Engineering Report

South Burlington IM CULV (24)

Interstate 89 Culvert Nos. 63-1N, 63-1S, 64-1N, and 64-1S
Culvert Improvement Project – South Burlington, VT

Prepared for: Vermont Agency of Transportation
Prepared by: VHB
Date: December 2014

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Executive Summary

The Vermont Agency of Transportation (VTrans) retained VHB to provide Engineering Evaluation and Design Services to develop a Base Technical Concept (BTC) for four culverts located on Interstate 89 (I-89) in South Burlington. Culvert Nos. 63-1N and 63-1S convey Potash Brook under I-89 Northbound and Southbound and Culvert Nos. 64-1N and 64-1S convey a Tributary to the Potash Brook under I-89 Northbound and Southbound. This Engineering Scoping Report was completed to evaluate the existing culverts and determine the preferred replacement alternative for the BTC. This report provides a detailed discussion of the existing conditions and replacement alternatives and the recommended alternative for the BTC.

I-89 is a south to north limited access highway with two lanes of traffic in each direction. The interstate extends from the Vermont/New Hampshire border in Hartford to the Canadian border in Highgate. I-89 runs east to west in the location of Culvert Nos. 63-1N&S and 64-1N&S. The Annual Average Daily Traffic (AADT) is 20,100 vehicles for each direction (northbound and southbound) with a Design Hourly Volume (DHV) of 2,600 vehicles for the northbound barrel and 2,700 vehicles for the southbound barrel in the location of the culverts. Both Potash Brook and its Tributary flow south to north and have a very shallow gradient with wetland features located at the inlet of Culvert 63-1S and the outlet of Culvert 63-1N. Wetlands are adjacent to the Tributary of Potash Brook at the inlet of Culvert 64-1S and in the median between Culverts 64-1S and 64-1N.

The culvert conditions' ranges from fair to serious condition with Culvert 63-1N in serious condition, Culverts 63-1S and 64-1N in poor condition, and Culvert 64-1S in fair condition. Three of the culverts are inspected annually with Culvert 64-1S being inspected on a five year basis. The VTrans Inspection Reports for three of the four culverts indicate that rehabilitation or replacement of the culverts should occur in the near future.

The recommended replacement alternatives for Culverts 63-1N, 63-1S, 64-1N, and 64-1S is a precast concrete box culvert with a natural channel bottom to allow for a stable stream channel and Aquatic Organism Passage (AOP). The precast concrete box culverts will be constructed using phased construction with lane shifts that provide two lanes in each direction to accommodate high peak hour volumes. The vertical and horizontal roadway alignments are "best fit" alignments consisting of shallow sag vertical curves for all of the culverts.

Project Overview

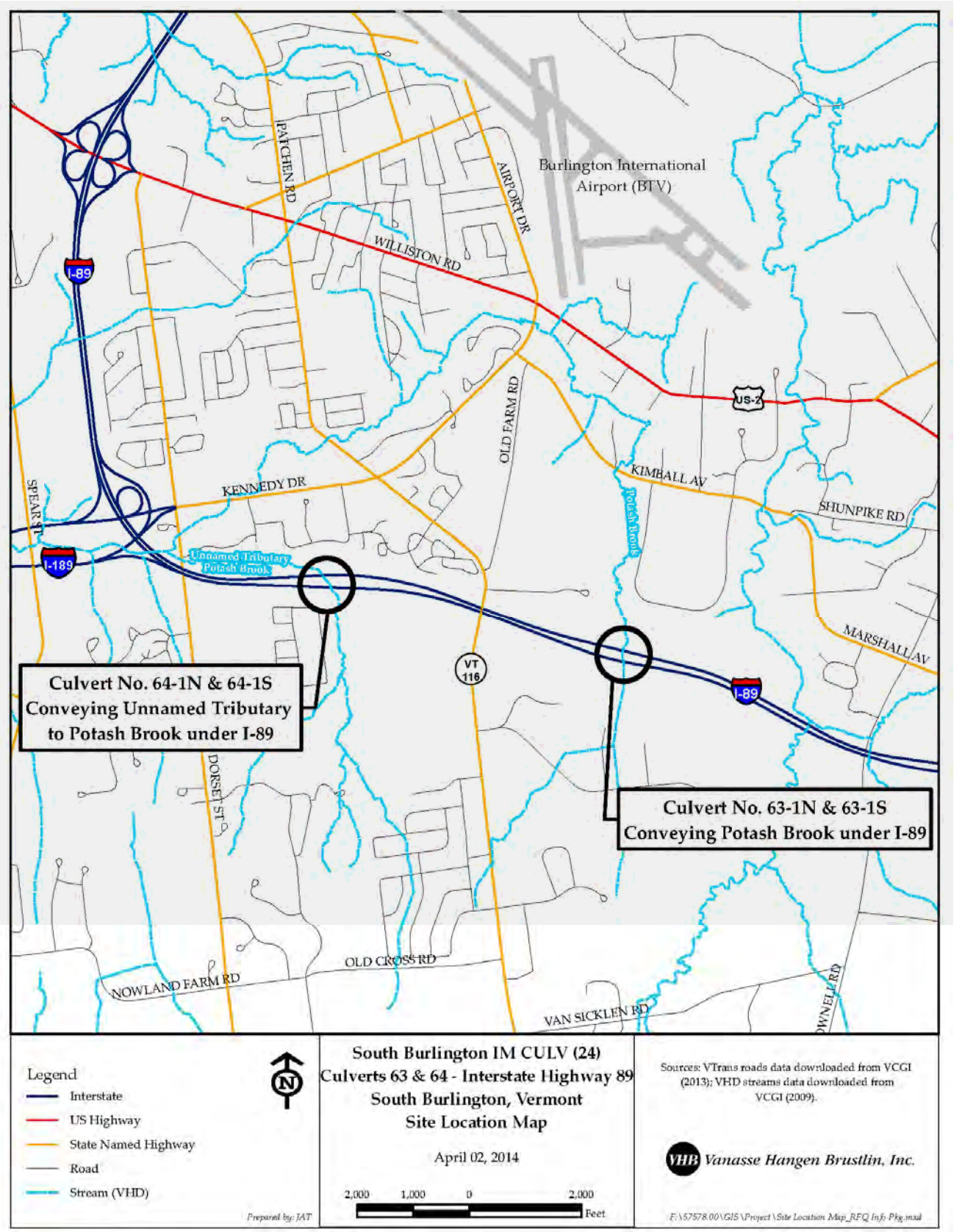
Project History

The project is located on Interstate 89 (I-89) in the City of South Burlington. The project consists of the replacement of four culverts; 63-1N, 63-1S, 64-1N and 64-1S. Culvert Nos. 63-1N and 63-1S convey Potash Brook under the northbound and southbound barrels of I-89 and are located approximately 0.7 miles west of the Williston/South Burlington Town/City Line and approximately 1.7 miles north of I-89 Exit 12. Culvert Nos. 64-1N and 64-1S convey a Tributary to Potash Brook under the northbound and southbound barrels of I-89 and are located approximately 1.8 miles west of the Williston/South Burlington Town/City Line and 0.9 miles south of I-89 Exit 13.

Culverts 63-1N and 63-1S are 7'-0" diameter corrugated metal pipes (CMPs) with lengths of 86 feet and 84 feet respectively. Both culverts were originally built in 1963 when the interstate was constructed and were both rehabilitated in 1984. Culvert 63-1N is in serious condition and Culvert 63-1S is in poor condition and both culverts are recommended for replacement.

Culverts 64-1N and 64-1S are 6'-6" high by 9'-0" wide corrugated metal multi plate pipe arches with lengths of 94 feet and 104 feet respectively. Both culverts were originally built in 1963 when the interstate was constructed and were both rehabilitated in 1984. Culvert 64-1N is in poor condition and is recommended for replacement. Culvert 64-1S is in fair condition and is not recommended for replacement. However, based on its continued deterioration, the culvert's condition has worsened over the past five (5) years from good to fair, and the fact that the downstream culvert, Culvert 64-1N is recommended to be replaced, Culvert 64-1S should also be replaced.

Location Map



Existing Conditions

Waterway

Potash Brook originates approximately 4,500 feet south of the I-89 crossing and flows to the north through wetlands and agricultural fields before reaching I-89. Potash Brook continues to flow north after crossing I-89, flowing through wetlands and undeveloped fields and wooded areas. It then turns northwest traveling through urban areas between Kimball Avenue and Williston Road. At this point, Potash Brook turns southwest and stays north of Kennedy Drive before crossing Kennedy Drive and again crossing I-89 just south of Exit 13.

The Tributary to Potash Brook originates approximately 8,900 feet south of the I-89 crossing and flows to the north through agricultural fields, residential developments, and wooded wetlands before reaching I-89. The Tributary to Potash brook turns west after crossing I-89 flowing through woods and wooded wetlands and crossing Dorset Street before its confluence with Potash Brook. The Tributary to Potash Brook intersects Potash Brook just west of Dorset Street before Potash Brook again crosses I-89 just south of Exit 13.

Culverts

VTrans performs yearly inspections on Culverts 63-1N, 63-1S, and 64-1N. Culvert 64-1S is inspected on a five year basis. Three of the culverts have been deemed structurally deficient and are recommended to be replaced per the VTrans Inspection Reports.

Culvert 63-1N is a 7'-0" diameter by 86'-0" long CMP structure in "serious" overall condition. A November 2010 and October 2011 inspection indicated that the culvert should be replaced in the near future. In September 2012 the inspection stated that "Due to the silt buildup in the invert unable to tell if there are perforations. Culvert should be flushed out clean." Recent inspections have indicated that the invert of the pipe has random perforations of less than 2 inches and missing bolts.

Culvert 63-1S is a 7'-0" diameter by 84'-0" long CMP structure in "poor" overall condition. A May 2009 inspection stated "Culvert is in fair to poor condition as invert has random perforation. Culvert has filled in with silt more since last inspection and holes are covered with silt. Pipe needs to be flushed out to determine if deterioration had progressed. Random bolts are missing along the haunches." In October of 2011 it was noted that the culvert will need replacement in the near future. Recent inspections have indicated that the steel pipe has random perforations of less than 2 inches and missing bolts.

Culvert 64-1N is a 6'-6" high by 9'-0" wide by 94'-0" long corrugated metal multi plate pipe arch in "poor" overall condition. A December 2007 inspection indicated there was a sink hole on the west end of the pipe that needed to be repaired. In the August 2008 inspection it was noted that the sinkhole had been repaired, but settlement was becoming noticeable on the west side again. It was noted at that time that the "pipe will need replacement soon". In September 2012 the inspection stated "Invert near the outlet should be monitored for further movement and crushing". Recent inspections have indicated there are random perforations less than 2 inches throughout the steel pipe.

Culvert 64-1S is a 6'-6" high by 9'-0" wide by 104'-0" long corrugated metal multi plate pipe arch in "fair" overall condition. A May 2009 inspection rated the culvert in fair condition, however, the invert at mid-span should be cleaned and flushed out. The steel pipe has minor corrosion/minimal perforations.

Field Survey

The field survey and development of a base plan was performed by VHB in January 2012. The survey was performed at each of the culvert sites including approaches and upstream and downstream reaches of the channels. The survey also included the surrounding topography and surface features.

Right-of-Way

The right-of-way for the project was plotted by VHB using the existing Interstate ROW plans provided by VTrans and field documentation surveyed by VHB. The project limits on the Base Technical Concept (BTC) are within the State Right-of-Way and there are no anticipated Right-of-Way impacts for the replacement of the culverts.

Traffic

Traffic data was compiled by the Vermont Agency of Transportation in 2013 and is projected for the years 2014 to 2024. The table on the following page shows the traffic information provided by VTrans.

I-89 Northbound

TRAFFIC DATA	2014	2024
AADT	20,100	22,500
DHV	2,600	2,900
ADTT	2,600	4,200
%T	9.3	13.5
%D	100	100

I-89 Southbound

TRAFFIC DATA	2014	2024
AADT	20,100	22,500
DHV	2,700	3,000
ADTT	2,000	3,200
%T	6.7	9.8
%D	100	100

Due to the Average Annual Daily Traffic (AADT) of 20,100 vehicles and the Design Hour Volume (DHV) of 2,600 vehicles northbound and 2,700 vehicles southbound, reducing the Interstate to a single lane during peak volume hours (6 AM to 8 PM) is not an option in this location of the interstate. Based on VTrans' past experience, backups will occur when reducing the interstate to a single lane anytime the Design Hourly Volume (DHV) is above 1,400 vehicles per hour. Management of traffic during construction will be a major component of the Base Technical Concept (BTC) and two lanes will need to be maintained in both directions during the construction of culverts 63-1N, 63-1S, 64-1N, and 64-1S.

Utilities

The only known utilities located within the project limits and the State Right-of-Way are two underground sewer lines owned by the City of South Burlington. The two sewer lines are located approximately 400 feet south and 120 feet north of Culvert 63-1N and 350 feet south and 150 feet north of Culvert 63-1S. Based on the Base Technical Concept (BTC) there are no anticipated impacts to the sewer lines for the replacement of the culverts.

Resources

A **Cultural Resource Assessment** was performed by VHB in March and April 2013 to determine the presence or absence of cultural resources (Historical and Archaeological) in and around the project areas.

HISTORICAL:

There are no listed or eligible standing structures or buildings within the project limits or immediately adjacent to it. Removal of the culverts is not subject to Section 106 of the National Historic Preservation Act of 1966 or Section 4(f) of the Department of Transportation Act due to adaptation of the Section 106 Exemption Regarding Effects to the Interstate Highway System by the Advisory Council on Historic Preservation on March 10, 2005. The project will not have an effect or adverse effect to any structure or building listed in, or potentially eligible for listing in, the National Register.

ARCHAEOLOGICAL:

There are twenty-nine (29) archaeological sites located within the 1-mile radius of culverts 63-1N and 63-1S and fifteen (15) archaeological sites located within the 1-mile radius of culverts 64-1N and 64-1S. None of these sites are located adjacent to or on the existing culverts. The culverts will be replaced within the existing VTrans Right-of-Way that was previously disturbed during construction of the interstate. There are no anticipated impacts to any archaeological resources.

A **Natural Resource Assessment** was performed by VHB in September 2012 to determine the natural resources (wetlands, waters, significant natural communities, necessary wildlife habitat, Rare, Threatened, and Endangered Species, and Prime Agricultural Soils) in and around the project areas. No Significant Natural Communities, Necessary Wildlife Habitat, Rare, Threatened, and Endangered Species, and Prime Agricultural Soils were found within the project limits or the Interstate Right-of-Way.

WETLANDS/WATERCOURSES:

VHB identified two Class II wetlands at the inlet of Culvert 63-1S and the outlet of Culvert 63-1N and two Class II wetlands adjacent to the inlet of Culvert 64-1S. VHB also identified three Class III wetlands adjacent to the channel in the median between Culverts 64-1N and 64-1S. VHB identified two streams in the project areas, Potash Brook at Culverts 63-1N and Culvert 63-1S and a Tributary to Potash Brook at Culverts 64-1N and 64-1S. In addition to the Tributary to Potash Brook, an Intermittent Stream that intersects with the Tributary to Potash Brook was identified at the toe of the slope for the northbound lane south of the outlet of Culvert 64-1N. Temporary and permanent impacts to the Class II and Class III wetlands along with temporary and permanent impacts to the channels are anticipated for this project.

Geotechnical

Terracon Consulting Engineers completed a subsurface investigation and prepared a Geotechnical Data Report on February 25, 2014. The purpose of the geotechnical investigation was to provide a general characterization of subsurface conditions and the composition of existing soils.

As part of the subsurface investigation, eight (8) soil borings (2 at each culvert) were completed within proximity of the existing culverts.

The Geotechnical Data Report was used by VHB to develop considerations and recommendations pertaining to the structure types and construction methodologies which have been incorporated into the "Alternatives" section discussed in this report.

Hydraulics

VHB performed hydraulic analyses to evaluate the existing and proposed culvert structures 63-1N, 63-1S, 64-1N, and 64-1S. VHB designed the proposed culverts using the Stream Simulation Methodology described in the 2009 Vermont Department of Fish and Wildlife Guidelines for the Design of Stream/Road Crossings for Passage of Aquatic Organisms in Vermont (VT, 2009). VHB determined the height and width of culverts to comply with the requirements of the Vermont Agency of Natural Resources (ANR) Department of Environmental Conservation Stream Alteration General Permit (SAGP) Section C.2.2.5 for the construction of new or replacement culverts (closed bottom structures).

VHB also performed a hydraulic analysis using the Federal Highway Administration (FHWA) tool HY-8 and the U.S. Army Corps of Engineers (USACE) tool HEC-RAS to evaluate the performance of the proposed culverts for storm design events including the Ordinary Low Water event, the 2-year Bankfull event, the 100-year event, and the 500-year event. VHB designed the culvert structures to tie in to the existing streambed both upstream and downstream of the culverts and to match the existing slopes. The table below shows the culvert's material/shape, internal dimensions, and slope.

Culvert Name	Material/Shape	Internal Dimensions (ft)	Slope (%)
63-1N	RC/Box	13 (W) x 8 (H)	0.95
63-1S	RC/Box	13 (W) x 7 (H)	0.00
64-1N	RC/Box	16 (W) x 7 (H)	0.15
64-1S	RC/Box	16 (W) x 7 (H)	2.00

Alternatives

Project Definition

ALTERNATIVE REQUIREMENTS

The replacement alternatives must be capable of being installed on an accelerated schedule to minimize the impacts to the traveling public, allow for 2 lanes of traffic during construction at peak volume hours (6 AM to 8 PM), maintain the existing channel flow during construction, minimize impacts to the channel and the wetlands, and be supported on the existing insitu soils. Additionally, the alternatives must have a 100 year design life, have minimal maintenance to reduce life cycle costs, and have a natural channel bottom to promote AOP and a stable channel.

CONSTRUCTION METHODS

Due to the shallow depth of the existing culverts, per the VTrans Inspection Reports the average cover over the culverts is 6'-0" for Culverts 63-1N and 63-1S and 8'-0" for Culverts 64-1N and 64-1S, open cut construction methods woul44d be the most reasonable type of construction for replacing the existing culverts provided construction phasing could be accomplished while maintaining two lanes in the northbound and southbound directions.

TRAFFIC MANAGEMENT DURING CONSTRUCTION

Phasing of traffic on the project site will be accomplished by lane shifts which will be achieved by widening the northbound and southbound barrels towards the inside (median) and/or the outside to create four traffic lanes in each barrel. As only two lanes are needed in each direction, the traffic can then be shifted back and forth between the four lanes in the northbound and southbound barrels to allow for phased construction of the culverts. The location of the lane shifts will depend on the existing site conditions, length of existing culvert, location of natural resources (wetlands), and the existing Right-of-Way.

STREAM ALIGNMENT

As it is necessary to maintain the existing channel during construction, it is advantageous to keep the existing culverts in place and construct the new structures off the channel alignment. This will decrease the construction costs by eliminating the need to install and remove a temporary pipe to convey the streams during construction. However, this approach may incur additional permanent impacts to the wetlands and the streams themselves as well as areas of mature forest. Therefore, in an effort to minimize these permanent impacts, the channel alignments for Potash Brook and the Tributary to the Potash Brook are to remain on their current alignments. A temporary pipe will be

required for conveyance of the streams during construction. The temporary pipe will require only temporary impacts to the wetlands and streams.

Structural Alternatives

Based on the project requirements as outlined in this engineering report, the following alternatives would be capable of meeting all or a majority of the project requirements. The following is a list of the Alternatives for this project:

- Do Nothing
- Precast Concrete Box
- Precast Concrete 3-Sided Box Culvert
- Corrugated Metal Pipe

DO NOTHING

The "Do Nothing" alternative would allow the existing culverts to remain in place and continue to function in their current condition. One of the culverts has a condition rating of serious and two of the culverts have a condition rating of poor. These culverts, if left in place, will continue to deteriorate and eventually fail. The fourth culvert has a condition rating of fair, but continues to deteriorate and over time will also become structurally deficient. The "Do Nothing" alternative will result in increased maintenance costs for each culvert and could result in expensive emergency repairs on a location of the interstate where high traffic volumes do not allow for single lane closures during commuter and daytime hours (6 AM to 8 PM) without incurring severe delays. The "Do Nothing" alternative does not meet the project's need.

PRECAST CONCRETE BOX

Precast concrete box culverts are prefabricated in segments allowing for quick installation and phased construction. They do not require footings and are able to be placed on weaker soils as they spread the live and dead loads over the entire width of the box culvert bottom slab. The disadvantage to using precast concrete box culverts is that they have a concrete bottom and require oversizing of the box vertically to provide a natural streambed bottom.

PRECAST CONCRETE 3-SIDED BOX CULVERT

Precast concrete 3-sided box culverts are prefabricated in segments allowing for quick installation and phased construction. Precast concrete 3-sided box culverts are 3-sided and do not have a bottom slab allowing for a natural streambed. The disadvantage to using a precast concrete 3-sided box culvert is that they require footings which need to be placed on denser, more stable soils than a box culvert and require a minimum of 5'-0" embedment below the streambed for frost protection or more depending on the scour requirements.

CORRUGATED METAL PIPE CULVERT

Corrugate metal pipe (CMP) can be installed in segments allowing for quick installation and phased construction. CMPs do not require footings and are able to be placed on weaker soils as they spread the live and dead loads over the entire bottom width of the pipe. The disadvantages to using CMPs is that it would require oversizing the pipe to provide a natural streambed. They also are constructed of aluminum or steel and do not have the same durability or expected design life as concrete.

Recommendations

Precast concrete box culverts are the preferred alternative for the Base Technical Concept. They would be constructed using open cut and phased construction with lane shifts having two lanes of traffic in each direction. Due to the traffic impacts the amount of time the lane shifts are utilized and the overall length of construction should be minimized. In order to reduce the construction time for the four culverts the construction schedule will be evaluated as part of the Request for Proposals (RFP) to encourage the Design-Build Teams to accelerate their construction of the four culverts.

In an effort to minimize the impacts to the wetlands at the inlet of Culvert 63-1S and the outlet of Culvert 63-1N, temporary steel sheet piling will be used to retain the lane shifts in the vicinity of the wetlands. Temporary steel sheet piling will also be used at the outlet of Culvert 64-1S to avoid impacts to the intermittent stream located east of the toe of slope of the southbound barrel by the Culvert 64-1S outlet. Temporary sheeting will also be used between phasing to construct and remove the temporary diversion pipes and remove and replace the existing culverts with precast concrete box culverts.

Other considerations that should be addressed by the Design – Build Team are as follows:

- Coordination with Burlington International Airport and the FAA over Equipment Height.
- NEPA Categorical Exclusion (CE) Reevaluation
- Army Corps of Engineering Section 404 General Permit Authorization
- Vermont State Wetlands Permit
- Vermont Construction Stormwater Permit
- Vermont Agency of Natural Resources, Department of Environmental Conservation Section 401 Water Quality Certification and Title 19 Stream Alteration Consultation
- Act 250 Permit Amendments and Coordination with the District Coordinator.

Traffic maintenance is a significant component of this project and a further discussion on the maintenance of traffic during construction is provided on the next page.

Maintenance of Traffic

The peak traffic volumes do not allow for single lane closures between 6 AM and 8 PM without creating traffic congestion. Therefore, two lanes of traffic need to be maintained in both directions between the hours of 6 AM and 8 PM daily. For this reason, lane shifts with two lanes in each direction will need to be constructed. In order to minimize impacts and keep the lane shifts within the Right-of-Way, the widths of the barrels during construction will be reduced from a 4'-0" shoulder on the inside (median side) with two 12'-0" travel lanes and a 10'-0" shoulder on the outside to two 2'-0" shoulders with two 12'-0" travel lanes. This will reduce the barrel width by 10 feet, from 38 feet for the existing barrel width down to 28 feet for the barrel width during construction. The posted speed limit will also be reduced from 65 mph to 55 mph thorough the lane shifts. As the posted speed limit changes from 65 mph to 55 mph just prior to the Exit 13 off ramp for I-189 in the northbound direction and from 55 mph to 65 mph just after the Exit 13 on ramp from I-189 in the southbound direction, the speed limit will remain at 55 mph between the beginning/end of the lane shifts and the 55 mph zone on each barrel.

Due to the length of Culverts 63-1N and 63-1S, it is possible to construct a wide lane shift to the outside of the northbound and southbound barrels to allow for construction phasing. For Culverts 63-1N and 63-1S the construction phasing will occur approximately about the center of the existing 10'-0" shoulder with two lanes of traffic on a reduced portion of the existing northbound and southbound barrels and two lanes of traffic on a small portion of the existing 10'-0" shoulder and the outside lane shift.

The length of Culverts 64-1N and 64-1S is less than that of Culverts 63-1N and 63-1S, which means it is necessary to construction a smaller lane shift to both the outside and inside (median side) of the northbound and southbound barrels to allow for construction phasing. For Culverts 64-1N and 64-1S the construction phasing will occur close to the center of the two existing travel lanes with two lanes of traffic on the outside lane shift, the existing 4'-0" shoulder and a portion of the existing left or passing lane of the northbound and southbound barrels and two lanes of traffic on a portion of the existing right or driving lane and the existing 10'-0" shoulder of the northbound and southbound barrels and the outside lane shift.

Additionally, the Design-Build Team will be required to develop a Traffic Management Plan including the use of a Smart Work Zone, to manage traffic during construction.

Project Photos

Photo 1: Culvert 63-1N Inlet (Looking North)

Photo 2: Culvert 63-1N Outlet (Looking South)

Photo 3: Culvert 63-1N Inlet (foreground) and 63-1S Outlet (Looking South)

Photo 4: Culvert 63-1N Outlet (Looking North)

Photo 5: Culvert 63-1S Inlet (Looking South)

Photo 6: Culvert 63-1S Outlet (Looking South)

Photo 7: Culvert 64-1N Inlet (Looking North)

Photo 8: Culvert 64-1N Inlet (Looking South)

Photo 9: Culvert 64-1N Outlet (Looking South)

Photo 10: Culvert 64-1S Inlet (Looking North)

Photo 11: Culvert 64-1S Inlet (Looking West)

Photo 12: Culvert 64-1S Outlet (Looking South)

APPENDIX A: VTrans Inspection Reports

STRUCTURE INSPECTION, INVENTORY and APPRAISAL SHEET

Vermont Agency of Transportation ~ Structures Section ~ Bridge Management and Inspection Unit

Inspection Report for S. BURLINGTON **bridge no.:** 63-1N **District:** 5

Located on: I89 **over** BROOK **approximately** 1.7 MI N EXIT 12 I89 **Maintained By:** STATE

CONDITION

Deck Rating: N NOT APPLICABLE

Superstructure Rating: N NOT APPLICABLE

Substructure Rating: N NOT APPLICABLE

Channel Rating: 6 SATISFACTORY

Culvert Rating: 3 SERIOUS

Federal Str. Number: 300089631N04141

AGE and SERVICE

Year Built: 1963 **Year Reconstructed:** 1984

Type of Service On: 1 HIGHWAY

Type of Service Under: 5 WATERWAY

Lanes On the Structure: 02

Lanes Under the Structure: 00

Bypass, Detour Length (miles): 01

ADT: 15050 **Year of ADT:** 1996

GEOMETRIC DATA

Length of Maximum Span (ft): 7

Structure Length (ft): 7

Lt Curb/Sidewalk Width (ft): 0

Rt Curb/Sidewalk Width (ft): 0

Bridge Rdwy Width Curb-to-Curb (ft): 0

Deck Width Out-to-Out (ft): 0

Appr. Roadway Width (ft): 38

Skew: 20

Bridge Median: 1 OPEN MEDIAN

Feature Under: FEATURE NOT A HIGHWAY OR RAILROAD

Min Vertical Underclr (ft): 04 FT 00 IN

STRUCTURE TYPE and MATERIALS

Bridge Type: CGMPPA

Number of Main Spans: 1

Kind of Material and/or Design: 3 STEEL

Deck Structure Type: N NOT APPLICABLE

Type of Wearing Surface: N NOT APPLICABLE

Type of Membrane: N NOT APPLICABLE

Deck Protection: N NOT APPLICABLE

CULVERT GEOMETRIC DATA and INDICATORS

Culvert Barrel Length (ft): 86

Average Cover Over Culvert (ft): 06

Waterway Area Through Culvert (sq.ft.): 28

Culvert Wing/Header Rating: 8 VERY GOOD CONDITION

Steel Culvert Corrosion Indicator: 4 RANDOM PERFORATIONS < 2" THROUGHOUT

Multi Plate Culvert Bolt Line Crack Indicator: 0 NO BOLT LINE CRACKS PRESENT

APPRAISAL

Appr. Rdwy. Alignment: 8 EQUAL TO DESIRABLE CRITERIA

INSPECTION

Inspection Date: 092012 **Inspection Frequency (months):** 12

INSPECTION SUMMARY and NEEDS

9/24/2012 Due to the silt buildup in the invert unable to tell if there are perforations. Culvert should be flushed out clean. FRE/JAS

10/14/2011 Culvert will need replacement in the near future or evaluated for a possible sleeve. ~FRE/DCP

11/30/2010 Culvert should be replaced in the near future or the pipe should be drained and the missing bolts replaced or a concrete invert poured. ~FRE / PNH

STRUCTURE INSPECTION, INVENTORY and APPRAISAL SHEET

Vermont Agency of Transportation ~ Structures Section ~ Bridge Management and Inspection Unit

Inspection Report for S. BURLINGTON **bridge no.:** 63-1S **District:** 5

Located on: I89 **over** BROOK **approximately** 1.7 MI N EXIT 12 I89 **Maintained By:** STATE

CONDITION

Deck Rating: N NOT APPLICABLE

Superstructure Rating: N NOT APPLICABLE

Substructure Rating: N NOT APPLICABLE

Channel Rating: 6 SATISFACTORY

Culvert Rating: 4 POOR

Federal Str. Number: 300089631S04141

AGE and SERVICE

Year Built: 1963 **Year Reconstructed:** 1984

Type of Service On: 1 HIGHWAY

Type of Service Under: 5 WATERWAY

Lanes On the Structure: 02

Lanes Under the Structure: 00

Bypass, Detour Length (miles): 01

ADT: 15050 **Year of ADT:** 1996

GEOMETRIC DATA

Length of Maximum Span (ft): 7

Structure Length (ft): 7

Lt Curb/Sidewalk Width (ft): 0

Rt Curb/Sidewalk Width (ft): 0

Bridge Rdwy Width Curb-to-Curb (ft): 0

Deck Width Out-to-Out (ft): 0

Appr. Roadway Width (ft): 38

Skew: 20

Bridge Median: 1 OPEN MEDIAN

Feature Under: FEATURE NOT A HIGHWAY OR RAILROAD

Min Vertical Underclr (ft): 04 FT 00 IN

STRUCTURE TYPE and MATERIALS

Bridge Type: CGMPPA

Number of Main Spans: 1

Kind of Material and/or Design: 3 STEEL

Deck Structure Type: N NOT APPLICABLE

Type of Wearing Surface: N NOT APPLICABLE

Type of Membrane: N NOT APPLICABLE

Deck Protection: N NOT APPLICABLE

CULVERT GEOMETRIC DATA and INDICATORS

Culvert Barrel Length (ft): 84

Average Cover Over Culvert (ft): 06

Waterway Area Through Culvert (sq.ft.): 28

Culvert Wing/Header Rating: 8 VERY GOOD CONDITION

Steel Culvert Corrosion Indicator: 4 RANDOM PERFORATIONS < 2" THROUGHOUT

Multi Plate Culvert Bolt Line Crack Indicator: 0 NO BOLT LINE CRACKS PRESENT

APPRAISAL

Appr. Rdwy. Alignment: 8 EQUAL TO DESIRABLE CRITERIA

INSPECTION

Inspection Date: 102011 **Inspection Frequency (months):** 12

INSPECTION SUMMARY and NEEDS

10/14/2011 Culvert will need replacement in the near future or evaluated for a possible sleeve. ~FRE/DCP

05-05-09 Culvert is in fair to poor condition as invert has random perforation. Culvert has filled in with silt more since last inspection and holes are covered with silt. Pipe needs to be flushed out to determine if deterioration has progressed. Random bolts are missing along the haunches. ~FRE

STRUCTURE INSPECTION, INVENTORY and APPRAISAL SHEET

Vermont Agency of Transportation ~ Structures Section ~ Bridge Management and Inspection Unit

Inspection Report for S. BURLINGTON **bridge no.:** 64-1N **District:** 5

Located on: I89 **over** BROOK **approximately** 0.9 MI S EXIT 13 I89 **Maintained By:** STATE

CONDITION

Deck Rating: N NOT APPLICABLE

Superstructure Rating: N NOT APPLICABLE

Substructure Rating: N NOT APPLICABLE

Channel Rating: 7 GOOD

Culvert Rating: 4 POOR

Federal Str. Number: 300089641N04141

AGE and SERVICE

Year Built: 1963 **Year Reconstructed:** 1984

Type of Service On: 1 HIGHWAY

Type of Service Under: 5 WATERWAY

Lanes On the Structure: 02

Lanes Under the Structure: 00

Bypass, Detour Length (miles): 01

ADT: 15050 **Year of ADT:** 1996

GEOMETRIC DATA

Length of Maximum Span (ft): 9

Structure Length (ft): 9

Lt Curb/Sidewalk Width (ft): 0

Rt Curb/Sidewalk Width (ft): 0

Bridge Rdwy Width Curb-to-Curb (ft): 0

Deck Width Out-to-Out (ft): 0

Appr. Roadway Width (ft): 38

Skew: 33

Bridge Median: 1 OPEN MEDIAN

Feature Under: FEATURE NOT A HIGHWAY OR RAILROAD

Min Vertical Underclr (ft): 06 FT 00 IN

STRUCTURE TYPE and MATERIALS

Bridge Type: MULTIPLATE PIPE ARCH

Number of Main Spans: 1

Kind of Material and/or Design: 3 STEEL

Deck Structure Type: N NOT APPLICABLE

Type of Wearing Surface: N NOT APPLICABLE

Type of Membrane: N NOT APPLICABLE

Deck Protection: N NOT APPLICABLE

CULVERT GEOMETRIC DATA and INDICATORS

Culvert Barrel Length (ft): 94

Average Cover Over Culvert (ft): 08

Waterway Area Through Culvert (sq.ft.): 46

Culvert Wing/Header Rating: 6 SATISFACTORY CONDITION

Steel Culvert Corrosion Indicator: 4 RANDOM PERFORATIONS < 2" THROUGHOUT

Multi Plate Culvert Bolt Line Crack Indicator: 0 NO BOLT LINE CRACKS PRESENT

APPRAISAL

Appr. Rdwy. Alignment: 8 EQUAL TO DESIRABLE CRITERIA

INSPECTION

Inspection Date: 092012 **Inspection Frequency (months):** 12

INSPECTION SUMMARY and NEEDS

9/24/2012 Invert near the outlet should be monitored for further movement and crushing. FRE/JAS

11/29/2010 Culvert should be evaluated for a concrete invert in the near future. ~FRE/PNH

Culvert is in poor condition. Piping is occurring pipe will need replacement soon. Settlement is very noticeable on the west side and sink hole has been repaired. Inspected 7-30-08 ~MK

Culvert is in fair to poor condition. Sink hole on the west end of the pipe needs to be repaired soon. Sink hole should be monitored periodically until repair has been made. Inspected 12-13-07

Culvert is in fair condition. Inspected 7-29-04

STRUCTURE INSPECTION, INVENTORY and APPRAISAL SHEET

Vermont Agency of Transportation ~ Structures Section ~ Bridge Management and Inspection Unit

Inspection Report for S. BURLINGTON **bridge no.:** 64-1S **District:** 5

Located on: I89 **over** BROOK **approximately** 0.9 MI S EXIT 13 I89 **Maintained By:** STATE

CONDITION

Deck Rating: N NOT APPLICABLE

Superstructure Rating: N NOT APPLICABLE

Substructure Rating: N NOT APPLICABLE

Channel Rating: 6 SATISFACTORY

Culvert Rating: 5 FAIR

Federal Str. Number: 300089641S04141

AGE and SERVICE

Year Built: 1963 **Year Reconstructed:** 1984

Type of Service On: 1 HIGHWAY

Type of Service Under: 5 WATERWAY

Lanes On the Structure: 02

Lanes Under the Structure: 00

Bypass, Detour Length (miles): 01

ADT: 15050 **Year of ADT:** 1996

GEOMETRIC DATA

Length of Maximum Span (ft): 9

Structure Length (ft): 9

Lt Curb/Sidewalk Width (ft): 0

Rt Curb/Sidewalk Width (ft): 0

Bridge Rdwy Width Curb-to-Curb (ft): 0

Deck Width Out-to-Out (ft): 0

Appr. Roadway Width (ft): 38

Skew: 33

Bridge Median: 1 OPEN MEDIAN

Feature Under: FEATURE NOT A HIGHWAY OR RAILROAD

Min Vertical Underclr (ft): 06 FT 00 IN

STRUCTURE TYPE and MATERIALS

Bridge Type: CGMPP

Number of Main Spans: 1

Kind of Material and/or Design: 3 STEEL

Deck Structure Type: N NOT APPLICABLE

Type of Wearing Surface: N NOT APPLICABLE

Type of Membrane: N NOT APPLICABLE

Deck Protection: N NOT APPLICABLE

CULVERT GEOMETRIC DATA and INDICATORS

Culvert Barrel Length (ft): 104

Average Cover Over Culvert (ft): 08

Waterway Area Through Culvert (sq.ft.): 46

Culvert Wing/Header Rating: 6 SATISFACTORY CONDITION

Steel Culvert Corrosion Indicator: 6 MINOR CORROSION/MINIMAL PERFORATIONS

Multi Plate Culvert Bolt Line Crack Indicator: 0 NO BOLT LINE CRACKS PRESENT

APPRAISAL

Appr. Rdwy. Alignment: 8 EQUAL TO DESIRABLE CRITERIA

INSPECTION

Inspection Date: 052009 **Inspection Frequency (months):** 60

INSPECTION SUMMARY and NEEDS

05/15/2009 Culvert is in fair condition however the invert at midspan should be cleaned and flushed out. ~FRE

Culvert is in good condition. Culvert should be flushed out. Inspected 7-29-04

APPENDIX B: Traffic Data Memo

AGENCY OF TRANSPORTATION **OFFICE MEMORANDUM**

POLICY, PLANNING AND INTERMODAL DEVELOPMENT DIVISION

TO: Aaron Guyette, VHB

FROM: Maureen Carr, Traffic Analysis Engineer MC
By: Colin Philbrook, Traffic Analysis Technician CCP

DATE: February 14, 2013

RE: South Burlington IM CULV(24)
I-89- MM 85.000 ~ 87.000

Per your request on January 11, 2013, please find complete estimated traffic data on the above project in the city of South Burlington. The data for the years 2014, 2024 and 2034 is included in the table below.

If you have any questions, or if further information is needed, please call at x3667.

Section	AADT		DHV		%T		%D		ADTT		ESALs	
	2014	2024	2014	2024	2014	2024	2014	2024	2014	2024	(2014 ~2024)	(2014 ~2034)
Northbound	20,100	22,500	2600	2900	9.3	13.5	100	100	2600	4200	4,798,000	12,002,000
Southbound	20,100	22,500	2700	3000	6.7	9.8	100	100	2000	3200	4,129,000	10,471,000

CC: Chris Cole, Director of Policy, Planning and Intermodal Development
Data Analysis Files

South Burlington IM CULV(24) Memo.docx

APPENDIX C: Cultural and Natural Resource Assessment Memos

Transportation
Land Development
Environmental
Services

Vanasse Hangen Brustlin, Inc.

7056 US Route 7
P. O. Box 120
North Ferrisburgh, VT 05473
802.497.6100

Memorandum

To: Aaron P. Guyette, P.E.

Date: May 22, 2013

Project No.: VHB 57578.00

From: Nicole Benjamin-Ma, Preservation Planner
Rita Walsh, Senior Preservation Planner
Carol S. Weed, Senior Archaeologist

Re: Cultural Resources Assessment, South Burlington IM CULV(24), Culverts 63-1 and 64-1, Interstate 89, South Burlington, Vermont

Introduction

This memorandum presents the results of the background and literature review completed in support of the proposed actions. The review was conducted between March 7, 2013, and April 27, 2013. The results of the review were used to inform conclusions concerning the presence or absence of previously reported cultural resources in the project areas. The cultural resources of concern were defined as above-ground structures and buildings and archaeological sites.

The site file review also provided information on the archaeological sensitivity of the direct impact area of the culverts (the Projects). The study area radius for each Project was defined as a one-mile radius around that Project. This radius size is typically used in site file searches conducted in Vermont. The Area of Potential Effect (APE) for the Projects was defined as the culvert to be replaced and 100-feet around that culvert. Culverts 63-1N and 63-1S (Culverts 63) direct the waters of Potash Brook under Interstate 89 (I-89). Culverts 64-1N and 64-1S (Culverts 64) direct the headwaters of Potash Brook under I-89. The general location of these culverts are presented on Figure 1 and specified on Figures 2 and 3.

Methods

As indirect visual impacts associated with these projects are very limited due to the culvert locations below the roadways, only potential direct impacts of the culvert replacements were assessed. No field assessment of the Project Areas was conducted.

A site file search was conducted on March 7, 2013 at the Vermont Division of Historic Preservation (DHP) office in Montpelier. The focus of the site file review was on archaeological data within the one-mile search radii. The DHP holds these data in various forms including marked, though dated, United State Geological Survey (USGS) hard copy maps with site plots, survey reports, and hard copy site forms. These sources were reviewed by Nicole Benjamin-Ma and the collected data were subsequently evaluated by Carol S. Weed. Site locations were plotted on a copy of the Project radius map (Figure 1). VHB technical specialists had assembled information concerning soils, wetlands,

and existing conditions and these data were used to develop a picture of the site setting variables that affect archaeological sensitivity.[1]

Results of Literature Review

Above-Ground (Historic) Resources

There are no listed or eligible standing structures or buildings within the Project or immediately adjacent to it. The I-89 culverts proposed for replacement date to the original 1957 construction of I-89 in this part of Vermont.

Removal of the culverts is not subject to Section 106 of the National Historic Preservation Act of 1966 or Section 4(f) of the Department of Transportation Act due to adaptation of the Section 106 Exemption Regarding Effects to the Interstate Highway System by the Advisory Council on Historic Preservation on March 10, 2005.

This exemption effectively excludes the majority of the 46,700-mile United States Interstate System from consideration as a historic property under Section 106 of the National Historic Preservation Act (NHPA). In addition, the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU, Public Law 109-59, Aug. 10, 2005) includes a provision (Section 6007) that exempts the bulk of the Interstate System from consideration as a historic resource under Section 4(f) of the Department of Transportation Act. With these two exemptions in place, Federal agencies are no longer required to consider the vast majority of the Interstate Highway System as historic property under Section 106 and Section 4(f) requirements. Excluded from these respective exemptions are elements of the Interstate System that are exceptional in some way or meet a national level of significance under the criteria for the National Register of Historic Places[2]. The I-89 culverts are not on the final list of elements that remain subject to Section 106 and Section 4(f).[3]

Archaeological Resources

Twenty-nine (29) archaeological sites are located within the 1-mile radius of Culverts 63 and fifteen (15) archaeological sites are reported within the one-mile radius of Culverts 64. None of these sites are located adjacent to or on the existing culverts. The archeological sites closest to the two project areas are VT-CH-936, approximately 1,500 feet southeast of Culverts 64, and site VT-CH-941[4], approximately 1,000 feet west/northwest of Culverts 63 (see Figure 1). Both sites are located on poorly drained soils within 500-feet of a seasonal or perennial water source (Figure 4). Based on the plotted distribution of the sites within the two study areas, the sites are located within proximity to the abundant wetlands that are present throughout this part of Chittenden County.

While the site distribution pattern, in general, favors the terraces to either side of the wetlands, the specific siting choices are less obvious. The site forms were reviewed for data applicable to siting choices. The table below presents the available soils, nearest water, and distance to water (in feet) data on the sites in the two study areas. Not all site forms had data presented. The site locations chosen do not appear to have been selected because they were well-drained or in within proximity to potable water. The soils of the locations selected are about equally divided between poorly drained Vergennes, Vergennes-Covington, Covington-Vergennes, and Enosburgh and Whately soils

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[1] Anonymous. Technical Memorandum South Burlington IM CULV(24) South Burlington, Vermont. Culverts 63-1N, 63-1S, 64-1N, and 64-1N Interstate Highway 89, Georgia, Vermont. Draft January 18, 2013. Re: Natural Resources Identification and Regulatory Discussion.

[2] http://environment.fhwa.dot.gov/histpres/highways.asp

[3] http://environment.fhwa.dot.gov/histpres/highways_list.asp

[4] Hubbard, Tom. Archaeological Phase I, II and III Studies for the Proposed Tilley Drive Recreation Path, Site VT-CH-941, South Burlington, Chittenden County, Vermont. Report on file, VTDHP.

and the well-drained Adams and Windsor, and Hinesburg loamy sands and fine sandy loams. Similarly, distance to either a seasonal or perennial potable water source ranges from 10-16 feet upwards to 1,312 feet.

Site #	Soils	Stream	Distance (in feet) to water
VT-CH-018	Vergennes clay	Muddy Brook	330
VT-CH-067	Enosburgh and Whately soils (EwA)	unnamed to Potash Brook	328
VT-CH-069	Adams loamy sand	Potash Brook	1312
VT-CH-076	Hinesburg loamy fine sand	not named	1320
VT-CH-090	Hinesburg fine sandy loam	Potash Brook	33
VT-CH-149	Covington (Cv), Limerick silt loam	Muddy Brook	
VT-CH-150	Enosburg and Whately (EwA); Limerick silt loam	Muddy Brook	
VT-CH-428	Adams Windsor (AdA) loamy sand	Potash Brook	33
VT-CH-429	Adams Windsor (AdA) loamy sand	Potash Brook	33
VT-CH-430	Adams Windsor (AdA) loamy sand	Potash Brook	33
VT-CH-873	Vergennes-Covington clay loam	Muddy Brook	164
VT-CH-874	Vergennes-Covington clay loam; Hinesburg sandy loam	Muddy Brook	16
VT-CH-875	Vergennes-Covington clay loam	Muddy Brook	246
VT-CH-876	Vergennes-Covington silty clay	unnamed seasonal	10 to 16
VT-CH-883	Adams and Windsor loamy sands	Potash Brook	16
VT-CH-935	Hinesburg fine sandy loam	not named	239
VT-CH-936	Enosburg and Whately soils	not named	219
VT-CH-937	Belgrade and Eldridge soils	not named	374
VT-CH-938	Vergennes clay	not named	590
VT-CH-941	Vergennes and Covington clays	not named	none given
VT-CH-948	Covington and Vergennes	not named	98
VT-CH-949	Covington and Vergennes	not named	98
VT-CH-952	Vergennes clay	not named	1312

The site location data suggest that cumulative factors rather than single variables were being considered in siting decisions. Thus, the conditions at the time of use were probably more important than a particular setting characteristic. For this reason, as long as the setting was reasonably dry at the time of its use, and was within in an acceptable distance to potable water and other resources, it could have been chosen.

For planning purposes, archaeologically sensitive areas were defined. These archaeologically sensitive locations were defined on the bases of five variables: soils known to host archaeological sites elsewhere, proximity to water based on the known site distribution, proximity to a intermittent or permanent water sources, topography with 8 percent or less slope, and prior disturbance. The latter was based on the existing condition aerial photography. All wetlands were excluded from

consideration as were woods lots. The reason for excluding the latter was that a contractor would not consider woods lots when identifying locations for temporary work areas. Based on the variables and the assumptions, archaeologically sensitive areas are defined for Culverts 63 and 64 and these are shown on Figure 4. Culverts 63 are surrounded by open fields on broad, level terraces. These locations are archaeologically sensitive. In contrast, while the same soils, topography, and distance to water characteristics are present in the vicinity of Culverts 64, the areas to either side of the interstate right-of-way are appreciably more developed.

Conclusions and Recommendations

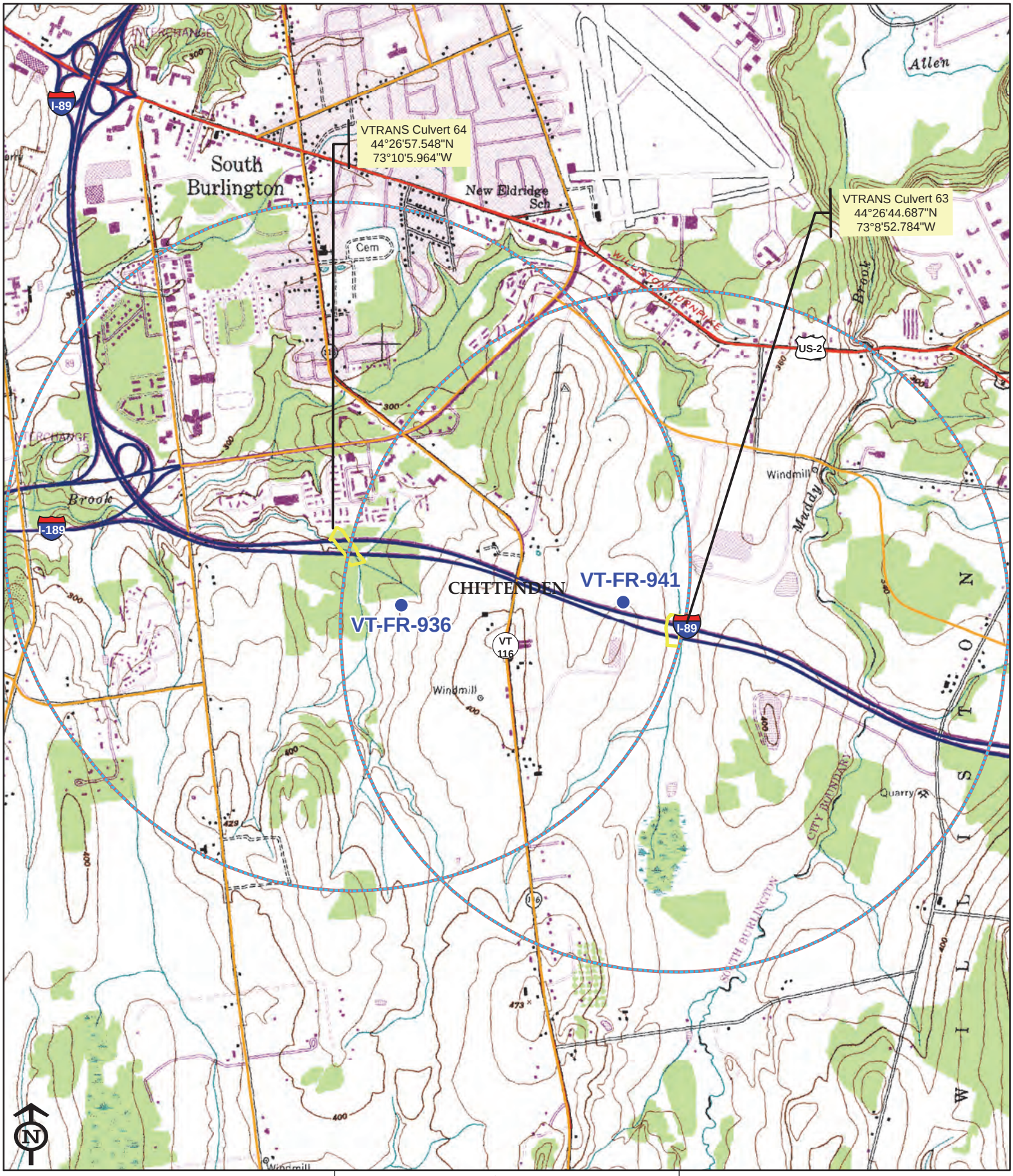
Above-Ground (Historic) Resources

We conclude that the Project will not have an effect or adverse effect to any structure or building listed in, or potentially eligible for listing in, the National Register. No further consideration of above-ground resources is recommended.

Archaeological Resources

As shown on Figures 2 and 3, the Project culverts are proposed to lie under the I-89 north- and south-bound lanes. In both instances, the culverts are set within the existing interstate right-of-way limits and within areas that were previously disturbed. The proposed I-89 Culvert Replacement Project as defined on Figures 2 through 4 will not impact archaeologically sensitive areas. No additional archaeological study is recommended.

If future project elements such as laydown areas and access roads are proposed that lie outside of the currently defined Project limits, an archaeological assessment of those locations may be required. While archaeologically sensitive areas in the near vicinity of the projects have been defined, any future project element locations will have to be assessed individually.



Legend
- One Mile Project Buffer
- South Burlington Culvert Investigation Area
- RTE Species/ Communities (NHIP)
- Interstate
- State Named Highway
- Town Road
- US Highway
- Vermont State Highway
- County Boundary

Figure 1
VTRANS Culvert Projects
Culvert # 63 and Culvert #64
Site Location Map
South Burlington, Vermont

May 10, 2013

2,000 1,000 0 2,000
Feet

Sources: Roads by VTrans (2009), VHD Streams, Town and County Boundaries and Roads from VCGI (2010); EO/Natural Community from ANR 2011; Investigation Area and Project Buffer by VHB (2012)

VHB Vanasse Hangen Brustlin, Inc.

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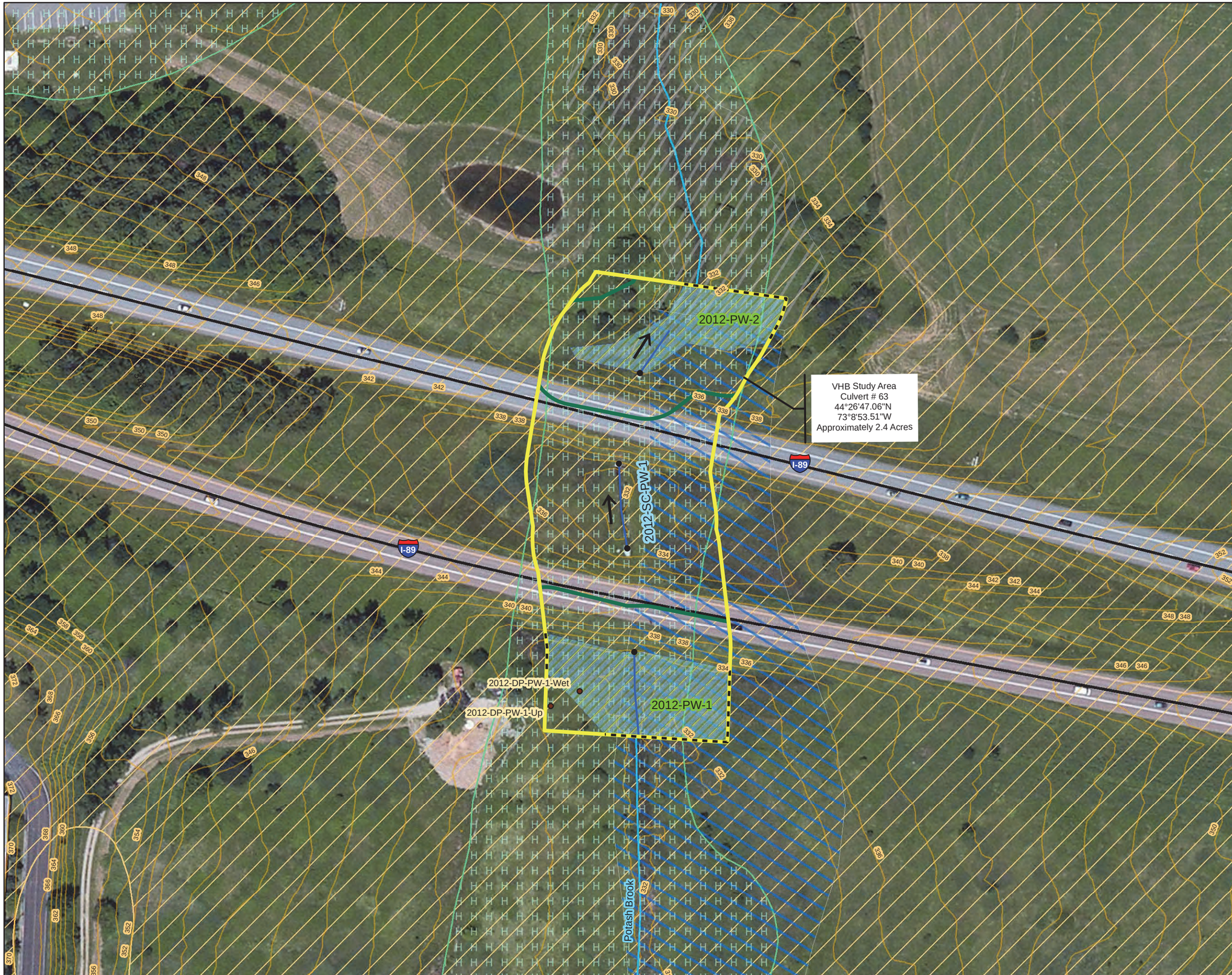

Figure 2
VTrans Culvert # 63
Natural Resources Map
South Burlington, Vermont

DRAFT: January 18, 2013

100 50 0 100
Feet

Legend

- VHB Study Area
- Culvert Invert Location
- VHB Delineated Perennial Stream (2012)
- VHB Proposed Class II Wetland (2012)
- Wetland Continues
- Proposed Class II Wetland Buffer (50 Ft)
- Delineation Data Point Locations (2012)
- 100 Year Floodzone (FEMA)
- 500 Year Floodzone (FEMA)
- Waterbody
- VHD Stream (2008)
- VSWI Wetland
- Hydric Soils
- Prime Agricultural Soils
- Deer Wintering Habitat (VT ANR)
- RTE Species/ Communities (WDP)
- 2ft Contours
- Town Boundary
- Local Road
- Stream Flow Direction

N

VHB Vanasse Hangen Brustlin, Inc.

Sources: Background by Bing (2011); Roads and Railroad by VTrans (2009); VHD Streams, Town and County Boundaries, Roads, Flood data, and Soils Data from VCGI (2010); Contours generated from HydroDEM by VCGI (2011); VSWI Wetlands, EO/Natural Community and Deer Wintering from ANR (2011); NRCS Soils (2008) downloaded from VCGI; VHB Study Area, Delineation Data Points, Delineated Streams and Wetlands, Wetland Buffers and Wetlands Continue Data by VHB (2012)

Prepared by: NSibley

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Figure 3
VTrans Culvert # 64
Natural Resources Map
South Burlington, Vermont

DRAFT: January 18, 2013

100 50 0 100
Feet

Legend

- VHB Study Area
- Culvert Invert Location

VHB Delineated Wetlands (2012)

- Proposed Class II
- Proposed Class III
- Wetland Continues
- Proposed Class II Wetland Buffer (50 ft)

VHB Delineated Streams (2012)

- Ephemeral Channel
- Intermittent
- Perennial
- VHD Stream (2008)
- 100 Year Floodzone (FEMA)
- 500 Year Floodzone (FEMA)
- VSWI Wetland
- Waterbody
- Hydric Soils
- Prime Agricultural Soils
- Deer Wintering Habitat (VT ANR)
- RTE Species/ Communities (NHIP)
- Town Boundary
- 2ft Contours
- Roads (VTrans)
- Stream Flow Direction

N

VHB Vanasse Hangen Brustlin, Inc.

Sources: Background by Bing (2011); Roads and Railroad by VTrans (2009); VHD Streams, Town and County Boundaries, Roads, Flood data, and Soils Data from VCGI (2010); Contours generated from HydroDEM by VCGI (2011); VSWI Wetlands, EO/Natural Community and Deer Wintering from ANR (2011); NRCS Soils (2008) downloaded from VCGI; VHB Study Area, Delineated Streams and Wetlands, Wetland Buffers and Wetlands Continue Data by VHB (2012)

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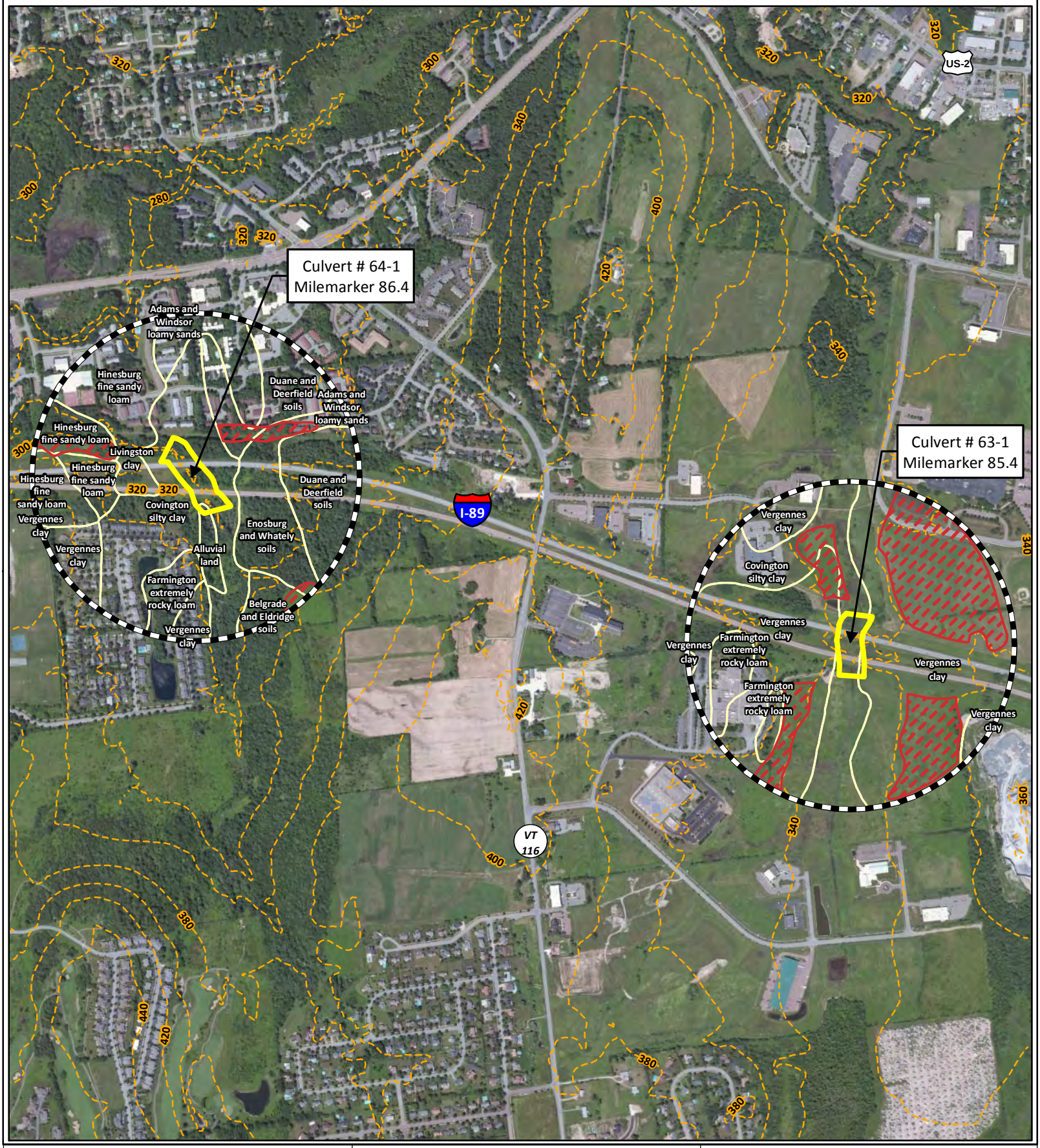

Legend

- Archaeologically Sensitive Area
- Project Area
- Quarter Mile Project Radius
- Soil Boundary (NRCS)
- 20 ft. Contours

N

Prepared by: JAT

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Figure 4:
South Burlington IM CULV (24)
Culverts 63-1 & 64-1 - Interstate 89
South Burlington, Vermont
Archaeologically Sensitive Areas

May 21, 2013

1,000 500 0 1,000 Feet

Sources: Background - Bing Imagery (2011-12); Archaeologically Sensitive Areas identified by VHB (2013); NRCS Soils downloaded from VCGI (2009); Study Areas by VHB (2013); Contours prepared by VHB using the VTHydro DEM layer (2013).

VHB Vanasse Hangen Brustlin, Inc.

TECHNICAL MEMORANDUM
South Burlington IM CULV(24)
South Burlington, Vermont

Culverts 63-1N, 63-1S, 64-1N, and 64-1S
Interstate Highway 89
South Burlington, Vermont

Date: January 18, 2013
Re: Natural Resources Identification and Regulatory Discussion

INTRODUCTION:
Vanasse Hangen Brustlin, Inc. (VHB) performed natural resource assessments within two study areas, in support of the planned replacement of Vermont Agency of Transportation ("VTrans") culverts 63-1N, 63-1S, 64-1N, and 64-1S on Interstate 89 ("I-89"), in South Burlington, Vermont ("Project"). This technical memorandum describes the most applicable Vermont and Federal regulatory programs for the resources investigated, overall site characteristics, study methods, and results of investigations conducted within the study areas. Included in the Attachment are the Site Location Map, VTrans Culvert 63 Natural Resources Map, VTrans Culvert 64 Natural Resources Map, Wetland Delineation Summary Table, Stream Delineation Summary Table, U.S. Army Corps of Engineers ("USACE") Wetland Determination Data Forms, Vermont Wetland Evaluation Forms, Wetland and Stream Representative Photographs, United States Department of Interior Fish and Wildlife Service Official Species list.

The study for these sites included a review of publicly available resource data, as well as a field investigation, and was designed to include an evaluation of the following natural resources:

Wetlands (*Vermont Department of Environmental Conservation ("VT DEC") Vermont Wetland Rules, USACE Section 404 of the Clean Water Act/ Vermont Section 401 Water Quality Certification*)
Projects are required to comply with the Vermont Wetland Rules ("VWR") (VT NRB 2010), which regulate impacts to significant wetlands (Class I and Class II wetlands) and their buffer zones. Impacts to Class III wetlands are not regulated by the VT DEC, but cumulative impacts from placement of fill are regulated by the USACE Section 404 of the Clean Water Act ("CWA") permit program, as well as the related VT DEC Section 401 Water Quality Certification ("WQC") review process.

Waters (*Vermont Title 19 Stream Alteration Review, Vermont Stream Obstruction Review, USACE Section 404 of the CWA, VT DEC Section 401 Water Quality Review/ Certification*), *Federal Emergency Management Agency ("FEMA") Special Flood Hazard Areas/National Flood Insurance Program ("NFIP")*
Currently, non-exempt work within a perennial stream requires a Stream Alteration Permit ("SAP") from the VT DEC. VTrans projects are reviewed under 19 VSA Section 10 (12) (VT DEC 2011), and do not require a SAP. In-stream work may require stream obstruction review from an Agency of Natural Resources ("ANR") fisheries biologist[1]. The Section 404 CWA regulatory program is administered by the USACE and regulates the cumulative impacts from placement of fill within jurisdictional Waters of the United States. Unavoidable impacts may require CWA Sections 404 permit authorization, or Section 401 CWA WQC from the VT DEC. As part of the Permit screening process, USACE may coordinate with state or other federal agencies to determine if other authorizations could be required for a project which would result in unavoidable impacts to jurisdictional features.

[1] Stream Obstruction Vermont law (10 V.S.A. § 4607) prohibits the installation of a structure that prevents fish movement, such as a rack, weir or other obstruction, unless an approval has been granted by the Commissioner of Fish and Wildlife.

Work within designated FEMA Special Flood Hazard Areas may require approval by VT DEC Rivers Management Program under NFIP regulations (VT ANR 2007).

Significant Natural Communities *(10 V.S.A. § 6086(a)(8))*
Should the Project need an Act 250 permit, the Vermont Wildlife Diversity Program ("WDP") can recommend that significant natural communities be deemed Rare and Irreplaceable Natural Areas ("RINA") under Act 250 Criterion 8 based on the combination of the natural community rarity and quality ranking. Under Act 250, a project must be shown to have no undue adverse effect on RINA. The presence of rare, threatened, or endangered ("RTE") species and these communities may be used by the WDP to make RINA recommendations. Rare (S1 and S2) natural communities can be considered RINA when quality-ranked as A, B, or C[2]. Uncommon (S3) community types require a quality rank of A or B to be considered as RINA. Assemblages of natural communities can also be considered RINA.

Necessary Wildlife Habitat *(10 V.S.A. §6086(a)(8)(A))*
Should the Project need an Act 250 permit, it must not cause any undue adverse impact on necessary wildlife habitat ("NWH"). NWH is most often defined as deer wintering areas ("DWA"), black bear habitat (concentrated beech/oak stands, forested wetlands, or black bear travel corridors), or in some cases, moose overwintering area.

Rare, Threatened, and Endangered Species *(Vermont State Takings Permit, Federal Section 10 Takings Permit; 10 V.S.A §6086(a)(8)(A))*
The Project should also not significantly impact or destroy Vermont or federally listed Endangered or Threatened Species or species proposed for federal listing.[3] If impacts to State threatened or endangered species or their critical habitat are unavoidable, a Vermont takings permit will likely be required (VT ANR 2004). If impacts to federally listed species or their critical habitat are unavoidable an Endangered Species Act ("ESA"), Section 10 Takings Permit may be required (USFWS 2011).

Prime Agricultural Soils (10 V.S.A § 6086 (a)(9)(B))
Should the Project need an Act 250 Permit, the Project must be shown to not significantly interfere with or jeopardize the continuation of agriculture or forestry or reduce the agricultural or forestry potential under Act 250 Criterion 9.

SITE DESCRIPTION:
VHB conducted delineations in two study areas in the City of South Burlington, VT (see Site Location Map, Attachment page 1). Both study areas bisect I-89 and are located in the Champlain Valley Biophysical Region. The sub-basin watershed of the study areas is the Lake Champlain Direct (HUC 8# 02010008). Both study areas are located in developed areas that contain a mix of transportation, open space, and light industrial development. The study area for culverts 63-1N and 63-1S which convey Potash Brook under I-89 is approximately 2.4 acres. The study area for culverts 64-1N and 64-1S is approximately 3.0, and conveys an unnamed tributary to Potash Brook south to north under I-89.

[2] Rankings from WDP *Vermont Natural Community Survey Form:* A: excellent estimated viability, B: good estimated viability, C: fair estimated viability, D: poor estimated viability. Survey Form available online at: http://www.vtfishandwildlife.com/wildlife_nongame.cfm
[3] Federal-listed species are protected under the U.S. Endangered Species Act and Vermont-listed species are protected under 10 V.S.A. §123.

ASSESSMENT METHODOLOGIES:

Wetlands

VHB Environmental Scientists Patti Kallfelz-Werts and Joseph Burt identified wetland resources in the field on September 13 and 14, 2012, in accordance with applicable methodologies outlined in the USACE *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region (Version 2.0)* (USACE 2011). The Regional Supplement requires the presence of three parameters to establish the occurrence of wetland resources: hydric soils, hydrophytic vegetation, and wetland hydrology. Under normal circumstances, which are present within both study areas, all three parameters must be met for an area to qualify as a wetland. Data were collected at the time of the delineation along the wetland and upland sides of the boundary, to document vegetation, soil characteristics, and evidence (or absence) of hydrology, in order to complete USACE Wetland Determination Data Sheets. Wetlands are classified in accordance with the *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin, et al. 1979). Wetlands are also assigned proposed VWR classifications by VHB using guidance from Section 4 of the VWR (VT NRB 2010).

Wetlands were flagged in the field using pink "wetland delineation" survey tape and labeled to include wetland ID and flag number (e.g., 2012-P1-1).

Waters

The delineation of jurisdictional waters occurred concurrently with the wetland delineation. Streams were mapped at the top-of-bank ("TB") or stream center ("SC") in accordance with the ANR *Riparian Buffer Guidance* (ANR 2005). Stream centers were flagged using orange survey tape and labeled with the stream ID and flag number (e.g., 2012-SC-P1-1). Streams delineated as TB were also flagged with orange survey tape and labeled with the stream ID and flag number (e.g., VHB 2012-TB-PW-1a). Observations on stream type (ephemeral, intermittent, or perennial), stream bed substrate, and bank characteristics were recorded in the field and are determined based on qualitative observations of in-stream hydrology indicators at the time of observation, as well as geomorphic characteristics, and are subject to professional judgment. Perennial streams typically show evidence of flow throughout the year, while intermittent streams typically only flow a part of the year, and ephemeral streams typically only flow following storm or snow melt events.

Photographs which depict representative conditions and delineated features were taken within each study area. VHB located wetland and stream delineation flags in the field using a Trimble® GPS unit capable of sub-meter accuracy. Data were post-processed using Trimble® Pathfinder software for enhanced accuracy.

Significant Natural Communities

In order to identify potential occurrences of known significant natural communities, VHB consulted the WDP database for the presence of known Element Occurrences ("Eos") of significant natural community types within and adjacent to the study areas. A 1-mile radius was used when querying the WDP database and information specific to each EO identified within the radius was obtained from the WDP on September 10, 2012.
This information was used to identify and target potential natural communities during the September 13 and 14, 2012 field surveys of onsite vegetative habitats.

Necessary Wildlife Habitat

In order to identify the potential occurrence of NWH, VHB reviewed GIS data provided by the ANR for the presence of NWH. VHB Wildlife Biologist Joseph Burt field reviewed the study areas on September 13 and 14, 2012 for evidence of on-site NWH.

Rare, Threatened, and Endangered Species
In order to identify known or potential occurrences of RTE species, particularly those that are Federal or Vermont-listed Threatened or Endangered, VHB researched the WDP database for the presence of known EOs of RTE within and adjacent to the study areas. A 1-mile radius was used when querying the WDP database and information specific to each EO identified within the radius was obtained from the WDP on September 10, 2012. Additionally, VHB queried the U.S. Fish and Wildlife Service ("USFWS") – Information, Planning, and Conservation ("IPaC") system project review database, to identify any federally listed, or proposed for listing, Threatened or Endangered species within the Project region. This information is used to identify target species for detailed surveys.

Prime Agricultural Soils
VHB researched available data provided by the Vermont Center for Geographic Information ("VCGI") for Natural Resource Conservation Service ("NRCS") survey-mapped prime agricultural soils ("PAS") within and adjacent to the study areas.

RESULTS:
Wetlands- Culverts 63-1N & 63-1S
VHB delineated two wetlands in the study area for culverts 63-1N and 63-1S (Wetlands 2012-P1 and 2012-P2)(see Culvert 63 Natural Resources Map, Attachment page 2). The wetlands are either palustrine emergent or a combination of Cowardin classification (see Representative Photographs, Attachment pages 84 through 90). Both wetlands likely meet the VWR Section 4.6 Presumptions, and would therefore be considered Class II. They provide the following functions and values according to the VWR Section 5 Functional Criteria for Evaluating a Wetland's Significance: 5.1 Water Storage for Flood Water and Storm Runoff, 5.2 Surface and Ground Water Protection, and 5.10 Erosion Control through Binding and Stabilizing the Soil (See Vermont Wetland Evaluation Forms, Pages 18 to 83 in the Attachment).

No vernal pools were identified within the study area.

Wetlands- Culverts 64-1N & 64-1S
VHB delineated five wetlands in the study area for culverts 64-1N and 64-1S study area (2012-P3, 2012-P4, 2012-J1, 2012-J2, and 2012-J3) (see Culvert 64 Natural Resources Map, Attachment page 3). The wetlands are either palustrine emergent or a combination of Cowardin classification (see Representative Photographs, Attachment pages 84 through 90). Wetland 2012-J3 is contiguous to a Vermont Significant Wetland Inventory ("VSWI")-mapped wetland, and would therefore, be considered Class II. Wetland 2012-JB-3 also provides the VWR Section 5 functions 5.1, 5.2, and 5.10 at a significant level. A representative photograph of wetland 2012-JB-3 can be found on Page 89 of the Attachment.

The four proposed Class III wetlands include palustrine emergent and palustrine emergent/palustrine forested Cowardin classifications. Using the parameters defined by VWR Section 5, these wetlands perform minimal function and values, based on landscape consideration, vegetative cover, and overall condition. The principal functions and values of the proposed Class III wetlands, however limited, primarily include 5.1 and 5.2.

Waters- Culverts 63-1N & 63-1S
VHB delineated one stream segment that is crossed by the study area (see the tabular Summary of Delineated Streams on page 5 of the Attachment) within the Lake Champlain Direct watershed sub-basin. Potash Brook (2012-SC-P1) is a Vermont Hydrography Dataset ("VHD")-mapped perennial stream, contiguous to wetland features, and has been mapped by the VT DEC Rivers Management Program with watershed size greater than 0.5 square mile. The stream channel becomes diffuse north of culvert 63-1N, within wetland 2012-PW-2 (see Culvert 63 Natural Resources Map, Page 2 of the Attachment). According to the VT DEC Watershed Sizes Maps for the City of South Burlington the watershed size of Potash Brook is approximately 0.5-1.0 square mile (VT DEC 2011).

The study area includes areas mapped by FEMA as Special Flood Hazard Areas (See Culvert 63 Natural Resources Map, page 2 of the Attachment). The surface waters in the study area are classified as Class B waters under the Vermont Water Quality Standards (VT NRB 2011).

Potash Brook is not included in the State of Vermont 2010 303(d) List of Waters, Part A- Impaired Surface Waters in Need of Total Maximum Daily Load ("TMDL"). However, it is listed under the State of Vermont 2012 List of Priority Surface Waters Outside the Scope of Clean Water Act Section 303(d), Part D- Surface Waters With Completed TMDLs (WMD 2012). The previously identified problem is elevated *E. coli* levels and the stream has an Environmental Protection Agency ("EPA") - approved TMDL as of September 30, 2011.

Waters- Culverts 64-1N & 64-1S
VHB delineated four stream segments that are crossed by the study area (2012-TB-PW-2, 2012-SC-JB-1, 2012-SC-JB-2, and 2012-SC-JB-3) (see the tabular Summary of Delineated Streams on page 5 of the Attachment) within the Lake Champlain Direct watershed sub-basin. 2012-TB-PW-2, an unnamed tributary to Potash Brook, is a VHD-mapped perennial stream, contiguous to wetland features, and has been mapped by the VT DEC Rivers Management Program with a watershed-size greater than .5 square mile. According to the VT DEC Watershed Sizes Maps for the City of South Burlington the watershed size of 2012-TB-PW-2 is approximately 1.0-10.0 square miles (VT DEC 2011).

Two of the delineated stream segments may be classified as intermittent (2012-SC-JB-1 and 2012-SC-JB-2) and one segment may be classified as an ephemeral channel (2012-SC-JB-3).

The study area includes areas mapped by FEMA as Special Flood Hazard Areas (See Culvert 64 Natural Resources Map, page 3 of the Attachment). The surface waters in the study area are classified as Class B waters under the Vermont Water Quality Standards (VT NRB 2011).

The delineated streams in this study area are not included in the State of Vermont 2010 303(d) List of Waters, Part A- Impaired Surface Waters in Need of TMDL, nor in the State of Vermont 2012 List of Priority Surface Waters Outside the Scope of Clean Water Act Section 303(d), Part D- Surface Waters With Completed TMDLs (WMD 2012).

Significant Natural Communities

A query of the WDP database returned three EOs of significant natural communities within one mile search radius of the study areas: Red Maple-Black Ash Seepage Swamp (S4- widespread), Wet Clayplain Forest (S2- rare in Vermont), and Wet Sand- Over- Clay Forest (S2). None of the EOs is mapped within the VHB study areas. The on-site communities are primarily a mix of disturbed road-side edge, maintained ROW, disturbed emergent and forested wetlands, and regenerating northern hardwood forest. The onsite habitat within the study areas does not align with the habitat descriptions of the EOs identified in the database query (Thompson and Sorenson 2005). Therefore, it is VHB's opinion that none of the onsite natural or otherwise vegetative communities should be considered significant.

Necessary Wildlife Habitat
The ANR database review did not identify any ANR mapped NWH. Field investigations corroborated the database review.

Rare, Threatened, and Endangered Species
A query of the WDP returned four EO species of RTEs within the one-mile search radius of the two study areas: Yellow bartonia (*Bartonia virginica*)(Plant, S2- State rare), Howe's sedge (*Carex atlantica ssp. capillacea*)(Plant, S1- State rare), merlin (*Falco columbarius*)(Bird, S2B- State rare breeding habitat), and clay-colored sparrow (*Spizella pallida*)(Bird, S2B- State rare breeding habitat). None are mapped within the VHB study areas.

The RTE plant species identified in the WDP communications are not likely to occur within the study areas based on typical habitat descriptions for the species. Yellow bartonia is typically found in peatlands and lake edges and Howe's sedge generally occurs in bogs or acidic swamps, none of which are found within the study areas. Merlin and clay-colored sparrow both utilize broad ranging habitat types for breeding. Merlin typically nest in semi-open mixed or coniferous forests and clay-colored sparrows nest in brushy grasslands and prairies. Field surveys were not conducted for merlin or clay-colored sparrows as any disturbance related to the culvert replacements would occur within previously disturbed areas and would not impact breeding habitat quality within the study area for these species.

The results of the USFWS IPaC query identified Indiana bat (*Myotis sodalis*) (Federal- Endangered) to occur within Chittenden County (See the United States Department of Interior Fish and Wildlife Service Official Species list on pages 91 through 95 of the Attachment), but no known EOs were identified by the WDP within one mile of the investigation area. No further field surveys are needed, as the study areas are outside of the summer range of Indiana bats and there were no potential roost trees observed within the study areas.

Prime Agricultural Soils
A database search of NRCS-mapped soils indicates there are mapped statewide agricultural soils within the culvert 63 study area (see Culvert 63 Natural Resources Map, page 2 of the Attachment). The Project should not reduce the agricultural potential of the prime agricultural soils as the study area is primarily disturbed roadside and wetland features. The culvert 64 study area does not have mapped prime or statewide agricultural soils.

REGULATORY DISCUSSION:
The following is a brief discussion of the most pertinent environmental regulatory programs that may be applicable to the resources under this review, and also provides VHB's recommendations for coordination under the specific program requirements:

Vermont Stream Alteration Permit
Any work within a perennial stream would require Title 19 review by the River Management Engineer for VTrans projects if it would result in the movement, excavation, or fill involving 10 or more cubic yards within the watercourse. Potash Brook has a watershed area between 0.5 and 1.0 square mile, therefore the 63-1N and 63-1S culvert replacements should be considered a Non-Reporting Activity under Vermont Stream Alteration General Permit requirements under Title 19 review. Stream 2012-TB-PW-2 has a watershed area between 1.0 and 10.0 square miles, therefore the 64-1N and 64-1S culvert replacements should also be considered a Non-Reporting Activity provided:

- Scour protection or erosion treatments do not reduce the channel cross section dimensions and cross-sectional area;
- There is no channel realignment;
- There is no roadway realignment;
- The repaired or replacement structure provides a span length 1.2 X bank full width or greater at the streambed elevation;
- The repaired or replacement structure provides a Q25 headwater depth + one (1) foot that is no higher than the elevation of the lowest superstructure element; and
- Any temporary structure for traffic maintenance during construction provides a span length 1.0X bank full width or greater.

VHB recommends coordination with the Vermont River Management Engineer (Chris Brunelle) to identify if the Project is exempt from further Title 19 review or Stream Obstruction review.

Section 404 of the Clean Water Act
The USACE regulates dredging or the placement of fill material into navigable waterways and their tributaries, including adjacent wetlands, under Section 404 of the CWA. If the project would result in unavoidable impacts to jurisdictional waters, an authorization from the USACE would be required. The current Vermont Programmatic General Permit (PGP) authorizes minor impacts to jurisdictional waters if the project complies with the General Conditions of the Vermont PGP. The PGP is divided into Category 1 authorizations for new fill discharge projects which comply with the General Conditions and would result in cumulative impacts of less than 3,000 square feet (or Projects where repair or maintenance of previously authorized fill occurs could be considered for Category 1 authorization); and Category 2 authorizations for projects which would result in impacts of more than 3,000 square feet, less than one acre, and comply with the General Conditions; the USACE can also impose Special Conditions on a Category 2 authorization to ensure impacts are minimal (USACE 2012). Cumulative impacts resulting from the placement of fill include permanent, temporary, or secondary; and direct and/or indirect impacts. If Project impacts are greater than one acre, an Individual Permit may be required.

Section 401 Water Quality Certification
Projects which require a Section 404 authorization for impacts to jurisdictional waters also require a Section 401 WQC which is administered by the VT DEC. The VT DEC has granted WQC for projects which qualify for authorization under Category 1 of the Vermont PGP. The VT DEC has also conditionally granted WQC for Category 2 activities, but reserves the right for project review by personnel from the various VT DEC division personnel; the VT DEC can require Individual WQC for Category 2 projects which do not meet the criteria for general WQC. If a project requires an Individual Section 404 Permit, then Individual WQC is required.

Vermont Wetland Rules

The VT DEC administers the VWR, which require a Vermont Wetlands Permit ("VWP") to authorize activities within Class I or Class II wetlands or their associated buffers, if the activities are not considered allowed uses. Certain reconstruction or repair projects, including public transportation facilities, may be considered an allowed use under VWR Section 6.12. Coordination with the VT DEC is necessary to review the proposed wetland classification and the project activity, to determine if impacts would occur to Class II wetlands or their 50-foot buffer-zones, and if a Vermont Wetland Permit is required (NRB 2010).

ATTACHMENT:

- VTrans Culverts 63 and 64 Site Location Map
- VTrans Culvert 63 Natural Resources Map
- VTrans Culvert 64 Natural Resources Map
- Wetland Delineation Summary Table
- Stream Delineation Summary Table
- USACE Wetland Determination Data Forms
- Vermont Wetland Evaluation Forms
- Wetland and Stream Delineation Representative Photographs
- United States Department of Interior Fish and Wildlife Service Official Species list

REFERENCES:

Cowardin, et al. 1979. Classification of Wetlands and Deepwater Habitat of the United States. U.S. Fish and Wildlife Service. FWS/OBD-79/31. 103pp.

Federal Emergency Management Agency (FEMA). 2011. Flood Insurance Rate Map – Chittenden County, Vermont. Map Number 50007C0143D – Effective Date: July 18, 2011. Available online at: https://msc.fema.gov/webapp/wcs/stores/servlet/FemaWelcomeView?storeId=10001&catalogId=10001&langId=-1

U.S. Army Corps of Engineers (USACE). 2005. "Regulatory Guidance Letter. Subject: Ordinary High Water Mark Identification." No. 05-05. Available online at: http://www.usace.army.mil/Portals/2/docs/civilworks/RGLS/rgl05-05.pdf

USACE. 2012. Department of the Army General Permit State of Vermont (General Permit No.: NAE-2012-1167). Effective December 11, 2012. Available online at http://www.nae.usace.army.mil/Regulatory/SGP/VT_PGP.pdf

USACE. 2011. *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region (Version 2.0)*, ed. J.S. Wakeley, R.W. Lichvar, C.V. Noble, and J.F. Berkowitz. ERDC/EL TR-12-1. Vicksburg, MS: U.S. Army Engineer Research and Development Center.

U.S. Fish and Wildlife Service. 2012. Endangered Species Program- Permits. Available online at http://www.fws.gov/endangered/permits/index.html

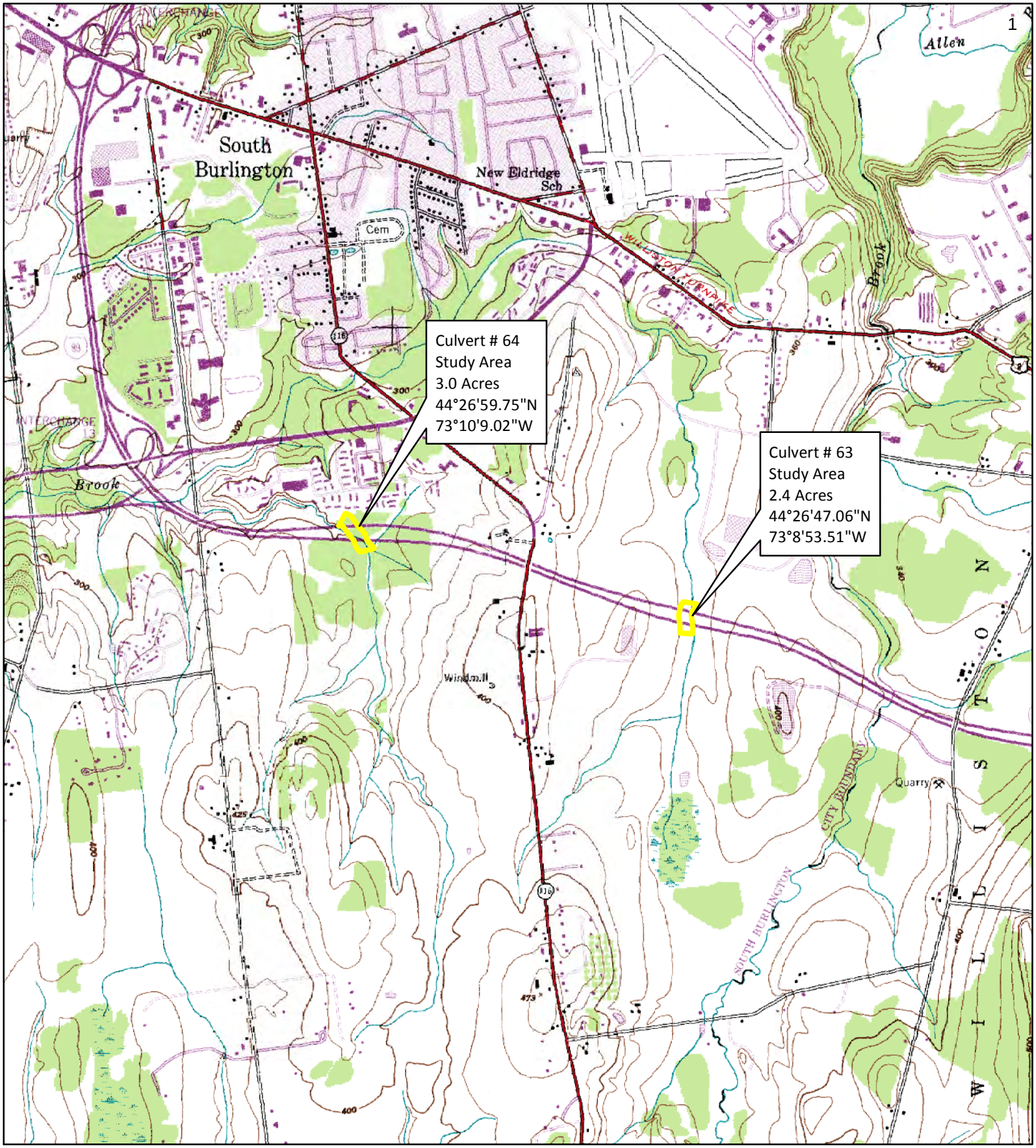
Vermont Department of Environmental Conservation (VT DEC). 2011. Watershed Sizes Used as Guidance in Stream Alteration Regulations – Colchester (Map). Available online at: http://www.anr.state.vt.us/dec//waterq/rivers/docs/SA_SWS/StreamAlterations_Colchester.pdf

Vermont Agency of Natural Resources (VT ANR). 2005. Riparian Buffer Guidance: December 9, 2005. Available online at http://www.state.vt.us/site/ht ml/buff/ anrbuffer2005.htm

Vermont Natural Resources Board (NRB). 2010. Vermont Wetland Rules. Effective August 1, 2010. Available online at: http://www.vtwaterquality.org/wetlands.htm

Vermont NRB. 2011. Vermont Water Quality Standards (Vt. Code R 12 004 052), Effective December 31, 2011.

VT DEC Watershed Management Division (WMD). 2012. *State of Vermont – 2012 – List of Priority Waters Outside the Scope of Clean Water Act Section 303 (d) List of Waters – Part D– SURFACE WATERS WITH COMPLETED AND APPROVED TMDLs*.



N

Legend

VHB Study Area

South Burlington IM CULV (24)
Culverts 63 & 64 - Interstate Highway 89
South Burlington, Vermont
Site Location Map

January 17, 2013

2,000 1,000 0 2,000
Feet

Vanasse Hangen Brustlin, Inc.

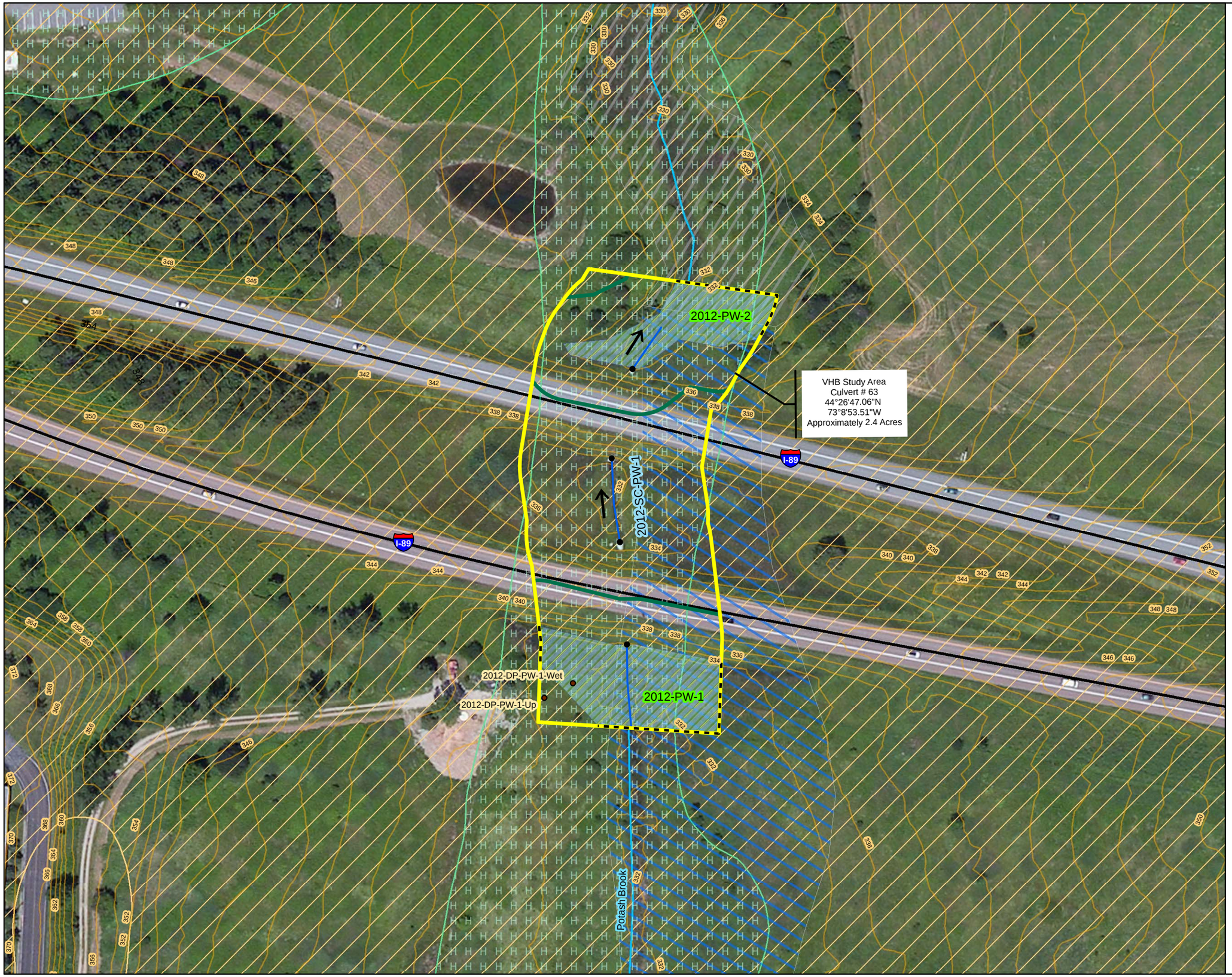
Sources: USGS Quads (Colchester and Burlington (1987)) from VCGI; VHB Study Areas by VHB

F:\57578.00\GIS\Project\Site Location Map.mxd On 1/17/2013 at 1:20:21 PM

Prepared by: MRB

VTrans Culvert # 63
Natural Resources Map
South Burlington, Vermont

DRAFT: January 18, 2013



100 50 0 100
Feet

Legend

- VHB Study Area
- Culvert Invert Location
- VHB Delineated Perennial Stream (2012)
- VHB Proposed Class II Wetland (2012)
- Wetland Continues
- Proposed Class II Wetland Buffer (50 Ft)
- Delineation Data Point Locations (2012)
- 100 Year Floodzone (FEMA)
- 500 Year Floodzone (FEMA)
- Waterbody
- VHD Stream (2008)
- VSWI Wetland
- Hydric Soils
- Prime Agricultural Soils
- Deer Wintering Habitat (VT ANR)
- RTE Species/ Communities (WDP)
- 2ft Contours
- Town Boundary
- Local Road
- Stream Flow Direction

N

Vanasse Hangen Brustlin, Inc.

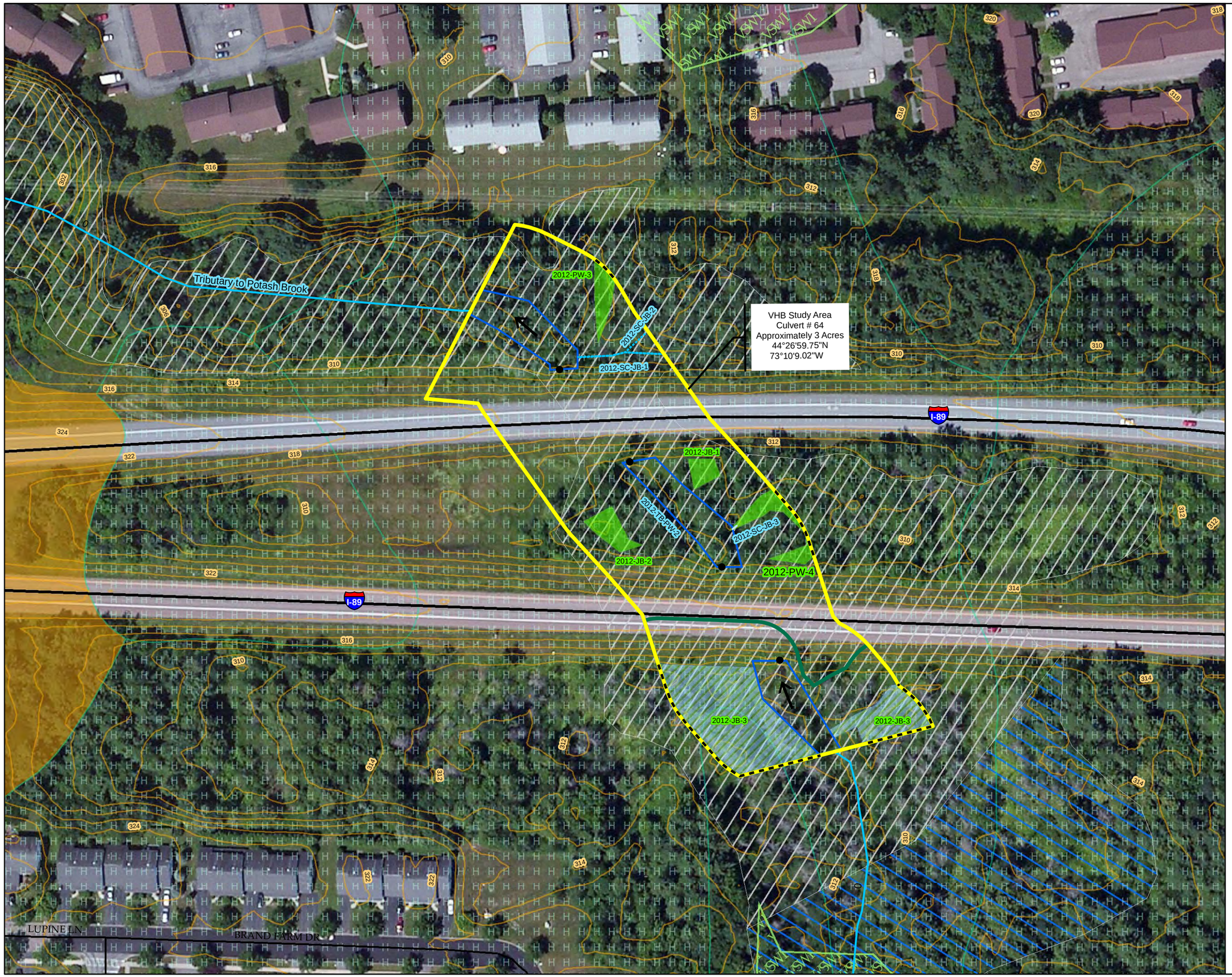
Sources: Background by Bing (2011); Roads and Railroad by VTrans (2009); VHD Streams, Town and County Boundaries, Roads, Flood data, and Soils Data from VCGI (2010); Contours generated from HydroDEM by VCGI (2011); VSWI Wetlands, EO/Natural Community and Deer Wintering from ANR (2011); NRCS Soils (2008) downloaded from VCGI; VHB Study Area, Delineation Data Points, Delineated Streams and Wetlands, Wetland Buffers and Wetlands Continue Data by VHB (2012)

Prepared by: NSibley

VTrans Culvert # 64
Natural Resources Map
South Burlington, Vermont

DRAFT: January 18, 2013

100 50 0 100
Feet



Legend

- VHB Study Area
- Culvert Invert Location

VHB Delineated Wetlands (2012)

- Proposed Class II
- Proposed Class III
- Wetland Continues
- Proposed Class II Wetland Buffer (50 ft)

VHB Delineated Streams (2012)

- Ephemeral Channel
- Intermittent
- Perennial
- VHD Stream (2008)
- 100 Year Floodzone (FEMA)
- 500 Year Floodzone (FEMA)
- VSWI Wetland
- Waterbody
- Hydric Soils
- Prime Agricultural Soils
- Deer Wintering Habitat (VT ANR)
- RTE Species/ Communities (NHIP)
- Town Boundary
- 2ft Contours
- Roads (VTrans)
- Stream Flow Direction

N

VHB Vanasse Hangen Brustlin, Inc.

Sources: Background by Bing (2011); Roads and Railroad by VTrans (2009); VHD Streams, Town and County Boundaries, Roads, Flood data, and Soils Data from VCGI (2010); Contours generated from HydroDEM by VCGI (2011); VSWI Wetlands, EO/Natural Community and Deer Wintering from ANR (2011); NRCS Soils (2008) downloaded from VCGI; VHB Study Area, Delineated Streams and Wetlands, Wetland Buffers and Wetlands Continue Data by VHB (2012)

South Burlington IM CULV (24)
Vtrans Culverts 63 and 64
South Burlington, Vermont
Wetland Delineation Summary Table
Prepared by VHB (J. Burt)
January 16, 2013

	VHB Delineated Wetlands										
				Vermont Wetland Rules Classification							
	Wetland ID	Delineated Area (Square Feet)[1]	Cowardin Classification[2]	Contiguous to a VSWI-mapped Wetland?	Elevation greater than 2500 feet	Riparian Wetland Contiguous to Stream Channel? (Flow Regime)[3]	VWR Section 4.6 Presumptions[4]	VWR Section 5 Functional Criteria Presence/ Significance		VHB Proposed VWR Classification[6]	Comments
								Type[5]	VHB-Proposed Significant?		
Culverts 63-1N & 63-1S	2012-PW-1	16,265	PEM	No	No	Yes (P)	a, c	5.1, 5.2, 5.10	Yes	Class II	Emergent wetland located along perennial stream Potash Brook (2012-SC-PW-1); saturated to the surface; hydrophytic vegetation includes narrowleaf cattail (*Typha angustifolia*) and small white aster (*Symphyotrichum lateriflorum var. lateriflorum*)
	2012-PW-2	10,538	PEM/PSS/PFO	No	No	Yes (P)	a, c	5.1, 5.2, 5.10	Yes	Class II	Emergent wetland located along perennial stream Potash Brook (2012-SC-PW-1); saturated to the surface; hydrophytic vegetation includes narrowleaf cattail (*Typha angustifolia*) and New England aster (*Symphyotrichum novae-angliae*)
Culverts 63-1N & 63-1S	2012-JB-1	842	PEM	No	No	No	-	5.1	No	Class III	Small emergent feature in a forested setting; saturated to surface in distinct topographical depression; hydrpohytic vegetation includes Sensitive fern (*Onoclea sensibilis*) and Jewelweed (*Impatiens capensis*)
	2012-JB-2	1,407	PEM/PFO	No	No	No	-	5.1	No	Class III	Emergent wetland feature located within a forested setting; saturated to the surface; receives run-off from Interstate 89; hydrophytic vegetation includes (*Carex crinita*), sensitive fern (*Onoclea sensibilis*), and soft rush (*Juncus effusus*)
	2012-JB-3	1,587	PEM/PSS	Yes	No	Yes (P)	a, c	5.1, 5.2, 5.10	Yes	Class II	Large feature contiguous to VSWI mapped; saturated to the surface; located along VHD mapped perennial stream, 2012-TB-PW-2; hydrophytic vegetation includes joe pye weed (*Eutrochium maculatum*), boneset (*Eupatorium perfoliatum*), giant goldenrod (*Solidago gigantea*)
	2012-PW-3	1,304	PEM	No	No	No	-	5.1	No	Class III	Feature saturated to surface; topographic depression; wetland drainage patterns observed; hydrophytic vegetation includes jewelweed (*Impatiens capensis*), melic mannagrass (*Glyceria melicaria*), white turtlehead (*Chelone glabra*)
	2012-PW-4	1,862	PEM	No	No	No	-	5.1, 5.2	No	Class III	Floodplane emergent wetland in forested setting; located in Interstate 89 median; hydrophytic vegetation includes sensitive fern (*Onoclea sensibilis*), field horsetail (*Equisetum arvense*)

[1] All wetlands field-delineated per the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northeast and North Central Region. U.S. Army Corps of Engineers. 2012. Vegetation indicator status assessed according to the 2012 National List of Wetland Plants (Lichvar 2012)

[2] Classification follows Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of Wetlands and Deepwater Habitat of the United States. U.S. Fish and Wildlife Service. FWS/OBD-79/31. 103pp.

[3] Wetland contiguity to streams as defined in the Vermont ANR 12/9/05 *Guidance for Agency Act 250 and Section 248 Comments Regarding Riparian Buffers* and confirmed if a delineated perennial or intermittent stream channel inflows, throughflows, and outflows from a delineated wetland (ephemeral channels not typically being subject to ANR Riparian Buffer Guidance). The vegetative assemblage or natural community type is used when determining riparian vegetation function. Flow regime determined based on qualitative observations of instream hydrology indicators and geomorphic characteristic and are subject to professional judgment (P=perennial, I=intermittent, E=ephemeral).

[4] Alpha-numeric codes correspond with Section 4.6 Presumption , of the 2010 Vermont Wetland Rules.

[5] VWR Section 5: Functional Criteria for Evaluating a Wetland's Significance: 5.1=Water Storage for Flood Water and Storm Runoff, 5.2=Surface and Groundwater Protection, 5.3=Fish Habitat, 5.4=Wildlife Habitat, 5.5=Exemplary Wetland Natural Community, 5.6=Rare, Threatened or Endangered Species Habitat, 5.7=Education and Research in Natural Sciences, 5.8=Recreational Value and Economic Benefits, 5.9=Open Space and Aesthetics, 5.10=Erosion Control Through Binding and Stabilizing the Soil.

[6] 2012 VHB-Proposed VWR Classification is based on review and application of the VWR effective September 15, 2010, particularly VHB's interpretation of Section 4.6 Presumptions and is subject to final determinations by the ANR-DE

South Burlington IM CULV (24)
VTrans Culverts 63 and 64
South Burlington, Vermont
Stream Delineation Summary Table
Prepared by VHB (J. Burt)
January 16, 2013

	VHB Delineated Streams							
	Feature ID	**Stream Name**	**Associated Wetlands**	**Average Ordinary High Water Width (OHW) Feet[1]**	**Flow Regime (Ephemeral Intermittent and Perennial)[2]**	**Watershed Size > 0.5 square miles (Yes/No)[3]**	**VWQS Classification (2011)[4]**	**Comments**
Culverts 63-1N & 63-1S	2012-SC-PW-1	Potash Brook	2012-PW-1; 2012-PW-2	4	Perennial	Yes	B	Drains through wetlands 2012-PW-1 and 2012-PW-2; drains through culverts under Interstate 89; VHD mapped stream; drains to Lake Champlain
Culverts 63-1N & 63-1S	2012-TB-PW-2	Unnamed Tributary to Potash Brook	2012-JB-3	6	Perennial	Yes	B	Drains through wetland 2012-JB-3; drains to Potash Brook; well definined banks; silt/clay substrate; drains under Interstate 89 via culverts
	2012-SC-JB-1	-	-	2	Intermittent	No	B	Cobble substrate; incised banks; drains to VHD mapped stream
	2012-SC-JB-2	-	-	3	Intermittent	No	B	Drains to stream 2012-SC-JB-1; cobble substrate; 3-foot banks
	2012-SC-JB-3	-	-	1	Ephemeral	No	B	Drains from wetland 2012-PW-4; drains to VHD mapped stream; organic substrate

[1]U.S. Army Corps of Engineers (USACE). 2005. "Regulatory Guidance Letter. Subject: Ordinary High Water Mark Identification." No. 05-05.

[2]Stream flow regime determined based on qualitative observations of instream hydrology indicators and geomorphic characteristic and are subject to professional judgment.

[3]Watershed size was determined using Vermont ANR Stream Alteration Regulatory Program mapping for the City of South Burlington, Vermont. Watershed Sizes Used as Guidance in Stream Alteration Regulations for the City of South Burlington

[4]Under Vermont Water Quality Standards (Vt. Code R. 12 004 052), Effective December 30, 2011, the waters found within the investigation area are considered Class B waters.

WETLAND DETERMINATION DATA FORM - Northcentral and Northeast Region

Project Site: Interstate 89 Culvert 64 City/County: South Burlington/Chittenden Samp. Date: 9/14/2012

Applicant/Owner: VTrans State: VERMONT Sampling Point: 2012-JB-3-PitB

Investigator(s): P. Werts Section, Township, Range: South Burlington

Landform (hillslope, terrace, etc.): Terrace Local relief (concave, convex, none): Concave Slope (%):

Subregion (LRR or MLRA): LRR R Lat: Long: Datum: NAD 83

Soil Map Unit: Covington silty clay NWI Class:

Are climatic/hydrologic conditions on the site typical for this time of year? NO (If no, explain in Remarks.)

Are Vegetation, Soil, or Hydrology significantly disturbed? No Normal Circumstances? Yes

Are Vegetation, Soil, or Hydrology naturally problematic? No (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS - Attach site map showing sample point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	NO	**Is This Sample Area Within a Wetland?**	NO
Hydric Soil Present?	NO		
Wetland Hydrology Present?	NO	**If yes, optional Wetland Site ID:**	

Remarks:

Data point located near flag 2012-JB-3-6

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

Surface Water (A1)	Water-Stained Leaves (B9)	Secondary Indicators (minimum of two required)
High Water Table (A2)	Aquatic Fauna (B13)	Surface Soil Cracks (B6)
Saturation (A3)	Marl Deposits (B15)	Drainage Patterns (B10)
Water Marks (B1)	Hydrogen Sulfide Odor (C1)	Moss Trim Lines (B16)
Sediment Deposits (B2)	Oxidized Rhizospheres on Living Roots (C3)	Dry-Season Water Table (C2)
Drift Deposits (B3)	Presence of Reduced Iron (C4)	Crayfish Burrows (C8)
Algal Mat or Crust (B4)	Recent Iron Reduction in Tilled Soils (C6)	Saturation Visible on Aerial (C9)
Iron Deposits (B5)	Thin Muck Surface (C7)	Stunted or Stressed Plants (D1)
Inundation Visible on Aerial (B7)	Other (Explain in Remarks)	Geomorphic Position (D2)
Sparsely Vegetated Concave Surface (B8)		Shallow Aquitard (D3)
		Microtopographic Relief (D4)
		FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?		Depth (inches):	
Water Table Present?		Depth (inches):	
Saturation Present? (includes capillary fringe)		Depth (inches):	

Wetland Hydrology Present? NO

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Precipitation recorded in Burlington, VT for 30 days prior to sampling was 4.11" which is 2.53" above normal . Rainfall 5 days prior to sampling was 0.00" (NOAA 2012)

Remarks:

Saturation greater than 18 inches

VEGETATION - Use scientific names of plants.

Sampling Point: 2012-JB-3-PitB

Tree Stratum (Plot size: 30' RAD)	Absolute % Cover	Dom. Sp?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
		= Total Cover	

Sapling Stratum (Plot size: 30' RAD)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
		= Total Cover	

Shrub Stratum (Plot size: 15' RAD)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
		= Total Cover	

Herb Stratum (Plot size: 10' RAD)			
1. Solidago canadensis L.	63	X	FACU
2. Euthamia caroliniana (L.) Greene ex Porter & Britton	15		FAC
3. Onoclea sensibilis L.	3		FACW
4. Hypericum punctatum Lam.	3		FAC
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	84	= Total Cover	

Woody Vines (Plot size: 15' RAD)			
1.			
2.			
3.			
4.			
5.			
		= Total Cover	

Dominance Test Worksheet:

# Dominants OBL, FACW, FAC:		(A)
# Dominants across all strata:	1	(B)
% Dominants OBL, FACW, FAC:		(A/B)

Prevalence Index Worksheet:

Total % Cover of:			Multiply By:
OBL		x 1 =	
FACW	3	x 2 =	6
FAC	18	x 3 =	54
FACU	63	x 4 =	252
UPL		x 5 =	
Sum:	84 (A)		312 (B)

Prevalence Index = B/A = 3.71

Hydrophytic Vegetation Indicators:

- ____ Dominance Test is > 50%
- ____ Prevalence Index is <= 3.0[1]
- ____ Problematic Hydrophytic Vegetation[1] (explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree - Woody plants, excluding woody vines, approximately 20ft (6m) or more in height and 3in (7.6cm) or larger in diameter at breast height (DBH).

Sapling - Woody plants, excluding woody vines, approximately 20ft (6m) or more in height and less than 3in (7.6cm) DBH.

Shrub - Woody plants, excluding woody vines, approximately 3 to 20ft (1 to 6m) in height.

Herb - All herbaceous (non-woody) plants, including herbaceous vines, regardless of size. Includes woody plants, except woody vines, less than approximately 3ft (1m) in height.

Woody vine - All woody vines, regardless of height.

Hydrophytic Vegetation Present? NO

Remarks: (If observed, list morphological adaptations below).

unidentified Aster species (approximately 15 percent cover)

SOIL

Sampling Point: 2012-JB-3-PitB

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(in)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-9	10YR 3/1						Silt Loam	
9-18	2.5Y 5/3		10YR 4/6				Silt Loam	CMD Redox

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains.

[2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ____ Histosol (A1)
- ____ Histic Epipedon (A2)
- ____ Black Histic (A3)
- ____ Hydrogen Sulfide (A4)
- ____ Stratified Layers (A5)
- ____ Depleted Below Dark Surface (A11)
- ____ Thick Dark Surface (A12)
- ____ Sandy Mucky Mineral (S1)
- ____ Sandy Gleyed Matrix (S4)
- ____ Sandy Redox (S5)
- ____ Stripped Matrix (S6)
- ____ Dark Surface (S7) (LRR R, MLRA 149B)
- ____ Polyvalue Below Surface (S8) (LRR R, MLRA 149B)
- ____ Thin Dark Surface (S9) (LRR R, MLRA 149B)
- ____ Loamy Mucky Mineral (F1) (LRR K, L)
- ____ Loamy Gleyed Matrix (F2)
- ____ Depleted Matrix (F3)
- ____ Redox Dark Surface (F6)
- ____ Depleted Dark Surface (F7)
- ____ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ____ 2cm Muck (A10) (LRR K, L, MLRA 149B)
- ____ Coast Prairie Redox (A16) (LRR K, L, R)
- ____ 5cm Mucky Peat or Peat (S3) (LRR K, L, R)
- ____ Dark Surface (S7) (LRR K, L)
- ____ Polyvalue Below Surface (S8) (LRR K, L)
- ____ Thin Dark Surface (S9) (LRR K, L)
- ____ Iron-Manganese Masses (F12) (LRR K, L, R)
- ____ Piedmont Floodplain Soils (F19) (MLRA 149B)
- ____ Mesic Spodic (TA6) (MLRA 144A, 145, 149B)
- ____ Red Parent Material (TF2)
- ____ Very Shallow Dark Surface (TF12)
- ____ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? NO

Remarks:

WETLAND DETERMINATION DATA FORM - Northcentral and Northeast Region

Project Site: Interstate 89 Culvert 64 City/County: South Burlington/Chittenden Samp. Date: 9/14/2012

Applicant/Owner: VTrans State: VERMONT Sampling Point: 2012-JB-3- PitA

Investigator(s): P. Werts Section, Township, Range: South Burlington

Landform (hillslope, terrace, etc.): Terrace Local relief (concave, convex, none): Concave Slope (%):

Subregion (LRR or MLRA): LRR R Lat: Long: Datum: NAD 83

Soil Map Unit: Covington silty clay NWI Class: PEM

Are climatic/hydrologic conditions on the site typical for this time of year? NO (If no, explain in Remarks.)

Are Vegetation, Soil, or Hydrology significantly disturbed? No Normal Circumstances? Yes

Are Vegetation, Soil, or Hydrology naturally problematic? No (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS - Attach site map showing sample point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	YES	**Is This Sample Area Within a Wetland?**	YES
Hydric Soil Present?	YES		
Wetland Hydrology Present?	YES	**If yes, optional Wetland Site ID:**	2012-JB-3

Remarks:

Data point located near flag 2012-JB-3-5

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

X	Surface Water (A1)		Water-Stained Leaves (B9)		Surface Soil Cracks (B6)
X	High Water Table (A2)		Aquatic Fauna (B13)		Drainage Patterns (B10)
X	Saturation (A3)		Marl Deposits (B15)		Moss Trim Lines (B16)
	Water Marks (B1)		Hydrogen Sulfide Odor (C1)		Dry-Season Water Table (C2)
	Sediment Deposits (B2)		Oxidized Rhizospheres on Living Roots (C3)		Crayfish Burrows (C8)
	Drift Deposits (B3)		Presence of Reduced Iron (C4)		Saturation Visible on Aerial (C9)
	Algal Mat or Crust (B4)		Recent Iron Reduction in Tilled Soils (C6)		Stunted or Stressed Plants (D1)
	Iron Deposits (B5)		Thin Muck Surface (C7)		Geomorphic Position (D2)
	Inundation Visible on Aerial (B7)		Other (Explain in Remarks)		Shallow Aquitard (D3)
	Sparsely Vegetated Concave Surface (B8)				Microtopographic Relief (D4)
					FAC-Neutral Test (D5)

Secondary Indicators (minimum of two required)

Field Observations:

Surface Water Present?	X	Depth (inches):	2
Water Table Present?	X	Depth (inches):	0
Saturation Present? (includes capillary fringe)	X	Depth (inches):	0

Wetland Hydrology Present? YES

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Precipitation recorded in Burlington, VT for 30 days prior to sampling was 4.11" which is 2.53" above normal . Rainfall 5 days prior to sampling was 0.00" (NOAA 2012)

Remarks:

VEGETATION - Use scientific names of plants.

Sampling Point: 2012-JB-3- PitA

Tree Stratum (Plot size: 30' RAD)	Absolute % Cover	Dom. Sp?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
		= Total Cover	

Sapling Stratum (Plot size: 30' RAD)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
		= Total Cover	

Shrub Stratum (Plot size: 15' RAD)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
		= Total Cover	

Herb Stratum (Plot size: 10' RAD)			
1. Sparganium americanum Nutt.	63	X	OBL
2. Eutrochium maculatum (L.) E.E. Lamont	3		OBL
3. Eupatorium perfoliatum L.	15		FACW
4. Lythrum salicaria L.	15		FACW
5. Solidago gigantea Aiton	3		FACW
6. Leersia oryzoides (L.) Sw.	15		OBL
7. Impatiens capensis Meerb.	3		FACW
8. Polygonum sagittatum L.	3		OBL
9. Symphyotrichum novae-angliae (L.) G.L. Nesom	3		FACW
10. Solanum dulcamara L.	3		FAC
11.			
12.			
	126	= Total Cover	

Woody Vines (Plot size: 15' RAD)			
1.			
2.			
3.			
4.			
5.			
		= Total Cover	

Dominance Test Worksheet:

# Dominants OBL, FACW, FAC:	1	(A)
# Dominants across all strata:	1	(B)
% Dominants OBL, FACW, FAC:	100%	(A/B)

Prevalence Index Worksheet:

Total % Cover of:			Multiply By:
OBL	84	x 1 =	84
FACW	39	x 2 =	78
FAC	3	x 3 =	9
FACU		x 4 =	
UPL		x 5 =	
Sum:	126 (A)		171 (B)

Prevalence Index = B/A = 1.36

Hydrophytic Vegetation Indicators:

X Dominance Test is > 50%

X Prevalence Index is <= 3.0[1]

__ Problematic Hydrophytic Vegetation[1] (explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree - Woody plants, excluding woody vines, approximately 20ft (6m) or more in height and 3in (7.6cm) or larger in diameter at breast height (DBH).

Sapling - Woody plants, excluding woody vines, approximately 20ft (6m) or more in height and less than 3in (7.6cm) DBH.

Shrub - Woody plants, excluding woody vines, approximately 3 to 20ft (1 to 6m) in height.

Herb - All herbaceous (non-woody) plants, including herbaceous vines, regardless of size. Includes woody plants, except woody vines, less than approximately 3ft (1m) in height.

Woody vine - All woody vines, regardless of height.

Hydrophytic Vegetation Present? YES

Remarks: (If observed, list morphological adaptations below).

SOIL

Sampling Point: 2012-JB-3- PitA

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(in)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-4	2.5Y 4/1						Silt Loam	
4-24+	5 GY 4/1						Clay Loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains.

[2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ____ Histosol (A1)
- ____ Histic Epipedon (A2)
- ____ Black Histic (A3)
- ____ Hydrogen Sulfide (A4)
- ____ Stratified Layers (A5)
- ____ Depleted Below Dark Surface (A11)
- ____ Thick Dark Surface (A12)
- ____ Sandy Mucky Mineral (S1)
- ____ Sandy Gleyed Matrix (S4)
- ____ Sandy Redox (S5)
- ____ Stripped Matrix (S6)
- ____ Dark Surface (S7) (LRR R, MLRA 149B)
- ____ Polyvalue Below Surface (S8) (LRR R, MLRA 149B)
- ____ Thin Dark Surface (S9) (LRR R, MLRA 149B)
- ____ Loamy Mucky Mineral (F1) (LRR K, L)
- X Loamy Gleyed Matrix (F2)
- ____ Depleted Matrix (F3)
- ____ Redox Dark Surface (F6)
- ____ Depleted Dark Surface (F7)
- ____ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ____ 2cm Muck (A10) (LRR K, L, MLRA 149B)
- ____ Coast Prairie Redox (A16) (LRR K, L, R)
- ____ 5cm Mucky Peat or Peat (S3) (LRR K, L, R)
- ____ Dark Surface (S7) (LRR K, L)
- ____ Polyvalue Below Surface (S8) (LRR K, L)
- ____ Thin Dark Surface (S9) (LRR K, L)
- ____ Iron-Manganese Masses (F12) (LRR K, L, R)
- ____ Piedmont Floodplain Soils (F19) (MLRA 149B)
- ____ Mesic Spodic (TA6) (MLRA 144A, 145, 149B)
- ____ Red Parent Material (TF2)
- ____ Very Shallow Dark Surface (TF12)
- ____ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? YES

Remarks:

WETLAND DETERMINATION DATA FORM - Northcentral and Northeast Region

Project Site: Interstate 89 Culvert 63 City/County: South Burlington/Chittenden Samp. Date: 9/14/2012

Applicant/Owner: VTrans State: VERMONT Sampling Point: 2012-PW-1-PitB

Investigator(s): P. Werts Section, Township, Range: South Burlington

Landform (hillslope, terrace, etc.): Terrace Local relief (concave, convex, none): Concave Slope (%):

Subregion (LRR or MLRA): LRR R Lat: 44°26'42.506"N Long: 73°8'54.075"W Datum: NAD 83

Soil Map Unit: Covington silty clay NWI Class:

Are climatic/hydrologic conditions on the site typical for this time of year? NO (If no, explain in Remarks.)

Are Vegetation, Soil, or Hydrology significantly disturbed? No Normal Circumstances? Yes

Are Vegetation, Soil, or Hydrology naturally problematic? No (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS - Attach site map showing sample point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	NO	**Is This Sample Area Within a Wetland?**	NO
Hydric Soil Present?	NO		
Wetland Hydrology Present?	YES	**If yes, optional Wetland Site ID:**	

Remarks:

Data point located near wetland flag 2012-PW-1-3

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

	Surface Water (A1)		Water-Stained Leaves (B9)		Surface Soil Cracks (B6)
	High Water Table (A2)		Aquatic Fauna (B13)		Drainage Patterns (B10)
X	Saturation (A3)		Marl Deposits (B15)		Moss Trim Lines (B16)
	Water Marks (B1)		Hydrogen Sulfide Odor (C1)		Dry-Season Water Table (C2)
	Sediment Deposits (B2)		Oxidized Rhizospheres on Living Roots (C3)		Crayfish Burrows (C8)
	Drift Deposits (B3)		Presence of Reduced Iron (C4)		Saturation Visible on Aerial (C9)
	Algal Mat or Crust (B4)		Recent Iron Reduction in Tilled Soils (C6)		Stunted or Stressed Plants (D1)
	Iron Deposits (B5)		Thin Muck Surface (C7)		Geomorphic Position (D2)
	Inundation Visible on Aerial (B7)		Other (Explain in Remarks)		Shallow Aquitard (D3)
	Sparsely Vegetated Concave Surface (B8)				Microtopographic Relief (D4)
					FAC-Neutral Test (D5)

Secondary Indicators (minimum of two required)

Field Observations:

Surface Water Present?		Depth (inches):			
Water Table Present?	X	Depth (inches):	18		
Saturation Present? (includes capillary fringe)	X	Depth (inches):	3	**Wetland Hydrology Present?**	YES

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Precipitation recorded in Burlington, VT for 30 days prior to sampling was 4.11" which is 2.53" above normal . Rainfall 5 days prior to sampling was 0.00" (NOAA 2012)

Remarks:

VEGETATION - Use scientific names of plants.

Sampling Point: 2012-PW-1-PitB

Tree Stratum (Plot size: 30' RAD)	Absolute % Cover	Dom. Sp?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
		= Total Cover	

Sapling Stratum (Plot size: 30' RAD)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
		= Total Cover	

Shrub Stratum (Plot size: 15' RAD)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
		= Total Cover	

Herb Stratum (Plot size: 10' RAD)			
1. Phalaris arundinacea L.	15		FACW
2. Erigeron annuus (L.) Pers.	15		FACU
3. Dactylis glomerata L.	63	X	FACU
4. Lythrum salicaria L.	3		FACW
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	96	= Total Cover	

Woody Vines (Plot size: 15' RAD)			
1.			
2.			
3.			
4.			
5.			
		= Total Cover	

Dominance Test Worksheet:

# Dominants OBL, FACW, FAC:		(A)
# Dominants across all strata:	1	(B)
% Dominants OBL, FACW, FAC:		(A/B)

Prevalence Index Worksheet:

Total % Cover of:			Multiply By:
OBL		x 1 =	
FACW	18	x 2 =	36
FAC		x 3 =	
FACU	78	x 4 =	312
UPL		x 5 =	
Sum:	96 (A)		348 (B)

Prevalence Index = B/A = 3.63

Hydrophytic Vegetation Indicators:

- ____ Dominance Test is > 50%
- ____ Prevalence Index is <= 3.0[1]
- ____ Problematic Hydrophytic Vegetation[1] (explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree - Woody plants, excluding woody vines, approximately 20ft (6m) or more in height and 3in (7.6cm) or larger in diameter at breast height (DBH).

Sapling - Woody plants, excluding woody vines, approximately 20ft (6m) or more in height and less than 3in (7.6cm) DBH.

Shrub - Woody plants, excluding woody vines, approximately 3 to 20ft (1 to 6m) in height.

Herb - All herbaceous (non-woody) plants, including herbaceous vines, regardless of size. Includes woody plants, except woody vines, less than approximately 3ft (1m) in height.

Woody vine - All woody vines, regardless of height.

Hydrophytic Vegetation Present? NO

Remarks: (If observed, list morphological adaptations below).

SOIL

Sampling Point: 2012-PW-1-PitB

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(in)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-10	2.5Y 3/3						Clay Loam	
10-18	10YR 4/2		10YR 3/6				Clay Loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains.

[2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ____ Histosol (A1)
- ____ Histic Epipedon (A2)
- ____ Black Histic (A3)
- ____ Hydrogen Sulfide (A4)
- ____ Stratified Layers (A5)
- ____ Depleted Below Dark Surface (A11)
- ____ Thick Dark Surface (A12)
- ____ Sandy Mucky Mineral (S1)
- ____ Sandy Gleyed Matrix (S4)
- ____ Sandy Redox (S5)
- ____ Stripped Matrix (S6)
- ____ Dark Surface (S7) (LRR R, MLRA 149B)
- ____ Polyvalue Below Surface (S8) (LRR R, MLRA 149B)
- ____ Thin Dark Surface (S9) (LRR R, MLRA 149B)
- ____ Loamy Mucky Mineral (F1) (LRR K, L)
- ____ Loamy Gleyed Matrix (F2)
- ____ Depleted Matrix (F3)
- ____ Redox Dark Surface (F6)
- ____ Depleted Dark Surface (F7)
- ____ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ____ 2cm Muck (A10) (LRR K, L, MLRA 149B)
- ____ Coast Prairie Redox (A16) (LRR K, L, R)
- ____ 5cm Mucky Peat or Peat (S3) (LRR K, L, R)
- ____ Dark Surface (S7) (LRR K, L)
- ____ Polyvalue Below Surface (S8) (LRR K, L)
- ____ Thin Dark Surface (S9) (LRR K, L)
- ____ Iron-Manganese Masses (F12) (LRR K, L, R)
- ____ Piedmont Floodplain Soils (F19) (MLRA 149B)
- ____ Mesic Spodic (TA6) (MLRA 144A, 145, 149B)
- ____ Red Parent Material (TF2)
- ____ Very Shallow Dark Surface (TF12)
- ____ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? NO

Remarks:

WETLAND DETERMINATION DATA FORM - Northcentral and Northeast Region

Project Site: Interstate 89 Culvert 63 City/County: South Burlington/Chittenden Samp. Date: 9/14/2012

Applicant/Owner: VTrans State: VERMONT Sampling Point: 2012-PW-1-PitA

Investigator(s): P. Werts Section, Township, Range: South Burlington

Landform (hillslope, terrace, etc.): TERRACE Local relief (concave, convex, none): CONCAVE Slope (%):

Subregion (LRR or MLRA): LRR R Lat: 44°26'42.658"N Long: 73°8'53.632"W Datum: NAD 83

Soil Map Unit: Covington silty clay NWI Class: PEM/PSS

Are climatic/hydrologic conditions on the site typical for this time of year? NO (If no, explain in Remarks.)

Are Vegetation, Soil, or Hydrology significantly disturbed? NO Normal Circumstances? YES

Are Vegetation, Soil, or Hydrology naturally problematic? NO (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS - Attach site map showing sample point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	YES	**Is This Sample Area Within a Wetland?**	YES
Hydric Soil Present?	YES		
Wetland Hydrology Present?	YES	**If yes, optional Wetland Site ID:**	2012-PW-1

Remarks:

Data point located near wetland flag 2012-PW-1-2

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

	Surface Water (A1)		Water-Stained Leaves (B9)		Surface Soil Cracks (B6)
	High Water Table (A2)		Aquatic Fauna (B13)		Drainage Patterns (B10)
X	Saturation (A3)		Marl Deposits (B15)		Moss Trim Lines (B16)
	Water Marks (B1)		Hydrogen Sulfide Odor (C1)		Dry-Season Water Table (C2)
	Sediment Deposits (B2)		Oxidized Rhizospheres on Living Roots (C3)		Crayfish Burrows (C8)
	Drift Deposits (B3)		Presence of Reduced Iron (C4)		Saturation Visible on Aerial (C9)
	Algal Mat or Crust (B4)		Recent Iron Reduction in Tilled Soils (C6)		Stunted or Stressed Plants (D1)
	Iron Deposits (B5)		Thin Muck Surface (C7)		Geomorphic Position (D2)
	Inundation Visible on Aerial (B7)		Other (Explain in Remarks)		Shallow Aquitard (D3)
	Sparsely Vegetated Concave Surface (B8)				Microtopographic Relief (D4)
					FAC-Neutral Test (D5)

Secondary Indicators (minimum of two required)

Field Observations:

Surface Water Present?		Depth (inches):	
Water Table Present?		Depth (inches):	
Saturation Present? (includes capillary fringe)		Depth (inches):	

Wetland Hydrology Present? YES

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Precipitation recorded in Burlington, VT for 30 days prior to sampling was 4.11" which is 2.53" above normal . Rainfall 5 days prior to sampling was 0.00" (NOAA 2012)

Remarks:

Saturation greater than 18 inches

VEGETATION - Use scientific names of plants.

Sampling Point: 2012-PW-1-PitA

Tree Stratum (Plot size: 30' RAD)	Absolute % Cover	Dom. Sp?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
		= Total Cover	

Sapling Stratum (Plot size: 30' RAD)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
		= Total Cover	

Shrub Stratum (Plot size: 15' RAD)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
		= Total Cover	

Herb Stratum (Plot size: 10' RAD)			
1. Phalaris arundinacea L.	15		FACW
2. Typha angustifolia L.	63	X	OBL
3. Carex vulpinoidea Michx.	3		OBL
4. Erigeron annuus (L.) Pers.	3		FACU
5. Lycopus americanus Muhl. ex W. Bartram	3		OBL
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	87	= Total Cover	

Woody Vines (Plot size: 15' RAD)			
1.			
2.			
3.			
4.			
5.			
		= Total Cover	

Dominance Test Worksheet:

# Dominants OBL, FACW, FAC:	1	(A)
# Dominants across all strata:	1	(B)
% Dominants OBL, FACW, FAC:	100%	(A/B)

Prevalence Index Worksheet:

Total % Cover of:			Multiply By:
OBL	69	x 1 =	69
FACW	15	x 2 =	30
FAC		x 3 =	
FACU	3	x 4 =	12
UPL		x 5 =	
Sum:	87 (A)		111 (B)

Prevalence Index = B/A = 1.28

Hydrophytic Vegetation Indicators:

X Dominance Test is > 50%

X Prevalence Index is <= 3.0[1]

__ Problematic Hydrophytic Vegetation[1] (explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree - Woody plants, excluding woody vines, approximately 20ft (6m) or more in height and 3in (7.6cm) or larger in diameter at breast height (DBH).

Sapling - Woody plants, excluding woody vines, approximately 20ft (6m) or more in height and less than 3in (7.6cm) DBH.

Shrub - Woody plants, excluding woody vines, approximately 3 to 20ft (1 to 6m) in height.

Herb - All herbaceous (non-woody) plants, including herbaceous vines, regardless of size. Includes woody plants, except woody vines, less than approximately 3ft (1m) in height.

Woody vine - All woody vines, regardless of height.

Hydrophytic Vegetation Present? YES

Remarks: (If observed, list morphological adaptations below).

Unidentified Agrostis species observed (approximately 3 Percent Cover)

SOIL

Sampling Point: 2012-PW-1-PitA

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(in)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-8	2.5Y 3/2						Silt Loam	
8-22	2.5Y 4/1		10YR 4/4			PL, M	Clay Loam	CMD Redox

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains.

[2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7) (LRR R, MLRA 149B)
- ___ Polyvalue Below Surface (S8) (LRR R, MLRA 149B)
- ___ Thin Dark Surface (S9) (LRR R, MLRA 149B)
- ___ Loamy Mucky Mineral (F1) (LRR K, L)
- ___ Loamy Gleyed Matrix (F2)
- X Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2cm Muck (A10) (LRR K, L, MLRA 149B)
- ___ Coast Prairie Redox (A16) (LRR K, L, R)
- ___ 5cm Mucky Peat or Peat (S3) (LRR K, L, R)
- ___ Dark Surface (S7) (LRR K, L)
- ___ Polyvalue Below Surface (S8) (LRR K, L)
- ___ Thin Dark Surface (S9) (LRR K, L)
- ___ Iron-Manganese Masses (F12) (LRR K, L, R)
- ___ Piedmont Floodplain Soils (F19) (MLRA 149B)
- ___ Mesic Spodic (TA6) (MLRA 144A, 145, 149B)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ___

Depth (inches): ___

Hydric Soil Present? YES

Remarks:

VERMONT WETLAND EVALUATION FORM

Project Name: South Burlington IM CULV(24) Project #: 57578.00

Date: 01/10/2013 Investigator: VHB (P. Werts and J. Burt)

SUMMARY OF FUNCTIONAL EVALUATION: 2012-JB-1
Each function gets a score of 0= not present; L = Low; P = Present; or H = High.

1. Water Storage for Flood Water and Storm Runoff	L	**6. Rare, Threatened, and Endangered Species Habitat**	0
2. Surface & Ground Water Protection	0	**7. Education and Research in Natural Sciences**	0
3. Fish Habitat	0	**8. Recreational Value and Economic Benefits**	0
4. Wildlife Habitat	0	**9. Open Space and Aesthetics**	0
5. Exemplary Wetland Natural Community	0	**10. Erosion Control through Binding and Stabilizing the Soil**	0

Note:

- ***When to use this form:*** This is a field form to help you compile data needed to evaluate the 10 possible functions and values of a wetland as described in the Vermont Wetland Rules. All information in this form is replicated in the applications for both wetland determinations and wetland permits.
- ***Both a desktop review and field examination*** should be employed to accurately determine surrounding land use, hydrology, hydroperiod, vegetation, position in the landscape, and physical attributes.
- ***The entire wetland or wetland complex*** in question must be evaluated to determine the level of function in all ten (10) categories for accurate classification. A wetland complex can be defined as a series of interconnected wetland types.
- ***The surrounding upland and outflow area*** of the wetland should be examined to determine land use, development, nearby natural resources, and hydrology. The surrounding land use,

previous development, and cumulative impacts may play a role in the current function of the wetland. For best results please read all descriptions prior to scoring activity.

- ***Evaluation***: The first portion in each section determines whether the wetland does or does not provide the function. If none of the conditions listed in the first section are met, proceed to the next section. If any of these conditions are met, determine if the wetland provides this function at a higher or lower level based on the information listed in the subsequent sections.
- ***Presumptions:*** Please note that many wetlands are already presumed to be significant under the Vermont Wetland Rules. A wetland is presumed to be significant if:
    - The wetland is mapped on the VSWI map
    - The wetland is contiguous to a VSWI mapped wetland
    - The wetland meets the presumptions of significance under Section 4.6
    - The wetland has a preliminary determination that it is Class II

1. Water Storage for Flood Water and Storm Runoff

☒ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.

- ☐ Constricted outlet or no outlet and an unconstricted inlet.
- ☒ Physical space for floodwater expansion and dense, persistent, emergent vegetation or dense woody vegetation that slows down flood waters or stormwater runoff during peak flows and facilitates water removal by evaporation and transpiration.
- ☐ If a stream is present, its course is sinuous and there is sufficient woody vegetation to intercept surface flows in the portion of the wetland that floods.
- ☐ Physical evidence of seasonal flooding or ponding such as water stained leaves, water marks on trees, drift rows, debris deposits, or standing water.
- ☐ Hydrologic or hydraulic study indicates wetland attenuates flooding.

If any of the above boxes are checked, the wetland provides this function. Complete the following to determine if the wetland provides this function above or below a moderate level:

☒ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *lower* level.

- ☐ Significant flood storage capacity upstream of the wetland, and the wetland in question provides this function at a negligible level in comparison to upstream storage (unless the upstream storage is temporary such as a beaver impoundment).
- ☐ Wetland is contiguous to a major lake or pond that provides storage benefits independently of the wetland.
- ☐ Wetland's storage capacity is created primarily by recent beaver dams or other temporary structures.
- ☒ Wetland is very small in size, not contiguous to a stream, and not part of a collection of small wetlands in the landscape that provide this function cumulatively.

☐ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *higher* level.

- ☐ History of downstream flood damage to public or private property.
- ☐ Any of the following conditions present downstream of the wetland, but upstream of a major lake or pond, could be impacted by a loss or reduction of the water storage function.
  - ☐ 1. Developed public or private property.
  - ☐ 2. Stream banks susceptible to scouring and erosion.
  - ☐ 3. Important habitat for aquatic life.
- ☐ The wetland is large in size and naturally vegetated.

☐ Any of the following conditions present upstream of the wetland may indicate a large volume of runoff may reach the wetland.

☐ 1. A large amount of impervious surface in urbanized areas.

☐ 2. Relatively impervious soils.

☐ 3. Steep slopes in the adjacent areas.

2. Surface and Ground Water Protection

☐ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.

☐ Constricted or no outlets.

☐ Low water velocity through dense, persistent vegetation.

☐ Hydroperiod permanently flooded or saturated.

☐ Wetlands in depositional environments with persistent vegetation wider than 20 feet.

☐ Wetlands with persistent vegetation comprising a defined delta, island, bar or peninsula.

☐ Presence of seeps or springs.

☐ Wetland contains a high amount of microtopography that helps slow and filter surface water.

☐ Position in the landscape indicates the wetland is a headwaters area.

☐ Wetland is adjacent to surface waters.

☐ Wetland recharges a drinking water source.

☐ Water sampling indicates removal of pollutants or nutrients.

☐ Water sampling indicates retention of sediments or organic matter.

☐ Fine mineral soils and alkalinity not low.

☐ The wetland provides an obvious filter between surface water or ground water and land uses that may contribute point or nonpoint sources of sediments, toxic substances or nutrients to the wetland, such as: steep erodible slopes; row crops; dumps; areas of pesticide, herbicide or fertilizer application; feed lots; parking lots or heavily traveled road; and septic systems.

If any of the above boxes are checked, the wetland provides this function. Complete the following to determine if the wetland provides this function above or below a moderate level.

☐ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *lower* level.

☐ Presence of dead forest or shrub areas in sufficient amounts to result in diminished

nutrient uptake.

- ☐ Presence of ditches or channels that confine water and restrict contact of water with vegetation.
- ☐ Wetland is very small in size, not contiguous to a stream, and not part of a collection of small wetlands in the landscape that provide this function cumulatively.
- ☐ Current use in the wetland results in disturbance that compromises this function.

☐ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *higher* level.

- ☐ The wetland is adjacent to a well head or source protection area, and provides ground water recharge.
- ☐ The wetland provides flows to Class A surface waters.
- ☐ The wetland contributes to the protection or improvement of water quality of any impaired waters.
- ☐ The wetland is large in size and naturally vegetated.

3. Fish Habitat

☐ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.

- ☐ Contains woody vegetation that overhangs the banks of a stream or river and provides any of the following: shading that controls summer water temperature; cover including refuges created by overhanging branches or undercut banks; source of terrestrial insects as fish food; or streambank stability.
- ☐ Provides spawning, nursery, feeding or cover habitat for fish (documented or professionally judged). Common habitat includes deep marsh and shallow marsh associates with lakes and streams, and seasonally flooded wetlands associated with streams and rivers.
- ☐ Documented or professionally judged spawning habitat for northern pike.
- ☐ Provides cold spring discharge that lowers the temperature of receiving waters and creates summer habitat for salmonoid species.
- ☐ The wetland is located along a tributary that does not support fish, but contributes to a larger body of water that does support fish. The tributary supports downstream fish by providing cooler water, and food sources.

4. Wildlife Habitat

☐ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.

- ☐ Provides resting, feeding staging or roosting habitat to support waterfowl migration, and feeding habitat for wading birds. Good habitats for these species include open water wetlands.
- ☐ Habitat to support one or more breeding pairs or broods of waterfowl including all species of ducks, geese, and swans. Good habitats for these species include open water habitats adjacent shallow marsh, deep marsh, shrub wetland, forested wetland, or naturally vegetated buffer zone.
- ☐ Provides a nest site, a buffer for a nest site or feeding habitat for wading birds including but not limited to: great blue heron, black-crowned night heron, green-backed heron, cattle egret, or snowy egret. Good habitats for these species include open water or deep marsh adjacent to forested wetlands, or standing dead trees.
- ☐ Supports or has the habitat to support one or more breeding pairs of any migratory bird that requires wetland habitat for breeding, nesting, rearing of young, feeding, staging roosting, or migration, including: Virginia rail, common snipe, marsh wren, American bittern, northern water thrush, northern harrier, spruce grouse, Cerulean warbler, and common loon.
- ☐ Supports winter habitat for white-tailed deer. Good habitats for these species include softwood swamps. Evidence of use includes deer browsing, bark stripping, worn trails, or pellet piles.
- ☐ Provides important feeding habitat for black bear, bobcat, or moose based on an assessment of use. Good habitat for these types of species includes wetlands located in a forested mosaic.
- ☐ Has the habitat to support muskrat, otter or mink. Good habitats for these species include deep marshes, wetlands adjacent to bodies of water including lakes, ponds, rivers and streams.
- ☐ Supports an active beaver dam, one or more lodges, or evidence of use in two or more consecutive years by an adult beaver population.
- ☐ Provides the following habitats that support the reproduction of Uncommon Vermont amphibian species including:
  - ☐ 1. Wood Frog, Jefferson Salamander, Blue-spotted Salamander, or Spotted Salamander. Breeding habitat for these species includes vernal pools and small ponds.
  - ☐ 2. Northern Dusky Salamander and the Spring Salamander. Habitat for these species includes headwater seeps, springs, and streams.
  - ☐ 3. The Four-toed salamander; Fowler's Toad; Western or Boreal Chorus frog, or other amphibians found in Vermont of similar significance.

- ☐ Supports or has the habitat to support significant populations of Vermont amphibian species including, but not limited to Pickerel Frog, Northern Leopard Frog, Mink Frog, and others found in Vermont of similar significance. Good habitat for these types of species includes large marsh systems with open water components.
- ☐ Supports or has the habitat to support populations of uncommon Vermont reptile species including: Wood Turtle, Northern Map Turtle, Eastern Musk Turtle, Spotted Turtle, Spiny Softshell, Eastern Ribbonsnake, Northern Watersnake, and others found in Vermont of similar significance.
- ☐ Supports or has the habitat to support significant populations of Vermont reptile species, including Smooth Greensnake, DeKay's Brownsnake, or other more common wetland-associated species.
- ☐ Meets four or more of the following conditions indicative of wildlife habitat diversity:
  - ☐ 1. Three or more wetland vegetation classes (greater than 1/2 acre) present including but not limited to: open water contiguous to, but not necessarily part of, the wetland, deep marsh, shallow marsh, shrub swamp, forested swamp, fen, or bog;
  - ☐ 2. The dominant vegetation class is one of the following types: deep marsh, shallow marsh, shrub swamp or, forested swamp;
  - ☐ 3. Located adjacent to a lake, pond, river or stream;
  - ☐ 4. Fifty percent or more of surrounding habitat type is one or more of the following: forest, agricultural land, old field or open land;
  - ☐ 5. Emergent or woody vegetation occupies 26 to 75 percent of wetland, the rest is open water;
  - ☐ 6. One of the following:
    - ☐ i. hydrologically connected to other wetlands of different dominant classes or open water within 1 mile;
    - ☐ ii. hydrologically connected to other wetlands of same dominant class within 1/2 mile;
    - ☐ iii. within 1/4 mile of other wetlands of different dominant classes or open water, but not hydrologically connected;
- ☐ Wetland or wetland complex is owned in whole or in part by state or federal government and managed for wildlife and habitat conservation; and
- ☐ Contains evidence that it is used by wetland dependent wildlife species.

If any of the above boxes are checked, the wetland provides this function. Complete the following to determine if the wetland provides this function above or below a moderate level.

☐ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *lower* level.

- ☐ The wetland is small in size for its type and does not represent fugitive habitat in

developed areas (vernal pools and seeps are generally small in size, so this does not apply).

- ☐ The surrounding land use is densely developed enough to limit use by wildlife species (with the exception of wetlands with open water habitat). Can be negated by evidence of use.
- ☐ The current use in the wetland results in frequent cutting, mowing or other disturbance.
- ☐ The wetland hydrology and character is at a drier end of the scale and does not support wetland dependent species.

☐ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *higher* level.

- ☐ The wetland complex is large in size and high in quality.
- ☐ The habitat has the potential to support several species based on the assessment above.
- ☐ Wetland is associated with an important wildlife corridor.
- ☐ The wetland has been identified by ANR-F&W as important habitat.

5. Exemplary Wetland Natural Community

☐ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.

- ☐ Wetlands that are identified as high quality examples of Vermont's natural community types recognized by the Natural Heritage Information Project of the Vermont Fish and Wildlife Department, including rare types such as dwarf shrub bogs, rich fens, alpine peatlands, red maple-black gum swamps and the more common types including deep bulrush marshes, cattail marshes, northern white cedar swamps, spruce-fir-tamarack swamps, and red maple-black ash seepage swamps are automatically significant for this function.

The wetland is also likely to be significant if any of the following conditions are met:

- ☐ Is an example of a wetland natural community type that has been identified and mapped by, or meets the ranking and mapping standards of, the Natural Heritage Information Project of the Vermont Fish and Wildlife Department.
- ☐ Contains ecological features that contribute to Vermont's natural heritage, including, but not limited to:
  - ☐ Deep peat accumulation reflecting a long history of wetland formation;
  - ☐ Forested wetlands displaying very old trees and other old growth characteristics;
  - ☐ A wetland natural community that is at the edge of the normal range for that type;

- ☐ A wetland mosaic containing examples of several to many wetland community types; or
- ☐ A large wetland complex with examples of several wetland community types.

6. Rare, Threatened, and Endangered Species Habitat

☐ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.

- ☐ Wetlands that contain one or more species on the federal or state threatened or endangered lists, as well as species that are rare in Vermont, are automatically significant for this function.

The wetland is also likely to be significant if any of the following apply:

- ☐ There is creditable documentation that the wetland provides important habitat for any species on the federal or state threatened or endangered species lists;
- ☐ There is creditable documentation that threatened or endangered species have been present in past 10 years;
- ☐ There is creditable documentation that the wetland provides important habitat for any species listed as rare in Vermont (S1 or S2 ranks), state historic (SH rank), or rare to uncommon globally (G1, G2, or G3 ranks) by the Natural Heritage Information Project of the Vermont Fish and Wildlife Department;
- ☐ There is creditable documentation that the wetland provides habitat for multiple uncommon species of plants or animals (S3 rank).

List name of species and ranking:

7. Education and Research in Natural Sciences

☐ Function is present and likely to be significant: Any of the following characteristics indicate the wetland provides this function.

- ☐ Owned by or leased to a public entity dedicated to education or research.
- ☐ History of use for education or research.
- ☐ Has one or more characteristics making it valuable for education or research.

8. Recreational Value and Economic Benefits

- ☐ Function is present and likely to be significant: Any of the following characteristics indicate the wetland provides this function.
  - ☐ Used for, or contributes to, recreational activities.
  - ☐ Provides economic benefits.
  - ☐ Provides important habitat for fish or wildlife which can be fished, hunted or trapped under applicable state law.
  - ☐ Used for harvesting of wild foods.

Comments:

9. Open Space and Aesthetics

- ☐ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.
  - ☐ Can be readily observed by the public; and
    - ☐ Possesses special or unique aesthetic qualities; or
    - ☐ Has prominence as a distinct feature in the surrounding landscape;
  - ☐ Has been identified as important open space in a municipal, regional or state plan.

10. Erosion Control through Binding and Stabilizing the Soil

- ☐ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.
  - ☐ Erosive forces such as wave or current energy are present and any of the following are present as well:
    - ☐ Dense, persistent vegetation along a shoreline or stream bank that reduces an adjacent erosive force.
    - ☐ Good interspersion of persistent emergent vegetation and water along course of water flow.
    - ☐ Studies show that wetlands of similar size, vegetation type, and hydrology are important for erosion control.

What type of erosive forces are present?

- ☐ Lake fetch and waves
- ☐ High current velocities
- ☐ Water level influenced by upstream impoundment

If any of the above boxes are checked, the wetland provides this function. Complete the following to determine if the wetland provides this function above or below a moderate level.

☐ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *lower* level.

- ☐ The stream is artificially channelized and/or lacks vegetation that contributes to controlling the erosive force.

☐ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *higher* level.

- ☐ The stream contains high sinuosity.
- ☐ Has been identified through fluvial geomorphic assessment to be important in maintaining the natural condition of the stream or river corridor.

VERMONT WETLAND EVALUATION FORM

Project Name: South Burlington IM CULV(24) Project #: 57578.00

Date: 01/10/2013 Investigator: VHB (P. Werts and J. Burt)

SUMMARY OF FUNCTIONAL EVALUATION: 2012-JB-3
Each function gets a score of 0= not present; L = Low; P = Present; or H = High.

1. Water Storage for Flood Water and Storm Runoff	H
2. Surface & Ground Water Protection	H
3. Fish Habitat	0
4. Wildlife Habitat	0
5. Exemplary Wetland Natural Community	0
6. Rare, Threatened, and Endangered Species Habitat	0
7. Education and Research in Natural Sciences	0
8. Recreational Value and Economic Benefits	0
9. Open Space and Aesthetics	0
10. Erosion Control through Binding and Stabilizing the Soil	H

Note:

- ***When to use this form:*** This is a field form to help you compile data needed to evaluate the 10 possible functions and values of a wetland as described in the Vermont Wetland Rules. All information in this form is replicated in the applications for both wetland determinations and wetland permits.
- ***Both a desktop review and field examination*** should be employed to accurately determine surrounding land use, hydrology, hydroperiod, vegetation, position in the landscape, and physical attributes.
- ***The entire wetland or wetland complex*** in question must be evaluated to determine the level of function in all ten (10) categories for accurate classification. A wetland complex can be defined as a series of interconnected wetland types.
- ***The surrounding upland and outflow area*** of the wetland should be examined to determine land use, development, nearby natural resources, and hydrology. The surrounding land use,

previous development, and cumulative impacts may play a role in the current function of the wetland. For best results please read all descriptions prior to scoring activity.

- ***Evaluation***: The first portion in each section determines whether the wetland does or does not provide the function. If none of the conditions listed in the first section are met, proceed to the next section. If any of these conditions are met, determine if the wetland provides this function at a higher or lower level based on the information listed in the subsequent sections.
- ***Presumptions:*** Please note that many wetlands are already presumed to be significant under the Vermont Wetland Rules. A wetland is presumed to be significant if:
    - The wetland is mapped on the VSWI map
    - The wetland is contiguous to a VSWI mapped wetland
    - The wetland meets the presumptions of significance under Section 4.6
    - The wetland has a preliminary determination that it is Class II

1. Water Storage for Flood Water and Storm Runoff

☒ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.

- ☐ Constricted outlet or no outlet and an unconstricted inlet.
- ☒ Physical space for floodwater expansion and dense, persistent, emergent vegetation or dense woody vegetation that slows down flood waters or stormwater runoff during peak flows and facilitates water removal by evaporation and transpiration.
- ☐ If a stream is present, its course is sinuous and there is sufficient woody vegetation to intercept surface flows in the portion of the wetland that floods.
- ☐ Physical evidence of seasonal flooding or ponding such as water stained leaves, water marks on trees, drift rows, debris deposits, or standing water.
- ☐ Hydrologic or hydraulic study indicates wetland attenuates flooding.

If any of the above boxes are checked, the wetland provides this function. Complete the following to determine if the wetland provides this function above or below a moderate level:

☐ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *lower* level.

- ☐ Significant flood storage capacity upstream of the wetland, and the wetland in question provides this function at a negligible level in comparison to upstream storage (unless the upstream storage is temporary such as a beaver impoundment).
- ☐ Wetland is contiguous to a major lake or pond that provides storage benefits independently of the wetland.
- ☐ Wetland's storage capacity is created primarily by recent beaver dams or other temporary structures.
- ☐ Wetland is very small in size, not contiguous to a stream, and not part of a collection of small wetlands in the landscape that provide this function cumulatively.

☐ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *higher* level.

- ☐ History of downstream flood damage to public or private property.
- ☐ Any of the following conditions present downstream of the wetland, but upstream of a major lake or pond, could be impacted by a loss or reduction of the water storage function.
  - ☐ 1. Developed public or private property.
  - ☐ 2. Stream banks susceptible to scouring and erosion.
  - ☐ 3. Important habitat for aquatic life.
- ☐ The wetland is large in size and naturally vegetated.

☐ Any of the following conditions present upstream of the wetland may indicate a large volume of runoff may reach the wetland.

☐ 1. A large amount of impervious surface in urbanized areas.

☐ 2. Relatively impervious soils.

☐ 3. Steep slopes in the adjacent areas.

2. Surface and Ground Water Protection

☒ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.

☐ Constricted or no outlets.

☐ Low water velocity through dense, persistent vegetation.

☒ Hydroperiod permanently flooded or saturated.

☐ Wetlands in depositional environments with persistent vegetation wider than 20 feet.

☐ Wetlands with persistent vegetation comprising a defined delta, island, bar or peninsula.

☐ Presence of seeps or springs.

☒ Wetland contains a high amount of microtopography that helps slow and filter surface water.

☐ Position in the landscape indicates the wetland is a headwaters area.

☒ Wetland is adjacent to surface waters.

☐ Wetland recharges a drinking water source.

☐ Water sampling indicates removal of pollutants or nutrients.

☐ Water sampling indicates retention of sediments or organic matter.

☐ Fine mineral soils and alkalinity not low.

☒ The wetland provides an obvious filter between surface water or ground water and land uses that may contribute point or nonpoint sources of sediments, toxic substances or nutrients to the wetland, such as: steep erodible slopes; row crops; dumps; areas of pesticide, herbicide or fertilizer application; feed lots; parking lots or heavily traveled road; and septic systems.

If any of the above boxes are checked, the wetland provides this function. Complete the following to determine if the wetland provides this function above or below a moderate level.

☐ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *lower* level.

☐ Presence of dead forest or shrub areas in sufficient amounts to result in diminished

nutrient uptake.

- ☐ Presence of ditches or channels that confine water and restrict contact of water with vegetation.
- ☐ Wetland is very small in size, not contiguous to a stream, and not part of a collection of small wetlands in the landscape that provide this function cumulatively.
- ☐ Current use in the wetland results in disturbance that compromises this function.

☒ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *higher* level.

- ☐ The wetland is adjacent to a well head or source protection area, and provides ground water recharge.
- ☐ The wetland provides flows to Class A surface waters.
- ☐ The wetland contributes to the protection or improvement of water quality of any impaired waters.
- ☒ The wetland is large in size and naturally vegetated.

3. Fish Habitat

☐ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.

- ☐ Contains woody vegetation that overhangs the banks of a stream or river and provides any of the following: shading that controls summer water temperature; cover including refuges created by overhanging branches or undercut banks; source of terrestrial insects as fish food; or streambank stability.
- ☐ Provides spawning, nursery, feeding or cover habitat for fish (documented or professionally judged). Common habitat includes deep marsh and shallow marsh associates with lakes and streams, and seasonally flooded wetlands associated with streams and rivers.
- ☐ Documented or professionally judged spawning habitat for northern pike.
- ☐ Provides cold spring discharge that lowers the temperature of receiving waters and creates summer habitat for salmonoid species.
- ☐ The wetland is located along a tributary that does not support fish, but contributes to a larger body of water that does support fish. The tributary supports downstream fish by providing cooler water, and food sources.

4. Wildlife Habitat

☐ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.

- ☐ Provides resting, feeding staging or roosting habitat to support waterfowl migration, and feeding habitat for wading birds. Good habitats for these species include open water wetlands.
- ☐ Habitat to support one or more breeding pairs or broods of waterfowl including all species of ducks, geese, and swans. Good habitats for these species include open water habitats adjacent shallow marsh, deep marsh, shrub wetland, forested wetland, or naturally vegetated buffer zone.
- ☐ Provides a nest site, a buffer for a nest site or feeding habitat for wading birds including but not limited to: great blue heron, black-crowned night heron, green-backed heron, cattle egret, or snowy egret. Good habitats for these species include open water or deep marsh adjacent to forested wetlands, or standing dead trees.
- ☐ Supports or has the habitat to support one or more breeding pairs of any migratory bird that requires wetland habitat for breeding, nesting, rearing of young, feeding, staging roosting, or migration, including: Virginia rail, common snipe, marsh wren, American bittern, northern water thrush, northern harrier, spruce grouse, Cerulean warbler, and common loon.
- ☐ Supports winter habitat for white-tailed deer. Good habitats for these species include softwood swamps. Evidence of use includes deer browsing, bark stripping, worn trails, or pellet piles.
- ☐ Provides important feeding habitat for black bear, bobcat, or moose based on an assessment of use. Good habitat for these types of species includes wetlands located in a forested mosaic.
- ☐ Has the habitat to support muskrat, otter or mink. Good habitats for these species include deep marshes, wetlands adjacent to bodies of water including lakes, ponds, rivers and streams.
- ☐ Supports an active beaver dam, one or more lodges, or evidence of use in two or more consecutive years by an adult beaver population.
- ☐ Provides the following habitats that support the reproduction of Uncommon Vermont amphibian species including:
  - ☐ 1. Wood Frog, Jefferson Salamander, Blue-spotted Salamander, or Spotted Salamander. Breeding habitat for these species includes vernal pools and small ponds.
  - ☐ 2. Northern Dusky Salamander and the Spring Salamander. Habitat for these species includes headwater seeps, springs, and streams.
  - ☐ 3. The Four-toed salamander; Fowler's Toad; Western or Boreal Chorus frog, or other amphibians found in Vermont of similar significance.

- ☐ Supports or has the habitat to support significant populations of Vermont amphibian species including, but not limited to Pickerel Frog, Northern Leopard Frog, Mink Frog, and others found in Vermont of similar significance. Good habitat for these types of species includes large marsh systems with open water components.
- ☐ Supports or has the habitat to support populations of uncommon Vermont reptile species including: Wood Turtle, Northern Map Turtle, Eastern Musk Turtle, Spotted Turtle, Spiny Softshell, Eastern Ribbonsnake, Northern Watersnake, and others found in Vermont of similar significance.
- ☐ Supports or has the habitat to support significant populations of Vermont reptile species, including Smooth Greensnake, DeKay's Brownsnake, or other more common wetland-associated species.
- ☐ Meets four or more of the following conditions indicative of wildlife habitat diversity:
  - ☐ 1. Three or more wetland vegetation classes (greater than 1/2 acre) present including but not limited to: open water contiguous to, but not necessarily part of, the wetland, deep marsh, shallow marsh, shrub swamp, forested swamp, fen, or bog;
  - ☐ 2. The dominant vegetation class is one of the following types: deep marsh, shallow marsh, shrub swamp or, forested swamp;
  - ☐ 3. Located adjacent to a lake, pond, river or stream;
  - ☐ 4. Fifty percent or more of surrounding habitat type is one or more of the following: forest, agricultural land, old field or open land;
  - ☐ 5. Emergent or woody vegetation occupies 26 to 75 percent of wetland, the rest is open water;
  - ☐ 6. One of the following:
    - ☐ i. hydrologically connected to other wetlands of different dominant classes or open water within 1 mile;
    - ☐ ii. hydrologically connected to other wetlands of same dominant class within 1/2 mile;
    - ☐ iii. within 1/4 mile of other wetlands of different dominant classes or open water, but not hydrologically connected;
- ☐ Wetland or wetland complex is owned in whole or in part by state or federal government and managed for wildlife and habitat conservation; and
- ☐ Contains evidence that it is used by wetland dependent wildlife species.

If any of the above boxes are checked, the wetland provides this function. Complete the following to determine if the wetland provides this function above or below a moderate level.

☐ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *lower* level.

- ☐ The wetland is small in size for its type and does not represent fugitive habitat in

developed areas (vernal pools and seeps are generally small in size, so this does not apply).

- ☐ The surrounding land use is densely developed enough to limit use by wildlife species (with the exception of wetlands with open water habitat). Can be negated by evidence of use.
- ☐ The current use in the wetland results in frequent cutting, mowing or other disturbance.
- ☐ The wetland hydrology and character is at a drier end of the scale and does not support wetland dependent species.

☐ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *higher* level.

- ☐ The wetland complex is large in size and high in quality.
- ☐ The habitat has the potential to support several species based on the assessment above.
- ☐ Wetland is associated with an important wildlife corridor.
- ☐ The wetland has been identified by ANR-F&W as important habitat.

5. Exemplary Wetland Natural Community

☐ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.

- ☐ Wetlands that are identified as high quality examples of Vermont's natural community types recognized by the Natural Heritage Information Project of the Vermont Fish and Wildlife Department, including rare types such as dwarf shrub bogs, rich fens, alpine peatlands, red maple-black gum swamps and the more common types including deep bulrush marshes, cattail marshes, northern white cedar swamps, spruce-fir-tamarack swamps, and red maple-black ash seepage swamps are automatically significant for this function.

The wetland is also likely to be significant if any of the following conditions are met:

- ☐ Is an example of a wetland natural community type that has been identified and mapped by, or meets the ranking and mapping standards of, the Natural Heritage Information Project of the Vermont Fish and Wildlife Department.
- ☐ Contains ecological features that contribute to Vermont's natural heritage, including, but not limited to:
  - ☐ Deep peat accumulation reflecting a long history of wetland formation;
  - ☐ Forested wetlands displaying very old trees and other old growth characteristics;
  - ☐ A wetland natural community that is at the edge of the normal range for that type;

- ☐ A wetland mosaic containing examples of several to many wetland community types; or
- ☐ A large wetland complex with examples of several wetland community types.

6. Rare, Threatened, and Endangered Species Habitat

☐ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.

- ☐ Wetlands that contain one or more species on the federal or state threatened or endangered lists, as well as species that are rare in Vermont, are automatically significant for this function.

The wetland is also likely to be significant if any of the following apply:

- ☐ There is creditable documentation that the wetland provides important habitat for any species on the federal or state threatened or endangered species lists;
- ☐ There is creditable documentation that threatened or endangered species have been present in past 10 years;
- ☐ There is creditable documentation that the wetland provides important habitat for any species listed as rare in Vermont (S1 or S2 ranks), state historic (SH rank), or rare to uncommon globally (G1, G2, or G3 ranks) by the Natural Heritage Information Project of the Vermont Fish and Wildlife Department;
- ☐ There is creditable documentation that the wetland provides habitat for multiple uncommon species of plants or animals (S3 rank).

List name of species and ranking:

7. Education and Research in Natural Sciences

☐ Function is present and likely to be significant: Any of the following characteristics indicate the wetland provides this function.

- ☐ Owned by or leased to a public entity dedicated to education or research.
- ☐ History of use for education or research.
- ☐ Has one or more characteristics making it valuable for education or research.

8. Recreational Value and Economic Benefits

☐ Function is present and likely to be significant: Any of the following characteristics indicate the wetland provides this function.

- ☐ Used for, or contributes to, recreational activities.
- ☐ Provides economic benefits.
- ☐ Provides important habitat for fish or wildlife which can be fished, hunted or trapped under applicable state law.
- ☐ Used for harvesting of wild foods.

Comments:

9. Open Space and Aesthetics

☐ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.

- ☐ Can be readily observed by the public; and
  - ☐ Possesses special or unique aesthetic qualities; or
  - ☐ Has prominence as a distinct feature in the surrounding landscape;
- ☐ Has been identified as important open space in a municipal, regional or state plan.

10. Erosion Control through Binding and Stabilizing the Soil

☒ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.

- ☐ Erosive forces such as wave or current energy are present and any of the following are present as well:
  - ☒ Dense, persistent vegetation along a shoreline or stream bank that reduces an adjacent erosive force.
  - ☐ Good interspersion of persistent emergent vegetation and water along course of water flow.
  - ☐ Studies show that wetlands of similar size, vegetation type, and hydrology are important for erosion control.

What type of erosive forces are present?

- ☐ Lake fetch and waves
- ☒ High current velocities
- ☐ Water level influenced by upstream impoundment

If any of the above boxes are checked, the wetland provides this function. Complete the following to determine if the wetland provides this function above or below a moderate level.

☐ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *lower* level.

- ☐ The stream is artificially channelized and/or lacks vegetation that contributes to controlling the erosive force.

☒ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *higher* level.

- ☒ The stream contains high sinuosity.
- ☐ Has been identified through fluvial geomorphic assessment to be important in maintaining the natural condition of the stream or river corridor.

VERMONT WETLAND EVALUATION FORM

Project Name: South Burlington IM CULV(24) Project #: 57578.00

Date: 01/10/2013 Investigator: VHB (P. Werts and J. Burt)

SUMMARY OF FUNCTIONAL EVALUATION: 2012-PW-1
Each function gets a score of 0= not present; L = Low; P = Present; or H = High.

1. Water Storage for Flood Water and Storm Runoff	H	**6. Rare, Threatened, and Endangered Species Habitat**	0
2. Surface & Ground Water Protection	H	**7. Education and Research in Natural Sciences**	0
3. Fish Habitat	0	**8. Recreational Value and Economic Benefits**	0
4. Wildlife Habitat	0	**9. Open Space and Aesthetics**	0
5. Exemplary Wetland Natural Community	0	**10. Erosion Control through Binding and Stabilizing the Soil**	P

Note:

- ***When to use this form:*** This is a field form to help you compile data needed to evaluate the 10 possible functions and values of a wetland as described in the Vermont Wetland Rules. All information in this form is replicated in the applications for both wetland determinations and wetland permits.
- ***Both a desktop review and field examination*** should be employed to accurately determine surrounding land use, hydrology, hydroperiod, vegetation, position in the landscape, and physical attributes.
- ***The entire wetland or wetland complex*** in question must be evaluated to determine the level of function in all ten (10) categories for accurate classification. A wetland complex can be defined as a series of interconnected wetland types.
- ***The surrounding upland and outflow area*** of the wetland should be examined to determine land use, development, nearby natural resources, and hydrology. The surrounding land use,

previous development, and cumulative impacts may play a role in the current function of the wetland. For best results please read all descriptions prior to scoring activity.

- ***Evaluation***: The first portion in each section determines whether the wetland does or does not provide the function. If none of the conditions listed in the first section are met, proceed to the next section. If any of these conditions are met, determine if the wetland provides this function at a higher or lower level based on the information listed in the subsequent sections.
- ***Presumptions:*** Please note that many wetlands are already presumed to be significant under the Vermont Wetland Rules. A wetland is presumed to be significant if:
    - The wetland is mapped on the VSWI map
    - The wetland is contiguous to a VSWI mapped wetland
    - The wetland meets the presumptions of significance under Section 4.6
    - The wetland has a preliminary determination that it is Class II

1. Water Storage for Flood Water and Storm Runoff

☒ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.

- ☐ Constricted outlet or no outlet and an unconstricted inlet.
- ☒ Physical space for floodwater expansion and dense, persistent, emergent vegetation or dense woody vegetation that slows down flood waters or stormwater runoff during peak flows and facilitates water removal by evaporation and transpiration.
- ☐ If a stream is present, its course is sinuous and there is sufficient woody vegetation to intercept surface flows in the portion of the wetland that floods.
- ☐ Physical evidence of seasonal flooding or ponding such as water stained leaves, water marks on trees, drift rows, debris deposits, or standing water.
- ☐ Hydrologic or hydraulic study indicates wetland attenuates flooding.

If any of the above boxes are checked, the wetland provides this function. Complete the following to determine if the wetland provides this function above or below a moderate level:

☐ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *lower* level.

- ☐ Significant flood storage capacity upstream of the wetland, and the wetland in question provides this function at a negligible level in comparison to upstream storage (unless the upstream storage is temporary such as a beaver impoundment).
- ☐ Wetland is contiguous to a major lake or pond that provides storage benefits independently of the wetland.
- ☐ Wetland's storage capacity is created primarily by recent beaver dams or other temporary structures.
- ☐ Wetland is very small in size, not contiguous to a stream, and not part of a collection of small wetlands in the landscape that provide this function cumulatively.

☒ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *higher* level.

- ☐ History of downstream flood damage to public or private property.
- ☐ Any of the following conditions present downstream of the wetland, but upstream of a major lake or pond, could be impacted by a loss or reduction of the water storage function.
  - ☐ 1. Developed public or private property.
  - ☐ 2. Stream banks susceptible to scouring and erosion.
  - ☐ 3. Important habitat for aquatic life.
- ☒ The wetland is large in size and naturally vegetated.

☐ Any of the following conditions present upstream of the wetland may indicate a large volume of runoff may reach the wetland.

☐ 1. A large amount of impervious surface in urbanized areas.

☐ 2. Relatively impervious soils.

☐ 3. Steep slopes in the adjacent areas.

2. Surface and Ground Water Protection

☒ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.

☐ Constricted or no outlets.

☒ Low water velocity through dense, persistent vegetation.

☐ Hydroperiod permanently flooded or saturated.

☐ Wetlands in depositional environments with persistent vegetation wider than 20 feet.

☐ Wetlands with persistent vegetation comprising a defined delta, island, bar or peninsula.

☐ Presence of seeps or springs.

☐ Wetland contains a high amount of microtopography that helps slow and filter surface water.

☐ Position in the landscape indicates the wetland is a headwaters area.

☒ Wetland is adjacent to surface waters.

☐ Wetland recharges a drinking water source.

☐ Water sampling indicates removal of pollutants or nutrients.

☐ Water sampling indicates retention of sediments or organic matter.

☐ Fine mineral soils and alkalinity not low.

☒ The wetland provides an obvious filter between surface water or ground water and land uses that may contribute point or nonpoint sources of sediments, toxic substances or nutrients to the wetland, such as: steep erodible slopes; row crops; dumps; areas of pesticide, herbicide or fertilizer application; feed lots; parking lots or heavily traveled road; and septic systems.

If any of the above boxes are checked, the wetland provides this function. Complete the following to determine if the wetland provides this function above or below a moderate level.

☐ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *lower* level.

☐ Presence of dead forest or shrub areas in sufficient amounts to result in diminished

nutrient uptake.

- ☐ Presence of ditches or channels that confine water and restrict contact of water with vegetation.
- ☐ Wetland is very small in size, not contiguous to a stream, and not part of a collection of small wetlands in the landscape that provide this function cumulatively.
- ☐ Current use in the wetland results in disturbance that compromises this function.

☒ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *higher* level.

- ☐ The wetland is adjacent to a well head or source protection area, and provides ground water recharge.
- ☐ The wetland provides flows to Class A surface waters.
- ☒ The wetland contributes to the protection or improvement of water quality of any impaired waters.
- ☒ The wetland is large in size and naturally vegetated.

3. Fish Habitat

☐ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.

- ☐ Contains woody vegetation that overhangs the banks of a stream or river and provides any of the following: shading that controls summer water temperature; cover including refuges created by overhanging branches or undercut banks; source of terrestrial insects as fish food; or streambank stability.
- ☐ Provides spawning, nursery, feeding or cover habitat for fish (documented or professionally judged). Common habitat includes deep marsh and shallow marsh associates with lakes and streams, and seasonally flooded wetlands associated with streams and rivers.
- ☐ Documented or professionally judged spawning habitat for northern pike.
- ☐ Provides cold spring discharge that lowers the temperature of receiving waters and creates summer habitat for salmonoid species.
- ☐ The wetland is located along a tributary that does not support fish, but contributes to a larger body of water that does support fish. The tributary supports downstream fish by providing cooler water, and food sources.

4. Wildlife Habitat

☐ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.

- ☐ Provides resting, feeding staging or roosting habitat to support waterfowl migration, and feeding habitat for wading birds. Good habitats for these species include open water wetlands.
- ☐ Habitat to support one or more breeding pairs or broods of waterfowl including all species of ducks, geese, and swans. Good habitats for these species include open water habitats adjacent shallow marsh, deep marsh, shrub wetland, forested wetland, or naturally vegetated buffer zone.
- ☐ Provides a nest site, a buffer for a nest site or feeding habitat for wading birds including but not limited to: great blue heron, black-crowned night heron, green-backed heron, cattle egret, or snowy egret. Good habitats for these species include open water or deep marsh adjacent to forested wetlands, or standing dead trees.
- ☐ Supports or has the habitat to support one or more breeding pairs of any migratory bird that requires wetland habitat for breeding, nesting, rearing of young, feeding, staging roosting, or migration, including: Virginia rail, common snipe, marsh wren, American bittern, northern water thrush, northern harrier, spruce grouse, Cerulean warbler, and common loon.
- ☐ Supports winter habitat for white-tailed deer. Good habitats for these species include softwood swamps. Evidence of use includes deer browsing, bark stripping, worn trails, or pellet piles.
- ☐ Provides important feeding habitat for black bear, bobcat, or moose based on an assessment of use. Good habitat for these types of species includes wetlands located in a forested mosaic.
- ☐ Has the habitat to support muskrat, otter or mink. Good habitats for these species include deep marshes, wetlands adjacent to bodies of water including lakes, ponds, rivers and streams.
- ☐ Supports an active beaver dam, one or more lodges, or evidence of use in two or more consecutive years by an adult beaver population.
- ☐ Provides the following habitats that support the reproduction of Uncommon Vermont amphibian species including:
  - ☐ 1. Wood Frog, Jefferson Salamander, Blue-spotted Salamander, or Spotted Salamander. Breeding habitat for these species includes vernal pools and small ponds.
  - ☐ 2. Northern Dusky Salamander and the Spring Salamander. Habitat for these species includes headwater seeps, springs, and streams.
  - ☐ 3. The Four-toed salamander; Fowler's Toad; Western or Boreal Chorus frog, or other amphibians found in Vermont of similar significance.

- ☐ Supports or has the habitat to support significant populations of Vermont amphibian species including, but not limited to Pickerel Frog, Northern Leopard Frog, Mink Frog, and others found in Vermont of similar significance. Good habitat for these types of species includes large marsh systems with open water components.
- ☐ Supports or has the habitat to support populations of uncommon Vermont reptile species including: Wood Turtle, Northern Map Turtle, Eastern Musk Turtle, Spotted Turtle, Spiny Softshell, Eastern Ribbonsnake, Northern Watersnake, and others found in Vermont of similar significance.
- ☐ Supports or has the habitat to support significant populations of Vermont reptile species, including Smooth Greensnake, DeKay's Brownsnake, or other more common wetland-associated species.
- ☐ Meets four or more of the following conditions indicative of wildlife habitat diversity:
  - ☐ 1. Three or more wetland vegetation classes (greater than 1/2 acre) present including but not limited to: open water contiguous to, but not necessarily part of, the wetland, deep marsh, shallow marsh, shrub swamp, forested swamp, fen, or bog;
  - ☐ 2. The dominant vegetation class is one of the following types: deep marsh, shallow marsh, shrub swamp or, forested swamp;
  - ☐ 3. Located adjacent to a lake, pond, river or stream;
  - ☐ 4. Fifty percent or more of surrounding habitat type is one or more of the following: forest, agricultural land, old field or open land;
  - ☐ 5. Emergent or woody vegetation occupies 26 to 75 percent of wetland, the rest is open water;
  - ☐ 6. One of the following:
    - ☐ i. hydrologically connected to other wetlands of different dominant classes or open water within 1 mile;
    - ☐ ii. hydrologically connected to other wetlands of same dominant class within 1/2 mile;
    - ☐ iii. within 1/4 mile of other wetlands of different dominant classes or open water, but not hydrologically connected;
- ☐ Wetland or wetland complex is owned in whole or in part by state or federal government and managed for wildlife and habitat conservation; and
- ☐ Contains evidence that it is used by wetland dependent wildlife species.

If any of the above boxes are checked, the wetland provides this function. Complete the following to determine if the wetland provides this function above or below a moderate level.

☐ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *lower* level.

- ☐ The wetland is small in size for its type and does not represent fugitive habitat in

developed areas (vernal pools and seeps are generally small in size, so this does not apply).

- ☐ The surrounding land use is densely developed enough to limit use by wildlife species (with the exception of wetlands with open water habitat). Can be negated by evidence of use.
- ☐ The current use in the wetland results in frequent cutting, mowing or other disturbance.
- ☐ The wetland hydrology and character is at a drier end of the scale and does not support wetland dependent species.

☐ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *higher* level.

- ☐ The wetland complex is large in size and high in quality.
- ☐ The habitat has the potential to support several species based on the assessment above.
- ☐ Wetland is associated with an important wildlife corridor.
- ☐ The wetland has been identified by ANR-F&W as important habitat.

5. Exemplary Wetland Natural Community

☐ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.

- ☐ Wetlands that are identified as high quality examples of Vermont's natural community types recognized by the Natural Heritage Information Project of the Vermont Fish and Wildlife Department, including rare types such as dwarf shrub bogs, rich fens, alpine peatlands, red maple-black gum swamps and the more common types including deep bulrush marshes, cattail marshes, northern white cedar swamps, spruce-fir-tamarack swamps, and red maple-black ash seepage swamps are automatically significant for this function.

The wetland is also likely to be significant if any of the following conditions are met:

- ☐ Is an example of a wetland natural community type that has been identified and mapped by, or meets the ranking and mapping standards of, the Natural Heritage Information Project of the Vermont Fish and Wildlife Department.
- ☐ Contains ecological features that contribute to Vermont's natural heritage, including, but not limited to:
  - ☐ Deep peat accumulation reflecting a long history of wetland formation;
  - ☐ Forested wetlands displaying very old trees and other old growth characteristics;
  - ☐ A wetland natural community that is at the edge of the normal range for that type;

- ☐ A wetland mosaic containing examples of several to many wetland community types; or
- ☐ A large wetland complex with examples of several wetland community types.

6. Rare, Threatened, and Endangered Species Habitat

☐ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.

- ☐ Wetlands that contain one or more species on the federal or state threatened or endangered lists, as well as species that are rare in Vermont, are automatically significant for this function.

The wetland is also likely to be significant if any of the following apply:

- ☐ There is creditable documentation that the wetland provides important habitat for any species on the federal or state threatened or endangered species lists;
- ☐ There is creditable documentation that threatened or endangered species have been present in past 10 years;
- ☐ There is creditable documentation that the wetland provides important habitat for any species listed as rare in Vermont (S1 or S2 ranks), state historic (SH rank), or rare to uncommon globally (G1, G2, or G3 ranks) by the Natural Heritage Information Project of the Vermont Fish and Wildlife Department;
- ☐ There is creditable documentation that the wetland provides habitat for multiple uncommon species of plants or animals (S3 rank).

List name of species and ranking:

7. Education and Research in Natural Sciences

☐ Function is present and likely to be significant: Any of the following characteristics indicate the wetland provides this function.

- ☐ Owned by or leased to a public entity dedicated to education or research.
- ☐ History of use for education or research.
- ☐ Has one or more characteristics making it valuable for education or research.

8. Recreational Value and Economic Benefits

☐ Function is present and likely to be significant: Any of the following characteristics indicate the wetland provides this function.

- ☐ Used for, or contributes to, recreational activities.
- ☐ Provides economic benefits.
- ☐ Provides important habitat for fish or wildlife which can be fished, hunted or trapped under applicable state law.
- ☐ Used for harvesting of wild foods.

Comments:

9. Open Space and Aesthetics

☐ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.

- ☐ Can be readily observed by the public; and
  - ☐ Possesses special or unique aesthetic qualities; or
  - ☐ Has prominence as a distinct feature in the surrounding landscape;
- ☐ Has been identified as important open space in a municipal, regional or state plan.

10. Erosion Control through Binding and Stabilizing the Soil

☒ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.

- ☒ Erosive forces such as wave or current energy are present and any of the following are present as well:
  - ☐ Dense, persistent vegetation along a shoreline or stream bank that reduces an adjacent erosive force.
  - ☒ Good interspersion of persistent emergent vegetation and water along course of water flow.
  - ☐ Studies show that wetlands of similar size, vegetation type, and hydrology are important for erosion control.

What type of erosive forces are present?

- ☐ Lake fetch and waves
- ☒ High current velocities
- ☐ Water level influenced by upstream impoundment

If any of the above boxes are checked, the wetland provides this function. Complete the following to determine if the wetland provides this function above or below a moderate level.

☐ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *lower* level.

- ☐ The stream is artificially channelized and/or lacks vegetation that contributes to controlling the erosive force.

☐ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *higher* level.

- ☐ The stream contains high sinuosity.
- ☐ Has been identified through fluvial geomorphic assessment to be important in maintaining the natural condition of the stream or river corridor.

VERMONT WETLAND EVALUATION FORM

Project Name: South Burlington IM CULV(24) Project #: 57578.00

Date: 01/10/2013 Investigator: VHB (P. Werts and J. Burt)

SUMMARY OF FUNCTIONAL EVALUATION: 2012-PW-2
Each function gets a score of 0= not present; L = Low; P = Present; or H = High.

1. Water Storage for Flood Water and Storm Runoff	H
2. Surface & Ground Water Protection	H
3. Fish Habitat	0
4. Wildlife Habitat	0
5. Exemplary Wetland Natural Community	0
6. Rare, Threatened, and Endangered Species Habitat	0
7. Education and Research in Natural Sciences	0
8. Recreational Value and Economic Benefits	0
9. Open Space and Aesthetics	0
10. Erosion Control through Binding and Stabilizing the Soil	P

Note:

- ***When to use this form:*** This is a field form to help you compile data needed to evaluate the 10 possible functions and values of a wetland as described in the Vermont Wetland Rules. All information in this form is replicated in the applications for both wetland determinations and wetland permits.
- ***Both a desktop review and field examination*** should be employed to accurately determine surrounding land use, hydrology, hydroperiod, vegetation, position in the landscape, and physical attributes.
- ***The entire wetland or wetland complex*** in question must be evaluated to determine the level of function in all ten (10) categories for accurate classification. A wetland complex can be defined as a series of interconnected wetland types.
- ***The surrounding upland and outflow area*** of the wetland should be examined to determine land use, development, nearby natural resources, and hydrology. The surrounding land use,

previous development, and cumulative impacts may play a role in the current function of the wetland. For best results please read all descriptions prior to scoring activity.

- ***Evaluation***: The first portion in each section determines whether the wetland does or does not provide the function. If none of the conditions listed in the first section are met, proceed to the next section. If any of these conditions are met, determine if the wetland provides this function at a higher or lower level based on the information listed in the subsequent sections.
- ***Presumptions:*** Please note that many wetlands are already presumed to be significant under the Vermont Wetland Rules. A wetland is presumed to be significant if:
    - The wetland is mapped on the VSWI map
    - The wetland is contiguous to a VSWI mapped wetland
    - The wetland meets the presumptions of significance under Section 4.6
    - The wetland has a preliminary determination that it is Class II

1. Water Storage for Flood Water and Storm Runoff

☒ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.

- ☐ Constricted outlet or no outlet and an unconstricted inlet.
- ☒ Physical space for floodwater expansion and dense, persistent, emergent vegetation or dense woody vegetation that slows down flood waters or stormwater runoff during peak flows and facilitates water removal by evaporation and transpiration.
- ☐ If a stream is present, its course is sinuous and there is sufficient woody vegetation to intercept surface flows in the portion of the wetland that floods.
- ☐ Physical evidence of seasonal flooding or ponding such as water stained leaves, water marks on trees, drift rows, debris deposits, or standing water.
- ☐ Hydrologic or hydraulic study indicates wetland attenuates flooding.

If any of the above boxes are checked, the wetland provides this function. Complete the following to determine if the wetland provides this function above or below a moderate level:

☐ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *lower* level.

- ☐ Significant flood storage capacity upstream of the wetland, and the wetland in question provides this function at a negligible level in comparison to upstream storage (unless the upstream storage is temporary such as a beaver impoundment).
- ☐ Wetland is contiguous to a major lake or pond that provides storage benefits independently of the wetland.
- ☐ Wetland's storage capacity is created primarily by recent beaver dams or other temporary structures.
- ☐ Wetland is very small in size, not contiguous to a stream, and not part of a collection of small wetlands in the landscape that provide this function cumulatively.

☒ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *higher* level.

- ☐ History of downstream flood damage to public or private property.
- ☐ Any of the following conditions present downstream of the wetland, but upstream of a major lake or pond, could be impacted by a loss or reduction of the water storage function.
  - ☐ 1. Developed public or private property.
  - ☐ 2. Stream banks susceptible to scouring and erosion.
  - ☐ 3. Important habitat for aquatic life.
- ☒ The wetland is large in size and naturally vegetated.

☐ Any of the following conditions present upstream of the wetland may indicate a large volume of runoff may reach the wetland.

☐ 1. A large amount of impervious surface in urbanized areas.

☐ 2. Relatively impervious soils.

☐ 3. Steep slopes in the adjacent areas.

2. Surface and Ground Water Protection

☒ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.

☐ Constricted or no outlets.

☒ Low water velocity through dense, persistent vegetation.

☐ Hydroperiod permanently flooded or saturated.

☐ Wetlands in depositional environments with persistent vegetation wider than 20 feet.

☐ Wetlands with persistent vegetation comprising a defined delta, island, bar or peninsula.

☐ Presence of seeps or springs.

☐ Wetland contains a high amount of microtopography that helps slow and filter surface water.

☐ Position in the landscape indicates the wetland is a headwaters area.

☒ Wetland is adjacent to surface waters.

☐ Wetland recharges a drinking water source.

☐ Water sampling indicates removal of pollutants or nutrients.

☐ Water sampling indicates retention of sediments or organic matter.

☐ Fine mineral soils and alkalinity not low.

☒ The wetland provides an obvious filter between surface water or ground water and land uses that may contribute point or nonpoint sources of sediments, toxic substances or nutrients to the wetland, such as: steep erodible slopes; row crops; dumps; areas of pesticide, herbicide or fertilizer application; feed lots; parking lots or heavily traveled road; and septic systems.

If any of the above boxes are checked, the wetland provides this function. Complete the following to determine if the wetland provides this function above or below a moderate level.

☐ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *lower* level.

☐ Presence of dead forest or shrub areas in sufficient amounts to result in diminished

nutrient uptake.

- ☐ Presence of ditches or channels that confine water and restrict contact of water with vegetation.
- ☐ Wetland is very small in size, not contiguous to a stream, and not part of a collection of small wetlands in the landscape that provide this function cumulatively.
- ☐ Current use in the wetland results in disturbance that compromises this function.

☒ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *higher* level.

- ☐ The wetland is adjacent to a well head or source protection area, and provides ground water recharge.
- ☐ The wetland provides flows to Class A surface waters.
- ☒ The wetland contributes to the protection or improvement of water quality of any impaired waters.
- ☒ The wetland is large in size and naturally vegetated.

3. Fish Habitat

☐ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.

- ☐ Contains woody vegetation that overhangs the banks of a stream or river and provides any of the following: shading that controls summer water temperature; cover including refuges created by overhanging branches or undercut banks; source of terrestrial insects as fish food; or streambank stability.
- ☐ Provides spawning, nursery, feeding or cover habitat for fish (documented or professionally judged). Common habitat includes deep marsh and shallow marsh associates with lakes and streams, and seasonally flooded wetlands associated with streams and rivers.
- ☐ Documented or professionally judged spawning habitat for northern pike.
- ☐ Provides cold spring discharge that lowers the temperature of receiving waters and creates summer habitat for salmonoid species.
- ☐ The wetland is located along a tributary that does not support fish, but contributes to a larger body of water that does support fish. The tributary supports downstream fish by providing cooler water, and food sources.

4. Wildlife Habitat

☐ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.

- ☐ Provides resting, feeding staging or roosting habitat to support waterfowl migration, and feeding habitat for wading birds. Good habitats for these species include open water wetlands.
- ☐ Habitat to support one or more breeding pairs or broods of waterfowl including all species of ducks, geese, and swans. Good habitats for these species include open water habitats adjacent shallow marsh, deep marsh, shrub wetland, forested wetland, or naturally vegetated buffer zone.
- ☐ Provides a nest site, a buffer for a nest site or feeding habitat for wading birds including but not limited to: great blue heron, black-crowned night heron, green-backed heron, cattle egret, or snowy egret. Good habitats for these species include open water or deep marsh adjacent to forested wetlands, or standing dead trees.
- ☐ Supports or has the habitat to support one or more breeding pairs of any migratory bird that requires wetland habitat for breeding, nesting, rearing of young, feeding, staging roosting, or migration, including: Virginia rail, common snipe, marsh wren, American bittern, northern water thrush, northern harrier, spruce grouse, Cerulean warbler, and common loon.
- ☐ Supports winter habitat for white-tailed deer. Good habitats for these species include softwood swamps. Evidence of use includes deer browsing, bark stripping, worn trails, or pellet piles.
- ☐ Provides important feeding habitat for black bear, bobcat, or moose based on an assessment of use. Good habitat for these types of species includes wetlands located in a forested mosaic.
- ☐ Has the habitat to support muskrat, otter or mink. Good habitats for these species include deep marshes, wetlands adjacent to bodies of water including lakes, ponds, rivers and streams.
- ☐ Supports an active beaver dam, one or more lodges, or evidence of use in two or more consecutive years by an adult beaver population.
- ☐ Provides the following habitats that support the reproduction of Uncommon Vermont amphibian species including:
  - ☐ 1. Wood Frog, Jefferson Salamander, Blue-spotted Salamander, or Spotted Salamander. Breeding habitat for these species includes vernal pools and small ponds.
  - ☐ 2. Northern Dusky Salamander and the Spring Salamander. Habitat for these species includes headwater seeps, springs, and streams.
  - ☐ 3. The Four-toed salamander; Fowler's Toad; Western or Boreal Chorus frog, or other amphibians found in Vermont of similar significance.

- ☐ Supports or has the habitat to support significant populations of Vermont amphibian species including, but not limited to Pickerel Frog, Northern Leopard Frog, Mink Frog, and others found in Vermont of similar significance. Good habitat for these types of species includes large marsh systems with open water components.
- ☐ Supports or has the habitat to support populations of uncommon Vermont reptile species including: Wood Turtle, Northern Map Turtle, Eastern Musk Turtle, Spotted Turtle, Spiny Softshell, Eastern Ribbonsnake, Northern Watersnake, and others found in Vermont of similar significance.
- ☐ Supports or has the habitat to support significant populations of Vermont reptile species, including Smooth Greensnake, DeKay's Brownsnake, or other more common wetland-associated species.
- ☐ Meets four or more of the following conditions indicative of wildlife habitat diversity:
  - ☐ 1. Three or more wetland vegetation classes (greater than 1/2 acre) present including but not limited to: open water contiguous to, but not necessarily part of, the wetland, deep marsh, shallow marsh, shrub swamp, forested swamp, fen, or bog;
  - ☐ 2. The dominant vegetation class is one of the following types: deep marsh, shallow marsh, shrub swamp or, forested swamp;
  - ☐ 3. Located adjacent to a lake, pond, river or stream;
  - ☐ 4. Fifty percent or more of surrounding habitat type is one or more of the following: forest, agricultural land, old field or open land;
  - ☐ 5. Emergent or woody vegetation occupies 26 to 75 percent of wetland, the rest is open water;
  - ☐ 6. One of the following:
    - ☐ i. hydrologically connected to other wetlands of different dominant classes or open water within 1 mile;
    - ☐ ii. hydrologically connected to other wetlands of same dominant class within 1/2 mile;
    - ☐ iii. within 1/4 mile of other wetlands of different dominant classes or open water, but not hydrologically connected;
- ☐ Wetland or wetland complex is owned in whole or in part by state or federal government and managed for wildlife and habitat conservation; and
- ☐ Contains evidence that it is used by wetland dependent wildlife species.

If any of the above boxes are checked, the wetland provides this function. Complete the following to determine if the wetland provides this function above or below a moderate level.

☐ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *lower* level.

- ☐ The wetland is small in size for its type and does not represent fugitive habitat in

developed areas (vernal pools and seeps are generally small in size, so this does not apply).

- ☐ The surrounding land use is densely developed enough to limit use by wildlife species (with the exception of wetlands with open water habitat). Can be negated by evidence of use.
- ☐ The current use in the wetland results in frequent cutting, mowing or other disturbance.
- ☐ The wetland hydrology and character is at a drier end of the scale and does not support wetland dependent species.

☐ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *higher* level.

- ☐ The wetland complex is large in size and high in quality.
- ☐ The habitat has the potential to support several species based on the assessment above.
- ☐ Wetland is associated with an important wildlife corridor.
- ☐ The wetland has been identified by ANR-F&W as important habitat.

5. Exemplary Wetland Natural Community

☐ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.

- ☐ Wetlands that are identified as high quality examples of Vermont's natural community types recognized by the Natural Heritage Information Project of the Vermont Fish and Wildlife Department, including rare types such as dwarf shrub bogs, rich fens, alpine peatlands, red maple-black gum swamps and the more common types including deep bulrush marshes, cattail marshes, northern white cedar swamps, spruce-fir-tamarack swamps, and red maple-black ash seepage swamps are automatically significant for this function.

The wetland is also likely to be significant if any of the following conditions are met:

- ☐ Is an example of a wetland natural community type that has been identified and mapped by, or meets the ranking and mapping standards of, the Natural Heritage Information Project of the Vermont Fish and Wildlife Department.
- ☐ Contains ecological features that contribute to Vermont's natural heritage, including, but not limited to:
  - ☐ Deep peat accumulation reflecting a long history of wetland formation;
  - ☐ Forested wetlands displaying very old trees and other old growth characteristics;
  - ☐ A wetland natural community that is at the edge of the normal range for that type;

- ☐ A wetland mosaic containing examples of several to many wetland community types; or
- ☐ A large wetland complex with examples of several wetland community types.

6. Rare, Threatened, and Endangered Species Habitat

☐ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.

- ☐ Wetlands that contain one or more species on the federal or state threatened or endangered lists, as well as species that are rare in Vermont, are automatically significant for this function.

The wetland is also likely to be significant if any of the following apply:

- ☐ There is creditable documentation that the wetland provides important habitat for any species on the federal or state threatened or endangered species lists;
- ☐ There is creditable documentation that threatened or endangered species have been present in past 10 years;
- ☐ There is creditable documentation that the wetland provides important habitat for any species listed as rare in Vermont (S1 or S2 ranks), state historic (SH rank), or rare to uncommon globally (G1, G2, or G3 ranks) by the Natural Heritage Information Project of the Vermont Fish and Wildlife Department;
- ☐ There is creditable documentation that the wetland provides habitat for multiple uncommon species of plants or animals (S3 rank).

List name of species and ranking:

7. Education and Research in Natural Sciences

☐ Function is present and likely to be significant: Any of the following characteristics indicate the wetland provides this function.

- ☐ Owned by or leased to a public entity dedicated to education or research.
- ☐ History of use for education or research.
- ☐ Has one or more characteristics making it valuable for education or research.

8. Recreational Value and Economic Benefits

☐ Function is present and likely to be significant: Any of the following characteristics indicate the wetland provides this function.

- ☐ Used for, or contributes to, recreational activities.
- ☐ Provides economic benefits.
- ☐ Provides important habitat for fish or wildlife which can be fished, hunted or trapped under applicable state law.
- ☐ Used for harvesting of wild foods.

Comments:

9. Open Space and Aesthetics

☐ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.

- ☐ Can be readily observed by the public; and
  - ☐ Possesses special or unique aesthetic qualities; or
  - ☐ Has prominence as a distinct feature in the surrounding landscape;
- ☐ Has been identified as important open space in a municipal, regional or state plan.

10. Erosion Control through Binding and Stabilizing the Soil

☒ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.

- ☒ Erosive forces such as wave or current energy are present and any of the following are present as well:
  - ☐ Dense, persistent vegetation along a shoreline or stream bank that reduces an adjacent erosive force.
  - ☒ Good interspersion of persistent emergent vegetation and water along course of water flow.
  - ☐ Studies show that wetlands of similar size, vegetation type, and hydrology are important for erosion control.

What type of erosive forces are present?

- ☐ Lake fetch and waves
- ☒ High current velocities
- ☐ Water level influenced by upstream impoundment

If any of the above boxes are checked, the wetland provides this function. Complete the following to determine if the wetland provides this function above or below a moderate level.

☐ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *lower* level.

- ☐ The stream is artificially channelized and/or lacks vegetation that contributes to controlling the erosive force.

☐ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *higher* level.

- ☐ The stream contains high sinuosity.
- ☐ Has been identified through fluvial geomorphic assessment to be important in maintaining the natural condition of the stream or river corridor.

VERMONT WETLAND EVALUATION FORM

Project Name: South Burlington IM CULV(24) Project #: 57578.00

Date: 01/10/2013 Investigator: VHB (P. Werts and J. Burt)

SUMMARY OF FUNCTIONAL EVALUATION: 2012-PW-3
Each function gets a score of 0= not present; L = Low; P = Present; or H = High.

1. Water Storage for Flood Water and Storm Runoff	L	**6. Rare, Threatened, and Endangered Species Habitat**	0
2. Surface & Ground Water Protection	0	**7. Education and Research in Natural Sciences**	0
3. Fish Habitat	0	**8. Recreational Value and Economic Benefits**	0
4. Wildlife Habitat	0	**9. Open Space and Aesthetics**	0
5. Exemplary Wetland Natural Community	0	**10. Erosion Control through Binding and Stabilizing the Soil**	0

Note:

- ***When to use this form:*** This is a field form to help you compile data needed to evaluate the 10 possible functions and values of a wetland as described in the Vermont Wetland Rules. All information in this form is replicated in the applications for both wetland determinations and wetland permits.
- ***Both a desktop review and field examination*** should be employed to accurately determine surrounding land use, hydrology, hydroperiod, vegetation, position in the landscape, and physical attributes.
- ***The entire wetland or wetland complex*** in question must be evaluated to determine the level of function in all ten (10) categories for accurate classification. A wetland complex can be defined as a series of interconnected wetland types.
- ***The surrounding upland and outflow area*** of the wetland should be examined to determine land use, development, nearby natural resources, and hydrology. The surrounding land use,

previous development, and cumulative impacts may play a role in the current function of the wetland. For best results please read all descriptions prior to scoring activity.

- ***Evaluation***: The first portion in each section determines whether the wetland does or does not provide the function. If none of the conditions listed in the first section are met, proceed to the next section. If any of these conditions are met, determine if the wetland provides this function at a higher or lower level based on the information listed in the subsequent sections.
- ***Presumptions:*** Please note that many wetlands are already presumed to be significant under the Vermont Wetland Rules. A wetland is presumed to be significant if:
    - The wetland is mapped on the VSWI map
    - The wetland is contiguous to a VSWI mapped wetland
    - The wetland meets the presumptions of significance under Section 4.6
    - The wetland has a preliminary determination that it is Class II

1. Water Storage for Flood Water and Storm Runoff

☒ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.

- ☐ Constricted outlet or no outlet and an unconstricted inlet.
- ☒ Physical space for floodwater expansion and dense, persistent, emergent vegetation or dense woody vegetation that slows down flood waters or stormwater runoff during peak flows and facilitates water removal by evaporation and transpiration.
- ☐ If a stream is present, its course is sinuous and there is sufficient woody vegetation to intercept surface flows in the portion of the wetland that floods.
- ☐ Physical evidence of seasonal flooding or ponding such as water stained leaves, water marks on trees, drift rows, debris deposits, or standing water.
- ☐ Hydrologic or hydraulic study indicates wetland attenuates flooding.

If any of the above boxes are checked, the wetland provides this function. Complete the following to determine if the wetland provides this function above or below a moderate level:

☒ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *lower* level.

- ☐ Significant flood storage capacity upstream of the wetland, and the wetland in question provides this function at a negligible level in comparison to upstream storage (unless the upstream storage is temporary such as a beaver impoundment).
- ☐ Wetland is contiguous to a major lake or pond that provides storage benefits independently of the wetland.
- ☐ Wetland's storage capacity is created primarily by recent beaver dams or other temporary structures.
- ☒ Wetland is very small in size, not contiguous to a stream, and not part of a collection of small wetlands in the landscape that provide this function cumulatively.

☐ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *higher* level.

- ☐ History of downstream flood damage to public or private property.
- ☐ Any of the following conditions present downstream of the wetland, but upstream of a major lake or pond, could be impacted by a loss or reduction of the water storage function.
  - ☐ 1. Developed public or private property.
  - ☐ 2. Stream banks susceptible to scouring and erosion.
  - ☐ 3. Important habitat for aquatic life.
- ☐ The wetland is large in size and naturally vegetated.

☐ Any of the following conditions present upstream of the wetland may indicate a large volume of runoff may reach the wetland.

☐ 1. A large amount of impervious surface in urbanized areas.

☐ 2. Relatively impervious soils.

☐ 3. Steep slopes in the adjacent areas.

2. Surface and Ground Water Protection

☐ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.

☐ Constricted or no outlets.

☐ Low water velocity through dense, persistent vegetation.

☐ Hydroperiod permanently flooded or saturated.

☐ Wetlands in depositional environments with persistent vegetation wider than 20 feet.

☐ Wetlands with persistent vegetation comprising a defined delta, island, bar or peninsula.

☐ Presence of seeps or springs.

☐ Wetland contains a high amount of microtopography that helps slow and filter surface water.

☐ Position in the landscape indicates the wetland is a headwaters area.

☐ Wetland is adjacent to surface waters.

☐ Wetland recharges a drinking water source.

☐ Water sampling indicates removal of pollutants or nutrients.

☐ Water sampling indicates retention of sediments or organic matter.

☐ Fine mineral soils and alkalinity not low.

☐ The wetland provides an obvious filter between surface water or ground water and land uses that may contribute point or nonpoint sources of sediments, toxic substances or nutrients to the wetland, such as: steep erodible slopes; row crops; dumps; areas of pesticide, herbicide or fertilizer application; feed lots; parking lots or heavily traveled road; and septic systems.

If any of the above boxes are checked, the wetland provides this function. Complete the following to determine if the wetland provides this function above or below a moderate level.

☐ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *lower* level.

☐ Presence of dead forest or shrub areas in sufficient amounts to result in diminished

nutrient uptake.

- ☐ Presence of ditches or channels that confine water and restrict contact of water with vegetation.
- ☐ Wetland is very small in size, not contiguous to a stream, and not part of a collection of small wetlands in the landscape that provide this function cumulatively.
- ☐ Current use in the wetland results in disturbance that compromises this function.

☐ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *higher* level.

- ☐ The wetland is adjacent to a well head or source protection area, and provides ground water recharge.
- ☐ The wetland provides flows to Class A surface waters.
- ☐ The wetland contributes to the protection or improvement of water quality of any impaired waters.
- ☐ The wetland is large in size and naturally vegetated.

3. Fish Habitat

☐ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.

- ☐ Contains woody vegetation that overhangs the banks of a stream or river and provides any of the following: shading that controls summer water temperature; cover including refuges created by overhanging branches or undercut banks; source of terrestrial insects as fish food; or streambank stability.
- ☐ Provides spawning, nursery, feeding or cover habitat for fish (documented or professionally judged). Common habitat includes deep marsh and shallow marsh associates with lakes and streams, and seasonally flooded wetlands associated with streams and rivers.
- ☐ Documented or professionally judged spawning habitat for northern pike.
- ☐ Provides cold spring discharge that lowers the temperature of receiving waters and creates summer habitat for salmonoid species.
- ☐ The wetland is located along a tributary that does not support fish, but contributes to a larger body of water that does support fish. The tributary supports downstream fish by providing cooler water, and food sources.

4. Wildlife Habitat

☐ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.

- ☐ Provides resting, feeding staging or roosting habitat to support waterfowl migration, and feeding habitat for wading birds. Good habitats for these species include open water wetlands.
- ☐ Habitat to support one or more breeding pairs or broods of waterfowl including all species of ducks, geese, and swans. Good habitats for these species include open water habitats adjacent shallow marsh, deep marsh, shrub wetland, forested wetland, or naturally vegetated buffer zone.
- ☐ Provides a nest site, a buffer for a nest site or feeding habitat for wading birds including but not limited to: great blue heron, black-crowned night heron, green-backed heron, cattle egret, or snowy egret. Good habitats for these species include open water or deep marsh adjacent to forested wetlands, or standing dead trees.
- ☐ Supports or has the habitat to support one or more breeding pairs of any migratory bird that requires wetland habitat for breeding, nesting, rearing of young, feeding, staging roosting, or migration, including: Virginia rail, common snipe, marsh wren, American bittern, northern water thrush, northern harrier, spruce grouse, Cerulean warbler, and common loon.
- ☐ Supports winter habitat for white-tailed deer. Good habitats for these species include softwood swamps. Evidence of use includes deer browsing, bark stripping, worn trails, or pellet piles.
- ☐ Provides important feeding habitat for black bear, bobcat, or moose based on an assessment of use. Good habitat for these types of species includes wetlands located in a forested mosaic.
- ☐ Has the habitat to support muskrat, otter or mink. Good habitats for these species include deep marshes, wetlands adjacent to bodies of water including lakes, ponds, rivers and streams.
- ☐ Supports an active beaver dam, one or more lodges, or evidence of use in two or more consecutive years by an adult beaver population.
- ☐ Provides the following habitats that support the reproduction of Uncommon Vermont amphibian species including:
  - ☐ 1. Wood Frog, Jefferson Salamander, Blue-spotted Salamander, or Spotted Salamander. Breeding habitat for these species includes vernal pools and small ponds.
  - ☐ 2. Northern Dusky Salamander and the Spring Salamander. Habitat for these species includes headwater seeps, springs, and streams.
  - ☐ 3. The Four-toed salamander; Fowler's Toad; Western or Boreal Chorus frog, or other amphibians found in Vermont of similar significance.

- ☐ Supports or has the habitat to support significant populations of Vermont amphibian species including, but not limited to Pickerel Frog, Northern Leopard Frog, Mink Frog, and others found in Vermont of similar significance. Good habitat for these types of species includes large marsh systems with open water components.
- ☐ Supports or has the habitat to support populations of uncommon Vermont reptile species including: Wood Turtle, Northern Map Turtle, Eastern Musk Turtle, Spotted Turtle, Spiny Softshell, Eastern Ribbonsnake, Northern Watersnake, and others found in Vermont of similar significance.
- ☐ Supports or has the habitat to support significant populations of Vermont reptile species, including Smooth Greensnake, DeKay's Brownsnake, or other more common wetland-associated species.
- ☐ Meets four or more of the following conditions indicative of wildlife habitat diversity:
  - ☐ 1. Three or more wetland vegetation classes (greater than 1/2 acre) present including but not limited to: open water contiguous to, but not necessarily part of, the wetland, deep marsh, shallow marsh, shrub swamp, forested swamp, fen, or bog;
  - ☐ 2. The dominant vegetation class is one of the following types: deep marsh, shallow marsh, shrub swamp or, forested swamp;
  - ☐ 3. Located adjacent to a lake, pond, river or stream;
  - ☐ 4. Fifty percent or more of surrounding habitat type is one or more of the following: forest, agricultural land, old field or open land;
  - ☐ 5. Emergent or woody vegetation occupies 26 to 75 percent of wetland, the rest is open water;
  - ☐ 6. One of the following:
    - ☐ i. hydrologically connected to other wetlands of different dominant classes or open water within 1 mile;
    - ☐ ii. hydrologically connected to other wetlands of same dominant class within 1/2 mile;
    - ☐ iii. within 1/4 mile of other wetlands of different dominant classes or open water, but not hydrologically connected;
- ☐ Wetland or wetland complex is owned in whole or in part by state or federal government and managed for wildlife and habitat conservation; and
- ☐ Contains evidence that it is used by wetland dependent wildlife species.

If any of the above boxes are checked, the wetland provides this function. Complete the following to determine if the wetland provides this function above or below a moderate level.

☐ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *lower* level.

- ☐ The wetland is small in size for its type and does not represent fugitive habitat in

developed areas (vernal pools and seeps are generally small in size, so this does not apply).

- ☐ The surrounding land use is densely developed enough to limit use by wildlife species (with the exception of wetlands with open water habitat). Can be negated by evidence of use.
- ☐ The current use in the wetland results in frequent cutting, mowing or other disturbance.
- ☐ The wetland hydrology and character is at a drier end of the scale and does not support wetland dependent species.

☐ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *higher* level.

- ☐ The wetland complex is large in size and high in quality.
- ☐ The habitat has the potential to support several species based on the assessment above.
- ☐ Wetland is associated with an important wildlife corridor.
- ☐ The wetland has been identified by ANR-F&W as important habitat.

5. Exemplary Wetland Natural Community

☐ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.

- ☐ Wetlands that are identified as high quality examples of Vermont's natural community types recognized by the Natural Heritage Information Project of the Vermont Fish and Wildlife Department, including rare types such as dwarf shrub bogs, rich fens, alpine peatlands, red maple-black gum swamps and the more common types including deep bulrush marshes, cattail marshes, northern white cedar swamps, spruce-fir-tamarack swamps, and red maple-black ash seepage swamps are automatically significant for this function.

The wetland is also likely to be significant if any of the following conditions are met:

- ☐ Is an example of a wetland natural community type that has been identified and mapped by, or meets the ranking and mapping standards of, the Natural Heritage Information Project of the Vermont Fish and Wildlife Department.
- ☐ Contains ecological features that contribute to Vermont's natural heritage, including, but not limited to:
  - ☐ Deep peat accumulation reflecting a long history of wetland formation;
  - ☐ Forested wetlands displaying very old trees and other old growth characteristics;
  - ☐ A wetland natural community that is at the edge of the normal range for that type;

- ☐ A wetland mosaic containing examples of several to many wetland community types; or
- ☐ A large wetland complex with examples of several wetland community types.

6. Rare, Threatened, and Endangered Species Habitat

☐ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.

- ☐ Wetlands that contain one or more species on the federal or state threatened or endangered lists, as well as species that are rare in Vermont, are automatically significant for this function.

The wetland is also likely to be significant if any of the following apply:

- ☐ There is creditable documentation that the wetland provides important habitat for any species on the federal or state threatened or endangered species lists;
- ☐ There is creditable documentation that threatened or endangered species have been present in past 10 years;
- ☐ There is creditable documentation that the wetland provides important habitat for any species listed as rare in Vermont (S1 or S2 ranks), state historic (SH rank), or rare to uncommon globally (G1, G2, or G3 ranks) by the Natural Heritage Information Project of the Vermont Fish and Wildlife Department;
- ☐ There is creditable documentation that the wetland provides habitat for multiple uncommon species of plants or animals (S3 rank).

List name of species and ranking:

7. Education and Research in Natural Sciences

☐ Function is present and likely to be significant: Any of the following characteristics indicate the wetland provides this function.

- ☐ Owned by or leased to a public entity dedicated to education or research.
- ☐ History of use for education or research.
- ☐ Has one or more characteristics making it valuable for education or research.

8. Recreational Value and Economic Benefits

- ☐ Function is present and likely to be significant: Any of the following characteristics indicate the wetland provides this function.
  - ☐ Used for, or contributes to, recreational activities.
  - ☐ Provides economic benefits.
  - ☐ Provides important habitat for fish or wildlife which can be fished, hunted or trapped under applicable state law.
  - ☐ Used for harvesting of wild foods.

Comments:

9. Open Space and Aesthetics

- ☐ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.
  - ☐ Can be readily observed by the public; and
    - ☐ Possesses special or unique aesthetic qualities; or
    - ☐ Has prominence as a distinct feature in the surrounding landscape;
  - ☐ Has been identified as important open space in a municipal, regional or state plan.

10. Erosion Control through Binding and Stabilizing the Soil

- ☐ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.
  - ☐ Erosive forces such as wave or current energy are present and any of the following are present as well:
    - ☐ Dense, persistent vegetation along a shoreline or stream bank that reduces an adjacent erosive force.
    - ☐ Good interspersion of persistent emergent vegetation and water along course of water flow.
    - ☐ Studies show that wetlands of similar size, vegetation type, and hydrology are important for erosion control.

What type of erosive forces are present?

- ☐ Lake fetch and waves
- ☐ High current velocities
- ☐ Water level influenced by upstream impoundment

If any of the above boxes are checked, the wetland provides this function. Complete the following to determine if the wetland provides this function above or below a moderate level.

☐ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *lower* level.

- ☐ The stream is artificially channelized and/or lacks vegetation that contributes to controlling the erosive force.

☐ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *higher* level.

- ☐ The stream contains high sinuosity.
- ☐ Has been identified through fluvial geomorphic assessment to be important in maintaining the natural condition of the stream or river corridor.

VERMONT WETLAND EVALUATION FORM

Project Name: South Burlington IM CULV(24) Project #: 57578.00

Date: 01/10/2013 Investigator: VHB (P. Werts and J. Burt)

SUMMARY OF FUNCTIONAL EVALUATION: 2012-PW-4
Each function gets a score of 0= not present; L = Low; P = Present; or H = High.

1. Water Storage for Flood Water and Storm Runoff	L	**6. Rare, Threatened, and Endangered Species Habitat**	0
2. Surface & Ground Water Protection	L	**7. Education and Research in Natural Sciences**	0
3. Fish Habitat	0	**8. Recreational Value and Economic Benefits**	0
4. Wildlife Habitat	0	**9. Open Space and Aesthetics**	0
5. Exemplary Wetland Natural Community	0	**10. Erosion Control through Binding and Stabilizing the Soil**	0

Note:

- ***When to use this form:*** This is a field form to help you compile data needed to evaluate the 10 possible functions and values of a wetland as described in the Vermont Wetland Rules. All information in this form is replicated in the applications for both wetland determinations and wetland permits.
- ***Both a desktop review and field examination*** should be employed to accurately determine surrounding land use, hydrology, hydroperiod, vegetation, position in the landscape, and physical attributes.
- ***The entire wetland or wetland complex*** in question must be evaluated to determine the level of function in all ten (10) categories for accurate classification. A wetland complex can be defined as a series of interconnected wetland types.
- ***The surrounding upland and outflow area*** of the wetland should be examined to determine land use, development, nearby natural resources, and hydrology. The surrounding land use,

previous development, and cumulative impacts may play a role in the current function of the wetland. For best results please read all descriptions prior to scoring activity.

- ***Evaluation***: The first portion in each section determines whether the wetland does or does not provide the function. If none of the conditions listed in the first section are met, proceed to the next section. If any of these conditions are met, determine if the wetland provides this function at a higher or lower level based on the information listed in the subsequent sections.
- ***Presumptions:*** Please note that many wetlands are already presumed to be significant under the Vermont Wetland Rules. A wetland is presumed to be significant if:
    - The wetland is mapped on the VSWI map
    - The wetland is contiguous to a VSWI mapped wetland
    - The wetland meets the presumptions of significance under Section 4.6
    - The wetland has a preliminary determination that it is Class II

1. Water Storage for Flood Water and Storm Runoff

☒ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.

- ☐ Constricted outlet or no outlet and an unconstricted inlet.
- ☒ Physical space for floodwater expansion and dense, persistent, emergent vegetation or dense woody vegetation that slows down flood waters or stormwater runoff during peak flows and facilitates water removal by evaporation and transpiration.
- ☐ If a stream is present, its course is sinuous and there is sufficient woody vegetation to intercept surface flows in the portion of the wetland that floods.
- ☐ Physical evidence of seasonal flooding or ponding such as water stained leaves, water marks on trees, drift rows, debris deposits, or standing water.
- ☐ Hydrologic or hydraulic study indicates wetland attenuates flooding.

If any of the above boxes are checked, the wetland provides this function. Complete the following to determine if the wetland provides this function above or below a moderate level:

☒ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *lower* level.

- ☐ Significant flood storage capacity upstream of the wetland, and the wetland in question provides this function at a negligible level in comparison to upstream storage (unless the upstream storage is temporary such as a beaver impoundment).
- ☐ Wetland is contiguous to a major lake or pond that provides storage benefits independently of the wetland.
- ☐ Wetland's storage capacity is created primarily by recent beaver dams or other temporary structures.
- ☒ Wetland is very small in size, not contiguous to a stream, and not part of a collection of small wetlands in the landscape that provide this function cumulatively.

☐ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *higher* level.

- ☐ History of downstream flood damage to public or private property.
- ☐ Any of the following conditions present downstream of the wetland, but upstream of a major lake or pond, could be impacted by a loss or reduction of the water storage function.
  - ☐ 1. Developed public or private property.
  - ☐ 2. Stream banks susceptible to scouring and erosion.
  - ☐ 3. Important habitat for aquatic life.
- ☐ The wetland is large in size and naturally vegetated.

☐ Any of the following conditions present upstream of the wetland may indicate a large volume of runoff may reach the wetland.

☐ 1. A large amount of impervious surface in urbanized areas.

☐ 2. Relatively impervious soils.

☐ 3. Steep slopes in the adjacent areas.

2. Surface and Ground Water Protection

☒ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.

☐ Constricted or no outlets.

☐ Low water velocity through dense, persistent vegetation.

☐ Hydroperiod permanently flooded or saturated.

☐ Wetlands in depositional environments with persistent vegetation wider than 20 feet.

☐ Wetlands with persistent vegetation comprising a defined delta, island, bar or peninsula.

☐ Presence of seeps or springs.

☐ Wetland contains a high amount of microtopography that helps slow and filter surface water.

☐ Position in the landscape indicates the wetland is a headwaters area.

☒ Wetland is adjacent to surface waters.

☐ Wetland recharges a drinking water source.

☐ Water sampling indicates removal of pollutants or nutrients.

☐ Water sampling indicates retention of sediments or organic matter.

☐ Fine mineral soils and alkalinity not low.

☐ The wetland provides an obvious filter between surface water or ground water and land uses that may contribute point or nonpoint sources of sediments, toxic substances or nutrients to the wetland, such as: steep erodible slopes; row crops; dumps; areas of pesticide, herbicide or fertilizer application; feed lots; parking lots or heavily traveled road; and septic systems.

If any of the above boxes are checked, the wetland provides this function. Complete the following to determine if the wetland provides this function above or below a moderate level.

☒ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *lower* level.

☐ Presence of dead forest or shrub areas in sufficient amounts to result in diminished

nutrient uptake.

- ☐ Presence of ditches or channels that confine water and restrict contact of water with vegetation.
- ☐ Wetland is very small in size, not contiguous to a stream, and not part of a collection of small wetlands in the landscape that provide this function cumulatively.
- ☒ Current use in the wetland results in disturbance that compromises this function.

☐ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *higher* level.

- ☐ The wetland is adjacent to a well head or source protection area, and provides ground water recharge.
- ☐ The wetland provides flows to Class A surface waters.
- ☐ The wetland contributes to the protection or improvement of water quality of any impaired waters.
- ☐ The wetland is large in size and naturally vegetated.

3. Fish Habitat

☐ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.

- ☐ Contains woody vegetation that overhangs the banks of a stream or river and provides any of the following: shading that controls summer water temperature; cover including refuges created by overhanging branches or undercut banks; source of terrestrial insects as fish food; or streambank stability.
- ☐ Provides spawning, nursery, feeding or cover habitat for fish (documented or professionally judged). Common habitat includes deep marsh and shallow marsh associates with lakes and streams, and seasonally flooded wetlands associated with streams and rivers.
- ☐ Documented or professionally judged spawning habitat for northern pike.
- ☐ Provides cold spring discharge that lowers the temperature of receiving waters and creates summer habitat for salmonoid species.
- ☐ The wetland is located along a tributary that does not support fish, but contributes to a larger body of water that does support fish. The tributary supports downstream fish by providing cooler water, and food sources.

4. Wildlife Habitat

☐ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.

- ☐ Provides resting, feeding staging or roosting habitat to support waterfowl migration, and feeding habitat for wading birds. Good habitats for these species include open water wetlands.
- ☐ Habitat to support one or more breeding pairs or broods of waterfowl including all species of ducks, geese, and swans. Good habitats for these species include open water habitats adjacent shallow marsh, deep marsh, shrub wetland, forested wetland, or naturally vegetated buffer zone.
- ☐ Provides a nest site, a buffer for a nest site or feeding habitat for wading birds including but not limited to: great blue heron, black-crowned night heron, green-backed heron, cattle egret, or snowy egret. Good habitats for these species include open water or deep marsh adjacent to forested wetlands, or standing dead trees.
- ☐ Supports or has the habitat to support one or more breeding pairs of any migratory bird that requires wetland habitat for breeding, nesting, rearing of young, feeding, staging roosting, or migration, including: Virginia rail, common snipe, marsh wren, American bittern, northern water thrush, northern harrier, spruce grouse, Cerulean warbler, and common loon.
- ☐ Supports winter habitat for white-tailed deer. Good habitats for these species include softwood swamps. Evidence of use includes deer browsing, bark stripping, worn trails, or pellet piles.
- ☐ Provides important feeding habitat for black bear, bobcat, or moose based on an assessment of use. Good habitat for these types of species includes wetlands located in a forested mosaic.
- ☐ Has the habitat to support muskrat, otter or mink. Good habitats for these species include deep marshes, wetlands adjacent to bodies of water including lakes, ponds, rivers and streams.
- ☐ Supports an active beaver dam, one or more lodges, or evidence of use in two or more consecutive years by an adult beaver population.
- ☐ Provides the following habitats that support the reproduction of Uncommon Vermont amphibian species including:
  - ☐ 1. Wood Frog, Jefferson Salamander, Blue-spotted Salamander, or Spotted Salamander. Breeding habitat for these species includes vernal pools and small ponds.
  - ☐ 2. Northern Dusky Salamander and the Spring Salamander. Habitat for these species includes headwater seeps, springs, and streams.
  - ☐ 3. The Four-toed salamander; Fowler's Toad; Western or Boreal Chorus frog, or other amphibians found in Vermont of similar significance.

- ☐ Supports or has the habitat to support significant populations of Vermont amphibian species including, but not limited to Pickerel Frog, Northern Leopard Frog, Mink Frog, and others found in Vermont of similar significance. Good habitat for these types of species includes large marsh systems with open water components.
- ☐ Supports or has the habitat to support populations of uncommon Vermont reptile species including: Wood Turtle, Northern Map Turtle, Eastern Musk Turtle, Spotted Turtle, Spiny Softshell, Eastern Ribbonsnake, Northern Watersnake, and others found in Vermont of similar significance.
- ☐ Supports or has the habitat to support significant populations of Vermont reptile species, including Smooth Greensnake, DeKay's Brownsnake, or other more common wetland-associated species.
- ☐ Meets four or more of the following conditions indicative of wildlife habitat diversity:
  - ☐ 1. Three or more wetland vegetation classes (greater than 1/2 acre) present including but not limited to: open water contiguous to, but not necessarily part of, the wetland, deep marsh, shallow marsh, shrub swamp, forested swamp, fen, or bog;
  - ☐ 2. The dominant vegetation class is one of the following types: deep marsh, shallow marsh, shrub swamp or, forested swamp;
  - ☐ 3. Located adjacent to a lake, pond, river or stream;
  - ☐ 4. Fifty percent or more of surrounding habitat type is one or more of the following: forest, agricultural land, old field or open land;
  - ☐ 5. Emergent or woody vegetation occupies 26 to 75 percent of wetland, the rest is open water;
  - ☐ 6. One of the following:
    - ☐ i. hydrologically connected to other wetlands of different dominant classes or open water within 1 mile;
    - ☐ ii. hydrologically connected to other wetlands of same dominant class within 1/2 mile;
    - ☐ iii. within 1/4 mile of other wetlands of different dominant classes or open water, but not hydrologically connected;
- ☐ Wetland or wetland complex is owned in whole or in part by state or federal government and managed for wildlife and habitat conservation; and
- ☐ Contains evidence that it is used by wetland dependent wildlife species.

If any of the above boxes are checked, the wetland provides this function. Complete the following to determine if the wetland provides this function above or below a moderate level.

☐ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *lower* level.

- ☐ The wetland is small in size for its type and does not represent fugitive habitat in

developed areas (vernal pools and seeps are generally small in size, so this does not apply).

- ☐ The surrounding land use is densely developed enough to limit use by wildlife species (with the exception of wetlands with open water habitat). Can be negated by evidence of use.
- ☐ The current use in the wetland results in frequent cutting, mowing or other disturbance.
- ☐ The wetland hydrology and character is at a drier end of the scale and does not support wetland dependent species.

☐ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *higher* level.

- ☐ The wetland complex is large in size and high in quality.
- ☐ The habitat has the potential to support several species based on the assessment above.
- ☐ Wetland is associated with an important wildlife corridor.
- ☐ The wetland has been identified by ANR-F&W as important habitat.

5. Exemplary Wetland Natural Community

☐ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.

- ☐ Wetlands that are identified as high quality examples of Vermont's natural community types recognized by the Natural Heritage Information Project of the Vermont Fish and Wildlife Department, including rare types such as dwarf shrub bogs, rich fens, alpine peatlands, red maple-black gum swamps and the more common types including deep bulrush marshes, cattail marshes, northern white cedar swamps, spruce-fir-tamarack swamps, and red maple-black ash seepage swamps are automatically significant for this function.

The wetland is also likely to be significant if any of the following conditions are met:

- ☐ Is an example of a wetland natural community type that has been identified and mapped by, or meets the ranking and mapping standards of, the Natural Heritage Information Project of the Vermont Fish and Wildlife Department.
- ☐ Contains ecological features that contribute to Vermont's natural heritage, including, but not limited to:
  - ☐ Deep peat accumulation reflecting a long history of wetland formation;
  - ☐ Forested wetlands displaying very old trees and other old growth characteristics;
  - ☐ A wetland natural community that is at the edge of the normal range for that type;

- ☐ A wetland mosaic containing examples of several to many wetland community types; or
- ☐ A large wetland complex with examples of several wetland community types.

6. Rare, Threatened, and Endangered Species Habitat

☐ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.

- ☐ Wetlands that contain one or more species on the federal or state threatened or endangered lists, as well as species that are rare in Vermont, are automatically significant for this function.

The wetland is also likely to be significant if any of the following apply:

- ☐ There is creditable documentation that the wetland provides important habitat for any species on the federal or state threatened or endangered species lists;
- ☐ There is creditable documentation that threatened or endangered species have been present in past 10 years;
- ☐ There is creditable documentation that the wetland provides important habitat for any species listed as rare in Vermont (S1 or S2 ranks), state historic (SH rank), or rare to uncommon globally (G1, G2, or G3 ranks) by the Natural Heritage Information Project of the Vermont Fish and Wildlife Department;
- ☐ There is creditable documentation that the wetland provides habitat for multiple uncommon species of plants or animals (S3 rank).

List name of species and ranking:

7. Education and Research in Natural Sciences

☐ Function is present and likely to be significant: Any of the following characteristics indicate the wetland provides this function.

- ☐ Owned by or leased to a public entity dedicated to education or research.
- ☐ History of use for education or research.
- ☐ Has one or more characteristics making it valuable for education or research.

8. Recreational Value and Economic Benefits

- ☐ Function is present and likely to be significant: Any of the following characteristics indicate the wetland provides this function.
  - ☐ Used for, or contributes to, recreational activities.
  - ☐ Provides economic benefits.
  - ☐ Provides important habitat for fish or wildlife which can be fished, hunted or trapped under applicable state law.
  - ☐ Used for harvesting of wild foods.

Comments:

9. Open Space and Aesthetics

- ☐ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.
  - ☐ Can be readily observed by the public; and
    - ☐ Possesses special or unique aesthetic qualities; or
    - ☐ Has prominence as a distinct feature in the surrounding landscape;
  - ☐ Has been identified as important open space in a municipal, regional or state plan.

10. Erosion Control through Binding and Stabilizing the Soil

- ☐ Function is present and likely to be significant: Any of the following physical and vegetative characteristics indicate the wetland provides this function.
  - ☐ Erosive forces such as wave or current energy are present and any of the following are present as well:
    - ☐ Dense, persistent vegetation along a shoreline or stream bank that reduces an adjacent erosive force.
    - ☐ Good interspersion of persistent emergent vegetation and water along course of water flow.
    - ☐ Studies show that wetlands of similar size, vegetation type, and hydrology are important for erosion control.

What type of erosive forces are present?

- ☐ Lake fetch and waves
- ☐ High current velocities
- ☐ Water level influenced by upstream impoundment

If any of the above boxes are checked, the wetland provides this function. Complete the following to determine if the wetland provides this function above or below a moderate level.

☐ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *lower* level.

- ☐ The stream is artificially channelized and/or lacks vegetation that contributes to controlling the erosive force.

☐ Check box if any of the following conditions apply that may indicate the wetland provides this function at a *higher* level.

- ☐ The stream contains high sinuosity.
- ☐ Has been identified through fluvial geomorphic assessment to be important in maintaining the natural condition of the stream or river corridor.

South Burlington IM CULV(24)
South Burlington, Vermont
Culverts 63-1N & 63-1S and 64-1N & 64-1S Replacement Projects
Interstate Highway 89
Wetland and Stream Delineation Representative Photographs

Photograph 1: Representative view of Proposed Class II wetland 2012-PW-1 at Culvert 63-1S, looking southeast

Photograph 2: View of Potash Brook (2012-SC-PW-1), at Culvert 63-1S, looking south

Photographs taken by Patti Kallfelz-Werts of VHB, September 13 and 14, 2012

South Burlington IM CULV(24)
South Burlington, Vermont
Culverts 63-1N & 63-1S and 64-1N & 64-1S Replacement Projects
Interstate Highway 89
Wetland and Stream Delineation Representative Photographs

Photograph 3: View of Interstate Southbound Culvert 63-1S inlet and Potash Brook, looking north

Photograph 4: View of Interstate 89 median, Potash Brook, and Culvert 63-1N inlet, looking northeast

Photographs taken by Patti Kallfelz-Werts of VHB, September 13 and 14, 2012

South Burlington IM CULV(24)
South Burlington, Vermont
Culverts 63-1N & 63-1S and 64-1N & 64-1S Replacement Projects
Interstate Highway 89
Wetland and Stream Delineation Representative Photographs

Photograph 5: View of Culvert 63-1N outlet and Potash Brook, looking south

Photograph 6: Representative view of Proposed Class II wetland 2012-PW-2, looking north

Photographs taken by Patti Kallfelz-Werts of VHB, September 13 and 14, 2012

South Burlington IM CULV(24)
South Burlington, Vermont
Culverts 63-1N & 63-1S and 64-1N & 64-1S Replacement Projects
Interstate Highway 89
Wetland and Stream Delineation Representative Photographs

Photograph 7: Representative view of VHD mapped tributary 2012-TB-P2 looking northwest

Photograph 9: Representative view of Culvert 64-1N, from outlet, looking south

South Burlington IM CULV(24)
South Burlington, Vermont
Culverts 63-1N & 63-1S and 64-1N & 64-1S Replacement Projects
Interstate Highway 89
Wetland and Stream Delineation Representative Photographs

Photograph 10: Intermittent stream, 2012-SC-JB-2, looking east

Photograph 11: Proposed Class III wetland 2012-JB-2, looking north

Photographs taken by Patti Kallfelz-Werts of VHB, September 13 and 14, 2012

South Burlington IM CULV(24)
South Burlington, Vermont
Culverts 63-1N & 63-1S and 64-1N & 64-1S Replacement Projects
Interstate Highway 89
Wetland and Stream Delineation Representative Photographs

Photograph 12: View of Proposed Class III wetland 2012-PW-4, looking south

Photograph 13: Representative view of Proposed Class II wetland 2012-JB-3, and intermittent stream 2012-TB-PW-2, from Culvert 64-1S, looking south

Photographs taken by Patti Kallfelz-Werts of VHB, September 13 and 14, 2012

South Burlington IM CULV(24)
South Burlington, Vermont
Culverts 63-1N & 63-1S and 64-1N & 64-1S Replacement Projects
Interstate Highway 89
Wetland and Stream Delineation Representative Photographs

Photograph 14: View of Interstate 89 roadside edge, Southbound, looking northwest

Photograph 15: View of Culvert 64-IS inlet, looking north

United States Department of the Interior

FISH AND WILDLIFE SERVICE
NEW ENGLAND ECOLOGICAL SERVICES FIELD OFFICE
70 COMMERCIAL STREET, SUITE 300
CONCORD, NH 3301
PHONE: (603)223-2541 FAX: (603)223-0104
URL: www.fws.gov/newengland

Consultation Tracking Number: 05E1NE00-2012-SLI-0259 September 10, 2012
Project Name: South Burlington Culvert # 63 and #64

Subject: List of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project.

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, and proposed species, designated critical habitat, and candidate species that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having

similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

http://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF

Please be aware that bald and golden eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668 *et seq.*), and projects affecting these species may require development of an eagle conservation plan (http://www.fws.gov/windenergy/eagle_guidance.html). Additionally, wind energy projects should follow the wind energy guidelines (http://www.fws.gov/windenergy/) for minimizing impacts to migratory birds and bats.

Guidance for minimizing impacts to migratory birds for projects including communications towers (e.g., cellular, digital television, radio, and emergency broadcast) can be found at: http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/towers.htm; http://www.towerkill.com; and http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/comtow.html.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Tracking Number in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment

United States Department of Interior
Fish and Wildlife Service

Project name: South Burlington Culvert # 63 and #64

Official Species List

Provided by:

NEW ENGLAND ECOLOGICAL SERVICES FIELD OFFICE
70 COMMERCIAL STREET, SUITE 300
CONCORD, NH 3301
(603) 223-2541
http://www.fws.gov/newengland

Consultation Tracking Number: 05E1NE00-2012-SLI-0259
Project Type: Highway Safety and Maintenance
Project Description: Design build project for two culverts #63 and #64 in South Burlington, Vermont

United States Department of Interior
Fish and Wildlife Service

Project name: South Burlington Culvert # 63 and #64

Project Counties: Chittenden, VT

United States Department of Interior
Fish and Wildlife Service

Project name: South Burlington Culvert # 63 and #64

Endangered Species Act Species List

Species lists are not entirely based upon the current range of a species but may also take into consideration actions that affect a species that exists in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species. Please contact the designated FWS office if you have questions.

Indiana bat *(Myotis sodalis)*

Listing Status: Endangered

APPENDIX D: Geotechnical Data Report

Geotechnical Data Report

South Burlington IM CULV(24)
Culvert No. 63N&S and 64N&S
Potash Brook Tributaries Under I-89
South Burlington, Vermont

PIN: 11A216
February 25, 2014
Terracon Project No. J1135173

Prepared for:
Vermont Agency of Transportation
Montpelier, Vermont

Prepared by:
Terracon Consultants, Inc.
Manchester, New Hampshire

terracon.com

Terracon

Environmental ■ Facilities ■ Geotechnical ■ Materials

February 25, 2014

Terracon

Vermont Agency of Transportation
Materials and Research
One National Life Drive
Montpelier, Vermont 05633

Attn: Mr. Christopher Benda, PE
P: [802] 828-6910
E: chris.benda@state.vt.us

Re: Geotechnical Data Report
South Burlington IM CUL(24)
Culvert No. 63N&S and 64N&S
Potash Brook Tributaries Under I-89
South Burlington, Vermont
PIN: 11A216
February 25, 2014
Terracon Project No. J1135173

Dear Mr. Benda:

Terracon Consultants, Inc. (Terracon) has completed the geotechnical engineering services for the above referenced project. This study was performed in general accordance with our proposal number PJ1130255 dated December 24, 2013. This report presents the findings of the subsurface exploration and laboratory testing for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

Anant Panwalkar
Senior Project Engineer

Lawrence J. Dwyer, P.E.
Principal

Enclosures
cc: 1 – Client (PDF)
1 – File

Page
1.0 INTRODUCTION 1
2.0 PROJECT INFORMATION 2
2.1 Project Description 2
2.2 Site Location and Description 2
3.0 SUBSURFACE CONDITIONS 2
3.1 Geology 2
3.2 Typical Profile 2
3.3 Groundwater 3
3.4 Laboratory Testing 3
4.0 GENERAL COMMENTS 3

APPENDIX A – FIELD EXPLORATION
Exhibit A-1 Site Location Map
Exhibit A-2a Exploration Location Plan and Geologic Cross Section
Exhibit A-2b Exploration Location Plan and Geologic Cross Section
Exhibit A-3 Field Exploration Description
Exhibit A-4 to A-11 Boring Logs

APPENDIX B – LABORATORY TESTING
Exhibit B-1 Laboratory Testing Results

GEOTECHNICAL DATA REPORT
South Burlington IM CULV(24), Culvert No. 63N&S and 64N&S
Potash Brook Tributaries Under I-89
SOUTH BURLINGTON, VERMONT

PIN:11a216

Terracon Project No. J1135173

February 25, 2014

1.0 INTRODUCTION

This report presents the results of our geotechnical exploration performed for the proposed replacement Culvert Nos. 63N&S and 64N&S carrying Potash Brook Tributaries under I-89 in South Burlington, Vermont. The purpose of these services is to provide potential design-builders with the subsurface information for the proposed culvert replacement project.

Our geotechnical engineering scope of services included advancing eight test borings, designated B-1 thru B-8, as identified on the Geotechnical Services Request Form prepared by Vermont Agency of Transportation (VAOT). Terracon finalized the boring depths and sampling intervals in accordance with the VAOT guidelines “MREI 11-01 Geotechnical Guidelines for the Subsurface Investigation Process”.

All eight borings were drilled to depths ranging from approximately 18 to 22 feet terminating approximately 15 feet below the existing culvert invert. Boring B-7 was inaccessible due to steep icy slope and was relocated 30 feet to west. All eight borings were completed from January 28, 2014 through January 30, 2014 using a hollow stem auger drilling method. Soil borings were advanced using an all-terrain vehicle mounted drill rig, owned and operated by Drillex Environmental of West Boylston, Massachusetts. Terracon personnel monitored the advancement of the soil borings within the project site.

The proposed boring locations were laid out in the field by a Terracon representative using a scaled site plan provided by VAOT. Ground surface elevations indicated on the boring logs were estimated based on the grading plan provided by VAOT. The locations and elevations of the borings should be considered accurate only to the degree implied by the means and methods used to define them.

The boring locations are shown on the Exploration Location Plans and Geologic Cross Sections in Appendix A. Logs of the borings along with a site location map are also included in Appendix A.

2.0 PROJECT INFORMATION

2.1 Project Description

Item	Description
Site layout	See Appendix A, Exhibit A-2a and A-2b: Exploration Location Plan and Geologic Cross Section.
Structure	The project consists of replacing existing pipe culverts along Potash Brook tributaries under I-89 embankment.
Cut and fill slopes	Cut and fill slopes will depend on the construction method selected.
Finish Elevation	Anticipated to be similar grade as the existing culverts and roadways.

2.2 Site Location and Description

Item	Description
Location	The proposed culverts are located along Potash Brook tributaries passing under I-89. Culvert 63 is located between mile markers 85.60 and 85.65 along the southbound lane and between mile markers 85.65 and 85.70 along the northbound lane. Culvert 64 is located between mile markers 86.65 and 86.70 along the southbound lane and between mile markers 86.75 and 86.80 along the northbound lane.
Existing improvements	The existing culverts consist of 48-inch diameter corrugated steel pipe draining to the north.
Current ground cover	Paved roadway with sloping embankment shoulders and wetland.
Existing topography	Approximate elevation (El) 340 feet at the road surface and El 310 feet at the brook bed.

3.0 SUBSURFACE CONDITIONS

3.1 Geology

As mapped in the Surficial Geology Map of Vermont (1970), surficial material at the project site primarily consists of pebbly marine sand with recent alluvium deposits mapped in the vicinity.

3.2 Typical Profile

Based on the results of the borings, subsurface conditions can be generalized as follows:

Stratum	Approximate Depth to Bottom of Stratum (feet)	Material Description	Consistency/ Density
Topsoil	0 to 0.33	Topsoil	N/A
Fill	0 to 4	Fine to medium sand and gravel with silt and occasional wood, brown, moist.	Medium dense to dense
Pebbly Marine Sand	2 to 10 (undetermined in B-1)	Silt and fine to coarse sand, trace gravel, brown/gray, saturated.	Very loose to medium dense
Marine Silt/Clay	10 to Undetermined	Silty clay, gray, saturated.	Very soft to soft

Conditions encountered at each boring location are indicated on the individual boring logs. Stratification boundaries on the exploration logs represent the approximate location of changes in soil types; in situ, the transition between materials may be gradual. Details for each of the explorations can be found on the logs in Appendix A of this report. Interpreted subsurface profiles along the culvert centerline are also presented in Appendix A.

3.3 Groundwater

Explorations were observed during and after drilling for the presence of groundwater. Observed groundwater depths varied from 2.0 feet to 5.0 feet below ground surface at the time of drilling with the exception of B-5 and B-6. Groundwater was not encountered in B-5 and B-6 during exploration. Based on the moisture content of the samples, groundwater in B-5 and B-6 is estimated to be at approximately 2.0 feet deep. Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff, brook elevation, and other factors not evident at the time the explorations were performed. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels indicated on the boring logs. Groundwater level fluctuations should be considered when developing the design and construction plans for the project.

3.4 Laboratory Testing

Laboratory testing was performed on each of the soil samples obtained from the test borings to assist in classification and evaluate engineering properties. Laboratory testing was performed by Vermont Agency of Transportation (VAOT) staff in the VAOT facility located in Berlin, Vermont. The results of the laboratory tests are presented in Appendix B of this report.

4.0 GENERAL COMMENTS

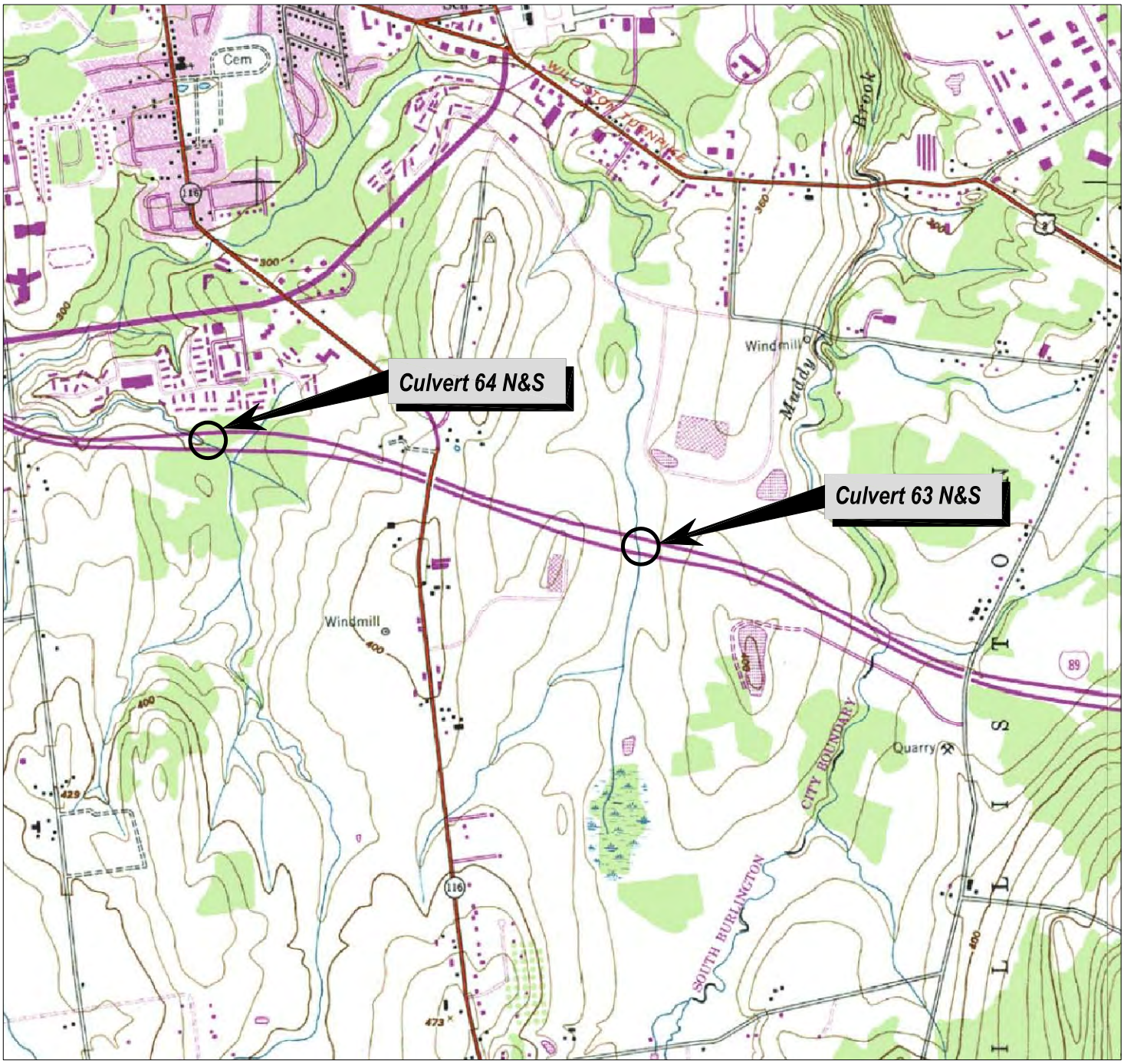
The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in

this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

APPENDIX A
FIELD EXPLORATION



SCALE: 1:24 000

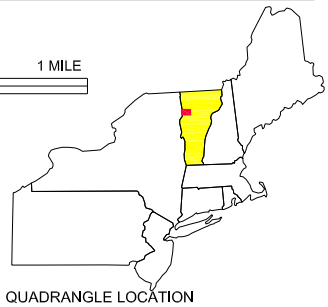
1 1/2 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

CONTOUR INTERVAL 20 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

N

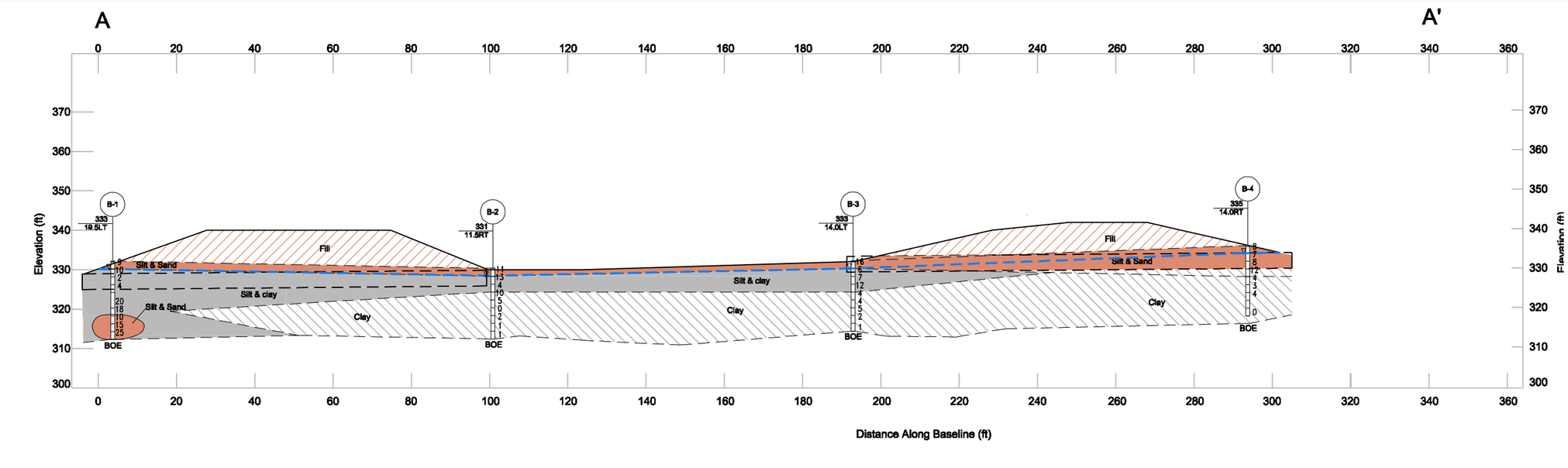


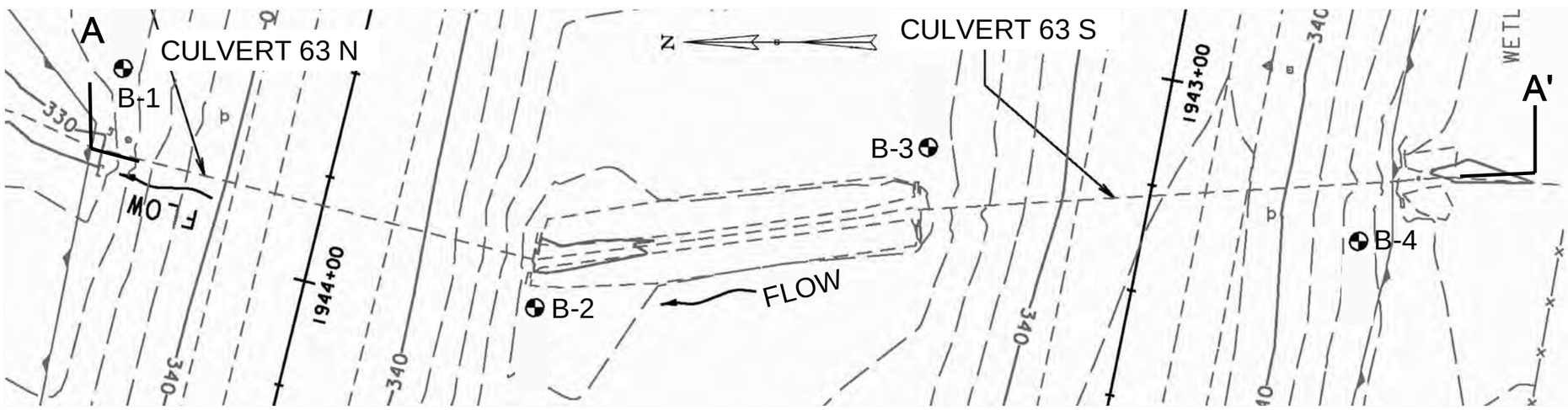
QUADRANGLE LOCATION
SOURCE:
USGS BURLINGTON, VT
1987

Project Mngr: ASP	Project No. J1135173	Terracon	SITE LOCATION MAP
Drawn By: MCR	Scale: AS SHOWN		CULVERT NOS. 63 N&S AND 64 N&S
Checked By: ASP	File No. J1135173.dwg		BURLINGTON, VERMONT
Approved By: LJD	Date: February 2012	77 Sundial Ave. Manchester, NH 03103 PH. (603)647-9700 FAX (603) 647-4432	BURLINGTON IM CULV(24)

EXHIBIT

A-1



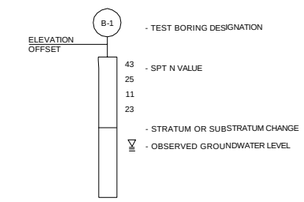


EXPLORATION LOCATION PLAN

BORING CHART

HOLE NO.	SURV. STATION	OFFSET (FEET)	NORTHING	EASTING	ALIGNMENT
B-1	1943+61.94	53.09 RT	710018.79	1471211.55	NORTHBOUND
B-2	1943+93.09	53.82 LT	709922.44	1471155.75	NORTHBOUND
B-3	1943+26.43	53.12 RT	709830.36	1471193.23	SOUTHBOUND
B-4	1943+28.39	49.90 LT	709729.65	1471171.44	SOUTHBOUND

LEGEND:



NOTES:

1. EXPLORATION LOCATION PLAN WAS PREPARED FROM A PLAN PROVIDED BY THE VERMONT AGENCY OF TRANSPORTATION.

2. TEST BORINGS SHOWN WERE ADVANCED ON 1/29, 2014 UNDER THE DIRECTION OF TERRACON WITH EQUIPMENT OWNED AND OPERATED BY DRILEX ENVIRONMENTAL OF WEST BOYLSTON, MA.

3. DATA CONCERNING THE VARIOUS STRATA HAVE BEEN INTERPOLATED AT BORING LOCATIONS ONLY. THE STRATIGRAPHY BETWEEN BORINGS MAY VARY FROM THAT SHOWN.

4. THE APPROXIMATE LOCATIONS OF THE TEST BORINGS SHOULD BE CONSIDERED ACCURATE TO THE DEGREE IMPLIED BY THE METHOD USED.

5. BORINGS ARE PROJECTED ON CULVERT PROFILE A–A' ALONG ELEVATION CONTOURS TO MATCH TOP OF BORINGS.

6. USE OF THIS PLAN IS LIMITED TO THE ILLUSTRATION OF THE APPROXIMATE LOCATION OF THE TEST BORINGS AND OTHER PERTINENT SITE FEATURES. OTHER USE OF THIS PLAN WITHOUT PERMISSION FROM TERRACON IS PROHIBITED.

GRAPHIC SCALE
7.5 0 7.5 15 30
(IN FEET)

VTrans Working to Get You There Vermont Agency of Transportation

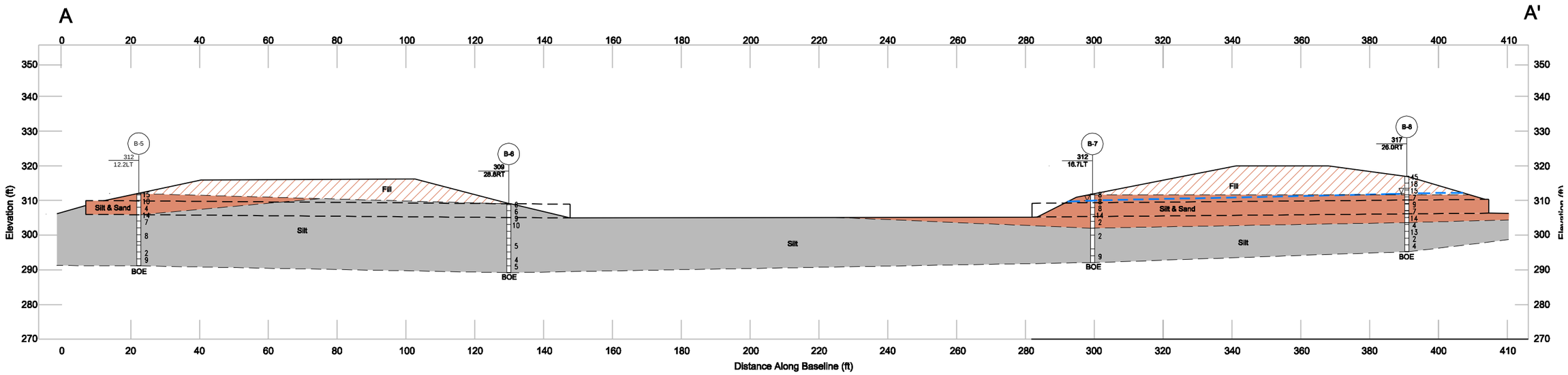
STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

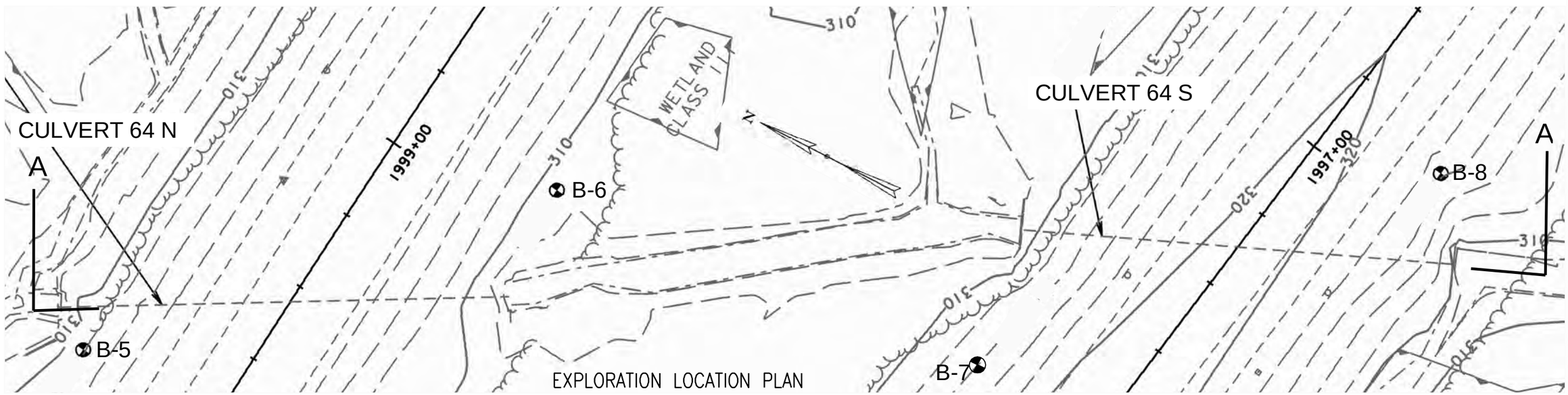
EXHIBIT A–2a

EXPLORATION LOCATION PLAN AND GEOLOGIC CROSS SECTION

Project Name: South Burlington
Location: Burlington, Vermont
Number: IM CULV(24)

J1135173.DWG



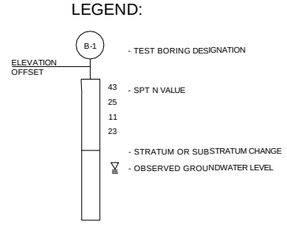


EXPLORATION LOCATION PLAN

BORING CHART

HOLE NO.	SURV. STATION	OFFSET (FEET)	NORTHING	EASTING	ALIGNMENT
B-5	1999+99.37	43.32 RT	711372.10	1465763.84	NORTHBOUND
B-6	1998+85.18	47.27 LT	711286.01	1465881.41	NORTHBOUND
B-7	1998+10.40	39.73 RT	711155.96	1465909.80	SOUTHBOUND
B-8	1996+83.94	34.21 LT	711078.14	1466033.89	SOUTHBOUND

LEGEND:



NOTES:

1. EXPLORATION LOCATION PLAN WAS PREPARED FROM A PLAN PROVIDED BY THE VERMONT AGENCY OF TRANSPORTATION.

2. TEST BORINGS SHOWN WERE ADVANCED ON 1/28 AND 1/30, 2014 UNDER THE DIRECTION OF TERRACON WITH EQUIPMENT OWNED AND OPERATED BY DRILEX ENVIRONMENTAL OF WEST BOYLSTON, MA.

3. DATA CONCERNING THE VARIOUS STRATA HAVE BEEN INTERPOLATED AT BORING LOCATIONS ONLY. THE STRATIGRAPHY BETWEEN BORINGS MAY VARY FROM THAT SHOWN.

4. THE APPROXIMATE LOCATIONS OF THE TEST BORINGS SHOULD BE CONSIDERED ACCURATE TO THE DEGREE IMPLIED BY THE METHOD USED.

5. BORINGS ARE PROJECTED ON CULVERT PROFILE A-A' ALONG ELEVATION CONTOURS TO MATCH TOP OF BORINGS.

6. USE OF THIS PLAN IS LIMITED TO THE ILLUSTRATION OF THE APPROXIMATE LOCATION OF THE TEST BORINGS AND OTHER PERTINENT SITE FEATURES. OTHER USE OF THIS PLAN WITHOUT PERMISSION FROM TERRACON IS PROHIBITED.

GRAPHIC SCALE
7.5 0 7.5 15 30
(IN FEET)

VTrans Working to Get You There Vermont Agency of Transportation

STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

EXHIBIT A-2b

EXPLORATION LOCATION PLAN AND GEOLOGIC CROSS SECTION

Project Name: South Burlington
Location: Burlington, Vermont
Number: IM CULV(24)

J1135173.DWG

Field Exploration Description

Eight test borings were completed at the site on January 28 through January 30, 2014. Terracon personnel monitored the advancement of the soil borings within the project site. Soil borings were advanced using an all-terrain vehicle mounted drill rig, owned and operated by Drillex Environmental of West Boylston, Massachusetts. All eight borings (B-1 through B-8) were advanced using an ATV mounted drill rig using a hollow stem auger drilling method to depths ranging from approximately 18 to 22 feet below existing grade.

The proposed boring locations were laid out in the field by a Terracon representative using a scaled site plan provided by VAOT. Ground surface elevations indicated on the boring logs were estimated based on the grading plan provided by VAOT. The locations and elevations of the borings should be considered accurate only to the degree implied by the means and methods used to define them.

Samples of the soil encountered in the borings were obtained using the split-barrel sampling procedures. In the split-barrel sampling procedure, the number of blows required to advance a standard 2-inch O.D. split-barrel sampler the last 12 inches of the typical total 18-inch penetration by means of a 140-pound hammer with a free fall of 30 inches, is the standard penetration resistance value (SPT-N). This value is used to estimate the in situ relative density of cohesionless soils and consistency of cohesive soils. Undisturbed Shelby tube samples of soft cohesive soils were collected at select locations as identified on the logs.

The samples were tagged for identification, sealed to reduce moisture loss, and taken to VAOT laboratory for further examination, testing, and classification. Information provided on the boring logs attached to this report includes soil descriptions, consistency evaluations, boring depths, sampling intervals, and groundwater conditions. The borings were backfilled with cuttings prior to the drill crew leaving the site.

A field log of each boring was prepared by Terracon representative. These logs included visual classifications of the materials encountered during drilling as well as Terracon representative's interpretation of the subsurface conditions between samples. Final boring logs included with this report represent the engineer's interpretation of the field logs and include modifications based on laboratory observation and tests of the samples.

STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

Culvert No. 63 N&S and 64 N&S
South Burlington,VT

IM CULV (24)

Boring No.: **B-1**
Page No.: 1 of 1
Pin No.: 11a216
Checked By: ASP

Boring Crew: Drilex/Terracon (CR)
Date Started: 1/29/14 Date Finished: 1/29/14
VTSPG NAD83: N 710018.79 ft E 1471211.55 ft
Station: 1943+61.94 Offset: 53.09RT
Ground Elevation: 333.0 ft

	Casing	Sampler
Type:	HSA	SS
I.D.:	4.25 in	2 in
Hammer Wt:	N.A.	140 lb.
Hammer Fall:	N.A.	N.A.
Hammer/Rod Type:	Auto	
Rig:	CME 55 ATV	C_E = 1.33

Groundwater Observations

Date	Depth (ft)	Notes
01/29/14	2.0	While sampling

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
		4-inches topsoil, Rec. = 1.2 ft A-4, SiSaGr, with wood and roots	17-4-5-47 (9)	48.6	5.8	26.5	67.7
2.5		A-6, SiGrSa, Rec. = 0.4 ft	4-5-5-6 (10)	22.1	28.6	22.8	48.6
5.0		No recovery, Rec. = 0.0 ft	1-1-1-2 (2)				
7.5		A-6, Si, Rec. = 1.0 ft	2-2-2-2 (4)	39.3		2.7	97.3
10.0		A-1-b, GrSiSa, Rec. = 1.2 ft	3-17-3-3 (20)	7.7	52.6	23.3	24.1
12.5		A-4, SiSaGr, Rec. = 0.8 ft	7-8-10-7 (18)	11.2	20.5	34.4	45.1
15.0		A-1-b, SaGrSi, Rec. = 0.8 ft	4-4-6-8 (10)	7.9	39.6	41.8	18.6
17.5		A-2-4, SaGrSi, Rec. = 1.0 ft	6-8-7-11 (15)	15.0	28.7	44.8	26.5
20.0		A-2-4, SaGrSi, Rec. = 1.5 ft	12-12-13-15 (25)	9.6	33.1	38.6	28.3
22.5		Hole stopped @ 20.0 ft					

Notes:
1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. C_E is the hammer energy correction factor. C_E is an estimated value.
3. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.
4. Ground surface elevations indicated on the boring logs were estimated based on the grading plan provided by VAOT.

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STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

Culvert No. 63 N&S and 64 N&S
South Burlington,VT

IM CULV (24)

Boring No.: **B-2**
Page No.: 1 of 1
Pin No.: 11a216
Checked By: ASP

Boring Crew: Drilex/Terracon (CR)
Date Started: 1/29/14 Date Finished: 1/29/14
VTSPG NAD83: N 709922.44 ft E 1471155.75 ft
Station: 1943+93.09 Offset: 53.82LT
Ground Elevation: 331.0 ft

	Casing	Sampler
Type:	HSA	SS
I.D.:	4.25 in	2 in
Hammer Wt:	N.A.	140 lb.
Hammer Fall:	N.A.	N.A.
Hammer/Rod Type:	Auto	
Rig:	CME 55 ATV	C_E = 1.33

Groundwater Observations

Date	Depth (ft)	Notes
01/29/14	2.0	While sampling

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
		4-inches topsoil, Rec. = 1.0 ft A-4, SiSaGr	17-8-3-4 (11)	30.4	9.5	36.6	53.9
2.5		A-4, SiSa, Rec. = 0.6 ft	6-6-7-6 (13)	35.3	2.7	21.0	76.3
5.0		A-4, SiSa, Rec. = 0.7 ft, (See Lab note)	2-2-2-3 (4)	38.0			
7.5		A-7-6, CL, Rec. = 1.8 ft	5-5-5-5 (10)	38.5	2.6	2.5	94.9
		A-7-6, CL, Rec. = 1.0 ft, (See Lab note)	3-2-3-3 (5)	42.8			
10.0		A-7-6, CH, Rec. = 1.2 ft	woh/18"-2 (0)	51.6		0.6	99.4
12.5		A-7-6, CH, Rec. = 1.5 ft, (See Lab note)	1-1-1-1 (2)	48.7			
15.0		A-7-6, CL, Rec. = 1.3 ft	woh/12"-1-2 (1)	49.4		0.9	99.1
17.5		A-7-6, CL, Rec. = 1.3 ft, (See Lab note)	woh/12"-1-1 (1)	52.5			
		Hole stopped @ 18.0 ft					
20.0							
22.5							

Notes:
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STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

Culvert No. 63 N&S and 64 N&S
South Burlington,VT

IM CULV (24)

Boring No.: **B-3**
Page No.: 1 of 1
Pin No.: 11a216
Checked By: ASP

Boring Crew: Drilex/Terracon (CR)
Date Started: 1/29/14 Date Finished: 1/29/14
VTSPG NAD83: N 709830.36 ft E 1471193.23 ft
Station: 1943+26.43 Offset: 53.12RT
Ground Elevation: 333.0 ft

	Casing	Sampler
Type:	HSA	SS
I.D.:	4.25 in	2 in
Hammer Wt:	N.A.	140 lb.
Hammer Fall:	N.A.	N.A.
Hammer/Rod Type:	Auto	
Rig:	CME 55 ATV	C_E = 1.33

Groundwater Observations

Date	Depth (ft)	Notes
01/29/14	2.0	While sampling

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
		4-inches topsoil, Rec. = 1.3 ft A-4, SiSaGr	5-7-9-17 (16)	28.6	8.8	9.0	82.2
2.5		No recovery, Rec. = 0.0 ft	4-3-3-3 (6)				
5.0		A-7-5, CH, Rec. = 1.5 ft	2-3-4-6 (7)	36.9	0.1	3.1	96.8
7.5		A-7-5, CH, Rec. = 1.8 ft, (See Lab note)	4-6-6-6 (12)	39.3			
10.0		A-7-5, CH, Rec. = 1.2 ft	1-2-2-3 (4)	45.0		2.7	97.3
		A-7-5, CH, Rec. = 1.3 ft, (See Lab note)	woh/6"-2-2-2 (4)	42.6			
12.5		A-7-6, CH, Rec. = 1.4 ft	2-2-3-2 (5)	49.2		1.9	98.1
15.0		A-6, CL, Rec. = 1.7 ft, (See Lab note)	1-1-1-1 (2)	47.4			
17.5		A-6, CL, Rec. = 1.5 ft	woh/15"-1/3"-1 (1)	45.8		0.7	99.3
		Hole stopped @ 18.0 ft					
20.0							
22.5							

Notes:
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2. N Values have not been corrected for hammer energy. C_E is the hammer energy correction factor. C_E is an estimated value.
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STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

Culvert No. 63 N&S and 64 N&S
South Burlington,VT

IM CULV (24)

Boring No.: **B-4**
Page No.: 1 of 1
Pin No.: 11a216
Checked By: ASP

Boring Crew: Drilex/Terracon (CR)
Date Started: 1/29/14 Date Finished: 1/29/14
VTSPG NAD83: N 709729.65 ft E 1471171.44 ft
Station: 1943+28.39 Offset: 49.90LT
Ground Elevation: 335.0 ft

	Casing	Sampler
Type:	HSA	SS
I.D.:	4.25 in	2 in
Hammer Wt:	N.A.	140 lb.
Hammer Fall:	N.A.	N.A.
Hammer/Rod Type:	Auto	
Rig:	CME 55 ATV	C_E = 1.33

Groundwater Observations

Date	Depth (ft)	Notes
01/29/14	2.0	While sampling

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
		4-inches topsoil, Rec. = 0.6 ft A-4, SiSaGr	6-4-4-6 (8)	27.5	7.1	17.6	75.3
2.5		A-4, SiSaGr, Rec. = 0.4 ft	4-3-4-4 (7)	24.7	13.0	28.3	58.7
5.0		A-7-5, CH, Rec. = 1.3 ft, (See Lab note)	2-4-4-6 (8)	33.6			
7.5		A-7-5, CH, Rec. = 1.5 ft	4-5-7-5 (12)	38.9	3.7	2.7	93.6
		A-7-5, CH, Rec. = 1.6 ft, (See Lab note)	2-2-2-4 (4)	38.9			
10.0		A-7-6, CH, Rec. = 1.7 ft	1-1-2-3 (3)	52.3		1.3	98.7
12.5		A-7-6, CL, Rec. = 1.8 ft, (See Lab note)	2-2-2-2 (4)	49.1			
15.0		Shelby tube sample, Rec. = 2.0 ft					
17.5		A-7-6, CL, Rec. = 1.7 ft	woh/18"-2 (0)	53.1		0.7	99.3
		Hole stopped @ 18.0 ft					
20.0							
22.5							

Notes:
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STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

Culvert No. 63 N&S and 64 N&S
South Burlington,VT
IM CULV (24)

Boring No.: **B-5**
Page No.: 1 of 1
Pin No.: 11a216
Checked By: ASP

Boring Crew: Drilex/Terracon (TT)
Date Started: 1/30/14 Date Finished: 1/30/14
VTSPG NAD83: N 711372.10 ft E 1465763.84 ft
Station: 1999+99.37 Offset: 43.32RT
Ground Elevation: 312.0 ft

	Casing	Sampler
Type:	HSA	SS
I.D.:	4.25 in	2 in
Hammer Wt:	N.A.	140 lb.
Hammer Fall:	N.A.	N.A.
Hammer/Rod Type:	Auto	
Rig:	CME 55 ATV	C_E = 1.33

Groundwater Observations

Date	Depth (ft)	Notes
01/30/14		None Encountered

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
		4-inches topsoil, Rec. = 1.2 ft A-4, SiSaGr	5-6-9-7 (15)	20.4	14.8	32.6	52.6
2.5		A-4, SiSa, Rec. = 1.0 ft, (See Lab note)	6-5-5-5 (10)	19.6			
5.0		A-4, SiSa, Rec. = 1.5 ft	1-2-2-2 (4)	28.3	2.7	41.5	55.8
7.5		A-4, Si, Rec. = 1.2 ft, (See Lab note)	5-6-8-7 (14)	24.9		2.1	97.9
10.0		A-4, Si, Rec. = 1.7 ft	2-3-4-5 (7)	28.7			
12.5		A-4, Si, Rec. = 1.3 ft	woh-woh-2-2	27.7		0.7	99.3
15.0		A-4, Si, Rec. = 1.3 ft, (See Lab note)	4-4-4-5 (8)	27.4			
		Shelby tube sample, Rec. = 0.5 ft					
17.5		A-4, Si, Rec. = 1.5 ft	1-1-1-1 (2)	27.4		0.5	99.5
20.0		A-4, Si, Rec. = 1.5 ft, (See Lab note)	3-4-5-1 (9)	26.1			
22.5		Hole stopped @ 21.0 ft					

Notes:
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STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

Culvert No. 63 N&S and 64 N&S
South Burlington,VT

IM CULV (24)

Boring No.: **B-6**
Page No.: 1 of 1
Pin No.: 11a216
Checked By: ASP

Boring Crew: Drilex/Terracon (TT)
Date Started: 1/30/14 Date Finished: 1/30/14
VTSPG NAD83: N 711286.01 ft E 1465881.41 ft
Station: 1998+85.18 Offset: 47.27LT
Ground Elevation: 309.0 ft

	Casing	Sampler
Type:	HSA	SS
I.D.:	4.25 in	2 in
Hammer Wt:	N.A.	140 lb.
Hammer Fall:	N.A.	N.A.
Hammer/Rod Type:	Auto	
Rig:	CME 55 ATV	C_E = 1.33

Groundwater Observations

Date	Depth (ft)	Notes
01/30/14		None Encountered

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
		4-inches topsoil, Rec. = 0.7 ft A-4, SiSa, with wood and roots	3-3-3-3 (6)	28.3	3.0	25.4	71.6
2.5		A-4, Si, Rec. = 1.8 ft, (See Lab note)	3-3-3-4 (6)	23.7			
5.0		A-4, Si, Rec. = 1.5 ft	4-4-5-7 (9)	27.4	0.4	2.7	96.9
7.5		A-4, Si, Rec. = 1.3 ft, (See Lab note)	8-5-5-5 (10)	28.7			
10.0		A-4, Si, Rec. = 1.6 ft, (See Lab note)	woh-woh-2-3	29.2			
12.5		A-4, Si, Rec. = 1.0 ft	woh-woh-2	26.5		3.2	96.8
15.0		A-4, Si, Rec. = 2.0 ft, (See Lab note)	woh-2-3-2 (5)	32.8			
17.5		A-4, Si, Rec. = 1.7 ft	woh-woh-1-1	30.5		0.7	99.3
20.0		A-4, Si, Rec. = 1.8 ft, (See Lab note)	1-1-3-3 (4)	29.2			
22.5		A-4, Si, Rec. = 1.7 ft	2-2-3-3 (5)	28.7		0.6	99.4
		Hole stopped @ 20.0 ft					

Notes:
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STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

Culvert No. 63 N&S and 64 N&S
South Burlington,VT

IM CULV (24)

Boring No.: **B-7**
Page No.: 1 of 1
Pin No.: 11a216
Checked By: ASP

Boring Crew: Drilex/Terracon (CR)
Date Started: 1/28/14 Date Finished: 1/28/14
VTSPG NAD83: N 711155.96 ft E 1465909.80 ft
Station: 1998+10.40 Offset: 37.73RT
Ground Elevation: 312.0 ft

	Casing	Sampler
Type:	HSA	SS
I.D.:	4.25 in	2 in
Hammer Wt:	N.A.	140 lb.
Hammer Fall:	N.A.	N.A.
Hammer/Rod Type:	Auto	
Rig:	CME 55 ATV	C_E = 1.33

Groundwater Observations

Date	Depth (ft)	Notes
01/28/14	2.0	While sampling

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
		4-inches topsoil, Rec. = 0.8 ft A-4, SiSaGr	3-3-5-4 (8)	19.8	14.0	37.6	48.4
2.5		A-4, Si, Rec. = 1.5 ft, (See Lab note)	4-4-4-3 (8)	21.8			
5.0		A-4, Si, Rec. = 1.0 ft	2-4-4-5 (8)	28.4		2.5	97.5
7.5		A-4, Si, Rec. = 1.5 ft, (See Lab note)	6-6-8-6 (14)	26.3			
10.0		A-4, Si, Rec. = 0.5 ft	1-1-1-2 (2)	27.1		4.4	95.6
12.5		A-4, Si, Rec. = 1.3 ft, (See Lab note)	woh-1/3"-2	29.1			
15.0		A-4, Si, Rec. = 1.8 ft	1-1-1-1 (2)	34.5		0.6	99.4
		Shelby tube sample, Rec. = 2.0 ft					
17.5		A-7-6, CL, Rec. = 1.7 ft, (See Lab note)	woh/20"-2/4"	30.5			
20.0		A-7-6, CL, Rec. = 1.8 ft	3-4-5-5 (9)	35.9		1.5	98.5
22.5		Hole stopped @ 20.0 ft					

Notes:
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STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION

BORING LOG

Culvert No. 63 N&S and 64 N&S
South Burlington,VT

IM CULV (24)

Boring No.: **B-8**
Page No.: 1 of 1
Pin No.: 11a216
Checked By: ASP

Boring Crew: Drilex/Terracon (CR)
Date Started: 1/28/14 Date Finished: 1/28/14
VTSPG NAD83: N 711078.14 ft E 1466033.89 ft
Station: 1996+83.94 Offset: 34.21LT
Ground Elevation: 317.0 ft

	Casing	Sampler
Type:	HSA	SS
I.D.:	4.25 in	2 in
Hammer Wt:	N.A.	140 lb.
Hammer Fall:	N.A.	N.A.
Hammer/Rod Type:	Auto	
Rig:	CME 55 ATV	C_E = 1.33

Groundwater Observations

Date	Depth (ft)	Notes
01/28/14	5.0	While sampling

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
		A-1-b, SaGrSi, Rec. = 1.7 ft, (Fill)	12-22-23-21 (45)	16.0	28.5	50.6	20.9
2.5		A-2-4, SaGrSi, Rec. = 1.0 ft, (Fill)	7-7-11-10 (18)	12.6	14.9	70.9	14.2
		A-2-4, GrSaSi, (Fill)		11.4	39.8	34.3	25.9
5.0		A-4, SiSa, Rec. = 1.3 ft	6-8-7-8 (15)	15.4	4.8	31.1	64.1
7.5		A-4, SiSaGr, Rec. = 0.6 ft	4-4-3-3 (7)	14.0	22.6	30.6	46.8
10.0		A-2-4, SaSiGr, Rec. = 0.8 ft	2-4-5-6 (9)	14.7	26.7	41.6	31.7
12.5		A-6, CL, Rec. = 1.1 ft	1-3-4-5 (7)	25.2		21.0	79.0
		A-2-4, SaSi, Rec. = 1.7 ft	8-7-7-9 (14)	21.8	1.2	74.9	23.9
		A-4, Si		27.8		4.5	95.5
15.0		A-4, Si, Rec. = 1.8 ft	5-2-2-4 (4)	28.0		3.8	96.2
17.5		A-4, Si, Rec. = 1.3 ft	4-7-6-7 (13)	27.2		0.3	99.7
20.0		A-4, Si, Rec. = 0.8 ft, (See Lab note)	1-1-1-2 (2)	28.3			
		A-4, Si, Rec. = 1.5 ft	woh/6"-2-2-3 (4)	28.4		0.9	99.1
22.5		Hole stopped @ 22.0 ft					

Notes:
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APPENDIX B
LABORATORY TEST RESULTS

Vermont Agency of Transportation
Materials and Research Section
1 National Life Drive
Montpelier, VT 05633-5001

Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140140 **Corrected copy:** N/A **Report Date:** 2/6/2014 9:43:23 A
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/29/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1943+61. **Offset:** 53.09'RT **Hole:** B-1 **Depth:** 0 FT **to:** 2 FT
Field description: Si Sa
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS
Comment:

Test Results

T-88	Sieve Analysis % Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	97.3%
2.00 mm (#10):	94.2%
850 µm (#20):	91.0%
425 µm (#40):	85.3%
250 µm (#60):	78.4%
150 µm (#100):	72.9%
75 µm (#200):	67.7%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 48.6%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr: 5.8% **D2487:** ML
Sa: 26.5% **M145:** A-4 Sandy Silt
Si: 67.7%

Comments: LAB NOTE: WOOD & ROOTS WERE WITHIN SAMPLE.
A SMALL AREA OF CLAY MATERIAL WAS NOTICEABLE.
SAMPLE WAS NOT TESTED FOR LIMITS.

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Distribution list

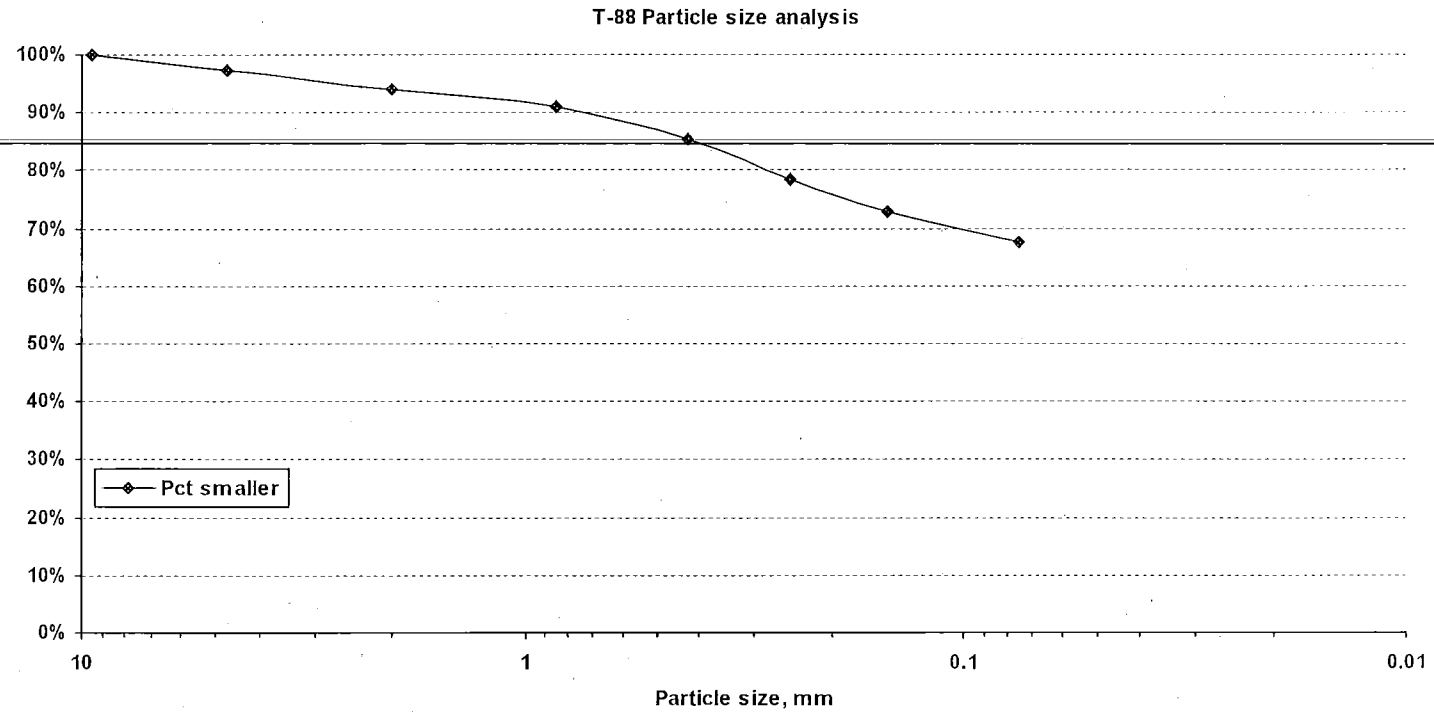
Vermont Agency of Transportation
Materials and Research Section
1 National Life Drive
Montpelier, VT 05633-5001

Report on Soil Sample

Lab number: E140140 **Corrected copy:** N/A **Report Date:** 2/6/2014 9:43:27 A

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-1 **Depth:** 0 FT - 2 FT



Vermont Agency of Transportation
Materials and Research Section
1 National Life Drive
Montpelier, VT 05633-5001

Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140141 **Corrected copy:** N/A **Report Date:** 2/6/2014 9:45:50 A
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64
Date sampled: 1/29/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1943+61. **Offset:** 53.09'RT **Hole:** B-1 **Depth:** 2 FT **to:** 4 FT
Field description: Si Cl
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS, AL
Comment:

Test Results

T-88	Sieve Analysis % Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	83.0%
4.75 mm (#4):	76.4%
2.00 mm (#10):	71.4%
850 µm (#20):	66.6%
425 µm (#40):	61.5%
250 µm (#60):	57.4%
150 µm (#100):	53.5%
75 µm (#200):	48.6%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content:	22.1%
T-89 Liquid Limit:	32
T-90 Plastic Limit:	20
T-90 Plasticity Index:	12

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr: 28.6% **D2487:** SC
Sa: 22.8% **M145:** A-6 Silty Clay
Si: 48.6%

Comments: LAB NOTE: BROKEN ROCK WAS WITHIN SAMPLE.

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Distribution list

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Materials and Research Section
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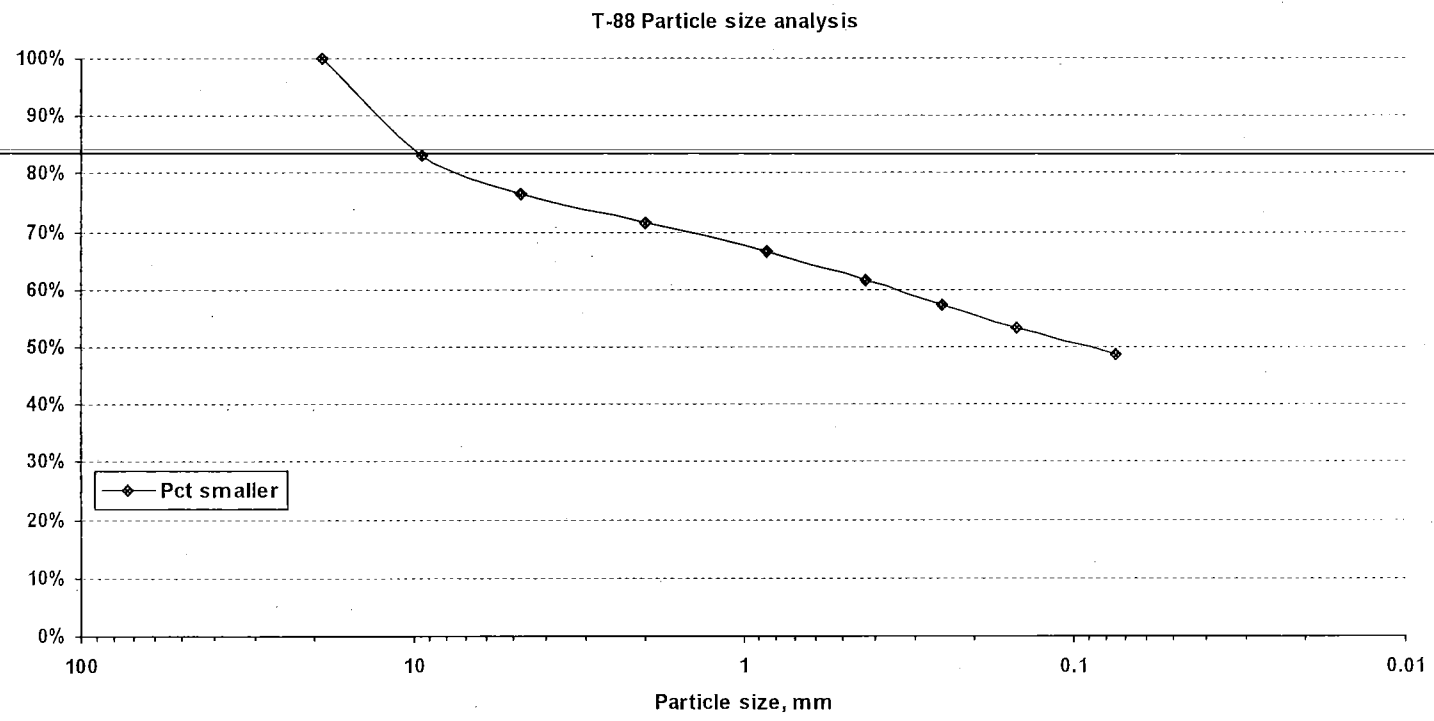
Montpelier, VT 05633-5001

Report on Soil Sample

Lab number: E140141 **Corrected copy:** N/A **Report Date:** 2/6/2014 9:45:55 A

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-1 **Depth:** 2 FT - 4 FT



Vermont Agency of Transportation
Materials and Research Section
1 National Life Drive
Montpelier, VT 05633-5001

Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140143 **Corrected copy:** N/A **Report Date:** 2/6/2014 9:52:51 A
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/29/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1943+61. **Offset:** 53.09'RT **Hole:** B-1 **Depth:** 6 FT **to:** 8 FT
Field description: Si Cl
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS, AL
Comment:

Test Results

T-88	Sieve Analysis % Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	100.0%
2.00 mm (#10):	100.0%
850 µm (#20):	
425 µm (#40):	99.5%
250 µm (#60):	98.6%
150 µm (#100):	97.9%
75 µm (#200):	97.3%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content:	39.3%
T-89 Liquid Limit:	40
T-90 Plastic Limit:	24
T-90 Plasticity Index:	16

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr: 0.0% **D2487:** CL
Sa: 2.7% **M145:** A-6 Silty Clay
Si: 97.3%

Comments:

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Distribution list

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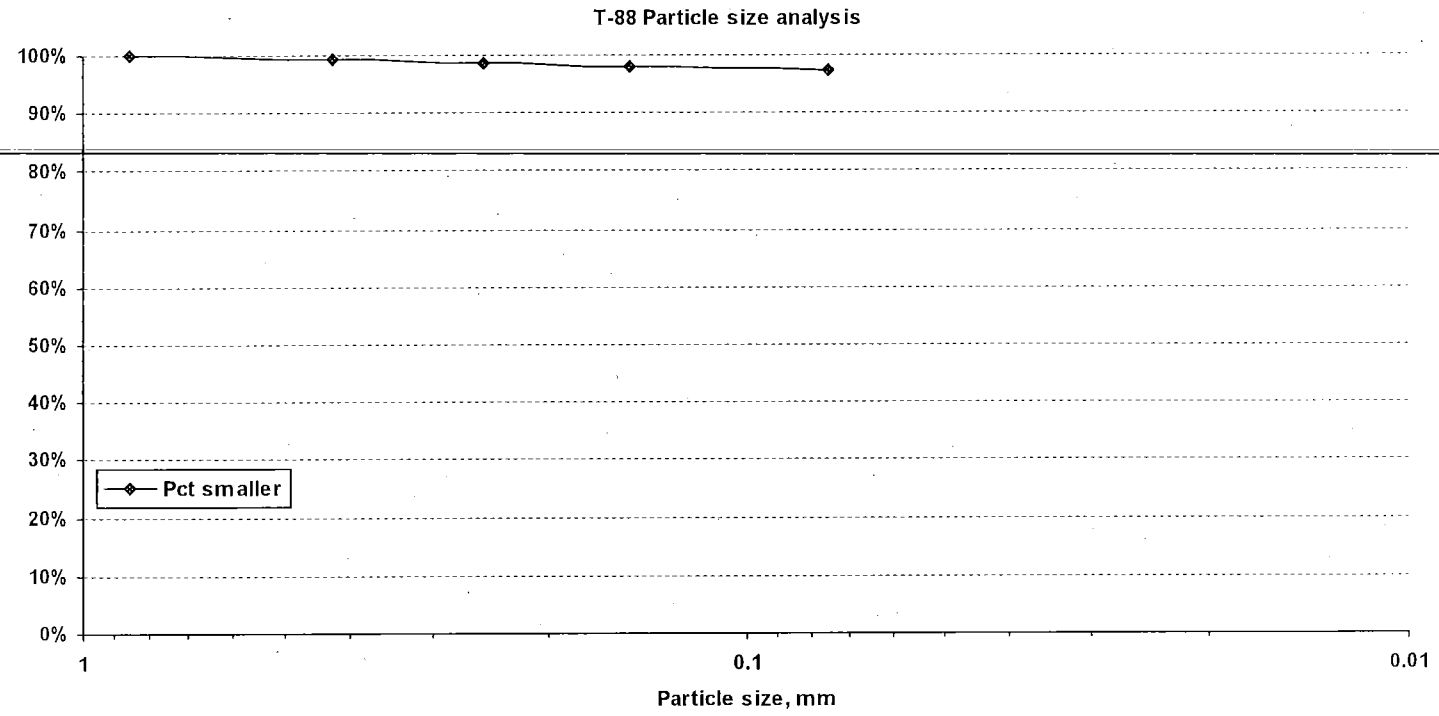
Materials and Research Section
1 National Life Drive
Montpelier, VT 05633-5001

Report on Soil Sample

Lab number: E140143 **Corrected copy:** N/A **Report Date:** 2/6/2014 9:52:55 A

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-1 **Depth:** 6 FT - 8 FT



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Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140142 **Corrected copy:** N/A **Report Date:** 2/18/2014 7:36:22 A
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/29/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1943+61. **Offset:** 53.09'RT **Hole:** B-1 **Depth:** 10 FT **to:** 12 FT
Field description: Si Cl
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS
Comment:

Test Results

Sieve Analysis

T-88	% Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	87.7%
9.5 mm (3/8"):	70.3%
4.75 mm (#4):	56.6%
2.00 mm (#10):	47.4%
850 µm (#20):	40.8%
425 µm (#40):	36.0%
250 µm (#60):	32.2%
150 µm (#100):	29.1%
75 µm (#200):	24.1%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 7.7%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: pcf
Optimum moisture:
T-100 Specific Gravity:

Gr: 52.6% **D2487:** GM
Sa: 23.3% **M145:** A-1-b Sandy Silty Gravel
Si: 24.1%

Comments: LAB NOTE: MOSTLY BROKEN ROCK WITH SAND, SILT, AND SOME CLAY. SAMPLE WAS NOT TESTED FOR LIMITS.

Reviewed by: T. Eliassen, P.G., Transportation Geologist

Distribution list

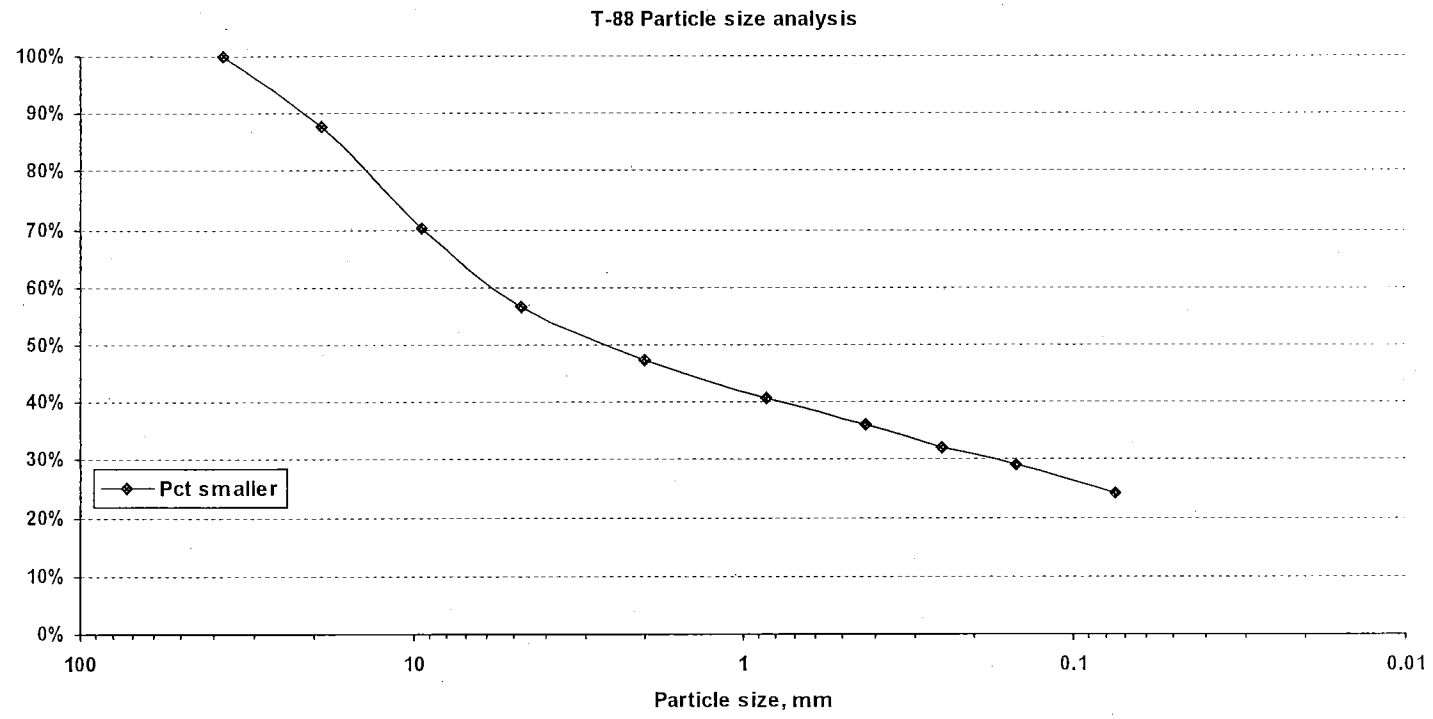
Vermont Agency of Transportation
Materials and Research Section
1 National Life Drive
Montpelier, VT 05633-5001

Report on Soil Sample

Lab number: E140142 **Corrected copy:** N/A **Report Date:** 2/18/2014 7:36:28 A

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-1 **Depth:** 10 FT - 12 FT



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Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140144 **Corrected copy:** N/A **Report Date:** 2/6/2014 9:56:43 A
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/29/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1943+61. **Offset:** 53.09'RT **Hole:** B-1 **Depth:** 12 FT **to:** 14 FT
Field description: CLAY
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS, AL
Comment:

Test Results

Sieve Analysis

T-88	% Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	97.8%
9.5 mm (3/8"):	92.4%
4.75 mm (#4):	85.4%
2.00 mm (#10):	79.5%
850 µm (#20):	73.6%
425 µm (#40):	67.4%
250 µm (#60):	61.1%
150 µm (#100):	54.6%
75 µm (#200):	45.1%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 11.2%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: pcf
Optimum moisture:
T-100 Specific Gravity:

Gr: 20.5% **D2487:** SM
Sa: 34.4% **M145:** A-4 Gravelly Sandy Silt
Si: 45.1%

Comments: LAB NOTE: A SMALL AREA OF CLAY WAS NOTICEABLE.
SAMPLE TESTED: (NP)

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Distribution list

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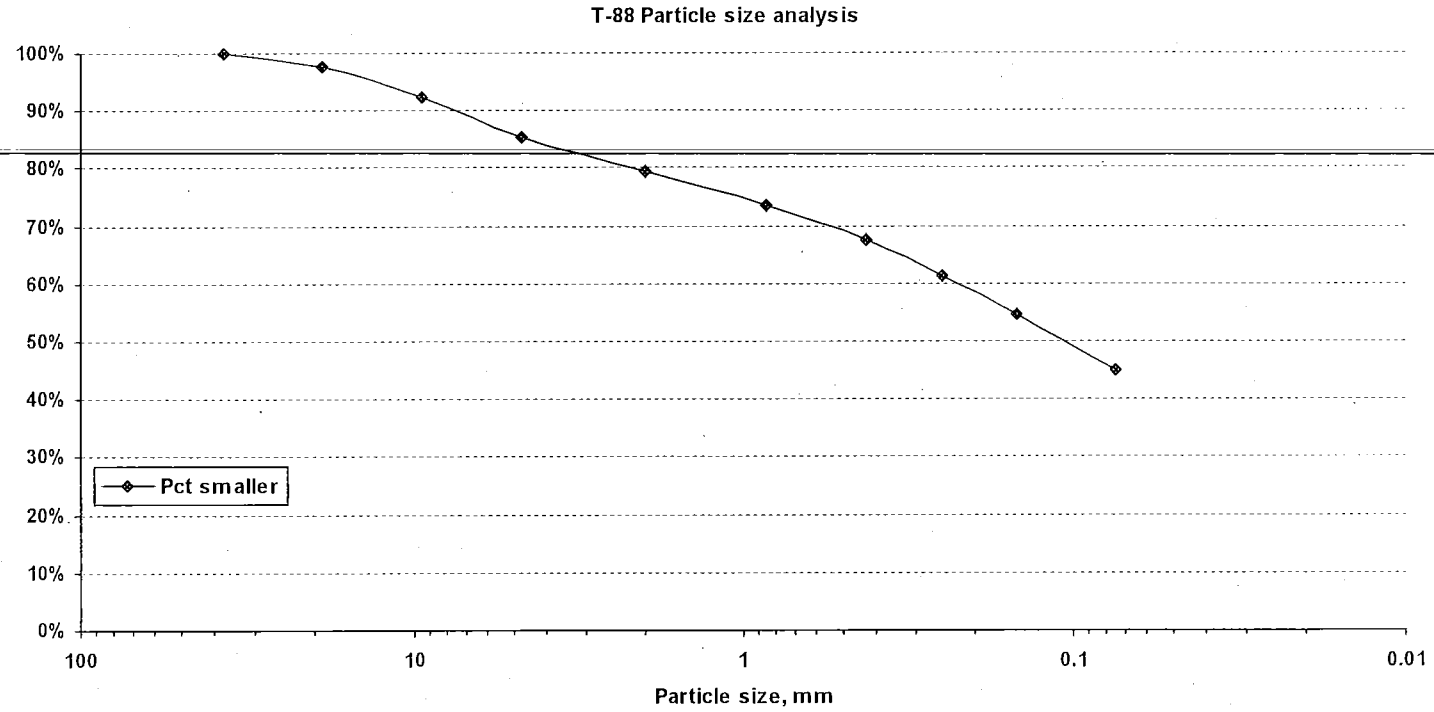
Report on Soil Sample

Lab number: E140144 **Corrected copy:** N/A **Report Date:** 2/6/2014 9:56:46 A

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-1 **Depth:** 12 FT - 14 FT



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Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140145 **Corrected copy:** N/A **Report Date:** 2/6/2014 9:59:14 A
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/29/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1943+61. **Offset:** 53.09'RT **Hole:** B-1 **Depth:** 14 FT **to:** 16 FT
Field description: Si Sa
Submitted by: TERRACON **Address:**
~~**Sample type:** SPLIT BARREL~~ ~~**Quantity:**~~
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS, AL
Comment:

Test Results

Sieve Analysis

T-88	% Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	95.2%
9.5 mm (3/8"):	84.5%
4.75 mm (#4):	73.2%
2.00 mm (#10):	60.4%
850 µm (#20):	50.1%
425 µm (#40):	39.9%
250 µm (#60):	31.4%
150 µm (#100):	25.2%
75 µm (#200):	18.6%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 7.9%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr: 39.6% **D2487:** SM
Sa: 41.8% **M145:** A-1-b Gravelly Sand
Si: 18.6%

Comments:

Reviewed by: T. Eliassen, P.G., Transportation Geologist

Distribution list

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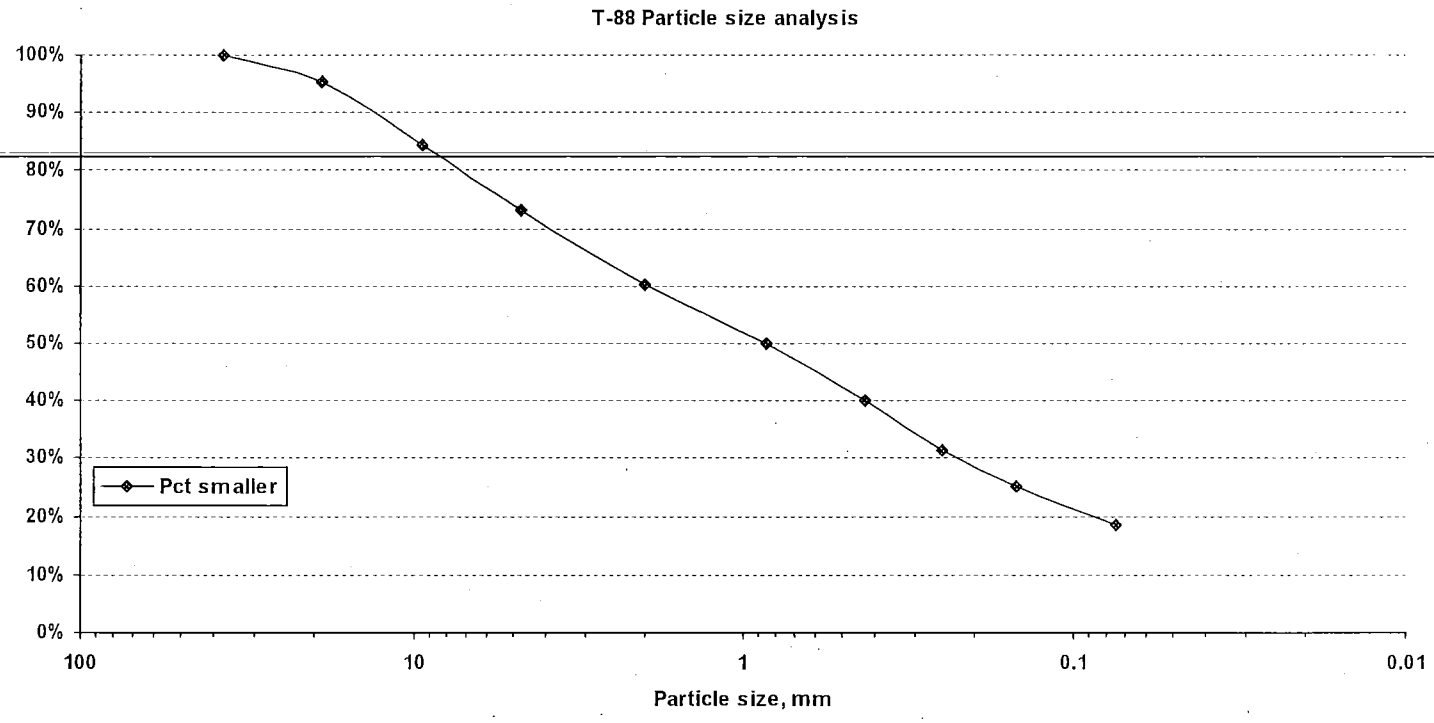
Montpelier, VT 05633-5001

Report on Soil Sample

Lab number: E140145 **Corrected copy:** N/A **Report Date:** 2/6/2014 9:59:18 A

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-1 **Depth:** 14 FT - 16 FT



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Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140146 **Corrected copy:** N/A **Report Date:** 2/6/2014 10:00:45 A
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/29/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1943+61. **Offset:** 53.09'RT **Hole:** B-1 **Depth:** 16 FT **to:** 18 FT
Field description: Si Sa
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS, AL
Comment:

Test Results

T-88	Sieve Analysis % Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	82.5%
9.5 mm (3/8"):	82.2%
4.75 mm (#4):	77.4%
2.00 mm (#10):	71.3%
850 µm (#20):	63.8%
425 µm (#40):	55.7%
250 µm (#60):	46.6%
150 µm (#100):	37.2%
75 µm (#200):	26.5%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 15.0%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr: 28.7% **D2487:** SM
Sa: 44.8% **M145:** A-2-4 Silty Gravelly Sand
Si: 26.5%

Comments:

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Distribution list

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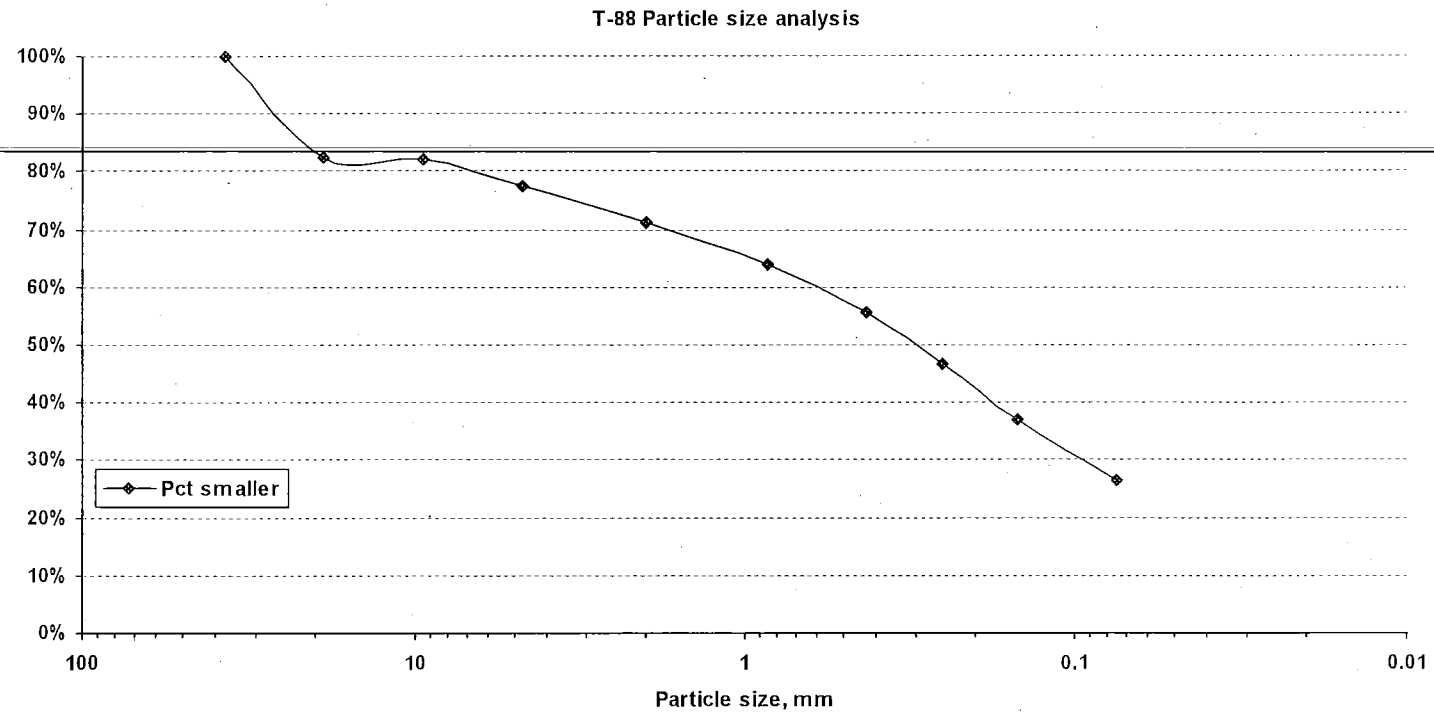
Materials and Research Section
1 National Life Drive
Montpelier, VT 05633-5001

Report on Soil Sample

Lab number: E140146 **Corrected copy:** N/A **Report Date:** 2/6/2014 10:00:50 A

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-1 **Depth:** 16 FT - 18 FT



Vermont Agency of Transportation
Materials and Research Section
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Montpelier, VT 05633-5001

Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140147 **Corrected copy:** N/A **Report Date:** 2/6/2014 10:02:20 A
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/29/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1943+61. **Offset:** 53.09'RT **Hole:** B-1 **Depth:** 18 FT **to:** 20 FT
Field description: Si Sa
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS, AL
Comment:

Test Results

Sieve Analysis

T-88	% Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	86.7%
4.75 mm (#4):	76.5%
2.00 mm (#10):	66.9%
850 µm (#20):	58.9%
425 µm (#40):	50.8%
250 µm (#60):	43.9%
150 µm (#100):	37.5%
75 µm (#200):	28.3%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 9.6%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: pcf
Optimum moisture:
T-100 Specific Gravity:

Gr: 33.1% **D2487:** SM
Sa: 38.6% **M145:** A-2-4 Silty Gravelly Sand
Si: 28.3%

Comments:

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Distribution list

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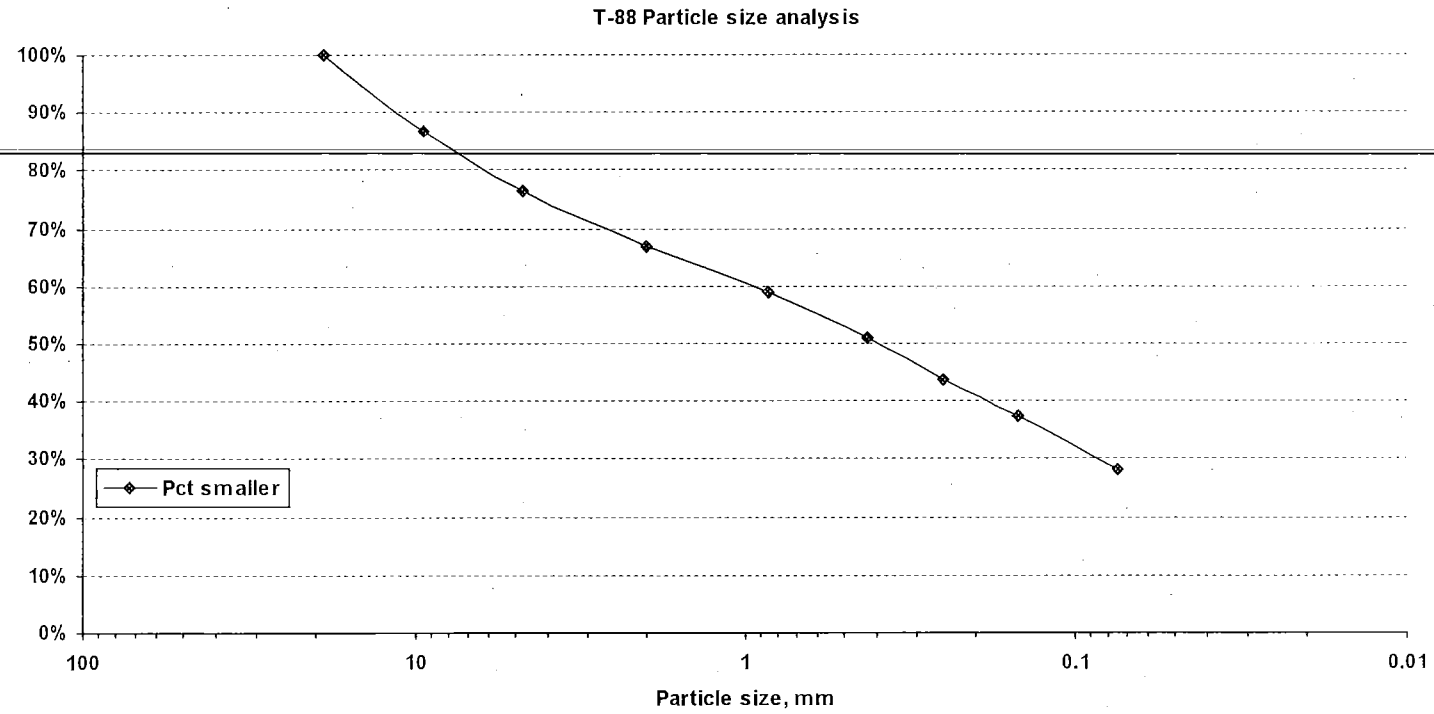
Report on Soil Sample

Lab number: E140147 **Corrected copy:** N/A **Report Date:** 2/6/2014 10:02:24 A

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-1 **Depth:** 18 FT - 20 FT



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Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140148 **Corrected copy:** N/A **Report Date:** 2/6/2014 10:05:50 A
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/29/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1943+93. **Offset:** 53.82'LT **Hole:** B-2 **Depth:** 0 FT **to:** 2 FT
Field description: Si Sa
Submitted by: TERRACON **Address:**
~~**Sample type:** SPLIT BARREL **Quantity:**~~
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS
Comment:

Test Results

Sieve Analysis

T-88	% Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	95.5%
2.00 mm (#10):	90.5%
850 µm (#20):	84.6%
425 µm (#40):	78.3%
250 µm (#60):	71.1%
150 µm (#100):	63.6%
75 µm (#200):	53.9%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 30.4%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr: 9.5% **D2487:** ML
Sa: 36.7% **M145:** A-4 Sandy Silt
Si: 53.9%

Comments: LAB NOTE: A SMALL AREA OF CLAY WAS NOTICEABLE
SAMPLE WAS NOT TESTED FOR LIMITS.

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Distribution list

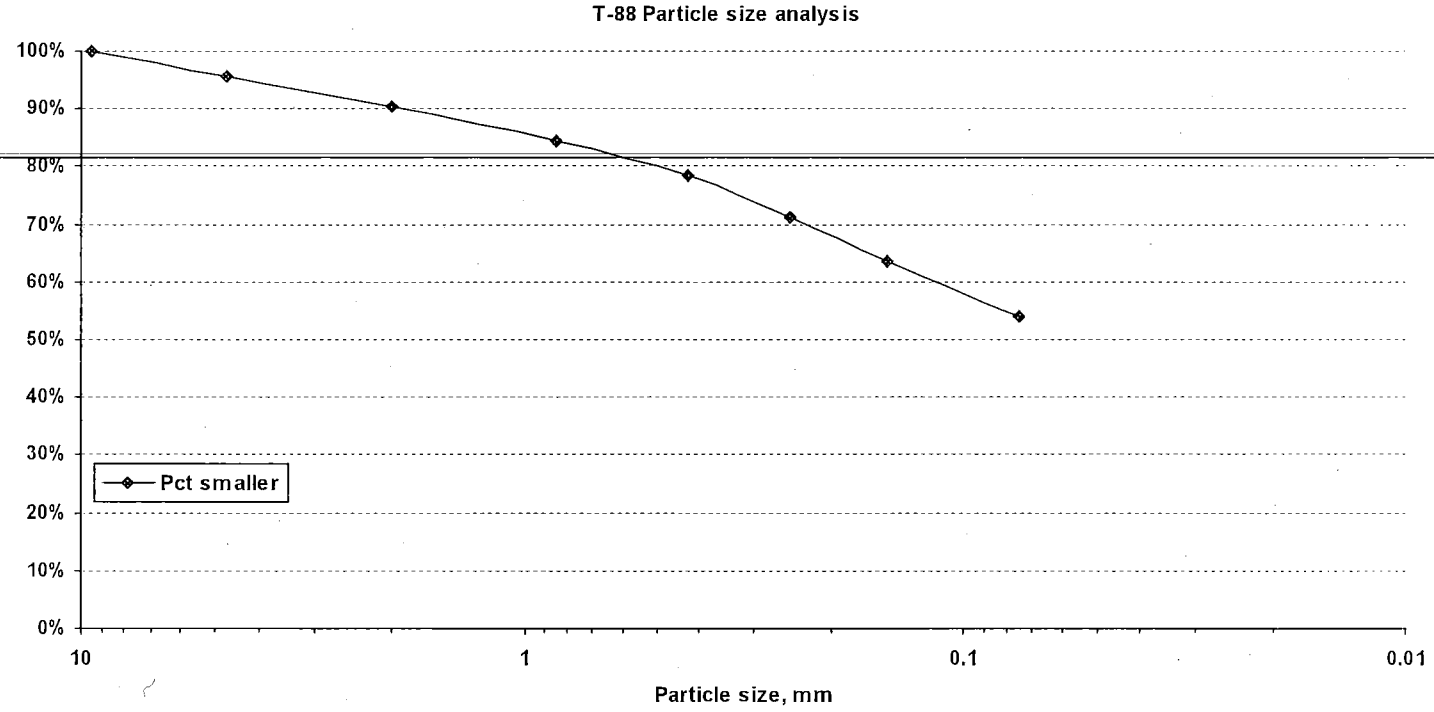
Vermont Agency of Transportation
Materials and Research Section
1 National Life Drive
Montpelier, VT 05633-5001

Report on Soil Sample

Lab number: E140148 **Corrected copy:** N/A **Report Date:** 2/6/2014 10:05:53 A

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-2 **Depth:** 0 FT - 2 FT



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Materials and Research Section
1 National Life Drive
Montpelier, VT 05633-5001

Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140149 **Corrected copy:** N/A **Report Date:** 2/6/2014 10:08:44 A
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/29/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1943+93. **Offset:** 53.82'LT **Hole:** B-2 **Depth:** 2 FT **to:** 4 FT
Field description: Si Cl
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS, AL
Comment:

Test Results

T-88	Sieve Analysis % Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	98.6%
2.00 mm (#10):	97.3%
850 µm (#20):	94.3%
425 µm (#40):	90.5%
250 µm (#60):	86.5%
150 µm (#100):	82.5%
75 µm (#200):	76.3%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content:	35.3%
T-89 Liquid Limit:	35
T-90 Plastic Limit:	26
T-90 Plasticity Index:	9

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr:	2.7%	D2487:	ML	
Sa:	21.0%	M145:	A-4	Clayey Silt
Si:	76.3%			

Comments:

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Distribution list

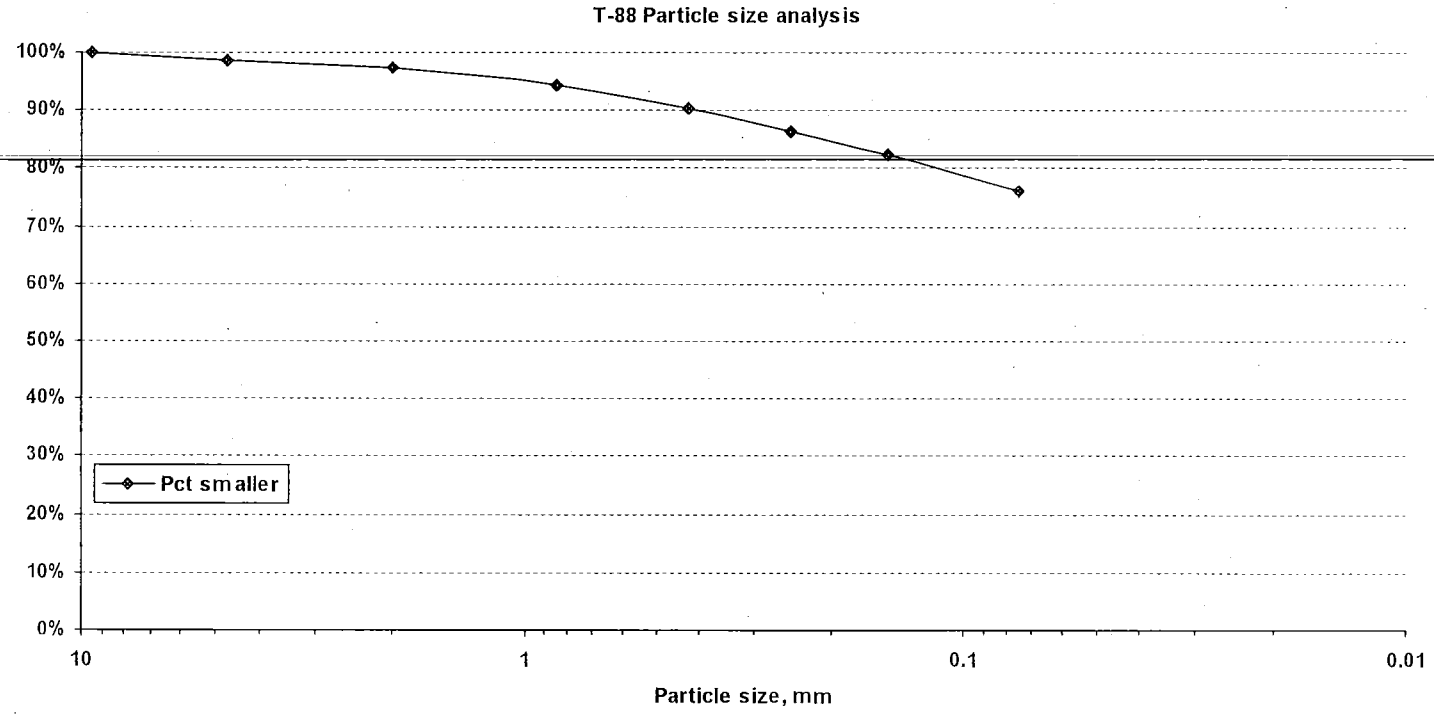
Vermont Agency of Transportation
Materials and Research Section
1 National Life Drive
Montpelier, VT 05633-5001

Report on Soil Sample

Lab number: E140149 **Corrected copy:** N/A **Report Date:** 2/6/2014 10:08:47 A

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-2 **Depth:** 2 FT - 4 FT



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Materials and Research Section
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Montpelier, VT 05633-5001

Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140150 **Corrected copy:** N/A **Report Date:** 2/6/2014 10:12:43 A
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/29/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1943+93. **Offset:** 53.82'LT **Hole:** B-2 **Depth:** 4 FT **to:** 6 FT
Field description: Si Cl
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC
Comment:

Test Results

T-88	Sieve Analysis % Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	
2.00 mm (#10):	
850 µm (#20):	
425 µm (#40):	
250 µm (#60):	
150 µm (#100):	
75 µm (#200):	

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 38.0%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: pcf
Optimum moisture:
T-100 Specific Gravity:

Gr: **D2487:** N/A
Sa: **M145:** N/A
Si:

Comments: LAB NOTE: MATERIAL WAS SIMILAR AS 2-4 FT.
SAMPLE WAS NOT TESTED FOR LIMITS. TE

Reviewed by: T. Eliassen, P.G., Transportation Geologist

Vermont Agency of Transportation
Materials and Research Section
1 National Life Drive
Montpelier, VT 05633-5001

Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140151 **Corrected copy:** N/A **Report Date:** 2/6/2014 10:15:29 A
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/29/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1943+93. **Offset:** 53.82'LT **Hole:** B-2 **Depth:** 6 FT **to:** 8 FT
Field description: Si Cl
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS, AL
Comment:

Test Results

T-88	Sieve Analysis % Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	97.9%
2.00 mm (#10):	97.4%
850 µm (#20):	97.0%
425 µm (#40):	96.5%
250 µm (#60):	96.0%
150 µm (#100):	95.6%
75 µm (#200):	94.9%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content:	38.5%
T-89 Liquid Limit:	47
T-90 Plastic Limit:	24
T-90 Plasticity Index:	23

Moisture Density

Test method: T-180 **Method:**
Maximum density: pcf
Optimum moisture:
T-100 Specific Gravity:

Gr: 2.6% **D2487:** CL
Sa: 2.5% **M145:** A-7-6 Clay
Si: 94.9%

Comments:

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Distribution list

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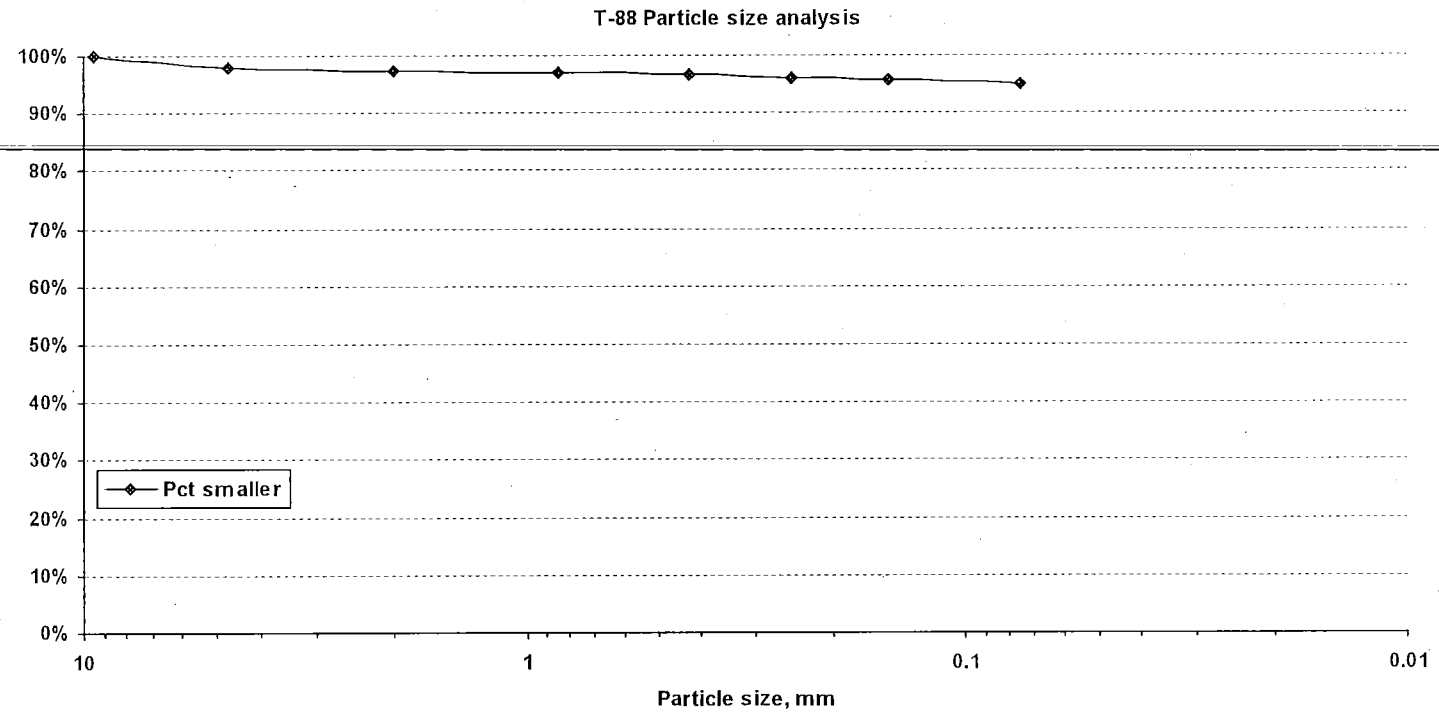
Materials and Research Section
1 National Life Drive
Montpelier, VT 05633-5001

Report on Soil Sample

Lab number: E140151 **Corrected copy:** N/A **Report Date:** 2/6/2014 10:15:32 A

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-2 **Depth:** 6 FT - 8 FT



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Materials and Research Section
1 National Life Drive
Montpelier, VT 05633-5001

Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140152 **Corrected copy:** N/A **Report Date:** 2/6/2014 10:17:47 A
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/29/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1943+93. **Offset:** 53.82'LT **Hole:** B-2 **Depth:** 8 FT **to:** 10 FT
Field description: Si Cl
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC
Comment:

Test Results

T-88	Sieve Analysis % Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	
2.00 mm (#10):	
850 µm (#20):	
425 µm (#40):	
250 µm (#60):	
150 µm (#100):	
75 µm (#200):	

Hydrometer Analysis Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 42.8%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr: **D2487:** N/A
Sa: **M145:** N/A
Si:

Comments: LAB NOTE: MATERIAL WAS SIMILAR AS 6-8 FT.
SAMPLE WAS NOT TESTED FOR LIMITS.

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

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Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140153 **Corrected copy:** N/A **Report Date:** 2/6/2014 10:19:56 A
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/29/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1943+93. **Offset:** 53.82'LT **Hole:** B-2 **Depth:** 10 FT **to:** 12 FT
Field description: CLAY
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS, AL
Comment:

Test Results

T-88	Sieve Analysis % Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	100.0%
2.00 mm (#10):	100.0%
850 µm (#20):	
425 µm (#40):	
250 µm (#60):	99.9%
150 µm (#100):	99.7%
75 µm (#200):	99.4%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content:	51.6%
T-89 Liquid Limit:	60
T-90 Plastic Limit:	27
T-90 Plasticity Index:	33

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr: 0.0% **D2487:** CH
Sa: 0.6% **M145:** A-7-6 Clay
Si: 99.4%

Comments:

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Distribution list

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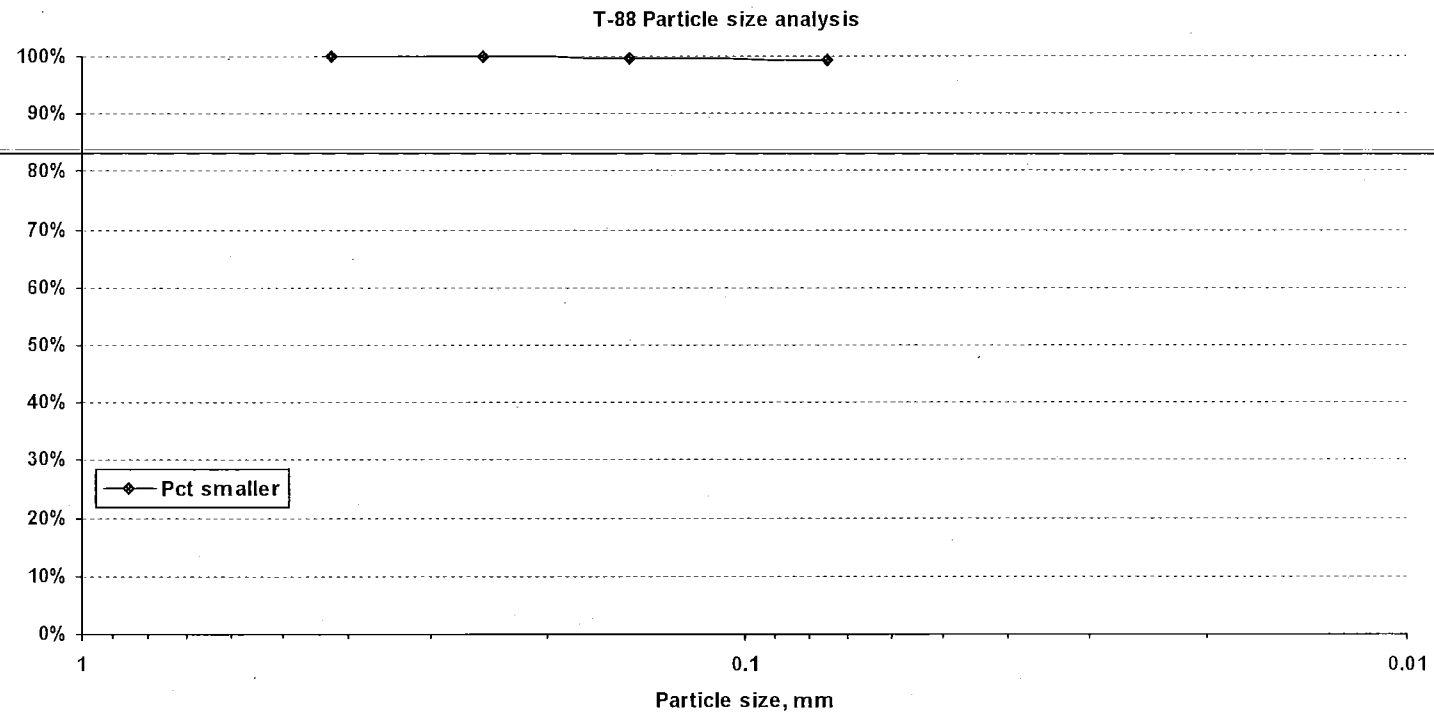
Montpelier, VT 05633-5001

Report on Soil Sample

Lab number: E140153 **Corrected copy:** N/A **Report Date:** 2/6/2014 10:20:00 A

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-2 **Depth:** 10 FT - 12 FT



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Materials and Research Section
1 National Life Drive
Montpelier, VT 05633-5001

Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140154 **Corrected copy:** N/A **Report Date:** 2/6/2014 10:21:43 A
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/29/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1943+93. **Offset:** 53.82'LT **Hole:** B-2 **Depth:** 12 FT **to:** 14 FT
Field description: CLAY
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC
Comment:

Test Results

Sieve Analysis

T-88	% Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	
2.00 mm (#10):	
850 µm (#20):	
425 µm (#40):	
250 µm (#60):	
150 µm (#100):	
75 µm (#200):	

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 48.7%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr: **D2487:** N/A
Sa: **M145:** N/A
Si:

Comments: LAB NOTE: MATERIAL WAS SIMILAR AS 14-16 FT.
SAMPLE WAS NOT TESTED FOR LIMITS.

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

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Materials and Research Section
1 National Life Drive
Montpelier, VT 05633-5001

Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140155 **Corrected copy:** N/A **Report Date:** 2/6/2014 10:23:37 A
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/29/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1943+93. **Offset:** 53.82'LT **Hole:** B-2 **Depth:** 14 FT **to:** 16 FT
Field description: CLAY
Submitted by: TERRACON **Address:**
~~**Sample type:** SPLIT BARREL~~ ~~**Quantity:**~~
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS, AL
Comment:

Test Results

T-88	Sieve Analysis % Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	100.0%
2.00 mm (#10):	100.0%
850 µm (#20):	
425 µm (#40):	
250 µm (#60):	99.9%
150 µm (#100):	99.5%
75 µm (#200):	99.1%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content:	49.4%
T-89 Liquid Limit:	47
T-90 Plastic Limit:	24
T-90 Plasticity Index:	23

Moisture Density

Test method: T-180 **Method:**
Maximum density: pcf
Optimum moisture:
T-100 Specific Gravity:

Gr: 0.0% **D2487:** CL
Sa: 0.9% **M145:** A-7-6 Clay
Si: 99.1%

Comments:

Reviewed by: T. Eliassen, P.G., Transportation Geologist

Distribution list

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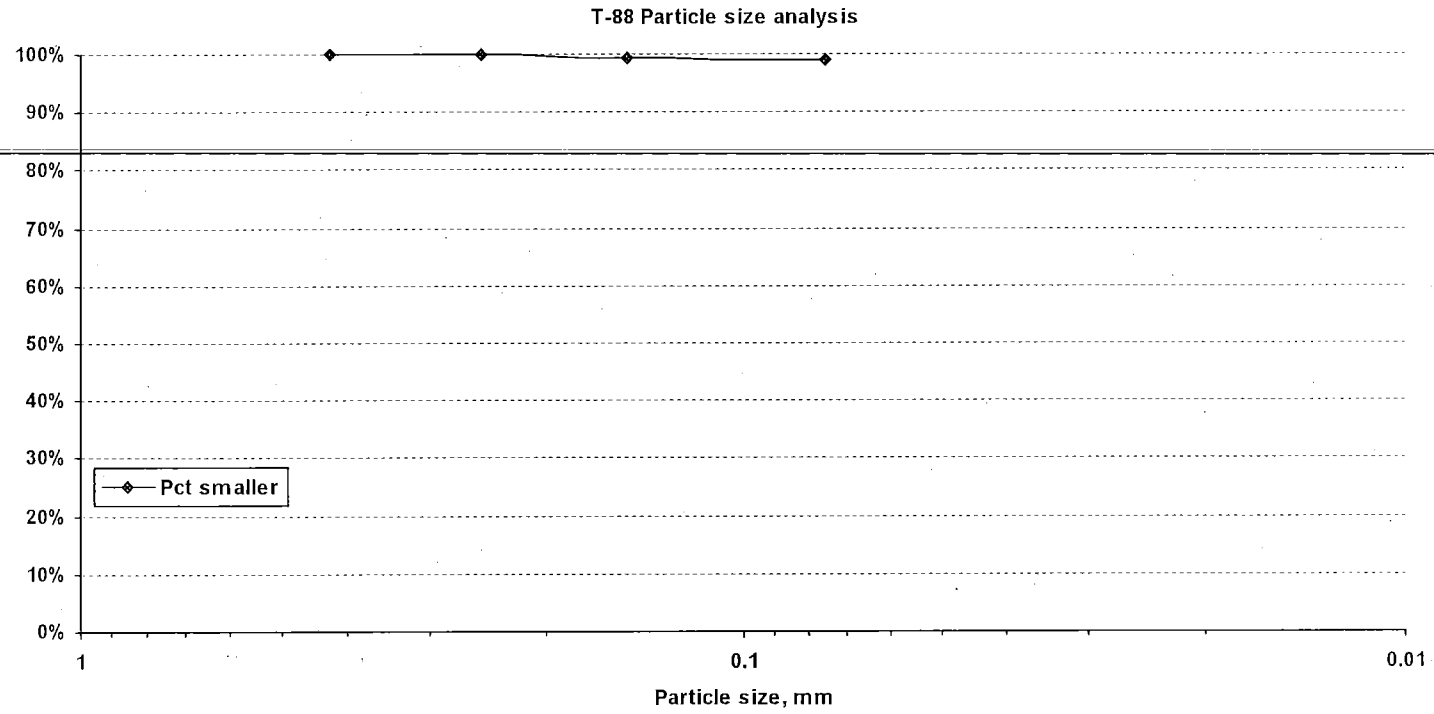
Report on Soil Sample

Lab number: E140155 **Corrected copy:** N/A **Report Date:** 2/6/2014 10:23:42 A

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-2 **Depth:** 14 FT - 16 FT



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Montpelier, VT 05633-5001

Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140156 **Corrected copy:** N/A **Report Date:** 2/6/2014 10:25:28 A
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/29/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1943+93. **Offset:** 53.82'LT **Hole:** B-2 **Depth:** 16 FT **to:** 18 FT
Field description: CLAY
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC
Comment:

Test Results

Sieve Analysis

T-88	% Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	
2.00 mm (#10):	
850 µm (#20):	
425 µm (#40):	
250 µm (#60):	
150 µm (#100):	
75 µm (#200):	

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 52.5%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr: **D2487:** N/A
Sa: **M145:** N/A
Si:

Comments: LAB NOTE: MATERIAL WAS SIMILAR AS 14-16 FT.
SAMPLE WAS NOT TESTED FOR LIMITS.

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Vermont Agency of Transportation
Materials and Research Section
1 National Life Drive
Montpelier, VT 05633-5001

Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140157 **Corrected copy:** N/A **Report Date:** 2/6/2014 10:27:48 A
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64
Date sampled: 1/29/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1943+26. **Offset:** 53.12'RT **Hole:** B-3 **Depth:** 0 FT **to:** 2 FT
Field description: Si Sa
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS, AL
Comment:

Test Results

T-88	Sieve Analysis % Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	94.8%
4.75 mm (#4):	92.6%
2.00 mm (#10):	91.2%
850 µm (#20):	90.0%
425 µm (#40):	88.4%
250 µm (#60):	86.5%
150 µm (#100):	85.1%
75 µm (#200):	82.2%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 28.6%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr: 8.8% **D2487:** ML
Sa: 8.9% **M145:** A-4 Silt
Si: 82.2%

Comments: LAB NOTE: BROKEN ROCK WAS WITHIN SAMPLE.

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Distribution list

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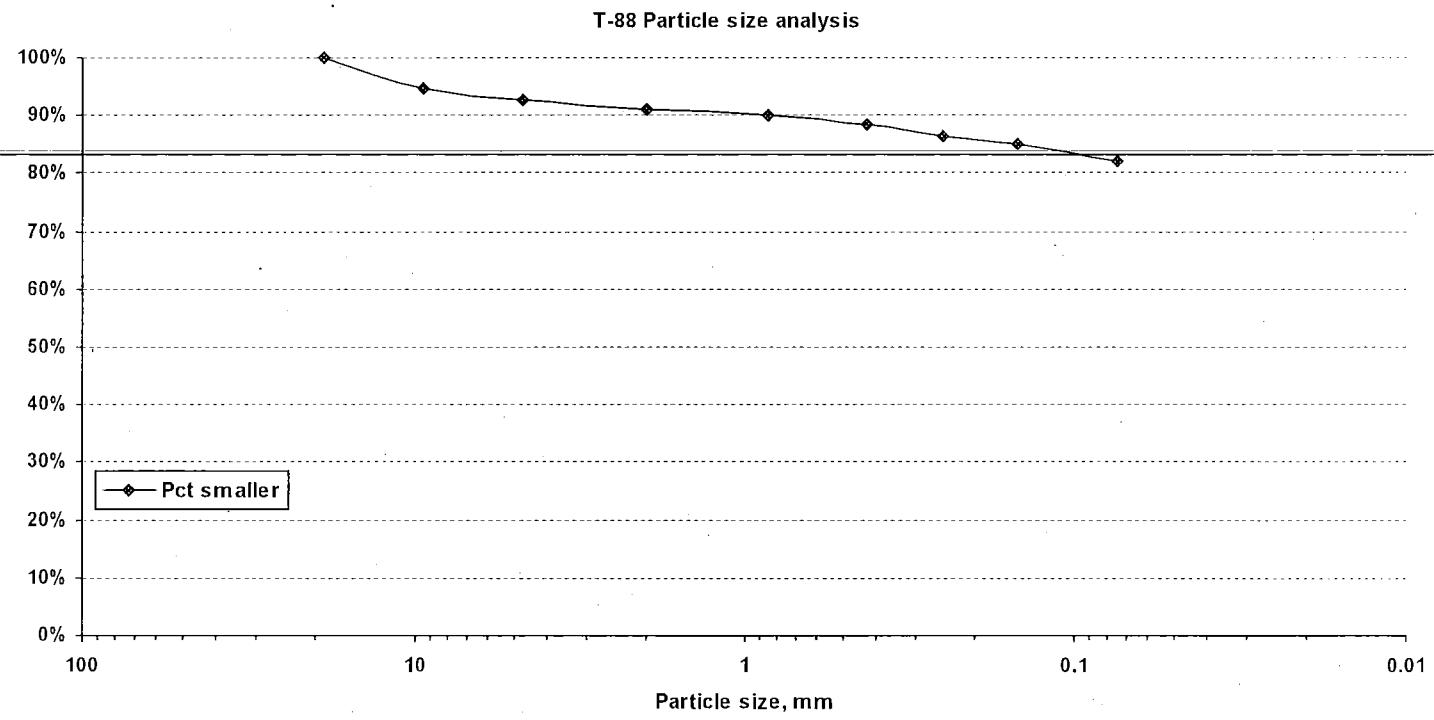
Montpelier, VT 05633-5001

Report on Soil Sample

Lab number: E140157 **Corrected copy:** N/A **Report Date:** 2/6/2014 10:27:54 A

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-3 **Depth:** 0 FT - 2 FT



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Materials and Research Section
1 National Life Drive
Montpelier, VT 05633-5001

Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140158 **Corrected copy:** N/A **Report Date:** 2/18/2014 7:38:47 A
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/29/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1943+26. **Offset:** 53.12'RT **Hole:** B-3 **Depth:** 4 FT **to:** 6 FT
Field description: Si Cl
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS, AL
Comment:

Test Results

T-88	Sieve Analysis % Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	100.0%
2.00 mm (#10):	99.9%
850 µm (#20):	99.6%
425 µm (#40):	98.6%
250 µm (#60):	98.1%
150 µm (#100):	97.5%
75 µm (#200):	96.8%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content:	36.9%
T-89 Liquid Limit:	64
T-90 Plastic Limit:	33
T-90 Plasticity Index:	31

Moisture Density

Test method: T-180 **Method:**
Maximum density: pcf
Optimum moisture:
T-100 Specific Gravity:

Gr: 0.1% **D2487:** CH
Sa: 3.0% **M145:** A-7-5 Clay
Si: 96.8%

Comments:

Reviewed by: T. Eliassen, P.G., Transportation Geologist

Distribution list

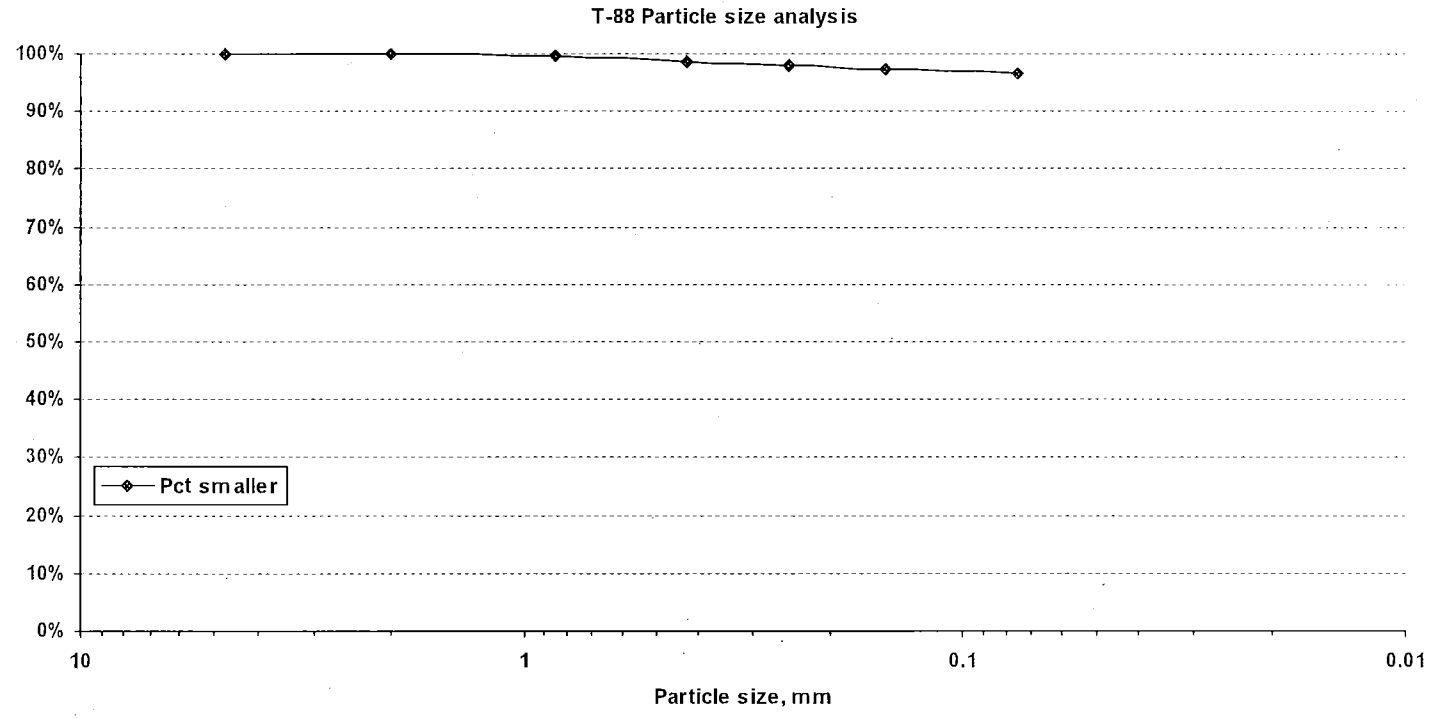
Vermont Agency of Transportation
Materials and Research Section
1 National Life Drive
Montpelier, VT 05633-5001

Report on Soil Sample

Lab number: E140158 **Corrected copy:** N/A **Report Date:** 2/18/2014 7:38:51 A

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-3 **Depth:** 4 FT - 6 FT



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Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140159 **Corrected copy:** N/A **Report Date:** 2/6/2014 10:40:22 A
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/29/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1943+26.. **Offset:** 53.12'RT **Hole:** B-3 **Depth:** 6 FT **to:** 8 FT
Field description: Si Cl
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC
Comment:

Test Results

Sieve Analysis

T-88	% Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	
2.00 mm (#10):	
850 µm (#20):	
425 µm (#40):	
250 µm (#60):	
150 µm (#100):	
75 µm (#200):	

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 39.3%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: pcf
Optimum moisture:
T-100 Specific Gravity:

Gr: **D2487:** N/A
Sa: **M145:** N/A
Si:

Comments: LAB NOTE: MATERIAL WAS SIMILAR AS 4-6 FT.
SAMPLE WAS NOT TESTED FOR LIMITS.

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Vermont Agency of Transportation
Materials and Research Section
1 National Life Drive
Montpelier, VT 05633-5001

Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140160 **Corrected copy:** N/A **Report Date:** 2/6/2014 10:42:31 A
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/29/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1943+26. **Offset:** 53.12'RT **Hole:** B-3 **Depth:** 8 FT **to:** 10 FT
Field description: Si Cl
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS, AL
Comment:

Test Results

T-88	Sieve Analysis % Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	100.0%
2.00 mm (#10):	100.0%
850 µm (#20):	99.7%
425 µm (#40):	99.3%
250 µm (#60):	98.5%
150 µm (#100):	97.9%
75 µm (#200):	97.3%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content:	45.0%
T-89 Liquid Limit:	74
T-90 Plastic Limit:	32
T-90 Plasticity Index:	42

Moisture Density

Test method: T-180 **Method:**
Maximum density: pcf
Optimum moisture:
T-100 Specific Gravity:

Gr: 0.0% **D2487:** CH
Sa: 2.7% **M145:** A-7-5 Clay
Si: 97.3%

Comments:

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Distribution list

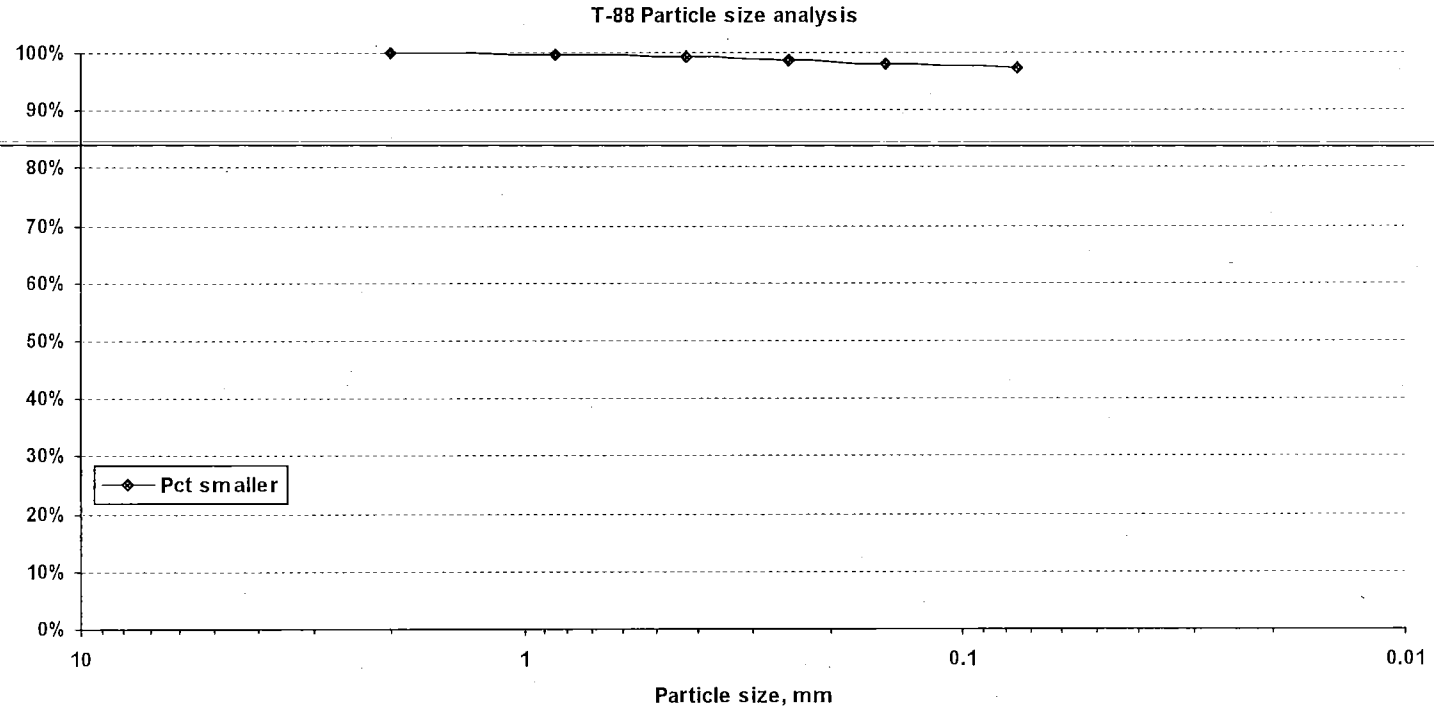
Vermont Agency of Transportation
Materials and Research Section
1 National Life Drive
Montpelier, VT 05633-5001

Report on Soil Sample

Lab number: E140160 **Corrected copy:** N/A **Report Date:** 2/6/2014 10:42:37 A

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-3 **Depth:** 8 FT - 10 FT



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Montpelier, VT 05633-5001

Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140161 **Corrected copy:** N/A **Report Date:** 2/6/2014 10:44:08 A
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/29/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1943+26. **Offset:** 53.12'RT **Hole:** B-3 **Depth:** 10 FT **to:** 12 FT
Field description: CLAY
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC
Comment:

Test Results

Sieve Analysis

T-88	% Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	
2.00 mm (#10):	
850 µm (#20):	
425 µm (#40):	
250 µm (#60):	
150 µm (#100):	
75 µm (#200):	

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 42.6%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: pcf
Optimum moisture:
T-100 Specific Gravity:

Gr: **D2487:** N/A
Sa: **M145:** N/A
Si:

Comments: LAB NOTE: MATERIAL WAS SIMILAR AS 8-10 FT.
SAMPLE WAS NOT TESTED FOR LIMITS.

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

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Materials and Research Section
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Montpelier, VT 05633-5001

Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140162 **Corrected copy:** N/A **Report Date:** 2/6/2014 10:46:14 A
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64
Date sampled: 1/29/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1943+26. **Offset:** 53.12'RT **Hole:** B-3 **Depth:** 12 FT **to:** 14 FT
Field description: CLAY
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS, AL
Comment:

Test Results

T-88	Sieve Analysis % Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	100.0%
2.00 mm (#10):	100.0%
850 µm (#20):	
425 µm (#40):	
250 µm (#60):	99.6%
150 µm (#100):	98.9%
75 µm (#200):	98.1%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content:	49.2%
T-89 Liquid Limit:	52
T-90 Plastic Limit:	25
T-90 Plasticity Index:	27

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr: 0.0% **D2487:** CH
Sa: 1.9% **M145:** A-7-6 Clay
Si: 98.1%

Comments:

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Distribution list

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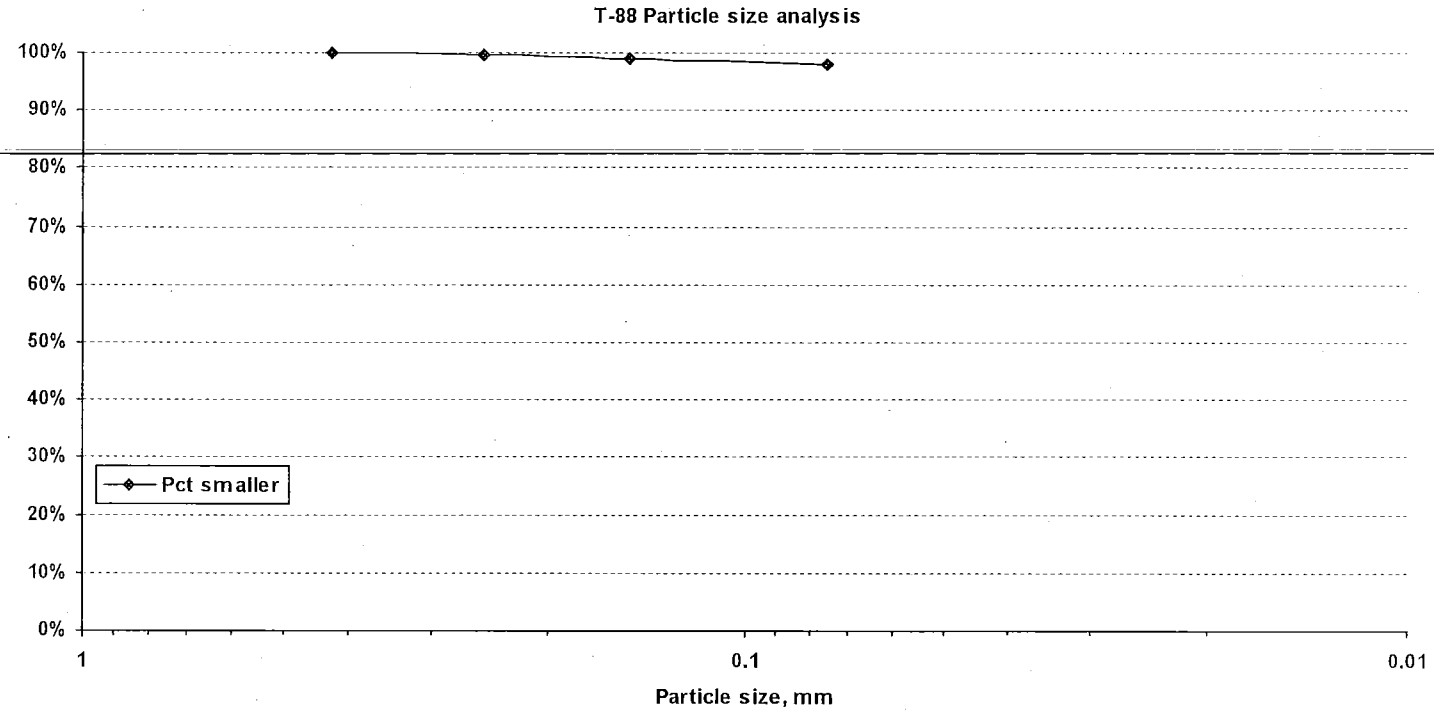
Report on Soil Sample

Lab number: E140162 **Corrected copy:** N/A **Report Date:** 2/6/2014 10:46:17 A

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-3 **Depth:** 12 FT - 14 FT



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Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140163 **Corrected copy:** N/A **Report Date:** 2/6/2014 11:09:24 A
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/29/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1943+26. **Offset:** 53.12'RT **Hole:** B-3 **Depth:** 14 FT **to:** 16 FT
Field description: CLAY
Submitted by: TERRACON **Address:**
~~**Sample type:** SPLIT BARREL **Quantity:**~~
Sample source/Outside agency name:
Location used: **Examined for:** MC
Comment:

Test Results

T-88	Sieve Analysis % Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	
2.00 mm (#10):	
850 µm (#20):	
425 µm (#40):	
250 µm (#60):	
150 µm (#100):	
75 µm (#200):	

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 47.4%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr: **D2487:** N/A
Sa: **M145:** N/A
Si:

Comments: LAB NOTE: MATERIAL WAS SIMILAR AS 16-18 FT.
SAMPLE WAS NOT TESTED FOR LIMITS. TE

Reviewed by: T. Eliassen, P.G., Transportation Geologist

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Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140164 **Corrected copy:** N/A **Report Date:** 2/6/2014 11:09:53 A
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/29/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1943+26. **Offset:** 53.12'RT **Hole:** B-3 **Depth:** 16 FT **to:** 18 FT
Field description: CLAY
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS, AL
Comment:

Test Results

T-88	Sieve Analysis % Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	100.0%
2.00 mm (#10):	100.0%
850 µm (#20):	
425 µm (#40):	
250 µm (#60):	
150 µm (#100):	99.7%
75 µm (#200):	99.3%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content:	45.8%
T-89 Liquid Limit:	39
T-90 Plastic Limit:	22
T-90 Plasticity Index:	17

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr: 0.0% **D2487:** CL
Sa: 0.7% **M145:** A-6 Silty Clay
Si: 99.3%

Comments:

Reviewed by: T. Eliassen, P.G., Transportation Geologist

Distribution list

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Materials and Research Section
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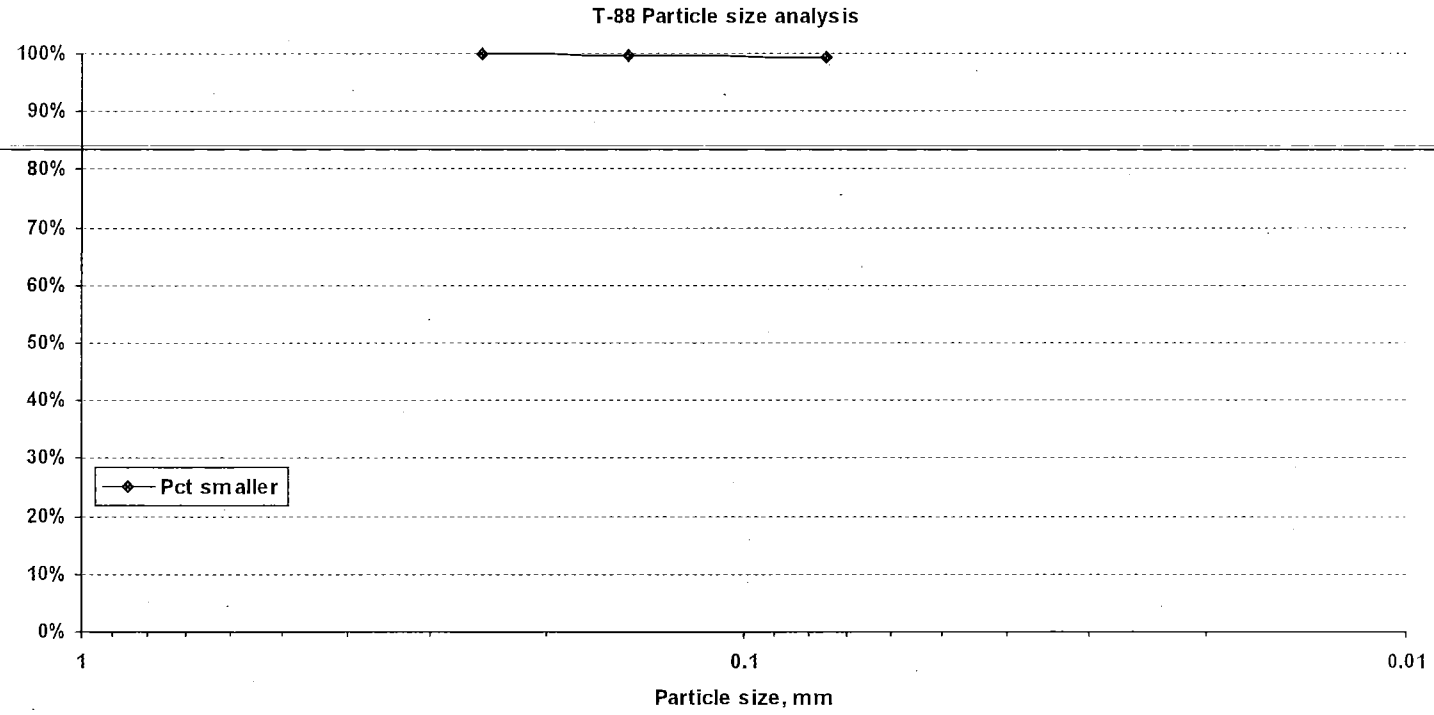
Montpelier, VT 05633-5001

Report on Soil Sample

Lab number: E140164 **Corrected copy:** N/A **Report Date:** 2/6/2014 11:09:57 A

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-3 **Depth:** 16 FT - 18 FT



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Materials and Research Section
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Distribution list
TERRACON
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J. TOUCHETTE

Report on Soil Sample

Lab number: E140165 **Corrected copy:** N/A **Report Date:** 2/6/2014 11:13:19 A
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/29/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1943+23. **Offset:** 49.9' LT **Hole:** B-4 **Depth:** 0 FT **to:** 2 FT
Field description: Si Sa
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS
Comment:

Test Results

T-88	Sieve Analysis % Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	99.4%
4.75 mm (#4):	96.9%
2.00 mm (#10):	92.9%
850 µm (#20):	90.2%
425 µm (#40):	87.3%
250 µm (#60):	84.0%
150 µm (#100):	80.5%
75 µm (#200):	75.3%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 27.5%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr: 7.1% **D2487:** ML
Sa: 17.6% **M145:** A-4 Silt
Si: 75.3%

Comments: LAB NOTE: SOME CLAY MATERIAL WAS NOTICEABLE.
SAMPLE WAS NOT TESTED FOR LIMITS.

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Distribution list

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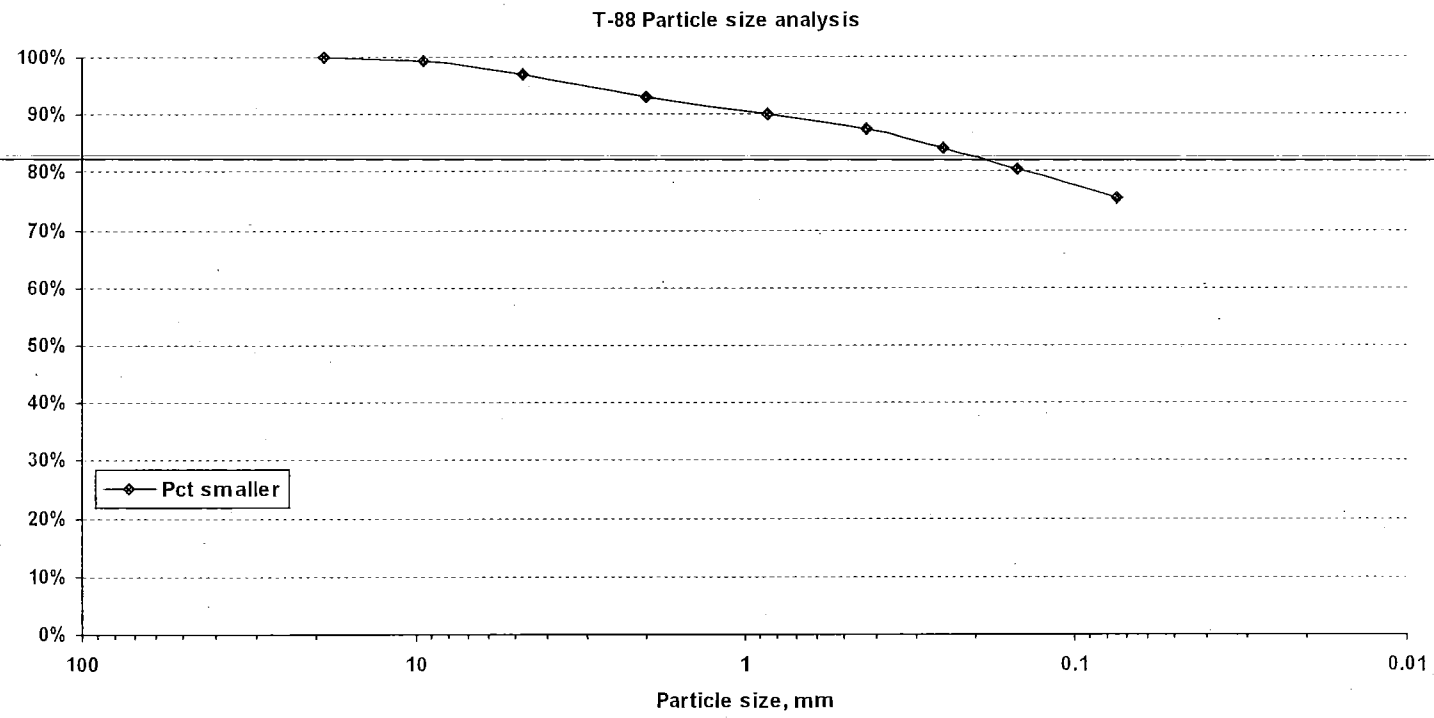
Report on Soil Sample

Lab number: E140165 **Corrected copy:** N/A **Report Date:** 2/6/2014 11:13:24 A

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-4 **Depth:** 0 FT - 2 FT



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Distribution list
TERRACON
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Report on Soil Sample

Lab number: E140166 **Corrected copy:** N/A **Report Date:** 2/6/2014 11:15:01 A
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64
Date sampled: 1/29/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1943+23. **Offset:** 49.9' LT **Hole:** B-4 **Depth:** 2 FT **to:** 4 FT
Field description: Si Sa
Submitted by: TERRACON **Address:**
~~**Sample type:** SPLIT BARREL **Quantity:**~~
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS
Comment:

Test Results

Sieve Analysis

T-88	% Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	96.3%
4.75 mm (#4):	91.5%
2.00 mm (#10):	87.0%
850 µm (#20):	83.0%
425 µm (#40):	78.4%
250 µm (#60):	72.9%
150 µm (#100):	67.2%
75 µm (#200):	58.7%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 24.7%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr: 13.0% **D2487:** ML
Sa: 28.3% **M145:** A-4 Sandy Silt
Si: 58.7%

Comments: LAB NOTE: SOME CLAY MATERIAL WAS NOTICEABLE.
SAMPLE WAS NOT TESTED FOR LIMITS.

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Distribution list

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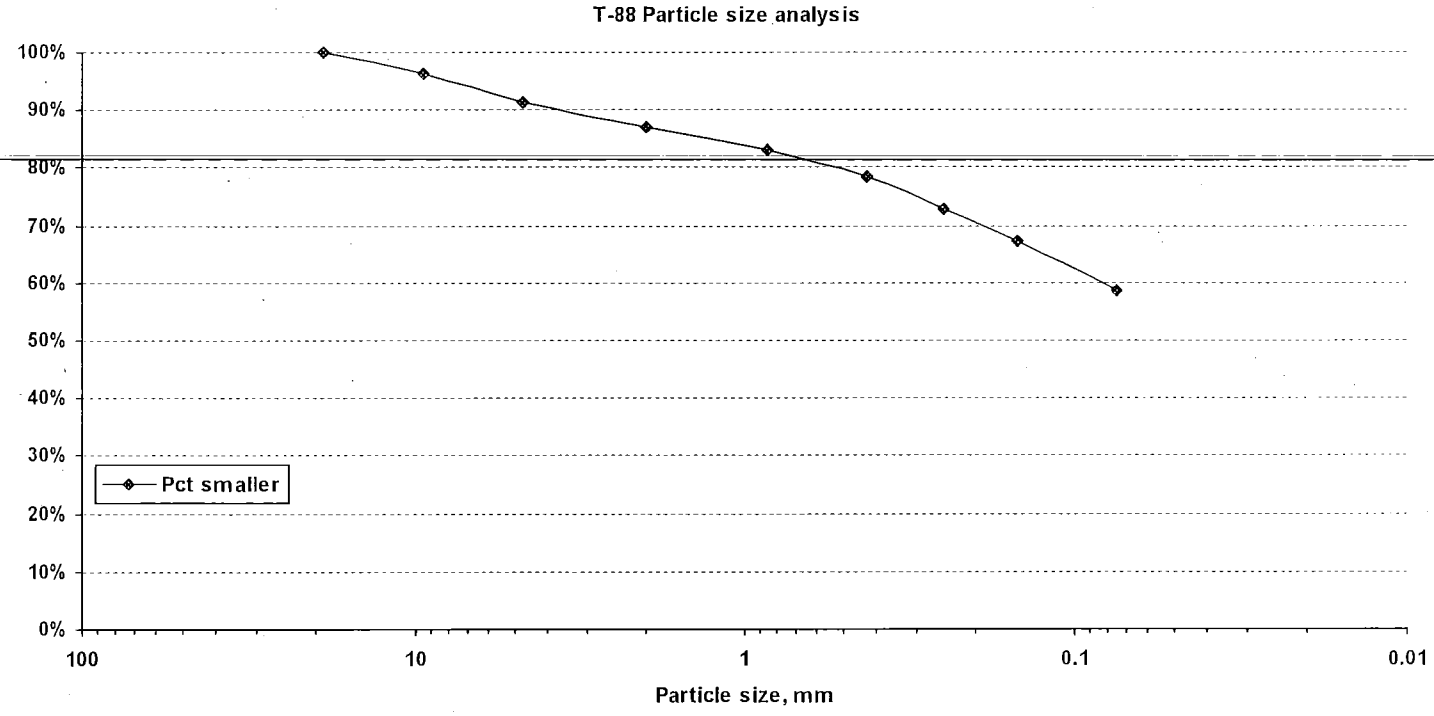
Report on Soil Sample

Lab number: E140166 **Corrected copy:** N/A **Report Date:** 2/6/2014 11:15:05 A

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-4 **Depth:** 2 FT - 4 FT



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Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140167 **Corrected copy:** N/A **Report Date:** 2/6/2014 11:16:46 A
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/29/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1943+23. **Offset:** 49.9' LT **Hole:** B-4 **Depth:** 4 FT **to:** 6 FT
Field description: Si Sa
Submitted by: TERRACON **Address:**
~~**Sample type:** SPLIT BARREL **Quantity:**~~
Sample source/Outside agency name:
Location used: **Examined for:** MC
Comment:

Test Results

Sieve Analysis

T-88	% Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	
2.00 mm (#10):	
850 µm (#20):	
425 µm (#40):	
250 µm (#60):	
150 µm (#100):	
75 µm (#200):	

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 33.6%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr: **D2487:** N/A
Sa: **M145:** N/A
Si:

Comments: LAB NOTE: MATERIAL WAS SIMILAR AS 6-8 FT.
SAMPLE WAS NOT TESTED FOR LIMITS.

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

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Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140168 **Corrected copy:** N/A **Report Date:** 2/6/2014 11:23:29 A
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/29/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1943+23. **Offset:** 49.9' LT **Hole:** B-4 **Depth:** 6 FT **to:** 8 FT
Field description: Si Cl
Submitted by: TERRACON **Address:**
~~**Sample type:** SPLIT BARREL~~ ~~**Quantity:**~~
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS, AL
Comment:

Test Results

Sieve Analysis

T-88	% Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	98.9%
4.75 mm (#4):	96.8%
2.00 mm (#10):	96.3%
850 µm (#20):	95.8%
425 µm (#40):	95.2%
250 µm (#60):	94.7%
150 µm (#100):	94.2%
75 µm (#200):	93.6%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content:	38.9%
T-89 Liquid Limit:	70
T-90 Plastic Limit:	30
T-90 Plasticity Index:	40

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr: 3.7% **D2487:** CH
Sa: 2.7% **M145:** A-7-5 Clay
Si: 93.6%

Comments:

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Distribution list

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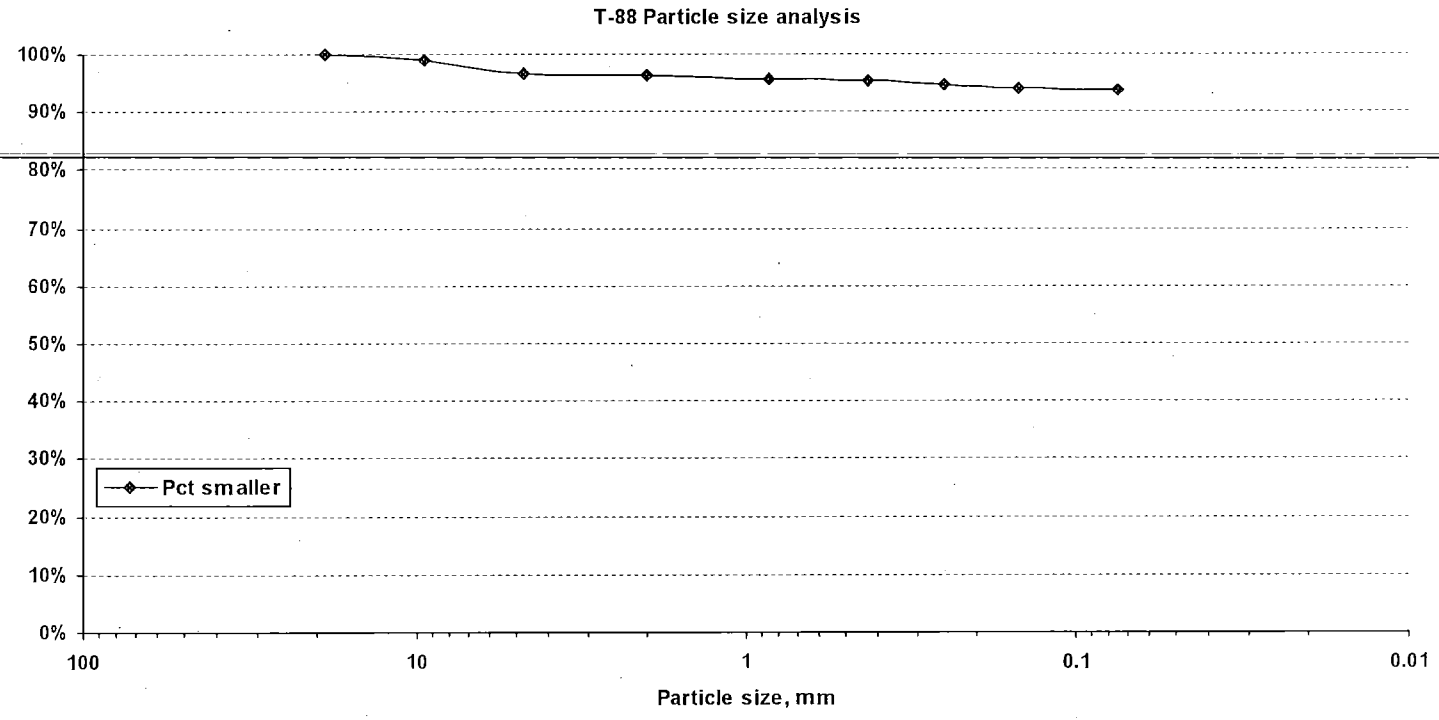
Montpelier, VT 05633-5001

Report on Soil Sample

Lab number: E140168 **Corrected copy:** N/A **Report Date:** 2/6/2014 11:23:33 A

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-4 **Depth:** 6 FT - 8 FT



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Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140169 **Corrected copy:** N/A **Report Date:** 2/6/2014 11:42:37 A
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/29/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1943+23. **Offset:** 49.9' LT **Hole:** B-4 **Depth:** 8 FT **to:** 10 FT
Field description: Si Cl
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC
Comment:

Test Results

Sieve Analysis

T-88	% Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	
2.00 mm (#10):	
850 µm (#20):	
425 µm (#40):	
250 µm (#60):	
150 µm (#100):	
75 µm (#200):	

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 38.9%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr: **D2487:** N/A
Sa: **M145:** N/A
Si:

Comments: LAB NOTE: MATERIAL WAS SIMILAR AS 6-8 FT.
SAMPLE WAS NOT TESTED FOR LIMITS.

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

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Materials and Research Section
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Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140170 **Corrected copy:** N/A **Report Date:** 2/6/2014 11:44:42 A
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/29/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1943+23. **Offset:** 49.9' LT **Hole:** B-4 **Depth:** 10 FT **to:** 12 FT
Field description: Si Cl
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS, AL
Comment:

Test Results

T-88	Sieve Analysis % Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	100.0%
2.00 mm (#10):	100.0%
850 µm (#20):	
425 µm (#40):	99.9%
250 µm (#60):	99.7%
150 µm (#100):	99.3%
75 µm (#200):	98.7%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content:	52.3%
T-89 Liquid Limit:	68
T-90 Plastic Limit:	30
T-90 Plasticity Index:	38

Moisture Density

Test method: T-180 **Method:**
Maximum density: pcf
Optimum moisture:
T-100 Specific Gravity:

Gr: 0.0% **D2487:** CH
Sa: 1.3% **M145:** A-7-6 Clay
Si: 98.7%

Comments:

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Distribution list

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Materials and Research Section
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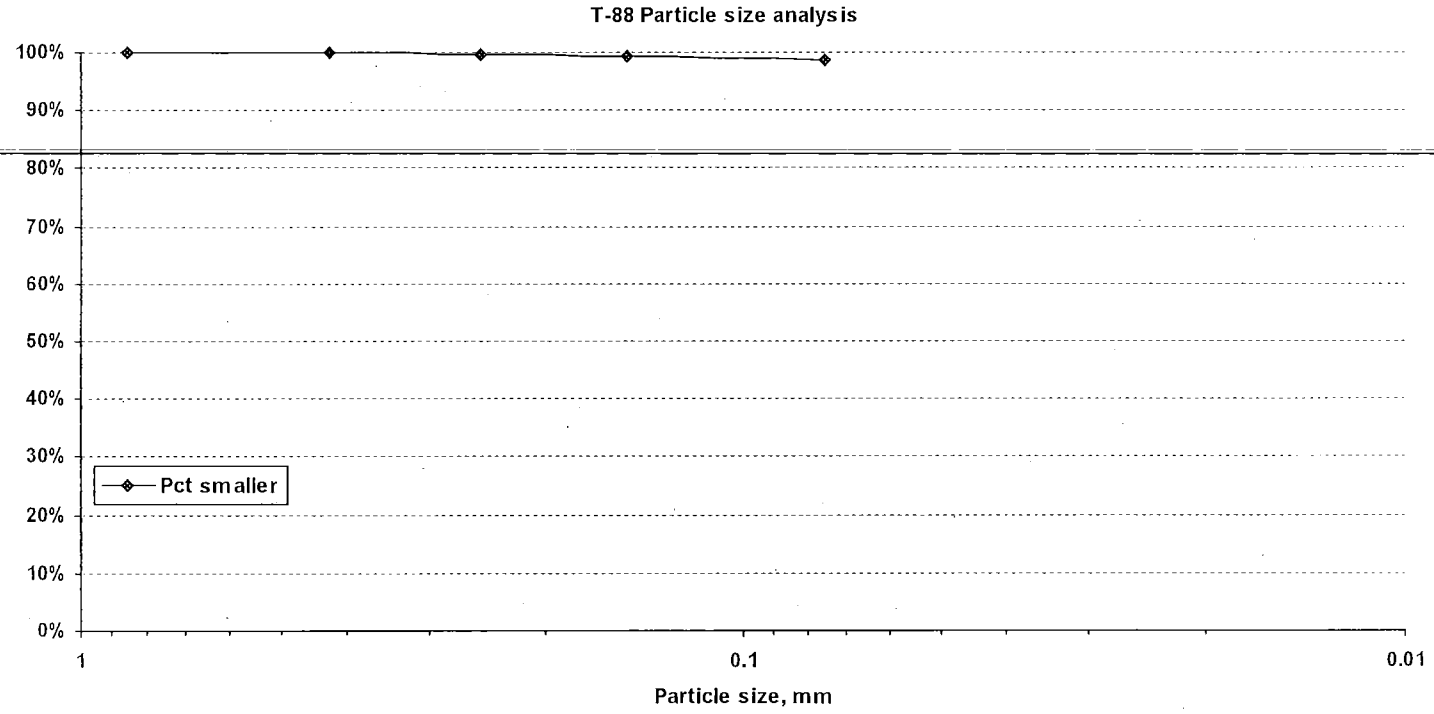
Report on Soil Sample

Lab number: E140170 **Corrected copy:** N/A **Report Date:** 2/6/2014 11:44:46 A

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-4 **Depth:** 10 FT - 12 FT



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Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140171 **Corrected copy:** N/A **Report Date:** 2/6/2014 11:46:25 A
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/29/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1943+23. **Offset:** 49.9' LT **Hole:** B-4 **Depth:** 12 FT **to:** 14 FT
Field description: CLAY
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC
Comment:

Test Results

Sieve Analysis

T-88	% Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	
2.00 mm (#10):	
850 µm (#20):	
425 µm (#40):	
250 µm (#60):	
150 µm (#100):	
75 µm (#200):	

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 49.1%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr: **D2487:** N/A
Sa: **M145:** N/A
Si:

Comments: LAB NOTE: MATERIAL WAS SIMILAR AS 16-18
SAMPLE WAS NOT TESTED FOR LIMITS.

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

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Materials and Research Section
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Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140172 **Corrected copy:** N/A **Report Date:** 2/6/2014 11:48:17 A
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/29/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1943+23. **Offset:** 49.9' LT **Hole:** B-4 **Depth:** 16 FT **to:** 18 FT
Field description: CLAY
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS, AL
Comment:

Test Results

T-88	Sieve Analysis % Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	100.0%
2.00 mm (#10):	100.0%
850 µm (#20):	
425 µm (#40):	
250 µm (#60):	
150 µm (#100):	99.7%
75 µm (#200):	99.3%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content:	53.1%
T-89 Liquid Limit:	49
T-90 Plastic Limit:	23
T-90 Plasticity Index:	26

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr:	0.0%	D2487:	CL	
Sa:	0.7%	M145:	A-7-6	Clay
Si:	99.3%			

Comments:

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Distribution list

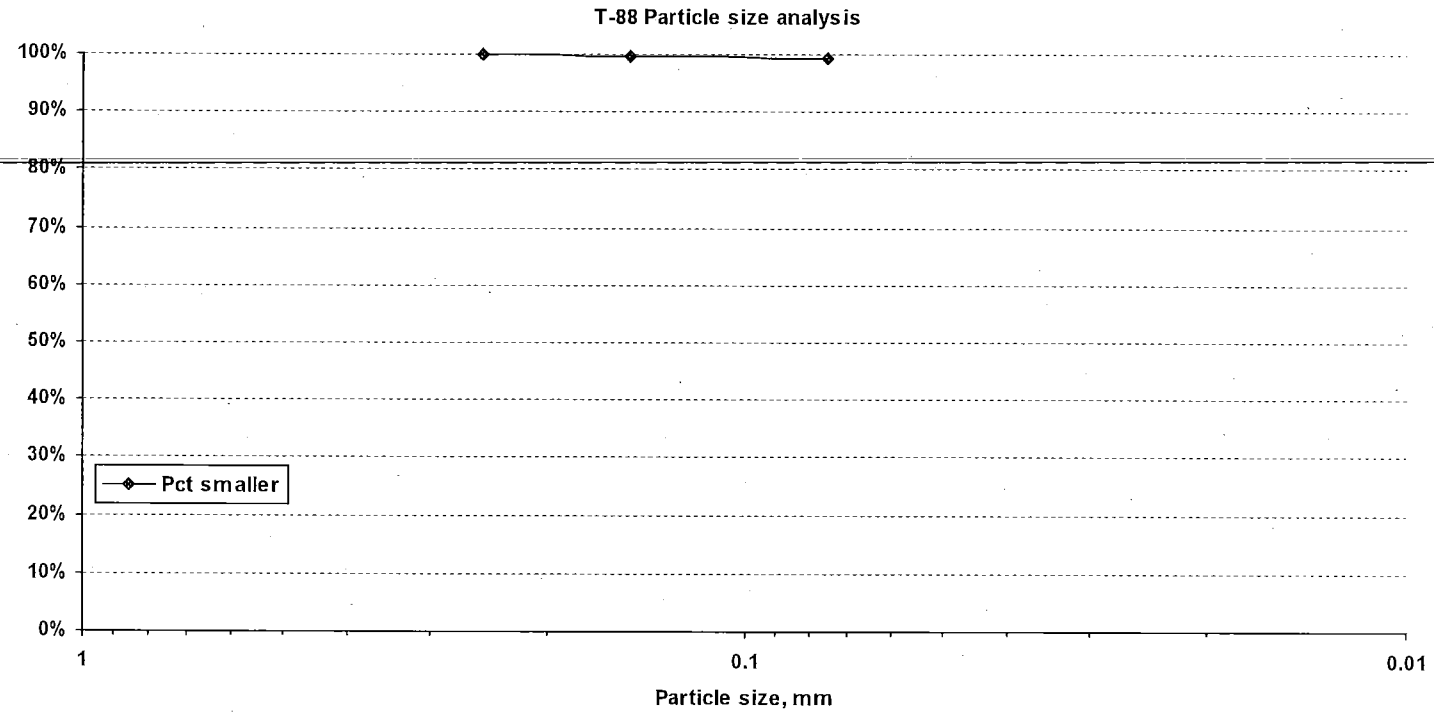
Vermont Agency of Transportation
Materials and Research Section
1 National Life Drive
Montpelier, VT 05633-5001

Report on Soil Sample

Lab number: E140172 **Corrected copy:** N/A **Report Date:** 2/6/2014 11:48:39 A

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-4 **Depth:** 16 FT - 18 FT



Vermont Agency of Transportation
Materials and Research Section
1 National Life Drive
Montpelier, VT 05633-5001

Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140173 **Corrected copy:** N/A **Report Date:** 2/6/2014 11:51:24 A
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64
Date sampled: 1/30/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 199+99.3 **Offset:** 43.32'RT **Hole:** B-5 **Depth:** 0 FT **to:** 2 FT
Field description: Si Sa
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS, AL
Comment:

Test Results

Sieve Analysis

T-88	% Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	93.9%
9.5 mm (3/8"):	92.6%
4.75 mm (#4):	87.2%
2.00 mm (#10):	85.2%
850 µm (#20):	81.7%
425 µm (#40):	76.0%
250 µm (#60):	69.0%
150 µm (#100):	62.2%
75 µm (#200):	52.6%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 20.4%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: pcf
Optimum moisture:
T-100 Specific Gravity:

Gr: 14.8% **D2487:** ML
Sa: 32.6% **M145:** A-4 Sandy Silt
Si: 52.6%

Comments: LAB NOTE: GRASS & ROOTS WERE WITHIN SAMPLE.

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Distribution list

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Materials and Research Section
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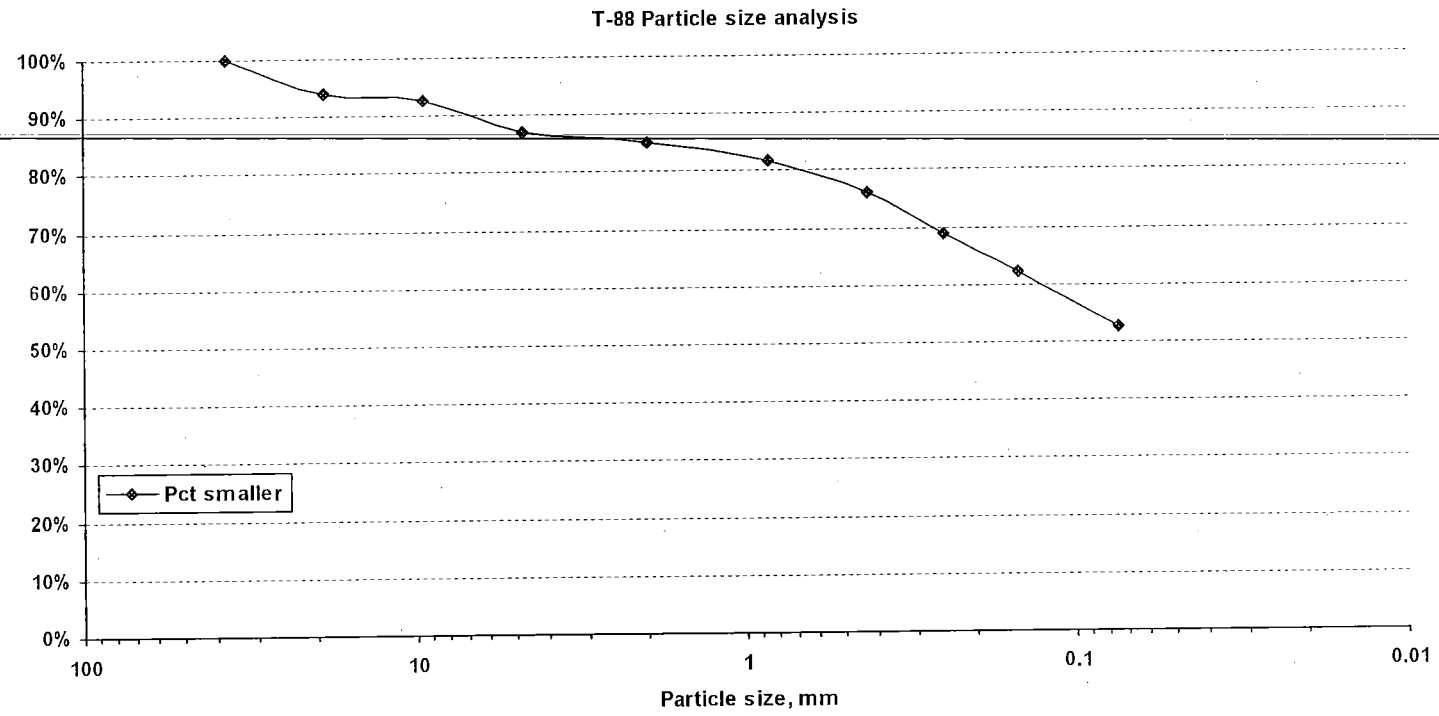
Report on Soil Sample

Lab number: E140173 **Corrected copy:** N/A **Report Date:** 2/6/2014 11:51:30 A

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-5 **Depth:** 0 FT - 2 FT



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Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140174 **Corrected copy:** N/A **Report Date:** 2/6/2014 11:53:42 A
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64
Date sampled: 1/30/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 199+99.3 **Offset:** 43.32'RT **Hole:** B-5 **Depth:** 2 FT **to:** 4 FT
Field description: Sa Si w/Cl
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC
Comment:

Test Results

Sieve Analysis

T-88	% Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	
2.00 mm (#10):	
850 µm (#20):	
425 µm (#40):	
250 µm (#60):	
150 µm (#100):	
75 µm (#200):	

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 19.6%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: pcf
Optimum moisture:
T-100 Specific Gravity:

Gr: **D2487:** N/A
Sa: **M145:** N/A
Si:

Comments: LAB NOTE: MATERIAL WAS SIMILAR AS 4-6 FT.
SAMPLE WAS NOT TESTED FOR LIMITS.

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

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Materials and Research Section
1 National Life Drive
Montpelier, VT 05633-5001

Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140175 **Corrected copy:** N/A **Report Date:** 2/6/2014 11:56:13 A
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64
Date sampled: 1/30/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 199+99.3 **Offset:** 43.32'RT **Hole:** B-5 **Depth:** 4 FT **to:** 6 FT
Field description: Sa Si w/Cl
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS, AL
Comment:

Test Results

Sieve Analysis

T-88	% Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	97.7%
2.00 mm (#10):	97.3%
850 µm (#20):	95.4%
425 µm (#40):	90.2%
250 µm (#60):	80.0%
150 µm (#100):	68.6%
75 µm (#200):	55.8%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content:	28.3%
T-89 Liquid Limit:	24
T-90 Plastic Limit:	21
T-90 Plasticity Index:	3

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr:	2.7%	D2487:	ML	
Sa:	41.5%	M145:	A-4	Sandy Silt
Si:	55.8%			

Comments:

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Distribution list

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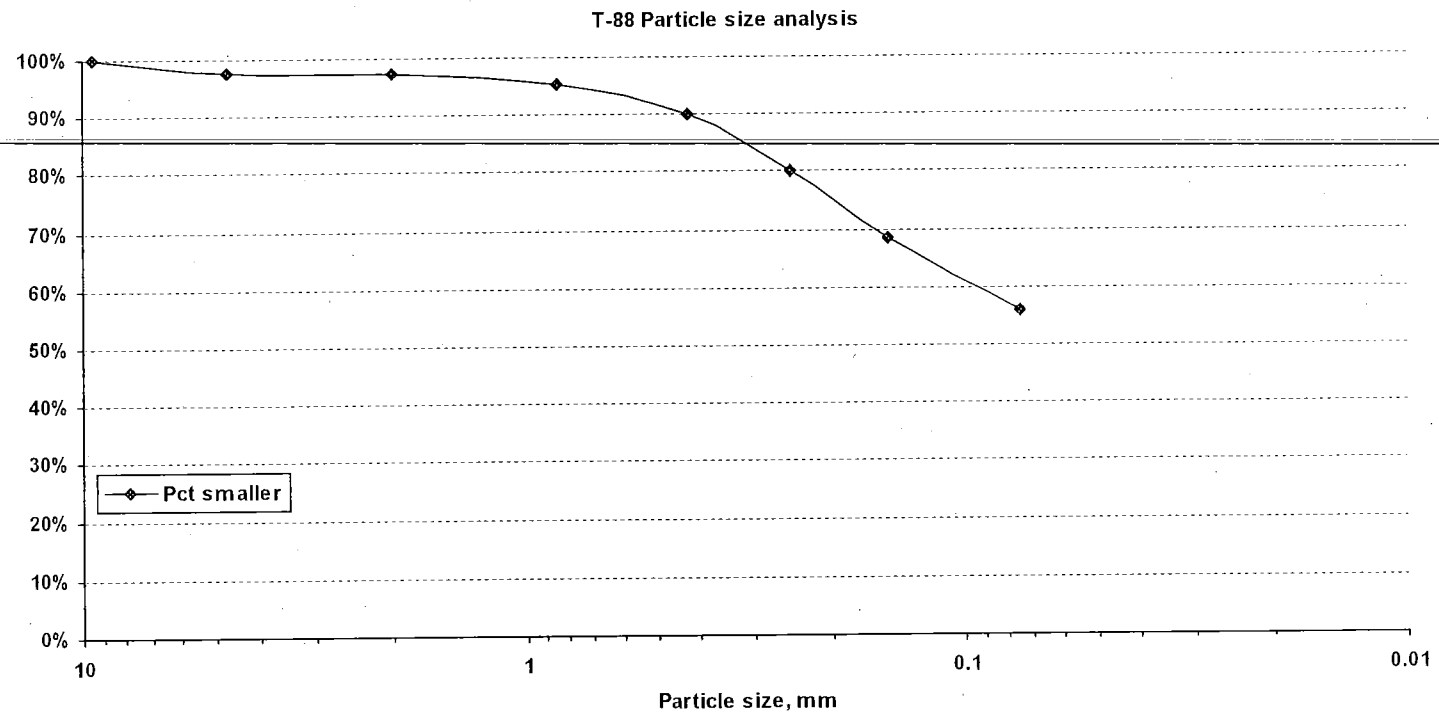
Materials and Research Section
1 National Life Drive
Montpelier, VT 05633-5001

Report on Soil Sample

Lab number: E140175 **Corrected copy:** N/A **Report Date:** 2/6/2014 11:56:17 A

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-5 **Depth:** 4 FT - 6 FT



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Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140176 **Corrected copy:** N/A **Report Date:** 2/6/2014 11:58:46 A
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/30/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 199+99.3 **Offset:** 43.32'RT **Hole:** B-5 **Depth:** 6 FT **to:** 8 FT
Field description: Si w/Cl
Submitted by: TERRACON **Address:**

Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS, AL
Comment:

Test Results

T-88	Sieve Analysis % Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	100.0%
2.00 mm (#10):	100.0%
850 µm (#20):	99.9%
425 µm (#40):	99.5%
250 µm (#60):	99.0%
150 µm (#100):	98.7%
75 µm (#200):	97.9%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 24.9%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: pcf
Optimum moisture:
T-100 Specific Gravity:

Gr: 0.0% **D2487:** ML
Sa: 2.1% **M145:** A-4 Silt
Si: 97.9%

Comments: LAB NOTE: A SMALL AREA OF CLAY MATERIAL WAS NOTICEABLE.
SAMPLE TESTED: (NP)

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Distribution list

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Materials and Research Section
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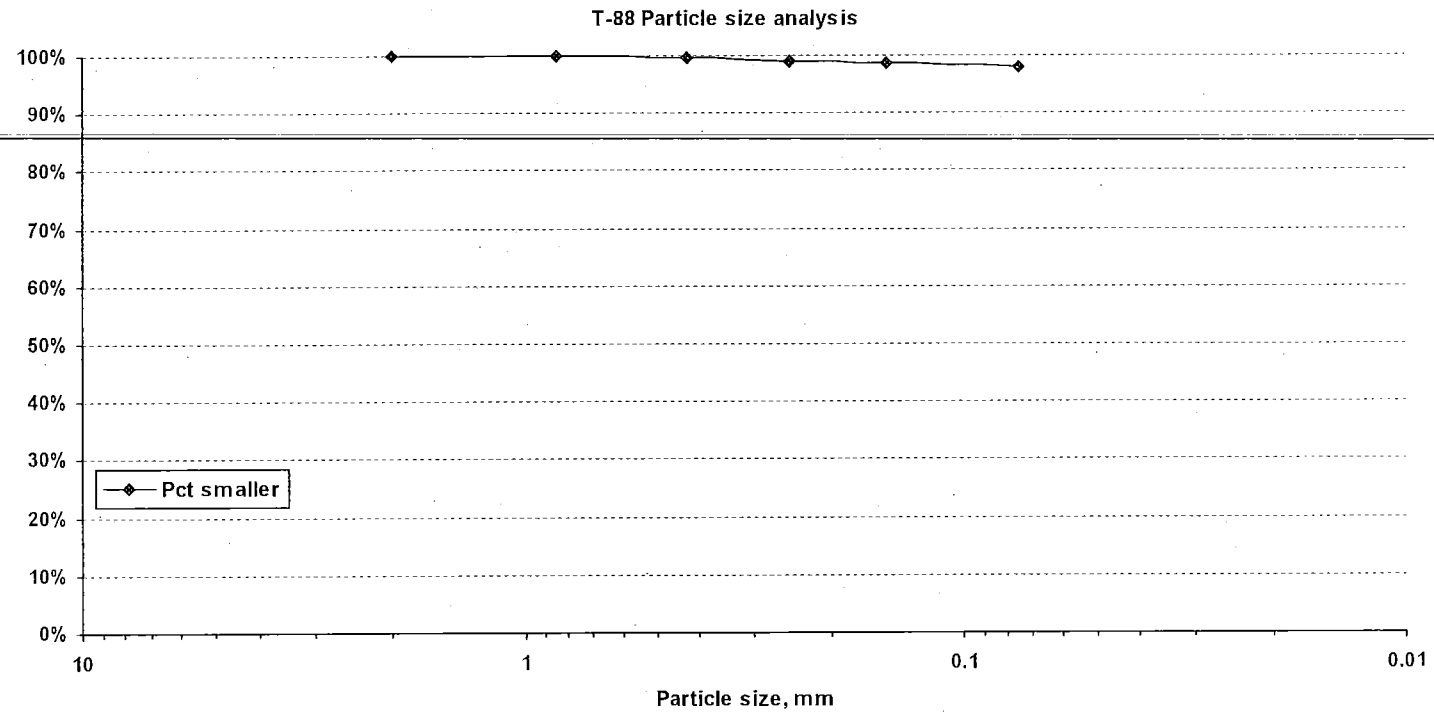
Montpelier, VT 05633-5001

Report on Soil Sample

Lab number: E140176 **Corrected copy:** N/A **Report Date:** 2/6/2014 11:58:49 A

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-5 **Depth:** 6 FT - 8 FT



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Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140177 **Corrected copy:** N/A **Report Date:** 2/6/2014 12:17:15 P
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64
Date sampled: 1/30/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 199+99.3 **Offset:** 43.32'RT **Hole:** B-5 **Depth:** 8 FT **to:** 10 FT
Field description: Si Cl
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC
Comment:

Test Results

T-88	Sieve Analysis % Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	
2.00 mm (#10):	
850 µm (#20):	
425 µm (#40):	
250 µm (#60):	
150 µm (#100):	
75 µm (#200):	

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 28.7%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: pcf
Optimum moisture:
T-100 Specific Gravity:

Gr: **D2487:** N/A
Sa: **M145:** N/A
Si:

Comments: LAB NOTE: MATERIAL WAS SIMILAR AS 10-12 FT.
SAMPLE WAS NOT TESTED FOR LIMITS.

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

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Materials and Research Section
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Montpelier, VT 05633-5001

Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140178 **Corrected copy:** N/A **Report Date:** 2/6/2014 12:19:40 P
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64
Date sampled: 1/30/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 199+99.3 **Offset:** 43.32'RT **Hole:** B-5 **Depth:** 10 FT **to:** 12 FT
Field description: CLAY
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS, AL
Comment:

Test Results

T-88	Sieve Analysis % Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	100.0%
2.00 mm (#10):	100.0%
850 µm (#20):	
425 µm (#40):	99.9%
250 µm (#60):	99.8%
150 µm (#100):	99.5%
75 µm (#200):	99.3%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content:	27.7%
T-89 Liquid Limit:	28
T-90 Plastic Limit:	23
T-90 Plasticity Index:	5

Moisture Density

Test method: T-180 **Method:**
Maximum density: pcf
Optimum moisture:
T-100 Specific Gravity:

Gr: 0.0% **D2487:** ML
Sa: 0.7% **M145:** A-4 Silt
Si: 99.3%

Comments:

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Distribution list

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Materials and Research Section
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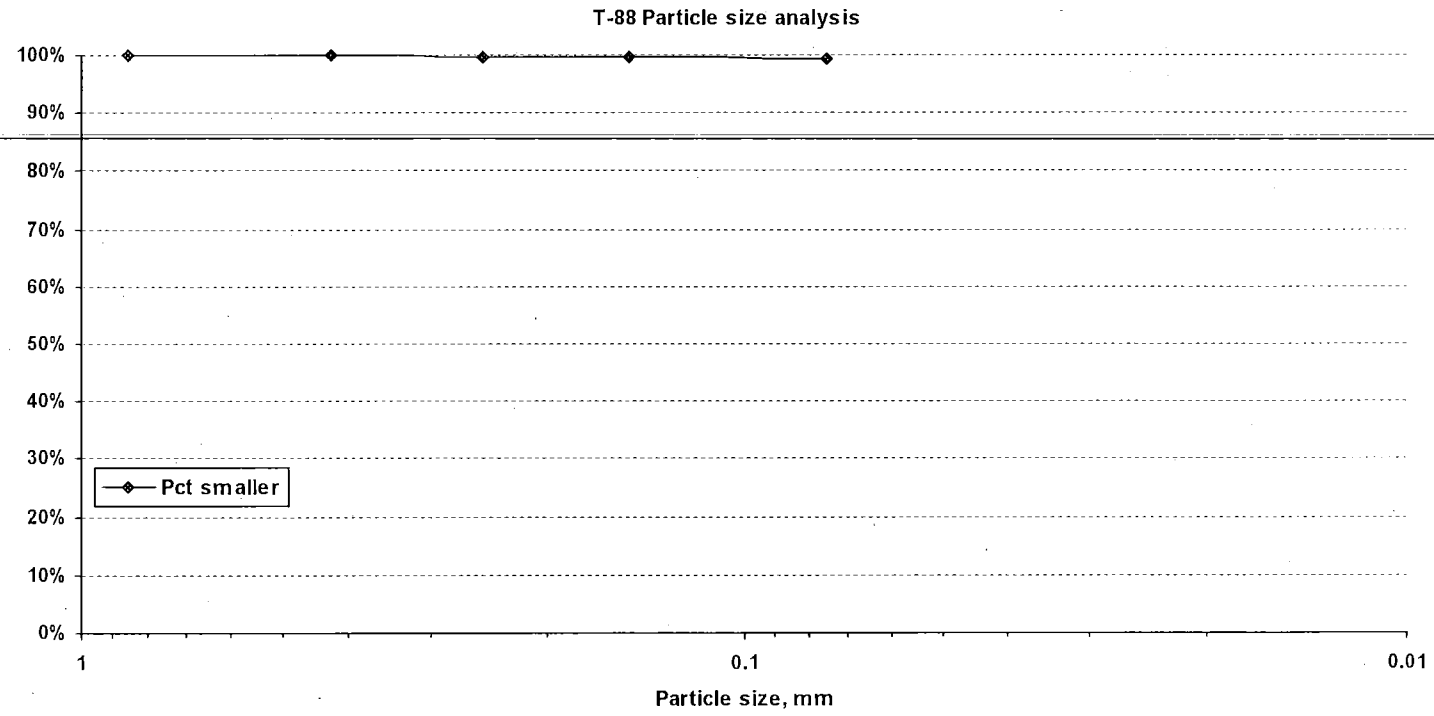
Montpelier, VT 05633-5001

Report on Soil Sample

Lab number: E140178 **Corrected copy:** N/A **Report Date:** 2/6/2014 12:19:44 P

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-5 **Depth:** 10 FT - 12 FT



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Materials and Research Section
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Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140179 **Corrected copy:** N/A **Report Date:** 2/6/2014 12:21:07 P
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/30/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 199+99.3 **Offset:** 43.32'RT **Hole:** B-5 **Depth:** 12 FT **to:** 14 FT
Field description: CLAY
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC
Comment:

Test Results

T-88	Sieve Analysis % Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	
2.00 mm (#10):	
850 µm (#20):	
425 µm (#40):	
250 µm (#60):	
150 µm (#100):	
75 µm (#200):	

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 27.4%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr: **D2487:** N/A
Sa: **M145:** N/A
Si:

Comments: LAB NOTE: MATERIAL WAS SIMILAR AS 10-12 FT.
SAMPLE WAS NOT TESTED FOR LIMITS.

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Vermont Agency of Transportation
Materials and Research Section
1 National Life Drive
Montpelier, VT 05633-5001

Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140180 **Corrected copy:** N/A **Report Date:** 2/6/2014 12:24:05 P
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/30/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 199+99.3 **Offset:** 43.32'RT **Hole:** B-5 **Depth:** 17 FT **to:** 19 FT
Field description: CLAY
Submitted by: TERRACON **Address:**

Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS, AL
Comment:

Test Results

T-88	Sieve Analysis % Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	100.0%
2.00 mm (#10):	100.0%
850 µm (#20):	
425 µm (#40):	
250 µm (#60):	
150 µm (#100):	99.9%
75 µm (#200):	99.5%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content:	27.4%
T-89 Liquid Limit:	30
T-90 Plastic Limit:	23
T-90 Plasticity Index:	7

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr: 0.0% **D2487:** ML
Sa: 0.5% **M145:** A-4 Clayey Silt
Si: 99.5%

Comments:

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Distribution list

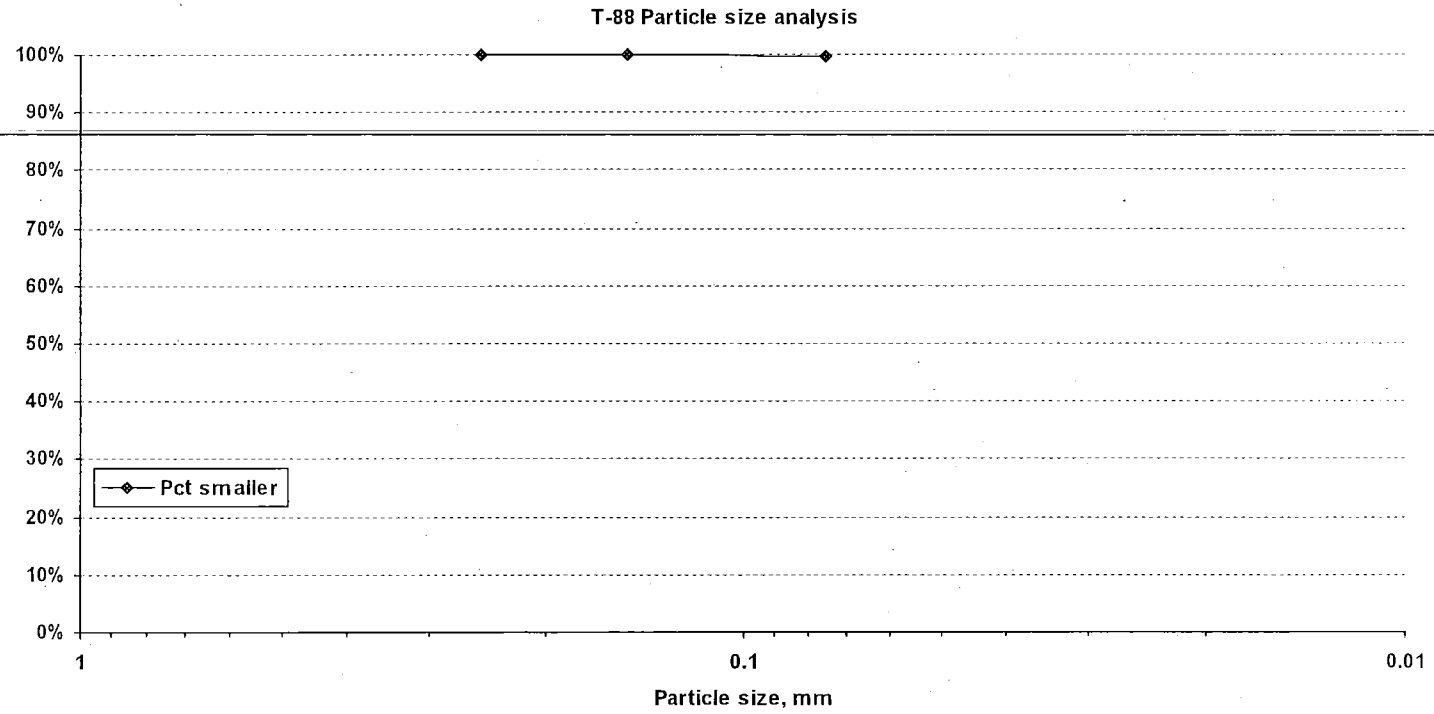
Vermont Agency of Transportation
Materials and Research Section
1 National Life Drive
Montpelier, VT 05633-5001

Report on Soil Sample

Lab number: E140180 **Corrected copy:** N/A **Report Date:** 2/6/2014 12:24:09 P

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-5 **Depth:** 17 FT - 19 FT



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Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140181 **Corrected copy:** N/A **Report Date:** 2/6/2014 12:25:29 P
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/30/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 199+99.3 **Offset:** 43.32'RT **Hole:** B-5 **Depth:** 19 FT **to:** 21 FT
Field description: CLAY
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC
Comment:

Test Results

Sieve Analysis

T-88	% Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	
2.00 mm (#10):	
850 µm (#20):	
425 µm (#40):	
250 µm (#60):	
150 µm (#100):	
75 µm (#200):	

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 26.1%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: pcf
Optimum moisture:
T-100 Specific Gravity:

Gr: **D2487:** N/A
Sa: **M145:** N/A
Si:

Comments: LAB NOTE: MATERIAL WAS SIMILAR AS 17-19 FT.
SAMPLE WAS NOT TESTED FOR LIMITS.

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Vermont Agency of Transportation
Materials and Research Section
1 National Life Drive
Montpelier, VT 05633-5001

Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140182 **Corrected copy:** N/A **Report Date:** 2/6/2014 12:27:41 P
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/30/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 199+85.1 **Offset:** 47.27'LT **Hole:** B-6 **Depth:** 0 FT **to:** 2 FT
Field description: Si Sa
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS, AL
Comment:

Test Results

T-88	Sieve Analysis % Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	97.8%
2.00 mm (#10):	97.0%
850 µm (#20):	94.7%
425 µm (#40):	90.2%
250 µm (#60):	85.7%
150 µm (#100):	80.6%
75 µm (#200):	71.6%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 28.3%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr: 3.0% **D2487:** ML
Sa: 25.4% **M145:** A-4 Sandy Silt
Si: 71.6%

Comments: LAB NOTE: WOOD & ROOTS WERE WITHIN SAMPLE.

Reviewed by: T. Eliassen, P.G., Transportation Geologist

Distribution list

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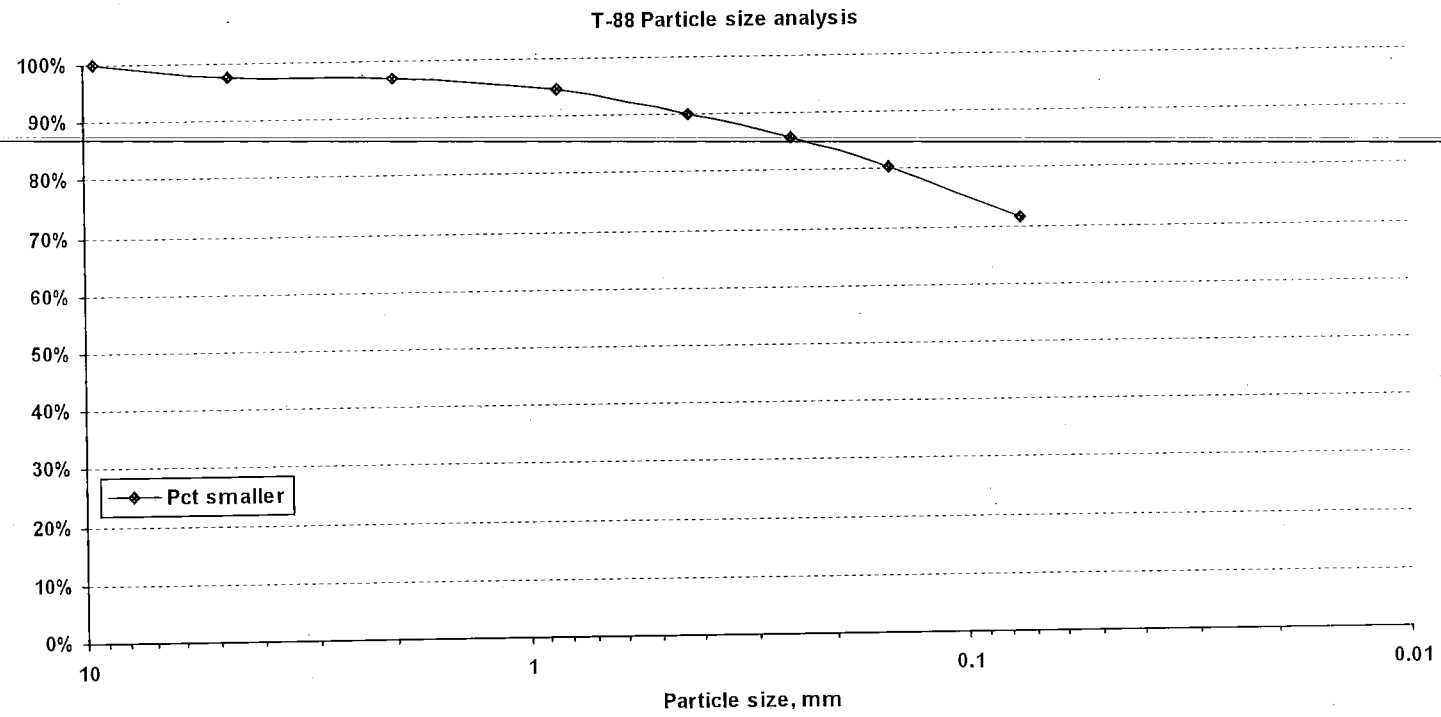
Materials and Research Section
1 National Life Drive
Montpelier, VT 05633-5001

Report on Soil Sample

Lab number: E140182 **Corrected copy:** N/A **Report Date:** 2/6/2014 12:27:45 P

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-6 **Depth:** 0 FT - 2 FT



Vermont Agency of Transportation
Materials and Research Section
1 National Life Drive
Montpelier, VT 05633-5001

Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140183 **Corrected copy:** N/A **Report Date:** 2/6/2014 12:29:04 P
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64
Date sampled: 1/30/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 199+85.1 **Offset:** 47.27'LT **Hole:** B-6 **Depth:** 2 FT **to:** 4 FT
Field description: Sa Si
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC
Comment:

Test Results

Sieve Analysis

T-88	% Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	
2.00 mm (#10):	
850 µm (#20):	
425 µm (#40):	
250 µm (#60):	
150 µm (#100):	
75 µm (#200):	

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 23.7%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: pcf
Optimum moisture:
T-100 Specific Gravity:

Gr: **D2487:** N/A
Sa: **M145:** N/A
Si:

Comments: LAB NOTE: MATERIAL WAS SIMILAR AS 4-6 FT.
SAMPLE WAS NOT TESTED FOR LIMITS.

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

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Materials and Research Section
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Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140184 **Corrected copy:** N/A **Report Date:** 2/6/2014 12:31:52 P
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/30/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 199+85.1 **Offset:** 47.27'LT **Hole:** B-6 **Depth:** 4 FT **to:** 6 FT
Field description: Si Cl
Submitted by: TERRACON **Address:**

Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS, AL
Comment:

Test Results

T-88	Sieve Analysis % Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	100.0%
2.00 mm (#10):	99.6%
850 µm (#20):	99.3%
425 µm (#40):	98.8%
250 µm (#60):	98.2%
150 µm (#100):	97.6%
75 µm (#200):	96.9%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content:	27.4%
T-89 Liquid Limit:	28
T-90 Plastic Limit:	26
T-90 Plasticity Index:	2

Moisture Density

Test method: T-180 **Method:**
Maximum density: pcf
Optimum moisture:
T-100 Specific Gravity:

Gr: 0.4% **D2487:** ML
Sa: 2.8% **M145:** A-4 Silt
Si: 96.9%

Comments:

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Distribution list

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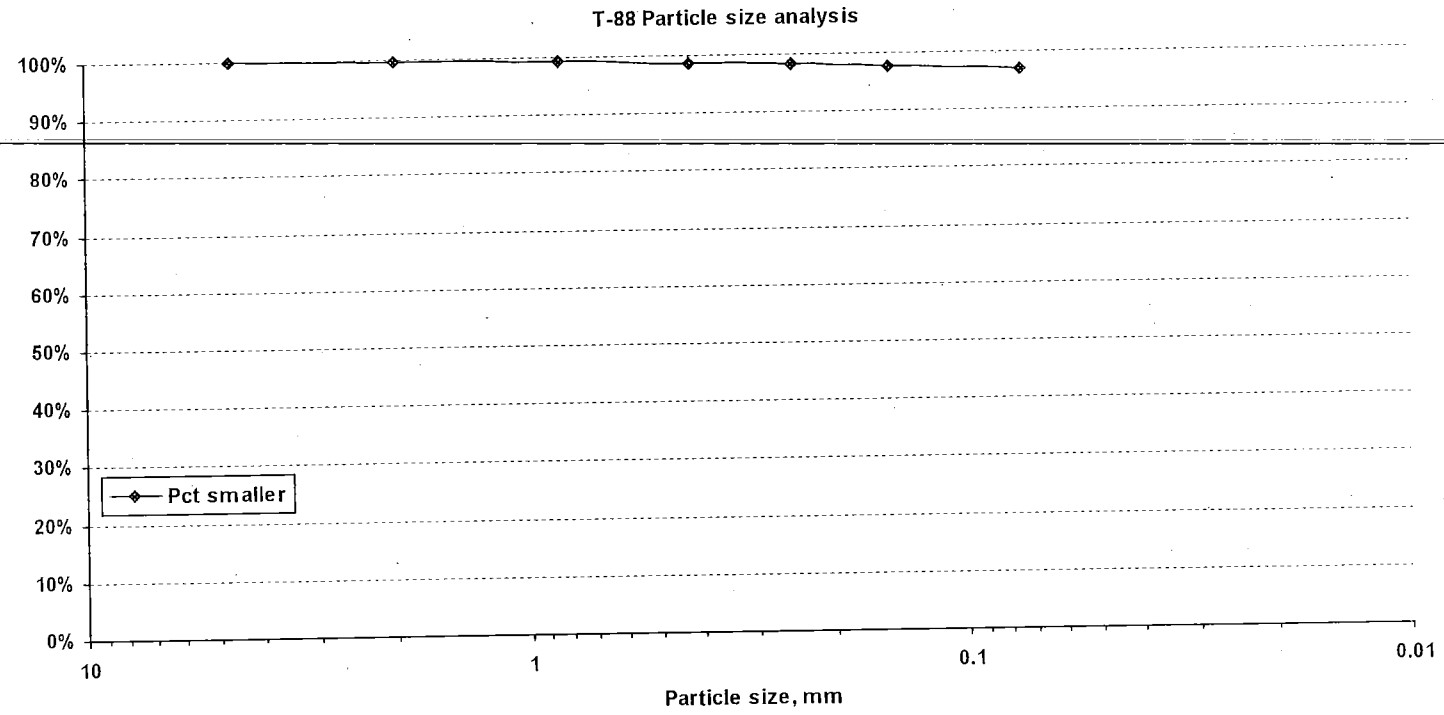
Report on Soil Sample

Lab number: E140184 **Corrected copy:** N/A **Report Date:** 2/6/2014 12:31:57 P

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-6 **Depth:** 4 FT - 6 FT



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Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140185 **Corrected copy:** N/A **Report Date:** 2/6/2014 12:33:35 P
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64
Date sampled: 1/30/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 199+85.1 **Offset:** 47.27'LT **Hole:** B-6 **Depth:** 6 FT **to:** 8 FT
Field description: Cl w/Sa
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC
Comment:

Test Results

T-88	Sieve Analysis % Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	
2.00 mm (#10):	
850 µm (#20):	
425 µm (#40):	
250 µm (#60):	
150 µm (#100):	
75 µm (#200):	

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 28.7%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: pcf
Optimum moisture:
T-100 Specific Gravity:

Gr: **D2487:** N/A
Sa: **M145:** N/A
Si:

Comments: LAB NOTE: MATERIAL WAS SIMILAR AS 4-6 FT.
SAMPLE WAS NOT TESTED FOR LIMITS.

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

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Materials and Research Section
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Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140186 **Corrected copy:** N/A **Report Date:** 2/6/2014 12:34:49 P
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/30/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 199+85.1 **Offset:** 47.27'LT **Hole:** B-6 **Depth:** 8 FT **to:** 10 FT
Field description: CLAY
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC
Comment:

Test Results

Sieve Analysis

T-88	% Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	
2.00 mm (#10):	
850 µm (#20):	
425 µm (#40):	
250 µm (#60):	
150 µm (#100):	
75 µm (#200):	

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 29.2%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: pcf
Optimum moisture:
T-100 Specific Gravity:

Gr: **D2487:** N/A
Sa: **M145:** N/A
Si:

Comments: LAB NOTE: MATERIAL WAS SIMILAR AS 10-12 FT.
SAMPLE WAS NOT TESTED FOR LIMITS.

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

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Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140187 **Corrected copy:** N/A **Report Date:** 2/6/2014 12:37:18 P
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/30/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 199+85.1 **Offset:** 47.27'LT **Hole:** B-6 **Depth:** 10 FT **to:** 12 FT
Field description: CLAY
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS, AL
Comment:

Test Results

T-88	Sieve Analysis % Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	100.0%
2.00 mm (#10):	100.0%
850 µm (#20):	99.7%
425 µm (#40):	99.2%
250 µm (#60):	98.7%
150 µm (#100):	98.0%
75 µm (#200):	96.8%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content:	26.5%
T-89 Liquid Limit:	26
T-90 Plastic Limit:	23
T-90 Plasticity Index:	3

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr: 0.0% **D2487:** ML
Sa: 3.2% **M145:** A-4 Silt
Si: 96.8%

Comments:

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Distribution list

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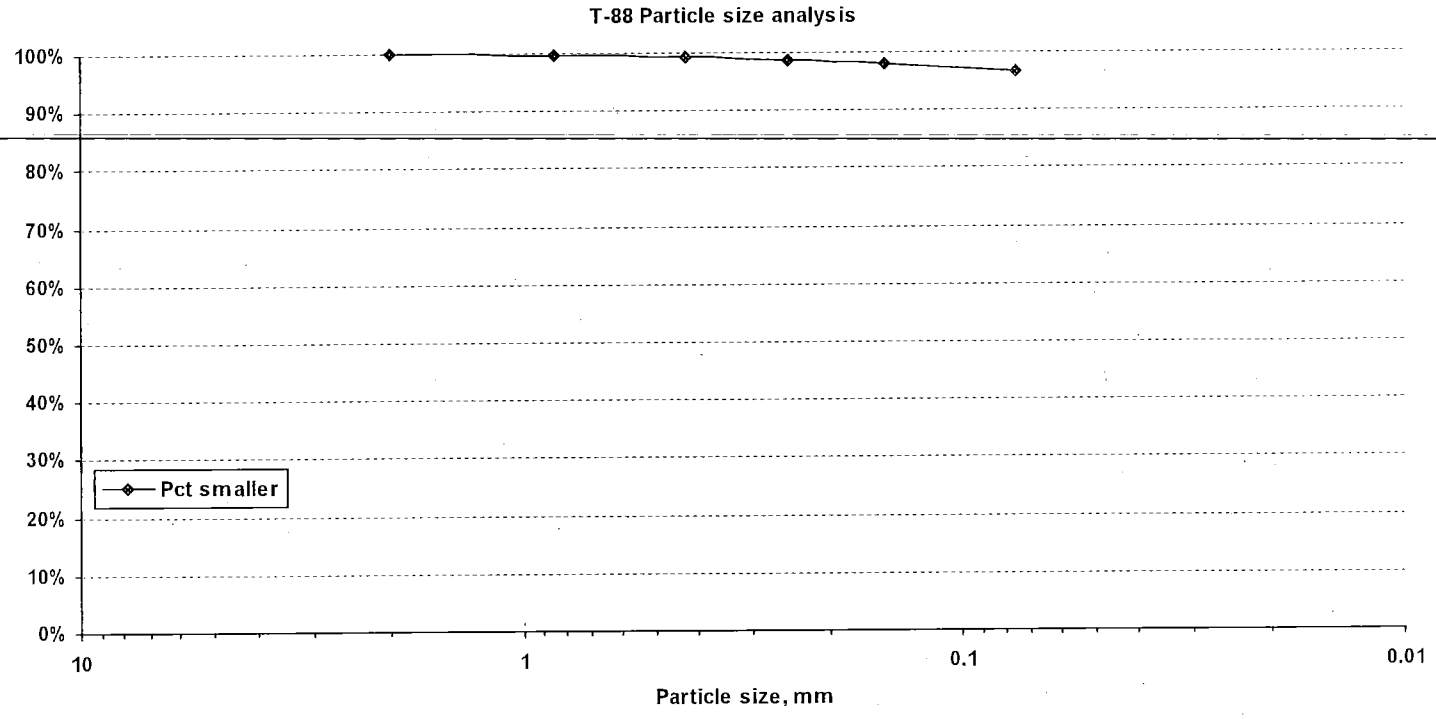
Report on Soil Sample

Lab number: E140187 **Corrected copy:** N/A **Report Date:** 2/6/2014 12:37:25 P

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-6 **Depth:** 10 FT - 12 FT



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Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140188 **Corrected copy:** N/A **Report Date:** 2/6/2014 12:38:43 P
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/30/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 199+85.1 **Offset:** 47.27'LT **Hole:** B-6 **Depth:** 12 FT **to:** 14 FT
Field description: CLAY
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC
Comment:

Test Results

Sieve Analysis

T-88	% Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	
2.00 mm (#10):	
850 µm (#20):	
425 µm (#40):	
250 µm (#60):	
150 µm (#100):	
75 µm (#200):	

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 32.8%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr: **D2487:** N/A
Sa: **M145:** N/A
Si:

Comments: LAB NOTE: MATERIAL WAS SIMILAR AS 14-16 FT.
SAMPLE WAS NOT TESTED FOR LIMITS.

Reviewed by: T. Eliassen, P.G., Transportation Geologist

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Materials and Research Section
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Montpelier, VT 05633-5001

Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140189 **Corrected copy:** N/A **Report Date:** 2/6/2014 12:41:57 P
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/30/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 199+85.1 **Offset:** 47.27'LT **Hole:** B-6 **Depth:** 14 FT **to:** 16 FT
Field description: CLAY
Submitted by: TERRACON **Address:**
~~**Sample type:** SPLIT BARREL~~ ~~**Quantity:**~~
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS, AL
Comment:

Test Results

Sieve Analysis

T-88	% Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	100.0%
2.00 mm (#10):	100.0%
850 µm (#20):	
425 µm (#40):	
250 µm (#60):	99.9%
150 µm (#100):	99.7%
75 µm (#200):	99.3%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content:	30.5%
T-89 Liquid Limit:	30
T-90 Plastic Limit:	24
T-90 Plasticity Index:	6

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr:	0.0%	**D2487:**	ML	
Sa:	0.7%	**M145:**	A-4	Silt
Si:	99.3%			

Comments:

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Distribution list

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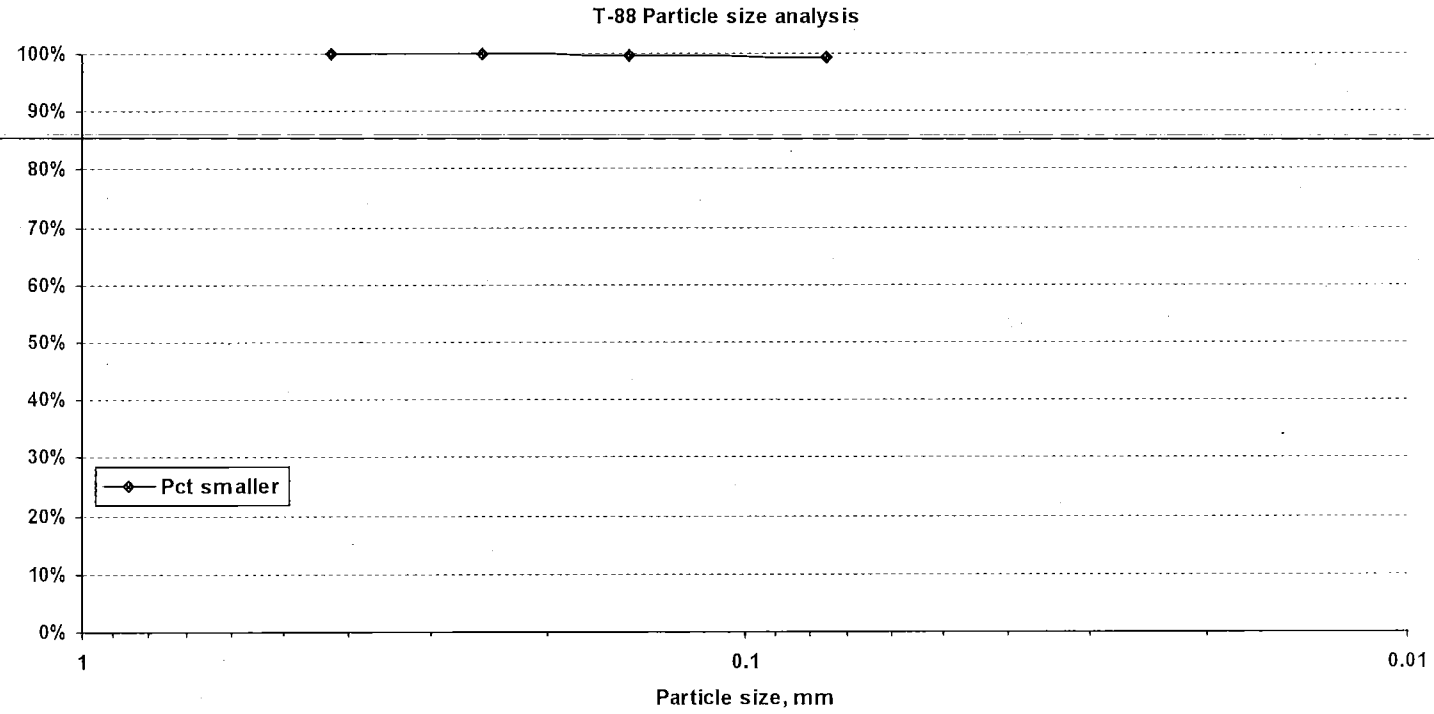
Report on Soil Sample

Lab number: E140189 **Corrected copy:** N/A **Report Date:** 2/6/2014 12:42:00 P

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-6 **Depth:** 14 FT - 16 FT



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Materials and Research Section
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Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140190 **Corrected copy:** N/A **Report Date:** 2/6/2014 12:43:22 P
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64
Date sampled: 1/30/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 199+85.1 **Offset:** 47.27'LT **Hole:** B-6 **Depth:** 16 FT **to:** 18 FT
Field description: CLAY
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC
Comment:

Test Results

T-88	Sieve Analysis % Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	
2.00 mm (#10):	
850 µm (#20):	
425 µm (#40):	
250 µm (#60):	
150 µm (#100):	
75 µm (#200):	

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 29.2%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: pcf
Optimum moisture:
T-100 Specific Gravity:

Gr: **D2487:** N/A
Sa: **M145:** N/A
Si:

Comments: LAB NOTE: MATERIAL WAS SIMILAR AS 18-20 FT.
SAMPLE WAS NOT TESTED FOR LIMITS.

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

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Materials and Research Section
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Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140191 **Corrected copy:** N/A **Report Date:** 2/6/2014 12:45:34 P
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/30/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 199+85.1 **Offset:** 47.27'LT **Hole:** B-6 **Depth:** 18 FT **to:** 20 FT
Field description: CLAY
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS, AL
Comment:

Test Results

T-88	Sieve Analysis % Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	100.0%
2.00 mm (#10):	100.0%
850 µm (#20):	
425 µm (#40):	
250 µm (#60):	99.9%
150 µm (#100):	99.6%
75 µm (#200):	99.4%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content:	28.7%
T-89 Liquid Limit:	28
T-90 Plastic Limit:	23
T-90 Plasticity Index:	5

Moisture Density

Test method: T-180 **Method:**
Maximum density: pcf
Optimum moisture:
T-100 Specific Gravity:

Gr: 0.0% **D2487:** ML
Sa: 0.6% **M145:** A-4 Silt
Si: 99.4%

Comments:

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Distribution list

Vermont Agency of Transportation
Materials and Research Section
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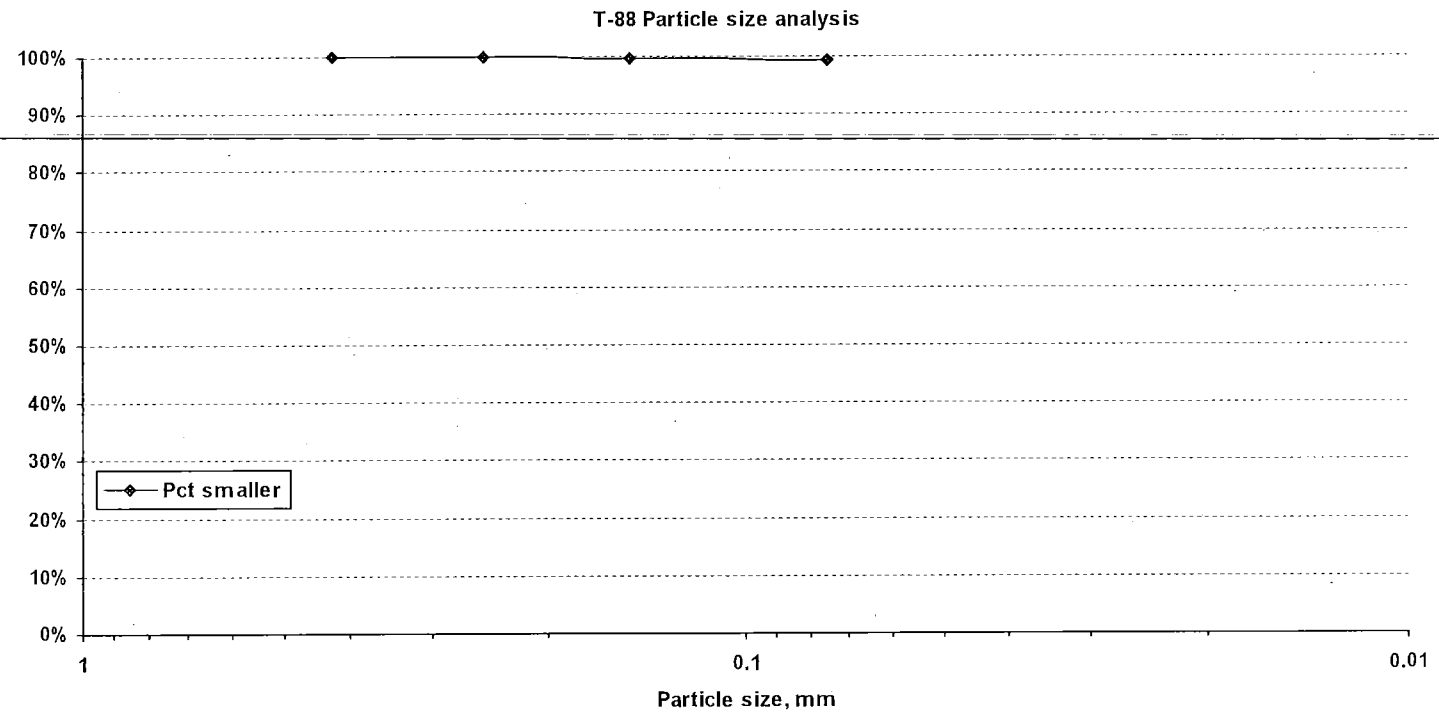
Montpelier, VT 05633-5001

Report on Soil Sample

Lab number: E140191 **Corrected copy:** N/A **Report Date:** 2/6/2014 12:45:39 P

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-6 **Depth:** 18 FT - 20 FT



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Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140192 **Corrected copy:** N/A **Report Date:** 2/6/2014 12:47:37 P
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64
Date sampled: 1/28/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1987+80. **Offset:** 37.66'RT **Hole:** B-7 **Depth:** 0 FT **to:** 2 FT
Field description: Si Sa
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS, AL
Comment:

Test Results

Sieve Analysis

T-88	% Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	92.2%
4.75 mm (#4):	88.6%
2.00 mm (#10):	86.0%
850 µm (#20):	83.4%
425 µm (#40):	78.8%
250 µm (#60):	70.2%
150 µm (#100):	60.1%
75 µm (#200):	48.4%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 19.8%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: pcf
Optimum moisture:
T-100 Specific Gravity:

Gr: 14.0% **D2487:** SM
Sa: 37.6% **M145:** A-4 Sandy Silt
Si: 48.4%

Comments:

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Distribution list

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Materials and Research Section
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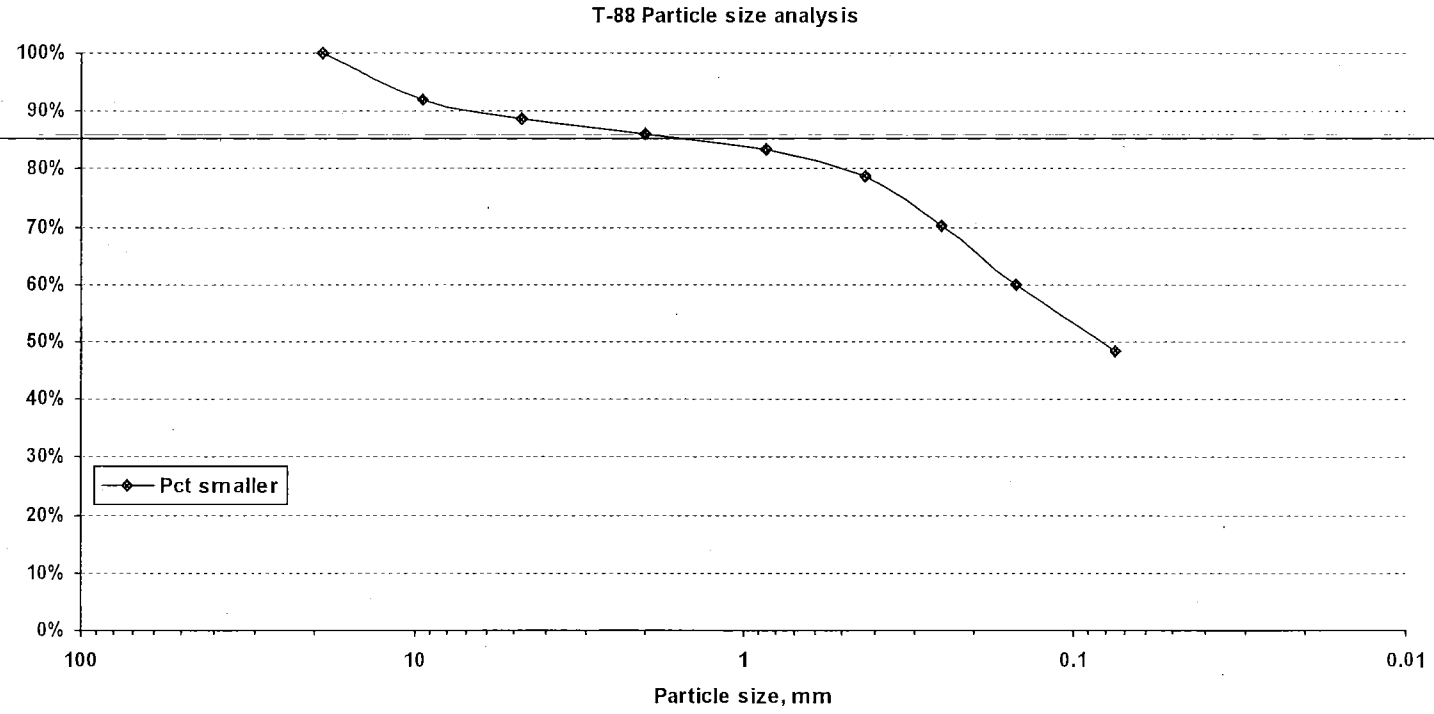
Report on Soil Sample

Lab number: E140192 **Corrected copy:** N/A **Report Date:** 2/6/2014 12:47:42 P

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-7 **Depth:** 0 FT - 2 FT



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Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140193 **Corrected copy:** N/A **Report Date:** 2/6/2014 12:49:11 P
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/28/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1987+80. **Offset:** 37.66'RT **Hole:** B-7 **Depth:** 2 FT **to:** 4 FT
Field description: Sa & Si
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC
Comment:

Test Results

Sieve Analysis

T-88	% Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	
2.00 mm (#10):	
850 µm (#20):	
425 µm (#40):	
250 µm (#60):	
150 µm (#100):	
75 µm (#200):	

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 21.8%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr: **D2487:** N/A
Sa: **M145:** N/A
Si:

Comments: LAB NOTE: MATERIAL WAS SIMILAR AS 4-6 FT.
SAMPLE WAS NOT TESTED FOR LIMITS.

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

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Materials and Research Section
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Montpelier, VT 05633-5001

Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140194 **Corrected copy:** N/A **Report Date:** 2/6/2014 12:51:15 P
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/28/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1987+80. **Offset:** 37.66'RT **Hole:** B-7 **Depth:** 4 FT **to:** 6 FT
Field description: Si Sa
Submitted by: TERRACON **Address:**
~~**Sample type:** SPLIT BARREL~~ ~~**Quantity:**~~
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS, AL
Comment:

Test Results

Sieve Analysis

T-88	% Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	100.0%
2.00 mm (#10):	100.0%
850 µm (#20):	99.7%
425 µm (#40):	99.3%
250 µm (#60):	98.8%
150 µm (#100):	98.3%
75 µm (#200):	97.5%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 28.4%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr: 0.0% **D2487:** ML
Sa: 2.5% **M145:** A-4 Silt
Si: 97.5%

Comments:

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Distribution list

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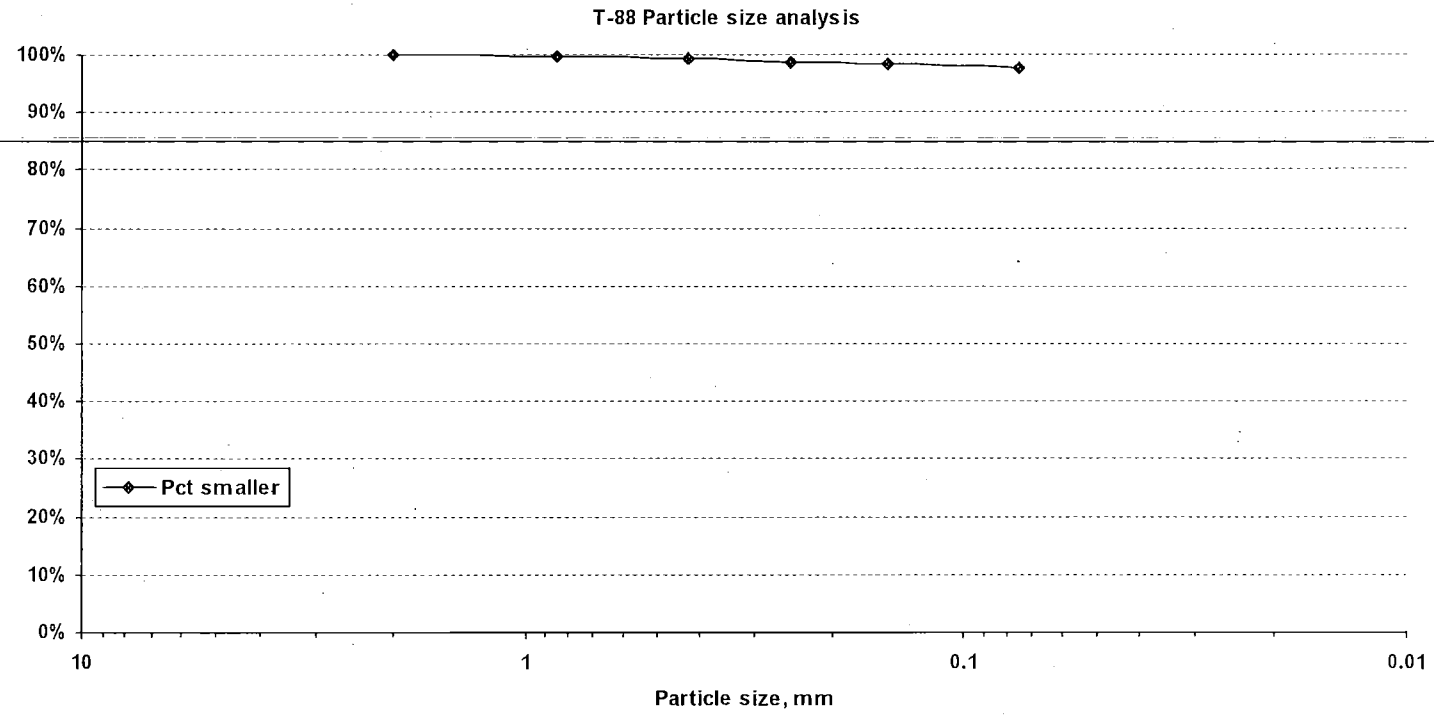
Report on Soil Sample

Lab number: E140194 **Corrected copy:** N/A **Report Date:** 2/6/2014 12:51:19 P

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-7 **Depth:** 4 FT - 6 FT



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Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140195 **Corrected copy:** N/A **Report Date:** 2/6/2014 12:52:37 P
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/28/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1987+80. **Offset:** 37.66'RT **Hole:** B-7 **Depth:** 6 FT **to:** 8 FT
Field description: Si Sa
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC
Comment:

Test Results

T-88	Sieve Analysis % Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	
2.00 mm (#10):	
850 µm (#20):	
425 µm (#40):	
250 µm (#60):	
150 µm (#100):	
75 µm (#200):	

Hydrometer Analysis Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 26.3%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: pcf
Optimum moisture:
T-100 Specific Gravity:

Gr: **D2487:** N/A
Sa: **M145:** N/A
Si:

Comments: LAB NOTE: MATERIAL WAS SIMILAR AS 8-10 FT.
SAMPLE WAS NOT TESTED FOR LIMITS.

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

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Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140196 **Corrected copy:** N/A **Report Date:** 2/6/2014 12:54:07 P
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/28/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1987+80 **Offset:** 37.66'RT **Hole:** B-7 **Depth:** 8 FT **to:** 10 FT
Field description: Si Sa
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS, AL
Comment:

Test Results

Sieve Analysis

T-88	% Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	100.0%
2.00 mm (#10):	100.0%
850 µm (#20):	99.6%
425 µm (#40):	98.9%
250 µm (#60):	98.2%
150 µm (#100):	97.2%
75 µm (#200):	95.6%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 27.1%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr: 0.0% **D2487:** ML
Sa: 4.4% **M145:** A-4 Silt
Si: 95.6%

Comments:

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Distribution list

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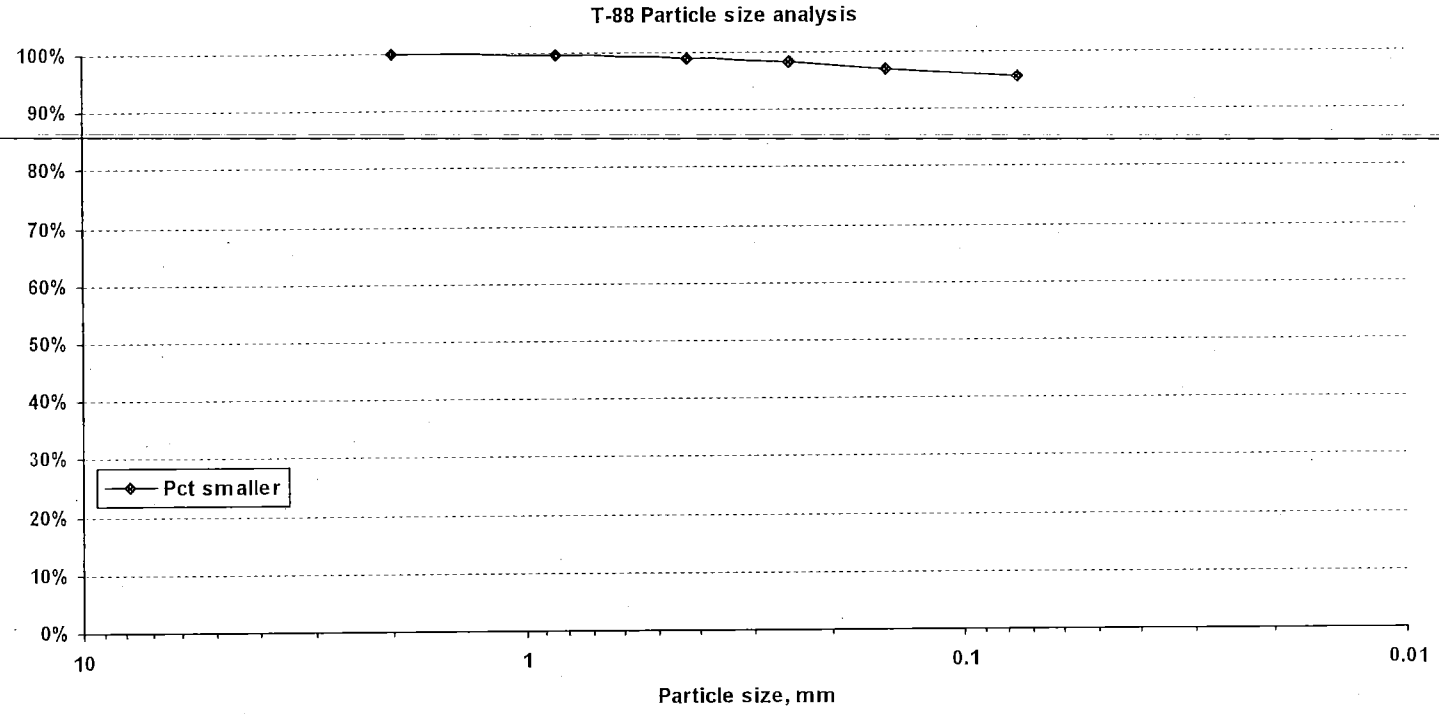
Report on Soil Sample

Lab number: E140196 **Corrected copy:** N/A **Report Date:** 2/6/2014 12:54:11 P

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-7 **Depth:** 8 FT - 10 FT



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Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140197 **Corrected copy:** N/A **Report Date:** 2/6/2014 12:55:32 P
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/28/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1987+80. **Offset:** 37.66'RT **Hole:** B-7 **Depth:** 10 FT **to:** 12 FT
Field description: Si Cl
Submitted by: TERRACON **Address:**

Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC
Comment:

Test Results

Sieve Analysis

T-88	% Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	
2.00 mm (#10):	
850 µm (#20):	
425 µm (#40):	
250 µm (#60):	
150 µm (#100):	
75 µm (#200):	

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 29.1%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: pcf
Optimum moisture:
T-100 Specific Gravity:

Gr: **D2487:** N/A
Sa: **M145:** N/A
Si:

Comments: LAB NOTE: MATERIAL WAS SIMILAR AS 12-14 FT.
SAMPLE WAS NOT TESTED FOR LIMITS.

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

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Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140198 **Corrected copy:** N/A **Report Date:** 2/6/2014 12:57:47 P
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64
Date sampled: 1/28/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1987+80. **Offset:** 37.66'RT **Hole:** B-7 **Depth:** 12 FT **to:** 14 FT
Field description: Si Cl
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS, AL
Comment:

Test Results

T-88	Sieve Analysis % Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	100.0%
2.00 mm (#10):	100.0%
850 µm (#20):	
425 µm (#40):	
250 µm (#60):	
150 µm (#100):	99.8%
75 µm (#200):	99.4%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content:	34.5%
T-89 Liquid Limit:	30
T-90 Plastic Limit:	24
T-90 Plasticity Index:	6

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr: 0.0% **D2487:** ML
Sa: 0.6% **M145:** A-4 Silt
Si: 99.4%

Comments:

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Distribution list

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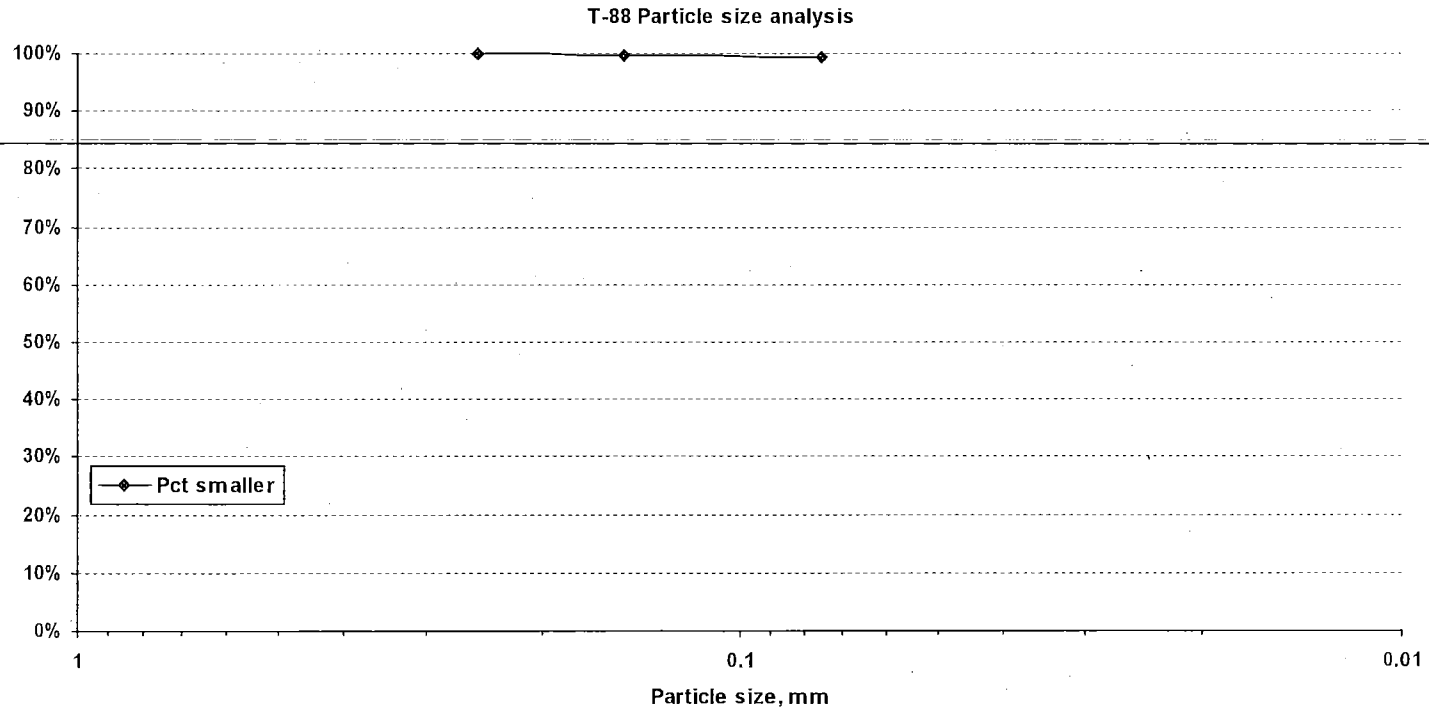
Report on Soil Sample

Lab number: E140198 **Corrected copy:** N/A **Report Date:** 2/6/2014 12:57:52 P

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-7 **Depth:** 12 FT - 14 FT



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Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140199 **Corrected copy:** N/A **Report Date:** 2/6/2014 1:02:34 P
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/28/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1987+80. **Offset:** 37.66'RT **Hole:** B-7 **Depth:** 16 FT **to:** 18 FT
Field description: Si Cl
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC
Comment:

Test Results

Sieve Analysis
T-88 **% Passing Total Sample**

75 mm (3.0"):
37.5 mm (1.5"):
19 mm (3/4"):
9.5 mm (3/8"):
4.75 mm (#4):
2.00 mm (#10):
850 µm (#20):
425 µm (#40):
250 µm (#60):
150 µm (#100):
75 µm (#200):

Hydrometer Analysis
Particles smaller **% total sample**

0.05 mm:
0.02 mm:
0.005 mm:
0.002 mm:
0.001 mm:

Limits
T-265 Moisture content: 30.5%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density
Test method: T-180 **Method:**
Maximum density: pcf
Optimum moisture:
T-100 Specific Gravity:

Gr: **D2487:** N/A
Sa: **M145:** N/A
Si:

Comments: LAB NOTE: MATERIAL WAS SIMILAR AS 18-20 FT.
SAMPLE WAS NOT TESTED FOR LIMITS.

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

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Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140200 **Corrected copy:** N/A **Report Date:** 2/6/2014 1:02:51 P
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/28/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1987+80. **Offset:** 37.66'RT **Hole:** B-7 **Depth:** 18 FT **to:** 20 FT
Field description: CLAY
Submitted by: TERRACON **Address:**
~~**Sample type:** SPLIT BARREL~~ ~~**Quantity:**~~
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS, AL
Comment:

Test Results

Sieve Analysis

T-88	% Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	100.0%
2.00 mm (#10):	100.0%
850 µm (#20):	99.9%
425 µm (#40):	99.6%
250 µm (#60):	99.4%
150 µm (#100):	99.1%
75 µm (#200):	98.5%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content:	35.9%
T-89 Liquid Limit:	42
T-90 Plastic Limit:	21
T-90 Plasticity Index:	21

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr: 0.0% **D2487:** CL
Sa: 1.5% **M145:** A-7-6 Clay
Si: 98.5%

Comments:

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Distribution list

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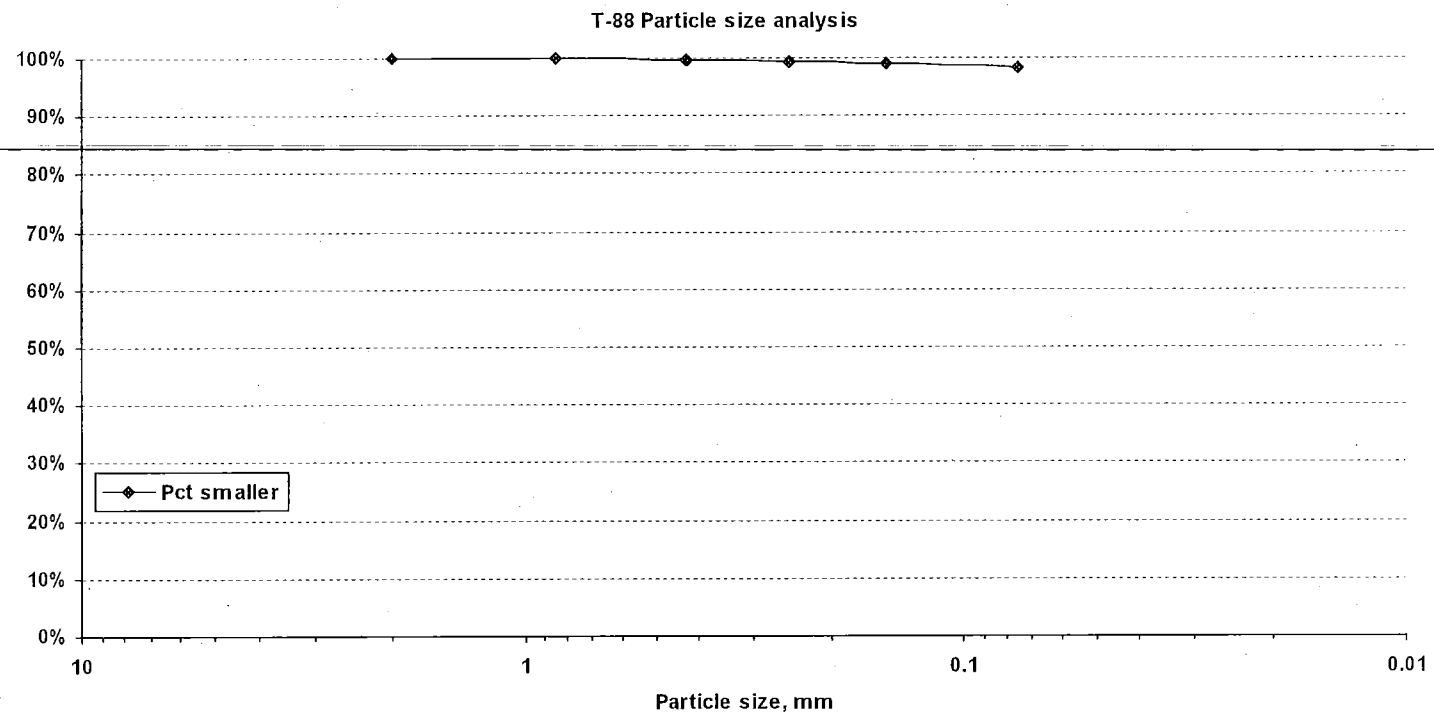
Report on Soil Sample

Lab number: E140200 **Corrected copy:** N/A **Report Date:** 2/6/2014 1:02:54 P

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-7 **Depth:** 18 FT - 20 FT



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Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140203 **Corrected copy:** N/A **Report Date:** 2/6/2014 1:05:04 P
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/28/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1996+83. **Offset:** 34.21'LT **Hole:** B-8 **Depth:** 0 FT **to:** 2 FT
Field description: Sa & Gr
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS, AL
Comment:

Test Results

Sieve Analysis

T-88	% Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	97.3%
4.75 mm (#4):	85.8%
2.00 mm (#10):	71.5%
850 µm (#20):	60.8%
425 µm (#40):	50.3%
250 µm (#60):	39.6%
150 µm (#100):	29.8%
75 µm (#200):	20.9%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 16.0%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr: 28.5% **D2487:** SM
Sa: 50.6% **M145:** A-1-b Silty Gravelly Sand
Si: 20.9%

Comments:

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Distribution list

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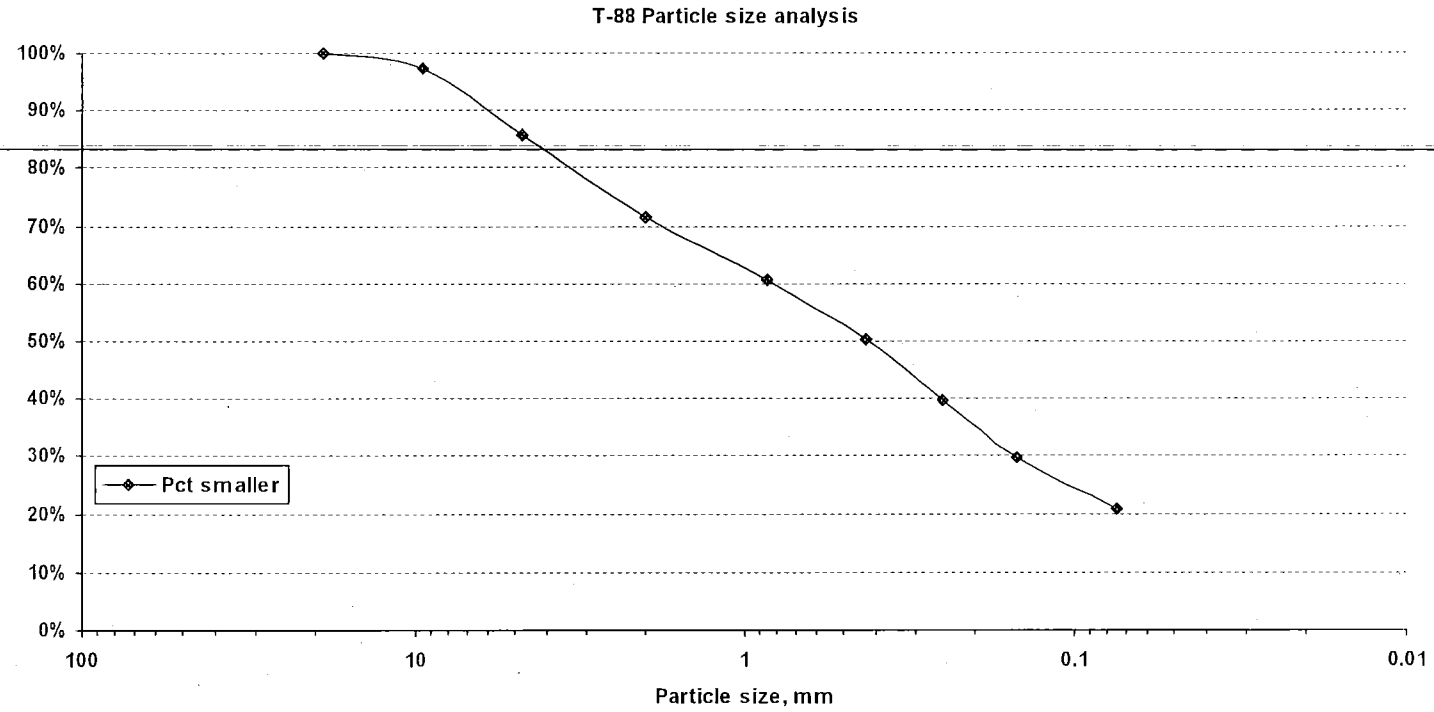
Materials and Research Section
1 National Life Drive
Montpelier, VT 05633-5001

Report on Soil Sample

Lab number: E140203 **Corrected copy:** N/A **Report Date:** 2/6/2014 1:05:07 P

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-8 **Depth:** 0 FT - 2 FT



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Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140204 **Corrected copy:** N/A **Report Date:** 2/6/2014 1:06:29 P
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/28/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1996+83. **Offset:** 34.21'LT **Hole:** B-8 **Depth:** 2 FT **to:** 3.5 FT
Field description: Sa & Gr
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS, AL
Comment:

Test Results

Sieve Analysis

T-88	% Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	92.5%
4.75 mm (#4):	90.8%
2.00 mm (#10):	85.1%
850 µm (#20):	72.6%
425 µm (#40):	57.0%
250 µm (#60):	46.0%
150 µm (#100):	33.8%
75 µm (#200):	14.2%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 12.6%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr: 14.9% **D2487:** SM
Sa: 70.9% **M145:** A-2-4 Sand
Si: 14.2%

Comments:

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Distribution list

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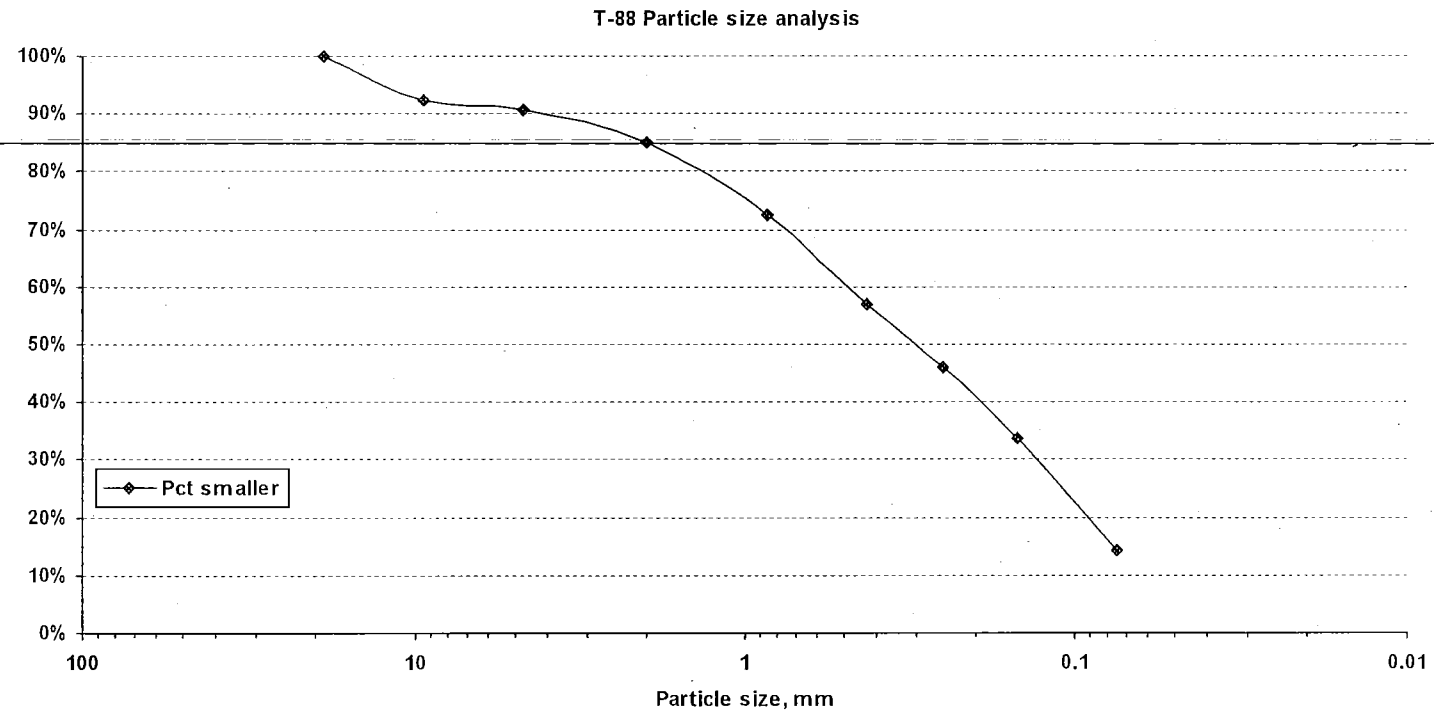
Report on Soil Sample

Lab number: E140204 **Corrected copy:** N/A **Report Date:** 2/6/2014 1:06:34 P

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-8 **Depth:** 2 FT - 3.5 FT



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Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140205 **Corrected copy:** N/A **Report Date:** 2/6/2014 1:08:26 P
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/28/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1996+83. **Offset:** 34.21'LT **Hole:** B-8 **Depth:** 3.5 FT **to:** 4 FT
Field description: Si Sa
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS, AL
Comment:

Test Results

Sieve Analysis

T-88	% Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	89.6%
9.5 mm (3/8"):	74.0%
4.75 mm (#4):	62.8%
2.00 mm (#10):	60.2%
850 µm (#20):	57.7%
425 µm (#40):	54.1%
250 µm (#60):	48.6%
150 µm (#100):	39.8%
75 µm (#200):	25.9%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 11.4%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: pcf
Optimum moisture:
T-100 Specific Gravity:

Gr: 39.8% **D2487:** GM
Sa: 34.3% **M145:** A-2-4 Silty Sandy Gravel
Si: 25.9%

Comments: LAB NOTE: LOTS OF BROKEN ROCK WAS WITHIN SAMPLE.

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Distribution list

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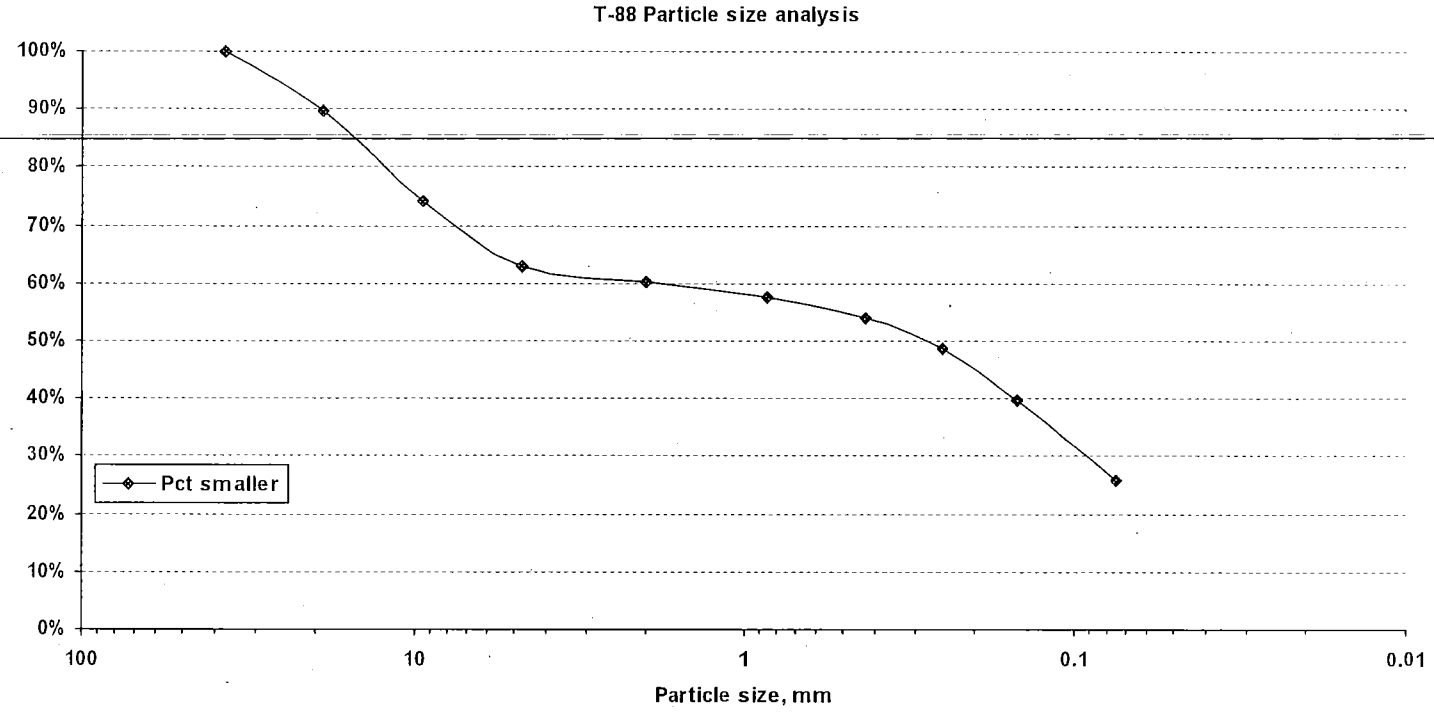
Report on Soil Sample

Lab number: E140205 **Corrected copy:** N/A **Report Date:** 2/6/2014 1:08:31 P

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-8 **Depth:** 3.5 FT - 4 FT



Vermont Agency of Transportation
Materials and Research Section
1 National Life Drive
Montpelier, VT 05633-5001

Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140206 **Corrected copy:** N/A **Report Date:** 2/6/2014 1:09:51 P
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/28/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1996+83. **Offset:** 34.21'LT **Hole:** B-8 **Depth:** 4 FT **to:** 6 FT
Field description: Si Sa
Submitted by: TERRACON **Address:**
~~**Sample type:** SPLIT BARREL~~ ~~**Quantity:**~~
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS, AL
Comment:

Test Results

T-88	Sieve Analysis % Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	97.5%
2.00 mm (#10):	95.2%
850 µm (#20):	92.8%
425 µm (#40):	89.1%
250 µm (#60):	82.1%
150 µm (#100):	74.3%
75 µm (#200):	64.1%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 15.4%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr: 4.8% **D2487:** ML
Sa: 31.1% **M145:** A-4 Sandy Silt
Si: 64.1%

Comments:

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Distribution list

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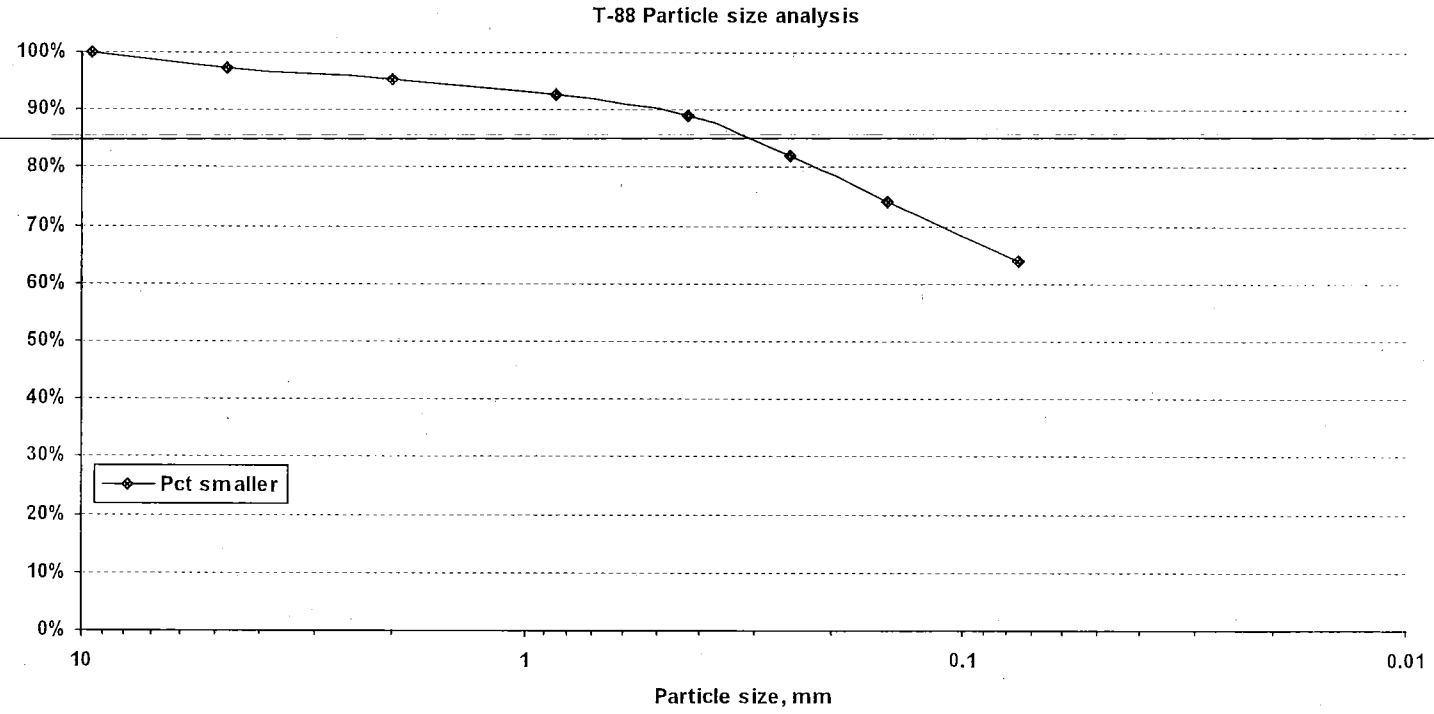
Report on Soil Sample

Lab number: E140206 **Corrected copy:** N/A **Report Date:** 2/6/2014 1:09:54 P

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-8 **Depth:** 4 FT - 6 FT



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Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140207 **Corrected copy:** N/A **Report Date:** 2/6/2014 1:12:26 P
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/28/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1996+83. **Offset:** 34.21'LT **Hole:** B-8 **Depth:** 6 FT **to:** 8 FT
Field description: Si Cl
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS, AL
Comment:

Test Results

T-88	Sieve Analysis % Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	86.0%
4.75 mm (#4):	82.5%
2.00 mm (#10):	77.4%
850 µm (#20):	72.6%
425 µm (#40):	67.5%
250 µm (#60):	61.7%
150 µm (#100):	55.5%
75 µm (#200):	46.8%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content:	14.0%
T-89 Liquid Limit:	19
T-90 Plastic Limit:	17
T-90 Plasticity Index:	2

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr:	22.6%	**D2487:**	SM	
Sa:	30.6%	**M145:**	A-4	Gravelly Sandy Silt
Si:	46.8%			

Comments:

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Distribution list

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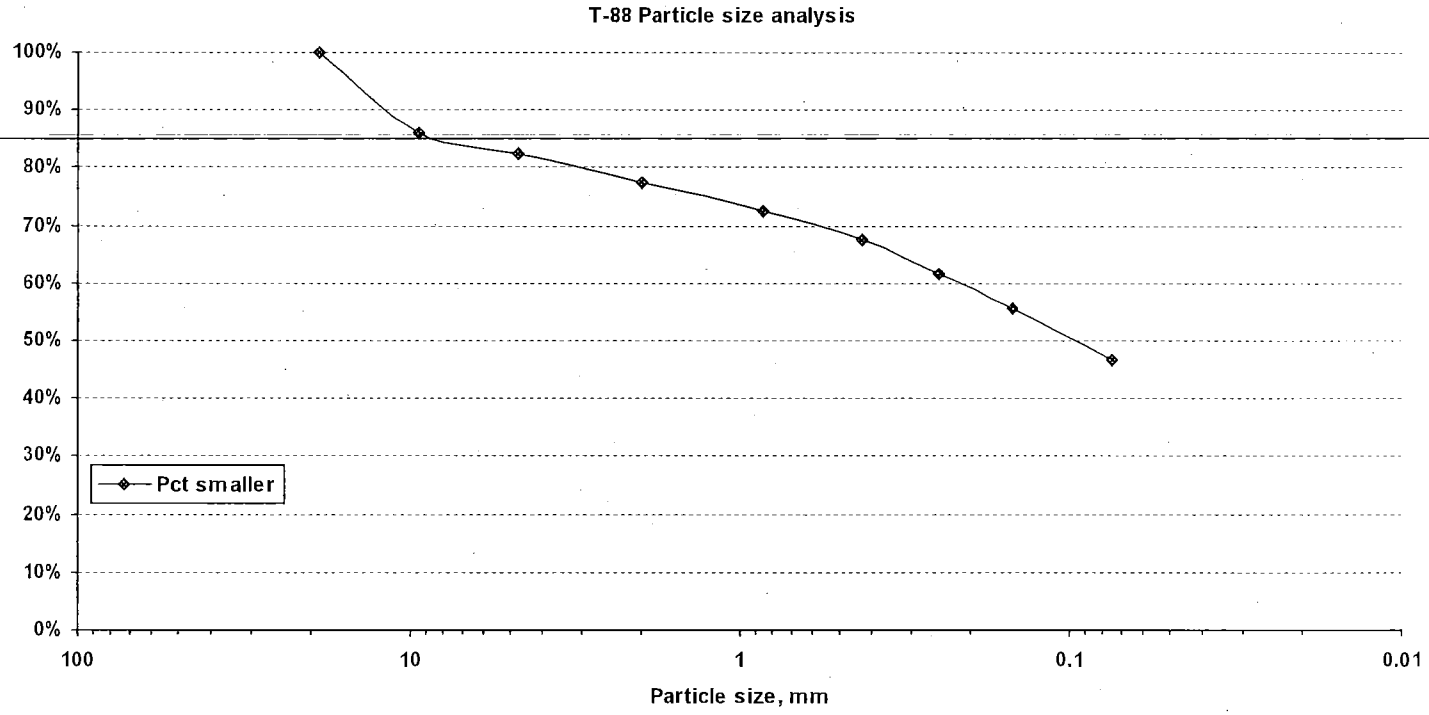
Report on Soil Sample

Lab number: E140207 **Corrected copy:** N/A **Report Date:** 2/6/2014 1:12:30 P

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-8 **Depth:** 6 FT - 8 FT



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Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140208 **Corrected copy:** N/A **Report Date:** 2/6/2014 1:14:02 P
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/28/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1996+83. **Offset:** 34.21'LT **Hole:** B-8 **Depth:** 8 FT **to:** 10 FT
Field description: Si Sa
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS, AL
Comment:

Test Results

Sieve Analysis

T-88	% Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	96.1%
9.5 mm (3/8"):	91.2%
4.75 mm (#4):	78.7%
2.00 mm (#10):	73.3%
850 µm (#20):	68.1%
425 µm (#40):	60.7%
250 µm (#60):	51.9%
150 µm (#100):	43.0%
75 µm (#200):	31.7%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 14.7%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr: 26.7% **D2487:** SM
Sa: 41.6% **M145:** A-2-4 Gravelly Silty Sand
Si: 31.7%

Comments:

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Distribution list

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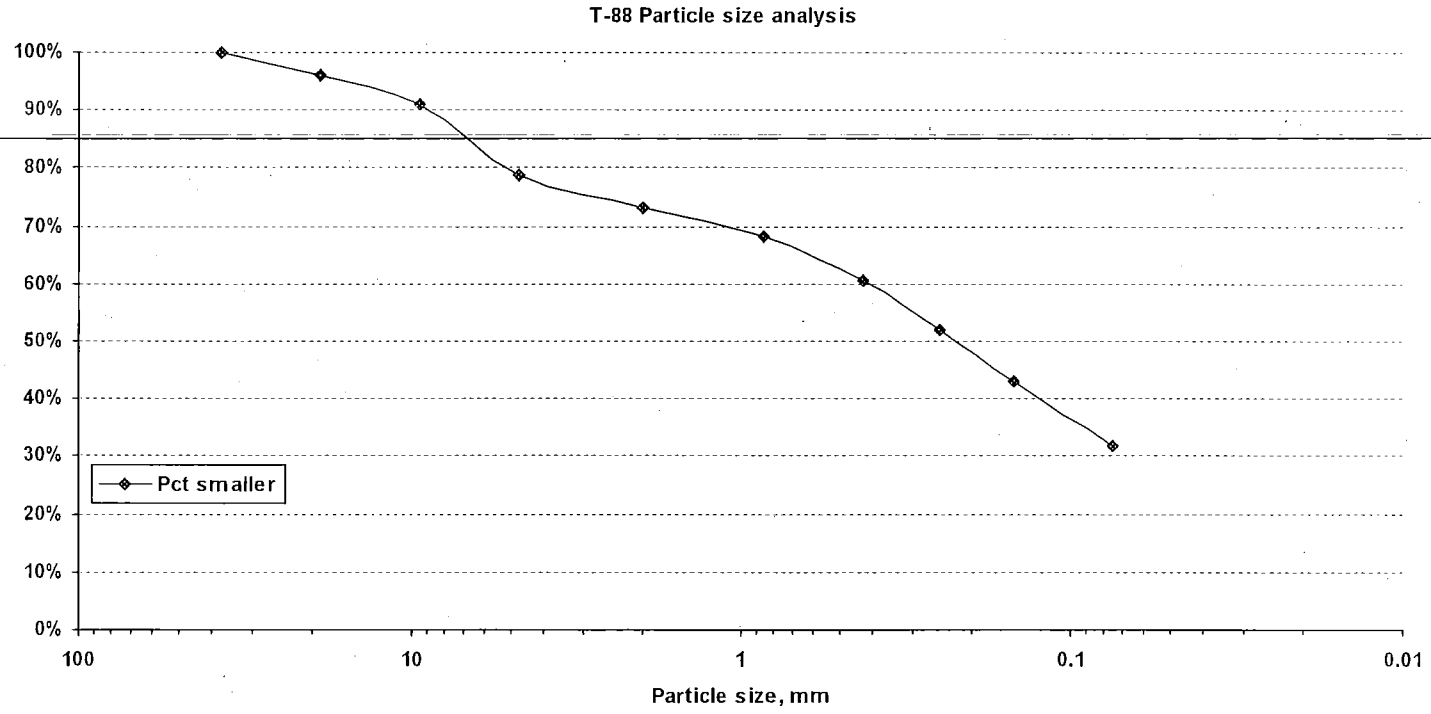
Report on Soil Sample

Lab number: E140208 **Corrected copy:** N/A **Report Date:** 2/6/2014 1:14:06 P

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-8 **Depth:** 8 FT - 10 FT



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Distribution list
TERRACON
T. ELIASSEN
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Report on Soil Sample

Lab number: E140209 **Corrected copy:** N/A **Report Date:** 2/6/2014 1:16:52 P
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/28/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1996+83. **Offset:** 34.21'LT **Hole:** B-8 **Depth:** 10 FT **to:** 12 FT
Field description: SILT
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS, AL
Comment:

Test Results

T-88	Sieve Analysis % Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	100.0%
2.00 mm (#10):	100.0%
850 µm (#20):	98.3%
425 µm (#40):	95.1%
250 µm (#60):	91.6%
150 µm (#100):	87.5%
75 µm (#200):	79.0%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content:	25.2%
T-89 Liquid Limit:	32
T-90 Plastic Limit:	19
T-90 Plasticity Index:	13

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr:	0.0%	D2487:	CL	
Sa:	21.0%	M145:	A-6	Silty Clay
Si:	79.0%			

Comments:

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Distribution list

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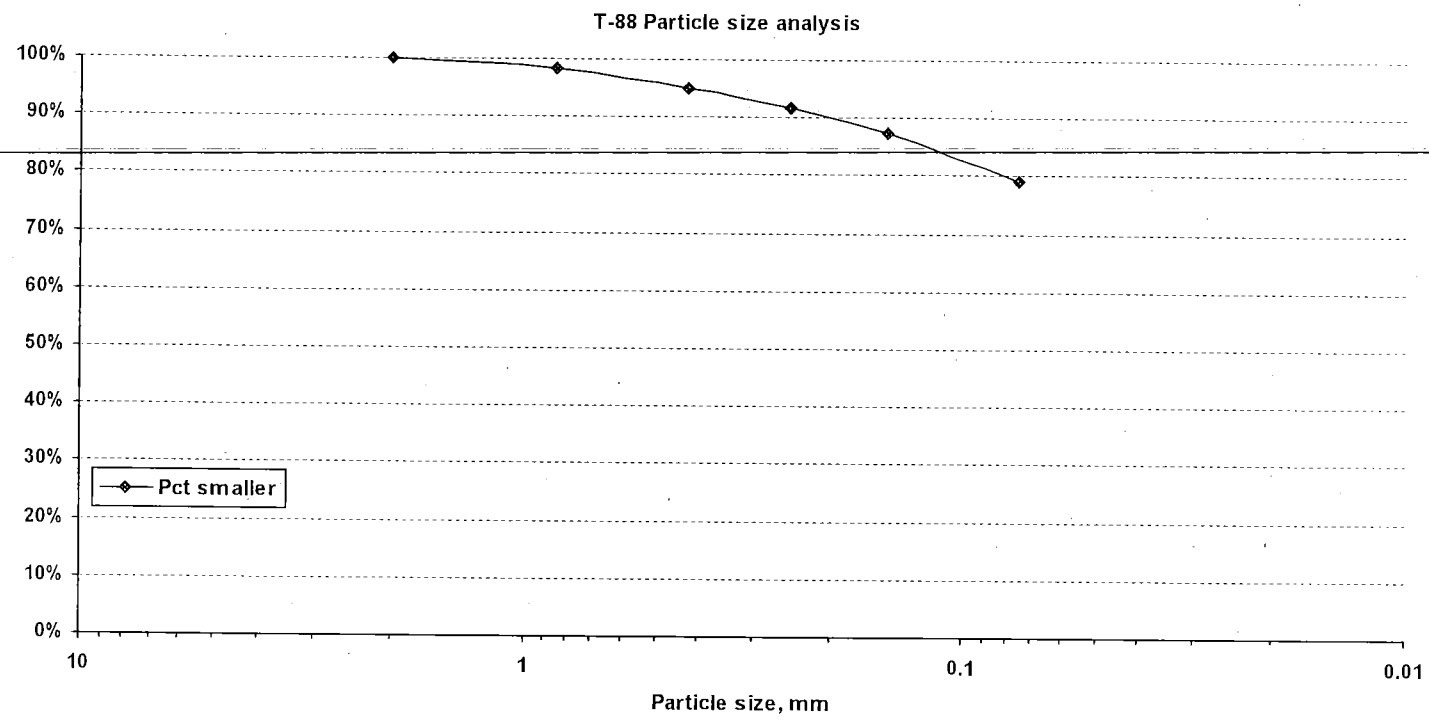
Report on Soil Sample

Lab number: E140209 **Corrected copy:** N/A **Report Date:** 2/6/2014 1:16:56 P

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-8 **Depth:** 10 FT - 12 FT



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Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140210 **Corrected copy:** N/A **Report Date:** 2/6/2014 1:18:23 P
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64
Date sampled: 1/28/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1996+83. **Offset:** 34.21'LT **Hole:** B-8 **Depth:** 12 FT **to:** 13.5 FT
Field description: Si Sa
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS, AL
Comment:

Test Results

Sieve Analysis

T-88	% Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	99.5%
2.00 mm (#10):	98.8%
850 µm (#20):	97.9%
425 µm (#40):	93.4%
250 µm (#60):	78.6%
150 µm (#100):	52.1%
75 µm (#200):	23.9%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 21.8%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr: 1.2% **D2487:** SM
Sa: 74.8% **M145:** A-2-4 Silty Sand
Si: 23.9%

Comments:

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Distribution list

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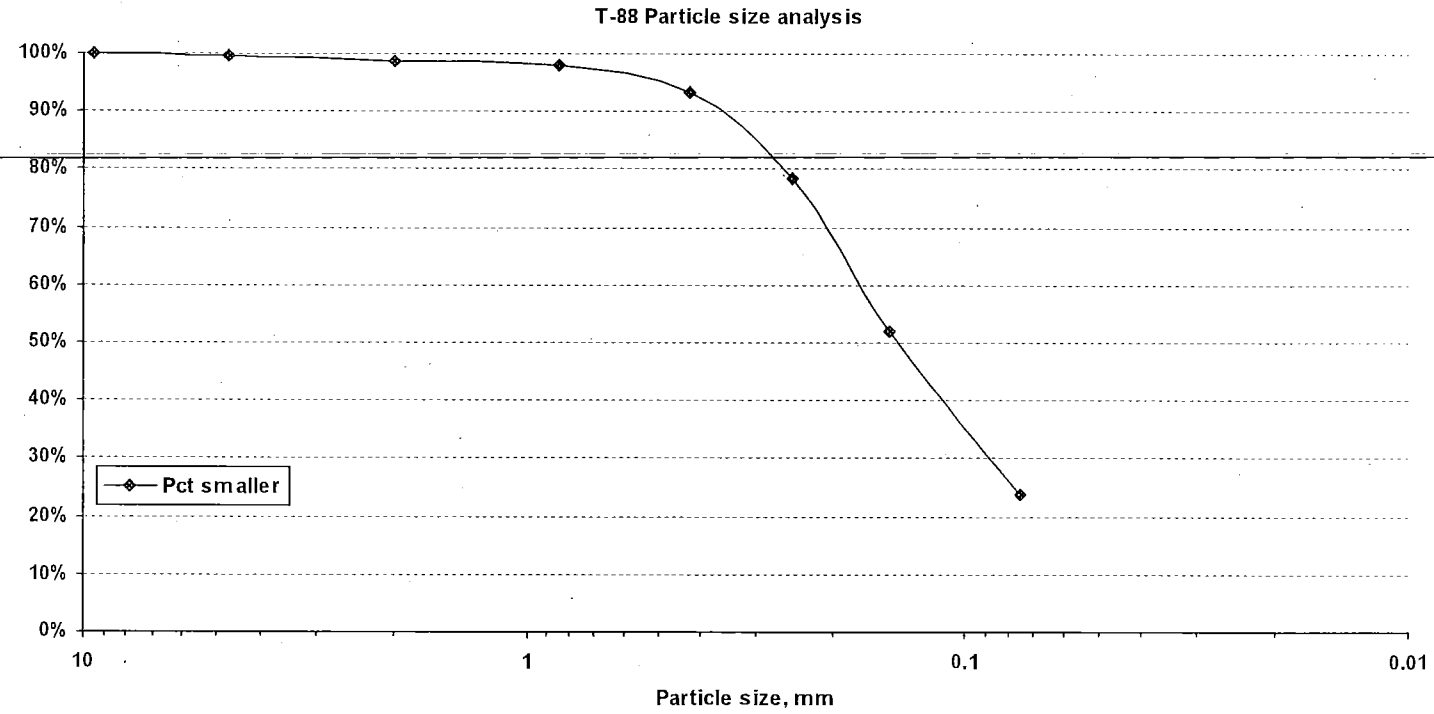
Report on Soil Sample

Lab number: E140210 **Corrected copy:** N/A **Report Date:** 2/6/2014 1:18:27 P

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-8 **Depth:** 12 FT - 13.5 FT



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Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140211 **Corrected copy:** N/A **Report Date:** 2/6/2014 1:25:29 P
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/28/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1996+83. **Offset:** 34.21'LT **Hole:** B-8 **Depth:** 13.5 FT **to:** 14 FT
Field description: SILT
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS
Comment:

Test Results

Sieve Analysis

T-88	% Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	100.0%
2.00 mm (#10):	100.0%
850 µm (#20):	99.6%
425 µm (#40):	99.3%
250 µm (#60):	98.5%
150 µm (#100):	97.7%
75 µm (#200):	95.5%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 27.8%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr: 0.0% **D2487:** ML
Sa: 4.5% **M145:** A-4 Silt
Si: 95.5%

Comments: LAB NOTE: A VERY SMALL AREA OF CLAY MATERIAL WAS NOTICEABLE. SAMPLE WAS NOT TESTED FOR LIMITS.

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Distribution list

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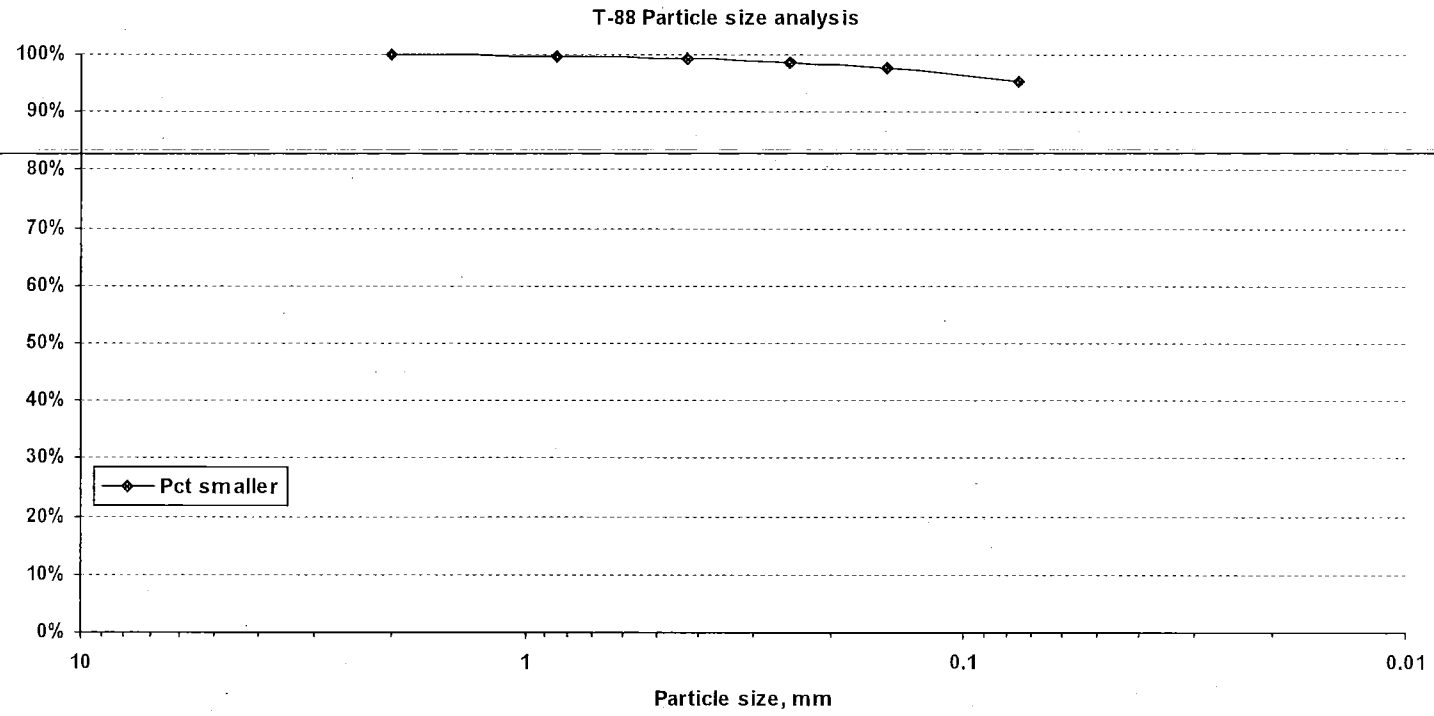
Report on Soil Sample

Lab number: E140211 **Corrected copy:** N/A **Report Date:** 2/6/2014 1:25:32 P

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-8 **Depth:** 13.5 FT - 14 FT



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Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140212 **Corrected copy:** N/A **Report Date:** 2/6/2014 1:27:58 P
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/28/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1996+83. **Offset:** 34.21'LT **Hole:** B-8 **Depth:** 14 FT **to:** 16 FT
Field description: SILT
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS, AL
Comment:

Test Results

T-88	Sieve Analysis % Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	100.0%
2.00 mm (#10):	100.0%
850 µm (#20):	99.7%
425 µm (#40):	99.1%
250 µm (#60):	98.3%
150 µm (#100):	97.6%
75 µm (#200):	96.2%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content:	28.0%
T-89 Liquid Limit:	27
T-90 Plastic Limit:	24
T-90 Plasticity Index:	3

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr: 0.0% **D2487:** ML
Sa: 3.8% **M145:** A-4 Silt
Si: 96.2%

Comments:

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Distribution list

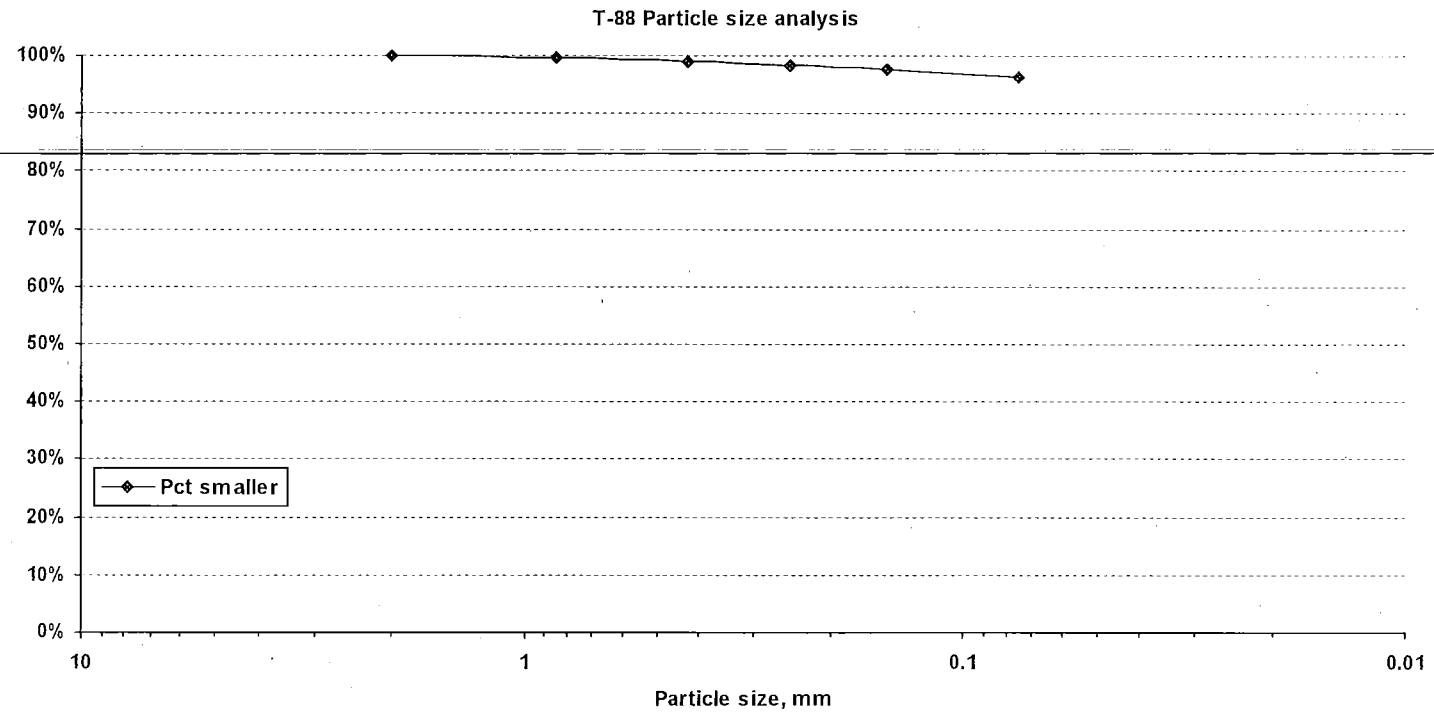
Vermont Agency of Transportation
Materials and Research Section
1 National Life Drive
Montpelier, VT 05633-5001

Report on Soil Sample

Lab number: E140212 **Corrected copy:** N/A **Report Date:** 2/6/2014 1:28:01 P

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-8 **Depth:** 14 FT - 16 FT



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Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140213 **Corrected copy:** N/A **Report Date:** 2/6/2014 1:29:25 P
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/28/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1996+83. **Offset:** 34.21'LT **Hole:** B-8 **Depth:** 16 FT **to:** 18 FT
Field description: SILT
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS, AL
Comment:

Test Results

Sieve Analysis

T-88	% Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	100.0%
2.00 mm (#10):	100.0%
850 µm (#20):	
425 µm (#40):	
250 µm (#60):	
150 µm (#100):	99.9%
75 µm (#200):	99.7%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 27.2%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: pcf
Optimum moisture:
T-100 Specific Gravity:

Gr: 0.0% **D2487:** ML
Sa: 0.3% **M145:** A-4 Silt
Si: 99.7%

Comments:

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Distribution list

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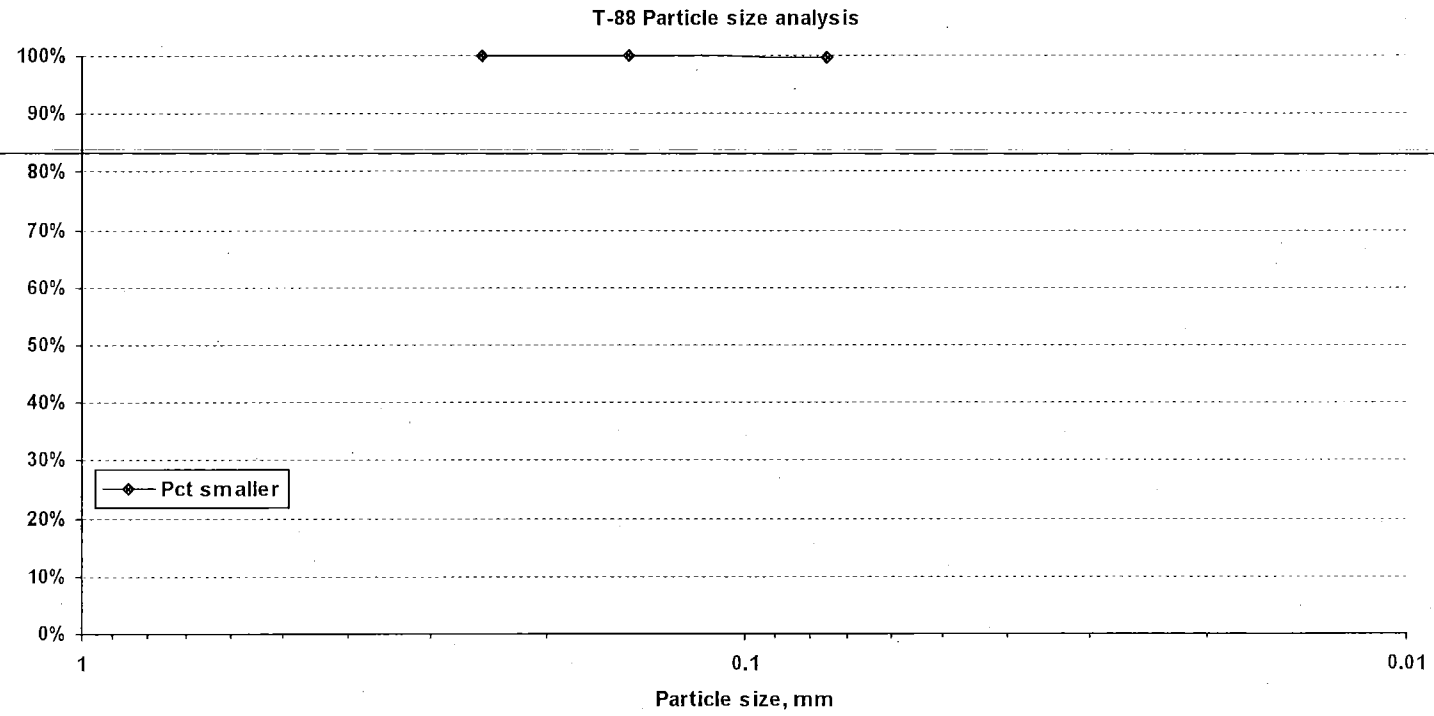
Report on Soil Sample

Lab number: E140213 **Corrected copy:** N/A **Report Date:** 2/6/2014 1:29:29 P

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-8 **Depth:** 16 FT - 18 FT



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Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140214 **Corrected copy:** N/A **Report Date:** 2/6/2014 1:30:43 P
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/28/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1996+83. **Offset:** 34.21'LT **Hole:** B-8 **Depth:** 18 FT **to:** 20 FT
Field description: SILT
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC
Comment:

Test Results

Sieve Analysis

T-88	% Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	
2.00 mm (#10):	
850 µm (#20):	
425 µm (#40):	
250 µm (#60):	
150 µm (#100):	
75 µm (#200):	

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 28.3%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: pcf
Optimum moisture:
T-100 Specific Gravity:

Gr: **D2487:** N/A
Sa: **M145:** N/A
Si:

Comments: LAB NOTE: MATERIAL WAS SIMILAR AS 20-22 FT.
SAMPLE WAS NOT TESTED FOR LIMITS.

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Vermont Agency of Transportation
Materials and Research Section
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Distribution list
TERRACON
T. ELIASSEN
J. TOUCHETTE

Report on Soil Sample

Lab number: E140215 **Corrected copy:** N/A **Report Date:** 2/6/2014 1:33:03 P
Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Date sampled: 1/28/2014 **Received:** 1/30/2014 **Tested:** 1/31/2014 **Tested by:** J. TOUCHETTE
Station: 1996+83. **Offset:** 34.21'LT **Hole:** B-8 **Depth:** 20 FT **to:** 22 FT
Field description: SILT
Submitted by: TERRACON **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** MC, GS, AL
Comment:

Test Results

T-88	Sieve Analysis % Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	100.0%
2.00 mm (#10):	100.0%
850 µm (#20):	
425 µm (#40):	
250 µm (#60):	99.9%
150 µm (#100):	99.5%
75 µm (#200):	99.1%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content:	28.4%
T-89 Liquid Limit:	28
T-90 Plastic Limit:	23
T-90 Plasticity Index:	5

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr:	0.0%	D2487:	ML	
Sa:	0.9%	M145:	A-4	Silt
Si:	99.1%			

Comments:

Reviewed by: T. Eliassen, P.G., Transportation Geologist TE

Distribution list

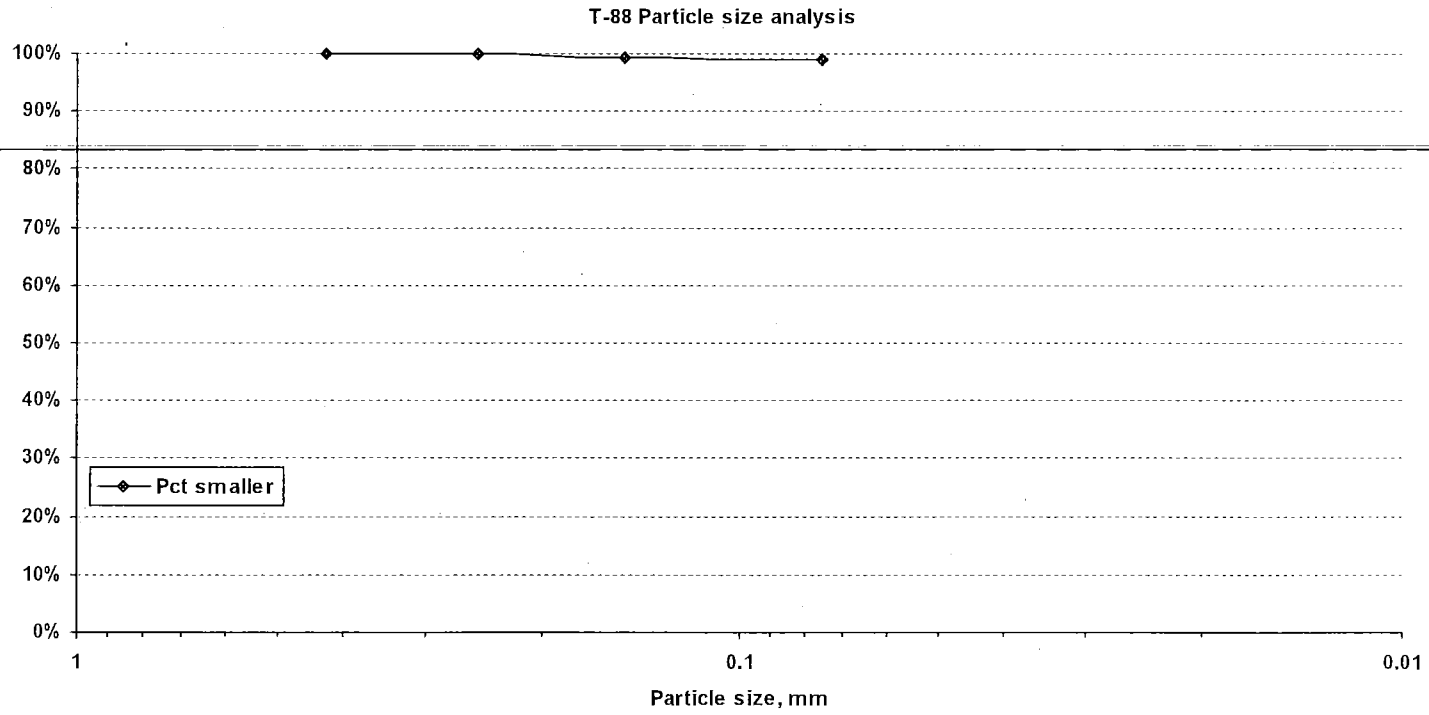
Vermont Agency of Transportation
Materials and Research Section
1 National Life Drive
Montpelier, VT 05633-5001

Report on Soil Sample

Lab number: E140215 **Corrected copy:** N/A **Report Date:** 2/6/2014 1:33:08 P

Project: SOUTH BURLINGTON **Number:** IM CULV(24) **Site:** I-89 BR 63 & 64

Hole: B-8 **Depth:** 20 FT - 22 FT



APPENDIX E: Stream Simulation Memo

Planning | Transportation | Land Development | Environmental

Vanasse Hangen Brustlin, Inc.
7056 U.S. Route 7
P.O. Box 120
North Ferrisburgh, VT 05473
802 497-6100 ▪ Fax 802 425-7799
www.vhb.com

Memorandum

To: Aaron Guyette
VHB, Inc.
7056 U.S. Route 7
P.O. Box 120
North Ferrisburgh, Vermont

Date: September 5, 2014

Project No.: 57579.00

From: Sarah A. Widing, P.E.

Re: I-89 Culverts 83N and 83S. Georgia, Vermont
Design specifications

This memo describes the work performed, by VHB, to provide specifications for stream simulation design culverts 83-1 at the crossings of Interstate 89 and the unnamed tributary to Stone Bridge Brook in Georgia, Vermont.

VHB performed hydraulic analyses to evaluate the existing and proposed culvert structures 83-1N and 83-1S. VHB designed the proposed culverts using the Stream Simulation Methodology described in the 2009 Vermont Department of Fish and Wildlife Guidelines for the Design of Stream/Road Crossings for Passage of Aquatic Organisms in Vermont (VT, 2009). VHB determined the height and width of culverts to comply with the requirements of the Vermont Agency of Natural Resources (ANR) Department of Environmental Conservation Stream Alteration General Permit (SAGP) Section C.2.2.5 for the construction of new or replacement culverts (closed bottom structures). The design team determined that the best structure for this location is a single culvert that passes underneath both directions of travel.

Table 1. Existing Culverts Characteristics

Name	Material/Shape	Dimensions	Length (ft)	Upstream Invert (ft)	Downstream Invert (ft)	Slope (%)
83-1N	CMP/Circular	6-ft dia	186	331.7	330.6	0.63%
83-1S	CMP/Circular	6-ft dia	222	330.5	329.2	0.60%

Design Flow Rates
Table 2 presents watershed characteristics for each culvert crossing.

Table 3 presents the design flow rates for the proposed culvert replacements calculated by the New England Transportation Consortium Regional (NETC) regression equations. The NETC regional regression equations are suitable for steep watersheds between 0.25 and 850 square miles with an average watersheds slope of at least 50 feet per mile.

Table 2. Watershed Characteristics

Culvert	Area (mi^2)	Ave. WS Slope (ft/mi)	P (in/yr)
83-1 N & S	0.78	268	37

Table 3. Design Flows

Event/Return Period	Peak Discharge (cfs)
OLW[1]	0.8
2	30
5	40
10	60
100	110
500	170

1. Ordinary Low Water (OLW) in cubic feet per second, where DA is Drainage area in square miles.
$OLW = 1.01569\ DA^{0.98023}$

Proposed Culvert Design Specifications

VHB performed a hydraulic analysis using the Federal Highway Administration (FHWA) tool HY-8 and the U.S. Army Corps of Engineers (USACE) tool HEC-RAS to evaluate the performance of the proposed culverts for several design events including the Ordinary Low Water event, the 2-year Bankfull event, the 100-year event, and the 500-year event. VHB designed the culvert structure to tie in to the existing streambed both upstream and downstream of the culvert, to match existing slopes, and to meet the requirements of the ANR SAGP Section C.2.2.5 for the construction of new or replacement culverts for closed bottom structures.

Table 4. presents the structural dimensions and inverts. The proposed culvert is designed to tie into the existing streambed elevations. In general, the slopes of these culverts are shallow and this design assessment indicates that high scour or significant aggradation is unlikely. These culverts are bounded upstream and downstream by wetlands, which support the assumption that the stream profile is generally stable.

Table 5 demonstrates that the proposed culvert meets the ANR SAGP requirements for culvert width. Table 6 demonstrates that the proposed culvert meets the ANR SAGP requirements for culvert height including embedment depth and open height. Table 7 presents select results of the hydraulic model to illustrate the depth of flow during low- and high-flow events and to illustrate velocities and shear stress on the culvert substrate during high flow events.

Table 8 presents a possible gradation of culvert substrate. The gradation of fine material is designed using the Fuller-Thompson method as described in VT, 2009 and modified to contain at least 10% fines to prevent subsurface flow. The gradation of coarse material is designed for stability during infrequent high-flow events using the USGS method as presented in the rock Riprap Design of Stream Channels near Highway Structures (Volume 2 – Evaluation of Rip Rap Design Procedures) VHB compared this grain size analysis for conformance with the draft ANR streambed stone fill specifications Type E1 stone for velocities less than 9ft/s. For these culverts, VHB designed the substrate gradation for stability during the 500-year return period event.

Table 4. Proposed Culverts Structural Specifications

Name	Material/Shape	Internal Dimensions (ft)	Slope (%)
83-1	RC/Box	15 (W) x 7 (H)	0.57%

Table 5. Proposed Culverts Stream Simulation Specifications – Culvert Width

Name	Bankfull Width[2] (ft)	Culvert Width (ft)	Check Culvert Width Ratio[3] (ft)	Meets C.2.2.5 (a)(i)(1) criteria
83-1	12	15	1.25	Yes

2. Bankfull width and depth derived from the Vermont Regional Geometry Curves due to lack of suitable reference reach.
3. The culvert width must be greater than 1.2 x the bankfull width (C.2.2.5(a) (i)(1)).

Table 6. Proposed Culverts Stream Simulation Specifications – Culvert Height

Name	Total Culvert Height (ft)	Bankfull Depth (ft)	Minimum Open Height C.2.2.5 (a)(ii)(1)	Minimum Embedment Depth C.2.2.5 (a)(iii)	Open Height Provided (ft)	Embedment Depth Provided (ft)	Meets C.2.2.5 (a)(ii and iii) criteria
83-1	7	0.9	3.6	2.1	4.9	2.1	Yes

Table 7. Hydraulic Performance – HEC-RAS model results

	83-1	Units
OLW depth	0.3	Feet
2-year depth	1.2	Feet
100-year depth	2.1	Feet
500-year velocity	5.5	Feet per second
500-year shear stress	0.9	Pounds per square foot

Table 8. Embedment Material Gradation Design – Units in inches

D(x) (% passing)	83-1	Method	Notes
D5	0.01	Fuller-Thompson	Fine material to prohibit subsurface flow
D10	0.07		Fine material to prohibit subsurface flow
D16	0.25	Fuller-Thompson	Fine material to prohibit subsurface flow
D50	12	USGS Method	Stable Coarse Material
D100	18	USGS Method	Immobile material

References:

Appendix E of the U.S. Department of Agriculture (USDA) Forest Service document, *"Stream Simulation: An Ecological Approach to Providing Passage for Aquatic Organisms at Road-Stream Crossings,"* contains detailed descriptions and procedures for assessing streambed stability for highway-stream crossing applications. Links to sections within the document, including each appendix, are available at http://stream.fs.fed.us/fishxing/aop_pdfs.html

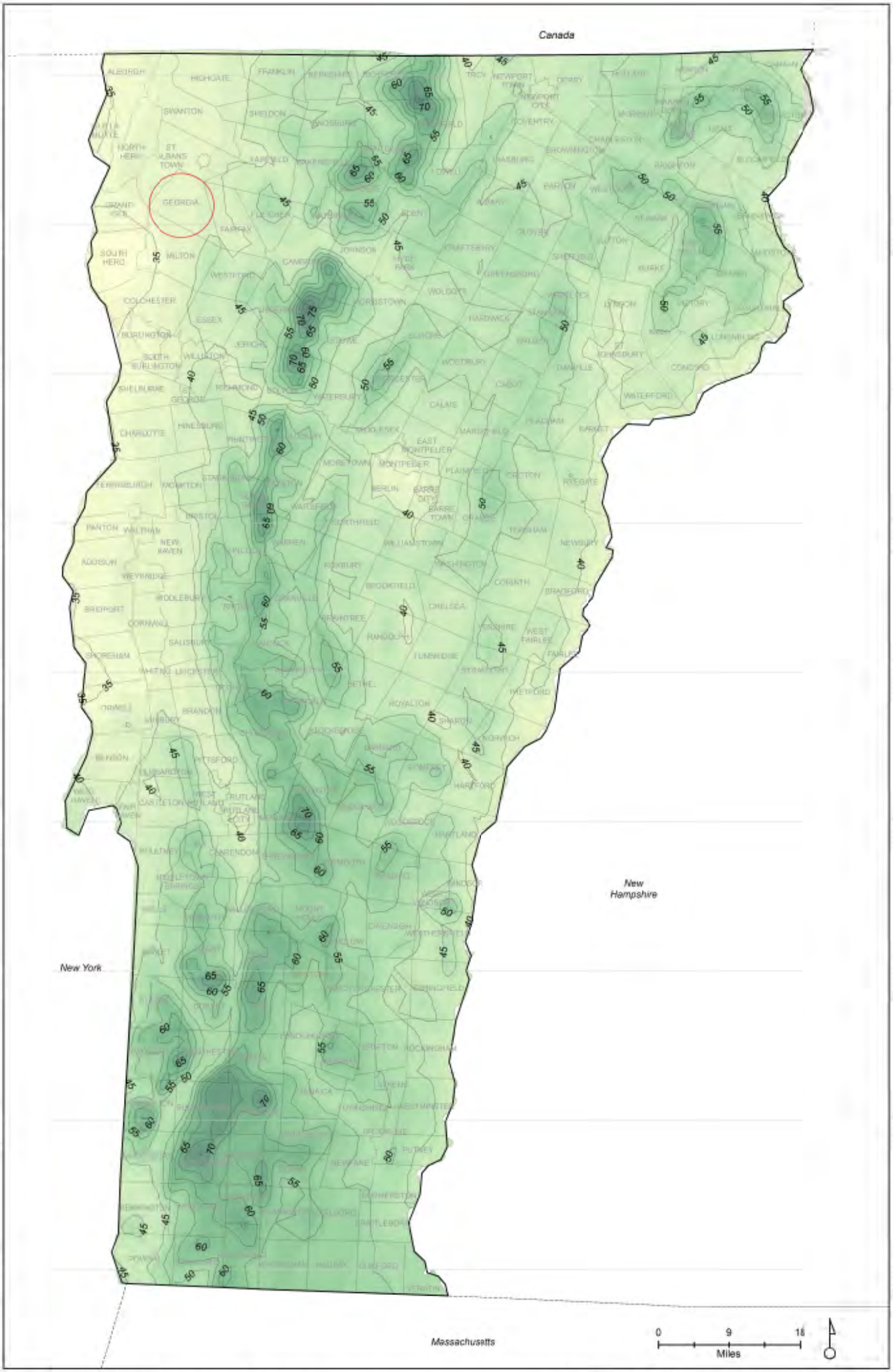
NRCS, 2007c. Natural Resource Conservation Service. Technical Supplement 14C, Stone Sizing Criteria. August 2007. http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17812.wba

VT 2009. Bates, K.K. and R. Kirn, 2009. Guidelines for the Design of Stream/Road Crossings for Passage of Aquatic Organisms in Vermont. Vermont Fish and Wildlife Department. http://www.vtfishandwildlife.com/library/Reports_and_Documents/Aquatic%20Organism%20Passage%20at%20Stream%20Crossings/_Guidelines%20for%20the%20Design%20of%20Stream_Road%20Crossings%20for%20Passage%20of%20Aquatic%20Organisms%20in%20Vermont.pdf

Figure 1. Hydrologic Locus Map

Attachments:

- Georgia Hydrophysiographic zones and rainfall-runoff erosivity factors
- Georgia Mean annual precipitation
- Culvert 83-1
    - Hydrologic Data Form
    - USGS Streamstats Report
    - NETC Regression Equation Method
    - HEC-RAS Results

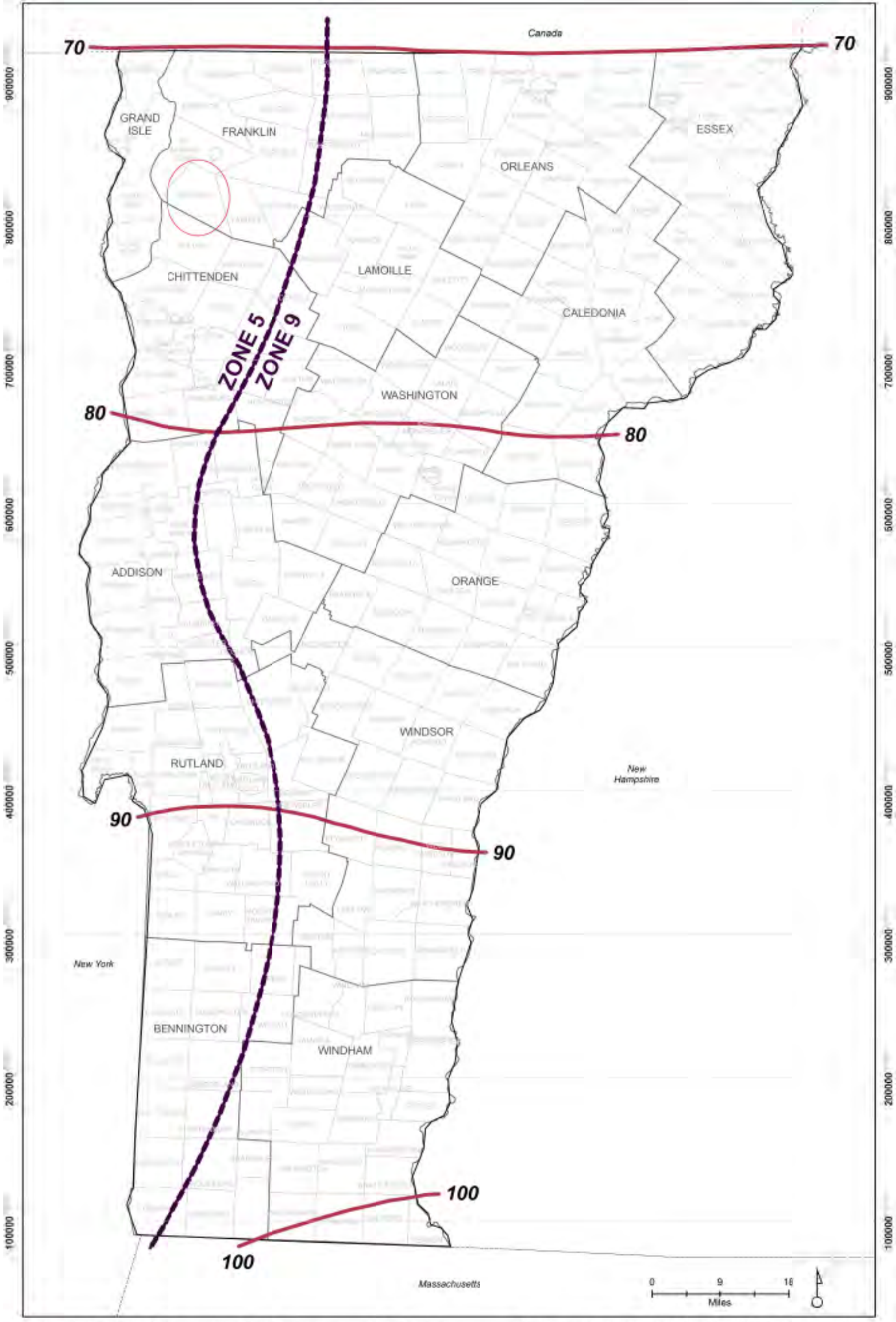


Mean Annual Precipitation (inches)

Town Boundaries

State Boundaries

Copyright © 2000, PRISM Climate Group, Oregon State University. Mean annual precipitation data for Vermont (1971-2000). Raster data created by VT Center for Geographic Information (2009). http://prism.oregonstate.edu



Hydrophysiographic Zones
Rainfall-Runoff Erosivity Factors
State Boundaries
County Boundaries
Town Boundaries

Hydrophysiographic zones and rainfall-runoff erosivity factors were digitized from: "Runoff Estimates for Small Rural Watersheds and Development of a Sound Design Method. Vol II, Recommendations for Preparing Design Manuals and Appendices B, C, D, E, F, G, & H" (1977). Report No. FHWA-RD-77-158.

Hydrologic Data Form

Town	Georgia	**Stream**	Unnamed Tributary
Project Number	57579.00	**Tributary to**	Stone Bridge Brook
Highway Number	I 89	**Structure No.**	Culvert 83 NB and SB

By	Sarah Widing
Date	7/23/2014
Checked By	Ryan Lizewski
Date	9/5/2014

General Drainage Area and Geographic Data

Drainage Area =	499.2	acres	0.78	square miles		
Area of Surface Water =		acres		square miles	0	% of DA
Area of Wetlands =		acres		square miles		% of DA
Area of Watershed Above 1200 feet=		acres		square miles		% of DA
Northing (feet) =	825,000	feet VT State Plane				
Elevation of Drainage Area Divide =		feet NAVD				
Elevation at Site =		feet NAVD				
Change in Elevation from Divide to Site =		feet				
Basin Length =		feet				
Main channel slope =		ft/ft		%	268	ft/mile
85% Elevation =		feet NAVD				
10% Elevation =		feet NAVD				
Elevation at End of Stream =		feet NAVD				
Terrain and Land Use =						

Hydrologic Methods

1 Log-Pearson Type III **(NOT USED IN THIS STUDY)**

2 Runoff Curve Number and Unit Hydrograph (RCN/UH) **(NOT USED IN THIS STUDY)**

3 Rational Method **(NOT USED IN THIS STUDY)**

4 USGS Regression Equation (may be replaced by verified StreamStats Output) **(NOT USED IN THIS STUDY, SLOPE > 50 FT/MI)**

5 NETC Regression Equation Method

Average Annual Precipitation (AAP) = 37.5 inches

6 FHWA

Zone (choose one): **Zone 5** Zone 9

Rainfall Runoff Erosivity (R) = 75

Difference in Height (DH) = 470 feet

Storage Correction Factor (Sc) = 1

7 Urban Hydrograph **(NOT USED IN THIS STUDY)**

USGS Vermont StreamStats

Streamstats Ungaged Site Report

Date: Thu Nov 7 2013 09:56:08 Mountain Standard Time
Site Location: Vermont
NAD27 Latitude: 44.6890 (44 41 20)
NAD27 Longitude: -73.1259 (-73 07 33)
NAD83 Latitude: 44.6891 (44 41 21)
NAD83 Longitude: -73.1255 (-73 07 32)
Drainage Area: 0.94 mi2

Peak Flows Region Grid Basin Characteristics			
100% Statewide Peak Flow (0.94 mi2)			
Parameter	Value	Regression Equation Valid Range	
		Min	Max
Drainage Area (square miles)	0.94	0.211	850
Percent Lakes and Ponds (percent)	0.18	0	6.86
Percentage of Basin Above 1200 ft (percent)	0	0	100
Geographic Factor for VT (dimensionless)	243005.8	-87	296194

Peak Flows Region Grid Streamflow Statistics					
Statistic	Flow (ft^3/s)	Prediction Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
				Minimum	Maximum
PK2	27.5	42	1.4	14	54
PK5	40.7	40	2.3	21	79.1
PK10	49.7	41	3.2	25.3	97.4
PK25	62.1	42	4.6	31.4	123
PK50	71.8	43	5.5	35.7	144
PK100	81.6	44	6.3	39.6	168
PK500	105	49	7.6	47.5	234

NETC Regression Equation Method

Project Name:	Culverts 83-1 NB and SB	**Proj. No.:**	57579.0
Project Location:	Georgia, VT	**Date:**	9/5/2014
		Calculated by:	SAW
		Checked by:	RL

Reference:

NETC. 2010. Estimating the Magnitude of Peak Flows for Steep Gradient Streams in New England. Dr. Jennifer Jacobs, PI at University of New Hampshire.

http://www.ct.gov/dot/LIB/dot/documents/dresearch/NETCR81_04-3.pdf

Applicability: Watershed Slope 268 ft/mile **The NETC Equations are applicable to this site**

Variable	Units	Description
Q_n	cfs	the estimated peak flow with the recurrence interval *n* in years
A	mi^2	the drainage area of the basin
P	in	mean annual precipitation

Peak Discharge Functions

$Q_2 = 0.01601\ A^{0.889} P^{2.12}$

$Q_5 = 0.01965\ A^{0.889} P^{2.19}$

$Q_{10} = 0.02430\ A^{0.891} P^{2.21}$

$Q_{25} = 0.03387\ A^{0.893} P^{2.20}$

$Q_{50} = 0.04372\ A^{0.895} P^{2.18}$

$Q_{100} = 0.05765\ A^{0.897} P^{2.15}$

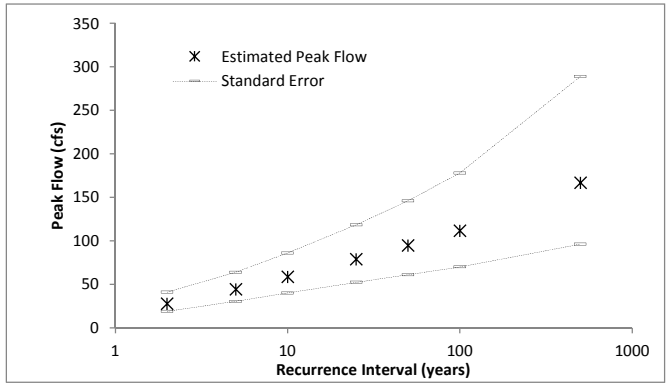
$Q_{500} = 0.111\ A^{0.903} P^{2.09}$

Required Data

Variable	Units	Value
A	mi^2	**0.78**
P	in	**37.5**

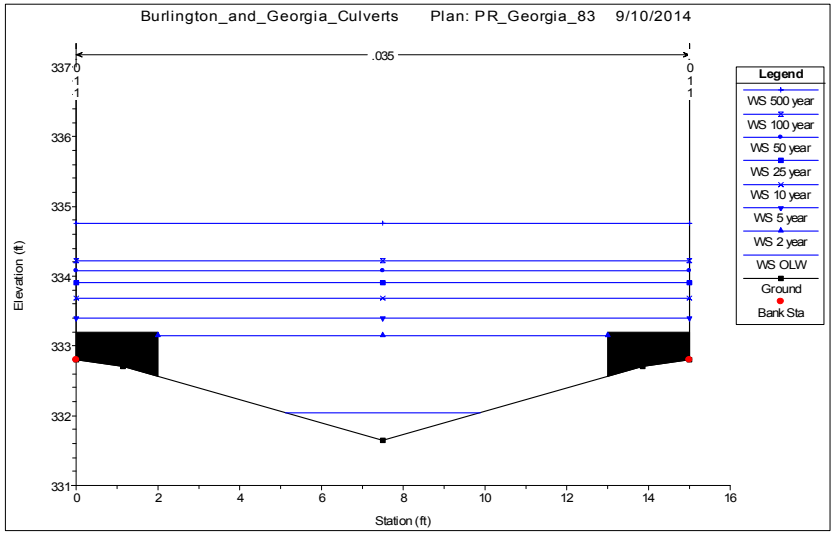
Results

Recurrence Interval n (years)		Q_n
2	Q_2=	28
5	Q_5=	44
10	Q_{10}=	59
25	Q_{25}=	79
50	Q_{50}=	95
100	Q_{100}=	112
500	Q_{500}=	167



Hydraulic Calculations and Results

Project Name: Culvert 83-1 NB and SB **Proj. No.:** 57579.0
Project Location: Georgia, VT **Date:** 9/10/2014



Culvert Slope
0.57%

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl	Shear Chan (lb/sq ft)	Depth (ft)
NB	175	OLW	0.8	331.7	332.0		332.05	0.003559	0.9	0.9	4.8	0.34	0.0	0.4
NB	175	2 year	30	331.7	333.2		333.26	0.004062	2.6	11.6	11.0	0.45	0.2	1.5
NB	175	5 year	40	331.7	333.4		333.51	0.00432	2.6	15.1	15.0	0.46	0.3	1.8
NB	175	10 year	60	331.7	333.7		333.83	0.00438	3.1	19.2	15.0	0.49	0.3	2.0
NB	175	25 year	80	331.7	333.9		334.1	0.004442	3.5	22.8	15.0	0.50	0.4	2.3
NB	175	50 year	95	331.7	334.1		334.29	0.004478	3.8	25.2	15.0	0.51	0.4	2.4
NB	175	100 year	110	331.7	334.2		334.47	0.004509	4.0	27.4	15.0	0.52	0.5	2.6
NB	175	500 year	170	331.7	334.8		335.11	0.004598	4.8	35.4	15.0	0.55	0.6	3.1
NB	0	OLW	0.8	329.7	330.0	329.87	329.97	0.007106	1.0	0.8	5.7	0.45	0.1	**0.3**
NB	0	2 year	30	329.7	330.9	330.55	331.02	0.007105	2.8	10.9	15.0	0.57	0.3	**1.2**
NB	0	5 year	40	329.7	331.0	330.68	331.18	0.007102	3.1	13.0	15.0	0.58	0.4	1.4
NB	0	10 year	60	329.7	331.3	330.96	331.48	0.007107	3.6	16.5	15.0	0.61	0.5	1.6
NB	0	25 year	80	329.7	331.5	331.12	331.74	0.0071	4.1	19.7	15.0	0.63	0.5	1.8
NB	0	50 year	95	329.7	331.6	331.24	331.92	0.007103	4.4	21.8	15.0	0.64	0.6	1.9
NB	0	100 year	110	329.7	331.8	331.35	332.09	0.007102	4.6	23.8	15.0	0.65	0.7	**2.1**
NB	0	500 year	170	329.7	332.2	331.75	332.7	0.007103	**5.5**	30.9	15.0	0.68	**0.9**	2.6

Results reported in the memo, "I-89 Culverts 83N and 83S. Georgia, Vermont Design specifications."

South Burlington IM CULV (24)