

Final Draft

July, 2021

Preliminary Engineering Report

**Town of Richmond, Vermont
West Main Street Sewer Extension**

GME Project # 24-029.10



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PRELIMINARY ENGINEERING REPORT
TOWN OF RICHMOND, VERMONT
WEST MAIN STREET SEWER EXTENSION

July, 2021

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1.0 PROJECT PLANNING

1.1 Location

The Town of Richmond is located in eastern Chittenden County, Vermont and is bordered to the north by the Town of Jericho, to the east by Bolton, to the south by Hinesburg and Huntington and to the west by Williston. A Project Location Map is included as Figure 1, Appendix A.

The Town of Richmond currently provides municipal water and wastewater services to the village area of Richmond. The Town wishes to expand its municipal wastewater service area to include the West Main Street (Route 2) area from the village to the I-89 Exit 11 interchange as well as a small portion of Route 117 to the Riverview Commons Mobile Home Park. The total length of the proposed extension area is approximately 1.75 miles. The study area is defined on the Aerial Study Map, Figure 2, Appendix A as well as the Topographical Area Study Area Map, Figure 3, Appendix A.

The Town is proposing to construct the wastewater expansion project in three separate construction phases as follows:

Phase 1: Connection to an existing sewer system via either a manhole located in front of #222 West Main Street and heading northwesterly along West Main Street approximately 3,200 feet to the “Reap Development” property located at #840 West Main Street or to an existing manhole near the Richmond Elementary School entrance on Jericho Road and heading cross country approximately 3,100 feet to the “Reap Development” property.

Phase 2: From #840 West Main Street northwesterly along West Main Street approximately 3,000 feet to 1436 West Main Street.

Phase 3: From #1436 West Main Street northwesterly along West Main Street approximately 3,200 feet to the existing Riverview Commons Mobile Home Park entrance located at the intersection of Route 117 and Summers Street, Richmond.

1.2 Environmental Resources Present

GME conducted cursory review of existing environmental resources using the State of Vermont’s Natural Resource Atlas. Where specific environmental resources were identified within the project area, more in-depth studies of those resources were performed as outlined in detail below.

1.2.1

Wetlands

Based on a review of the Natural Resource Atlas, a number of currently mapped wetland areas were identified. GME subsequently contracted with Gilman Briggs Environmental, of Barre Vermont who delineated six separate small wetland areas that could potentially be impacted. A Wetlands Map identifying these areas is included as Figure 4, Appendix A. Note that the wetlands were only mapped within close proximity to the roadway (proposed route). The actual wetland boundaries may therefore be larger than shown however these areas would not be impacted by the proposed project.

1.2.2 Flood Prone Areas

The Winooski River flows to the west of West Main Street as well as Route 117. Portions of the project near the Exit 11, I-89 interchange are within the 100-year flood plain. Flood Prone Areas are shown on Figure 5, Appendix A.

1.2.3 Hydrology

There are six (6) ditches and other drainage features that intersect the proposed route. There are no large or named river crossings within the project limits. A Hydrology Map showing the location of these features is included as Figure 6, Appendix A

1.2.4 Rare or Endangered Species

Based on information obtained from the Natural Resource Atlas, there were no "Rare or Endangered Species" or "significant natural communities" identified within the project area. There are two areas of significant natural community (one animal and one natural community) within the Riverview Commons Mobile Home Park; but these areas are not within any areas of proposed construction disturbance.

1.2.5 Deer Wintering Areas

Based on information obtained from the Natural Resource Atlas, there were no deer wintering areas identified within the project area.

1.2.6 Prime Agricultural Soils

Based on information obtained from the Natural Resource Atlas, the majority of the study area along West Main Street and Route 117 is currently identified as Prime Agricultural soils. Figure 7, Appendix A identifies the Prime Agricultural Soils in the area.

1.2.7 Soils for On-site Wastewater Suitability

A Custom Soils Report from the USDA Web Soil Survey for the proposed service area extension is provided in Figure 8, Appendix A. The soils report evaluated the area soils for suitability and limitations with regard to Vermont soil-based residential on-site wastewater disposal. The ratings are represented by symbols for five interpretive groups and their subgroups. These groups and subgroups are described in the following paragraphs.

Group I Soils: are well suited to soil-based wastewater disposal systems. Good performance and low maintenance can be expected. The soils in this group are sandy and gravelly soils that have rapid permeability and well drained soils. These are suitable for conventional systems.

Group II soils: are moderately suited to soil-based wastewater disposal systems. This group includes soils with moderately slow to very slow permeability; complexes in which one or more of the soils have bedrock at a moderate depth (20 to 40 inches); soils that would qualify for inclusion in group I but have slopes of more than 20 percent; and soils that have a seasonal high-water table at a depth of 18 inches or more. On-site wastewater disposal systems in areas with these types of soils typically require a mound system.

Group III Soils: are marginally suited to soil-based wastewater disposal systems. Intensive onsite investigation may be needed to locate suitable areas, or special design, extra maintenance, or costly alteration may be needed to overcome the soil related limitations. In areas where the water table is at a shallow depth, seasonal onsite monitoring of the water table may be needed to determine whether the site is suitable. These areas typically require a mound system along with a pre-treatment system, a hydrogeological study, mounding analysis, enhanced prescriptive or performance-based system design. Some areas of any of the map units in group III may not be suitable for soil-based wastewater disposal systems.

Group IV Soils: map units are generally not suited to soil-based wastewater disposal systems because of such limitations as wetness, depth to bedrock, restricted permeability, and slope.

Group V Soils: are not rated for soil-based wastewater disposal systems. This group includes miscellaneous areas that have been filled, excavated, regraded, or otherwise disturbed by human activities; areas that are mapped above the series level; and areas of water. The miscellaneous areas and the areas mapped above the series level have a wide range of soil properties. Onsite investigation is needed to determine the suitability of these areas for soil-based wastewater disposal.

Table 1 provides a summary of the percentage of soils within the proposed wastewater expansion area by group.

Table 1
On Site Wastewater Suitability Rating

Group No.	Septic Suitability Rating	Includes Soil Types	Percent of Area
I	Well Suited	Ada, AdB, AgA, AgD, ScB, Sd	6%
II	Moderately Suited	AdE, AgE, DdA, DdC, HiD, PsC	23%
III	Marginally Suited	Au, BiB, LyD, MuD, MyC, Wo	17%
IV	Not Suited	HiE, Le, Lf, MyB	37%
V	Not Rated	An, Br	17%

An analysis of the soils, as shown in Table 1, reveals less than half of the soils in the study area are classified as being even marginally suited for on-site wastewater disposal. The limitations of these types of soils generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and higher than average maintenance costs can normally be expected.

1.2.8 Public Lands

There are no public parks or forests located within the project area.

1.2.9 Archeology

The majority of the proposed corridor runs parallel with the Winooski River located to the west of West Main Street as well as Route 117. Areas along significant river channels are often considered prime sites of potential archeological significance. GME contracted

with Hartgen Archeological Associates Inc. (Hartgen) of Putney Vermont to conduct an Archeological Resouce Assessment of the area. Archeological potential is defined as the likelihood of locating intact archeological remains within an area. The consideration of archeological potential takes into account a number of factors including current and past uses of an area and the disturbance those uses would likely have on archeological remains. Areas along the proposed cooridor where the Hartgen study noted arechological potential are on Figure 9, Appendix A. A complete copy of Hartgen’s Archelological Resource Study is contained in Appendix B.

1.3 Population Trends

The population of the Town of Richmond is 4,081 (2010 Census) which includes both the village area served by municipal water and sewer and the rest of the Town. As of the date this report was written, 2020 Census data was not yet available. There were significant increases in population to the Town of Richmond from 1970 to 2000. However, the population of Richmond has been relatively constant from 2000 to 2010. This can likely be attributed to the loss of the Town’s largest employer in 1999, the Saputo Cheese plant. US Census Data summarized since 1970 below:

Table 2
US Census Bureau Population Trends
Richmond, Vermont

Year	Population
1970	2,249
1980	3,159
1990	3,729
2000	4,090
2010	4,081

Richmond’s population does not have significant seasonal influences and is fairly consistent year round. The Town of Richmond’s population over the past 40-years has been steadily increasing. Although there was a leveling off between 2000 and 2010, much of that can likely be attributed to Richmond losing its largest employer in 1999. The last year that full census data was available was 2010. The average increase in population from 1970 until 2010 was slightly over 2% per year. Although Vermont’s statewide populaton has in recent years stagnated, this has not been the case for Chittenden County and, in particular, towns such as Richmond that are considered “bedroom communities” for the larger Burlington metropolitan area. Richmond is well

positioned for future population growth due to its location inside of Chittenden County, ample area for future growth and the expansion of broadband technology. GME anticipates that a similar population growth trend of approximately 2% annually will continue into the foreseeable future.

Employment in the Town used to be centered on the dairy industry with a cheese plant as the main employer. The Saputo cheese plant closed in 1999 and the Town would like to provide the ability for additional employment opportunities. These opportunities include extending municipal wastewater to zoned growth areas of the Town that need the services to grow due to limited on-site wastewater availability.

1.4 Community Engagement

The Town of Richmond has actively engaged the community and elected officials in the proposed West Main Street sewer expansion project. These engagement activities included:

- A survey questionnaire sent to all property owners within the proposed expanded service area in 2015.
- Negotiations with the Riverview Commons Mobile Home Park in 2015 and once again in 2021.
- Completion of a Phase I Scoping Study of the proposed project.
- Two (2) public hearings on the results of the Scoping Study (11/17/14 and 12/1/14).
- Discussions of the project at regularly scheduled Water & Sewer Commission meetings in 2015, 2016, 2020 and 2021 which are open to the public.
- Rezoning of the Gateway zoning district and associated public meetings.
- Bond vote informational meeting on March 2, 2015
- Positive bond vote on March 4, 2015 in the amount of \$1,025,000.00.
- Income survey of the proposed expanded service area including the Route 2 area and residents within the Riverview Commons Mobile Home Park.
- A positive vote of all residents within the current wastewater district as well as the future expanded wastewater district will be required to expand the current wastewater district. This process will necessitate additional public informational meetings as well as targeted mailings and other public educational information releases. This process is anticipated to occur in late 2021.
- If the Town votes to expand the current wastewater district, a second vote of all residents in the Town of Richmond will be required to finance the project if public monies are utilized for permitting, design and construction. Once again

this will necessitate additional public informational meetings as well as other targeted public informational releases.

The Town of Richmond sent out a survey/questionnaire to all property owners within the study area in 2015. Eight (8) surveys were returned. All eight surveys were in favor of the wastewater utility extension. The Riverview Commons Mobile Home Park was one of the respondents who indicated that they were interested in the extension.

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2.0 EXISTING FACILITIES

2.1 Location Map

A current and proposed wastewater service area map is provided as Figure 2, Appendix A.

2.2 History

The municipal wastewater treatment facility is located on Esplanade Street in Richmond village. The wastewater collection system was last expanded in 1999 along Cochran road to cover the remainder of the homes in the service area. The wastewater plant was upgraded in 2005 as part of a \$3.9 million project to reduce phosphorous discharged to a maximum of 0.8 mg/l. The system lost its largest customer in 1999 with the closing of the Saputo Cheese Plant which was located on the corner of Bridge Street and Jolina Court. The plant closing created significant excess wastewater capacity within the existing plant. At that time, the Saputo plant provided 67% of the wastewater system revenue. No new large single customers have connected since that time to fill the void. A number of relatively small commercial and residential developments have moved into town, however the wastewater plant still has significant excess reserve capacity. In 2020, an average of approximately 68,883 gallons of wastewater was treated per day, equaling approximately 39% of the plant's capacity. Due to the large excess reserve capacity, wastewater operations now include septage receiving from septic tank pumping companies. In fact, wastewater revenue from septage receiving and treatment now exceeds traditional wastewater revenues from Richmond's residents and businesses. Septage receiving does not preclude potential customers from buying additional uncommitted capacity, but it does generate much needed revenue for wastewater operations.

2.3 Condition of Existing Facilities

Presently, wastewater generated within the West Main Street and Route 117 portions of the study area are treated in individual on-site septic systems. Due to lot sizes, individual water wells, marginal soil conditions, and depth to groundwater, it can be difficult to provide sufficient wastewater on-site treatment. The proper land area required to meet Vermont's stringent on-site disposal standards may not be available for a number of homes or businesses within the study area. Portions of the study area have a naturally high ground water table, which is a limiting characteristic of the dominant soil type in the study area. In these areas, it would be necessary to construct expensive mound systems to comply with applicable health codes, which may not be a feasible option in some cases

due to financial and technical limitations. Concerns for future development in this area where both septic systems and water wells are utilized on each site are high due to the potential for groundwater/drinking water contamination. On-site wastewater suitability is a major constraint to the development of this area as a growth center.

The Riverview Commons Mobile Home Park has a permitted Indirect Discharge wastewater treatment and disposal system. The system consists of gravity sewers, a large septic tank, dosing pump station and a large subsurface disposal system. The system is approximately 30 years old. Some of the leach fields have clogged and failed in the past, requiring the fields to be replaced.

2.4 Financial Status of Existing Facilities

2.4.1 Wastewater Revenue

Table 3 provides a summary of the Town’s existing rate structure for wastewater.

Table 3
User Rate Structure (2020)

System	User Type	User Rate
Wastewater	Commercial	\$475.05/Annual Fee \$16.17/1,000 gal treated
	Residential	\$169.72/Annual Fee \$18.87/1,000 gal treated

Based on the existing service area user types and flow usage, in FY 2020 the Town received \$349,924 in wastewater revenues in FY-2020 for user fees. The Town also received approximately \$430,000 in wastewater (septage) receiving fees in FY-2020. The average annual wastewater fee for a typical single family residential home is \$565.73 annually. These user rates are relatively high compared to average municipal wastewater rates in the State. If the Town were to be able to increase their user base, these rates could be reduced.

2.4.2 Debt Repayments

Table 4 provides a summary of the existing debt repayments for the municipal wastewater system as provide by the Town of Richmond.

Table 4
Existing Wastewater System Debt Repayments

Debt	Annual Payment	Year Due
RFL-101 Planning Loan Payment	\$12,081	2027
Project 7a – Sanitary Loan Payment	\$14,093	2032
Phosphorous SRF Loan Payment	\$22,220	2026
Jericho Road (principal & Interest)	\$29,621	2032
Total	\$78,015	

2.4.3 Existing O&M Costs

Table 5 provides a summary of the existing municipal wastewater system O&M costs as provided by the Town of Richmond.

Table 5
Existing Wastewater System O&M Costs (2020)

Debt	Existing O&M Cost
Administration	\$41,137
Engineering	\$500
Biosolids Disposal	\$120,000
Insurance	\$15,868
Repairs/Maintenance	\$35,000
Salaries/Benefits	\$197,217
Supplies	\$87,300
Utilities	\$84,500
Total	\$581,522

2.5 Water/Energy/Waste Audits

Water, energy and waste audits are not applicable to this project.

3.0 NEED FOR PROJECT

3.1 Health, Sanitation, and Security

The proposed wastewater expansion area will benefit from the addition of municipal wastewater. Riverview Commons Mobile Home Park currently has one large leach field that provides wastewater service for 146 of the 148 residential mobile homes in the park. This system has had maintenance issues over the years including replacement of a number of failed leach field trenches. Further, private wells currently supply all of the residents' potable water in the proposed expansion area. This could in the future lead to endangerment of the resident's water supply due to faulty or malfunctioning septic systems.

3.2 Aging Infrastructure

Many of the on-site septic systems within the expansion area, have generally matured to the point that replacement on-site treatment will either become very costly or not possible to meet the current rules. However, with the provision of a municipal wastewater system, user fees cover the cost of operation for the public portion of the system. This assures the system is always in good working condition

3.3 Reasonable Growth

The Town's zoning regulations are established to preserve the look and feel of the Richmond area while accommodating reasonable development and growth in designated areas. As shown on Figure 11, Appendix A, the study area is located within five (5) zoning districts including:

- a. Gateway Commercial District (G)
- b. Commercial (C)
- c. Industrial/Commercial (IC)
- d. Mobile Home Park (MHP)
- e. Special Flood Hazard Area

Gateway Commercial - The majority the proposed expansion area along the east side of West Main Street from Richmond Village to I-89 is in the Gateway Commercial District. This district is designated to allow for both residential and commercial uses. There are various allowed and conditional uses as specified in the zoning regulations. Currently water supply and wastewater disposal in the area are both served by

on-site individual systems. The Gateway Commercial District allows for 1 acre lots served by municipal sewer.

Commercial - The Commercial District spans a small portion of the proposed expansion area along both sides of Route 117. This area allows a wide variety of permitted commercial uses as well as conditional uses.

Industrial/Commercial - A small area on the east side of the Exit 11 interchange is within the Industrial/Commercial District. This district also allows a wide variety of permitted commercial and light industrial uses as well as conditional uses.

Mobile Home Park - The Mobile Home Park District is located on the east side of Route 117. The district currently contains the Riverview Mobile Home Park which as currently proposed would become a part of this project. Permitted uses of this district are primarily mobile home parks or single family housing. A lot which is not defined as a mobile home park (MHP) shall not be less than 1 acre. A lot which is defined as a mobile home park shall contain not less than 10 acres and each individual dwelling unit in the park must be situated on a lot containing at least ¼ acre.

Special Flood Hazard Area - The majority of the route along the west side of West Main Street stretching from the village to I-89 is within the Special Flood Hazard Area zoning district. This district has very specific and limited uses in terms of development. No new structures are allowed and existing structures must conform with strict requirements for renovations and additions.

3.4 WWTF Uncommitted Reserve Capacity

The uncommitted reserve capacity of the Wastewater Treatment Facility (WWTF) is calculated by adding the measured annual average daily flow to the committed unconnected allocations (new projects) and then subtracting the total from 80% of the total plant design capacity. The average daily flow information for calendar year 2020 as provided by the Town of Richmond was 68,883 gallons as summarized in Table 6. The current unconnected committed allocations are 2,360 gallons per day as outlined in Table 7. The permitted design capacity of the wastewater treatment plant is 222,000 gallons per day. The WWTP facility's subsequent uncommitted reserve capacity is 106,407 gpd as shown in Table 8.

Table 6
WWTF 12-Month Average Daily Flow
Calendar Year 2020

Month	Average Daily Flow (gpd)
January	58,000
February	51,000
March	62,000
April	76,000
May	67,000
June	75,000
July	74,000
August	72,000
September	71,000
October	79,000
November	76,000
December	65,000
12 Month Average =	68,883

Table 7
Estimated Unconnected Committed
Sewer Allocated Flows (2020)

Applicant	Unconnected Committed Sewer Allocated Flows (gpd)
Peaceable Kingdom (Residential)	1,680
Whistle Stop Lane (Residential)	680
Total Unconnected Committed Sewer Allocations	2,360

Table 8
Estimated Municipal Wastewater Plant
Uncommitted Reserve Capacity (2020)

Description	Flow (gpd)
WWTF Permitted Design Capacity	222,000
80% of WWTF Permitted Capacity	177,600
12-Month Annual Average Daily Flow	68,833
Unconnected Committed Sewer Allocated Flows	2,360
Total Uncommitted Reserve Capacity (gpd)	106,407

3.5 Existing and Future Wastewater Flows

3.5.1 Current Wastewater Flows

A wastewater flow estimate for each existing residential home and commercial business within the proposed wastewater expansion area was included within this survey. Estimated wastewater flows for commercial uses within the proposed expansion area were calculated using estimates included in Subchapter 8, Table 8-3 of the Wastewater System and Potable Water Supply Rules, Effective April 12, 2019. The “Quantity” information used in the commercial estimates was supplied by the Town of Richmond.

Residential wastewater flows were based on current data provided by the Town of Richmond. Average annual residential flows as reported by the Town of Richmond are 32,000 gallons per year (88 gpd) per living unit. GME conservatively used 100 gpd per living unit for the future residential flow estimates. Infiltration is not envisioned in the low-pressure force main piping. Average daily flows for the Riverview Mobile Home Park were obtained from the maintenance staff for calendar years 2018 (21,724 gpd) and 2019 (21,212 gpd). The average of the 2018 and 2019 data was used to estimate existing wastewater flows of 147 gpd/unit for the mobile home park.

3.5.2 Future Wastewater Flows

As outlined in Table 9, the total current estimated wastewater flow demand for the proposed expansion area for all three phases is 44,840 gpd.

Table 9**Current and Estimated Future Expansion Area Wastewater Flow Demand**

Phase/ Address	Current Use Description	Assumed Future User Type	Quantity	Flow Basis	Current Flow (gpd)	Estimated Future Ave. Daily Flow (gpd)
Phase 1						
282 W Main	Residential	Duplex	2	100 gpd/Unit	200	200
434 W Main	Residential	Single Family Home	1	100 gpd/Unit	100	100
840 W Main	Commercial	Reap Office Building/ Employees	42	15 gpd/employee	630	630
		2 nd Office Building	51	15 gpd/employee	765	765
		Preschool/Day Care	30	15 gpd/staff & child	450	450
		Barn Conversion (Future set aside)	1			800
Subtotal Phase 1					2,145	2,945
Phase 2						
878 W Main	Residential	Single Family Home	1	100 gpd/Unit	100	100
920 W Main	Res./Commercial	Single Family Home/Tow Business	1	100 gpd/Unit	100	100
932 W Main	Residential	Single Family Home/Home Business	1	100 gpd/Unit	100	100
978 W Main	Residential	Single Family Home	1	100 gpd/Unit	100	100
1010-1014 W Main	Residential	Duplex	2	100 gpd/Unit	200	200
1008-1012 W Main	Residential	Duplex	2	210 gpd/Unit	200	200
1070 W Main	Commercial	Office Bldg./Employees	20	15 gpd/Employee	300	300
1108 W Main	Commercial	Dog Day Care				
		Employees	8	15 gpd/staff	120	120
		Kennels	40	25 gpd/kennel	1,000	1,000
		Grooming Station	1	400 gpd/station	400	400
1151 W Main	Res./Commercial	Residence	1	100 gpd/Unit	100	100
		Chiropractor Office	3	35 gpd/Employee	105	105
			16	10 gpd/patient	160	160
-	Vacant	Residential	1	100 gpd/Unit		100
-	Vacant	Residential	1	100 gpd/Unit		100
-	Vacant	Commercial	2	100 gpd/Unit		200
		Residential	2	300 gpd/Unit		600
1436 W Main	Commercial	1 st Pump Set	1	500 gpd/Pump		500
	Gas Station	Additional Pump Sets	3	300 gpd/Pump		900
		Employees	6	15 gpd/employee		90
Subtotal Phase 2					2,985	5,475
Subtotal Phase 1 and 2					5,130	8,420
Phase 3						

9 Gov. Peck	Commercial-Fuel	Employees	8	15 gpd/Employee	120	120
116 River Rd	Commercial Fuel	Employees	10	15 gpd/Employee	150	150
Rte. 117	Mobile Home Park (current)	Mobile Homes	146	147 gpd/MH	21,460	21,450
Rte. 117	Mobile Home Park (Phase II)	Mobile Homes	100	147 gpd/MH		14,700
Subtotal Phase 3					21,730	36,420
Total Phase 1, 2 and 3					26,860	44,840

Table 10 outlines the available wastewater treatment capacity in the existing WWTF.

Table 10
Richmond WWTF
Estimated Future Wastewater Capacity

Description	Existing	Estimated Full Build-Out
Available Plant Capacity 2020 (gpd)	106,407	106,407
Phase 1 Flows (gpd)	2,145	2,945
Remaining Plant Capacity (gpd)	104,262	103,462
% Remaining of Available Capacity	98%	97%
Phase 1 & 2 Flows	5,130	8,420
Remaining Plant Capacity (Phases 1 & 2)	101,577	98,287
% Remaining of Available Capacity	95%	92%
Phase 1, 2 & 3 Flows (gpd)	26,860	44,840
Remaining Plant Capacity (gpd)	79,547	61,567
% Remaining of Available Capacity	75%	58%

4.0 ALTERNATIVES CONSIDERED

As discussed, the Town of Richmond has significant excess wastewater capacity at its municipal wastewater treatment facility. At the same time there is a need for municipal wastewater services in the West Main Street corridor and parts of the Route 117 corridor west of the village.

4.1 Force Main Route Alternatives

4.1.1 Force Main Route Alternatives – Phase 1

Two separate alternatives were evaluated for Phase 1 of the project. The first alternative (Alternate A) would consist of installing a new low pressure forcemain approximately 3,100-feet from an existing manhole near the elementary school entrance on Jericho Road, cross country to the “Reap Property” located at #840 West Main Street.

The second Alternative (Alternate B) would begin at an existing manhole in the Route 2 right of way located in front of #222 West Main Street as shown in Figure 14, Appendix A. A new low-pressure force main would extend from the manhole approximately 3,200-feet northward along the Route 2 right of way to the “Reap Property” located at #840 West Main Street. Both Phase 1 route alternatives considered are shown in Figure 10, Appendix A.

4.1.2 Force Main Route Alternatives - Phase 2 and Phase 3

The objective of the project is to incorporate the existing properties along the Route 2 and Route 117 corridors as part of the expanded wastewater collection system. Both roadways are State Highways that have substantial right of way widths. The majority of residential houses and commercial businesses that could potentially benefit from this project are located on the east side of both roadways. Assuming that each individual property would have its own storage tank and grinder pump that feeds the forcemain, having the forcemain on the east side of the highway would be the most cost-effective choice for the adjacent property owners. Pipe stubs which cross Route 2 at specific locations would be necessary to service the current and future residential buildings located on the west side of Route 2.

4.2 Potential Environmental Impacts

As outlined in Section 1.2, potential environmental impacts from this project include wetlands, floodplains, existing hydraulic features, prime agricultural soils as well as archeology.

4.2.1 Wetlands

Both Class II and Class III wetlands were identified within the project area as shown on Figure 4, Appendix A. GME proposes to mitigate the impacts to wetlands by utilizing directional boring technology to wetland impacts while installing the low pressure forcemain. Using this technology should minimize if not eliminate any wetland impacts. In several areas the project will be within 50' of mapped wetlands. As such, State of Vermont wetlands permit(s) will be required as part of the design and permitting process.

4.2.2 Flood Prone Areas

There are areas of the proposed corridor that are within the 100-year flood plain as shown on Figure 5, Appendix A. GME proposes to mitigate any concerns related to working within the floodplain by ensuring that no additional fill is added and no existing changes to existing grades are made within these areas as part of the project. Additionally, the majority of the project will be performed by directional drilling which has almost no impact on surface conditions. GME anticipates that coordination with the State of Vermont Watershed Management Division, Rivers Program will be required as part of the design and permitting process.

4.2.3 Hydrology

There are six (6) ditches and other drainage features that intersect the proposed route. There are no large or named river crossings within the project limits. To the extent possible these drainage crossings would likely be done by directional drilling to minimize potential impacts. Additional field reconnaissance will be required to determine the appropriate installation and mitigation measures for each crossing. Stream Alteration Permits as well as potential wetland permits may be required for some or all of these crossings as part of the final design and permitting process.

4.2.4 Prime Agricultural Soils

Prime Agricultural Soils within the proposed corridor are shown on Figure 7, Appendix A. The majority of the proposed corridor is within areas defined as "prime agricultural soils". However, the entire corridor as proposed is within the Route 2 and Route 117 right of ways. Use of the ROW is dedicated to transportation and utility rights of way in perpetuity. The land adjacent to both highways in this corridor is made up of relatively small residential and

commercial lots no longer suitable for agriculture. As such, the land within the right of way where the low pressure forcemain would be located no longer contains areas of “agricultural importance” as defined and generally recognized by the State of Vermont.

4.2.5 Archeology

As outlined in Section 1.2.8, Hartgen Archeological Associates was contracted to conduct an archaeological resource assessment within the project corridor. The Hartgen study noted a number of areas with archaeological potential along the cross-country route (alternate A) in Phase I. The Hartgen study also noted archaeological potential in a number of areas adjacent to West Main Street (generally outside of the current right of way) along the proposed corridor where prior disturbance from filling, roadway and utility construction had not previously been performed. As a result, areas with archaeological potential were fairly limited within the existing West Main Street right of way. There were no areas of archaeological potential noted near the I-89 exit 11 interchange or further north along the Route 117 corridor. Areas with archaeological potential along the corridor are shown on Figure 9, Appendix A. The conclusion and recommendations from the Hartgen Archaeological Assessment were as follows ***“It is recommended that project disturbance stay as close to the edge of the roadways as possible, to minimize affecting areas of archaeological potential. Directional boring of the lines could help avoid effects to archaeologically sensitive areas. If jack and bore pits (a necessary part of direction boring) could avoid those areas, it would limit the need for testing. If, however, these pits have to be placed in sensitive areas, the testing would be much less than open trench placement. If areas of archaeological potential cannot be avoided, Phase IB archaeological reconnaissance survey is recommended.”***

4.2.6 Other Considerations

GME anticipates that Act 250 permitting will be required as part of the permitting phase for this project. Depending upon the depth of review as well as questions and concerns raised during the public comment period, Act 250 may require a complete engineering design as well as permitting for all three phases of the project up front prior to approval. This could result in a shift in portions of the currently anticipated engineering costs from Phases 2 and 3 to Phase 1.

4.3 Land Requirements

The entire project as proposed is within the Vermont Agency of Transportation (VTrans) right of way with the exception of a small portion near I-89 Exit 11 interchange. A Vtrans

permit will be required for work within the State right of way areas of route 2 and Route 117. The Federal Highway Administration (FHWA) may also need to be involved in areas around the I-89 Exit 11 interchange. Specific details as to which agency has right of way authority over these areas will be addressed as part of final design. In determining an Opinion of Probable Cost, GME has assumed that permitting coordination with FHWA will be required.

4.4 Sustainability Considerations

Water and energy efficiencies are not applicable. In addition, there are no sustainability or green infrastructure considerations in this project.

4.5 Opinion of Probable Construction Cost

Prior to development of the Opinion of Probable Cost information, quantity take-offs were completed to establish unit quantities for projected project unit price bid items. Material and labor costs have undergone significant price changes over the past 12 months. Due to severe price escalations due to the Covid pandemic as well as unusually high inflation, historical construction costs which would normally be utilized to generate future cost estimates are in most cases not accurate at this juncture. Estimated future construction costs were therefore generated based on direct conversations with local contractors in June of 2021. Significant inflationary numbers, material shortages or other unknowns could further impact these estimates in the future. The Opinions of Probable Cost include a 20% contingency. At the planning level, a 20% contingency is reasonable and customary as any number of things could be encountered during the permitting or design stage that could not reasonably be anticipated at the planning stages of a project of this size.

An Opinion of Probable Construction costs were developed for each phase of construction as provided in Table 11. Detailed Opinions of Probable Cost Estimates are located in Appendix D.

Table 11
Opinion of Probable Construction Cost (2021 dollars)

Phase/Alternate	Opinion of Probable Cost
Phase 1 – Alternate B (#222 West Main to Reap Property #840 West Main) (This alternative was selected for use)	\$401,800
Phase 2 - Reap Property to Mobile Station (#1436 West Main)	\$379,103
Phase 3 – Mobile Station to Riverview Commons Mobile Home Park	\$520,898
Total	\$1,301,801

5.0 SELECTION OF AN ALTERNATIVE

Two separate routes (Alternate A and Alternate B) were considered for Phase 1 as previously discussed. Opinions of Probable Construction Costs for Alternative A and Alternative B were noted to be of similar magnitude for both alternatives. Hartgen’s recommendation related to archeology was to avoid Alternative A (cross country route) if possible. Alternate B was recommended by Hartgen as this route showed limited archaeological potential due to past disturbance from grading/filling, road construction and utility construction along West Main Street (Route 2) and Route 117. The few portions of the route that may contain areas of archaeological potential should be avoidable using directional boring techniques. The locations of required directional boring pits should be included in the detailed design and should be strategically chosen to avoid disturbance to hydraulic features, wetlands or areas with archaeological potential. For these reasons, the Town ultimately selected Alternate B (West Main Street) as the preferred route for Phase 1.

Due to the proximity of the future users of the system and ease of using the State right of way as opposed to having multiple easements on private property, as well as avoiding numerous highway crossings by choosing the east side of West Main Street as well as Route 117 as the preferred corridor for the project.

5.1 Life Cycle Cost Analysis

A life cycle cost analysis is not applicable to this type of project. The piping material will be HDPE which for all practical purposes has an unlimited life expectancy.

5.2 Non-Monetary Considerations

GME envisions that pipe stubs for future connections will be left at each adjacent property. Although outside the scope of the PER, future final design considerations will be to include stubs for each building along the route, ensure that each hookup meets the criteria outlined in Chapter 1 of the Wastewater and Potable Water Supply Rules including backflow prevention, storage, and adequately sized pumps to ensure that minimum scouring velocities are achieved in the low-pressure force main.

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6.0 PROPOSED PROJECT

6.1 Preliminary Project Design

The selected project entails extending the existing the current wastewater service area from the current manhole located in front of house #222 West Main Street to the Riverview Mobile Home Park as shown on Figure's 12, 13 and 14. The project will include three separate phases of work which total approximately 1.75 miles.

6.2 Project Schedule

Project funding will be the key driver with regard to the project construction schedule. It is the Town's goal to secure funding for Phase 1 in calendar year 2022 with construction to follow in 2023. The schedule of Phases 2 and 3 will be subject to funding.

6.3 Sustainability Considerations

6.3.1 Water and Energy Efficiencies

The use of HDPE pipe helps promote water efficiency as fusion welding creates one solid pipe with no opportunity for joint leakage.

6.3.2 Green Infrastructure

There are no green infrastructure initiatives as part of this project.

6.4 Project Costs

GME's opinion of project construction costs were previously summarized in Table 10, Appendix D. All costs are in 2021 dollars. Except where noted, costs for final design and construction engineering service are based on current State of Vermont, Water Investment Division, Engineering Services Curve formulas. These curves are subject to change in the future.

6.5 Annual Operating Budget

6.5.1 Income

Table 12 provides a summary of the Town's existing rate structure for water and sewer.

Table 12
Existing User Rate Structure (2020)

System	User Type	User Rate
Wastewater	Commercial	\$475.05/Annual Fee \$16.17/1,000 gal
	Residential	\$169.72/Annual Fee \$18.87/1,000 gal.

Based on the existing service area user types and flow usage, the Town currently receives approximately \$349,924 in wastewater revenues per year for user fees. The Town also receives approximately \$430,000 annually in septage receiving fees as summarized in Table 13.

Table 13
Current Richmond Wastewater Revenue (2020)

Income Type	Existing Wastewater System
User Fees	\$349,924
Septage Fees	\$430,000
Total	\$779,924

The Town's current rate for hookup fees is \$4.41/gal/day plus \$150 for an inspection fee for each property. Table 14 provides a summary of anticipated hook-on fees based on currently established rates. Wastewater generation quantities for the purposes of establishing hook-on fees are typically done using permitted design quantities or the standard design flow rates from Chapter 1 of the Environmental Protection Rules. Current hook-on fees are \$4.41/gal/day plus \$150 inspection fee.

Table 14
Estimated Study Area Wastewater Hook-On Fees

Phase/ Address	Use Description	User Type	Quantity	Flow For Fee Basis*	Average Daily Flow (gpd)	Est. Hook-On Fee*
Phase 1						
282 W Main	Residential	Duplex	2	210 gpd/Unit	420	\$2,002
434 W Main	Residential	Single Family Home	1	210 gpd/Unit	210	\$1,076
840 W Main	Commercial	Reap Office Building/ Employees	42	15 gpd/staff	630	\$2,928
Subtotal Phase 1					1,260	\$6,006
Phase 2						
878 W Main	Residential	Single Family Home	1	210 gpd/Unit	210	\$1,076
920 W Main	Res./Commercial	Single Family Home/Town/Business	1	210 gpd/Unit	210	\$1,076
932 W Main	Residential	Single Family Home/Home Business	1	210 gpd/Unit	210	\$1,076
978 W Main	Residential	Single Family Home	1	210 gpd/Unit	210	\$1,076
1010-1014 W Main	Residential	Duplex	2	210 gpd/Unit	420	\$2,002
1008-1012 W Main	Residential	Duplex	2	210 gpd/Unit	420	\$2,002
1070 W Main	Commercial	Office Bldg./Employees	20	15 gpd/staff	300	\$1,473
1108 W Main	Commercial	Dog Day Care Employees Kennels Grooming Station	8 40 1	15 gpd/staff 25 gpd/kennel 400gpd/station	120 1,000 400	\$6,853
1151 W Main	Res./Commercial	Residence Chiropractor Office	1 3 16	210 gpd/Unit 35 gpd/staff 10 gpd/patient	210 105 160	\$2,245
-	Vacant	Hay barn	-	-	-	
-	Vacant	Field South Side	-	-	-	
-	Vacant	Empty Lot	-	-	-	
Subtotal Phase 2					3,975	\$18,879
Subtotal Phase 1 and 2					5,235	\$24,885
Phase 3						
1436 W Main	Commercial Gas Station	1 st Pump Set Add'l Pump Sets Employees	1 3 6	500 gpd/Pump 300 gpd/Pump 15 gpd/staff	500 900 90	\$6,721
9 Gov. Peck	Commercial-Fuel	Employees	8	15 gpd/staff	120	\$679
116River Rd	Commercial -Fuel	Employees	10	15 gpd/staff	150	\$812
Rte. 117	Mobile Home Park	Mobile Homes	146	210 gpd/MH	30,660	\$135,360
Subtotal Phase 3					32,420	\$143,572
Subtotal Phase 1, 2 and 3					37,655	\$168,457

*Based on estimates, State "book flows" or existing State Permits **gpd x \$4.41/Gal/Day + \$150 Inspection Fee

Table 15
Estimated Future Expansion Area Wastewater Revenue (Full Buildout)

Phase/ Address	Current Use Description	Assumed Future User Type	Est. Future Avg. Annual Flow (GPY)	Annual Flat Wastewater Fee (\$475.05/C \$169.72/R)	Est. Wastewater Treatment Cost \$0.01671/C \$0.01887/R	Total Estimated Annual Wastewater Revenue
Phase 1						
282 Main	W Residential	Duplex (365 days)	73,000	\$339.44	\$1,377	\$1,716
434 Main	W Residential	Single Family (365 days)	36,500	\$169.72	\$688	\$857
840 Main	W Commercial	Reap Office Building (260 days)	163,800	\$475.05	\$2,737	\$3,212
		2 nd Office Building (260 days)	198,900	\$475.05	\$3,323	\$3,798
		Preschool/Day Care (260 days)	117,000	\$475.05	\$1,955	\$2,430
		Barn Conversion (Future set aside) (260 days)	208,000	\$475.05	3,475	\$3,950
Subtotal =						\$15,963
Phase 2						
878 Main	W Residential	Single Family (365 days)	36,500	\$169.72	\$688	\$857
920 Main	W Res./Commercial	Single Family Home/Tow Business (365 days)	36,500	\$169.72	\$688	\$857
932 Main	W Residential	Single Family Home/Home Business(365 days)	36,500	\$169.72	\$688	\$857
978 Main	W Residential	Single Family (365 days)	36,500	\$169.72	\$688	\$857
1010-1014 W Main	Residential	Duplex (365 days)	73,000	\$339.44	\$1,377	\$1,716
1008-1012 W Main	Residential	Duplex (365 days)	73,000	\$339.44	\$1,377	\$1,716
1070 Main	W Commercial	Office Bldg./Employees (260 days)	78,000	\$475.05	\$1,303	\$1,778
1108 Main	W Commercial	Dog Day Care Employees	31,200	\$475.05	\$521	\$996
		Kennels	260,000	-----	\$4,344	\$4,344
		Grooming Station	104,000	-----	\$1,738	\$1,738

		(260 days)				
1151	W	Res./Commercial	Residence	36,500	\$169.72	\$688
Main			Chiropractor Office	27,300	\$475.05	\$456
			(260 Days)	41,600	-----	\$695
-		Vacant	Residential	36,500	\$169.72	\$688
-		Vacant	Residential	36,500	\$169.72	\$688
-		Vacant	Commercial (260)	52,000	\$475.05	\$869
			Residential (365)	219,000	\$1,018.32	\$4,132
1436	W	Commercial	1 st Pump Set	182,500	\$475.05	\$3,049
Main		Gas Station	Additional Pumps	328,500	-----	\$5,489
			Employees	32,850	-----	\$548
			(365 days)			
Subtotal =						\$35,968

Phase 3

9	Gov.	Commercial-Fuel	Employees (260 days)	31,200	\$475.05	\$521	\$996
116	River Rd	Commercial - Fuel	Employees (260 days)	39,000	\$475.05	\$651	\$1,126
Rte. 117		Mobile Home Park (current) ¹	Residential (146) (365 days)	7,833,630	\$25,118.56	\$147,820	\$172,938
Rte. 117		Mobile Home Park (Phase II) ¹	Residential (100) (365 days)	5,365,500	\$16,972	\$101,246	\$118,218
Subtotal=						\$293,278	

Total Ant. Revenue Phases 1, 2 & 3 =

\$345,209

¹ Actual measured average daily flow rates for the Riverview Mobile Home Park of 147 gpd/unit were utilized for this analysis

Table 16 provides a summary of the Town's existing and proposed wastewater income based on the existing and proposed user base, the above rate structure as well as septage fees.

Table 16
Estimated Current and Future Wastewater Revenue (Full Buildout)

Income Type	Anticipated Revenues
Existing User Fees	\$349,924
Est. Expansion Area User Fees	\$345,209
Septage Fees (Assume 50% of 2020) ¹	\$215,000
Total	\$910,133

1. The future expansion area is estimated to utilize only 43% of the current excess plant capacity. It is assumed that remaining capacity will be used for septage disposal.

6.5.2 Annual O&M Costs

Table 17 provides a summary of the existing and proposed O&M costs for the wastewater system assuming the full expansion project is constructed.

Table 17
Anticipated Future Wastewater Annual Expenditures - Full Buildout (Phase 3)
(2021 dollars)

Administrative Costs	Current	Anticipated With Expansion
Administration	\$41,137	\$45,000
Engineering	\$500	\$500
Biosolids Disposal	\$120,000	\$125,000
Insurance	\$15,868	\$15,868
Repairs/Maintenance	\$35,000	\$35,000
Salaries/Benefits	\$197,217	\$197,217
Supplies	\$87,300	\$90,000
Utilities	\$84,500	\$87,000
Sub-Total	\$581,522	\$595,585

6.5.3 Debt Repayment

The current and future wastewater debt repayments are summarized on Table 18.

Table 18
Current and Future Debt Repayment

Existing Debt Service	Annual Payment	Anticipated With Expansion
RFL-101 Planning Loan Payment (2027)	\$12,081	\$12,081
Project 7a – Sanitary Loan Payment (2032)	\$14,093	\$14,093
Phosphorous SRF Loan Payment (2026)	\$22,220	\$22,220
Jericho Road (2032)	\$29,621	\$29,621
Sub-Total	\$78,015	\$78,015

Anticipated Future Debt Service	Annual Payment	Anticipated With Expansion
West Main Street WW Extension Loan ¹	\$0	\$54,130
Sub-Total	\$0	\$54,130

1 West Main Street Extension loan assumes \$1,300,000 principal, 1.5% annual interest rate and a 30-year term.

Town has set a policy for this project that the new users within the expansion area will pay for the debt service for the project.

The Town may use a number of different financing sources to fund this project. In 2015, the Town approved a bond vote for \$1,025,000 for the same purpose. For a number of reasons, the original 2015 project has not moved forward. As one would anticipate, the estimated construction costs for the project have increased since the original estimates were completed in 2015. As outlined in Table 11, the current Opinion of Probable Cost for all three phases of construction in 2021 dollars is \$1,300,000. The Town has a number of options in terms of how to fund the project including but not limited to:

- Targeted grant funding
- Constructing Phases 1 & 2 of the project with currently approved bond funding. Funding of phase 3 of the project with local funds impacts fees, increased hook-on-fees or other forms of locally derived funding
- Request new bond funding for the project to authorize the entire amount estimated for permitting, design and construction of all three phases of the project. This approach would have other advantages such as providing the ability to construct the entire project at one time rather than a phase approach. This would improve the economy of scale of the project and likely reduce overall construction costs.

If the Town decides to borrow the full capital cost of all three phases of construction, and assuming that the capital costs for these loans are ultimately consolidated into a single 30-year loan for simplicity, using an assumed principal of \$1,300,000 and an interest rate of 1.5%, the annual payment for the loan would be approximately \$54,130. Because the Town's policy is to have the new users within the project area pay for the capital construction costs, a logical approach would be to pro-rate and spread the capital cost across the new user base using a percentage of anticipated use.

6.5.4 Anticipated User Rates

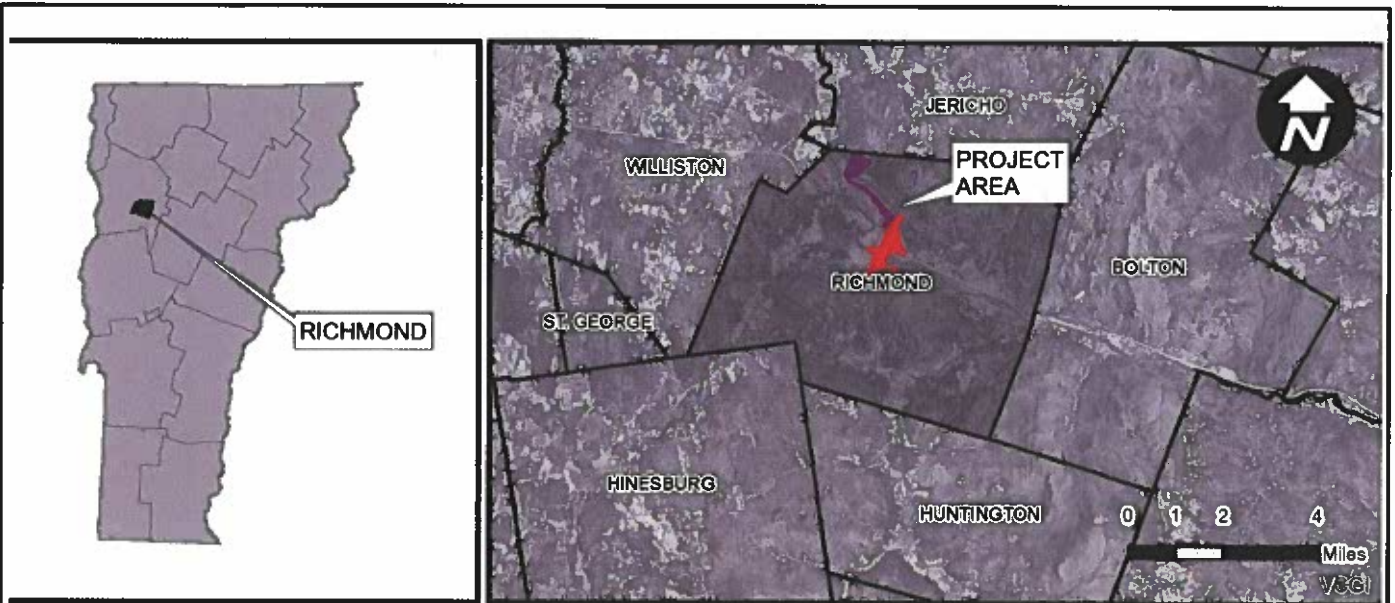
It is anticipated that the additional users will reduce the overall operating costs for the Town's municipal wastewater system. As noted in Tables 16 and 17, using the current wastewater rates, if all three phases of construction were completed, revenues should exceed expenditures. In that circumstance, it is anticipated that the Town would reduce average user rates to the point that annual revenues and expenditures would be closely matched. One significant advantage Richmond has as it considers how to approach funding and future user rates as revenues this project is the ability to control septage receiving volumes and subsequent revenues during a phased approach. This provides the

Town with the ability to maximize revenues and keep local user rates lower during the phasing process.

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Appendix A

Figures



PROPOSED WASTEWATER EXPANSION AREA

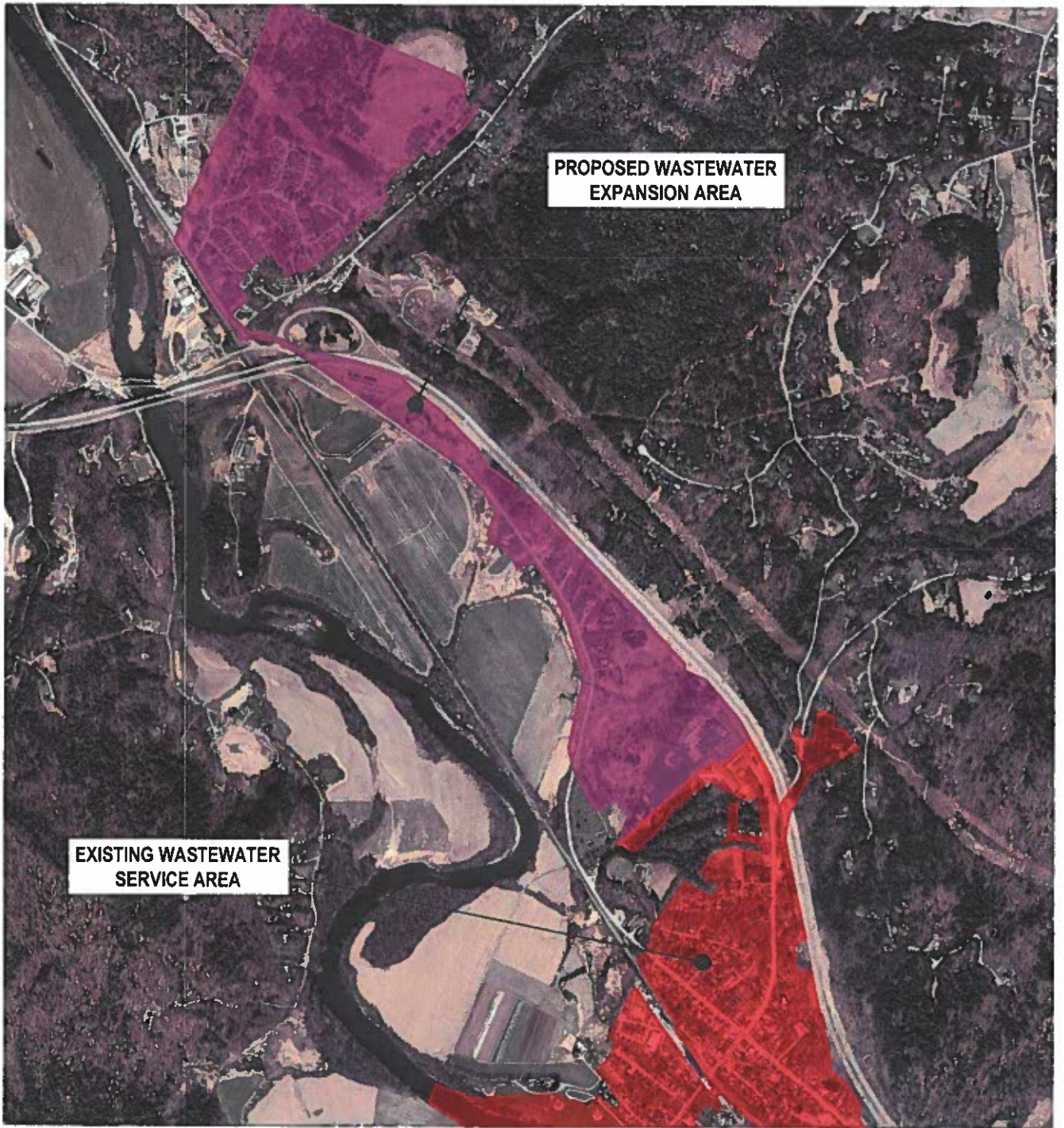
EXISTING WASTEWATER SERVICE AREA

GREEN MOUNTAIN ENGINEERING

CIVIL WATER WASTEWATER

1438 SOUTH BROWNELL ROAD
WILLISTON, VERMONT 05495
PHONE: (802)862-5590
FAX: (802)862-7588

DRAWING TITLE		DESIGNED	PROJECT NO.
PROJECT LOCATION MAP		SP	24-029
		DRAWN	
PROJECT		JJB	DRAWING NO.
		AM	
WEST MAIN STREET WASTEWATER EXTENSION		7/2/21	1
		SCALE	
CLIENT		AS SHOWN	
		DATE	
TOWN OF RICHMOND, VERMONT		JUN. 2021	



**EXISTING WASTEWATER
SERVICE AREA**

**PROPOSED WASTEWATER
EXPANSION AREA**

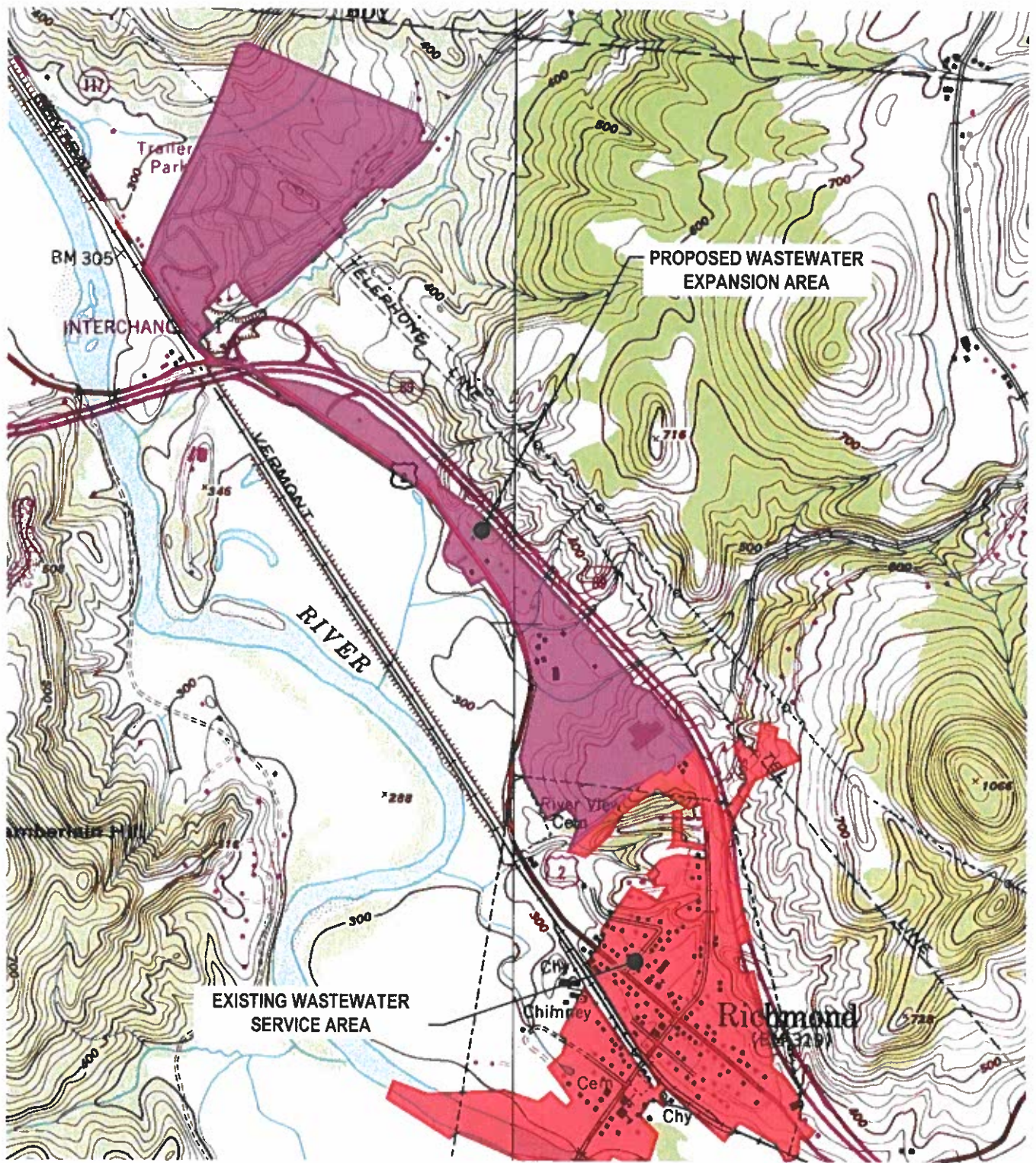
**GREEN
MOUNTAIN
ENGINEERING**

CIVIL
WATER
WASTEWATER

1438 SOUTH BROWNELL ROAD
WILLISTON, VERMONT 05495
PHONE (802)862-5590
FAX (802)862-7568

DRAWING TITLE	CURRENT & PROPOSED WASTEWATER SERVICE MAP (AERIAL VIEW)
PROJECT	WEST MAIN STREET WASTEWATER EXTENSION
CLIENT	TOWN OF RICHMOND, VERMONT

DESIGNED	SP	PROJECT NO. 24-029
DRAWN	JJB	
CHECKED	AH	
PLOT DATE	6/5/21	DRAWING NO. 2
SCALE	1" = 1500'	
DATE	JUN. 2021	



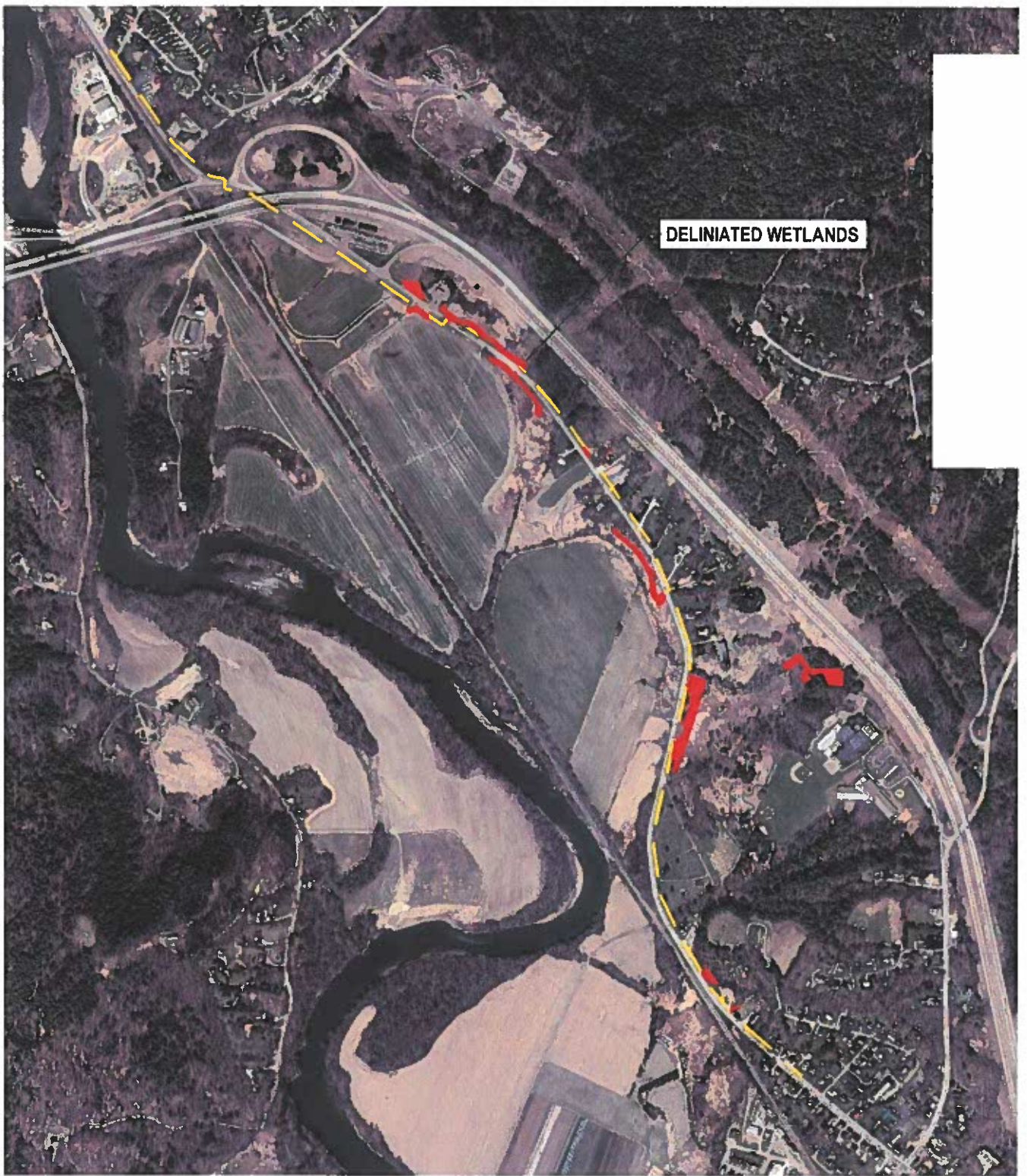
GREEN MOUNTAIN ENGINEERING

CIVIL
WATER
WASTEWATER

1438 SOUTH BROWNELL ROAD
WILLISTON, VERMONT 05495
PHONE: (802)882-5590
FAX: (802)882-7588

DRAWING TITLE	CURRENT & PROPOSED WASTEWATER SERVICE MAP (TOPO VIEW)	
PROJECT	WEST MAIN STREET WASTEWATER EXTENSION	
CLIENT	TOWN OF RICHMOND, VERMONT	

DESIGNED	SP	PROJECT NO.	24-029
DRAWN	JB		
CHECKED	AH	DRAWING NO.	3
PLOT DATE	7/2/21		
SCALE	1" = 1500'		
DATE	JUN, 2021		



DELINIATED WETLANDS

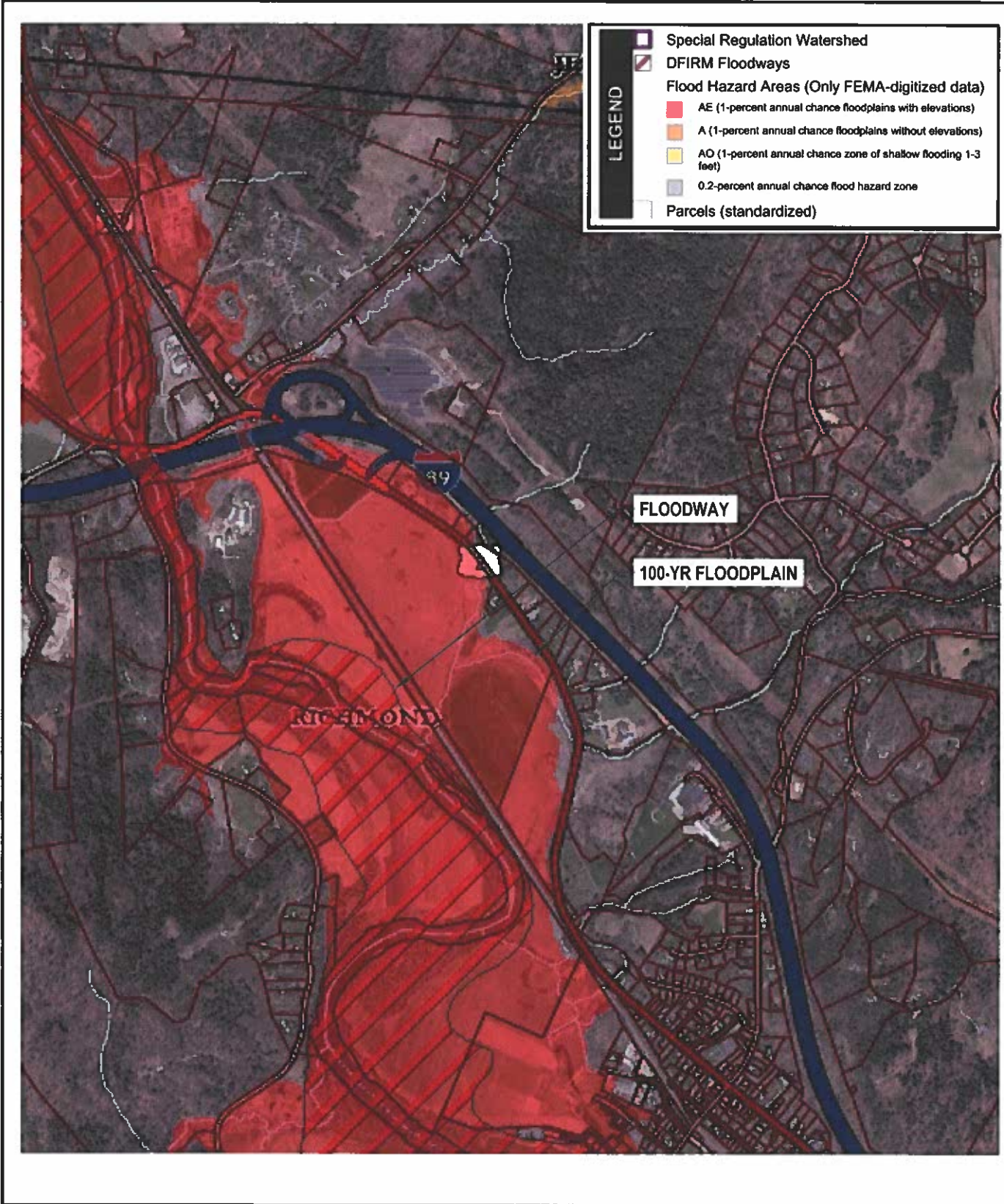
GREEN MOUNTAIN ENGINEERING

CIVIL WATER WASTEWATER

1438 SOUTH BROWNELL ROAD
WILLISTON, VERMONT 05495
PHONE: (802)862-5590
FAX: (802)862-7598

DESIGNED	SP
DRAWN	JIB
CHECKED	AH
PROJECT	WEST MAIN STREET WASTEWATER EXTENSION
CLIENT	TOWN OF RICHMOND, VERMONT
PLLOT DATE	7/2/21
SCALE	1" = 1000'
DATE	JUN. 2021

PROJECT NO.	24-029
DRAWING NO.	4



1438 SOUTH BROYHNELL ROAD
WILLISTON, VERMONT 05495
PHONE: (802)862-5500
FAX: (802)862-7566

GREEN MOUNTAIN ENGINEERING

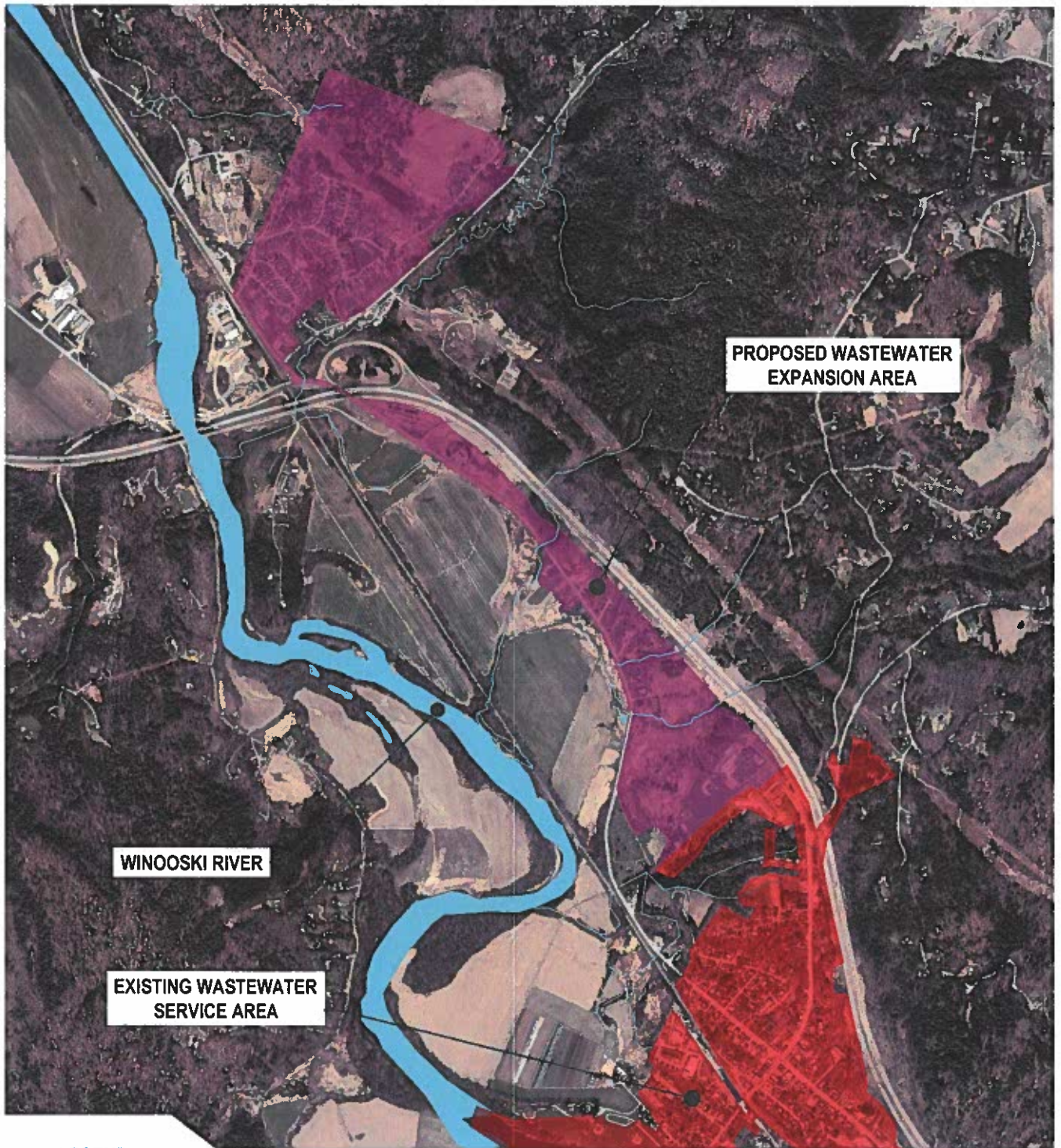
CIVIL
WATER
WASTEWATER

PROJECT
WEST MAIN STREET WASTEWATER EXTENSION

CLIENT
TOWN OF RICHMOND, VERMONT

DESIGNED	SP
DRAWN	JJB
CHECKED	AH
PLOT DATE	7/2/21
SCALE	1" = 1500'
DATE	JUN. 2021

PROJECT NO.	24-029
DRAWING NO.	5



WINOOSKI RIVER

EXISTING WASTEWATER SERVICE AREA

PROPOSED WASTEWATER EXPANSION AREA

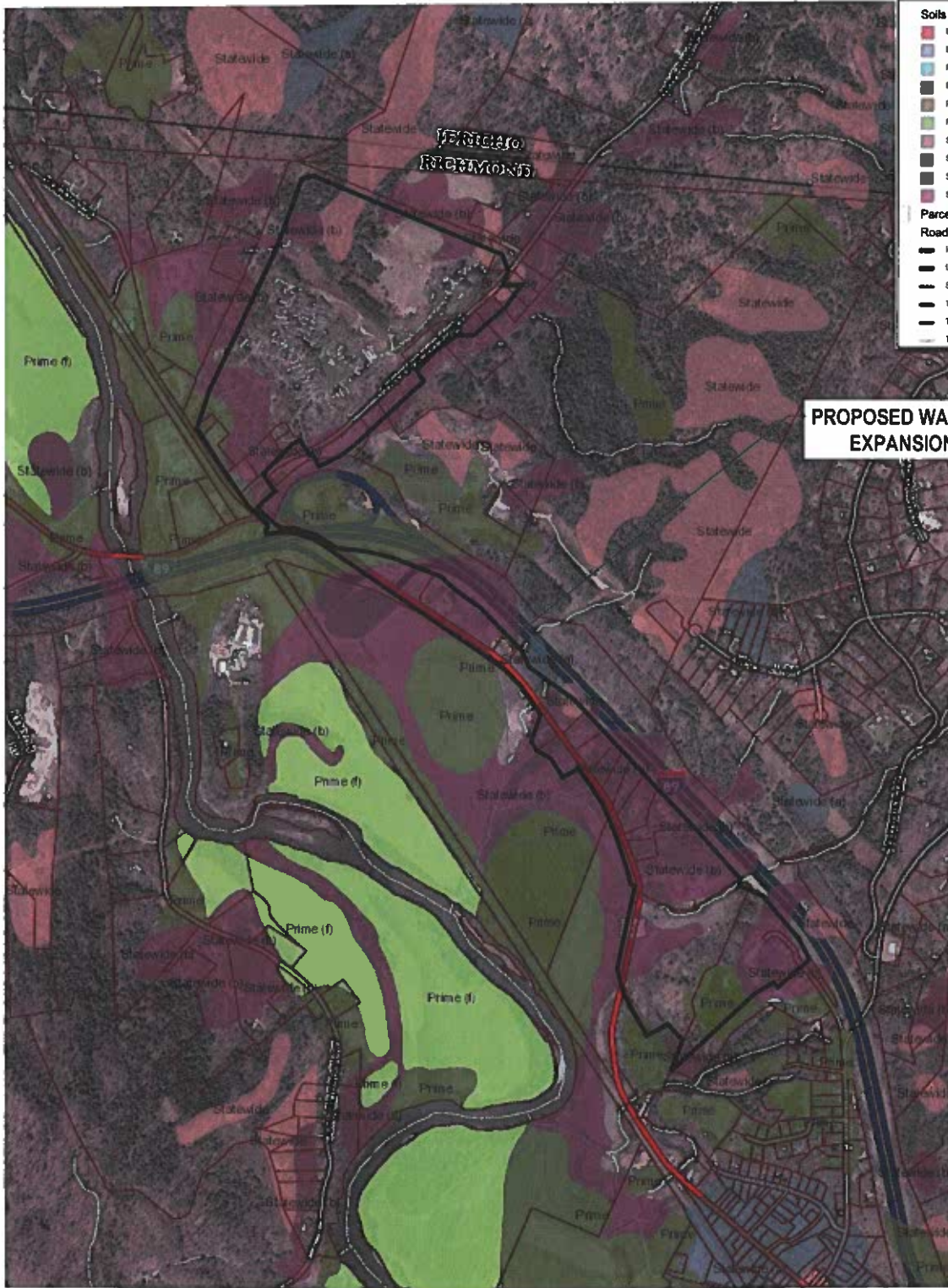
LEGEND

~ STREAM

GREEN MOUNTAIN ENGINEERING
 CIVIL WATER WASTEWATER

1438 SOUTH BROWNELL ROAD
 WILLISTON, VERMONT 05495
 PHONE: (802)862-5500
 FAX: (802)862-7508

DRAWING TITLE	HYDROLOGY MAP		DESIGNED	SP	PROJECT NO.
			DRAWN	JJB	
PROJECT	WEST MAIN STREET WASTEWATER EXTENSION		CHECKED	AH	DRAWING NO.
			PLOT DATE	7/2/21	
CLIENT	TOWN OF RICHMOND, VERMONT		SCALE	1" = 1500'	
			DATE	JUN. 2021	



LEGEND	
Soils - Prime Agricultural	
[Red]	Local
[Light Blue]	Local (b)
[Light Green]	Not rated
[Dark Green]	Prime
[Light Green]	Prime (b)
[Light Green]	Prime (f)
[Pink]	Statewide
[Dark Pink]	Statewide (a)
[Dark Pink]	Statewide (b)
[Dark Pink]	Statewide (c)
Parcels (standardized)	
Roads	
[Thick Black Line]	Interstate
[Thin Black Line]	US Highway, 1
[Thin Black Line]	State Highway
[Thin Black Line]	Town Highway (Class 1)
[Thin Black Line]	Town Highway (Class 2.3)
[Thin Black Line]	Town Highway (Class 4)

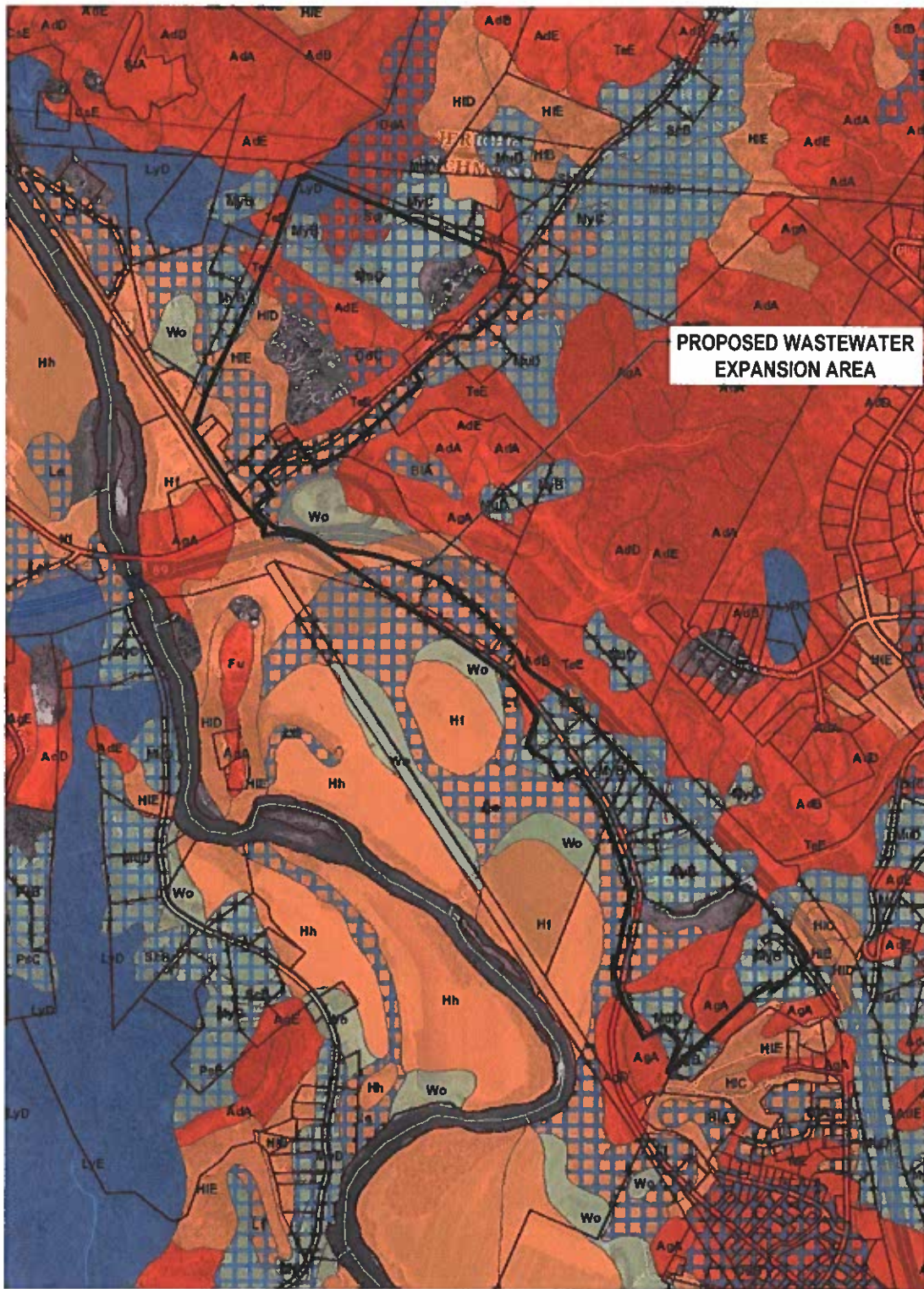
PROPOSED WASTEWATER EXPANSION AREA

GREEN MOUNTAIN ENGINEERING
 CIVIL WATER WASTEWATER

1438 SOUTH BROWNELL ROAD
 WILLISTON, VERMONT 05495
 PHONE: (802)862-5590
 FAX: (802)862-7598

DRAWING TITLE	PRIME AG SOILS MAP
PROJECT	WEST MAIN STREET WASTEWATER EXTENSION
CLIENT	TOWN OF RICHMOND, VERMONT


DESIGNED	SP	PROJECT NO.	24-029
DRAWN	JJB		
CHECKED	AH		
PLOT DATE	7/2/21	DRAWING NO.	7
SCALE	1" = 1500'		
DATE	JUN. 2021		



LEGEND	
Soils - Hydrologic Group	
[Red]	A
[Light Red]	Ap
[Orange]	S
[Light Orange]	Sp
[Yellow]	C
[Light Yellow]	Co
[Green]	D
Parcels (standardized)	
Roads	
[Thick Line]	Interstate
[Double Line]	US Highway 1
[Thin Line]	State Highway
[Dashed Line]	Town Highway (Class 1)
[Dotted Line]	Town Highway (Class 2,3)
[Dotted Line]	Town Highway (Class 4)
[Thin Line]	State Forest Trail
[Thin Line]	Natural Forest Trail
[Thin Line]	Legal Trail
[Thin Line]	Private Road/Driveway
[Thin Line]	Proposed Road
Stream/River	
[Blue Line]	Stream
[Blue Line]	Intermittent Stream
[Thin Line]	Town Boundary

PROPOSED WASTEWATER EXPANSION AREA

1438 SOUTH BROWNELL ROAD
WILLISTON, VERMONT 05495
PHONE (802)862-5590
FAX (802)862-7586

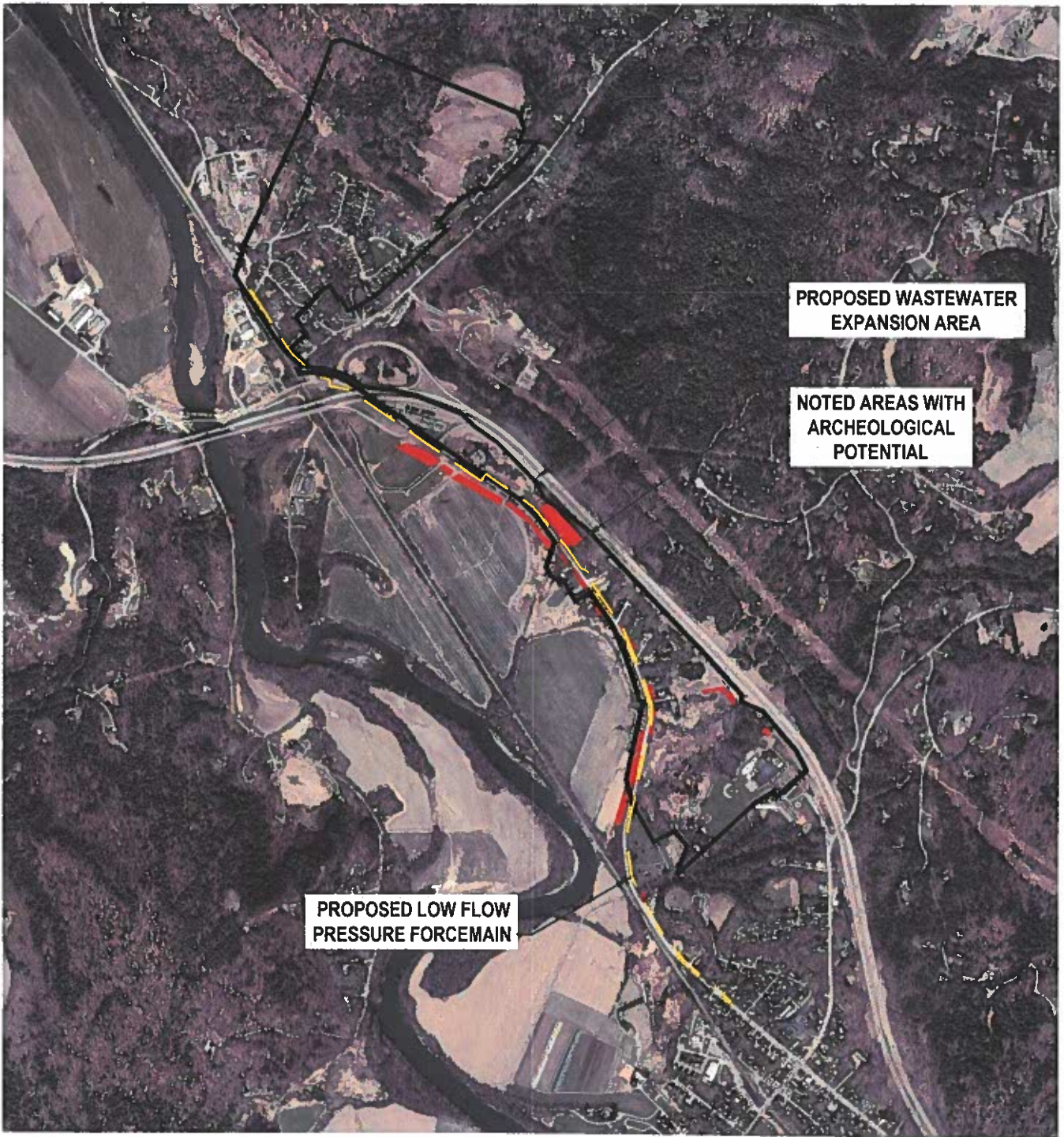


GREEN MOUNTAIN ENGINEERING

CIVIL WATER WASTEWATER

DRAWING TITLE	USDA SOIL SURVEY MAP
PROJECT	WEST MAIN STREET WASTEWATER EXTENSION
CLEBIT	TOWN OF RICHMOND, VERMONT


DESIGNED	SP	PROJECT NO.	
DRAWN	JJB		24-029
CHECKED	AH		
PLOT DATE	7/2/21	DRAWING NO.	
SCALE	1" = 1500'		8
DATE	JUN. 2021		

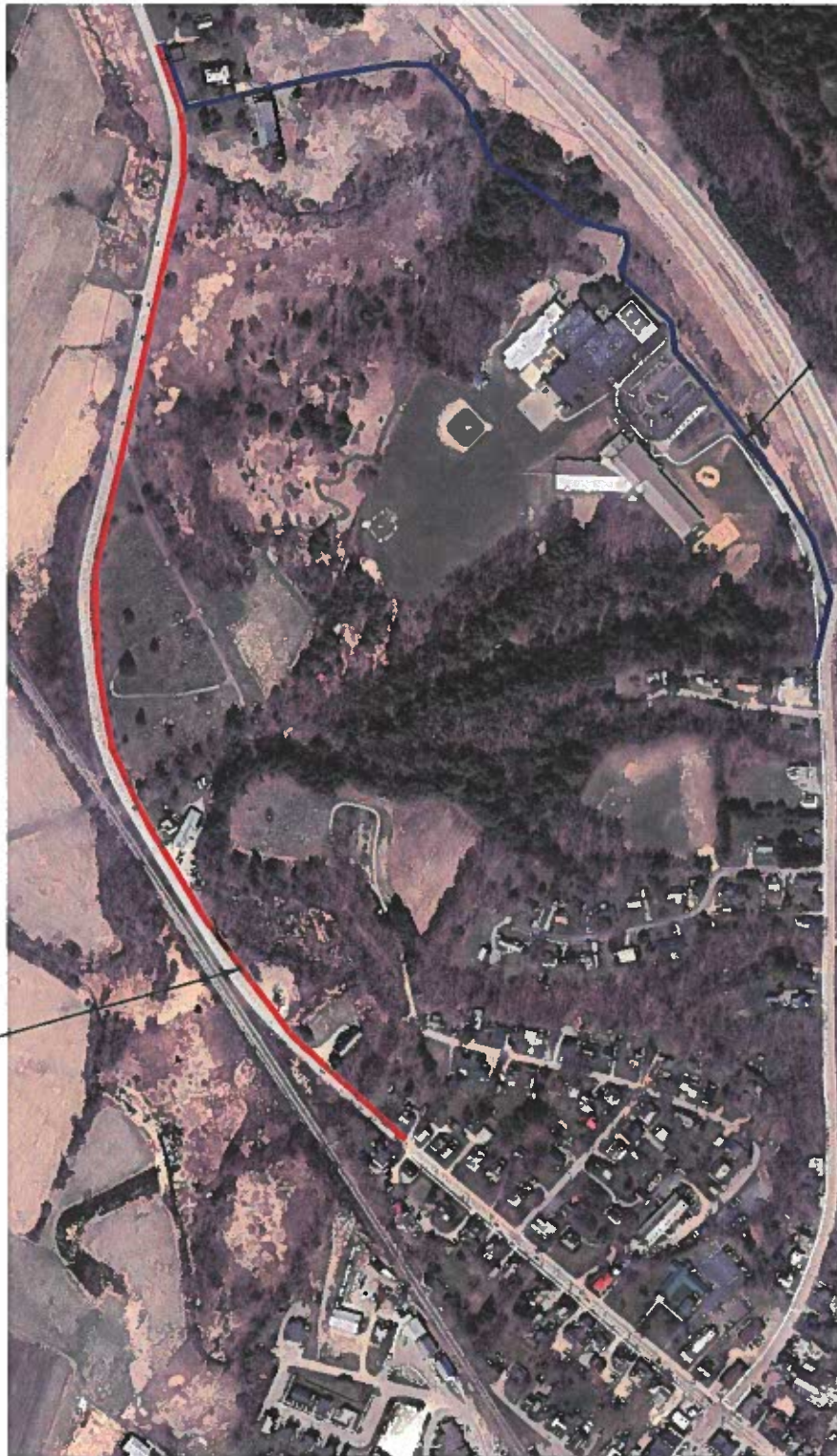


**PROPOSED WASTEWATER
EXPANSION AREA**

**NOTED AREAS WITH
ARCHEOLOGICAL
POTENTIAL**

**PROPOSED LOW FLOW
PRESSURE FORCEMAIN**

 GREEN MOUNTAIN ENGINEERING <small>CIVIL WATER WASTEWATER</small>	1438 SOUTH BROVHILL ROAD WILLISTON, VERMONT 05495 PHONE: (802)862-5580 FAX: (802)862-7588	DRAWING TITLE ARCHEOLOGICAL POTENTIAL	DESIGNED: SP DRAWN: JJB CHECKED: AH	PROJECT NO. 24-029
		PROJECT WEST MAIN STREET WASTEWATER EXTENSION	PLOT DATE 7/2/21	DRAWING NO. 9
		CLIENT TOWN OF RICHMOND, VERMONT	SCALE 1" = 1500'	
			DATE MAY 2021	



PHASE 1 OPTION A
(±3075 LF)

PHASE 1 OPTION B
(±3300 LF)

GREEN MOUNTAIN ENGINEERING

CIVIL
WATER
WASTEWATER

1438 SOUTH BROWNELL ROAD
WILLISTON, VERMONT 05405
PHONE: (802)882-5590
FAX: (802)882-7598

DRAWING TITLE		DESIGNED	PROJECT NO.
PHASE 1 ALTERNATIVES		SP	24-029
		DRAWN	
PROJECT		JJB	DRAWING NO.
		AH	
WEST MAIN STREET WASTEWATER EXTENSION		7/2/21	10
		SCALE	
		1" = 50'	
CLIENT		DATE	
		MAY 2021	

PROJECT	WEST MAIN STREET WASTEWATER EXTENSION
CLIENT	TOWN OF RICHMOND, VERMONT

Official Zoning District Map Richmond, Vermont

Legend		
Zoning District	Flood Hazard Overlay District	Road Centerline
<ul style="list-style-type: none"> Agriculture/Residential (AR) High Density Residential (pHUR) Residential/Commercial (RC) Commercial (C) Industrial/Commercial (IC) Gateway Commercial (G) Village Commercial (VC) Mobile Home Park (MHP) 	<ul style="list-style-type: none"> Flooding Special Flood Hazard Area Designated Village Center Municipal Water & Sewer District Steam Centerline Water Body 	<ul style="list-style-type: none"> Interstate US or State Highway Town Highway Class 1 - 3 Town Highway Class 4 Railroad Tax Parcel Boundary

**PROPOSED WASTEWATER
EXPANSION AREA**

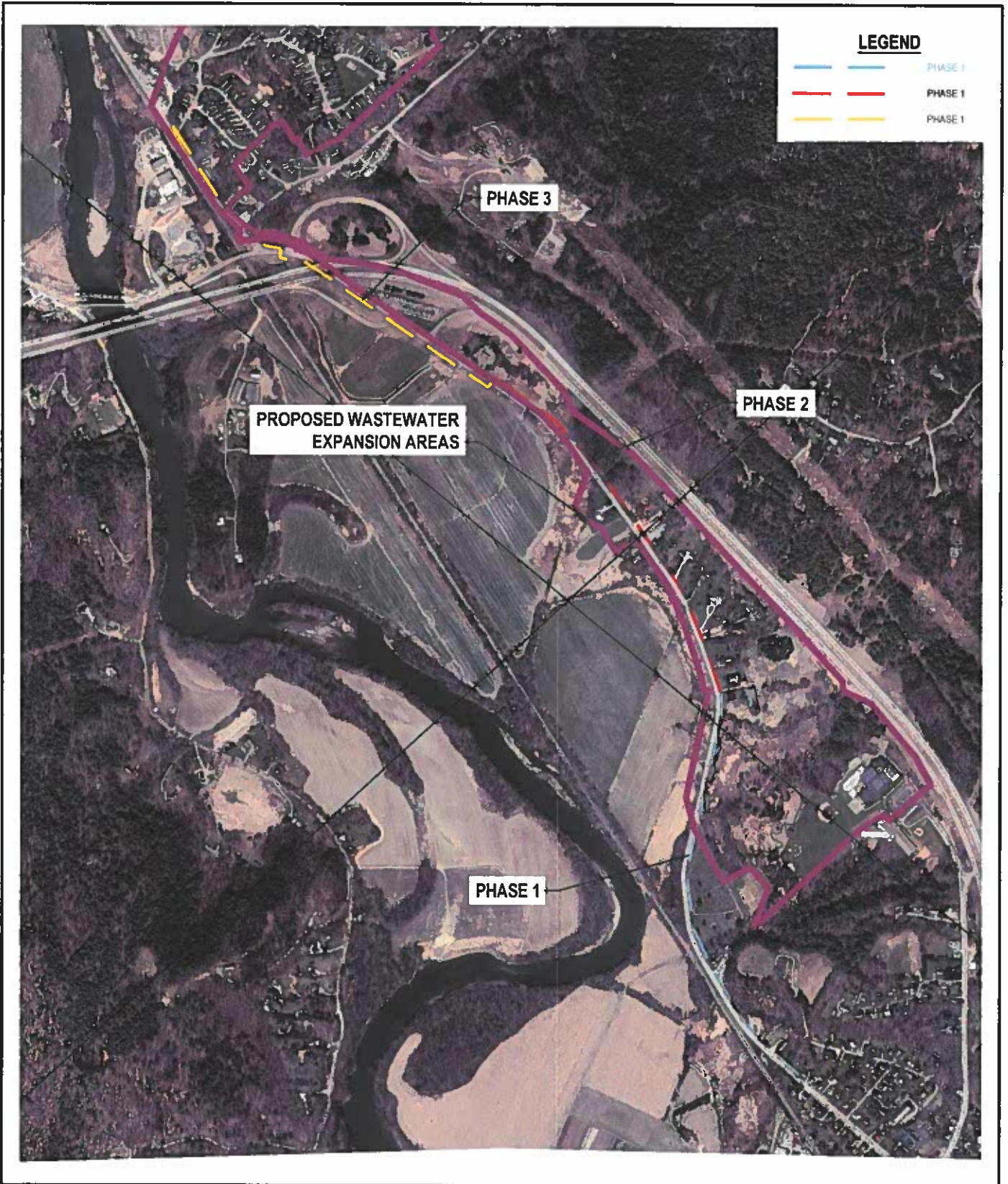


1438 SOUTH BROWNELL ROAD
WILLISTON, VERMONT 05495
PHONE: (802)862-5590
FAX: (802)862-7588

GREEN MOUNTAIN ENGINEERING

CIVIL WATER WASTEWATER

DRAWING TITLE	RICHMOND, VT ZONING MAP	
	DESIGNED	SP
PROJECT	WEST MAIN STREET WASTEWATER EXTENSION	PROJECT NO.
	CLIENT	TOWN OF RICHMOND, VERMONT
DATE	7/2/21	DRAWING NO.
	1" = 1000'	11
DATE	MAY, 2021	



1438 SOUTH BROWNELL ROAD
WILLISTON, VERMONT 05495
PHONE (802)882-6580
FAX (802)882-7588

GREEN MOUNTAIN ENGINEERING

CIVIL
WATER
WASTEWATER

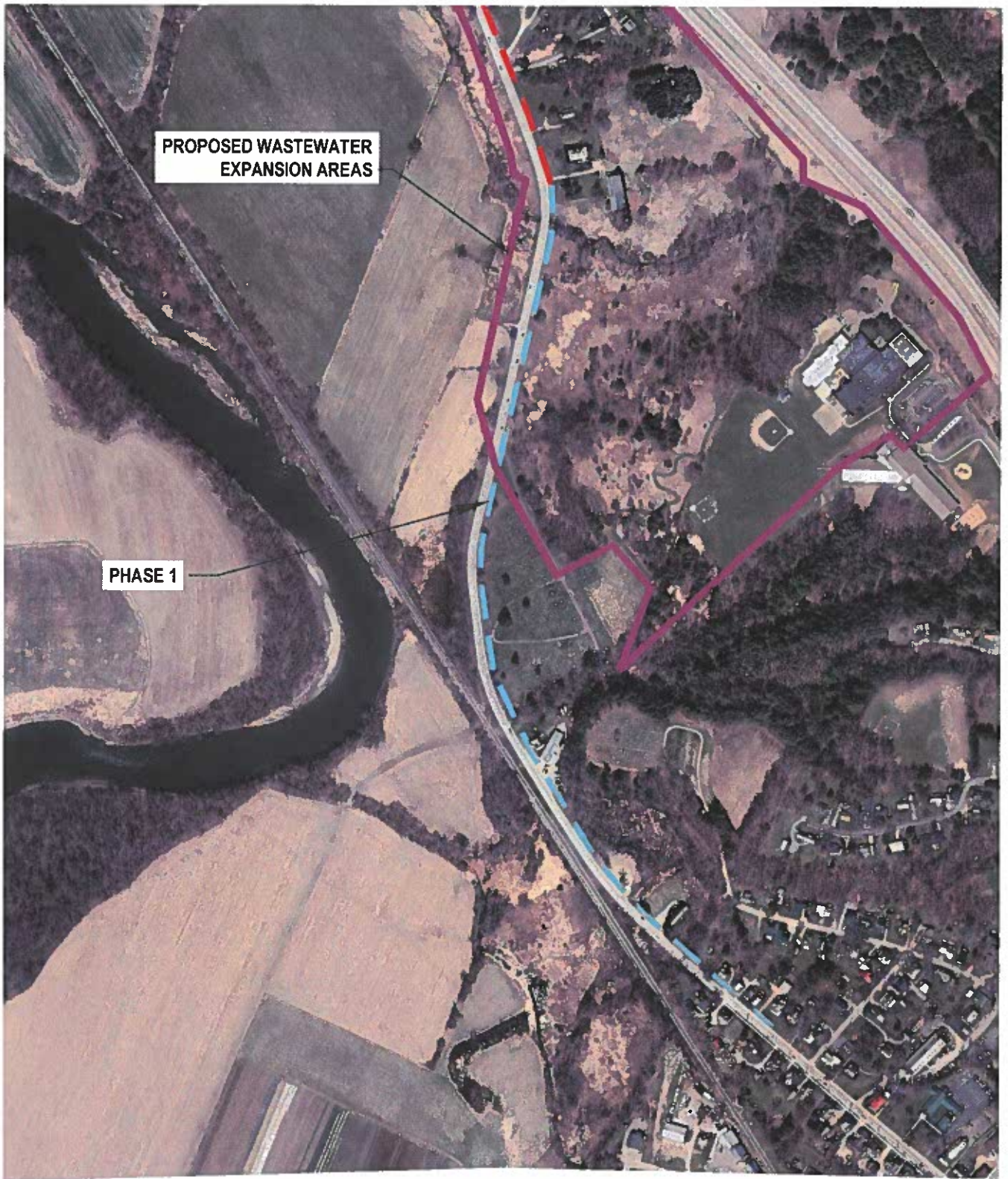
DESIGNED: SP
DRAWN: JJB
CHECKED: AH
PROJECT: WEST MAIN STREET WASTEWATER EXTENSION
CLIENT: TOWN OF RICHMOND, VERMONT

DESIGNED: SP
DRAWN: JJB
CHECKED: AH
PROJECT: WEST MAIN STREET WASTEWATER EXTENSION
CLIENT: TOWN OF RICHMOND, VERMONT

PROJECT NO.
24-029

DRAWING NO.
12

PLLOT DATE: 7/2/21
SCALE: 1" = 1000'
DATE: JUN. 2021



**PROPOSED WASTEWATER
EXPANSION AREAS**

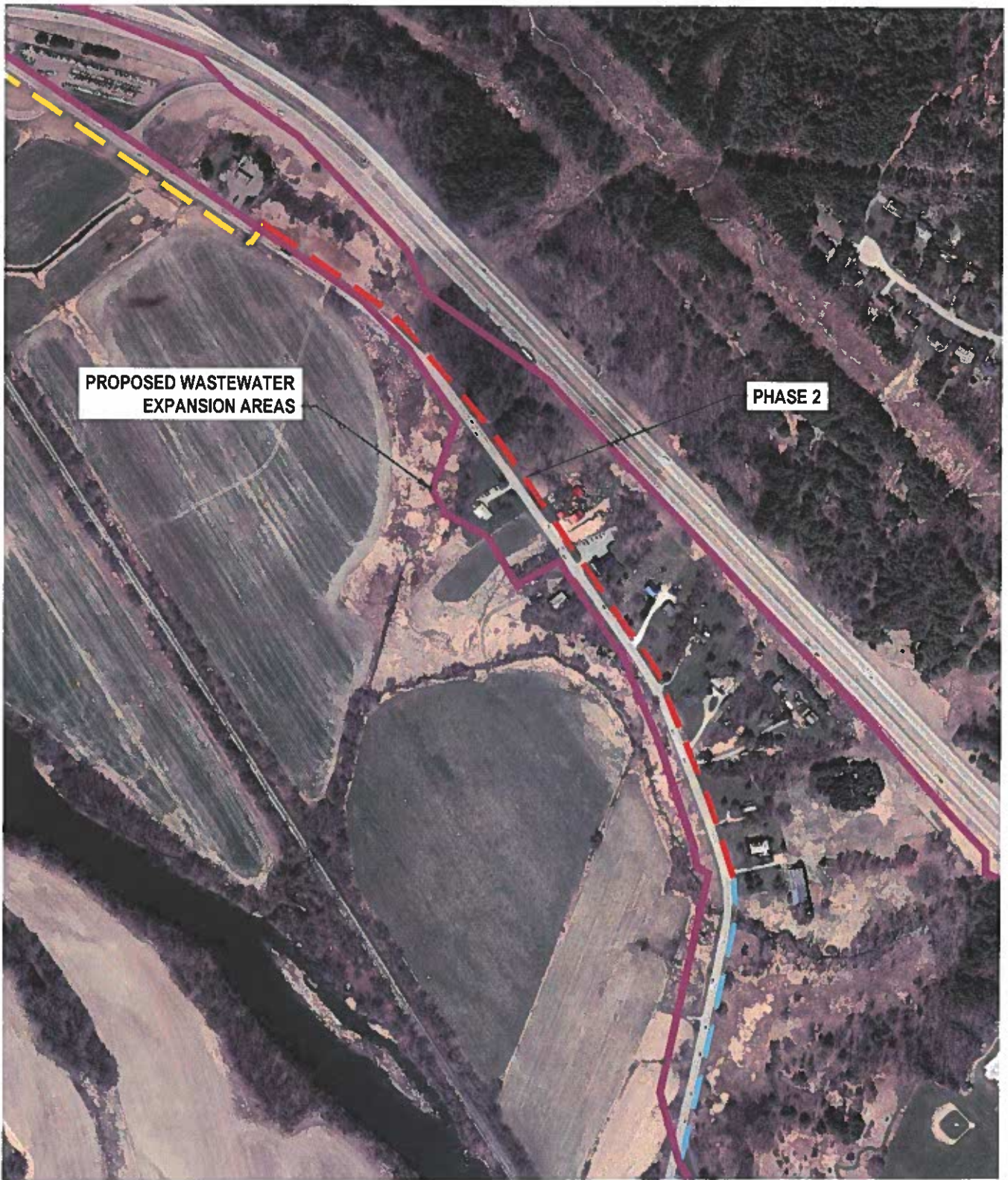
PHASE 1

1438 SOUTH BROYNELL ROAD
WILLISTON, VERMONT 05495
PHONE: (802)882-6590
FAX: (802)882-7588

**GREEN
MOUNTAIN
ENGINEERING**

CIVIL
WATER
WASTEWATER

DRAWING TITLE	DESIGNED	PROJECT NO.
	SP	24-029
PROJECT	DRAWN	DRAWING NO.
	JJB	
CLIENT	CHECKED	PLOT DATE
	AH	
CLIENT	SCALE	DATE
	1" = 500'	



**PROPOSED WASTEWATER
EXPANSION AREAS**

PHASE 2

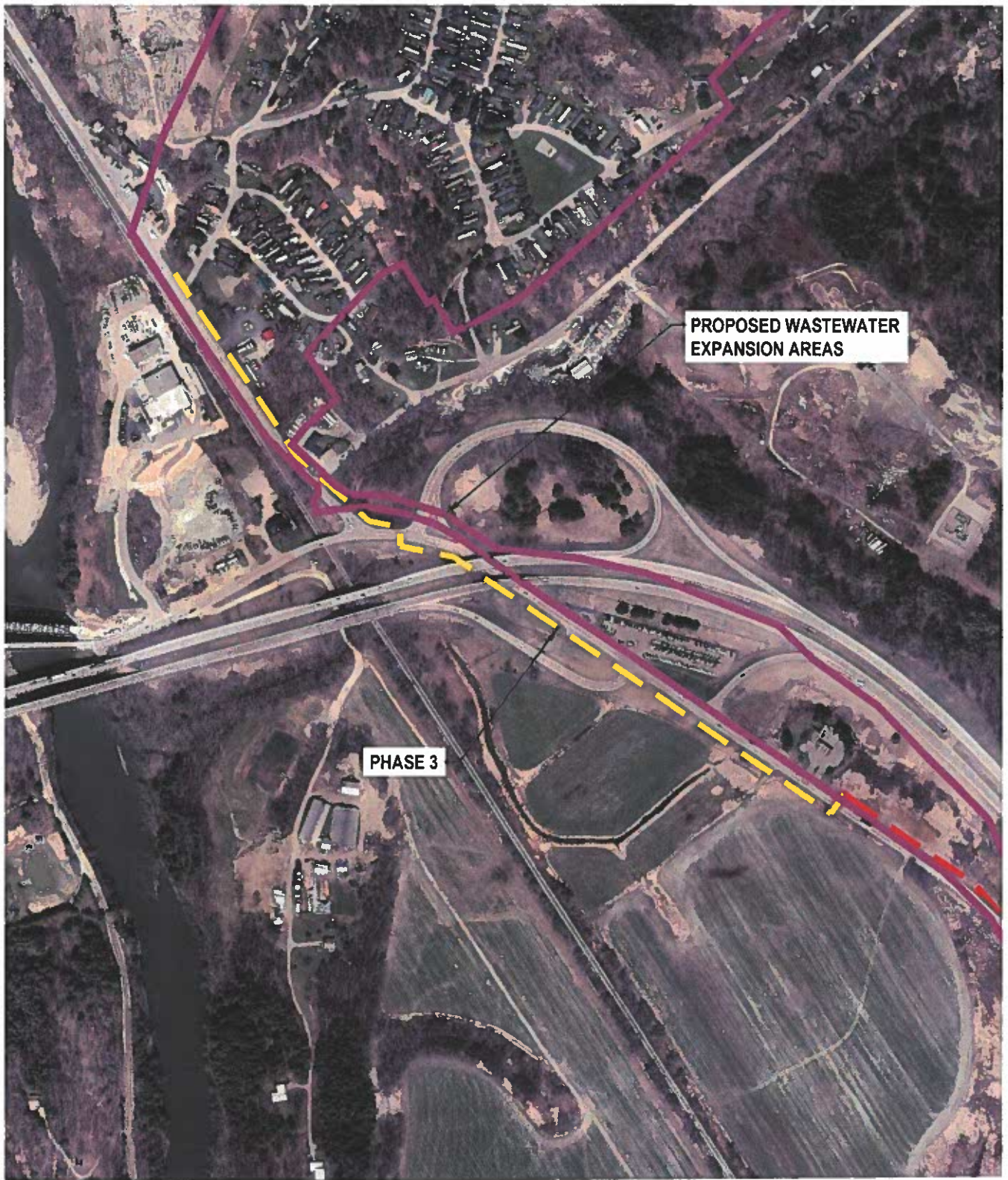
**GREEN
MOUNTAIN
ENGINEERING**

CIVIL
WATER
WASTEWATER

1438 SOUTH BROWNELL ROAD
WILLISTON, VERMONT 05485
PHONE: (802)862-5590
FAX: (802)862-7588

DRAWING TITLE	
PROPOSED SEWER LINE EXTENSION PHASE 2 PLAN	
PROJECT	WEST MAIN STREET WASTEWATER EXTENSION
CLIENT	TOWN OF RICHMOND, VERMONT

DESIGNED	SP	PROJECT NO.	24-029
DRAWN	JJB		
CHECKED	AH		
PLOT DATE	7/2/21	DRAWING NO.	14
SCALE	1" = 500'		
DATE	MAY 2021		



**PROPOSED WASTEWATER
EXPANSION AREAS**

PHASE 3

**GREEN
MOUNTAIN
ENGINEERING**

CIVIL
WATER
WASTEWATER

1438 SOUTH BROWNELL ROAD
WILLISTON, VERMONT 05485
PHONE: (802)882-5500
FAX: (802)882-7568

DRAWING TITLE		DESIGNED	PROJECT NO.
PROPOSED SEWERLINE EXTENSION PHASE 3 PLAN		SP	24-029
		DRAWN	
PROJECT		JJB	DRAWING NO.
		AH	
WEST MAIN STREET WASTEWATER EXTENSION		CHECKED	15
CLIENT		PLOT DATE	
		7/2/21	
TOWN OF RICHMOND, VERMONT		SCALE	
		1" = 500'	
		DATE	
		MAY, 2021	

Appendix B

Hartgen Archeological Study

ARCHEOLOGICAL RESOURCE ASSESSMENT
Richmond West Main Street Sewer and Water Extension

Town of Richmond
Chittenden County, Vermont

HAA # 4868-12

Submitted to:

Green Mountain Engineering, Inc.
PO Box 159
Williston, Vermont 05495

Prepared by:

Hartgen Archeological Associates, Inc.

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Putney, VT 05346
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f +1 802 387 8524
e hartgen@hartgen.com

www.hartgen.com

An ACRA Member Firm
www.acra-crm.org

June 2021

MANAGEMENT SUMMARY

SHPO Project Review Number:

Involved State and Federal Agencies: *Vermont Water Supply Division, USDA Rural Development*

Phase of Survey: *Archeological Resource Assessment*

LOCATION INFORMATION

Municipality: *Town of Richmond*

County: *Chittenden*

State: *Vermont*

SURVEY AREA

Length

Water: *2.05 miles (3.3 km)*

Sewer: *2.28 miles (3.67 km)*

Access Road: *0.21 mile (0.34 km)*

Width: *6.1 meters (20 ft)*

Area: *11 acres (4.45 ha)*

RESULTS OF RESEARCH

Archeological sites within one mile: *4*

Surveys in or adjacent: *4*

NR/NRE sites in or adjacent: *2*

Precontact Sensitivity: *Moderate*

Historic Sensitivity: *Moderate*

RECOMMENDATIONS

Avoid areas of archeological potential. Phase IB archeological reconnaissance survey recommended for areas that cannot be avoided.

Report Authors: *Thomas R. Jamison*

Date of Report: *June 2021*

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ARCHEOLOGICAL RESOURCE ASSESSMENT

1 Introduction

Hartgen Archeological Associates, Inc. (Hartgen) conducted an Archeological Resource Assessment for the proposed Richmond West Main Street Sewer and Water Extension project (Project) located in the Town of Richmond, Chittenden County, Vermont (Map 1). The Project requires approvals by Vermont Water Supply Division. This investigation was conducted to comply with Section 106 of the National Historic Preservation Act of 1966, as amended and will be reviewed by the Vermont Division for Historic Preservation (VDHP). This investigation adheres to the Vermont State Historic Preservation Office's (SHPO) *Guidelines for Conducting Archeology in Vermont* (2017).

2 Project Information

Site visits were conducted by Thomas R. Jamison on June 17, 2015 and May 26, 2021 to observe and photograph existing conditions within the Project Area. The information gathered during the site visits is included in the relevant sections of the report.

2.1 Project Location

The project is located in the northwest corner of the Town of Richmond. It extends from 214 West Main Street (Route 2) northwest to River Road (Route 117) where it ends at Summers Street, the entrance to Riverside Mobile Home Park. An alternative alignment extends from the Camel's Hump Middle School, running northwest cross country to connect to the Route 2 corridor at 840 West Main Street and continue on to Riverside Mobile Home Park (Maps 2a-d).

2.2 Description of the Project

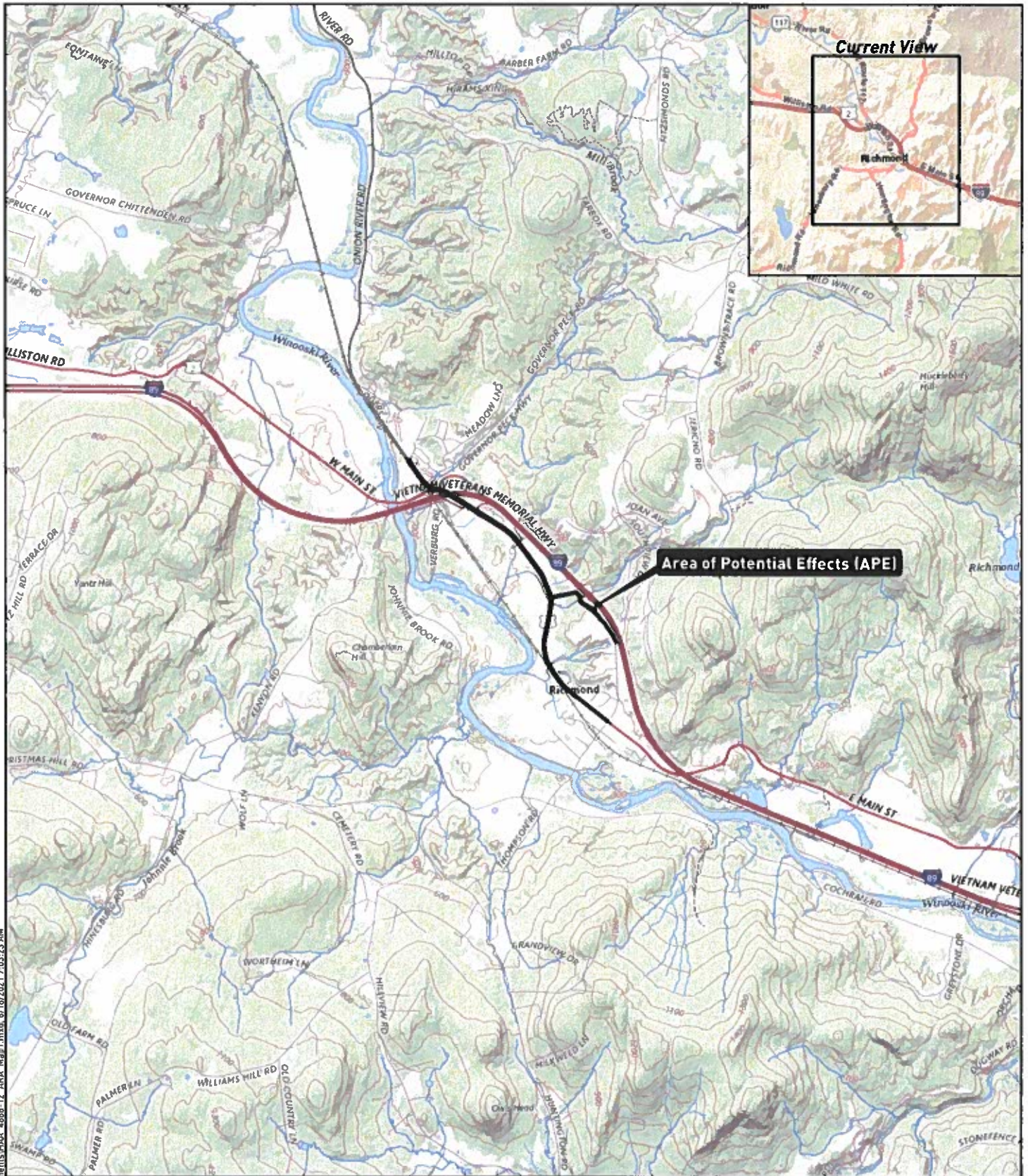
The project includes the following components (Map 2a-d):

- The most likely preferred alternative is the extension of the town water and sewer system from the vicinity of 214 West Main Street (Route 20) to the Riverside Mobile Home Park at Summers Street.
- A secondary alternative would extend the town water system from the Camel's Hump Middle School to Riverside Mobile Home Park and the town sewer system from Jericho Road at the entrance to the Middle School to Riverside Mobile Home Park. This alternative would include construction of an access road along the cross country segment of this alignment.
- The project will also include the installation of five fire hydrants

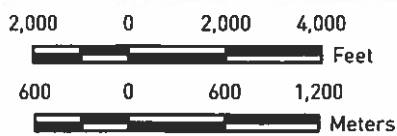
2.3 Description of the Area of Potential Effects (APE)

The area of potential effects (APE) includes all portions of the property that will be directly or indirectly altered by the proposed undertaking. The alignment of the water line is proposed to be on the north side of Route 2 and 117 while the wastewater alignment is on the south side. For the cross-country route, the two lines will be on either side of a new access road. The project alignment is approximately 2.05 miles (3.3 km) for the water line, 2.28 miles (3.67 km) for the sewer alignment and 0.21 miles (0.34 km) of new access road. The width of the APE is estimated at 20 feet (6.1 m). Based on these proposed effects, the APE includes approximately 11 acres (4.45 ha).

Richmond West Main Street Sewer and Water Extension, Town of Richmond, Chittenden County, Vermont
 Archeological Resource Assessment



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Note: Contour interval is 100 feet.

Project Location

GIS Services Accessed 6/18/2021:
 Environmental Systems Research
 Institute, Inc., World Street Map;
 USGS The National Map



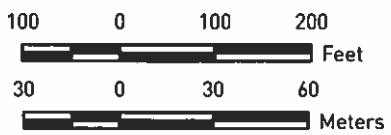
HARTGEN
 archeological associates inc

Map 1

Richmond West Main Street Sewer and Water Extension, Town of Richmond, Chittenden County, Vermont
 Archeological Resource Assessment



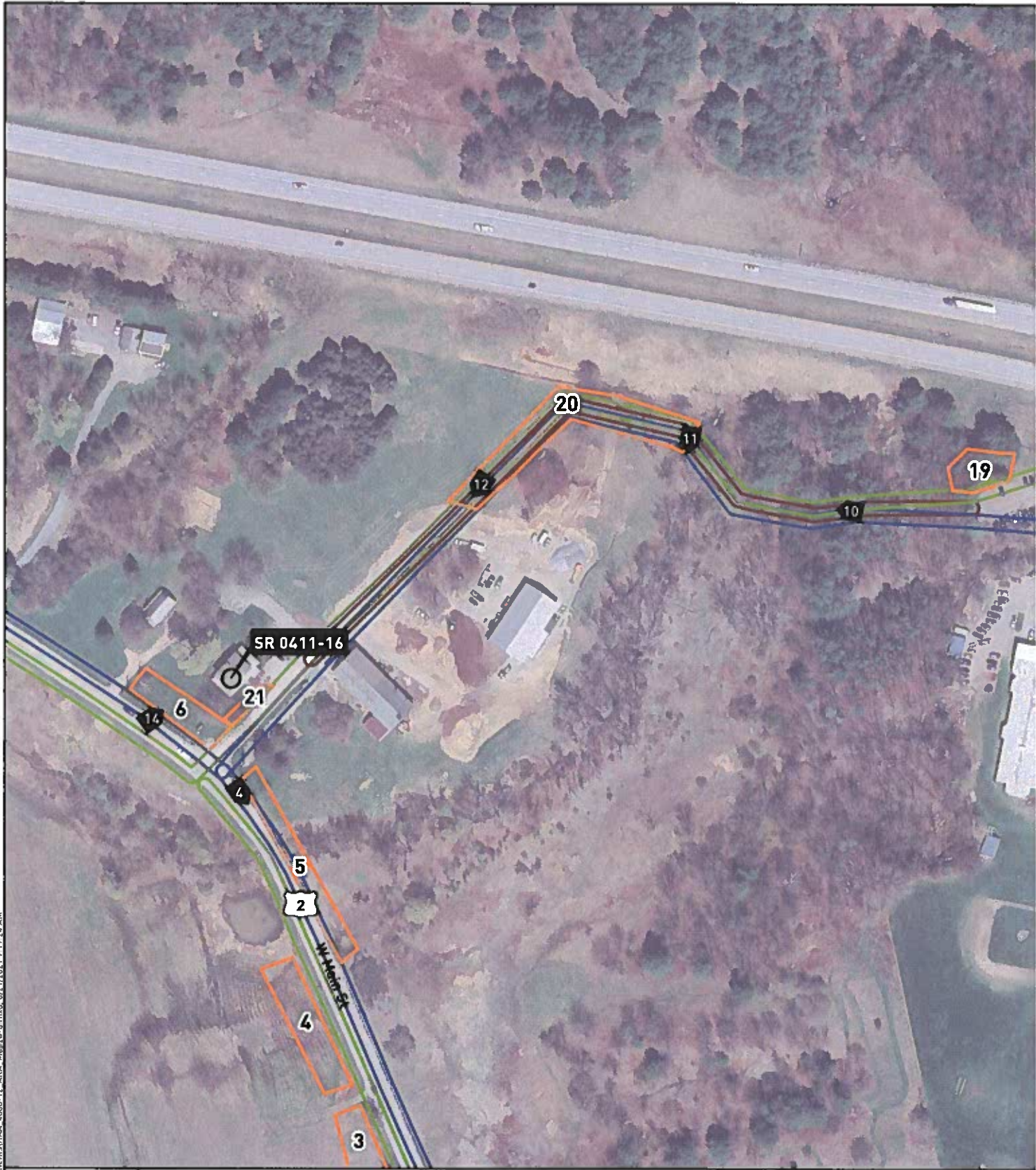
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Legend

- Photo Angle
- Archeologically Sensitive Area (ASA)
- RI
- RI

Richmond West Main Street Sewer and Water Extension, Town of Richmond, Chittenden County, Vermont
 Archeological Resource Assessment



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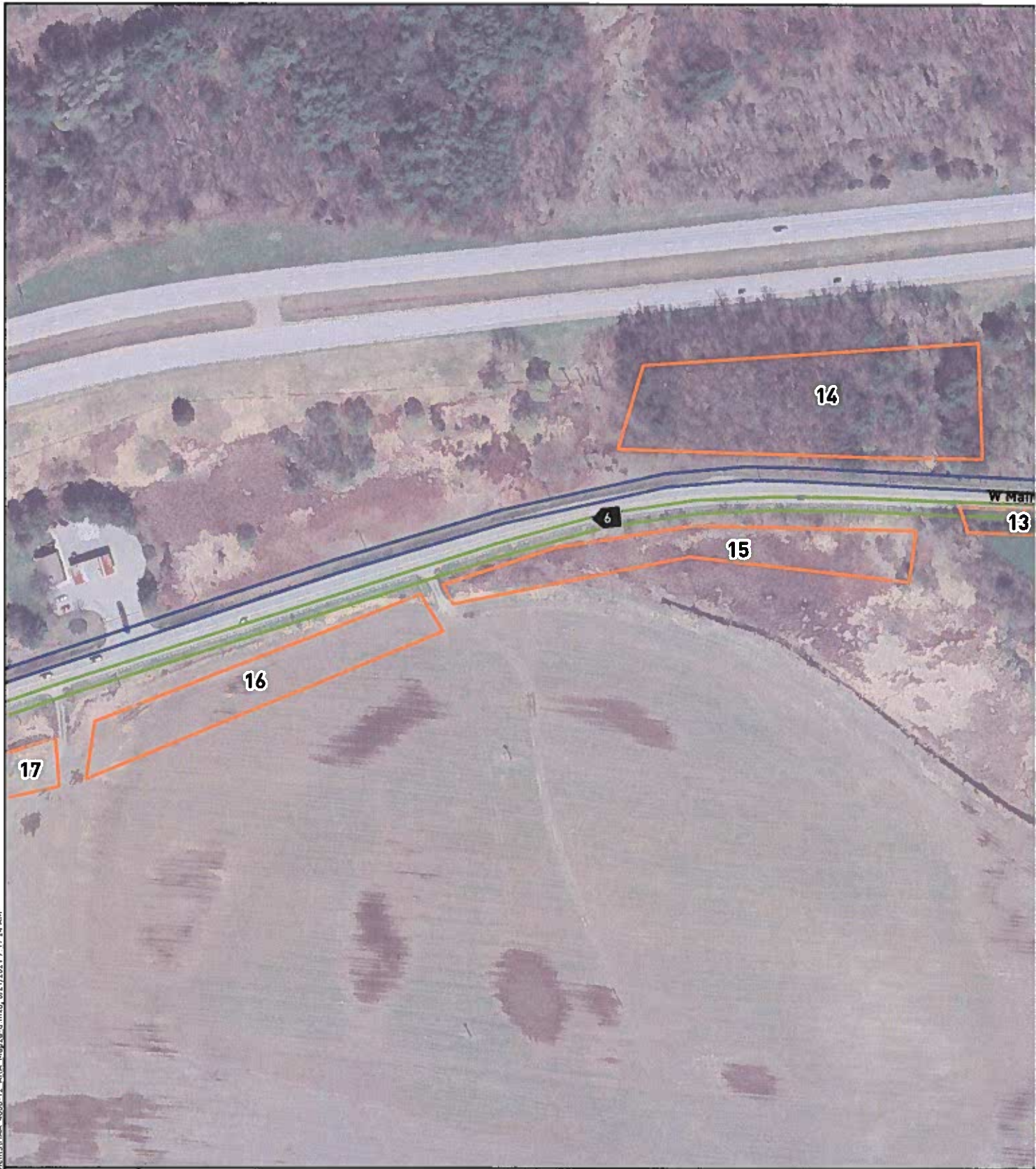


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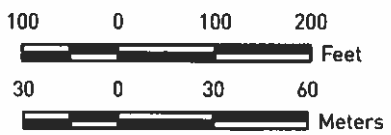
- Photo Angle
- Historic Structure
- Archeologically Sensitive Area (ASA)

- Ri
- Ri
- Ri

Richmond West Main Street Sewer and Water Extension, Town of Richmond, Chittenden County, Vermont
 Archeological Resource Assessment



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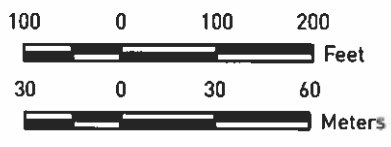
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- Photo Angle
- Historic Structure
- Archeologically Sensitive Area (ASA)
- Ri
- Ri

Richmond West Main Street Sewer and Water Extension, Town of Richmond, Chittenden County, Vermont
 Archeological Resource Assessment



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Legend

- Photo Angle
- Archeologically Sensitive Area (ASA)
- R
- R

3 Environmental Background

The environment of an area is significant for determining the sensitivity of the Project Area for archeological resources. Precontact and historic groups often favored level, well-drained areas near wetlands and waterways. Therefore, topography, proximity to wetlands, and soils are examined to determine if there are landforms in the Project Area that are more likely to contain archeological resources. In addition, bedrock formations may contain chert or other resources that may have been quarried by precontact groups. Soil conditions can provide a clue to past climatic conditions, as well as changes in local hydrology.

3.1 Present Land Use and Current Conditions

Most of the project alignment is located along the busy Route 2 corridor (Photos 1 to 8). The existing conditions along that section and along Route 117 are characterized as the edge of lawns, agricultural fields and highly disturbed areas where Route 2 passes near and under I-89. Much of the alignments on either side of the corridor have embankments, cut slopes and ditches along the roadside. Embankments and ditches generally extend a short distance from the road and beyond those features the adjacent areas are often undisturbed alluvial fields or raised terraces. The alternative alignment from the Camel's Hump Middle School crosses several different landforms as it passes from the school to Route 2 (Photos 9 to 12). The cross-country alignment extending from the middle school parking lot is wooded and generally sloped with a great deal of surface water present, although there is a small terrace on the alignment between a small school parking lot and I-89. Once the alignment crosses a small brook it is a gradual slope down to Route 2 that is partly open field and partly recently constructed driveway to a new structure and parking lot.

Utilities along the alignment include a gas line and underground telephone/cable lines. Most of these disturbances are along the north side of Route 2 and the north side of Route 117.



Photo 1. Water alignment connection to system at 214 West Main Street. Note disturbance from road and landscaping. View to the northwest.



Photo 2. Route 2 corridor immediately west of the village of Richmond core area. Note railroad and ditching on the right with disturbance from gravel parking area on the left. The village is concentrated on the rise in the background. View to the southeast.



Photo 3. Small drainage crossing the APE at 434 West Main Street (ASA 2). Note plastic culvert at toe of slope of Route 2 with small level areas on either side. View to the east/northeast.



Photo 4. Small drainage crossing the APE east of Willis Road (ASA 5). View to the south.



Photo 5. Terrace area adjacent to the Winooski flood plain on both sides of Route 2 (ASA 12 in the foreground). Note low embankment in the foreground that increases in height in the background. View to the southeast.

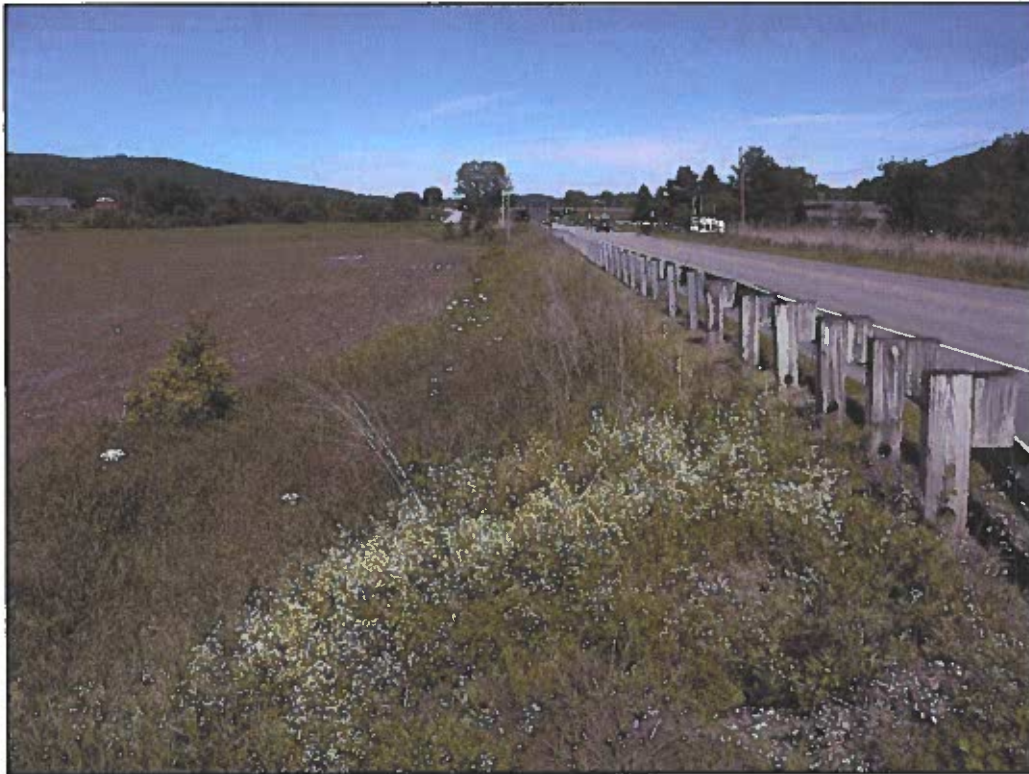


Photo 6. Field on Winooski River flood plain (ASA 16). Note embankment of Route 2 to the left and overpass of I-89 in the background. View to the northwest.



Photo 7. Disturbance of I-89 and associated park and ride lot. View to the northwest.



Photo 8. Embankment along Route 117 at entrance to Riverside Mobile Home Park. Note buried telephone/cable marker. View to the southeast.



Photo 9. Entrance to Camel's Hump Middle School. Note cut bank on the right and sidewalk with embankment on the left. View to the northwest.



Photo 10. Steeply sloped and wet area at east end of cross country route. View to the northwest.



Photo 11. Brook crossed by cross-country route. View to the southwest.



Photo 12. Field behind Westall Farm (SR 0411-16) (ASA 20). Note house and barn in the background and gradual slope up to the foreground. A recently constructed access road runs through the field along the right side of the trees on the left. View to the west/southwest.

3.2 Soils

Soil surveys provide a general characterization of the types and depths of soils that are found in an area. This information is an important factor in determining the appropriate methodology if and when a field study is recommended. The soil type also informs the degree of artifact visibility and likely recovery rates. For example, artifacts are more visible and more easily recovered in sand than in stiff glacial clay, which will not pass through a screen easily.

The soils along Route 2 and extending to the mobile home park, developed on a combination of glacial outwash deposits at the south end and lake plain sediments and recent alluvial soils associated with the Winooski River to the north. The soils extending from the school to Route 2 are generally moderately well drained silt loam deposits on glacial till or lacustrine/marine deposits terraces (USDA 2021). The alluvial deposits have the potential for deeply buried and stratified archeological deposits.

Table 1. Soils in Project Area (east to west)

Symbol	Name	Textures	Slope	Drainage	Landform
<i>Route 2 to Route 117</i>					
AgD	Agawam	Fine sandy loam	12-30%	Well drained	Glacial outwash
DdB	Duane and Deerfield	Very gravelly sand	5-12%	Moderately well drained	Glacial outwash
HiE	Hartland	Very fine sandy loam	25-60%	Well drained	Lake plain sediments
MyB	Munson and Raynham	Silt loam	2-6%	Somewhat poorly drained	Lacustrine and marine silt over clay on lake plains
MuD	Munson and Belgrade	Silt loam	12-25%	Somewhat poorly drained	Lacustrine and marine silt over clay on lake plains
Le	Limerick	Silt loam	0-3%	Poorly drained	Flood plain

Symbol	Name	Textures	Slope	Drainage	Landform
TeE	Terrace escarpments	Silty and clayey	12-25%	Moderately well drained	Terrace slopes
Lf	Limerick	Silt loam, very wet	0-3%	Poorly drained	Flood plain
Hf	Hadley	Very fine sandy loam	0-3%	Well drained	Flood plain
<i>Route 117 to Mobile Home Park</i>					
Hf	Hadley	Very fine sandy loam	0-3%	Well drained	Flood plain
<i>School to Route 2:</i>					
MuD	Munson and Belgrade	Silt loam	12-25%	Moderately well drained	Glacio-lacustrine terraces
PsC	Peru	Extremely stony loam	0-20%	Moderately well drained	Glacial till on uplands
MyB	Munson and Raynham	Silt loam	2-6%	Somewhat poorly drained	Lacustrine and marine silt over clay on lake plains
TeE	Terrace escarpments	Silty and clayey	12-25%	Moderately well drained	Terrace slopes
An	Alluvial land	Silt loam	0-3%	Well drained	Alluvial deposits

3.3 Bedrock Geology

The bedrock in the Project Area is primarily of the Pinnacle formation consisting of muscovite-chlorite-biotite-feldspar-quartz schist phyllite and metagraywacke. The APE crosses a band of the Pinnacle formation that consists of metabasalt and volcanics. The western limit of the APE crosses onto the Fairfield Pond formation of quartz-sericite-chlorite phyllite and foliated quartzite (Ratcliffe 2011).

These formations were not typically used by Native American groups for stone tool manufacture. However, they could have been utilized on an expedient basis.

3.4 Physiography and Hydrology

The Project Area high point is at the Camel's Hump Middle School, which is located on a high terrace along I-89. From that point, the alignment drops about 23 meters (75 ft), from 123 meters (405 ft) to 101 meters (330 ft) to a small brook that crosses the alignment. From there, the APE gradually drops down to Route 2 at about 95 meters (313 ft). Route 2 varies slightly, with a high point of 104 meters (341 ft) and dropping down to about 91 meters (300 ft) at the park and ride lot before rising at Route 117 and ending at about 94 meters (309 ft) at the entrance to the Riverview Mobile Home Park.

Several small drainages cross the APE. The primary one is the small brook below the school (Photo 11). Another small drainage, which flows into the first, is located at the start of the APE at the school parking lot. Further to the west, three small drainages cross the APE. However, each of them are somewhat or extensively channelized, suggesting significant disturbance.

4 Documentary Research

Hartgen conducted research at the Vermont Division for Historic Preservation (VDHP) to identify previously reported archeological sites, State and National Register (NR) properties, properties determined eligible for the NR (NRE), and previous cultural resource surveys.

4.1 Archeological Sites

The archeological site files at VDHP contained four reported sites within one mile (1.6 km) of the Project Area (Table 2). Previously reported archeological sites provide an overview of both the types of sites that may be present in the APE and the relationship of sites throughout the surrounding region. The presence of few reported sites, however, may result from a lack of previous systematic survey and does not necessarily indicate a decreased archeological sensitivity within the APE.

In the case of the Richmond project area, the lack of reported sites is probably due to the limited amount of survey conducted in the area, judging by the high number of sites known to exist further to the west and east. The known sites in the project vicinity include the Conant Site (VT-CH-639) across the river from the mobile home park. At that site, 61 precontact features were identified during Phase I, II and III investigations. The radiocarbon samples dated the site to 3600 years before present, or the Late Archaic (Skins 2012). In the village of Richmond, the Esplanade Site (VT-CH-1098) consisted of an isolated find of a Levanna projectile point under levels of historic fill. Historic sites identified in the village consist of the 1908 Fire Site (VT-CH-1108) that consists of large amounts of fill in the foundations of structures that burned during the 1908 fire that devastated most of the business district.

Over a mile from the APE there are several clusters of precontact sites located to the west and several important sites to the east along the Winooski River and its tributaries. The presence of those sites indicates the lack of sites in the project vicinity is likely due to the limited investigation in the area, rather than a true lack of sites.

Table 2. Vermont Archeological Inventory (VAI) sites within one mile (1.6 km) of the Project Area

VAI Site No.	Site Identifier	Description	Proximity to Project Area
VT-CH-639	Conant Site	Late Archaic, many features, stone tools, botanical remains	0.4 mile to SW
VT-CH-1098	Esplanade Site	Late Woodland, isolated find of Levanna projectile point	0.6 mile to S
VT-CH-1108	1908 Fire Site	Early 20 th -century deposits associated with 1908 fire	0.6 mile to S
VT-CH-1109	Pump Station Site	19 th -century house and blacksmith shop	1 mile to S

4.2 Historic Properties

An examination of the files at VDHP identified no NR properties, three State Register listed properties within the North Main Street Historic District and two SR properties west of and outside of the historic district adjacent to the APE (Table 3). The properties contributing to the historic district are three early 20th-century houses at the edge of the district along West Main Street. The two SR properties outside of the historic district include one early 19th-century structure and one early 20th-century structure. The project APE passes through and across the front of the property of the Westhall Farm (SR 0411-16).

Table 3. Inventoried properties within or adjacent to the APE

VHSS #	Name	Address	Status	Description of Building
North Main Street Historic District				
0411-1, 14		214 West Main Street	SRL 4/9/1980	c. 1920 clapboard house
0411-1, 15		222 West Main Street	SRL 4/9/1980	c. 1905 clapboard and shingled house
0411-1, 16		217 West Main Street	SRL 4/9/1980	c. 1910 clapboard house
Outside Historic District				
0411-16	Willis Residence/former Westhall Farm	840 West Main Street	SRL 4/9/1980	c. 1910 "Tourist Home" large frame hipped roof house with associated barn and silos
0144-17	Thompson House	1070 West Main Street	SRL 4/9/1980	c. 1815 Federal style house

4.3 Previous Surveys

On file at VDHP are four previous surveys within the immediate vicinity of the Project (Table 4). These surveys include one at the eastern end of the APE that examined the archeological potential of utility improvements along Jericho Road and in the village of Richmond (Hartgen 2012). This survey extended to the intersection of Jericho Road and School Street, where the current APE begins. This location was determined to be disturbed. One survey has been conducted along the south side of Route 2 adjacent to the APE approximately

half way between the two ends of the project alignment. This survey on a small terrace overlooking the Winooski River floodplain identified disturbance in that APE but indicated other parts of the landform could retain intact deposits (Skinas 1999) Two surveys have been conducted adjacent to the west end of the APE. These surveys include an expansion of the Milton CAT facility located slightly to the southwest of the mobile home park where no archeological deposits were encountered (Hartgen 2010) and a Phase IA assessment for J. Hutchins excavation contractors immediately to the northwest of the mobile home park (Frink and Hathaway 2001) that determined no archeological potential for the property.

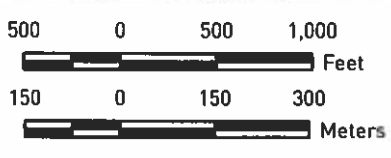
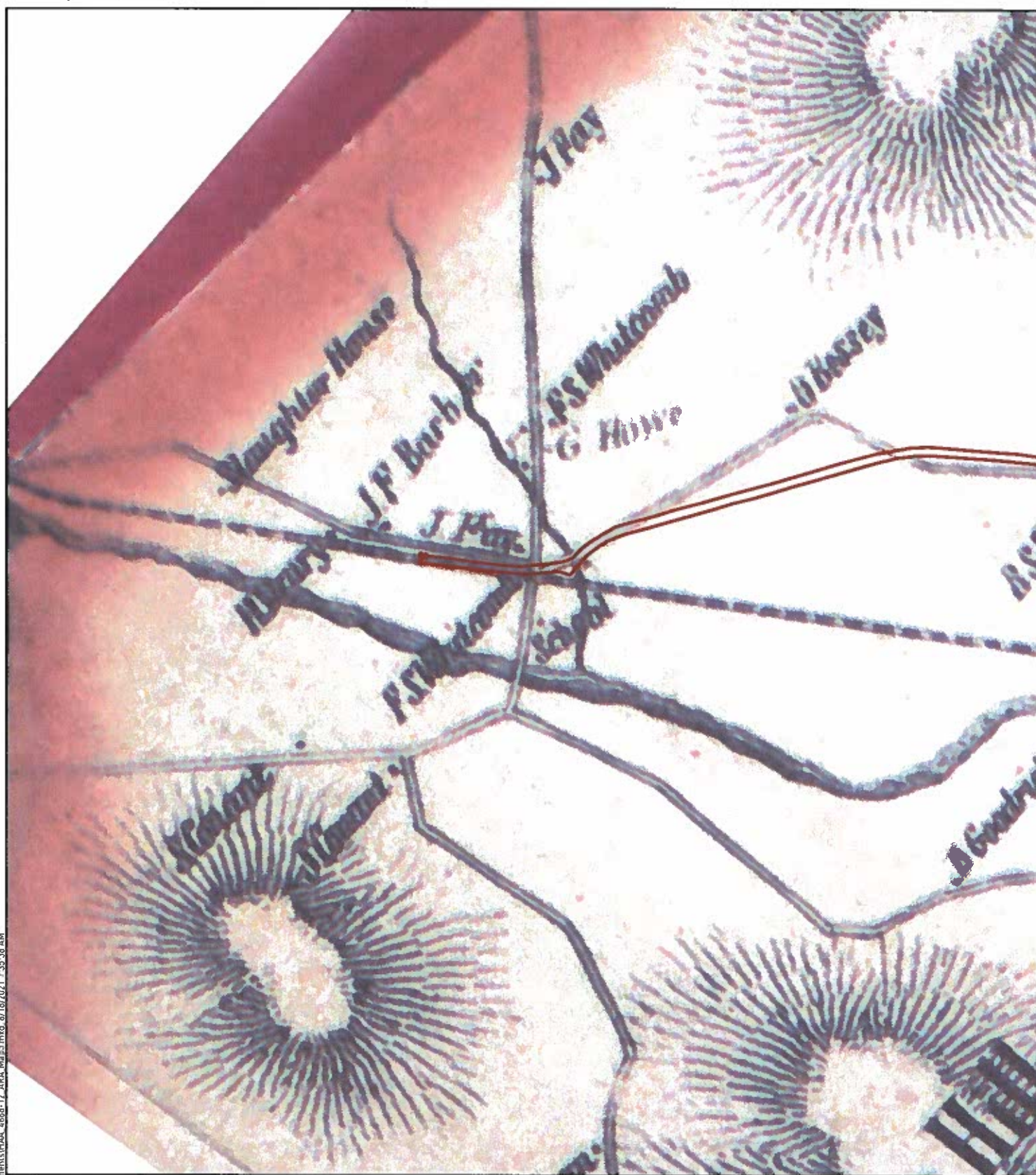
Table 4. Relevant previous surveys within or adjacent to the Project

Year	Investigator	Methodology	Results	Notes
1999	David Skinas-USDA NRCS	Surface survey and stps	Identified disturbance in APE	Vergurg borrow area
2010	Frink and Hathaway	Phase IA archeological and geomorphological assessment	Determined to be not sensitive	J. Hutchins
2012	David Skinas-USDA NRCS	Phase I to III surface survey, stp and unit excavation, plowzone stripping and feature excavation	Identification of 61 precontact features, Late Archaic occupation	Conant Site
2012	Hartgen Archeological Associates, Inc.	Phase I survey for municipal infrastructure improvements	Disturbance in vicinity of current APE	Richmond Infrastructure

5 Historical Map Review

Review of the historic maps of the project area identifies several structures that were located along the APE. These structures are mostly along Route 2 and the intersection with Route 117, although one structure is located on the cross country route. The 1856 Walling map of Richmond (Map 3) depicts five residences along the north side of Route 2 and one blacksmith shop on the south side (Walling 1857). The houses within the historic district do not appear until after this map. The 1869 Beers atlas (Map 4) depicts most of the same structures, although one residence has been removed and another added in a different location and the blacksmith shop is not shown (Beers 1869). The 1906 and 1924 USGS quadrangles depict the same structures as the Beers map, along with a structure at 434 West Main Street (adjacent to the large Riverview Cemetery), and the structures within the historic district on West Main Street (USGS 1906, 1924). The 1948 USGS quad shows the presence of the barns across Route 2 from the Thompson House (SR 0411-17), the vicinity of the blacksmith shop shown on the 1857 map (USGS 1948). The structure on the cross country route first appears on the 1869 Beers map labeled B. Lincoln (Map 4). It continues to be present on the USGS maps until at least 1980 (USGS 1980). At the west end of the APE, the intersection of Routes 2 and 117 was heavily disturbed by a quarry that is shown on the 1948 and 1980 USGS quads. This disturbance extends slightly into the Riverview Mobile Home Park. However, it appears to not extend to the edge of Route 117, potentially leaving a sliver of undisturbed land along the northeast side of Route 117. None of the Sanborn maps cover any of the APE (Sanborn 1939), with the exception of the structure at 217 West Main Street that appears on the 1926 and 1939 versions.

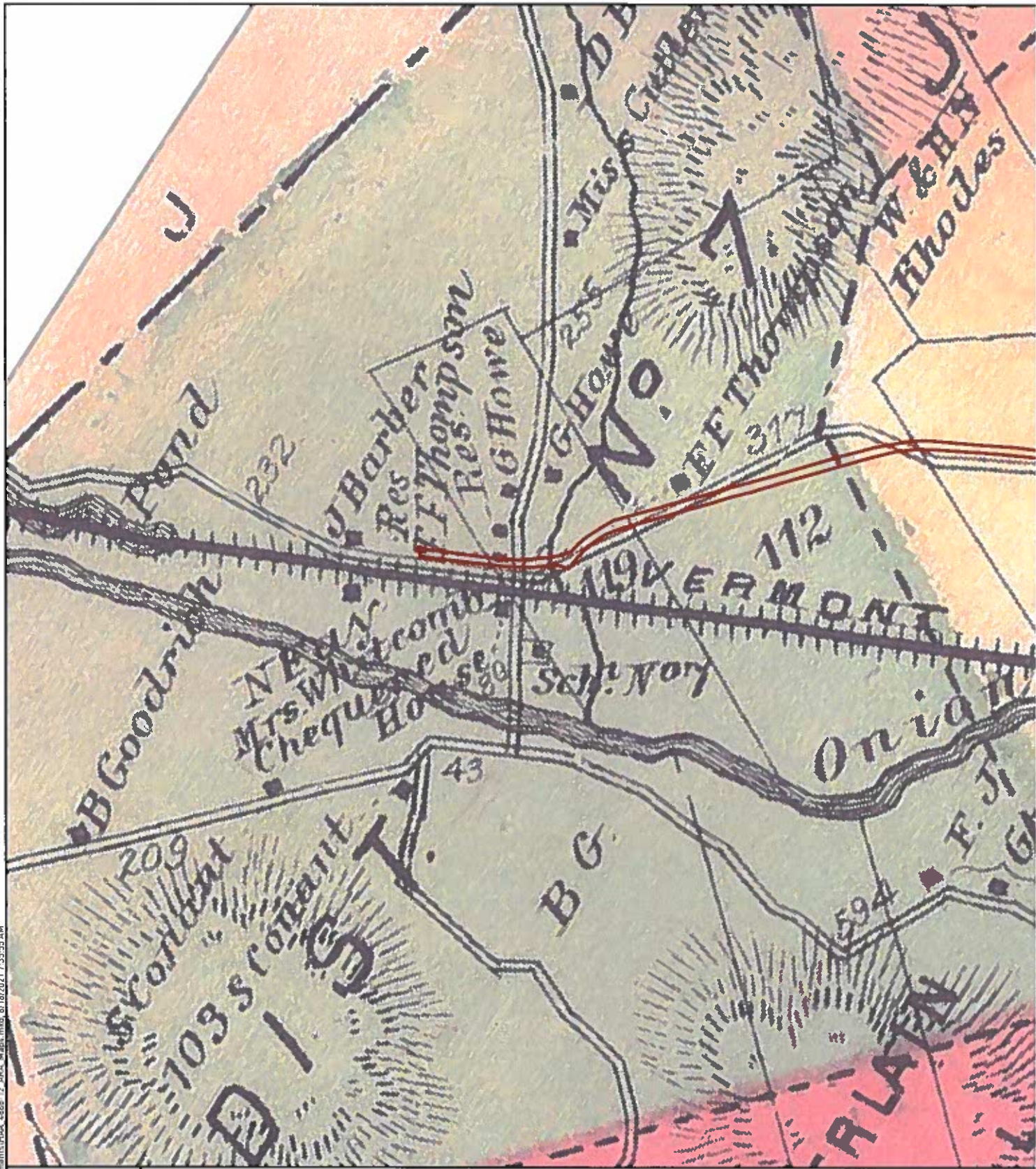
Richmond West Main Street Sewer and Water Extension, Town of Richmond, Chittenden County, Vermont
 Archeological Resource Assessment



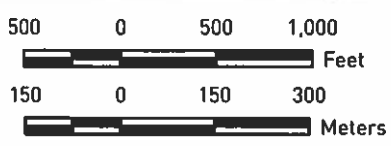
Legend
 Area of Potential Effects (APE)

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Richmond West Main Street Sewer and Water Extension, Town of Richmond, Chittenden County, Vermont
Archaeological Resource Assessment



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 Area of Potential Effects (APE)

6 Archeological Discussion

6.1 Precontact Archeological Sensitivity Assessment

Completion of the VDHP Environmental Predictive Model provides a measure of the precontact archeological sensitivity of the project area (Appendix 1). The Project Area is sensitive for proximity to permanent stream, seasonal stream, floodplain, wetlands, high elevated landform, valley edge features, Champlain Sea/glacial lake shoreline and natural travel corridor. Points were reduced for the Project Area having significant disturbance related to railroad, highway and utility construction and the presence of slope along the alternative alignment. The Project Area has a score of 68. A score of 32 and above is considered to indicate precontact sensitivity. This sensitivity is supported by a number of sites in similar locations as the APE, including the Conant Site across the river from the mobile home park and the Esplanade Site in the Village of Richmond.

6.2 Historic Archeological Sensitivity Assessment

The historic sensitivity of an area is based primarily on proximity to previously documented historic archeological sites, map-documented structures, or other documented historical activities (e.g. battlefields).

As demonstrated by the historic maps of the area, historic occupation of the project APE has always been at a fairly low density, translating into a relatively low sensitivity for early historic archeological sites. The only standing historic structures adjacent to the APE that appear on the historic maps are the c. 1920 State Register listed house at 217 West Main Street (SR 0411-1, 14) that was shown on the 1926 Sanborn map (Photo 1), an early 20th-century house (and site of an earlier mid-19th-century structure) at 434 West Main Street seen on many of the maps (Photos 3 and 13), and the two State Register listed structures (SR 0411-16 and 0411-17; Table 3). SR 0411-16, the Westhall Farm, dates to c. 1910 (Photo 14). However, the 1857 Walling and 1869 Beers maps depict a structure in that location labeled J. Whipple and W. S. Freeman, respectively. Therefore, there may be archeological remains on the property related to earlier structures, perhaps closer to the edge of Route 2. Similarly, the Beers map shows a structure labeled B. Lincoln on a road that no longer exists, but that appears to be the alignment of the cross country route east of the Westhall Farm. A structure also appears in this location on the USGS quads from 1921 to 1980. No evidence of structural remains were noted along the alignment in this area during the site visit. However, very high vegetation prevented thorough examination. The c. 1815 Thompson House (SR 0411-17) appears on both the 1857 and 1869 maps, labeled W. Rhodes (Photo 15). The 1869 map shows two structures in that location, suggesting there may be the remains of other structures on the property. A structure labeled O. Bessey appears on the 1857 Walling map about 288 meters (945 ft) east of the current Mobil gas station near the I-89 South entrance ramp. This area is currently bounded by a cut bank along Route 2. A structure labeled F. F. Thompson on the 1869 Beers map is located within what is now the heavily disturbed park and ride lot. Another structure labeled F. F. Thompson is shown on the 1869 map in the northeast quadrant of the intersection of Routes 2 and 117. This area, however, was later heavily disturbed by quarrying as shown on several late 20th-century USGS quads.

6.3 Archeological Potential

Archeological potential is the likelihood of locating intact archeological remains within an area. The consideration of archeological potential takes into account subsequent uses of an area and the disturbance those uses would likely have on archeological remains.

The archeological potential of the APE varies considerably along the route. Map 2 depicts areas of archeological potential derived from the information presented above. Some of these locations are set off from the edge of Route 2 due to the presence of cut or fill or buried utilities directly adjacent to the road. However, if project disturbance is proposed to extend beyond such existing disturbance, areas of archeological potential should be expected to be present. In some locations the precise location of buried utilities is unclear, so they may intersect areas of archeological potential. Areas of archeological potential within or adjacent to the APE are listed in Table 5 and illustrated on Maps 2a to 2d.

Table 5. Summary of archeological potential

Area	Archeological Potential	Length	Location
1	Precontact	21 m/70 ft	Adjacent to wetland at 282 West Main Street
2	Precontact and historic	26 m/85 ft	Adjacent to drainage and historic house at 434 West Main Street
3	Precontact	241 m/792 ft	S side of Route 2, slightly offset from road
4	Precontact	65 m/212 ft	S side of Route 2, slightly offset from road
5	Precontact	94 m/310 ft	N side of Route 2, immediately south of SR 0411-16
6	Precontact and historic	47 m/155 ft	West of and in front of SR 0411-16
7	Precontact	61 m/156 ft	N side Rte 2, offset from road
8	Precontact	44 m/144 ft	N side Rte 2, offset from road
9	Precontact and historic	73 m/239 ft	N side Rte 2, in front of SR 0411-17
10	Precontact and historic	17 m/56 ft	N side Rte 2, adjacent to SR 0411-17
11	Precontact and historic	98 m/321 ft	S side Rte 2, site of barns assoc. with SR 0411-17
12	Precontact and historic	73 m/239 ft	S side Rte 2, raised terrace vicinity of SR 0411-17
13	Precontact	51 m/169 ft	S side Rte 2, raised terrace
14	Precontact and historic	162 m/534 ft	N side Rte 2, vicinity of O. Bessey on 1857 map, offset from road
15	Precontact	214 m/701 ft	S side Rte 2, offset from road
16	Precontact	165 m/542 ft	S side Rte 2, offset from road
17	Precontact	37 m/120 ft	S side Rte 2, offset from road
18	Precontact	123 m/404 ft	S side Rte 2, offset from road
19	Precontact	27 m/90 ft	Adjacent to school parking lot
20	Precontact and historic	205 m/674 ft	On cross country alignment east of SR 0411-16
21	Precontact and historic	25 m/82 ft	South of and adjacent to SR 0411-16

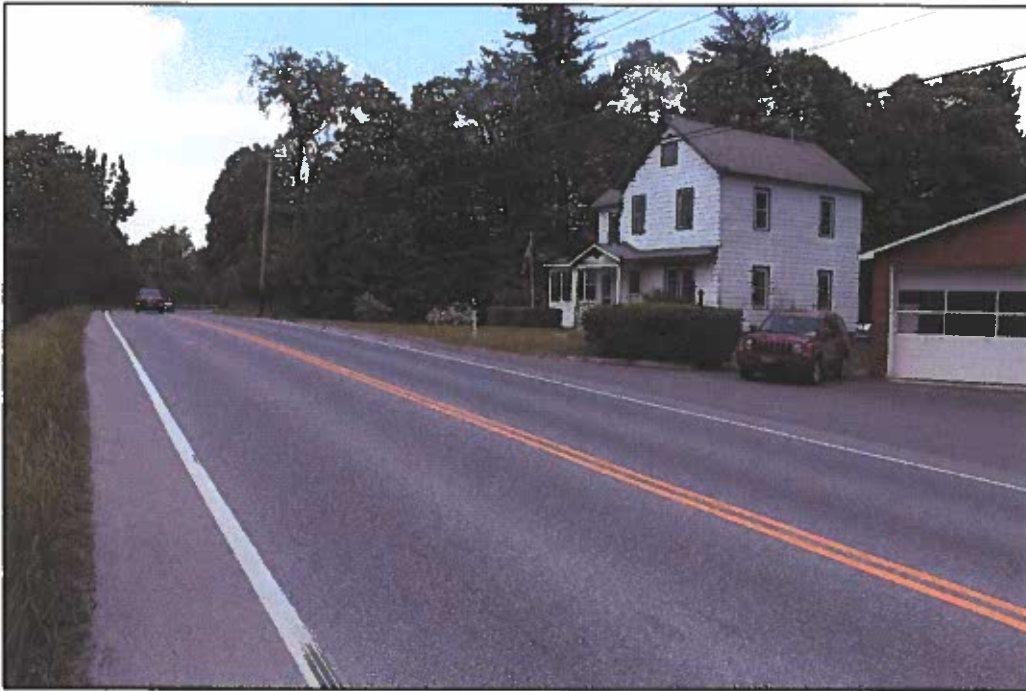


Photo 13. 434 West Main Street. House is sited adjacent to a small drainage and is likely the location of an earlier structure noted on the 1856 Walling map. View to the north.



Photo 14. Westhall Farm (SR 0411-16). Note lawn in foreground that extends to the side of Route 2. View to the east.



Photo 15. Thompson House (SR 0411-17). Note lawn in front of house and Route 2 in the foreground. View to the east.

6.4 Archeological Recommendations

Since the project is in the scoping phase, the exact location of the proposed lines is uncertain. The areas of archeological potential outlined above provide some guidance as to where project disturbance could intersect archeological deposits. It is recommended that project disturbance stay as close to the edge of the roadways as possible, to minimize affecting areas of archeological potential. Directional boring of the lines could help avoid effects to archeologically sensitive areas. If jack and bore pits could avoid those areas, which would limit the need for testing. If, however, those pits have to be placed in sensitive areas, the testing would be much less than open trench placement. If areas of archeological potential cannot be avoided, Phase IB archeological reconnaissance survey is recommended.

7 Bibliography

Beers, Frederick W.

- 1869 *Atlas of Chittenden County, Vermont*. F. W. Beers, A. D. Ellis & G. G. Soule, New York.

Frink, Douglas S. and Allen Hathaway

- 2001 *Phase IA Archeological Site Sensitivity Study of the Proposed J. Hutchins, Inc. Facility in the Town of Richmond, Chittenden County, Vermont*, On file at VDHP, Montpelier.

Green Mountain Engineering, Inc.

- 2015 *Access Road with Water and Sewer Extensions for West Main Street, Figures 4, 4A, 6 and 6A. Town of Richmond, Chittenden County, Vermont*.

Hartgen Archeological Associates, Inc.

- 2010 *Phase IB Archeological Investigation, Milton CAT Expansion Project, Town of Richmond, Chittenden County, Vermont (HAA #V537-21)*, On file at VDHP, Montpelier.

- 2012 *Phase I Archeological Reconnaissance Survey. Richmond Village Infrastructure Improvements Project, Town of Richmond, Chittenden County, Vermont (HAA #V481-31)*, On file at VDHP, Montpelier.

Ratcliffe, N. M., R. S. Stanley, M. H. Gale, P. J. Thompson and G. J. Walsh

- 2011 *Bedrock Geologic Map of Vermont: U.S. Geological Survey Scientific Investigations Map 3184, 3 Sheets, scale 1:100,000*. Vermont Geological Survey, Waterbury, Vermont.

Sanborn Map Company, Inc.

- 1939 *Richmond, Chittenden County, Vermont, Sheet 1*. Sanborn Map Company, New York, NY.

Skinas, David

- 1999 *Practice Description Form for Cultural Resources Review, Verburg Borrow Area, Town of Richmond, Chittenden County, Vermont*, On file at VDHP, Montpelier.

- 2012 *The Conant Farm Data Recovery Project: A Late Archaic Habitation Site Along the Winooski River*, USDA Natural Resources Conservation Service.

United States Department of Agriculture (USDA)

- 2021 *Web Soil Survey of Chittenden County United States Department of Agriculture*, Available online at <http://websoilsurvey.nrcs.usda.gov/> accessed May 2021.

United States Geological Survey

- 1948 *Essex Junction, Vermont 7.5' Topographic Quadrangle*. USGS, Reston, Virginia.

United States Geological Survey (USGS)

- 1906 *Burlington, Vermont 15' Topographic Quadrangle*. USGS, Washington, DC.

- 1924 *Camel's Hump 15' Topographic Quadrangle*. USGS, Washington, DC.

- 1980 *Richmond, Vermont 7.5' Topographic Quadrangle*. USGS, Reston, Virginia.

- 2021 *USGS The National Map Topo Base Map - Small Scale*, USGSTopo (MapServer), The National Map Seamless Server, USGS, Sioux Falls, South Dakota, <http://basemap.nationalmap.gov/arcgis/rest/services/USGSTopo/MapServer>.

Richmond West Main Street Sewer and Water Extension, Town of Richmond, Chittenden County, Vermont
Archeological Resource Assessment

Vermont Center for Geographic Information (VCGI)

2016 Best of Color Imagery, Cached, VT State Plane Meters, Web Service. VCGI, Waterbury, Vermont. Electronic document, http://vsgi.vermont.gov/warehouse/web_services.

Vermont Division for Historic Preservation

2017 *Guidelines for Conducting Archaeology in Vermont*. Vermont Division for Historic Preservation, Montpelier, VT.

Walling, Henry Francis

1857 *Map of Chittenden County, Vermont: From Actual Surveys*. Baker, Tilden & Co., New York.

Appendix 1: VDHP Environmental Predictive Model

VERMONT DIVISION FOR HISTORIC PRESERVATION
Environmental Predictive Model for Locating Pre-contact Archaeological Sites

Project Name **Richmond Water-Sewer** County **Chittenden** Town **Richmond**
 DHP No. Map No. Staff Init. **T. Jamison** Date

Additional Information

Environmental Variable	Proximity	Value	Assigned Score
A. RIVERS and STREAMS (EXISTING or RELICT):			
1) Distance to River or Permanent Stream (measured from top of bank)	0- 90 m	12	12
	90- 180 m	6	
2) Distance to Intermittent Stream	0- 90 m	8	8
	90-180 m	4	
3) Confluence of River/River or River/Stream	0-90 m	12	
	90 -180 m	6	
4) Confluence of Intermittent Streams	0 - 90 m	8	
	90 - 180 m	4	
5) Falls or Rapids	0 - 90 m	8	
	90 - 180 m	4	
6) Head of Draw	0 - 90 m	8	
	90 - 180 m	4	
7) Major Floodplain/Alluvial Terrace		32	32
8) Knoll or swamp island		32	
9) Stable Riverine Island		32	
B. LAKES and PONDS (EXISTING or RELICT):			
10) Distance to Pond or Lake	0- 90 m	12	
	90 -180 m	6	
11) Confluence of River or Stream	0-90 m	12	
	90 -180 m	6	
12) Lake Cove/Peninsula/Head of Bay		12	
C. WETLANDS:			
13) Distance to Wetland (wetland > one acre in size)	0- 90 m	12	12
	90 -180 m	6	
14) Knoll or swamp island		32	
D. VALLEY EDGE and GLACIAL LAND FORMS:			
15) High elevated landform such as Knoll Top/Ridge Crest/ Promontory		12	12
16) Valley edge features such as Kame/Outwash Terrace**		12	12

17) Marine/Lake Delta Complex**		12	
18) Champlain Sea or Glacial Lake Shore Line**		32	32
E. OTHER ENVIRONMENTAL FACTORS:			
19) Caves /Rockshelters		32	
20) <input checked="" type="checkbox"/> Natural Travel Corridor <input type="checkbox"/> Sole or important access to another drainage <input type="checkbox"/> Drainage divide		12	12
21) Existing or Relict Spring	0 – 90 m 90 – 180 m	8 4	
22) Potential or Apparent Prehistoric Quarry for stone procurement	0 – 180 m	32	
23)) Special Environmental or Natural Area, such as Milton aquifer, mountain top, etc. (these may be historic or prehistoric sacred or traditional site locations and prehistoric site types as well)		32	
F. OTHER HIGH SENSITIVITY FACTORS:			
24) High Likelihood of Burials		32	
25) High Recorded Site Density		32	
26) High likelihood of containing significant site based on recorded or archival data or oral tradition		32	
G. NEGATIVE FACTORS:			
27) Excessive Slope (>15%) or Steep Erosional Slope (>20)		- 32	-32
28) Previously disturbed land as evaluated by a qualified archeological professional or engineer based on coring, earlier as-built plans, or obvious surface evidence (such as a gravel pit)		- 32	-32
** refer to 1970 Surficial Geological Map of Vermont			
			Total Score: 68
Other Comments :			
0- 31 = Archeologically Non- Sensitive 32+ = Archeologically Sensitive			

Appendix C

Engineers Opinion of Probable Cost
Phase I – Alternate A and Alternate B

Appendix C

Phase 1

Alternative Route Analysis

Richmond West Main Street Wastewater Expansion Alternatives

Revised 7/7/2021

Description	Phase 1 - Alternate A			Phase 1 - Alternate B		
	School to Reap Property			Route 2 to Reap Property		
	Unit Cost	Quantity	Total Cost	Unit Cost	Quantity	Total Cost
ENGINEERING						
A. Preliminary Engineering (Step I)						
Archeology	\$9,900	1	\$9,900	\$9,900	1	\$9,900
Additional Environmental	\$1,900	1	\$1,900	\$1,900	1	\$1,900
	\$1,800	1	<u>\$1,800</u>	\$1,800	1	<u>\$1,800</u>
	Step I Subtotal=		\$13,600	Step I Subtotal =		\$13,600
B. Final Design/Permitting (Step II - State Fee Curve)						
Phase II Archeology	\$21,353	1	\$21,353	\$21,353	1	\$21,353
Act 250 Permitting	\$10,000	1	\$10,000	\$0	1	\$0
Wetlands Permitting	\$15,000	1	\$15,000	\$15,000	1	\$15,000
VT AOT Permitting	\$1,500	1	\$1,500	\$1,500	1	\$1,500
FHWA Permitting (as required)	\$0	1	\$0	\$5,000	1	\$5,000
	\$5,000	1	<u>\$5,000</u>	\$5,000	1	<u>\$5,000</u>
	Step II Subtotal =		\$52,853	Step II Subtotal =		\$47,853
C. Bidding/Construction Phase (Step III - State Fee Curve)						
Additional DBE Requirements	\$36,136	1	\$36,136	\$39,147	1	\$39,147
	\$2,000	1	<u>\$2,000</u>	\$2,000	1	<u>\$2,000</u>
	Step III Subtotal =		\$38,136	Step III Subtotal =		\$41,147
Total Phase I Engineering Cost =			\$104,589	\$102,600		
ADMINISTRATION						
Permit Fees	\$5,000	1	\$5,000	\$5,000	1	\$5,000
Legal (Municipal Bond Issuance)	\$3,000	1	\$3,000	\$3,000	1	\$3,000
Legal (Right of Way Certification & Easements)	\$5,000	1	\$5,000	\$5,000	1	\$5,000
Misc.	\$5,000	1	<u>\$5,000</u>	\$5,000	1	<u>\$5,000</u>
Phase 1 Total Administration Cost=			\$18,000	\$18,000		
CONSTRUCTION						
Site Preparation & Misc.	\$10,000	\$1	\$10,000	\$10,000	\$1	\$10,000
Archeological Monitoring (For Bore Pits)	\$5,000	1	\$5,000	\$0	1	\$0
3" Low Pressure Force Main (ft)	\$40	3,100	\$124,000	\$40	3,200	\$128,000
6" Sleeves	\$60	0	\$0	\$60	0	\$0
Blasting/Rock Removal (YD)	\$400	20	\$8,000	\$400	20	\$8,000
Surface Restoration/Landscaping (LS)	\$10,000	1	\$10,000	\$10,000	1	\$10,000
Erosion Control (LS)	\$10,000	1	\$10,000	\$10,000	1	\$10,000
Signage/Traffic Control (LS)	\$5,000	1	\$5,000	\$25,000	1	\$25,000
Surveying/Layout	\$5,000	1	\$5,000	\$5,000	1	\$5,000
Excavator for Bore Pits	\$5,000	1	\$5,000	\$5,000	1	\$5,000
Mobilization (LS)	\$30,000	1	\$30,000	\$30,000	1	\$30,000
Bonds (LS)	\$5,000	1	\$5,000	\$5,000	1	\$5,000
Contingency (20%)		0.20	<u>\$40,400</u>		0.20	<u>\$45,200</u>
Subtotal			\$257,400	\$281,200		
Engineers Opinion of Total Phase 1 Options Costs =			\$379,989	\$401,800		

Notes

1. Opinion of Probable Cost is based on preliminary phase estimates only. More detailed costs should be developed during Final Design based on actual design quantities.
2. Assumes Right of Way/easement purchase is not required.
3. Storage, pumps, alarms, controls and electrical by others.
4. Step 1 Engineering based on draft agreement.
5. Step II & III Engineering Estimates are based on the State fee curve plus additional non-customary engineering items where necessary.
6. Assumes a minimal amount of ledge and large cobbles are encountered during directional drilling.
7. "Site Preparation and Misc". Includes miscellaneous equipment to be supplied, temporary offices, clean up and contractors contract administrator

Appendix D

Engineers Opinion of Probable Cost
Phases 1, 2 and 3

Appendix D

Phase 1 (Alternate B) Engineers Opinion of Probable Cost Proposed Richmond West Main Street Wastewater Expansion

Revised 7 -7-21

Description	Unit Cost	Quantity	Total Cost
ENGINEERING (Phase 1)			
A. Preliminary Engineering (Step I)			
Archeology	\$9,900	1	\$9,900
Additional Environmental	\$1,900	1	\$1,900
	\$1,800	1	\$1,800
Step I Subtotal =			\$13,600
B. Final Design/Permitting (Step II)			
VT Eng. Fee Curve		1	\$21,353
Act 250 Permitting (T&M) ^a	\$15,000	1	\$15,000
Wetlands Permitting	\$1,500	1	\$1,500
VT AOT Coordination/Permitting	\$5,000	1	\$5,000
FHWA Coordination/Permitting	\$5,000	1	\$5,000
Step II Subtotal =			\$47,853
C. Bidding/Construction (Step III)			
VT Eng. Fee Curve		1	\$39,147
Additional DBE Requirements	\$2,000	1	\$2,000
Step III Subtotal =			\$41,147
Total Phase 1 Engineering Cost =			\$102,600

ADMINISTRATION (Phase 1)			
Permit Fees	\$5,000	1	\$5,000
Legal (Municipal Bond Issuance)	\$3,000	1	\$3,000
Legal (Right of Way Certification & Easements)	\$5,000	1	\$5,000
Misc.	\$5,000	1	\$5,000
Total Phase 1 Total Administration Cost=			\$18,000

CONSTRUCTION (Phase 1)			
Site Preparation & Misc.	\$10,000	\$1	\$10,000
3" Low Pressure Force Main (ft)	\$40	3,200	\$128,000
2" Low Pressure FM (Res./Com. connection)	\$30	0	\$0
8" Sleeves (Res/Com. Connection)	\$100	0	\$0
*Blasting/Rock Removal (YD)	\$400	20	\$8,000
Surface Restoration/Landscaping (LS)	\$10,000	1	\$10,000
Erosion Control (LS)	\$10,000	1	\$10,000
Signage/Traffic Control (LS)	\$25,000	1	\$25,000
Surveying/Layout	\$5,000	1	\$5,000
Excavator for bore pits (assume 1,000' max.)	\$5,000	1	\$5,000
Mobilization (LS)	\$30,000	1	\$30,000
Bonds (LS)	\$5,000	1	\$5,000
Contingency (20%)		0.20	\$45,200
Total Phase 1 Construction Cost=			\$281,200

Engineers Opinion of Total Phase 1 Costs =	\$401,800
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Notes

1. Opinion of Probable Cost is based on preliminary phase estimates only. More detailed costs should be developed during Final Design based on actual design quantities.
2. Assumes Right of Way/easement purchase is not required.
3. Storage, pumps, alarms, controls and electrical by others.
4. Step 1 Engineering based on draft agreement.
5. Step II & III Engineering Estimates are based on the State fee curve plus additional non-customary engineering items where necessary.
6. Assumes a minimal amount of ledge and large cobbles are encountered during directional drilling.
7. "Site Preparation and Misc". includes miscellaneous equipment to be supplied, temporary offices, clean up and contractors contract administration.
8. Act 250 Permitting costs are highly variable and project dependent. Final costs are generally a reflection of the amount of local resistance there is to a project which is unpredictable until permits are applied for.

Appendix D

Phase 2

Engineers Opinion of Probable Cost

Proposed Richmond West Main Street Wastewater Expansion

Revised 7-7-21

Description	Unit Cost	Quantity	Total Cost
ENGINEERING (Phase 2)			
A. Preliminary Engineering (Step I)			
Archeology	Completed in Phase 1	0	\$0
Additional Environmental	Completed in Phase 1	0	\$0
	Completed in Phase 1	0	<u>\$0</u>
		Step I Subtotal =	\$0
B. Final Design/Permitting (Step II)			
VT Eng. Fee Curve		1	\$21,982
VT AOT Coordination/Permitting	\$5,000	1	\$5,000
Wetlands Permitting	\$1,500	1	\$1,500
		Step II Subtotal =	\$28,482
C. Bidding/Construction (Step III)			
VT Eng. Fee Curve		1	\$40,300
Additional DBE Requirements	\$2,000	1	<u>\$2,000</u>
		Step III Subtotal =	\$42,300
		Total Phase 2 Engineering Cost =	\$70,783
ADMINISTRATION (Phase 2)			
Permit Fees	\$5,000	1	\$5,000
Legal (Municipal Bond Issuance)	\$3,000	1	\$3,000
Legal (Right of Way Certification & Easements)	\$5,000	1	\$5,000
Misc.	\$5,000	1	<u>\$5,000</u>
		Total Phase 2 Total Administration Cost=	\$18,000
CONSTRUCTION (Phase 2)			
Site Preparation & Misc.	\$10,000	1	\$10,000
3" Low Pressure Force Main (ft)	\$40	3,000	\$120,000
2" Low Pressure FM (Res./Com. connection)	\$30	120	\$3,600
8" Sleeves (Res/Com. Connection)	\$100	120	\$12,000
*Blasting/Rock Removal (YD)	\$400	20	\$8,000
Surface Restoration/Landscaping (LS)	\$10,000	1	\$10,000
Erosion Control (LS)	\$10,000	1	\$10,000
Signage/Traffic Control (LS)	\$25,000	1	\$25,000
Surveying/Layout	\$5,000	1	\$5,000
Excavator for bore pits (assume 1,000' max.)	\$5,000	1	\$5,000
Mobilization (LS)	\$30,000	1	\$30,000
Bonds (LS)	\$5,000	1	\$5,000
Contingency (20%)		0.20	<u>\$46,720</u>
		Total Phase 2 Construction Cost=	\$290,320
Engineers Opinion of Total Phase 2 Costs =			\$379,103

Notes

1. Opinion of Probable Cost is based on preliminary phase estimates only. More detailed costs should be developed during Final Design based on actual design quantities.
2. Assumes Right of Way/easement purchase is not required.
3. Storage, pumps, alarms, controls and electrical by others.
4. Step 1 Engineering based on draft agreement.
5. Step II & III Engineering Estimates are based on the State fee curve plus additional non-customary engineering items where necessary.
6. Assumes a minimal amount of ledge and large cobbles are encountered during directional drilling.
7. "Site Preparation and Misc". includes miscellaneous equipment to be supplied, temporary offices, clean up and contractors contract administration.

Appendix D

**Phase 3
Engineers Opinion of Probable Cost
Proposed Richmond West Main Street Wastewater Expansion**

Revised 7-7-21

Description	Unit Cost	Quantity	Total Cost
ENGINEERING (Phase 3)			
A. Preliminary Engineering (Step I)			
Archeology	Completed in Phase 1	0	\$0
Additional Environmental	Completed in Phase 1	0	\$0
		0	<u>\$0</u>
Step I Subtotal =			\$0
B. Final Design/Permitting (Step II)			
VT Eng. Fee Curve		1	\$29,964
VT AOT Coordination/Permitting	\$5,000	1	\$5,000
Wetlands Permitting	\$1,500	0	\$0
FHWA Coordination/Permitting	\$5,000	1	<u>\$5,000</u>
Step II Subtotal =			\$39,964
C. Bidding/Construction (Step III)			
VT Eng. Fee Curve		1	\$54,934
Additional DBE Requirements	\$2,000	1	<u>\$2,000</u>
Step III Subtotal =			\$56,934
Total Phase 3 Engineering Cost =			\$96,898

ADMINISTRATION (Phase 3)			
Permit Fees	\$5,000	1	\$5,000
Legal (Municipal Bond Issuance)	\$3,000	1	\$3,000
Legal (Right of Way Certification & Easements)	\$5,000	1	\$5,000
Misc.	\$5,000	1	<u>\$5,000</u>
Total Phase 3 Total Administration Cost=			\$18,000

CONSTRUCTION (Phase 3)			
Site Preparation & Misc.	\$10,000	\$1	\$10,000
3" Low Pressure Force Main (ft) ⁸	\$60	3,200	\$192,000
10" Sleeves (3" FM Road Crossing)	\$200	200	\$40,000
2" Low Pressure FM (Res./Com. Connection)	\$30	0	\$0
8" Sleeves (Res./Com. Connection)	\$80	0	\$0
*Blasting/Rock Removal (YD)	\$400	20	\$8,000
Surface Restoration/Landscaping (LS)	\$10,000	1	\$10,000
Erosion Control (LS)	\$10,000	1	\$10,000
Signage/Traffic Control (LS)	\$25,000	1	\$25,000
Surveying/Layout	\$5,000	1	\$5,000
Excavator for bore pits (assume 1,000' max.)	\$5,000	1	\$5,000
Mobilization (LS)	\$30,000	1	\$30,000
Bonds (LS)	\$5,000	1	\$5,000
Contingency (20%)		0.20	<u>\$66,000</u>
Total Phase 3 Construction Cost=			\$406,000

Engineers Opinion of Total Phase 3 Costs =	\$520,898
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Notes

1. Opinion of Probable Cost is based on preliminary phase estimates only. More detailed costs should be developed during Final Design based on actual design quantities.
2. Assumes Right of Way/easement purchase is not required.
3. Storage, pumps, alarms, controls and electrical by others.
4. Step 1 Engineering based on draft agreement.
5. Step II & III Engineering Estimates are based on the State fee curve plus additional non-customary engineering items where necessary.
6. Assumes a minimal amount of ledge and large cobbles are encountered during directional drilling.
7. "Site Preparation and Misc". includes miscellaneous equipment to be supplied, temporary offices, clean up and contractors contract administration.
8. Anticipated 3" Low Pressure Force Main costs are increased due to the likelihood of technical challenges and slow pace of road and highway crossings.