17' to 19'.
19' - 24'	Gray/brown, fine sandy silt; completely saturated for the first 3' or 4', but grading into a drier material of similar texture.
24' - 30'	Medium brown, fine, silty sand with some small gravel comprising approximately 10%; unsaturated. Appear to have drilled beneath the perched water table.

<u>Hole #8</u>

0' - 5.5'	Medium brown, dry, sandy/silty gravel; crunching and grinding indicating larger cobbles below ground surface that are not being recovered.
5.5' - 9'	Medium brown, dry, fine, sandy silt grading into a moist/saturated fine, sandy silt at 6.5' to 7'; fine, sandy silt grades into a medium/dark brown, medium/coarse sand at 7'.

<u>Hole #8</u> (cont.)

9' - 14'	Moist, uniform, medium/coarse sand with 10% pebbles grading down into a fine sand towards the bottom of the hole.
14' - 19'	Medium brown, uniform, clean, fine, silty sand that is saturated at approximately 17.5'.
19' - 24'	Clean, uniform, fine, silty sand with no gravel; saturated.
24' - 30'	Same saturated fine, silty sand.

<u>Hole #9</u>

0' - 4'	Medium brown/dark brown, silty, sandy gravel; gravel sizes vary from 1/2" to 1-1/2"; crunching and grinding indicates larger cobbles at depth that do not come up with recovered material.
4' - 9'	Silty/sandy gravel grading into fine, sandy silt with pebbles at approximately 5'; fine, sandy silt with pebbles grading to dark brown, medium fine, pebbly sand towards bottom of the hole.
9' - 14'	Medium brown, fine sand with 5% to 10% silt; several color variations through the 5-foot interval from medium brown/tan to dark gray.
14' - 19'	Medium fine sand with little silt grading into medium brown, fine silty sand/sandy silt at 15.5'.
19' - 24'	Interlayered fine sand and fine silty sand with color changes from black to tan; 5% pebbles towards 23' to 24'.
24' - 30'	Dark gray, coarse, sandy gravel/gravelly sand with 20% to 30% gravel which ranges from 1/4" to 1/2" diameter.

<u>Hole #10</u>

0' - 4'	Medium brown, dry, silty gravel, with crunching and grinding indicating larger cobbles at depth; gravel percentage increases towards 4'.
4' - 9'	Change from gravelly silt to medium brown, clean, fine silty sand at about 7'; semi-saturated at 9'.
9' - 14'	Clean, uniform, medium fine, moist sand; saturated at about 12' to 14'; does not feel like it has much silt, but it is saturated.
14' - 19'	Clean, medium/coarse sand with some grinding at about 18'; completely saturated at 18.5' to 19'.
19' - 30'	Medium fine, silty sand; completely saturated; crunching and grinding at 29', but no gravel observed in the recovery.

<u>Hole #11</u>

0' - 4'	Medium brown, dry, coarse sandy gravel, with gravel up to 1.5" diameter. Lots of crunching and grinding indicating large cobbles and boulders at depth.
4' - 9'	Coarse, sandy gravel grading into medium brown, fine, silty sand at 6.5'.
9' - 14'	Medium brown, clean, uniform, fine, silty sand; saturated at 13'.

Higgins Gravel Pit Investigation
Moretown, Vermont
Drill Logs
Page 5

<u>Hole #11</u> (cont.)

14' - 19'	Medium brown, fine, clean, uniform, silty sand; moist to semi-saturated.
19' - 30'	Same fine, silty sand; saturated to bottom of hole.

<u>Hole #12</u>

0' - 4'	Dark brown, moist, loamy gravel; grinding and crunching indicating larger cobbles below ground surface.
4' - 9'	Loamy gravel grading into a gravelly silt at 6.5' to 7'; grading into a fine silty sand at 7.5'; sand is medium to fine.
9' - 14'	Medium brown, dry, pebbly fine, silty sand; pebbles almost all gone by 14'; sand coarsens with depth.
14' - 19'	Medium brown, clean, medium/coarse sand; saturated between 16' and 17'.
19' - 29'	Saturated, clean, uniform, fine sandy silt.

CHARLES GRENIER
CONSULTING ENGINEER PC
BOX 445 244-6413
WATERBURY, VT. 05676

July 12, 1990

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Eric Blatt, Regional Engineer
District #5 Enviornmental Office
324 North Main Street
Barre, VT 05641

Bruce Douglas, Hydrogeologist
Agency of Natural Resources
103 South Main Street
Waterbury, VT 05676

Re: Moretown Elementary School, Doreen Higgins Site

Dear Eric and Bruce:

Attached with this cover letter is our recently completed Preliminary Engineering Report of the Wastewater Capacity of the Doreen Higgins site. We have also included a copy of the Wagner, Heindel and Noyes report of May 21, 1990 and the Chenette Engineering Inc. report of December, 1988.

If any questions arise as a result of this information please do not hesitate to contact us.

Respectfully,

Charles J. Grenier

Charles J. Grenier, P.C.

CJG:lgw

CHARLES GRENIER
CONSULTING ENGINEER PC
BOX 445 244-6413
WATERBURY, VT. 05676

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July 9, 1990

DRAFT

Moretown Elementary School
Jean Eisele, Principal
Moretown, Vermont 05660

Re: Wastewater diposal, Doreen Higgins 5 acre field, Moretown.

Dear Ms. Eisele:

At the request of the Moretown Elementary School Building Committee, our office has prepared this report giving a preliminary opinion as to the wastewater disposal capacity of the Doreen Higgins site. We have reviewed the soils report completed by Wagner, Heindel and Noyes, Inc., Consulting Hydrogeologists. This report was prepared for Doreen Higgins. This preliminary opinion will direct comments toward the following four issues:

1. The type of soil encountered and the wastewater disposal capacity of the site.

2. The impact of wastewater disposal on neighboring wells and springs.

3. The alternatives for delivering wastewater to the site by a new force main and pump station.

4. The State of Vermont "Indirect Discharge Regulations" which are pertinent for flows exceeding 6,500 GPD are proposed.

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Moretown Elementary School
Page 2
July 9, 1990

ISSUE #1 - SOIL TYPE AND DISPOSAL CAPACITY

1. On June 28, 1990 we dug ten deep test holes with a large back hoe. State Regional Engineer, Eric Blatt was present. These test holes were dug at locations between the 12 deep borings done by Wagner, Heindel, and Noyes, Inc. in April 1990. After analyzing the 22 holes, it is our conclusion that this site is well suited for wastewater disposal from a soil perspective. There is 4 to 8 feet of course sand and gravel over a deep layer of fine to medium sand. The depth to a seasonal groundwater table ranges from 13 to 25 feet from the surface.

2. The applicable State Regulations used in our analysis are for wastewater disposal systems of less than 6,500 GPD. If the building population at the school in ten years is 250 students plus staff and no hot lunches or showers are installed, 15 gallons per person would be used to calculate a total flow of 3,750 GPD. If a new school was constructed and 1,250 GPD was used for the conversion of the existing school to office space, or some other use, 5,000 GPD would be the total design flow. Our site plan shows a layout of twin leachfields with a total capacity of 6,500 GPD. State Regulations require dual alternating leachfields for design flows exceeding 5,000 GPD. When the wastewater design flow reaches 5,000 GPD the second pair of leachfields need to be installed. Given the rate of population increase predicted between 1990 and 1997 it appears prudent to design the leachfields and the pump station system for a flow of at least 6,500 GPD. A 6,500 GPD system gives the school significant expansion capabilities. If the School board chooses not to include the existing building in its' expansion plans, then some surplus capacity would be available to convert the building into offices, a Senior Citizen Center, or some other low flow use.

3. It has come to our attention that the Moretown Store, owned by Robert Dowdell, is experiencing wastewater disposal problems. We have spoken with Robert Dowdell's Engineer, Bernard Chenette, of Montpelier. It is our understanding that approximately 2 years ago Chenette dug testholes on the Doreen Higgins site. The site was suitable for the Store's wastewater disposal needs but Dowdell was unable to purchase the property from Higgins at an acceptable price. We feel that there is enough space in the northwest corner of the field to dispose of wastewater from the Moretown Store. A separate pump station and force main would need to be constructed from the Store to the site. Our site plan shows a likely location for the Store leachfield.

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ISSUE #2 - HIGGINS SITE LEACHFIELDS AND THEIR AFFECT UPON NEIGHBORING WATER SUPPLIES

1. Westerly and downhill from the Higgins site are a series of drilled wells owned by Cutler, Moretown Store, Kalantari, Dowdell, and Westerman. These drilled wells average 400' from the proposed leachfield area and probably would not be impacted. Further investigation including a review of the well logs to determine the soil conditions is necessary.

2. Southwesterly of the Higgins site along Route 100B are a series of wells 500' to 1200' away. These wells are owned by Schultz, Booth, Nelson, Dicarlo, Piazza, the Methodist Church parsonage, Tweedie, and Ferris. We expect that it can be proven that these wells would not be impacted by leachfields constructed on the Higgins site.

3. Southwesterly of the site is a shallow spring along Doctor Brook, owned by Robert and Mary Holden. It may be difficult to show that this spring will not be adversely impacted by leachfields 350' away on the Higgins site. State regulations require a two year residence time before wastewater effluent reaches the water supply. Given the 100' elevation difference from the spring to the Higgins site and the sand and gravel soils, it may be difficult to show that the Holden spring will not be impacted. However, if there is a good clay layer protecting this spring, it may be safe. The school district may be required to drill a well for Holden and abandon the spring.

4. Approximately 225' north of the leachfield area is a drilled well owned by Mervin Cutler which serves his mobile home. This well may be adversely impacted by the leachfields. However, it does appear that the flow pattern on the Higgins site is radially in a northerly, westerly, and southerly direction. The leachfields could be constructed on the westerly end of the peninsula shaped site, and it may be possible to prove that the wastewater does not flow toward Cutler's well. It may also be possible to show that the Cutler well is protected by a deep layer of silt or clay. Further information and a review of the well logs is necessary.

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5. In a northeasterly direction a distance of 600'± from the leachfield are springs owned by Eugene Grandfield and Howard Ferris. These springs are along the steep embankment between the Moretown Common Road and Route 100 B. Even though the springs are at an elevation lower than the Higgins field, they may not be down gradient. The flow direction from the Higgins site is likely to be southerly and not directed toward these springs. Further investigation is necessary.

6. In an easterly direction 800'± away at approximately the same elevation as the Higgins site are a group of drilled wells owned by Houghton/Cook, Lamart, formerly Warren White, Elwell, and Eastman. It appears that these wells are not down gradient from the leachfield site and are adequately isolated.

7. In order to receive approval for 6,500 GPD at the Higgins site, a hydrogeologist must be retained to determine the impact on neighboring wells and springs. Calculations are necessary to prove that there is a two year residence time between the leachfields and any down gradient well or spring. Impact on neighboring water supplies is a "significant issue" with the Higgins site. If it cannot be proven that a water supply is adequately protected, the School will be required to replace the water supply of the affected party. It has been our experience that impact on neighboring water supplies is a major stumbling block in receiving State permits.

ISSUE #3 - WASTEWATER FORCE MAIN ROUTES

In order to deliver settled wastewater to the Higgins site from either a new school or an expanded school, new septic tanks and wastewater pumping stations are required. After walking the area and reviewing the tax map, it appears that there are four possible routes for a 3" PVC force main to deliver wastewater to the site. We offer the following comments regarding each route:

1. Route #1 would be the Route 100B/Dowdell route which involves constructing a force main along the driveway between the School and the Methodist Church before proceeding along the easterly edge of Route 100B. The force main would cross Doctor Brook on the up stream side of the bridge before reaching the Moretown Store. At the Store the force main would turn easterly and proceed up the steep bank to the Higgins site. There are many obstacles along this 1800' route, not the least of which are the power poles, the

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pavement along Route 100B and the crossing of Doctor Brook. Also, State Regulations require that this force main be 50' from any drilled well and 75' from any spring or point source. A preliminary survey of the wells along this route was completed. The site plan shows many springs and wells along this route. There are also a substantial number of spring lines which cross Route 100B from the steep hillside behind the School. This issue is very similar to the situation which faced the Roxbury School. If wells or springs become obstacles along the route they must be replaced. This route would require an easement from the Moretown Store. It is our understanding that the Store has a failed septic system and we would expect cooperation from Mr. Dowdell regarding this issue.

2. Route #2 would involve the construction of a force main across School property in an easterly direction behind the buildings along Route 100B, then across the Schultz property toward Doctor Brook and the Moretown Store site. This 1700' route would involve significantly less construction along Route 100B in front of all the buildings and would be better isolated from springs and wells. This route would require an easement from both Dowdell and Schultz.

3. It appears possible to construct an 1800' force main in an easterly direction toward the baseball field, before crossing the Calitri property. This Route #3 would involve crossing Doctor Brook and negotiating a steep embankment, but would be in open land with no impact on springs and wells along its' route. The force main would be more cost effective to construct. This route would require an easement from Calitri. It is our understanding that the Calitri parcel is land locked and that an easement from the Town and/or Holden has been pursued.

4. A shorter Route #4 would cross the School property, Doctor Brook, and Holden's field before proceeding up the steep embankment owned by Calitri. This 1450' route involves obtaining an easement from Calitri and Holden in order to save 350' of force main.

5. We prepared a construction cost estimate for new septic tanks, pump station, leachfields, and force mains to deliver the settled wastewater to the Higgins site. We have budgeted for construction of two leachfields with a capacity of 5,000 GPD. We estimate the total cost at $95,000. This estimate does not include the cost of easements and/or replacing water supplies if necessary. The pump station required for this application is more expensive because of the 100' static lift to deliver the wastewater to the Higgins site. We have budgeted two 5 Horsepower grinder pumps which add significant cost to the project.

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The Roxbury Elementary School is in the process of constructing a new septic system similar to the Higgins site situation. In Roxbury's case wastewater is pumped 3,000' along a flat gradient to a sandy site. The total cost of this leachfield in Roxbury is near $60,000. In general, the Higgins site application is more difficult, the septic tanks and pump station are more expensive, and the leachfields are larger.

ISSUE #4 - INDIRECT DISCHARGE REGULATIONS

In the event that the School board were to seek approval for more than 6,500 gallons of wastewater disposal on the Higgins site, the new State of Vermont "indirect discharge" rules, adopted on January 15, 1990 would be invoked. In our opinion, these regulations are "extremely conservative" and would have a dramatic effect on leachfield construction and related costs. A brief summary of the impact of the indirect discharge regulations for a septic system of 8,000 GPD follows:

1. The sizing of the leachfields is much more conservative because the wastewater application rate is much lower. Our site plan shows four rectangles which illustrates the space an 8,000 GPD system needs. A dual alternating system must be constructed. We estimate the cost of the four leachfields alone at $50,000.

2. The leachfields must be constructed using pressure distribution. Pressure distribution ensures that the wastewater is spread evenly over the entire system. A pressure system is more difficult to design and results in larger pumps. Given the fact that we have over 100' of static head to overcome, pressure distribution will result in very expensive pumps.

3. These regulations are new and the administration of the regulations is in a state of turmoil. Significantly more hydrogeological studies are required to prove that the wastewater will be adequately treated and not adversely impact ground water and the aquatic biota of the Mad River and Doctor Brook. We spoke with Wagner, Heindel, and Noyes regarding the indirect discharge regulations. They estimate that studies costing from $3,000 to $25,000 are necessary to prove this site adequate for 8,000 GPD without adversely impacting waters of the State and neighboring water supplies. It may be difficult to show that this site can dispose of more than 6,500 gallons of wastewater.

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4. It is hoped that these indirect discharge regulations will eventually be relaxed because in their present form they can be easily used to stop development of any site.

FINAL CONCLUSIONS

It is our final conclusion that given the present State of Vermont environmental regulations, the Doreen Higgins site may be the only site near the Moretown Elementary School where 6,500 gallons of wastewater can be disposed. In addition to the cost of the Higgins property, there are considerations as to the cost of easements and the potential of replacing water supplies. We recommend that the School Board proceed with an attempt to purchase the Higgins property contingent upon receipt of all State Permits. Because of the complexity of this project there is a significant amount of engineering and hydrogeological work remaining to obtain the permits. We recommend that the Board allow at least one year for obtaining all required permits and easements.

After you have had a chance to review this preliminary report , please do not hesitate to contact us for further discussion.

Respectfully,

Charles J Grenier

Charles J. Grenier, P. C.

cc: David Clemons
Sam Scofield
Jack Barnes
Superintendent Meaghan
Tom Good

CHARLES GRENIER
CONSULTING ENGINEER PC
BOX 445 244-6413
WATERBURY, VT. 05676

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CONSTRUCTION COST ESTIMATE
NEW SEPTIC SYSTEM FOR MORETOWN ELEMENTARY SCHOOL
DOREEN HIGGINS 5 ACRE FIELD SITE
JULY 9, 1990

New Septic Tanks, Pump Station Tanks and Valve Pit.....	$15,000
New Duplex Pump Station: Mechanical Equipment, Control Panel, Piping, Alarm System, Valving and two 5 Horsepower Grinder Pumps..........................	20,000
1800' Route 100B/Dowdell Force Main....................	24,000
*New 5000 GPD Leachfield (2 Trench Systems.............	13,000
SUBTOTAL..........	$72,000
Construction Contingency @ 15% +/-.....................	10,000
Engineering, Hydrogeology and Permit Costs.............	13,000
TOTAL COST........	$95,000

*Actual capacity of leachfield is 6500 GPD, but the field will be limited to 5000 GPD to avoid constructing another pair of leachfields.

CHARLES GRENIER
CONSULTING ENGINEER PC
BOX 445 244-6413
WATERBURY, VT. 05676

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TEST PIT LOGS
DOREEN HIGGINS 5.3 ACRE MEADOW
MORETOWN VILLAGE
JUNE 28, 1990

PRESENT: Charles J. Grenier, Consulting Engineer; along with Regional Engineer, Eric Blatt

Test Pit "A"

0" - 6"	Dark brown topsoil
6" - 72"	Coarse sand and gravels, some large cobbles, brown, friable
72" -168"	Light brown fine sands, medium sands, silty sand, no staining, loose, single grained

Test Pit "B"

0" - 8"	Brown topsoil
8" - 81"	Coarse brown sand and gravel, some large cobbles,
81" -160"	Fine loose sands, silty sand, wet silty sands @ 144" - 160"

Test Pit "C"

0" - 8"	Brown topsoil
8" - 80"	Coarse brown sand and gravel, friable
80" -174"	Fine to medium light brown sand wet silty sand @ 162" - 174", some silt

Test Pit "D"

0" - 8"	Brown topsoil
8" - 60"	Coarse brown sand and gravel
60" -196"	Fine sand, light brown, some silty sand, loose single grain, moist @ 180"

Test Pit "E"

0" - 9"	Brown topsoil
9" - 71"	Coarse brown friable sand and gravel
71" -172"	Light brown fine sand, silty sand, moist @ 160"

Test Pit "F"

0" - 8"	Brown topsoil
8" - 85"	Friable brown coarse sand and gravel
85" -180"	Light brown fine sand, silty sand, wet @ 162"

Test Pit "G"

0" - 8"	Dark brown topsoil
8" - 97"	Coarse brown friable sand and gravel
97" -180"	Light brown fine sand, silty sand, loose, moist @ 170"

Doreen Higgins - Test Pit Logs
Page 2

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Test Pit "H"

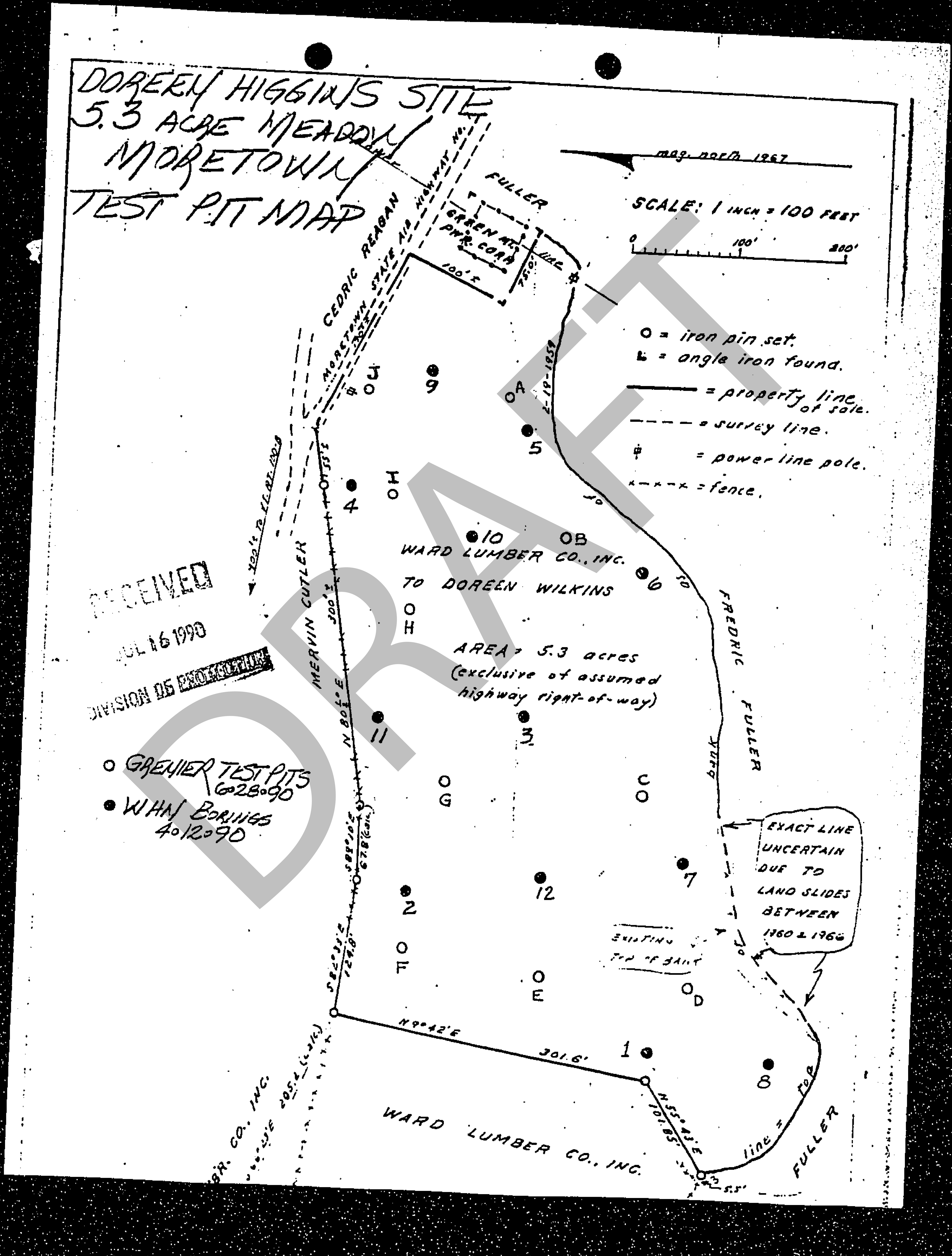
0" - 6"	Brown topsoil
6" - 92"	Coarse friable brown sand and gravel
92" -176"	Fine sand, silty sand, light brown moist @ 164"

Test Pit "I"

0" - 7"	Brown topsoil
7" - 84"	Brown friable coarse sand and gravel
84" -178"	Fine sand, silty sand, light brown, moist @ 166"

Test Pit "J"

0" - 8"	Brown topsoil
8" - 73"	Coarse brown friable sand and gravel
73" -186"	Light brown fine sand, silty sand, moist @ 178"



DOREEN HIGGINS SITE
5.3 ACRE MEADOW
MORETOWN
TEST PIT MAP
mag. north 1967
SCALE: 1 inch = 100 feet
0
100'
200'
FULLER
GREEN MT. PWR. CORP.
100'±
75.0'
line
CEDRIC REAGAN
MORETOWN STATE AID HIGHWAY No.
o = iron pin set.
= angle iron found.
= property line of sale.
= survey line.
= power line pole.
= fence.
MERVIN CUTLER
N 80½° E
300'±
WARD LUMBER CO., INC.
TO DOREEN WILKINS
AREA = 5.3 acres
(exclusive of assumed highway right-of-way)
FREDRIC FULLER
bank
EXACT LINE UNCERTAIN DUE TO LAND SLIDES BETWEEN 1960 & 1966
EXISTING TOP OF BANK
N 9° 42' E
301.6'
WARD LUMBER CO., INC.
line = top
FULLER
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o GRENIER TEST PITS 6-28-90
● WHN BORINGS 4-12-90
J 9 A 5 I 4 10 B 6 H 11 3 G C 2 12 7 F E D 1 8
DRAFT

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DOREEN HIGGINS SITE-MORETOWN
NEIGHBORING PROPERTIES & WATER SUPPLIES
BY: CHARLES J. GRENIER
JULY 1990 200± SCALE

CEI

Chenette Engineering, Inc.

50 State Street
Montpelier, VT 05602
(802) 229-1442

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JUL 16 1990
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July 9, 1990

Charlie Grenier
Demerrit Place
Waterbury, VT 05676

RE: Proposed Moretown Septic System

Dear Charlie:

Enclosed, please find soil testing data on the Higgins property, as requested. This testing was performed by the Johnson Company, Inc. in December of 1988.

We have estimated that the minimum design flow for the Moretown Store would be 1,835 GPD. If you should have any questions, please do not hesitate to call.

Sincerely,

CHENETTE ENGINEERING, INC.

Michael J. Chenette

Michael J. Chenette, P.E.
Project Manager

MJC/bac
Grenier.let

Enclosure

cc: Scott Bennett, Palisades

MORETOWN GENERAL STORE

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INTRODUCTION

This report presents the results of our soils and site investigation to determine the suitability of the subject property for the installation of a 6450 gpd waste water disposal system.

The project area is situated on a gently sloping terrace overlooking the Moretown General Store. The property is presently used for agricultural purposes. The proposed waste water disposal system will serve several buildings and businesses as detailed in Table 1 - Waste Water Design Flows.

FIELD INVESTIGATION

On December 2, 1988, a total of 8 tests were excavated on the property. Four of the pits were located in the vicinity of the proposed disposal site, with the remaining pits spread out along the perimeter of the property. The stratigraphy of the property was observed to be very consistent and can be generally summarized as:

0 - 12"	Organic topsoil
12 - 48"	sand w/gravels, cobbles
48 - 120"	loamy sand

Logs of all test pits are included in Appendix A.

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Following excavation of the test pits, a total of four perc tests were performed, two in each of the sandy deposits. Perc test results are included in Appendix B. These tests indicate a percolation rate of 3-5 minutes per inch for both horizons.

On December 29, 1988, an additional 3 test pits were excavated in order that Eric Blatt and Bruce Douglass (Vermont Agency of Natural Resources) could observe the subsurface conditions first hand. It was decided that an additional four perc tests would be necessary as a total of four beds (two primary plus two alternate) are required. Groundwater mounding analysis was requested, therefore a Guelph Permeameter was used to obtain permeability (k) values on each sandy deposit. The results of the permeameter tests are included in Appendix C.

MOUNDING ANALYSIS

A mounding analysis was performed for the proposed 6450 gpd leach beds. The analysis is a microcomputer model of artificial recharge using Glover's solution is for a homogeneous, isotropic unconfined aquifer with constant recharge and an initial horizontal water table. The application of an analysis assuming isotropy and homogeneity of the soils is conservative in that the modelling is being performed in the least permeable stratigraphic unit: the loamy sand. Furthermore, the model assumes an initial horizontal water table. Other assumptions include:

1) specific yield = ____
2) depth to seasonal high groundwater = 10ft.
3) transmissivity = ____

where: $T = Kb$

$K =$

$b = 4$

Assumption $b = 4$ allows for a 6ft. below ground surface unsaturated zone.

The mounding analysis indicates that loading the two _____ ft. by ___ ft. beds with 6450 gpd over a one year period will result in a ground water mound x feet above the current ground water table (see Appendix D).

SITE DESCRIPTION

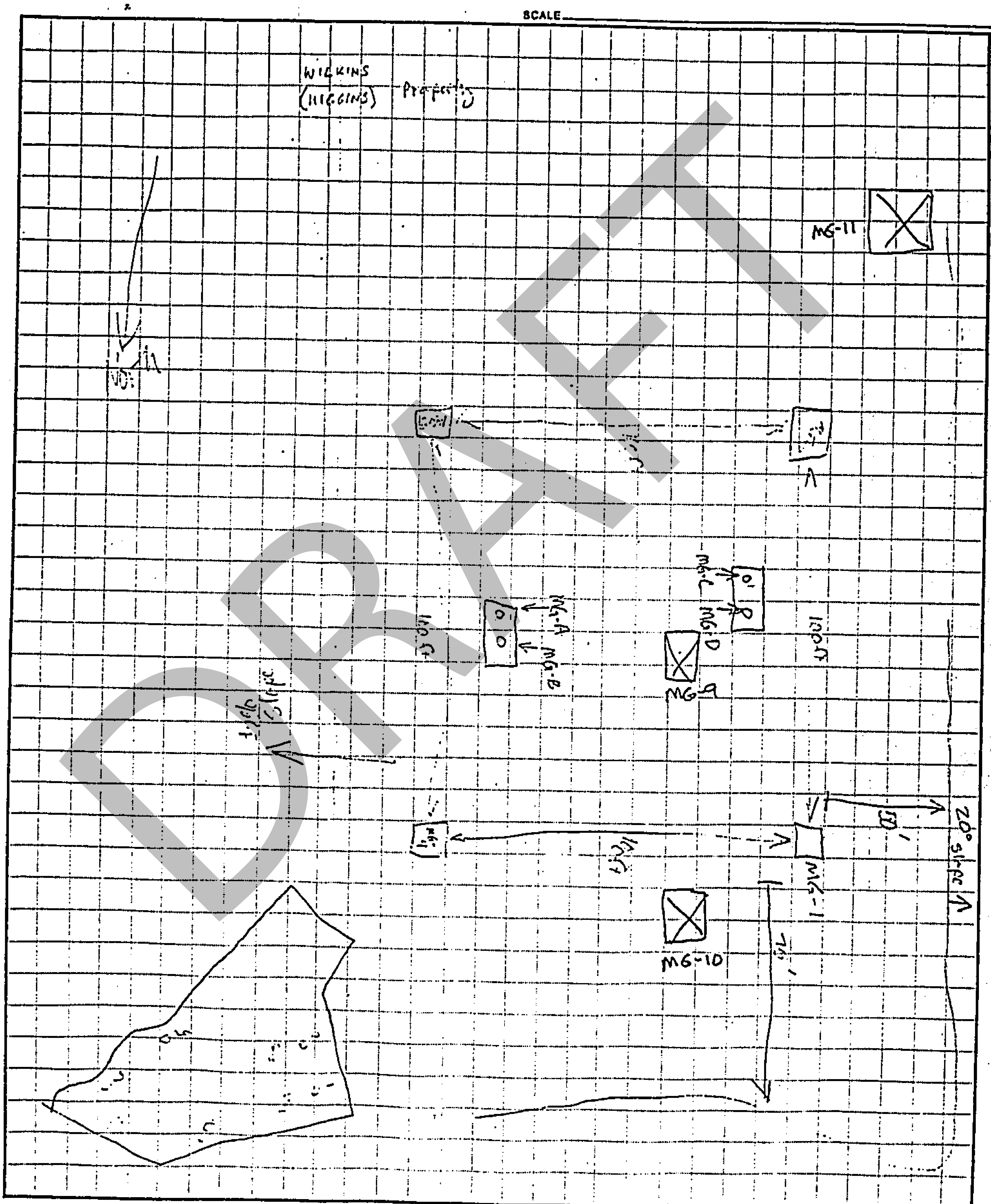
The project area consists of a 5.3 acre parcel located along ____ road in Moretown, Vermont. The parcel is part of a terrace that appears to be deltaic in origin and was originally deposited in conjunction with glacial lake Vermont. As observed during our test pits, the uppermost soils (beneath the surficial organic soils) consist of clean, well sorted sands and gravels which are consistent with deltaic deposition. It is likely that the source of these materials would be the Mad River tributary that has since carved the step-sided valley which is presently located directly south of the project area. There was no indication of groundwater within 8 feet of ground surface in the area of the disposal field. Some minor iron staining was observed at depths of 3 feet, with heavier manganese straining occurring consistently 1 foot above the contact between the coarse sands ant the loamy sand. Both of these conditions are attributed to relict groundwater conditions, primarily because conditions at the time of deposition a well as shortly thereafter would have included groundwater levels much closer to ground surface than occurs presently. In addition, groundwater is presently greater than 14 feet below ground surface and there is no indication of a continuous impeding layer or any sign of blockage neat the bluff that would contain any groundwater. Also, there is insufficient recharge area to expect groundwater levels to rise more than the eight feet necessary to result in failure of the in-ground disposal system. Finally, magnesium is easily reduced and would go into solution if groundwater levels were regularly higher than the level at which manganese was observed.

MORETOWN.GEN

SCW/cll

THE JOHNSON COMPANY, INC.
5 State Street
MONTPELIER, VERMONT 05602
(802) 229-4600

JOB ______
SHEET NO. ______ OF ______
CALCULATED BY ______ DATE ______
CHECKED BY ______ DATE ______
SCALE ______



PRODUCT 204-1 NEBS Inc., Groton, Mass. 01471

THE JOHNSON COMPANY, INC.
5 State Street
Montpelier, Vermont 05602
(802)229-4600

Client/Project:	Moretown Grocery
Job #:	1-1601-5(11)
City/Town/State:	Moretown, Vermont

Test Pit Number:	MG-1
Location:	Higgins Property
Evaluator:	Steve Wrenn
Date:	December 2, 1988

Soil Profile (Color, Texture, Consistency, Structure, Mottling):

0 - 10"	Dark brown, fine sandy loam, friable, angular blocky, damp.
10" - 21"	Dark yellowish brown, gravelly sand, firm, single grain, damp.
21" - 60"	Olive brown, sandy gravel, gravelly sand, very firm,firm in place, loose removed, some boulders, single grain, iron staining at 36".
60" - 120"	Grayish brown, loamy fine sand(contains lenses of coarse sand), friable, angular blocky, day.

Summary:

Test Pit Bottom: 120"
Reason for Stopping: bottom of pit
ESHWT: N/A
Restrictive Layer: none
Depth of Roots: 21"
Bedrock Depth: N/A
Depth Water Observed:N/A

Notes:

Surface Elevation: N/A
Surface Slope: 0-5%
Surface Vegetation: grasses
Parent Material: Glacial Outwash
SCS Soil: N/A
Depth Perc.test should be performed: 60"

Other:

MG-1

THE JOHNSON COMPANY, INC.
5 State Street
Montpelier, Vermont 05602
(802)229-4600

Client/Project:	Moretown Grocery
Job #:	1-1601-5(11)
City/Town/State:	Moretown, Vermont

Test Pit Number:	MG-2
Location:	Higgins Property
Evaluator:	Steve Wrenn
Date:	December 2, 1988

Soil Profile (Color, Texture, Consistency, Structure, Mottling):

0"-8"	Dark brown, fine sandy loam, very friable, granular, damp.
8"-18"	Dark yellowish brown, sandy loam, friable, angular blocky, damp.
18"-30"	Dark yellowish brown, gravelly sand w/some cobbles, firm as before, angular blocky, damp.
30"-36"	Grayish brown, sandy gravel, firm in place, loose removed, single grain, some iron staining, damp.
36"-58"	Grayish brown, gravelly sand, firm in place, loose removed, single grain, damp.
58"-190"	Light olive brown, sand to loamy fine sand includes thin lenses of coarse sand, firm, angular blocky, damp.

Summary:

Test Pit Bottom: 120"
Reason for Stopping: botton of pit
ESHWT: N/A
Restrictive Layer: none
Depth of Roots: 36"

Bedrock Depth: N/A
Depth Water Observed: N/A

Notes:

Surface Elevation: N/A
Surface Slope: 0-5%
Surface Vegetation: grasses
Parent Material: Glacial Outwash
SCS Soil: N/A
Depth Perc.test should be performed: 60"
Other: MG-2

THE JOHNSON COMPANY, INC.
5 State Street
Montpelier, Vermont 05602
(802)229-4600

Client/Project:	Moretown Grocery
Job #:	1-1601-5(11)
City/Town/State:	Moretown, Vermont

Test Pit Number:	MG-3
Location:	Higgins Property
Evaluator:	Steve Wrenn
Date:	December 2, 1988

Soil Profile (Color, Texture, Consistency, Structure, Mottling):

0-9"	Dark brown, fine sandy loam, very friable, granular, damp.
9"-19"	Dark brown, sandy loam w/some gravel, firm in place, loose removed, single grain, damp.
19"-30"	Grayish brown, gravelly coarse sand, firm in place, loose removed, single grain, damp.
30"-53"	Grayish brown, sandy gravel, firm in place, loose removed, single grain, damp.
53"-74"	Grayish brown, gravelly coarse sand, firm in place, single grain, damp.
74"-120"	Light olive brown, loamy sand to loamy fine sand, firm, angular blocky, damp.

Summary:

Test Pit Bottom: 120"
Reason for Stopping: N/A
ESHWT: N/A
Restrictive Layer: N/A
Depth of Roots: 30"

Bedrock Depth: N/A
Depth Water Observed:N/A

Notes:

Surface Elevation: N/A
Surface Slope: 0-5%
Surface Vegetation: grasses
Parent Material: Glacial Outwash
SCS Soil: N/A
Depth Perc.test should be performed: 74"

Other:
MG-3

THE JOHNSON COMPANY, INC.
5 State Street
Montpelier, Vermont 05602
(802)229-4600

Client/Project:	Moretown Grocery .
Job #:	1-1601-5(11)
City/Town/State:	Moretown, Vermont

Test Pit Number:	MG-4
Location:	Higgins Property
Evaluator:	Steve Wrenn
Date:	December 2, 1988

Soil Profile (Color, Texture, Consistency, Structure, Mottling):

0-8"	Dark brown, fine sandy loam, friable, angular blocky, damp.
8"-24"	Dark yellowish brown, silt loam, friable, angular blocky, moist.
24"-72"	Grayish brown, gravely coarse sand, firm in place, loose removed, single grain, damp.
72"-120"	Light olive brown, loamy sand, firm, angular blocky, damp.

Summary:

Test Pit Bottom: 120"
Reason for Stopping: N/A
ESHWT: N/A
Restrictive Layer: N/A
Depth of Roots: N/A

Bedrock Depth: N/A
Depth Water Observed:N/A

Notes:

Surface Elevation:
Surface Slope: 0-5%
Surface Vegetation: grasses
Parent Material: Glacial Outwash
SCS Soil: N/A
Depth Perc.test should be performed: 72"

Other:
MG-4

THE JOHNSON COMPANY, INC.
5 State Street
Montpelier, Vermont 05602
(802)229-4600

Client/Project:	Moretown Grocery
Job #:	1-1601-5(11)
City/Town/State:	Moretown, Vermont

Test Pit Number:	MG-5
Location:	Higgins Property
Evaluator:	Steve Wrenn
Date:	December 2, 1988

Soil Profile (Color, Texture, Consistency, Structure, Mottling):

0-10	Dark brown, fine sandy loam, friable, angular blocky, damp.
10"-23"	Dark yellowish brown, loamy fine sand, friable, angular blocky, damp.
23"-33"	Grayish brown, coarse sand w/small gravels, firm, in place, loose removed, single grain, damp.
33"-72"	Grayish brown, gravelly coarse sand, firm in place, loose removed, single grain, damp.
72"-120"	Light olive brown, loamy sand w/lenses of coarse sand, friable, angular blocky, damp.

Summary:

Test Pit Bottom: 120"
Reason for Stopping: N/A
ESHWT: N/A
Restrictive Layer: N/A
Depth of Roots: 40"
Bedrock Depth: N/A
Depth Water Observed: N/A

Notes:

Surface Elevation: N/A
Surface Slope: 0-5%
Surface Vegetation: grassey
Parent Material: Glacial Outwash
SCS Soil: N/A
Depth Perc.test should be performed: 72"

Other:

MG-5

5 State Street
Montpelier, Vermont 05602
(802)229-4600

Client/Project: Moretown Grocery
Job #: 1-1601-5(11)
City/Town/State: Moretown, Vermont

Test Pit Number: MG-6
Location: Higgins Property
Evaluator: Steve Wrenn
Date: December 2, 1988

Soil Profile (Color, Texture, Consistency, Structure, Mottling):

0-8"	Dark brown, fine sandy loam, friable, angular blocky, damp.
8"-22"	Dark yellow brown, loamy sand w/gravels & cobble, friable, angular blocky, damp.
22"-32"	Dark yellowish brown, gravelly sand, some cobbles, friable, angular blocky, some iron staining at 48", damp.
32"-40"	Dark yellowish brown, loamy fine sand, friable, angular blocky, moist.
40"-55"	Grayish brown, gravelly coarse sand(some cobbles), firm in place, single grain, damp.
55"-72"	Grayish brown, gravelly sand, friable, single grain, damp.
72"-128"	Light olive brown, loamy fine sand(occasional thin coarse sand lenses), friable, angular blocky, damp.

Summary:

Test Pit Bottom: 128'
Reason for Stopping: N/A
ESHWT: N/A
Restrictive Layer: N/A
Depth of Roots: 32"

Bedrock Depth: N/A
Depth Water Observed:N/A

Notes:

Surface Elevation: N/A
Surface Slope: 0-5%
Surface Vegetation: grasses
Parent Material: Glacial Outwash
SCS Soil: N/A
Depth Perc.test should be performed: 72"
Other:

MG-6

THE JOHNSON COMPANY, INC.
5 State Street
Montpelier, Vermont 05602
(802)229-4600

Client/Project:	Moretown Grocery
Job #:	1-1601-5(11)
City/Town/State:	Moretown, Vermont

Test Pit Number:	MG-7
Location:	Higgins Property
Evaluator:	Steve Wrenn
Date:	December 2, 1988

Soil Profile (Color, Texture, Consistency, Structure, Mottling):

0-10"	Dark brown, fine sandy loam, friable, angular blocky, damp.
10"-58"	Dark yellow brown/grayish brown, gravelly sand/sandy gravel w/cobbles & stones to 24", firm in place, single grain.
58"-80"	Grayish brown, gravelly sand, friable, angular blocky, damp.
80"-100"	Grayish brown, loamy fine sand, friable, angular blocky, damp.
100"-130"	Light olive brown, loamy fine sand, firm, angular blocky, moist to wet.

Summary:

Test Pit Bottom: 120"
Reason for Stopping: N/A
ESHWT: N/A
Restrictive Layer: N/A
Depth of Roots: 30"

Bedrock Depth: N/A
Depth Water Observed:N/A

Notes:

Surface Elevation: N/A
Surface Slope: 0-5%
Surface Vegetation: grasses
Parent Material: Glacial Outwash
SCS Soil: N/A
Depth Perc.test should be performed: 60"

Other:

MG-7

THE JOHNSON COMPANY, INC.
5 State Street
Montpelier, Vermont 05602
(802)229-4600

Client/Project:	Moretown Grocery
Job #:	1-1601-5(11)
City/Town/State:	Moretown, Vermont

Test Pit Number:	MG-8
Location:	Higgins Property
Evaluator:	Steve Wrenn
Date:	December 2, 1988

Soil Profile (Color, Texture, Consistency, Structure, Mottling):

0-10"	Dark brown, fine sandy loam, very friable, angular blocky, damp.
10"-30"	Dark yellowish brown, loamy sand, friable, angular blocky, damp.
30"-84"	Grayish brown, gravelly sand, sandy gravel, some cobbles and stones to 12", firm in place, single grain, damp.
84"-130"	Light olive brown, loamy fine sand, friable, angular blocky, damp to moist.

Summary:

Test Pit Bottom: N/A
Reason for Stopping: N/A
ESHWT: N/A
Restrictive Layer: N/A
Depth of Roots: 30"
Bedrock Depth: N/A
Depth Water Observed: N/A

Notes:

Surface Elevation: N/A
Surface Slope: 0-5%
Surface Vegetation: grasses
Parent Material: Glacial Outwash
SCS Soil: N/A
Depth Perc.test should be performed: 30"

Other:

DATE	ACTION	BY
12/2/88	Test	SCW
12/5/88	Computations	SCW
	Checked	

PERCOLATION TEST DATA AND COMPUTATIONS

The Johnson Company, Inc.
5 State Street
Montpelier, VT 05602

Client: Palisades Landfill, Inc.

Address:

Project: Moretown Store & Property Investigation

Location: WILKINS Property

Percolation Test Hole No.: MG-A

Depth from normal ground surface to:

- bottom of hole = 88 inches
- top of pea stone filter = — inches
- water surface (drop = 0.0) = 74 inches

Specified drop = 4 inches

Results of regression analysis for Power Curve Fit, $y = ax^b$

Regression Coefficients: $a = 0.33$, $b = 0.32$

Coefficient of Determination $r^2 = 0.98$

Percolation rate for x=1440 min, y = 3.38 min./inch

Test	Test Run		Fill Time			Drop Time, t		Elapsed Time, t		Drop, H		dT/dH
	Begin Time	End Time	Fill Time	Convert to	Average		Convert to	dT	Accum (x-axis)	dH	Accum	Min/in (y-axis)
No.	h m s	h m s	seconds	dec.min	dec.min	min.sec	dec.min	dec.min	dec.min	inch	inch	dec.min
					Σ Col.5/n	Col. 3-2		Col.6+8				Col.9/11
1	2	3	4	5	6	7	8	9	10	11	12	13
1	0:00	1:15				1:15	1.25	1.47	1.47	4	4	0.37
2	1:35	3:30	:20	.33		1:55	1.92	2.14	3.61	4	8	0.53
3	3:43	5:41	:13	.22		1:58	1.97	2.19	5.80	4	12	0.55
4	5:56	8:26	:15	.25		2:30	2.50	2.72	8.52	4	16	0.68
5	8:48	11:30	:18	.30		2:42	2.70	2.92	11.44	4	20	0.73
6	11:44	14:35	:14	.23	.27	2:51	2.85	3.07	14.52	4	24	0.77
			80		.22							

DRAFT

PERCOLATION TEST DATA AND COMPUTATIONS

The Johnson Company, Inc.
5 State Street
Montpelier, VT 05602

DATE	ACTION	BY
12/2/98	Test	scw
12/5/88	Computations	scw
	Checked	

Client: PALISADES LANDFILL, Inc.

Address:

Project: MORETOWN STORE & PROPERTY INVESTIGATION

Location: WILKINS PROPERTY

Percolation Test Hole No.: MG-B

Depth from normal ground surface to:

- bottom of hole = 52 inches
- top of pea stone filter = inches
- water surface (drop = 0.0) = 42 inches

Specified drop = 2" inches

Results of regression analysis for Power Curve Fit, $y = ax^b$

Regression Coefficients: $a = 0.36$, $b = 0.37$

Coefficient of Determination $r^2 = 0.95$

Percolation rate for x=1440 min, y = 5.31 min./inch

Test	Test Run		Fill Time			Drop Time, t		Elapsed Time, t		Drop, H		dT/dH
	Begin Time	End Time	Fill Time	Convert to	Average		Convert to	dT	Accum. (x-axis)	dH	Accum	Min/in (y-axis)
No.	h m s	h m s	seconds	dec.min	dec.min	min.sec	dec.min	dec.min	dec.min	inch	inch	dec.min
					ΣCol.5/n	Col. 3-2		Col.6+8				Col.9/11
1	2	3	4	5	6	7	8	9	10	11	12	13
1	0:00	0:23				0.23	0.38	0.64	0.64	2	2	0.32
2	0:38	1:07	:15			0.29	0.48	0.74	1.38	2	4	0.37
3	1:26	2:16	:19			0.50	0.83	1.09	2.47	2	6	0.55
4	2:36	3:30	:20			0.54	0.90	1.16	3.63	2	8	0.58
5	3:53	4:56	:23			1.03	1.05	1.31	4.93	2	10	0.65
			77		.26							

PERCOLATION TEST DATA AND COMPUTATIONS

The Johnson Company, Inc.
5 State Street
Montpelier, VT 05602

DATE	ACTION	BY
12/2/88	Test	SCW
12/5/88	Computations	SCW
	Checked	

Client: PALLISADES LANDFILL, INC

Address:

Project: MORETOWN STORE & PROPERTY INVESTIGATION

Location: MORETOWN, VT

Percolation Test Hole No.: MG-C

Depth from normal ground surface to:
- bottom of hole = 60 inches
- top of pea stone filter = – inches
- water surface (drop = 0.0) = 50 inches
- Specified drop = 4 inches

Results of regression analysis for Power Curve Fit, Regression Coefficients: $y = ax^b$

$a = .13$

$b = .23$

Coefficient of Determination $r^2 = .96$

Percolation rate for x=1440 min, y = 0.69 min./inch

Test	Test Run		Fill Time			Drop Time, t		Elapsed Time, t		Drop, H		dT/dH
	Begin Time	End Time	Fill Time	Convert to	Average		Convert to	dT	Accum (x-axis)	dH	Accum	Min/in (y-axis)
No.	h m s	h m s	seconds	dec.min	dec.min	min.sec	dec.min	dec.min	dec.min	inch	inch	dec.min
					Σ Col.5/n	Col. 3–2		Col.6+8				Col.9/11
1	2	3	4	5	6	7	8	9	10	11	12	13
1	0:00	0:20				0.20	0.33	0.45	0.45			0.11
2	0:30	0:54	:10			0.24	0.40	0.52	0.97			0.13
3	1:01	1:30	:07			0.29	0.48	0.60	1.58			0.15
4	1:40	2:10	:10			0.30	0.50	0.62	2.19			0.15
5	2:17	2:52	:07			0.35	0.58	0.70	2.90			0.18
6	3:01	3:35	:09			0.34	0.57	0.69	3.58			0.17
			43		.12							

PERCOLATION TEST DATA AND COMPUTATIONS

The Johnson Company, Inc.
5 State Street
Montpelier, VT 05602

DATE	ACTION	BY.
12/2/88	Test	SLW
12/5/88	Computations	SLW
	Checked	

Client: PALLISADES LANDFILL, INC

Project: MORETOWN STORE & PROPERTY INVESTIGATION

Address:

Location: MORETOWN VT

Percolation Test Hole No.: M6-D
Depth from normal ground surface to:
bottom of hole = 30 inches
top of pea stone filter = – inches
water surface (drop = 0.0) = 20 inches
Specified drop = 4 inches

Results of regression analysis
for Power Curve Fit, $y = ax^b$
Regression Coefficients: $a = 0.10$
$b = 0.23$
Coefficient of Determination $r^2 = 0.96$
Percolation rate for x=1440 min, y = 0.53 min./inch

Test	Test Run		Fill Time			Drop Time, t		Elapsed Time, t		Drop, H		dT/dH
	Begin Time	End Time	Fill Time	Convert to	Average		Convert to	dT	Accum. (x–axis)	dH	Accum	Min/in (y–axis)
No.	h m s	h m s	seconds	dec.min	dec.min	min.sec	dec.min	dec.min	dec.min	inch	inch	dec.min
					ΣCol.5/n	Col. 3–2		Col.6+8				Col.9/11
1	2	3	4	5	6	7	8	9	10	11	12	13
1	0:00	0:09				0.09	0.15	0.30	0.30	4	4	0.07
2	0:22	0:35	13			0.13	0.22	0.36	0.66		8	0.09
3	0:47	1:02	12			0.15	0.25	0.40	1.06		12	0.10
4	1:11	1:26	09			0.15	0.25	0.40	1.46		16	0.10
5	1:36	1:53	10			0.17	0.28	0.43	1.89		20	0.11
6	2:03	2:16	10			0.13	0.22	0.36	2.25		24	0.09
7	2:24	2:42	08			0.18	0.30	0.45	2.70		28	0.11
			62		0.15							

16 MORRSTOWN STORE 12/24/88

(BOB DOWDELL, OWNER)

SITE VISIT / STEAM ...

[illegible]

BIOLOGY

0-6 ... SAND ...

... SAND ...

OTA GRAY

6.6-8.2 ... SAND ...

8.2-9' ...

2 0-2 GR. L SAND

2-5.6 gravel ... sand ...

5.6-9 Strat. sand & L sand

6-

9.5

7 ...

8 0-2 ... SAND

2-6 GR SAND

6-7 SAND

7-8 ... DIPPING STRATA

RECEIVED
JUN 21 1990
DIVISION OF PROTECTION

ERIC BLATT,
BARRE OFFICE

BLACK RIVER DESIGN

PROJECT: (name, address) Moretown School Relocatable Units

ARCHITECT'S PROJECT NO:

DATE: 6/20/90

TO: Eric Blatt, Regional Engineer District 5 Environmental Office

RECEIVED JUN 21 1990 DIVISION OF PROTECTION

If enclosures are not as noted, please inform us immediately.

If checked below, please:

( ) Acknowledge receipt of enclosures.

( ) Return enclosures to us.

ATTN:

WE TRANSMIT:

(X) herewith ( ) under separate cover via

( ) in accordance with your request

FOR YOUR:

(X) approval ( ) distribution to parties ( ) information

( ) review & comment ( ) record

( ) use ( )

THE FOLLOWING:

(X) Drawings ( ) Shop Drawing Prints ( ) Samples

( ) Specifications ( ) Shop Drawing Reproducibles ( ) Product Literature

( ) Change Order ( )

COPIES	DATE	REV. NO.	DESCRIPTION	ACTION CODE
2	6/14/90		Building & Site Plan	
2	6/1/90		Schematic Site Proposal	

ACTION CODE

A. Action indicated on item transmitted

B. No action required

C. For signature and return to this office

D. For signature and forwarding as noted below under REMARKS

E. See REMARKS below

REMARKS

COPIES TO: (with enclosures)

Charles Grenier (1)

BY: Tom Cood.

1640 MASSACHUSETTS AVENUE
CAMBRIDGE, MASSACHUSETTS 02138
(617) 661-7086

73 MAIN STREET
MONTPELIER, VERMONT 05602
(802) 223-2044

State of Vermont

479-3621
Agency of Natural Resources
Dept. of Environmental Conservation
324 North Main Street
Barre, Vermont 05641

Department of Fish and Wildlife
Department of Forests, Parks and Recreation
Department of Water Resources & Environmental Engineering
Natural Resources Conservation Council

June 6, 1990

Moretown Elementary School
Moretown, VT 05660

Dear Applicant:

RE: WW-5-0227 , add temporary classrooms, MORETOWN

We received your completed application for the above referenced project on June 6, 1990, including a fee of $0. This application falls under the Water/Wastewater: Less than 500 GPD program and under the Performance Standards for this program area we have a maximum of 30 days of "in-house" time for our review of your application.

Based upon the present workload, we anticipate review of your project within the next two to three weeks.

If a Project Review Sheet is not attached to this letter, it will be sent under separate cover. A Project Review Sheet indicates other State agencies you should contact regarding any approvals you may need under their programs.

If you have not already done so, you should check with town officials regarding any local requirements you may need to meet.

DEPARTMENT OF ENVIRONMENTAL CONSERVATION

BY Alida J. Conti
Alida J. Conti, Administrative Secretary

CC Town Planning Commission
Charles Grenier

~~Fee paid by check~~ #________

App. # WW-5-0227
(office use only)

AGENCY OF NATURAL RESOURCES
Permits, Compliance & Protection Division

WATER SUPPLY & WASTEWATER DISPOSAL

(See instructions on back. Contact District Environmental Office if questions.)

LANDOWNER:

Name: Moretown Elementary School

Address: Moretown, Vermont 05660
(mail)

Tel. No.: 496-3742

APPLICANT: (if other than landowner)

Name: Same

RECEIVED
JUN 6 1990
DIVISION OF PROTECTION

Address:
(mail)

Tel. No.:

BUSINESS NAME IF OTHER THAN ABOVE:

CONSULTANT: (architect, engineer, plumber)

Name: Charles J. Grenier, Consulting Engineer Tel. No.: 244-6413

Address: P.O. Box 445 (street) Waterbury (town) Vermont (state) 05676 (zip)
(mail)

PROJECT:

Location: (Attach map) Town: Moretown Road/Highway: Vermont Route 100B

A. Size of Parcel: (include all adjacent tracts of land which you may own, or control by lease, option, etc.) 160 ± acres

B. Does landowner own or control (lease, option, etc.) any other property within a 5-mile radius: Yes ___ No X . If so, what? ___ Acreage: ___

List any prior Environmental or Act 250 permits issued for A & B above: PB-5-0523

Describe the project: (Be specific: see item #1 on back) (Attach 2 sets of plans)

Add temporary classroom or library space to existing Moretown Elementary School

TYPE OF WATER SOURCE: (Municipal, offsite, community, onsite) onsite drilled well
(Attach approvals - see #6 on back).

TYPE OF SEWAGE DISPOSAL: (Municipal, offsite, community, onsite) onsite leachfield
(If municipal, attach approval - see #5 on back)

Number of gallons of sewage generated: 2860 GPD (no increase in flow)

Project Cost: (Building and site improvements only. DO NOT include cost of land, plant equipment, etc.) TOTAL COST: Unknown at this time, $30,000±

APPLICATION FEE: Sewage Flows: 0 - 499 gpd - $60.00; 500 - 1000 gpd - $100.00; over 1000 gpd - $175.00, payable to STATE OF VERMONT. AMOUNT ENCLOSED N/A

5/30/90 (date) Debra A. Merrick (signature of landowner) ___ (date) ___ (signature of applicant)

Chairperson Moretown Board of School Directors

THERE IS TO BE NO SITE WORK OR CONSTRUCTION COMMENCED ON THIS PROJECT WITHOUT WRITTEN APPROVAL FROM THE AGENCY OF NATURAL RESOURCES.

R. 7/88

CHARLES GRENIER
CONSULTING ENGINEER PC
BOX 445 244-6413
WATERBURY, VT. 05676

May 3Ø, 199Ø

RECEIVED
JUN 6 1990
DIVISION OF PROTECTION

Eric Blatt, Regional Engineer
District #5 Environmental Office
324 North Main Street
Barre, Vermont Ø5641

RE: Temporary Classrooms for Moretown Elementary School

Dear Eric:

As a result of our recent meeting and discussions with the Building Committee and Principal, Jean Eisele, we have prepared the attached Water Supply and Wastewater Disposal permit for your review. The Moretown Elementary School is proposing temporary classrooms to help solve their overcrowding problem while long term solutions are being considered. Black River Design, the architects for the School are deciding whether to use the temporary building for classroom or library space.

We reviewed our files and Public Building Permit 5-Ø523 issued January 21, 1983. A September 2Ø, 1982 letter from our office explained the 1982 capacities of the existing water and sewer systems at the School. It is our determination that the septic system capacity of the School was based upon a total population of 143 people (131 students plus 12 staff) at that time and 2Ø gallons per capita was used in calculating the wastewater design flow. The total design flow was 286Ø GPD.

Until December of 1989 hot lunches were prepared at the School. The School Board decided to eliminate food preparation at the School at that time. As a result of this change, State regulations allow 15 gallons per capita per day to be used in estimating the wastewater design flow. We visited the School and witnessed the operation of the kitchen area which is only used to serve meals prepared at Harwood Union High School and to wash the trays and serving implements. It is estimated that the dishwasher in the kitchen will use not more than 1ØØ gallons per day and that an additional 3Ø gallons per day is necessary to wash some of the bigger trays in the three bay sink. As a result, we would subtract 13Ø gallons per day from the total of 286Ø available gallons yielding a maximum of 273Ø GPD for bathroom use at the School. Using 15 gallons per capita, means that a total population level of 182 is acceptable for the School.

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JUN 6 1990
DIVISION OF PROTECTION

After speaking with Principal, Jean Eisele, we received a copy of the projected School population through 1997. The following is a summary of the population projections.

School Year	Estimated Student Population	Staff Requirements	Total Building Population
1989-1990	152	17	169
1990-1991	164	18	182
1991-1992	175	18	193
1992-1993	196	18	214
1993-1994	208	18	226
1994-1995	214	18	232
1995-1996	204	18	222
1996-1997	210	18	228

The projected school population in September of 1991 is 193 which exceeds the septic system capacity of 182. However, it maybe unrealistic to expect a solution to Moretown's school problems by September 1991. In conclusion, it is our opinion that the Moretown Elementary School can meet State wastewater disposal requirements until September of 1992 when the total School population is expected to increase to 214 people. As a result of the elimination of the hot lunch program, the Moretown School system has "two years" in which to solve their wastewater disposal problems. At this time a conscientious effort is being made by the Building Committee to resolve the problem. Acceptable wastewater disposal sites near the School have not yet been secured. A continued effort towards resolving the long term wastewater disposal needs of the School is being undertaken.

If any questions arise as a result of this letter, please do not hesitate to contact us. This letter was reviewed prior to submittal by members of the Building Committee and Moretown Elementary School Principal, Jean Eisele.

Respectfully,

Charles J. Grenier

Charles J. Grenier
Consulting Engineer, P.C.

CJG:lar

cc. Sam Scofield
David Clemons
John Rahill
Jean Eisele
Jack Barnes

DRAFT

State of Vermont

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JUN 6 1990
DIVISION OF PROTECTION

LAND USE PERMIT

CASE No. PB-5-0523
APPLICANT Moretown School Board
ADDRESS Moretown, VT 05660

LAWS/REGULATIONS INVOLVED

Environmental Protection Rules
Chapter 4, Public Buildings
Chapter 9, Plumbing
Vermont Health Regulations,
Chapter 5, Subchapter 3, School-house Regulations

This project, consisting of the construction of two new classrooms and the renovation of an existing classroom and toilet room, located off Route 100B, Moretown, Vermont, is hereby approved under the requirements of the regulations named above, subject to the following conditions:

1. The project must be completed as shown on the plans listed as follows: Drawing A.2, floor plan, dated 11/24/82, prepared by C.S. Ltd., Architects; Drawing HV&P, dated 11/24/82, last revised 12/10/82, prepared by Steve Beloin; Drawing HV&P2, dated 11/24/82, last revised 12/10/82, prepared by C.S. Ltd., Architects; Mechanical specifications, dated 11/1/82, prepared by C.S. Ltd., Architects, and which have been stamped "APPROVED" by the Division of Protection. No alterations of these plans shall be allowed except where written application has been made to the Agency of Environmental Conservation and approval obtained.

2. A copy of the approved plans and the Land Use Permit shall remain on the project during all phases of construction and, upon request, shall be made available for inspection by State or local personnel.

3. The Vermont Department of Health is to be contacted in regards to any regulations and/or licenses required by their department. (They may be reached at 60 Main Street, Burlington, Vermont 862-5701 ext. 321.)

4. The applicant is reminded that all plumbing material and workmanship must meet the standards of the Environmental Protection Rules, Chapter 9-Plumbing, the National Plumbing Code, and the requirements of the Vermont Fire Prevention Section of the Department of Labor and Industry.

4A. The exhaust through the two toilet rooms in each of the four classrooms in the 1959 addition must be approved by the Board of Health. A copy of their approval shall be submitted to this office for our consideration.

5. Upon completion of the rough-in for the waste plumbing, and prior to said plumbing being covered or closed-in, the Agency of Environmental Conservation is to be contacted so that we may have the opportunity to inspect the workmanship.

6. This project is served by an existing on-site wastewater disposal system as shown on the site plan prepared by Charles Grenier, P.E., dated 6/23/81 and last revised

(CONTINUED)

LAND USE PERMIT
PB-5-0523
Moretown School Board
PAGE 2

October 20, 1982, The system shall be operated in a manner that will not allow the discharge of effluent onto the surface of the ground or into waters of the State. An inspection of the system shall be conducted during the spring of 1983 shortly after the snow melts. If any evidence of failure is observed during the inspection, plans prepared by a Vermont Registered Professional Engineer must be submitted for a new system. The new system must be installed prior to July 1, 1983.

7. The school is served by an existing drilled well water supply.

FOR THE DEPARTMENT OF WATER RESOURCES AND ENVIRONMENTAL ENGINEERING

EB 1/21/83

Eric Blatt, District Administrator

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JUN 6 1990
DIVISION OF PROTECTION

cc Town Planning Commission
C.S. Architects
Charles Grenier ✓
Gary Shultz

CHARLES GRENIER
CONSULTING ENGINEER
WATERBURY, VT. 05676 · 244-6413
BOX 445

October 20, 1982

RECEIVED

JUN 6 1990

DIVISION OF PROTECTION

Mr. Eric Blatt
Regional Engineer
District #5 Environmental Office
255 North Main Street
Barre, Vermont 05641

Re: Water and Septic Systems at Moretown Elementary School

Dear Eric;

Enclosed with this letter are several attachments which show the design and locations of the water and septic systems at the Moretown Elementary School. It is our understanding in speaking with Bruce Wade from C. S. Architects that the proposed school expansion is to provide the classroom necessary for a better educational facility. The only work in the school involving plumbing would be to relocate two existing sinks in the old building and to renovate an existing bathroom in the new building to provide a handicapped toilet. It is our understanding that the total population of the school is 131 students and 12 staff members giving a total occupancy of 143 people.

A new well was drilled in August of 1981 for the School and major revisions to the water system were completed. We feel that beyond any question that this water system is adequate at this time to meet the school's needs because the well was pump tested for 72 hours and improvements to the water system were made. We are certain that once you review the attached plans that you will concur.

The original septic system for the school, which was constructed in 1959, has been shown on plans prepared by architect Julian Goodrich of South Burlington, Vermont. An attached site plan prepared by our office shows the approximate location of thisseptic system. The original septic system had a disposal area of at least 840 square feet. To our understanding this septic system lasted until its' failure in 1977.

Lloyd Grount, a local contractor was called in to renovate this septic system in May of 1977. Upon excavating the distribution box he found it completely plugged with sludge. It is our understanding, speaking with Mr. Grout's employee and with Mr. Lincoln, the superintendent of Washington West School District that the distribution box shown on the attached site plans was cleaned and a new leach field constructed in a location shown approximately on our site plan. This new leach field appears to cover an area of approximately 30' x 60' and is raised 12" to 18" above the normal ground. We are under the impression that the new leach field is a bed system and may have a square foot area varying from 1200 to 1800 square feet. A bill of sale shows 480' of 4" perforated pipe and 36 cubic yards of crushed stone.

On October 12th the writer visited the Elementary School site and could find no evidence that any problem with the septic system was occurring. There was no evidence of sewage surfacing and no odor was present. There are clay soils in the area but there may be an adequate loamy soil over the clay to allow for percolation. On October 20th a test pit was dug near the septic system revealing: 0-1' topsoil, 1-2' loam, 2-3½' silt, 3½-8' clay, no water to depth, mottles in silt layer.

Based upon the fact that the original septic system lasted 18 years before plugging, we feel that there is a good chance that the septic system constructed in 1977 may last many years. However, in the event that the septic system were to fail there appears to be adequate room South of the leach field area to construct another septic system. We would recommend raising the system to insure proper treatment.

We hope you will concur with our opinion so that a Public Building Permit can be issued allowing the addition to the school to be constructed.

If any questions arise concerning this information, please do not hesitate to contact us immediately, due to the fact that construction must start soon to beat the weather.

Respectfully,

Charles J. Grenier

Charles J. Grenier, P. E.

c.c. Bruce Wade
Moretown Elementary School Board

RECEIVED
JUN 6 1990
DIVISION OF PROTECTION

AGENCY OF NATURAL RESOURCES AND ENVIRONMENTAL BOARD
PROJECT REVIEW SHEET

District# 5
Application # WW-5-0227

THIS IS NOT A PERMIT

Applicant Moretown Elem. School
Town Moretown
Mail: Moretown 05660

On 6/18/90 I reviewed information concerning a project on a tract/tracts of land of 160 ± acres, proposed by Moretown Elem. School. The project will be on Lands owned by Same in Moretown, Vermont, and is generally described as:
Construct/add temporary classroom or library space to existing school. Onsite water supply & sewage disposal. On Rte 100B.

Prior permits from this office: ______

A permit must be obtained for this project under the following permit programs which I have checked: NO ACT 250. PERMITS/COMPLIANCE/PROTECTION PERMITS: ______ Deferral of Subdivision Yes Water Supply & Wastewater Disposal ______ Subdivision ______ Tent/Trailer ______ Mobile Home Park ______ Stream Alteration ______ Municipal Sewer Line Ext. FISH & WILDLIFE PERMIT: ______ Stream Obstruction. THESE ARE THE ONLY PERMITS OBTAINABLE FROM THIS OFFICE. NO CONSTRUCTION OR SALE OF LOTS IS PERMITTED UNTIL ALL PERMITS CHECKED ABOVE HAVE BEEN ISSUED IN WRITING.

The above jurisdictional determination is based upon information provided and the following:

>10 acres involved

THIS IS AN ADVISORY OPINION AND MAY BE APPEALED. ANY PARTY WHO DISAGREES WITH THIS OPINION MAY REQUEST A REVIEW DIRECTLY BY THE EXECUTIVE OFFICER OF THE ENVIRONMENTAL BOARD (ACT 250), OR THE DIRECTOR OF THE PROTECTION DIVISION, AS APPROPRIATE WITHIN 30 DAYS OF DECISION.

I also recommend that you contact the following Vermont State Agencies because this project may need approval under their programs or they may be able to assist you in preparing your project.

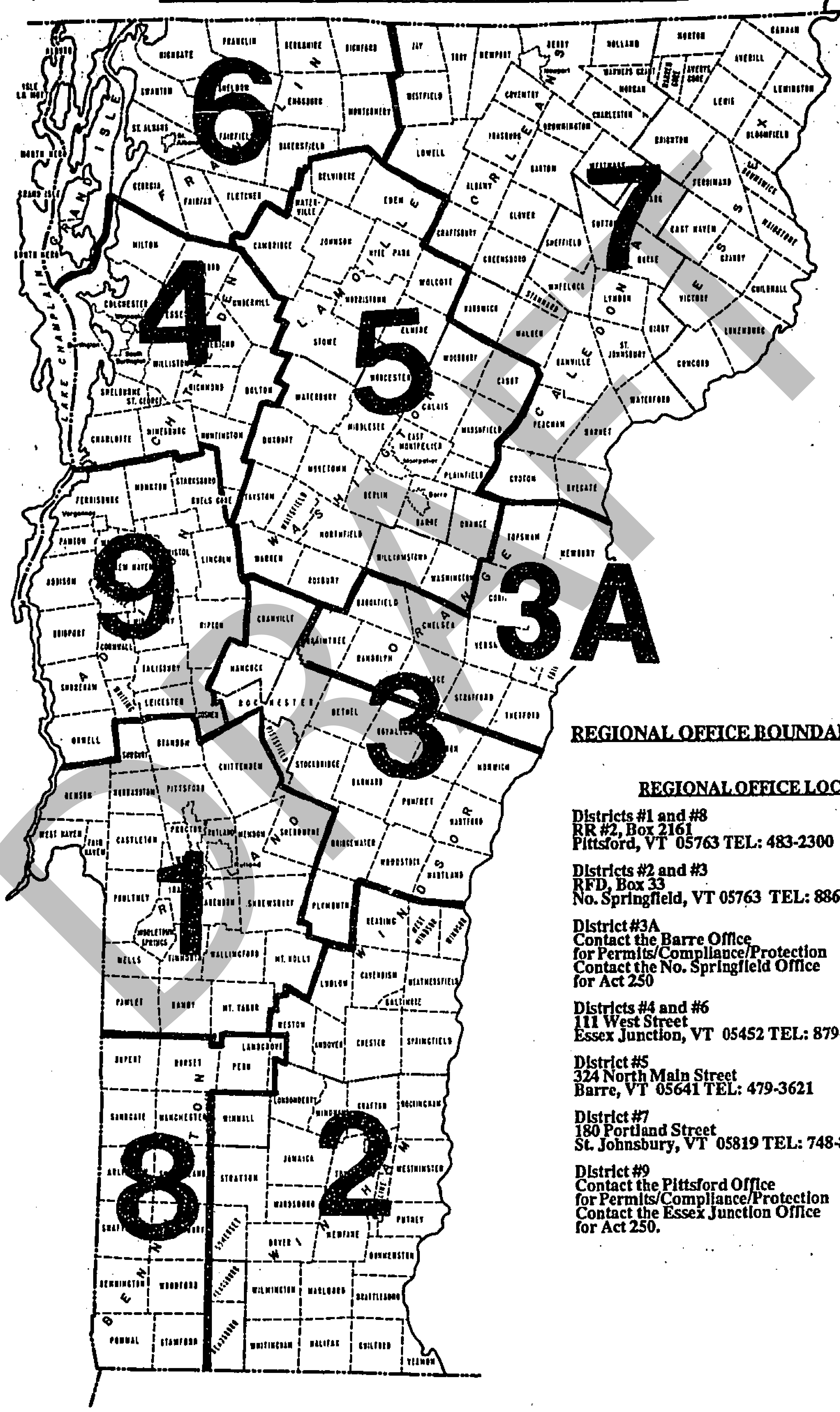
1. AGENCY OF NATURAL RESOURCES, Waterbury, VT 05676
   - ______ Air Pollution Control (244-8731)
   - ______ Hydro Electric Projects (244-7347)
   - ______ Dam Operations & Review (244-8755)
   - ______ Management of Lakes and Ponds (244-6951)
   - ______ Discharge of Temporary Pollution & Stormwater Permit (244-5674)
   - ______ Industrial Furnace/Boiler Conversion/ Installation (244-8731)
   - ______ Water Quality Certificate, if Federal permit req. (244-6951)
   - ______ Use of Chemicals in State Waters (244-5638)
   - ______ Bulk Fuel/Chemical Storage/Hazardous Wastes (244-8702)
   - ______ Industrial Process Air Emissions (244-8731)
   - ______ Indirect Discharge (greater than 6,500 gpd) (244-5674)
   - ______ Underground Storage Tanks (244-8702)
   - ______ Wetlands (244-6951)
   - ______ Waste Management Sanitary Landfills (244-8702)
2. DEPARTMENT OF LABOR & INDUSTRY, Montpelier, VT 05602 - Tel: 828-2106
   - ✓ Electrical Wiring Approval
   - ✓ Fire Prevention Approval
   - ✓ Access for Handicapped Approval
   - ______ Plumbing in Public Buildings
   - ______ Boilers and Pressure Vessels
   - ______ Storage of Flammable Liquids, Explosives
   - ______ Tramways and Ski Facilities
   - ______ Elevators
   - ______ Plumbing in single Family Residences Served by Public Water/Sewer w/ 10 or More customers
3. ______ DEPARTMENT OF HEALTH, Burlington, VT 05401 - Tel: 863-7220 (Contact: ______)
   - ______ Food, Lodging, Bakeries & Children's Camps
   - ______ Nursing Homes/Hospitals/Homes for Aged
   - ______ Protection of Public Water Source
   - ______ Extension of Water Lines over 500'
   - ______ Public Water systems
4. DISTRICT TRANSPORTATION ADMINISTRATOR (Consult the telephone directory under VERMONT, STATE OF, Highways)
   - ______ Access to State Highways (Residential Driveways)
   - ______ Development within 500' of a Limited Access Highway
5. AGENCY OF TRANSPORTATION, Montpelier, VT 05602 (Contact: ______)
   - ______ Signs (Travel Information Council) (828-2651)
   - ______ Airports and Landing Strips (828-2828)
   - ______ Junkyards (828-2587)
   - ______ Construction Within a State Highway Right-of-Way (Utilities, Signs, Driveways) (828-2653)
6. ______ DEPARTMENT OF AGRICULTURE, Montpelier, VT 05602 (Contact: ______)
   - ______ Use of Pesticides (828-2428)
   - ______ Slaughter Houses (828-2426)
   - ______ Primary Agricultural Soils (828-2504)
   - ______ Milk Processing Facilities (828-2433)
   - ______ Animal Shelters/Kennels (828-2421)
7. ______ AGENCY OF HUMAN SERVICES, Waterbury, VT 05676 Tel: 241-2158 (Contact: ______)
   - ______ Day Care Facilities
   - ______ Community Care Homes
   - ______ Residential Child Care Facilities
8. PUBLIC SERVICE BOARD (828-2358)/PUBLIC SERVICE DEPARTMENT (828-2811)
   - ______ Hydro Projects
   - ______ Alternative Energy Sources n
   - ______ Energy Conservation Measures
9. ______ DIVISION FOR HISTORIC PRESERVATION, Montpelier, VT 05602 - Tel: 828-3226
10. ✓ LOCAL PERMITS - Contact Your Town Officials
11. OTHER: Dept. of Education

BY: Faye Clutter / [illegible] Protection Division/Environmental Board
Add: 324 No. Main, Barre, VT 05641
Telephone Number 479-3621

Sent to Statutory Parties: YES ______ NO ______

3/89 White copy - Applicant Yellow copy - File Pink copy - Protection Division (Waterbury)

DISTRICT ENVIRONMENTAL COMMISSION BOUNDARY MAP



REGIONAL OFFICE BOUNDARY MAP

REGIONAL OFFICE LOCATIONS

Districts #1 and #8
RR #2, Box 2161
Pittsford, VT 05763 TEL: 483-2300

Districts #2 and #3
RFD, Box 33
No. Springfield, VT 05763 TEL: 886-2215

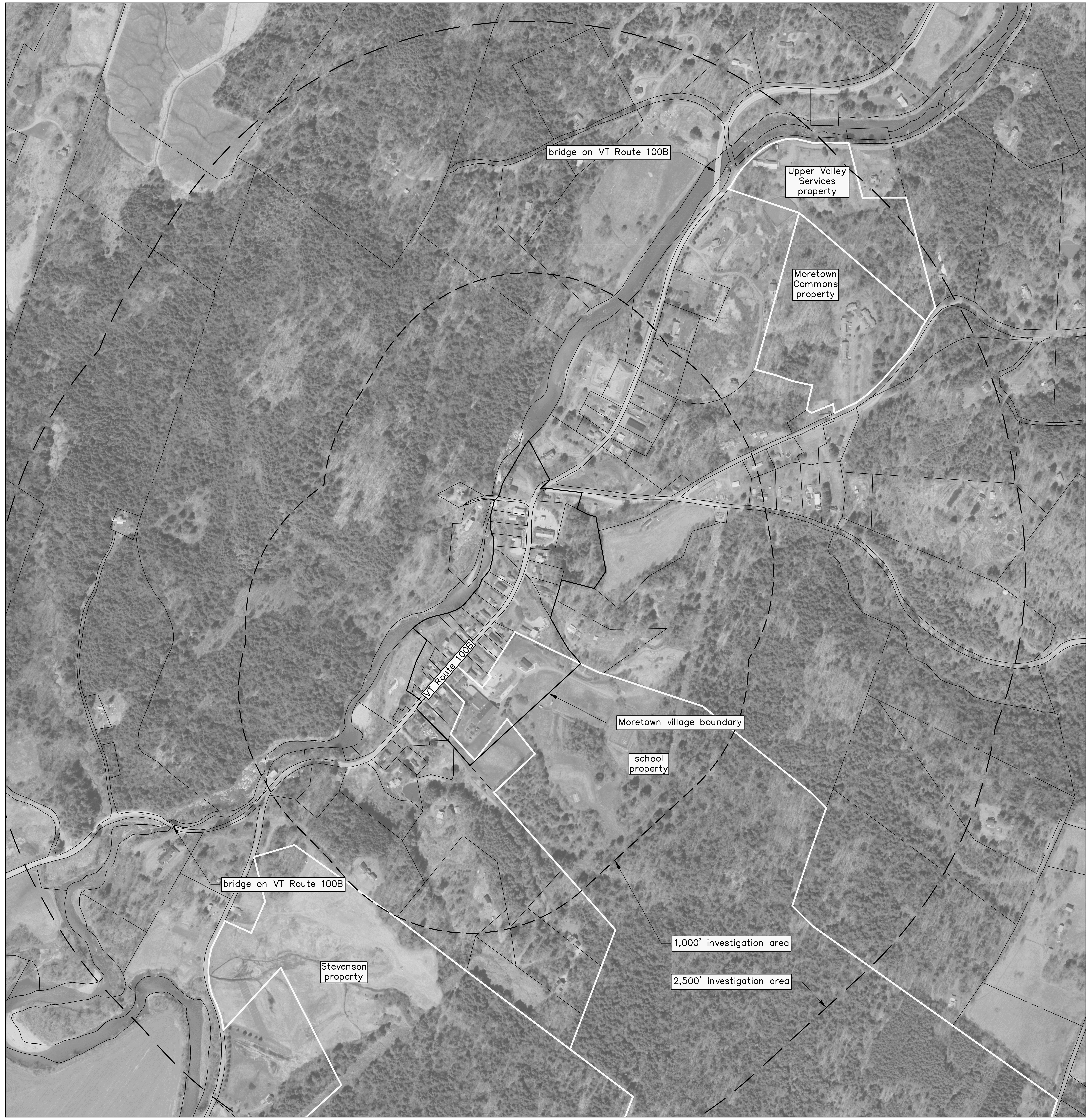
District #3A
Contact the Barre Office
for Permits/Compliance/Protection
Contact the No. Springfield Office
for Act 250

Districts #4 and #6
111 West Street
Essex Junction, VT 05452 TEL: 879-6563

District #5
324 North Main Street
Barre, VT 05641 TEL: 479-3621

District #7
180 Portland Street
St. Johnsbury, VT 05819 TEL: 748-8787

District #9
Contact the Pittsford Office
for Permits/Compliance/Protection
Contact the Essex Junction Office
for Act 250.



GRAPHIC SCALE

300 0 150 300 600 1200

(IN FEET)
1 inch = 300 ft.

OTTER CREEK ENGINEERING

404 East Main Street
P.O. Box 712
East Middlebury, VT 05740
Telephone: 802 382-8522
Fax: 802 382-8640
~
110 Merchants Row
4th Floor, Suite 15
Rutland, VT 05701
Telephone: 802 747-3080
Fax: 802 747-4820
~
93 South Main Street
Suite 203a
West Lebanon, NH 03784
Telephone: 603 696-3075
~
E-mail: info@ottercrk.com

STAMP AND SIGNATURE:

DESIGN ENGINEER

GRID NORTH

TOWN OF MORETOWN

VILLAGE WASTEWATER

MORETOWN, VERMONT

REVIEW

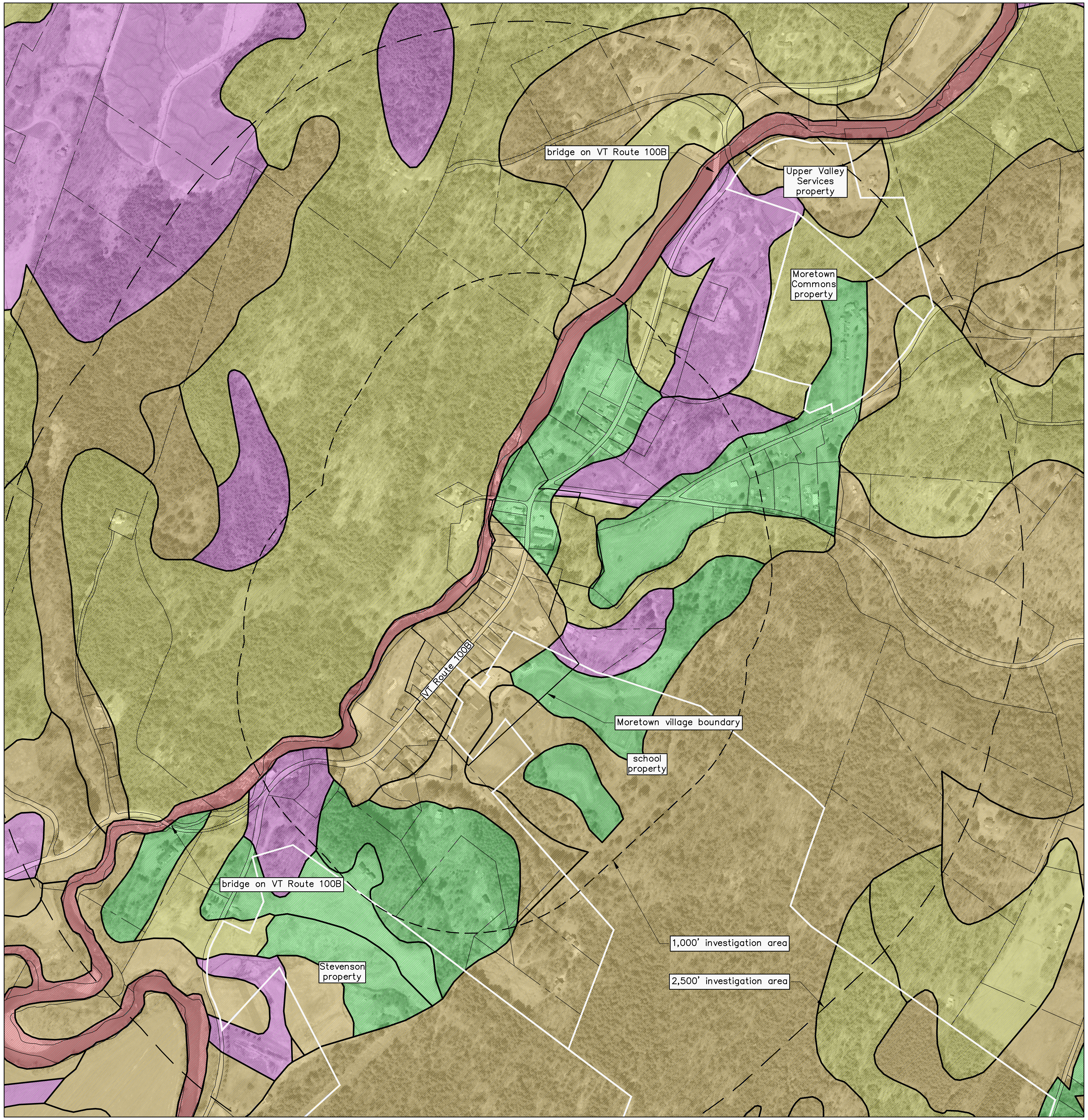
DATE ISSUED:	12/15/2022
REVISIONS:	
DRAWN BY:	BB
CHECKED BY:	RC
SCALE:	1"=300'
PROJECT NO.:	1174.001
CADD FILE:	1174-001

TITLE:

INVESTIGATION RADIUS

DRAWING NO.

1



LEGEND

- ON SITE SEWAGE DISPOSAL RATING 1
- ON SITE SEWAGE DISPOSAL RATING 2
- ON SITE SEWAGE DISPOSAL RATING 3
- ON SITE SEWAGE DISPOSAL RATING 4
- ON SITE SEWAGE DISPOSAL RATING 5

GRAPHIC SCALE

300 0 150 300 600 1200

(IN FEET)
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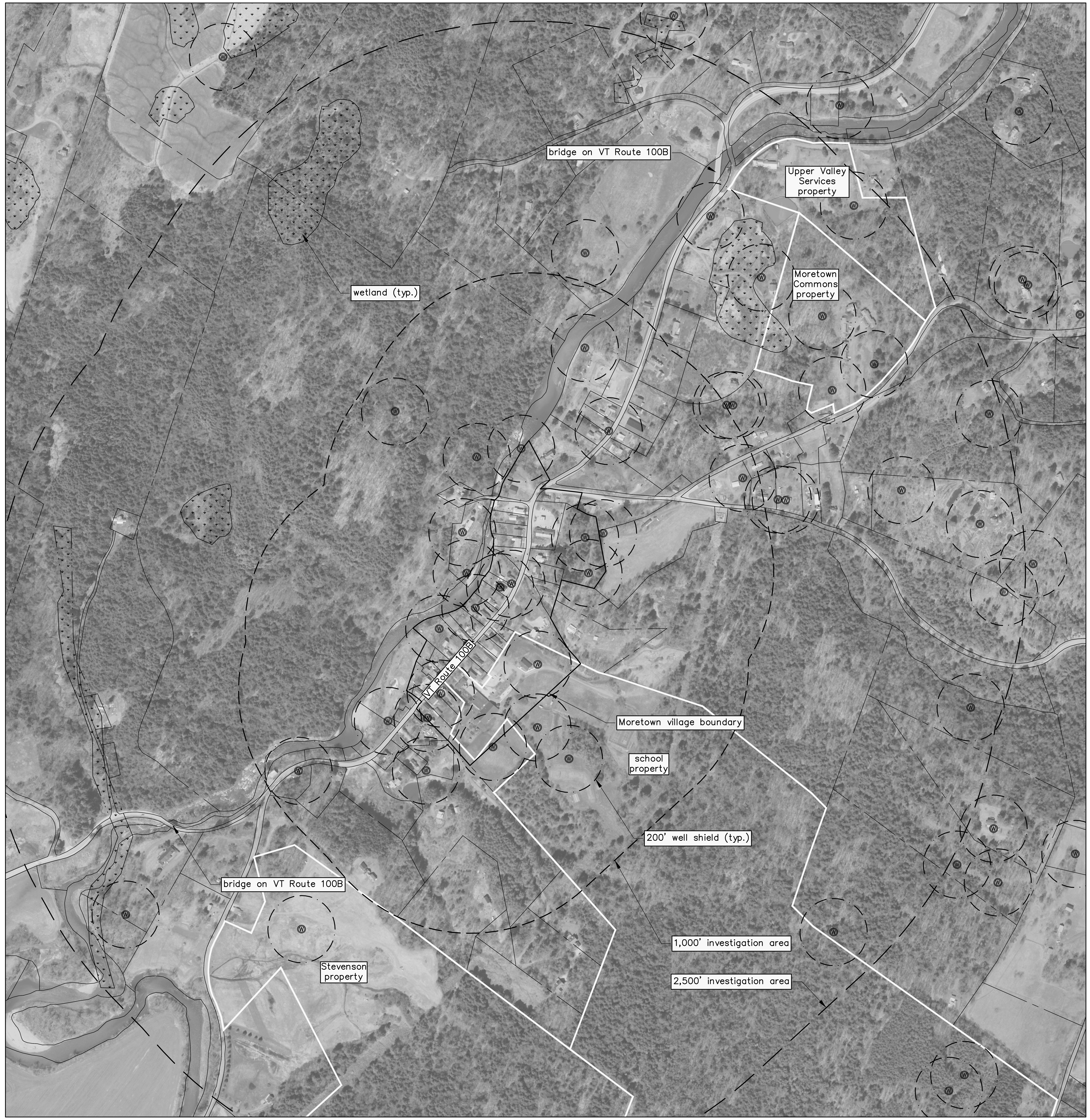
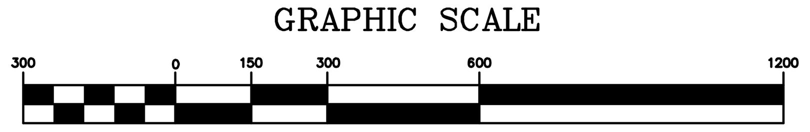
TITLE:

SOILS MAP

DRAWING NO.

2





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TITLE:

EXISTING POTABLE WATER SUPPLIES

DRAWING NO.

3