Fitzgerald Environmental Associates, LLC.

Applied Watershed Science & Ecology

Town of Richmond Phase I
Stream Geomorphic Assessment Report

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Prepared for:

Chittenden County Regional Planning Commission
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1.0 Executive Summary

This report summarizes data collected by Fitzgerald Environmental Associates, LLC. for three small tributary watersheds draining directly to the Winooski River in the Town of Richmond, Vermont. The watersheds have been named according to their proximity to Richmond Town roads, as follows: Governor Peck Road Tributary; Jericho Road Tributary; Stage Road Tributary. The watersheds have drainage areas of 2.6, 1.9 and 1.4 square miles, respectively. The three tributaries were identified for assessment by the Town of Richmond and the Chittenden County Regional Planning Commission, and the Phase 1 approach of the VTANR Stream Geomorphic Assessment (SGA) Protocol (VTDEC, 2006) was utilized for data collection and analysis.

The Governor Peck Road Tributary watershed contains a mix of agricultural, forested, and low to medium-density residential land use with a low degree of urbanization (3.7% impervious cover). The mainstem channel network is largely characterized by high-gradient reaches with gravel and cobble substrate found in unconfined valley settings. The primary stressors to geomorphic stability and habitat conditions in the watershed include: 1) historic impacts to the channel boundary conditions (e.g., straightening) in the lower watershed; 2) current impacts from encroachment of residential and commercial land uses on the stream corridor along Governor Peck Road; 3) undersized culverts associated with upper Governor Peck Road crossings. Based on the results of the Phase 1 analysis, a total of 7 reaches have been identified for future assessment using the SGA Phase 2 approach.

The Jericho Road Tributary watershed also contains a mix of agricultural, forested, and low to medium-density residential land use with a low degree of urbanization (2.8% impervious cover). The mainstem channel network is largely characterized by high-gradient reaches with cobble substrate and steep valley side slopes. The primary stressors to geomorphic stability and habitat conditions in this tributary watershed include: 1) historic impacts to the channel boundary conditions (e.g., straightening) in the lower watershed; 2) aggradation of fine sediment in the middle reaches caused by road (and ATV trail) runoff, floodplain reduction along the Old Jericho Road Trail, and large-scale mass wasting. Based on the results of the Phase 1 analysis, a total of 6 reaches have been identified for future assessment using the SGA Phase 2 approach.

The Stage Road Tributary watershed contains a mix of forested and low-density residential land use with a very low degree of urbanization (1.7% impervious cover). The mainstem channel network is characterized by high-gradient reaches with cobble

substrate and steep valley side slopes, with the exception of two depositional reaches in the lower watershed. The primary stressors to geomorphic stability and habitat conditions in this tributary watershed are channelization, straightening and river corridor development in the lower watershed. Based on the results of the Phase 1 analysis, a total of 3 reaches have been identified for future assessment using the SGA Phase 2 approach.

Additional recommendations for data analysis beyond the SGA Phase 2 approach include the development of rainfall-runoff models for those reaches where culverts have been identified as problematic and potentially undersized. Little additional effort would be required to develop the data needed to run the rainfall-runoff models (much of the data has been generated through the Phase 1 analysis), and the resulting discharge data would provide a sound basis for prioritizing structures for replacement for the Town of Richmond. This approach is described in further detail in the conclusions in Section 7.0.

2.0 Introduction:

The Town of Richmond and the Chittenden County Regional Planning Commission (CCRPC) identified three tributary watersheds within Richmond for assessment of fluvial geomorphic condition and erosion hazards. Fitzgerald Environmental Associates, LLC. (FEA) was retained by CCRPC to carry out a Phase 1 assessment following the Stream Geomorphic Assessment (SGA) Protocols developed by VTANR. The Phase 1 SGA approach utilizes the Stream Geomorphic Assessment Tool (SGAT), a GIS extension developed by VTANR for the collection of reach and watershed scale data. In addition to the GIS and remote sensing effort, a cursory field assessment ("windshield survey") is included for the verification of stream and valley forms, significant channel features and the location of man-made infrastructure. The Phase 1 SGA approach results in watershed-scale data about the landscape (e.g., soils and land cover) and the stream channel (e.g., slope and form), providing a basis for understanding the natural and human-impacted conditions within the watershed. The SGA data also aids in the identification of specific stressors affecting the physical conditions of the stream channels and structures (e.g., bridges and culverts). Included in the Phase 1 approach is a rigorous Quality Assurance Protocol carried out by VTANR staff to ensure the integrity of the final dataset.

Each of the three tributary watersheds has a drainage area less than 3 square miles and outlets directly to the Winooski River in Richmond. The tributary watersheds were previously unnamed, and were named during this analysis according to their proximity to Richmond Town roads. The SGA convention for reach numbering is consistent with that

used in the analysis of the Winooski mainstem, where the "R" refers to the Winooski River reach where each small tributary (S) enters. Separate summaries of the watershed data are provided below for the three tributaries. These summaries include descriptions of the watershed zones and specific reaches where land cover and soils characteristics indicate potential areas for channel adjustments and fluvial erosion hazards. Following these descriptions are recommendations for future monitoring and data collection that would aid in the identification of projects that that could protect, sustain, or restore fluvial geomorphic equilibrium conditions, through the implementation of either passive or active stream corridor management strategies.

Tables summarizing the data compiled through the Phase 1 analysis are found in Appendix B. These tables include summaries of the watershed land use and land cover (Table 1), the physical conditions and reference stream types in the watershed (Table 2), impact ratings and priorities for future assessment (Table 3), and predicted stream channel adjustment processes (Tables 4). The relative reach impact score within each watershed was evaluated to determine the priority for future Phase 2 assessment. Generally, reaches with higher impact scores received a higher priority ranking. However some reaches with low impact scores were considered high priorities for future assessment if they contain problematic stream crossings (e.g., culverts), or had channel adjustment processes observed during the windshield surveys that warrant further investigation. Data specific to each reach are summarized in the reach summary sheets in Appendix C. These data form the basis for the impact ratings and prioritization as described above.

3.0 Governor Peck Road Tributary Watershed (R8.S1)

The Governor Peck Road Tributary watershed is found in the northwestern part of Richmond and extends into the town of Jericho in the vicinity of Browns Trace Road (see map in Appendix A). The watershed encompasses an area of 2.6 square miles, with 4.5 miles of stream channel along the mainstem from the headwaters to the outlet. The overall slope of the mainstem channel is 2.9%, reflecting the moderate to high-gradient nature of a majority of the reaches in the watershed. One additional subtributary draining a residential area along Sunset Ridge Road was included in the analysis (R8.S1.04-S1).

The land use within this tributary watershed is dominated by forested and agricultural areas, with a mix of low and medium-density residential and commercial land along Governor Peck Road. Currently the impervious cover of the watershed is 3.7%, below

levels (5-10%) associated with decline of channel stability and biotic integrity in small watersheds in Chittenden County (Fitzgerald, 2007).

The surficial geology of the watershed is dominated by lacustrine clays deposited during the early Holocene when Lake Vermont occupied much of the Champlain Valley and persisted at an elevation of 620 feet above sea level for approximately 4,000 years (Wright, 2003). Some areas of glacial till and alluvial substrates are also found in the headwaters zone and near the tributary outlet to the Winooski River, respectively. In the lower part of the watershed, the highly erosive properties of the soils have led to the development of steep valley side walls in two low-gradient reaches. These reaches are characterized by narrow, meandering gravel-bottomed channels found within unconfined valleys with recurring beaver ponding. In the middle and upper reaches of the watershed where glacial till is present and the channel slopes are greater, coarse-bottomed (e.g., gravel and cobble) channels are found in mostly confined valley settings.

Below are narrative descriptions of three zones of the Governor Peck Road Tributary watershed summarized during the Phase 1 analysis:

Upper Watershed Zone (R8.S1.06 through R8.S1.08)

The upper watershed zone of this tributary area above Browns Trace Road and south of Milo White Road is occupied by forested terrain that has been only minimally impacted by low-density residential development. Due to the steep topography of this watershed zone, B and C-type channels (Rosgen, 1994) are found where the valley setting is more confined and substrates are coarser. Due to the limited human impacts in this watershed zone, no reaches have been identified from the Phase 1 analysis as having a high priority for further assessment, but recommendations have been made for the Phase 2 assessment of two reaches with medium priority (see Section 6.0).

Middle Watershed Zone (R8.S1.03-R8.S1.05; R8.S1.04-S1)

The middle zone of the watershed is found along Governor Peck Road up to the crossing with Browns Trace Road. Throughout the middle zone of the watershed most of the mainstem reaches are characterized by coarse-bottomed channels with B and C-type geometry found in unconfined and semi-confined valley settings. The subtributary stemming from the fourth mainstem reach (R8.S1.04-S1) is found in very steep terrain (channel slopes greater than 5%) in a confined valley

setting. Impacts from road encroachment, two undersized culverts, and stormwater runoff concentrated by roadside ditches were observed along the Governor Peck Road during the windshield survey. Few impacts from the residential area associated with Sunset Ridge Road were noted. From the Phase 1 analysis, two reaches from this watershed zone have been identified as having high impact ratings and high priorities for further assessment.

- **R8.S1.03:** This mainstem reach is found to the east of Governor Peck Road upstream of an area of historic beaver activity. The reach is characterized by a moderate-gradient, gravel-bottomed channel with C-type geometry. This reach has received a high impact rating due to the observed changes in planform (28% of the reach has been straightened), and the road encroachment which has led to a reduced floodplain and corridor. Some depositional features were observed during the field visit (Figure 1), indicating the potential for future lateral adjustments.

Figure 1. Depositional feature in reach R8.S1.03

- **R8.S1.05:** This mainstem reach is found along Governor Peck Road from the confluence with the subtributary upstream to where the channel bends to the east away from the road. The reach is characterized by a moderate-gradient, gravel-bottomed channel with C-type geometry. This reach has received a high impact rating due to the encroachments, stormwater

discharges, and undersized culverts associated with Governor Peck Road. Two culvert crossings appear to be inadequately sized, resulting in aggradation of sediment above the structure and scour below. One roadside drainage along Governor Peck Road enters main channel in upper reach and delivers significant amounts sediment to the downstream section. Numerous depositional features were observed during the field visit (Figure 2), indicating the potential for future lateral adjustments. Despite these impacts, numerous brook trout were observed in the reach in plunge pools (at the culvert outfalls) during August, indicating that reach provides important cold water refugia for trout in late summer.

Figure 2. Depositional features in reach R8.S1.05

Lower Watershed Zone (R8.S1.01 & R8.S1.02)

The lower watershed zone is found from the outlet to the Winooski River up to the reach break with R8.S1.03. In this watershed zone the channel slope lessens, maintaining a highly sinuous planform (in the absence of straightening) with E-type channel geometry. Although no beaver activity was observed during the windshield surveys in this watershed zone, a review of aerial photography from 1999 and 2003 suggests that beaver ponding occurs frequently in reach R8.S1.02. Impacts to channel stability were noted due to encroachment on the stream corridor by the road and adjacent commercial land uses, as well as historic

straightening associated with the Verberg farm near the outlet. Numerous meander migrations in reach R8.S1.02 suggest that the channel is active in its lateral migration, perhaps in partial response to beaver influences. From the Phase 1 analysis, both reaches have been identified as having high impact ratings and high priorities for further assessment.

- **R8.S1.01:** This mainstem reach is found from the outlet to the Winooski River up to the reach break approximately 250 feet upstream of the I-89 culvert inlet. This reach has had severe historic impacts to the planform (44% of the channel has been straightened). In addition, a section of the reach in the vicinity of the I-89 crossing lacks a vegetative buffer greater than 25 feet, which likely elevates surface water temperatures during the summer months due to lack of canopy cover.

Figure 3. Stormwater outfall and lack of woody vegetative buffer in R8.S1.01

- **R8.S1.02:** This reach is found from the reach break with R8.S1.01 up to an area of historic beaver activity along Governor Peck Road. Although this reach has had limited direct impacts to the channel boundary conditions (channel straightening in 15% of reach), its changes in planform and abundant depositional features indicate that it is undergoing significant lateral migration. Additionally, the adjacent commercial and

industrial land use in the lower reach is causing significant fine sediment delivery to the channel (Figure 4).

Figure 4. Suspended sediments in lower R8.S1.02 during baseflow conditions.

4.0 Jericho Road Tributary Watershed (R8.S2)

The Jericho Road Tributary watershed is also found in the northwestern part of Richmond (see map in Appendix A). The watershed encompasses an area of 1.9 square miles, with 2.7 miles of stream channel along the mainstem from the headwaters to the outlet. The overall slope of the mainstem channel is 5.4%, reflecting the high-gradient nature of a majority of the reaches in the watershed. Three additional small subtributaries stemming from the mainstem were included in the analysis.

The land use within this tributary watershed is dominated by forested and agricultural areas, with a mix of low and medium-density residential land along Jericho Road. Currently the impervious cover of the watershed is 2.8%, below levels (5-10%) associated with decline of channel stability and biotic integrity in small watersheds in Chittenden County (Fitzgerald, 2007).

The surficial geology of the watershed is very similar to that described for the Governor Peck Road tributary; it is dominated by lacustrine clays in the lower watershed with areas of glacial till and alluvial substrates found in the headwaters zone and near the tributary outlet to the Winooski River, respectively. With the exception of two reaches, much of

the watershed is characterized by steep topography and sediment transport reaches with A and B-type geometry. The lowermost reach upstream of the outlet (R8.S2.01) is a low gradient, sand-bottomed channel with E-type geometry. Reach R8.S2.05, found just upstream of the Jericho Road crossing, is moderate-gradient, gravel-bottomed channel with C-type geometry.

Below are narrative descriptions of three zones of the Jericho Road Tributary watershed summarized during the Phase 1 analysis:

Upper Watershed Zone (R8.S2.05, R8.S2.06, R8.S2.05-S1)

The upper watershed zone of this tributary area above the Jericho Road crossing is occupied by forested terrain that has been only minimally impacted by low-density residential development. Due to the steep topography of this watershed zone, A-type channels are found where the valley setting is more confined and substrates are coarser. However, the reach immediately above the Jericho Road crossing (R8.S2.05) is found in an unconfined setting with C-type geometry. Due to the channel straightening associated with an adjacent pond, this reach has a medium priority and has been recommended for further assessment.

Middle Watershed Zone (R8.S2.02-R8.S2.04)

The middle zone of the watershed is found above the I-89 crossing up to the crossing with Jericho Road. Throughout this watershed zone the mainstem reaches are characterized by coarse-bottomed channels with A and B-type geometry found in confined valley settings. The two subtributaries stemming from the second (R8.S2.02.S1) and third mainstem (R8.S3.02.S1) reaches are found in very steep terrain (channel slopes greater than 5%) in confined valley settings. Sedimentation impacts from road and ATV trail encroachment (Figure 5) and failing valley side slopes were observed in this watershed zone during the windshield survey. Although no reaches have been identified as having high impact ratings, four reaches impacted by the stressors described above have a medium priority for further assessment, and are included in the list of recommended reaches for Phase 2 assessment in Section 6.0 of this report.

Figure 5. Deposition of fine sediments in R8.S2.02

Lower Watershed Zone (R8.S2.01)

The lower watershed zone is encompassed by a single reach, R8.S2.01. This reach is found in the alluvial setting of the historic Winooski River floodplain where the mainstem channel slope mush less than upslope reaches (reach slope is 0.6%) and agriculture has impacted the channel planform and buffer conditions for over a century. This reach has been identified as having a high impact rating and a high priority for further assessment.

Figure 6. Coarse substrate downstream of Rt. 2 crossing in reach R8.S2.01

- **R8.S2.01:** This mainstem reach is found from the outlet to the Winooski River up to the reach break approximately 150 feet downstream of the I-89 culvert outlet. The channel is characterized by E-type geometry with sand substrates, with the exception of an area of coarse substrate downstream of the Route 2 crossing (Figure 6). This reach has had severe historic impacts to the planform (68% of the channel has been straightened). In addition, much of the reach lacks a vegetative buffer greater than 25 feet, which likely contributes to the direct input of sediment and nutrients from the adjacent agricultural fields, and also elevates surface water temperatures during the summer months due to lack of canopy cover.

5.0 Stage Road Tributary Watershed (R9.S2)

The Stage Road Tributary watershed is found in the eastern part of Richmond and extends into the town of Bolton east of Stage Road (see map in Appendix A). The watershed encompasses an area of 1.4 square miles, with 2.1 miles of stream channel along the mainstem from the headwaters to the outlet. The overall slope of the mainstem channel is 5.0%, reflecting the very high gradient of a majority of the reaches in the watershed. One additional subtributary draining a forested area to the east of Stage Road was included in the analysis (R9.S2.04-S1).

The land use within this tributary watershed is dominated by forested areas, with some agricultural land in the lower watershed along Route 2 and some low-density residential land along Stage Road. Currently the impervious cover of the watershed is 1.7%, well below levels (5-10%) associated with decline of channel stability and biotic integrity in small watersheds in Chittenden County (Fitzgerald, 2007).

The surficial geology of the watershed is very different from the two other tributaries to the west. With the exception of an area of alluvial soils associated with the historic Winooski River floodplain in the lower reaches, the watershed soils are dominated by glacial till and some areas of exposed bedrock where the terrain is very steep (slope greater than 15%). Upslope of the alluvial setting in the lower watershed, most reaches are characterized by coarse-bottomed (e.g., gravel and cobble) channels found in confined valley settings.

Below are narrative summaries of two zones of the Stage Road Tributary watershed summarized during the Phase 1 analysis:

Upper Watershed Zone (R9.S2.04 – R9.S2.07)

The upper watershed zone of this tributary along Stage Road is occupied by forested terrain that has been only minimally impacted by low-density residential development. Due to the steep topography of this zone, A and B-type channels are found where the valley setting is more confined and cobble, boulder, and bedrock substrates are present. Numerous grade controls were observed in reach R9.S2.04 during the field visit. One unconfined reach (R9.S2.06) with C-type geometry is found in the upper watershed to the west of Stage Road. Due to the limited human impacts in this watershed zone, and the absence of problematic stream crossings, no reaches have been identified from the Phase 1 analysis for further assessment.

Lower Watershed Zone (R9.S2.01-R9.S2.03)

The lower zone of the watershed is found from the tributary outlet to the Winooski River up to a change in valley slope at the reach break with R9.S2.04. The first (R9.S2.01) and third (R9.S2.03) reaches are similar in their confinement and stream type geometry. Both reaches are found in unconfined valley settings and have C-type geometry with coarse bed substrates. The second reach (R9.S2.02) has been severely altered by the I-89 culvert crossing, resulting in a straightened channel with a steep slope and confined valley setting. The channel impacts noted in this zone include channel straightening, encroachment from agricultural and residential land uses, and depositional features causing lateral channel migration. From Phase 1 analysis, all three reaches from this watershed zone have been identified as having high impact ratings and high priorities for further assessment.

- **R9.S2.01:** This reach is found from the tributary outlet up to a 90 degree bend in the channel at the upstream reach break. The reach is characterized by a low-gradient, sand and gravel-bottomed channel with C-type geometry. This reach has received a high impact rating due to the observed changes in planform (20% of the reach has been straightened), the encroachment on the corridor by adjacent agricultural and residential land, and the depositional features causing lateral channel migration. In addition, the channel was observed to be dry during the field visit in August, 2007 (Figure 7).

Figure 7. Dry channel below Rt. 2 box culvert in reach R9.S2.01

- **R9.S2.02:** This mainstem reach is found from the downstream reach break up to the I-89 culvert inlet. The reach is characterized by a high-gradient, cobble-bottomed channel with B-type geometry. This reach has received a high impact rating due to the impacts associated with the I89 culvert, which has straightened over 90% of the channel. Although a Phase 2 assessment of this reach is only appropriate for the unchannelized lower section, this part of the reach (found in a residential area) should be assessed to determine if fluvial erosion hazards exist downstream of the I-89 culvert outfall.

- **R9.S2.03:** This reach is found from the I-89 culvert inlet up to a change in valley slope and confinement at the upstream reach break. The reach is characterized by a low-gradient, gravel-bottomed channel with C-type geometry. This reach has received a high impact rating due to the observed changes in planform (40% of the reach has been straightened), the encroachment on the corridor by adjacent residential land, and the depositional features causing lateral channel migration.

6.0 Future Assessment Recommendations

Based on the results of the Phase 1 analysis, 15 tributary reaches and 1 subtributary reach have been selected for recommendation for further assessment (see priority rankings in Appendix B; Table 3) using the Phase 2 approach of the SGA protocols (including bridge and culvert assessments).

- **Governor Peck Road Tributary:** Seven reaches are recommended for further Phase 2 assessment in this watershed:
    - **Reaches R8.S1.01 to R8.S1.03 (high priority)** should be investigated in further detail to determine the impacts of historic straightening and a lack of vegetative buffer, and to evaluate the potential for stream corridor protection given the encroachment of agricultural, commercial, and residential land uses. This effort would also involve landowner outreach to assess the social constraints to stream restoration.
    - **Reach R8.S1.04 (medium priority)** should be assessed to determine the connectivity of adjustments along the channel network, as a high degree of lateral channel migration was observed in the upstream reach.
    - **Reach R8.S1.05 (high priority)** contains two culvert beneath Governor Peck Road which appear to be undersized. The culverts should be assessed to determine whether they are a priority for the replacement by the Town of Richmond. In addition, one problematic stormwater discharge was noted (previously described), and multiple depositional features were noted throughout the reach.
    - **Reaches R8.S1.06 & R8.S1.07 (medium priority)** are priority reaches for assessment due to the high degree of lateral migration observed in the downstream reach (R8.S1.05), and the possibility of these impacts being longitudinally-connected to reaches upstream. In addition, given that brook trout appear to be using this tributary as cold-water refugia in the summer months, assessment of habitat in the upper reaches is recommended.

- **Jericho Road Tributary:** Six reaches are recommended for further Phase 2 assessment in this watershed:
    - **Reach R8.S2.01 (high priority)** should be investigated in further detail to determine the impacts of historic straightening and a lack of vegetative buffer, and to evaluate the potential for stream corridor protection given the encroachment of agricultural and residential land uses. This effort

would also involve landowner outreach to assess the social constraints to stream restoration.

- **Reaches R8.S2.02 to R8.S2.04 (medium priority)** should be assessed to investigate the sedimentation impacts from road and ATV trail encroachment and failing valley side slopes that were observed during the windshield survey. In addition, the I-89 culvert should be evaluated for impediments to fish passage, given that no brook trout were observed in this tributary during August (unlike in the Governor Peck Road tributary).
- **R8.S2.05 (medium priority)** should be assessed to evaluate the impacts of channel straightening resulting from the construction of a pond in the stream corridor. The straightening through this depositional reach may be resulting in additional sediment delivery to downstream reaches.
- **Reach R8.S2.02-S1.01 (medium priority)** is a small subtributary which drains a residential area along Southview Drive and Joan Ave. One headcut was noted in the channel just upstream of the confluence with reach R8.S2.02, and may be a source of fine sediment for the mainstem reaches.

- **Stage Road Tributary:** Three reaches are recommended for further Phase 2 assessment in this watershed:
  - **Reach R9.S2.01 & R9.S2.03 (high priority)** should both be investigated in further detail to determine the impacts of historic straightening and a lack of vegetative buffer, and to evaluate the potential for stream corridor protection given the encroachment of agricultural and residential land uses. This effort would also involve landowner outreach to assess the social constraints to stream restoration.
  - **Reaches R9.S2.02 (high priority)** should also be assessed to determine if fluvial erosion hazards exist downstream of the I-89 culvert outfall.

7.0 Conclusions

The Phase 1 approach for the Richmond tributary watersheds has provided initial data to describe the topographic, geologic and anthropogenic settings within the Town of Richmond. The overall conditions within the Governor Peck Road Tributary watershed vary significantly depending on the adjacent land use (historic and current) and the presence or absence of undersized culverts. Many reaches in this watershed are predicted to have significant channel adjustment processes with fair to poor geomorphic conditions. As a result, a total of 7 reaches have been recommended for future Phase 2 assessment.

The overall conditions within Jericho Road Tributary watershed also vary significantly depending on the adjacent land use, historic channel straightening, and impacts from residential land use. Two reaches in this watershed are predicted to have significant channel adjustment processes with fair geomorphic conditions, and a total of five reaches have been recommended for future Phase 2 assessment. The overall conditions within Stage Road Tributary watershed are impacted in the lower watershed by the encroachment of agricultural and residential land use on the stream corridor, and by historic channel straightening. Three reaches in this watershed are predicted to have significant channel adjustment processes with fair to poor geomorphic conditions, and are recommended for future Phase 2 assessment.

For the fifth mainstem reach in the Governor Peck Road Tributary (R8.S1.05), two undersized culverts appear to be dominant stressors on channel stability. Additional data describing the hydrologic regime (e.g., magnitude and frequency of discharge events) could be coupled with culvert survey data (ANR methods during Phase 2 assessment) to further evaluate and prioritize these structures. The Phase 1 data generated by this study provide a convenient basis for developing rainfall-runoff models (using the NRCS approach with the TR20 model) that can determine the peak flow rates through these structures during larger storm events. Much of the data required to develop these models is inherent in the Phase 1 results (including watershed areas, soils data, and land use), and little additional effort using GIS would be needed. It is recommended that discharge data for a spectrum of large storm events (10, 25 and 100 year return) be generated for these two stream crossings.

8.0 References

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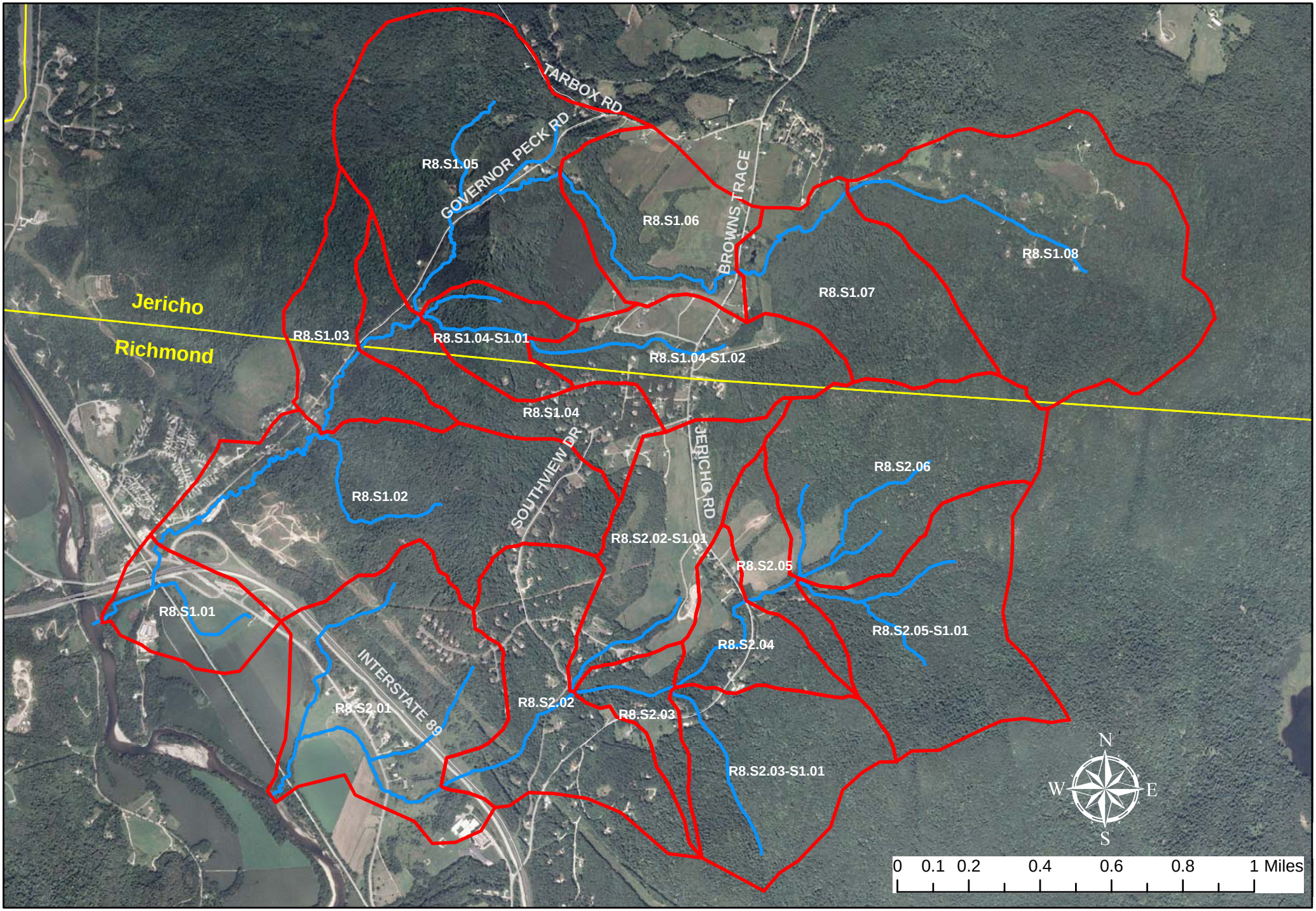
APPENDIX A

SUBWATERSHED MAPPING



Subwatershed Boundaries

Surface Waters

Governor Peck Road and Jericho Road Tributaries Subwatershed Map

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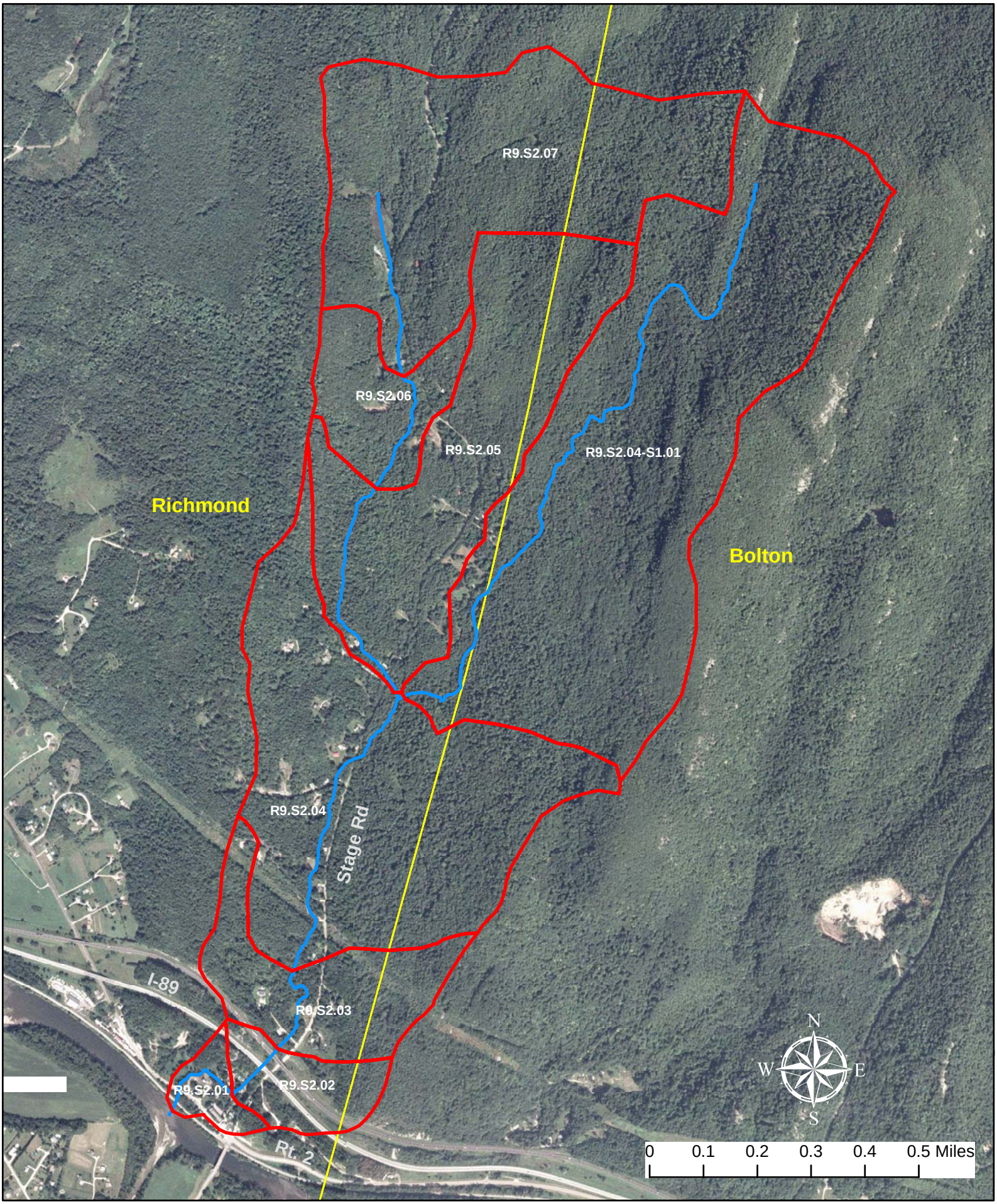

Subwatershed Boundaries

Surface Waters

Stage Road Tributary Subwatershed Map

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APPENDIX B

WATERSHED SUMMARY DATA

Table 1. Land Cover for Richmond Tributaries

Land Cover Type*	Gov. Peck Rd. Tributary	Jericho Rd. Tributary	Stage Rd. Tributary
Forested	68.0%	64.3%	84.3%
Agriculture	17.8%	22.8%	5.1%
Residential	3.1%	2.2%	1.7%
Commercial	0.2%	0.4%	0.0%
Transportation	5.4%	4.2%	2.7%
Barren Land	1.0%	0.0%	0.0%
Water & Wetland	4.4%	6.1%	6.2%

* 2002 LandSat Data from UVM Spatial Analysis Lab (2005)

Table 2. Richmond Tributaries Preliminary Stream Types (Step 2)

Reach ID	Elevation Up (ft.)	Elevation Down (ft.)	Valley Length (ft.)	Valley Slope (%)	Channel Length (ft.)	Channel Slope (%)	Sinuosity	Watershed Area (sq. mi.)	Channel Width (ft.)	Valley Width (ft.)	Confinement Ratio	Confinement Type*	Reference Stream Type	Bedform	Bed Substrate
R8.S1.01	300	295	1515	0.33	1711	0.29	1.13	2.58	19.9	353	17.8	VB	E	Dune-Ripple	Sand
R8.S1.02	318	300	3024	0.60	4354	0.41	1.44	2.47	19.5	350	17.9	VB	E	Riffle-Pool	Gravel
R8.S1.03	338	318	1452	1.38	1556	1.29	1.07	2	17.8	282	15.9	VB	C	Riffle-Pool	Gravel
R8.S1.04	360	338	1071	2.05	1304	1.69	1.22	1.86	17.2	209	12.1	VB	C	Riffle-Pool	Gravel
R8.S1.04-S1.01	580	360	1712	12.85	1713	12.84	1	0.29	7.6	30	4	SC	A	Step-Pool	Cobble
R8.S1.04-S1.02	740	580	3125	5.12	3204	4.99	1.03	0.2	6.5	25	3.9	SC	A	Step-Pool	Cobble
R8.S1.05	485	360	3398	3.68	3928	3.18	1.16	1.42	15.3	259	17	VB	C	Riffle-Pool	Gravel
R8.S1.06	720	485	3516	6.68	3997	5.88	1.14	0.94	12.7	30	2.4	SC	B	Step-Pool	Cobble
R8.S1.07	760	720	2097	1.91	2555	1.57	1.22	0.75	11.5	358	31.1	VB	C	Riffle-Pool	Gravel
R8.S1.08	1120	760	3967	9.07	4061	8.86	1.02	0.51	9.8	30	3.1	SC	B	Step-Pool	Cobble
R8.S2.01	320	296	3340	0.72	4030	0.60	1.21	1.93	17.5	434	24.8	VB	E	Dune-Ripple	Sand
R8.S2.02	460	320	2525	5.54	2570	5.45	1.02	1.57	16	40	2.5	SC	B	Step-Pool	Cobble
R8.S2.02-S1.01	680	460	2235	9.84	2317	9.50	1.04	0.21	6.6	25	3.8	SC	A	Step-Pool	Cobble
R8.S2.03	560	460	1485	6.73	1540	6.49	1.04	1.09	13.6	30	2.2	SC	B	Step-Pool	Cobble
R8.S2.03-S1.01	810	560	2895	8.64	2941	8.50	1.02	0.23	6.9	25	3.6	SC	B	Step-Pool	Cobble
R8.S2.04	680	560	1889	6.35	2101	5.71	1.11	0.79	11.8	25	2.1	SC	B	Step-Pool	Cobble
R8.S2.05	695	680	844	1.78	912	1.64	1.08	0.69	11.1	244	22	VB	C	Riffle-Pool	Gravel
R8.S2.05-S1.01	900	695	2600	7.88	2639	7.77	1.02	0.29	7.6	40	5.2	NW	A	Step-Pool	Cobble
R8.S2.06	1060	695	2768	13.19	2953	12.36	1.07	0.32	7.9	30	3.8	SC	A	Step-Pool	Cobble
R9.S2.01	315	310	781	0.64	933	0.54	1.19	1.42	15.3	262	17.1	VB	C	Riffle-Pool	Gravel
R9.S2.02	355	315	635	6.30	636	6.29	1	1.4	15.2	35	2.3	SC	B	Step-Pool	Cobble
R9.S2.03	380	355	800	3.13	1046	2.39	1.31	1.37	15	299	19.9	VB	C	Riffle-Pool	Cobble
R9.S2.04	620	380	3072	7.81	3140	7.64	1.02	1.28	14.6	20	1.4	NC	A	Cascade	Bedrock
R9.S2.04-S1.01	1400	620	7444	10.48	7721	10.10	1.04	0.46	9.3	20	2.2	SC	B	Step-Pool	Cobble
R9.S2.05	860	620	2353	10.20	2366	10.14	1.01	0.53	9.9	15	1.5	NC	A	Step-Pool	Cobble
R9.S2.06	900	860	1138	3.51	1300	3.08	1.14	0.33	8	120	15	VB	C	Plane Bed	Cobble
R9.S2.07	1000	900	1800	5.56	1853	5.40	1.03	0.27	7.3	30	4.1	NW	B	Step-Pool	Cobble

* NW = Narrow; SC = Semi-confined; BD = Broad; VB = Very Broad

Table 3. Richmond Tributaries Impact Ratings (Step 8)

	Step Number† with Impact Score*																Total	Priority
Reach ID	**4.1**	**4.2**	**4.3**	**5.1**	**5.2**	**5.3**	**5.4**	**5.5**	**6.1**	**6.2**	**6.3**	**6.4**	**6.5**	**6.6**	**7.2**	**7.3**	**Score**	**Ranking**
R8.S1.01	2	2	0	0	1	0	2	0	0	0	1	0	2	2	0	1	13	High
R8.S1.02	2	2	1	0	0	0	1	0	2	1	2	2	0	0	0	2	15	High
R8.S1.03	2	2	0	0	0	0	2	0	1	0	1	0	1	1	0	0	10	High
R8.S1.04	2	2	0	0	0	0	0	0	1	0	0	0	2	1	0	0	8	Medium
R8.S1.04-S1.01	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	Low
R8.S1.04-S1.02	2	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	5	Low
R8.S1.05	2	2	1	0	0	0	1	0	1	0	2	1	2	2	1	2	17	High
R8.S1.06	2	2	0	0	0	0	1	0	0	1	0	0	0	0	0	0	6	Medium
R8.S1.07	2	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	5	Medium
R8.S1.08	2	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	5	Low
R8.S2.01	2	2	1	0	0	0	2	0	0	0	1	2	2	2	0	1	15	High
R8.S2.02	2	2	0	0	1	0	1	0	1	0	2	0	0	0	0	0	9	Medium
R8.S2.02-S1.01	2	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	5	Medium
R8.S2.03	1	2	0	0	0	0	0	0	2	0	0	0	0	0	0	0	5	Medium
R8.S2.03-S1.01	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	5	Low
R8.S2.04	1	2	0	0	0	0	1	0	2	0	1	0	0	0	0	0	7	Medium
R8.S2.05	0	1	0	0	0	0	2	0	0	0	1	0	2	2	0	1	9	Medium
R8.S2.05-S1.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Low
R8.S2.06	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	Low
R9.S2.01	2	2	2	0	1	0	2	0	0	0	2	2	2	2	0	0	17	High
R9.S2.02	2	2	0	0	2	0	2	0	0	2	0	2	0	0	0	1	13	High
R9.S2.03	2	2	1	0	1	0	2	0	0	0	1	1	2	2	0	0	14	High
R9.S2.04	1	2	0	0	1	0	0	0	0	1	0	0	0	0	0	0	5	Low
R9.S2.04-S1.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Low
R9.S2.05	2	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	5	Low
R9.S2.06	1	2	0	0	0	0	0	0	0	0	0	0	1	2	0	0	6	Low
R9.S2.07	1	2	1	0	0	0	0	0	1	0	0	0	0	0	0	0	5	Low

* 0 = Not Significant or No Data; 1 = Low; 2 = High

† Step 4: Land Cover and Reach Hydrology
Step 5: Channel Modifications
Step 6: Floodplain Modifications and Planform Changes
Step 7: Bed and Bank Condition

Table 4. Richmond Tributaries Predicted Channel Adjustment Processes (Step 9)

	9.1 Predicted Adjustment Scores				9.2 Reach Condition		9.3 Reach
Reach ID	**Degradation**	**Aggradation**	**Widening**	**Planform**	**Project***	**Statewide***	**Sensitivity**
R8.S1.01	**7**	6	5	**7**	Fair	Good	High
R8.S1.02	5	**9**	7	7	Fair	Good	High
R8.S1.03	5	**6**	5	**6**	Fair	Good	High
R8.S1.04	4	4	2	0	Good	Reference	High
R8.S1.04-S1.01	4	3	2	0	Good	Reference	High
R8.S1.04-S1.02	4	4	2	0	Good	Reference	Moderate
R8.S1.05	5	**9**	7	5	Fair	Good	High
R8.S1.06	5	**6**	5	2	Fair	Good	Moderate
R8.S1.07	4	3	2	0	Good	Reference	High
R8.S1.08	4	4	2	0	Good	Reference	Moderate
R8.S2.01	6	7	5	**8**	Fair	Good	High
R8.S2.02	6	6	**7**	3	Fair	Good	Moderate
R8.S2.02-S1.01	5	**6**	5	0	Fair	Good	High
R8.S2.03	4	3	0	0	Good	Reference	Moderate
R8.S2.03-S1.01	2	5	2	0	Good	Reference	High
R8.S2.04	5	5	3	1	Good	Good	Moderate
R8.S2.05	4	1	0	2	Good	Reference	High
R8.S2.05-S1.01	2	0	0	0	Reference	Reference	High
R8.S2.06	2	2	0	0	Reference	Reference	High
R9.S2.01	7	8	9	**11**	Poor	Fair	High
R9.S2.02	**10**	8	5	0	Fair	Good	High
R9.S2.03	**7**	**7**	5	**7**	Fair	Good	Moderate
R9.S2.04	3	3	0	0	Reference	Reference	Very Low
R9.S2.04-S1.01	2	0	0	0	Reference	Reference	High
R9.S2.05	4	4	2	0	Good	Reference	High
R9.S2.06	4	3	0	0	Good	Reference	Moderate
R9.S2.07	2	4	0	0	Reference	Reference	Moderate

* Conditions relative to the Pond Brook watershed ("project") versus overall Vermont ("statewide")

Note: **Bold** values indicate the dominant adjustment processes (when moderate to severe; value > 5)

APPENDIX C

PHASE 1 REACH REPORTS

Richmond tribs

Phase 1 - Reach Summary Report

Basin: **Winooski**
Stream Name: **Governor Peck Rd Tributary** Reach **R8.S1.01**
Topo Maps: **ESSEX JUNCTION**
Date Last Edited: **Thu, September 27, 2007**
Watershed: **Winooski River**
Sub-watershed: **Winooski River -- Huntington River to mouth**
Is Reach an Impoundment? **No**

Step 1. Reach Location

1.1 Reach Description: **From confluence with the Winooski River to reach break where**
1.2 Towns: **Richmond**
1.3 Downstream Latitude: **44.42**
1.3 Downstream Longitude: **-73.02**

Step 2. Stream Type

2.1 Elevation Upstream: **300**
2.1 Elevation Downstream: **295**
2.1 Is Gradient Gentle? **No**
2.2 Valley Length: **1515** feet. **0.29** Miles.
2.3 Valley Slope: **0.33** %
2.4.Channel Length: **1711** feet. **0.32** Miles.
2.5 Channel Slope: **0.29** %
2.6 Sinuosity: **1.13**
2.7 Watershed Area: **3** Square Miles
2.8 Channel Width: feet.
2.9 Valley Width: **353** feet.
2.10 Confinement Ratio: **0**
2.10 Confinement Type: **Very Broad**
2.11 Reference Stream Type: **E**
Bedform: **Dune-Ripple**
Sub-class Slope: **None**
Bed Material: **Sand**

Step 3. Basin Characteristics:

3.1 Alluvial Fan: **None**
3.2 Grade Control: **None**
3.3 Dominant Geologic Mat.: **Alluvial** **89.0**%
3.3 Sub-dominant Geological Mat.: **Ice-Contact**
3.4 Left Valley Side **Steep**
3.4 Right Valley Side **Extremely Steep**
3.5 Soils

Hydrologic Group:	**B**	**79.0** %
Flooding:	**Occasional**	**70.0** %
Water Table Deep:	**6.0**	**79.0** %
Water Table Shallow:	**4.0**	**70.0** %
Erodibility:		%

7.4 Comments:

Step 4. Land Cover - Reach Hydrology

4.1 Watershed
Historic Land Cover: **Crop**
Current Dominant land Cover: **Forest** **61.0** %
Current Sub-Dominant Land Cover: **Urban**
4.2 Corridor
Historic Land Cover: **Crop**
Current Dominant land Cover: **Urban** **47.0** %
Current Sub-Dominant Land Cover: **Field**

4.3 Riparian Buffer	Left Bank	Right Bank
Dominant:	**51-100**	**51-100**
Sub-dominant:	**26-50**	**26-50**
Length w/ less than 25 ft.:	**0**	**0**

4.4 Ground Water Inputs: **Abundant**

Step 5. Instream Channel Modifications

5.1 Flow Regulation - (old):
Type: **None**
Use:
5.2 Bridges and Culverts: **3** **16** %
5.3 Bank Armoring: **0.0**
5.4 Channel Straightening: **938** **54 %**
5.5 Dredging History: **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads	One Side	Both Sides
Road:	**0.0** ft.	**0.0** ft.
Railroad:	**0.0** ft.	**0.0** ft.
Berm:	**0.0** ft.	**0.0** ft.
Improved Path:	**0.0** ft.	**0.0** ft.
Berms and Roads (old):	**0.0** ft.	**0.0**
6.2 Floodplain Development:	**0.0** ft.	**0.0**

6.3 Channel Bars: **Mid-channel**
6.4 Meander Migration:
6.5 Meander Width: **19.9** Ratio: **1.0**
6.6 Wavelength: **19.9** Ratio: **1.0**

Step 7. Windshield Survey

7.2 Bank Erosion: **0.00 ft.**
7.2 Bank Height: **0.00 ft.**
7.3 Ice/Debris Jam Potential: **Culvert**

4.1	4.2	4.3	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	6.6	7.2	7.3	Total
2 High	2 High	0 N.S.	0 N.S.	1 Low	0 N.S.	2 High	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	2 High	2 High	0 N.S.	0 N.S.	11

Richmond tribs

Phase 1 - Reach Summary Report

Basin: **Winooski**
Stream Name: **Governor Peck Rd Tributary** Reach **R8.S1.02**
Topo Maps: **ESSEX JUNCTION**
Date Last Edited: **Thu, September 27, 2007**
Watershed: **Winooski River**
Sub-watershed: **Winooski River -- Huntington River to mouth**
Is Reach an Impoundment? **No**

Step 1. Reach Location

1.1 Reach Description: **Parallels Governor Peck Highway for about 4000 feet.**
1.2 Towns: **Richmond**
1.3 Downstream Latitude: **44.43**
1.3 Downstream Longitude: **-73.01**

Step 2. Stream Type

2.1 Elevation Upstream: **318**
2.1 Elevation Downstream: **300**
2.1 Is Gradient Gentle? **No**
2.2 Valley Length: **3024** feet. **0.57** Miles.
2.3 Valley Slope: **0.60** %
2.4.Channel Length: **4354** feet. **0.82** Miles.
2.5 Channel Slope: **0.41** %
2.6 Sinuosity: **1.44**
2.7 Watershed Area: **2** Square Miles
2.8 Channel Width: feet.
2.9 Valley Width: **350** feet.
2.10 Confinement Ratio: **0**
2.10 Confinement Type: **Very Broad**
2.11 Reference Stream Type: **E**
Bedform: **Riffle-Pool**
Sub-class Slope:
Bed Material: **Gravel**

Step 3. Basin Characteristics:

3.1 Alluvial Fan: **None**
3.2 Grade Control: **None**
3.3 Dominant Geologic Mat.: **Alluvial** **80.0**%
3.3 Sub-dominant Geological Mat.: **Glacial**
3.4 Left Valley Side **Extremely Steep**
3.4 Right Valley Side **Very Steep**
3.5 Soils

Hydrologic Group:	**C**	**80.0** %
Flooding:	**Frequent**	**80.0** %
Water Table Deep:	**1.5**	**80.0** %
Water Table Shallow:	**0.0**	**80.0** %
Erodibility:	**High -**	**13.0** %

7.4 Comments:

Step 4. Land Cover - Reach Hydrology

4.1 Watershed
Historic Land Cover: **Field**
Current Dominant land Cover: **Forest** **64.0** %
Current Sub-Dominant Land Cover: **Urban**
4.2 Corridor
Historic Land Cover: **Field**
Current Dominant land Cover: **Urban** **38.0** %
Current Sub-Dominant Land Cover: **Forest**

4.3 Riparian Buffer	Left Bank	Right Bank
Dominant:	**>100**	**>100**
Sub-dominant:	**0-25**	**51-100**
Length w/ less than 25 ft.:	**410**	**0**

4.4 Ground Water Inputs: **Abundant**

Step 5. Instream Channel Modifications

5.1 Flow Regulation - (old):
Type: **None**
Use:
5.2 Bridges and Culverts: **2** **1** %
5.3 Bank Armoring: **0.0**
5.4 Channel Straightening: **663** **15 %**
5.5 Dredging History: **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads	One Side	Both Sides
Road:	**951** ft.	**0.0** ft.
Railroad:	**0.0** ft.	**0.0** ft.
Berm:	**0.0** ft.	**0.0** ft.
Improved Path:	**0.0** ft.	**0.0** ft.
Berms and Roads (old):	**353.8** ft.	**8 %**

6.2 Floodplain Development: **951** ft. **21 %**
6.3 Channel Bars: **Multiple**
6.4 Meander Migration: **Neck Cutoff**
6.5 Meander Width: **120.0** Ratio: **6.2**
6.6 Wavelength: **220.0** Ratio: **11.3**

Step 7. Windshield Survey

7.2 Bank Erosion: **54.42 ft.**
7.2 Bank Height: **3.00 ft.**
7.3 Ice/Debris Jam Potential: **Culvert**

4.1	4.2	4.3	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	6.6	7.2	7.3	Total
2 High	2 High	0 N.S.	0 N.S.	0 N.S.	0 N.S.	2 High	0 N.S.	1 Low	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	7

Richmond tribs

Phase 1 - Reach Summary Report

Basin: **Winooski**
Stream Name: **Governor Peck Rd Tributary** Reach **R8.S1.03**
Topo Maps: **ESSEX JUNCTION**
Date Last Edited: **Thu, September 27, 2007**
Watershed: **Winooski River**
Sub-watershed: **Winooski River -- Huntington River to mouth**
Is Reach an Impoundment? **No**

Step 1. Reach Location

1.1 Reach Description: **Parallels Governor Peck Highway for about 1500 feet.**
1.2 Towns: **Richmond**
1.3 Downstream Latitude: **44.43**
1.3 Downstream Longitude: **-73.00**

Step 2. Stream Type

2.1 Elevation Upstream: **338**
2.1 Elevation Downstream: **318**
2.1 Is Gradient Gentle? **No**
2.2 Valley Length: **1452** feet. **0.28** Miles.
2.3 Valley Slope: **1.38** %
2.4.Channel Length: **1556** feet. **0.29** Miles.
2.5 Channel Slope: **1.29** %
2.6 Sinuosity: **1.07**
2.7 Watershed Area: **2** Square Miles
2.8 Channel Width: feet.
2.9 Valley Width: **282** feet.
2.10 Confinement Ratio: **0**
2.10 Confinement Type: **Very Broad**
2.11 Reference Stream Type: **C**
Bedform: **Riffle-Pool**
Sub-class Slope:
Bed Material: **Gravel**

Step 3. Basin Characteristics:

3.1 Alluvial Fan: **None**
3.2 Grade Control: **None**
3.3 Dominant Geologic Mat.: **Alluvial** **69.0**%
3.3 Sub-dominant Geological Mat.: **Glacial**
3.4 Left Valley Side **Very Steep**
3.4 Right Valley Side **Very Steep**
3.5 Soils

Hydrologic Group:	**C**	**69.0** %
Flooding:	**Frequent**	**69.0** %
Water Table Deep:	**1.5**	**69.0** %
Water Table Shallow:	**0.0**	**93.0** %
Erodibility:	**High -**	**29.0** %

7.4 Comments:

Step 4. Land Cover - Reach Hydrology

4.1 Watershed
Historic Land Cover: **Field**
Current Dominant land Cover: **Forest** **63.0** %
Current Sub-Dominant Land Cover: **Urban**
4.2 Corridor
Historic Land Cover: **Field**
Current Dominant land Cover: **Urban** **52.0** %
Current Sub-Dominant Land Cover: **Forest**

4.3 Riparian Buffer	Left Bank	Right Bank
Dominant:	**>100**	**26-50**
Sub-dominant:	**None**	**51-100**
Length w/ less than 25 ft.:	**0**	**0**

4.4 Ground Water Inputs: **Abundant**

Step 5. Instream Channel Modifications

5.1 Flow Regulation - (old):
Type: **None**
Use:
5.2 Bridges and Culverts: **0** **0** %
5.3 Bank Armoring: **0.0**
5.4 Channel Straightening: **437** **28 %**
5.5 Dredging History: **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads	One Side	Both Sides
Road:	**236** ft.	**0.0** ft.
Railroad:	**0.0** ft.	**0.0** ft.
Berm:	**0.0** ft.	**0.0** ft.
Improved Path:	**0.0** ft.	**0.0** ft.
Berms and Roads (old):	**0.0** ft.	**0.0**

6.2 Floodplain Development: **236** ft. **15 %**
6.3 Channel Bars: **Side**
6.4 Meander Migration:
6.5 Meander Width: **80.0** Ratio: **4.5**
6.6 Wavelength: **250.0** Ratio: **14.1**

Step 7. Windshield Survey

7.2 Bank Erosion: **0.00 ft.**
7.2 Bank Height: **0.00 ft.**
7.3 Ice/Debris Jam Potential: **None**

4.1	4.2	4.3	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	6.6	7.2	7.3	Total
2 High	2 High	0 N.S.	0 N.S.	0 N.S.	0 N.S.	2 High	0 N.S.	1 Low	0 N.S.	0 N.S.	0 N.S.	1 Low	1 Low	0 N.S.	0 N.S.	9

Richmond tribs

Phase 1 - Reach Summary Report

Basin: **Winooski**
Stream Name: **Governor Peck Rd Tributary** Reach **R8.S1.04**
Topo Maps: **ESSEX JUNCTION, RICHMOND**
Date Last Edited: **Thu, September 27, 2007**
Watershed: **Winooski River**
Sub-watershed: **Winooski River -- Huntington River to mouth**
Is Reach an Impoundment? **No**

Step 1. Reach Location

1.1 Reach Description: **Parallels Governor Peck Highway for about 1300 feet.**
1.2 Towns: **Jericho, Richmond**
1.3 Downstream Latitude: **44.43**
1.3 Downstream Longitude: **-73.00**

Step 2. Stream Type

2.1 Elevation Upstream: **360**
2.1 Elevation Downstream: **338**
2.1 Is Gradient Gentle? **No**
2.2 Valley Length: **1071** feet. **0.20** Miles.
2.3 Valley Slope: **2.05** %
2.4.Channel Length: **1304** feet. **0.25** Miles.
2.5 Channel Slope: **1.69** %
2.6 Sinuosity: **1.22**
2.7 Watershed Area: **2** Square Miles
2.8 Channel Width: feet.
2.9 Valley Width: **209** feet.
2.10 Confinement Ratio: **0**
2.10 Confinement Type: **Very Broad**
2.11 Reference Stream Type: **C**
Bedform: **Riffle-Pool**
Sub-class Slope:
Bed Material: **Gravel**

Step 3. Basin Characteristics:

3.1 Alluvial Fan: **None**
3.2 Grade Control: **None**
3.3 Dominant Geologic Mat.: **Glacial Lake 100.** %
3.3 Sub-dominant Geological Mat.:
3.4 Left Valley Side **Very Steep**
3.4 Right Valley Side **Very Steep**

3.5 Soils

Hydrologic Group:	**D**	**98.0** %
Flooding:	**None/Rare**	**100.** %
Water Table Deep:	**1.0**	**73.0** %
Water Table Shallow:	**0.0**	**73.0** %
Erodibility:	**High -**	**99.0** %

7.4 Comments:

Step 4. Land Cover - Reach Hydrology

4.1 Watershed
Historic Land Cover: **Field**
Current Dominant land Cover: **Forest** **62.0** %
Current Sub-Dominant Land Cover: **Urban**

4.2 Corridor
Historic Land Cover: **Field**
Current Dominant land Cover: **Forest** **43.0** %
Current Sub-Dominant Land Cover: **Urban**

4.3 Riparian Buffer	Left Bank	Right Bank
Dominant:	**>100**	**>100**
Sub-dominant:	**None**	**51-100**
Length w/ less than 25 ft.:	**0**	**0**

4.4 Ground Water Inputs: **None**

Step 5. Instream Channel Modifications

5.1 Flow Regulation - (old):
Type: **None**
Use:
5.2 Bridges and Culverts: **0** **0** %
5.3 Bank Armoring: **0.0**
5.4 Channel Straightening: **0.0** **0.0**
5.5 Dredging History: **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads	One Side	Both Sides
Road:	**119** ft.	**0.0** ft.
Railroad:	**0.0** ft.	**0.0** ft.
Berm:	**0.0** ft.	**0.0** ft.
Improved Path:	**0.0** ft.	**0.0** ft.
Berms and Roads (old):	**0.0** ft.	**0.0**

6.2 Floodplain Development: **119** ft. **9 %**
6.3 Channel Bars: **Not Evaluated**
6.4 Meander Migration:
6.5 Meander Width: **50.0** Ratio: **2.9**
6.6 Wavelength: **125.0** Ratio: **7.3**

Step 7. Windshield Survey

7.2 Bank Erosion: **0.00 ft.**
7.2 Bank Height: **0.00 ft.**
7.3 Ice/Debris Jam Potential: **None**

4.1	4.2	4.3	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	6.6	7.2	7.3	Total
2 High	2 High	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	2 High	1 Low	0 N.S.	0 N.S.	7

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Phase 1 - Reach Summary Report

Basin: **Winooski**
Stream Name: **Sunset Ridge Rd Tributary** Reach **R8.S1.04-S1.01**
Topo Maps: **RICHMOND**
Date Last Edited: **Thu, September 27, 2007**
Watershed: **Winooski River**
Sub-watershed: **Winooski River -- Huntington River to mouth**
Is Reach an Impoundment? **No**

Step 1. Reach Location

1.1 Reach Description: **Tributary heading east off the left bank of R8.S1.04 toward Hidden**
1.2 Towns: **Jericho**
1.3 Downstream Latitude: **44.43**
1.3 Downstream Longitude: **-73.00**

Step 2. Stream Type

2.1 Elevation Upstream: **580**
2.1 Elevation Downstream: **360**
2.1 Is Gradient Gentle? **No**
2.2 Valley Length: **1712** feet. **0.32** Miles.
2.3 Valley Slope: **12.85** %
2.4.Channel Length: **1713** feet. **0.32** Miles.
2.5 Channel Slope: **12.84** %
2.6 Sinuosity: **1.00**
2.7 Watershed Area: **0** Square Miles
2.8 Channel Width: feet.
2.9 Valley Width: **14** feet.
2.10 Confinement Ratio: **0**
2.10 Confinement Type: **Narrowly Confined**
2.11 Reference Stream Type: **A**
Bedform: **Step-Pool**
Sub-class Slope:
Bed Material: **Cobble**

Step 3. Basin Characteristics:

3.1 Alluvial Fan: **None**
3.2 Grade Control: **None**
3.3 Dominant Geologic Mat.: **Glacial Lake 53.0**%
3.3 Sub-dominant Geological Mat.: **Ice-Contact**
3.4 Left Valley Side **Extremely Steep**
3.4 Right Valley Side **Extremely Steep**
3.5 Soils

Hydrologic Group:	**A**	**46.0** %
Flooding:	**None/Rare**	**100.** %
Water Table Deep:	**6.0**	**78.0** %
Water Table Shallow:	**6.0**	**78.0** %
Erodibility:	**High -**	**95.0** %

7.4 Comments:

Step 4. Land Cover - Reach Hydrology

4.1 Watershed
Historic Land Cover: **Field**
Current Dominant land Cover: **Urban** **44.0** %
Current Sub-Dominant Land Cover: **Forest**
4.2 Corridor
Historic Land Cover: **Forest**
Current Dominant land Cover: **Forest** **49.0** %
Current Sub-Dominant Land Cover: **Urban**

4.3 Riparian Buffer	Left Bank	Right Bank
Dominant:	**>100**	**>100**
Sub-dominant:	**None**	**None**
Length w/ less than 25 ft.:	**0**	**0**

4.4 Ground Water Inputs: **Minimal**

Step 5. Instream Channel Modifications

5.1 Flow Regulation - (old):
Type: **None**
Use:
5.2 Bridges and Culverts: **1** **2** %
5.3 Bank Armoring: **0.0**
5.4 Channel Straightening: **0.0** **0.0**
5.5 Dredging History: **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads	One Side	Both Sides
Road:	**0.0** ft.	**0.0** ft.
Railroad:	**0.0** ft.	**0.0** ft.
Berm:	**0.0** ft.	**0.0** ft.
Improved Path:	**0.0** ft.	**0.0** ft.
Berms and Roads (old):	**0.0** ft.	**0.0**

6.2 Floodplain Development: **0.0** ft. **0.0**
6.3 Channel Bars: **Not Evaluated**
6.4 Meander Migration:
6.5 Meander Width: Ratio: **0.0**
6.6 Wavelength: Ratio: **0.0**

Step 7. Windshield Survey

7.2 Bank Erosion: **0.00 ft.**
7.2 Bank Height: **0.00 ft.**
7.3 Ice/Debris Jam Potential: **None**

4.1	4.2	4.3	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	6.6	7.2	7.3	Total
2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
High	Low	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	

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Phase 1 - Reach Summary Report

Basin: **Winooski**
Stream Name: **Sunset Ridge Rd Tributary** Reach **R8.S1.04-S1.02**
Topo Maps: **RICHMOND**
Date Last Edited: **Thu, September 27, 2007**
Watershed: **Winooski River**
Sub-watershed: **Winooski River -- Huntington River to mouth**
Is Reach an Impoundment? **No**

Step 1. Reach Location

1.1 Reach Description: **North of Hidden Pines Circle ending east of Jericho Road.**
1.2 Towns: **Jericho**
1.3 Downstream Latitude: **44.43**
1.3 Downstream Longitude: **-72.99**

Step 2. Stream Type

2.1 Elevation Upstream: **740**
2.1 Elevation Downstream: **580**
2.1 Is Gradient Gentle? **No**
2.2 Valley Length: **3125** feet. **0.59** Miles.
2.3 Valley Slope: **5.12** %
2.4.Channel Length: **3204** feet. **0.61** Miles.
2.5 Channel Slope: **4.99** %
2.6 Sinuosity: **1.03**
2.7 Watershed Area: **0** Square Miles
2.8 Channel Width: feet.
2.9 Valley Width: **25** feet.
2.10 Confinement Ratio: **0**
2.10 Confinement Type: **Semi-confined**
2.11 Reference Stream Type: **B**
Bedform: **Step-Pool**
Sub-class Slope: **a**
Bed Material: **Cobble**

Step 3. Basin Characteristics:

3.1 Alluvial Fan: **None**
3.2 Grade Control: **None**
3.3 Dominant Geologic Mat.: **Ice-Contact** **98.0**%
3.3 Sub-dominant Geological Mat.: **Till**
3.4 Left Valley Side **Very Steep**
3.4 Right Valley Side **Very Steep**
3.5 Soils

Hydrologic Group:	**A**	**53.0** %
Flooding:	**None/Rare**	**100.** %
Water Table Deep:	**6.0**	**63.0** %
Water Table Shallow:	**6.0**	**63.0** %
Erodibility:	**High -**	**94.0** %

7.4 Comments:

Step 4. Land Cover - Reach Hydrology

4.1 Watershed
Historic Land Cover: **Crop**
Current Dominant land Cover: **Urban** **57.0** %
Current Sub-Dominant Land Cover: **Forest**
4.2 Corridor
Historic Land Cover: **Forest**
Current Dominant land Cover: **Urban** **72.0** %
Current Sub-Dominant Land Cover: **Forest**

4.3 Riparian Buffer	Left Bank	Right Bank
Dominant:	**>100**	**>100**
Sub-dominant:	**26-50**	**26-50**
Length w/ less than 25 ft.:	**0**	**0**

4.4 Ground Water Inputs: **None**

Step 5. Instream Channel Modifications

5.1 Flow Regulation - (old):
Type: **None**
Use:
5.2 Bridges and Culverts: **1** **2** %
5.3 Bank Armoring: **0.0**
5.4 Channel Straightening: **0.0** **0.0**
5.5 Dredging History: **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads	One Side	Both Sides
Road:	**0.0** ft.	**0.0** ft.
Railroad:	**0.0** ft.	**0.0** ft.
Berm:	**0.0** ft.	**0.0** ft.
Improved Path:	**0.0** ft.	**0.0** ft.
Berms and Roads (old):	**565** ft.	**17 %**

6.2 Floodplain Development: **0.0** ft. **0.0**
6.3 Channel Bars: **None**
6.4 Meander Migration:
6.5 Meander Width: Ratio: **0.0**
6.6 Wavelength: Ratio: **0.0**

Step 7. Windshield Survey

7.2 Bank Erosion: **0.00 ft.**
7.2 Bank Height: **0.00 ft.**
7.3 Ice/Debris Jam Potential: **Culvert**

4.1	4.2	4.3	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	6.6	7.2	7.3	Total
2 High	2 High	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	1 Low	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	5

Richmond tribs

Phase 1 - Reach Summary Report

Basin: **Winooski**
Stream Name: **Governor Peck Rd Tributary** Reach **R8.S1.05**
Topo Maps: **RICHMOND**
Date Last Edited: **Thu, September 27, 2007**
Watershed: **Winooski River**
Sub-watershed: **Winooski River -- Huntington River to mouth**
Is Reach an Impoundment? **No**

Step 1. Reach Location

1.1 Reach Description: **Parallels Governor Peck Highway for approximately 3000 feet**
1.2 Towns: **Jericho**
1.3 Downstream Latitude: **44.43**
1.3 Downstream Longitude: **-73.00**

Step 2. Stream Type

2.1 Elevation Upstream: **485**
2.1 Elevation Downstream: **360**
2.1 Is Gradient Gentle? **No**
2.2 Valley Length: **3398** feet. **0.64** Miles.
2.3 Valley Slope: **3.68** %
2.4.Channel Length: **3928** feet. **0.74** Miles.
2.5 Channel Slope: **3.18** %
2.6 Sinuosity: **1.16**
2.7 Watershed Area: **1** Square Miles
2.8 Channel Width: feet.
2.9 Valley Width: **259** feet.
2.10 Confinement Ratio: **0**
2.10 Confinement Type: **Very Broad**
2.11 Reference Stream Type: **C**
Bedform: **Riffle-Pool**
Sub-class Slope: **b**
Bed Material: **Gravel**

Step 3. Basin Characteristics:

3.1 Alluvial Fan: **None**
3.2 Grade Control: **None**
3.3 Dominant Geologic Mat.: **Glacial Lake 55.0**%
3.3 Sub-dominant Geological Mat.: **Alluvial**
3.4 Left Valley Side **Steep**
3.4 Right Valley Side **Steep**
3.5 Soils

Hydrologic Group:	**D**	**45.0** %
Flooding:	**None/Rare**	**58.0** %
Water Table Deep:	**2.0**	**28.0** %
Water Table Shallow:	**0.5**	**28.0** %
Erodibility:	**High -**	**40.0** %

7.4 Comments:

Step 4. Land Cover - Reach Hydrology

4.1 Watershed
Historic Land Cover: **Field**
Current Dominant land Cover: **Forest** **68.0** %
Current Sub-Dominant Land Cover: **Urban**
4.2 Corridor
Historic Land Cover: **Crop**
Current Dominant land Cover: **Urban** **35.0** %
Current Sub-Dominant Land Cover: **Forest**

4.3 Riparian Buffer	Left Bank	Right Bank
Dominant:	**>100**	**>100**
Sub-dominant:	**26-50**	**0-25**
Length w/ less than 25 ft.:	**100**	**529**

4.4 Ground Water Inputs: **Abundant**

Step 5. Instream Channel Modifications

5.1 Flow Regulation - (old):
Type: **None**
Use:
5.2 Bridges and Culverts: **3** **3** %
5.3 Bank Armoring: **0.0**
5.4 Channel Straightening: **308.1** **7 %**
5.5 Dredging History: **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads	One Side	Both Sides
Road:	**351** ft.	**0.0** ft.
Railroad:	**0.0** ft.	**0.0** ft.
Berm:	**0.0** ft.	**0.0** ft.
Improved Path:	**0.0** ft.	**0.0** ft.
Berms and Roads (old):	**0.0** ft.	**0.0**

6.2 Floodplain Development: **532** ft. **13 %**
6.3 Channel Bars: **Multiple**
6.4 Meander Migration:
6.5 Meander Width: **36.0** Ratio: **2.4**
6.6 Wavelength: **80.0** Ratio: **5.2**

Step 7. Windshield Survey

7.2 Bank Erosion: **0.00 ft.**
7.2 Bank Height: **0.00 ft.**
7.3 Ice/Debris Jam Potential: **Culvert**

4.1	4.2	4.3	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	6.6	7.2	7.3	Total
2 High	2 High	1 Low	0 N.S.	0 N.S.	0 N.S.	2 High	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	2 High	2 High	0 N.S.	0 N.S.	11

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Phase 1 - Reach Summary Report

Basin: **Winooski**
Stream Name: **Governor Peck Rd Tributary** Reach **R8.S1.06**
Topo Maps: **RICHMOND**
Date Last Edited: **Thu, September 27, 2007**
Watershed: **Winooski River**
Sub-watershed: **Winooski River -- Huntington River to mouth**
Is Reach an Impoundment? **No**

Step 1. Reach Location

1.1 Reach Description: **From Governor Peck Highway channel moves east and reach ends at**
1.2 Towns: **Jericho**
1.3 Downstream Latitude: **44.44**
1.3 Downstream Longitude: **-72.99**

Step 2. Stream Type

2.1 Elevation Upstream: **720**
2.1 Elevation Downstream: **485**
2.1 Is Gradient Gentle? **No**
2.2 Valley Length: **3516** feet. **0.67** Miles.
2.3 Valley Slope: **6.68** %
2.4.Channel Length: **3997** feet. **0.76** Miles.
2.5 Channel Slope: **5.88** %
2.6 Sinuosity: **1.14**
2.7 Watershed Area: **1** Square Miles
2.8 Channel Width: feet.
2.9 Valley Width: **30** feet.
2.10 Confinement Ratio: **0**
2.10 Confinement Type: **Semi-confined**
2.11 Reference Stream Type: **B**
Bedform: **Step-Pool**
Sub-class Slope: **a**
Bed Material: **Cobble**

Step 3. Basin Characteristics:

3.1 Alluvial Fan: **None**
3.2 Grade Control: **None**
3.3 Dominant Geologic Mat.: **Ice-Contact** **85.0**%
3.3 Sub-dominant Geological Mat.: **Alluvial**
3.4 Left Valley Side **Extremely Steep**
3.4 Right Valley Side **Extremely Steep**
3.5 Soils

Hydrologic Group:	**A**	**84.0** %
Flooding:	**None/Rare**	**92.0** %
Water Table Deep:	**6.0**	**84.0** %
Water Table Shallow:	**6.0**	**84.0** %
Erodibility:	**High -**	**91.0** %

7.4 Comments:

Step 4. Land Cover - Reach Hydrology

4.1 Watershed
Historic Land Cover: **Field**
Current Dominant land Cover: **Forest** **67.0** %
Current Sub-Dominant Land Cover: **Urban**
4.2 Corridor
Historic Land Cover: **Forest**
Current Dominant land Cover: **Forest** **41.0** %
Current Sub-Dominant Land Cover: **Urban**

4.3 Riparian Buffer	Left Bank	Right Bank
Dominant:	**>100**	**>100**
Sub-dominant:	**26-50**	**51-100**
Length w/ less than 25 ft.:	**0**	**0**

4.4 Ground Water Inputs: **None**

Step 5. Instream Channel Modifications

5.1 Flow Regulation - (old):
Type: **None**
Use:
5.2 Bridges and Culverts: **1** **1** %
5.3 Bank Armoring: **0.0**
5.4 Channel Straightening: **164.1** **4 %**
5.5 Dredging History: **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads	One Side	Both Sides
Road:	**0.0** ft.	**0.0** ft.
Railroad:	**0.0** ft.	**0.0** ft.
Berm:	**0.0** ft.	**0.0** ft.
Improved Path:	**0.0** ft.	**0.0** ft.
Berms and Roads (old):	**315** ft.	**7 %**

6.2 Floodplain Development: **0.0** ft. **0.0**
6.3 Channel Bars: **Not Evaluated**
6.4 Meander Migration:
6.5 Meander Width: Ratio: **0.0**
6.6 Wavelength: Ratio: **0.0**

Step 7. Windshield Survey

7.2 Bank Erosion: **0.00 ft.**
7.2 Bank Height: **0.00 ft.**
7.3 Ice/Debris Jam Potential: **None**

4.1	4.2	4.3	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	6.6	7.2	7.3	Total
2 High	2 High	0 N.S.	0 N.S.	0 N.S.	0 N.S.	2 High	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	6

Richmond tribs

Phase 1 - Reach Summary Report

Basin: **Winooski**
Stream Name: **Governor Peck Rd Tributary** Reach **R8.S1.07**
Topo Maps: **RICHMOND**
Date Last Edited: **Wed, September 19, 2007**
Watershed: **Winooski River**
Sub-watershed: **Winooski River -- Huntington River to mouth**
Is Reach an Impoundment? **No**

Step 1. Reach Location

1.1 Reach Description: **From Browns Trace Road to Milo White Road**
1.2 Towns: **Jericho**
1.3 Downstream Latitude: **44.44**
1.3 Downstream Longitude: **-72.98**

Step 2. Stream Type

2.1 Elevation Upstream: **760**
2.1 Elevation Downstream: **720**
2.1 Is Gradient Gentle? **No**
2.2 Valley Length: **2097** feet. **0.40** Miles.
2.3 Valley Slope: **1.91** %
2.4.Channel Length: **2555** feet. **0.48** Miles.
2.5 Channel Slope: **1.57** %
2.6 Sinuosity: **1.22**
2.7 Watershed Area: **1** Square Miles
2.8 Channel Width: feet.
2.9 Valley Width: **358** feet.
2.10 Confinement Ratio: **0**
2.10 Confinement Type: **Very Broad**
2.11 Reference Stream Type: **C**
Bedform: **Riffle-Pool**
Sub-class Slope:
Bed Material: **Gravel**

Step 3. Basin Characteristics:

3.1 Alluvial Fan: **None**
3.2 Grade Control: **None**
3.3 Dominant Geologic Mat.: **Alluvial** **45.0**%
3.3 Sub-dominant Geological Mat.: **Ice-Contact**
3.4 Left Valley Side **Very Steep**
3.4 Right Valley Side **Steep**
3.5 Soils

Hydrologic Group:	**Not Rated**	**45.0** %
Flooding:	**None/Rare**	**54.0** %
Water Table Deep:	**3.0**	**23.0** %
Water Table Shallow:	**1.5**	**32.0** %
Erodibility:	**High -**	**17.0** %

7.4 Comments:

Step 4. Land Cover - Reach Hydrology

4.1 Watershed
Historic Land Cover: **Crop**
Current Dominant land Cover: **Forest** **77.0** %
Current Sub-Dominant Land Cover: **Urban**
4.2 Corridor
Historic Land Cover: **Field**
Current Dominant land Cover: **Forest** **38.0** %
Current Sub-Dominant Land Cover: **Field**

4.3 Riparian Buffer	Left Bank	Right Bank
Dominant:	**>100**	**26-50**
Sub-dominant:	**26-50**	**51-100**
Length w/ less than 25 ft.:	**---**	**---**

4.4 Ground Water Inputs: **Minimal**

Step 5. Instream Channel Modifications

5.1 Flow Regulation - (old): **None**
Type:
Use:
5.2 Bridges and Culverts: **0** **0** %
5.3 Bank Armoring: **0.0**
5.4 Channel Straightening: **0.0**
5.5 Dredging History: **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads	One Side	Both Sides
Road:	ft.	ft.
Railroad:	ft.	ft.
Berm:	ft.	ft.
Improved Path:	ft.	ft.
Berms and Roads (old):	**0.0** ft.	**0.0**
6.2 Floodplain Development:	**0.0** ft.	**0.0**

6.3 Channel Bars: **Not Evaluated**
6.4 Meander Migration:
6.5 Meander Width: **43.0** Ratio: **3.7**
6.6 Wavelength: **72.0** Ratio: **6.3**

Step 7. Windshield Survey

7.2 Bank Erosion: **None**
7.2 Bank Height: **No Data**
7.3 Ice/Debris Jam Potential: **Culvert**

4.1	4.2	4.3	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	6.6	7.2	7.3	Total
2	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	5
High	Low	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	Low	Low	N.S.	N.S.	

Richmond tribs

Phase 1 - Reach Summary Report

Basin: **Winooski**
Stream Name: **Governor Peck Rd Tributary** Reach **R8.S1.08**
Topo Maps: **RICHMOND**
Date Last Edited: **Thu, September 27, 2007**
Watershed: **Winooski River**
Sub-watershed: **Winooski River -- Huntington River to mouth**
Is Reach an Impoundment? **No**

Step 1. Reach Location

1.1 Reach Description: **From Milo White Road the Channel heads east toward the end of**
1.2 Towns: **Jericho**
1.3 Downstream Latitude: **44.44**
1.3 Downstream Longitude: **-72.97**

Step 2. Stream Type

2.1 Elevation Upstream: **1120**
2.1 Elevation Downstream: **760**
2.1 Is Gradient Gentle? **No**
2.2 Valley Length: **3967** feet. **0.75** Miles.
2.3 Valley Slope: **9.07** %
2.4.Channel Length: **4061** feet. **0.77** Miles.
2.5 Channel Slope: **8.86** %
2.6 Sinuosity: **1.02**
2.7 Watershed Area: **1** Square Miles
2.8 Channel Width: feet.
2.9 Valley Width: **30** feet.
2.10 Confinement Ratio: **0**
2.10 Confinement Type: **Semi-confined**
2.11 Reference Stream Type: **B**
Bedform: **Step-Pool**
Sub-class Slope: **a**
Bed Material: **Cobble**

Step 3. Basin Characteristics:

3.1 Alluvial Fan: **None**
3.2 Grade Control: **None**
3.3 Dominant Geologic Mat.: **Till** **96.0**%
3.3 Sub-dominant Geological Mat.: **Ice-Contact**
3.4 Left Valley Side **Extremely Steep**
3.4 Right Valley Side **Extremely Steep**
3.5 Soils

Hydrologic Group:	**C**	**96.0** %
Flooding:	**None/Rare**	**100.** %
Water Table Deep:	**2.5**	**64.0** %
Water Table Shallow:	**1.5**	**67.0** %
Erodibility:	**High -**	**95.0** %

7.4 Comments:

Step 4. Land Cover - Reach Hydrology

4.1 Watershed
Historic Land Cover: **Field**
Current Dominant land Cover: **Forest** **73.0** %
Current Sub-Dominant Land Cover: **Urban**
4.2 Corridor
Historic Land Cover: **Forest**
Current Dominant land Cover: **Urban** **43.0** %
Current Sub-Dominant Land Cover: **Forest**

4.3 Riparian Buffer	Left Bank	Right Bank
Dominant:	**>100**	**>100**
Sub-dominant:	**51-100**	**51-100**
Length w/ less than 25 ft.:	**0**	**0**

4.4 Ground Water Inputs: **None**

Step 5. Instream Channel Modifications

5.1 Flow Regulation - (old):
Type: **None**
Use:
5.2 Bridges and Culverts: **3** **3** %
5.3 Bank Armoring: **0.0**
5.4 Channel Straightening: **0.0** **0.0**
5.5 Dredging History: **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads	One Side	Both Sides
Road:	**0.0** ft.	**0.0** ft.
Railroad:	**0.0** ft.	**0.0** ft.
Berm:	**0.0** ft.	**0.0** ft.
Improved Path:	**0.0** ft.	**0.0** ft.
Berms and Roads (old):	**265** ft.	**6 %**

6.2 Floodplain Development: **0.0** ft. **0.0**
6.3 Channel Bars: **Not Evaluated**
6.4 Meander Migration:
6.5 Meander Width: Ratio: **0.0**
6.6 Wavelength: Ratio: **0.0**

Step 7. Windshield Survey

7.2 Bank Erosion: **0.00 ft.**
7.2 Bank Height: **0.00 ft.**
7.3 Ice/Debris Jam Potential: **None**

4.1	4.2	4.3	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	6.6	7.2	7.3	Total
2 High	2 High	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	4

Richmond tribs

Phase 1 - Reach Summary Report

Basin: **Winooski**
Stream Name: **Jericho Road Tributary** Reach **R8.S2.01**
Topo Maps: **ESSEX JUNCTION, RICHMOND**
Date Last Edited: **Thu, September 27, 2007**
Watershed: **Winooski River**
Sub-watershed: **Winooski River -- Huntington River to mouth**
Is Reach an Impoundment? **No**

Step 1. Reach Location

1.1 Reach Description: **From confluence with the Winooski River to reach break on the west**
1.2 Towns: **Richmond**
1.3 Downstream Latitude: **44.41**
1.3 Downstream Longitude: **-73.01**

Step 2. Stream Type

2.1 Elevation Upstream: **320**
2.1 Elevation Downstream: **296**
2.1 Is Gradient Gentle? **No**
2.2 Valley Length: **3340** feet. **0.63** Miles.
2.3 Valley Slope: **0.72** %
2.4.Channel Length: **4030** feet. **0.76** Miles.
2.5 Channel Slope: **0.60** %
2.6 Sinuosity: **1.21**
2.7 Watershed Area: **2** Square Miles
2.8 Channel Width: feet.
2.9 Valley Width: **434** feet.
2.10 Confinement Ratio: **0**
2.10 Confinement Type: **Very Broad**
2.11 Reference Stream Type: **E**
Bedform: **Dune-Ripple**
Sub-class Slope:
Bed Material: **Sand**

Step 3. Basin Characteristics:

3.1 Alluvial Fan: **Yes**
3.2 Grade Control: **None**
3.3 Dominant Geologic Mat.: **Alluvial** **87.0**%
3.3 Sub-dominant Geological Mat.: **Glacial**
3.4 Left Valley Side **Very Steep**
3.4 Right Valley Side **Extremely Steep**
3.5 Soils

Hydrologic Group:	**C**	**52.0** %
Flooding:	**Frequent**	**80.0** %
Water Table Deep:	**1.5**	**52.0** %
Water Table Shallow:	**0.0**	**64.0** %
Erodibility:	**High -**	**12.0** %

7.4 Comments:

Step 4. Land Cover - Reach Hydrology

4.1 Watershed
Historic Land Cover: **Crop**
Current Dominant land Cover: **Forest** **55.0** %
Current Sub-Dominant Land Cover: **Urban**
4.2 Corridor
Historic Land Cover: **Crop**
Current Dominant land Cover: **Field** **21.0** %
Current Sub-Dominant Land Cover: **Crop**

4.3 Riparian Buffer	Left Bank	Right Bank
Dominant:	**26-50**	**26-50**
Sub-dominant:	**0-25**	**None**
Length w/ less than 25 ft.:	**782**	**366**

4.4 Ground Water Inputs: **Minimal**

Step 5. Instream Channel Modifications

5.1 Flow Regulation - (old):
Type: **None**
Use:
5.2 Bridges and Culverts: **2** **3** %
5.3 Bank Armoring: **0.0**
5.4 Channel Straightening: **2757** **68 %**
5.5 Dredging History: **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads	One Side	Both Sides
Road:	**0.0** ft.	**0.0** ft.
Railroad:	**0.0** ft.	**0.0** ft.
Berm:	**0.0** ft.	**0.0** ft.
Improved Path:	**0.0** ft.	**0.0** ft.
Berms and Roads (old):	**0.0** ft.	**0.0**

6.2 Floodplain Development: **0.0** ft. **0.0**
6.3 Channel Bars: **Point**
6.4 Meander Migration:
6.5 Meander Width: **17.5** Ratio: **1.0**
6.6 Wavelength: **17.5** Ratio: **1.0**

Step 7. Windshield Survey

7.2 Bank Erosion: **0.00 ft.**
7.2 Bank Height: **0.00 ft.**
7.3 Ice/Debris Jam Potential: **Culvert**

4.1	4.2	4.3	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	6.6	7.2	7.3	Total
2 High	2 High	1 Low	0 N.S.	0 N.S.	0 N.S.	2 High	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	2 High	2 High	0 N.S.	0 N.S.	11

Richmond tribs

Phase 1 - Reach Summary Report

Basin: **Winooski**
Stream Name: **Jericho Road Tributary** Reach **R8.S2.02**
Topo Maps: **RICHMOND**
Date Last Edited: **Thu, September 27, 2007**
Watershed: **Winooski River**
Sub-watershed: **Winooski River -- Huntington River to mouth**
Is Reach an Impoundment? **No**

Step 1. Reach Location

1.1 Reach Description: **From reach break by I-89 to intersection of Southview Drive and Old**
1.2 Towns: **Richmond**
1.3 Downstream Latitude: **44.42**
1.3 Downstream Longitude: **-73.00**

Step 2. Stream Type

2.1 Elevation Upstream: **460**
2.1 Elevation Downstream: **320**
2.1 Is Gradient Gentle? **No**
2.2 Valley Length: **2525** feet. **0.48** Miles.
2.3 Valley Slope: **5.54** %
2.4.Channel Length: **2570** feet. **0.49** Miles.
2.5 Channel Slope: **5.45** %
2.6 Sinuosity: **1.02**
2.7 Watershed Area: **2** Square Miles
2.8 Channel Width: feet.
2.9 Valley Width: **40** feet.
2.10 Confinement Ratio: **0**
2.10 Confinement Type: **Semi-confined**
2.11 Reference Stream Type: **B**
Bedform: **Step-Pool**
Sub-class Slope: **a**
Bed Material: **Cobble**

Step 3. Basin Characteristics:

3.1 Alluvial Fan: **None**
3.2 Grade Control: **None**
3.3 Dominant Geologic Mat.: **Glacial Lake 79.0**%
3.3 Sub-dominant Geological Mat.: **Ice-Contact**
3.4 Left Valley Side **Very Steep**
3.4 Right Valley Side **Very Steep**
3.5 Soils

Hydrologic Group:	**Not Rated**	**80.0** %
Flooding:	**None/Rare**	**94.0** %
Water Table Deep:	**6.0**	**11.0** %
Water Table Shallow:	**6.0**	**11.0** %
Erodibility:	**High -**	**19.0** %

7.4 Comments:

Step 4. Land Cover - Reach Hydrology

4.1 Watershed
Historic Land Cover: **Field**
Current Dominant land Cover: **Forest** **62.0** %
Current Sub-Dominant Land Cover: **Urban**
4.2 Corridor
Historic Land Cover: **Field**
Current Dominant land Cover: **Urban** **51.0** %
Current Sub-Dominant Land Cover: **Forest**

4.3 Riparian Buffer	Left Bank	Right Bank
Dominant:	**51-100**	**>100**
Sub-dominant:	**51-100**	**51-100**
Length w/ less than 25 ft.:	**0**	**0**

4.4 Ground Water Inputs: **None**

Step 5. Instream Channel Modifications

5.1 Flow Regulation - (old):
Type: **None**
Use:
5.2 Bridges and Culverts: **2** **16** %
5.3 Bank Armoring: **0.0**
5.4 Channel Straightening: **463** **18 %**
5.5 Dredging History: **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads	One Side	Both Sides
Road:	**0.0** ft.	**0.0** ft.
Railroad:	**0.0** ft.	**0.0** ft.
Berm:	**0.0** ft.	**0.0** ft.
Improved Path:	**188** ft.	**0.0** ft.
Berms and Roads (old):	**0.0** ft.	**0.0**

6.2 Floodplain Development: **188** ft. **7 %**
6.3 Channel Bars: **Multiple**
6.4 Meander Migration:
6.5 Meander Width: Ratio: **0.0**
6.6 Wavelength: Ratio: **0.0**

Step 7. Windshield Survey

7.2 Bank Erosion: **0.00 ft.**
7.2 Bank Height: **0.00 ft.**
7.3 Ice/Debris Jam Potential: **Culvert**

4.1	4.2	4.3	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	6.6	7.2	7.3	Total
2 High	2 High	0 N.S.	0 N.S.	1 Low	0 N.S.	2 High	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	7

Richmond tribs

Phase 1 - Reach Summary Report

Basin: **Winooski**
Stream Name: **Joan Ave Tributary** Reach **R8.S2.02-S1.01**
Topo Maps: **RICHMOND**
Date Last Edited: **Thu, September 27, 2007**
Watershed: **Winooski River**
Sub-watershed: **Winooski River -- Huntington River to mouth**
Is Reach an Impoundment? **No**

Step 1. Reach Location

1.1 Reach Description: **From intersection of Southview Drive and Old Jericho Road up to Richmond**
1.2 Towns:
1.3 Downstream Latitude: **44.42**
1.3 Downstream Longitude: **-72.99**

Step 2. Stream Type

2.1 Elevation Upstream: **680**
2.1 Elevation Downstream: **460**
2.1 Is Gradient Gentle? **No**
2.2 Valley Length: **2235** feet. **0.42** Miles.
2.3 Valley Slope: **9.84** %
2.4.Channel Length: **2317** feet. **0.44** Miles.
2.5 Channel Slope: **9.50** %
2.6 Sinuosity: **1.04**
2.7 Watershed Area: **0** Square Miles
2.8 Channel Width: feet.
2.9 Valley Width: **12** feet.
2.10 Confinement Ratio: **0**
2.10 Confinement Type: **Narrowly Confined**
2.11 Reference Stream Type: **A**
Bedform: **Step-Pool**
Sub-class Slope:
Bed Material: **Cobble**

Step 3. Basin Characteristics:

3.1 Alluvial Fan: **None**
3.2 Grade Control: **None**
3.3 Dominant Geologic Mat.: **Ice-Contact** **77.0** %
3.3 Sub-dominant Geological Mat.: **Till**
3.4 Left Valley Side **Extremely Steep**
3.4 Right Valley Side **Extremely Steep**
3.5 Soils

Hydrologic Group:	**B**	**41.0** %
Flooding:	**None/Rare**	**100.** %
Water Table Deep:	**6.0**	**54.0** %
Water Table Shallow:	**6.0**	**54.0** %
Erodibility:	**High -**	**84.0** %

7.4 Comments:

Step 4. Land Cover - Reach Hydrology

4.1 Watershed
Historic Land Cover: **Field**
Current Dominant land Cover: **Field** **43.0** %
Current Sub-Dominant Land Cover: **Urban**
4.2 Corridor
Historic Land Cover: **Forest**
Current Dominant land Cover: **Urban** **30.0** %
Current Sub-Dominant Land Cover: **Field**

4.3 Riparian Buffer	Left Bank	Right Bank
Dominant:	**51-100**	**51-100**
Sub-dominant:	**26-50**	**26-50**
Length w/ less than 25 ft.:	**0**	**0**

4.4 Ground Water Inputs: **None**

Step 5. Instream Channel Modifications

5.1 Flow Regulation - (old):
Type: **None**
Use:
5.2 Bridges and Culverts: **2** **7** %
5.3 Bank Armoring: **0.0**
5.4 Channel Straightening: **0.0** **0.0**
5.5 Dredging History: **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads	One Side	Both Sides
Road:	**0.0** ft.	**0.0** ft.
Railroad:	**0.0** ft.	**0.0** ft.
Berm:	**0.0** ft.	**0.0** ft.
Improved Path:	**0.0** ft.	**0.0** ft.
Berms and Roads (old):	**0.0** ft.	**0.0**

6.2 Floodplain Development: **0.0** ft. **0.0**
6.3 Channel Bars: **None**
6.4 Meander Migration:
6.5 Meander Width: Ratio: **0.0**
6.6 Wavelength: Ratio: **0.0**

Step 7. Windshield Survey

7.2 Bank Erosion: **0.00 ft.**
7.2 Bank Height: **0.00 ft.**
7.3 Ice/Debris Jam Potential: **Culvert**

4.1	4.2	4.3	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	6.6	7.2	7.3	Total
2 High	2 High	0 N.S.	0 N.S.	1 Low	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	5

Richmond tribs

Phase 1 - Reach Summary Report

Basin: **Winooski**
Stream Name: **Jericho Road Tributary** Reach **R8.S2.03**
Topo Maps: **RICHMOND**
Date Last Edited: **Thu, September 27, 2007**
Watershed: **Winooski River**
Sub-watershed: **Winooski River -- Huntington River to mouth**
Is Reach an Impoundment? **No**

Step 1. Reach Location

1.1 Reach Description: **Parallels Jericho Road for about 1500 feet.**
1.2 Towns: **Richmond**
1.3 Downstream Latitude: **44.42**
1.3 Downstream Longitude: **-72.99**

Step 2. Stream Type

2.1 Elevation Upstream: **560**
2.1 Elevation Downstream: **460**
2.1 Is Gradient Gentle? **No**
2.2 Valley Length: **1485** feet. **0.28** Miles.
2.3 Valley Slope: **6.73** %
2.4.Channel Length: **1540** feet. **0.29** Miles.
2.5 Channel Slope: **6.49** %
2.6 Sinuosity: **1.04**
2.7 Watershed Area: **1** Square Miles
2.8 Channel Width: feet.
2.9 Valley Width: **30** feet.
2.10 Confinement Ratio: **0**
2.10 Confinement Type: **Semi-confined**
2.11 Reference Stream Type: **B**
Bedform: **Step-Pool**
Sub-class Slope: **a**
Bed Material: **Cobble**

Step 3. Basin Characteristics:

3.1 Alluvial Fan: **None**
3.2 Grade Control: **None**
3.3 Dominant Geologic Mat.: **Ice-Contact** **100.** %
3.3 Sub-dominant Geological Mat.:
3.4 Left Valley Side **Extremely Steep**
3.4 Right Valley Side **Extremely Steep**

3.5 Soils

Hydrologic Group:	**B**	**99.0** %
Flooding:	**None/Rare**	**100.** %
Water Table Deep:	**6.0**	**98.0** %
Water Table Shallow:	**6.0**	**98.0** %
Erodibility:	**High -**	**99.0** %

7.4 Comments:

Step 4. Land Cover - Reach Hydrology

4.1 Watershed
Historic Land Cover: **Crop**
Current Dominant land Cover: **Forest** **76.0** %
Current Sub-Dominant Land Cover: **Urban**

4.2 Corridor
Historic Land Cover: **Forest**
Current Dominant land Cover: **Urban** **77.0** %
Current Sub-Dominant Land Cover:

4.3 Riparian Buffer	Left Bank	Right Bank
Dominant:	**>100**	**>100**
Sub-dominant:	**None**	**None**
Length w/ less than 25 ft.:	**0**	**0**

4.4 Ground Water Inputs: **None**

Step 5. Instream Channel Modifications

5.1 Flow Regulation - (old):
Type: **None**
Use:
5.2 Bridges and Culverts: **0** **0** %
5.3 Bank Armoring: **0.0**
5.4 Channel Straightening: **0.0** **0.0**
5.5 Dredging History: **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads	One Side	Both Sides
Road:	**0.0** ft.	**0.0** ft.
Railroad:	**0.0** ft.	**0.0** ft.
Berm:	**0.0** ft.	**0.0** ft.
Improved Path:	**1540** ft.	**0.0** ft.
Berms and Roads (old):	**0.0** ft.	**0.0**

6.2 Floodplain Development: **1540** ft. **100 %**
6.3 Channel Bars: **None**
6.4 Meander Migration:
6.5 Meander Width: Ratio: **0.0**
6.6 Wavelength: Ratio: **0.0**

Step 7. Windshield Survey

7.2 Bank Erosion: **0.00 ft.**
7.2 Bank Height: **0.00 ft.**
7.3 Ice/Debris Jam Potential: **None**

4.1	4.2	4.3	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	6.6	7.2	7.3	Total
1	2	0	0	0	0	0	0	2	0	0	0	0	0	0	0	5
Low	High	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	High	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	

Richmond tribs

Phase 1 - Reach Summary Report

Basin: **Winooski**
Stream Name: **Unnamed Tributary** Reach **R8.S2.03-S1.01**
Topo Maps: **RICHMOND**
Date Last Edited: **Thu, September 27, 2007**
Watershed: **Winooski River**
Sub-watershed: **Winooski River -- Huntington River to mouth**
Is Reach an Impoundment? **No**

Step 1. Reach Location

1.1 Reach Description: **Reach extends southeast for about one-half of a mile past Jericho**
1.2 Towns: **Richmond**
1.3 Downstream Latitude: **44.42**
1.3 Downstream Longitude: **-72.98**

Step 2. Stream Type

2.1 Elevation Upstream: **810**
2.1 Elevation Downstream: **560**
2.1 Is Gradient Gentle? **No**
2.2 Valley Length: **2895** feet. **0.55** Miles.
2.3 Valley Slope: **8.64** %
2.4.Channel Length: **2941** feet. **0.56** Miles.
2.5 Channel Slope: **8.50** %
2.6 Sinuosity: **1.02**
2.7 Watershed Area: **0** Square Miles
2.8 Channel Width: feet.
2.9 Valley Width: **13** feet.
2.10 Confinement Ratio: **0**
2.10 Confinement Type: **Narrowly Confined**
2.11 Reference Stream Type: **A**
Bedform: **Step-Pool**
Sub-class Slope:
Bed Material: **Cobble**

Step 3. Basin Characteristics:

3.1 Alluvial Fan: **None**
3.2 Grade Control: **None**
3.3 Dominant Geologic Mat.: **Till** **76.0**%
3.3 Sub-dominant Geological Mat.: **Ice-Contact**
3.4 Left Valley Side **Extremely Steep**
3.4 Right Valley Side **Extremely Steep**
3.5 Soils

Hydrologic Group:	**D**	**39.0** %
Flooding:	**None/Rare**	**100.** %
Water Table Deep:	**6.0**	**62.0** %
Water Table Shallow:	**2.0**	**39.0** %
Erodibility:	**High -**	**95.0** %

7.4 Comments:

Step 4. Land Cover - Reach Hydrology

4.1 Watershed
Historic Land Cover: **Forest**
Current Dominant land Cover: **Forest** **84.0** %
Current Sub-Dominant Land Cover: **Urban**
4.2 Corridor
Historic Land Cover: **Forest**
Current Dominant land Cover: **Forest** **49.0** %
Current Sub-Dominant Land Cover: **Urban**

4.3 Riparian Buffer	Left Bank	Right Bank
Dominant:	**>100**	**>100**
Sub-dominant:	**51-100**	**51-100**
Length w/ less than 25 ft.:	**0**	**0**

4.4 Ground Water Inputs: **None**

Step 5. Instream Channel Modifications

5.1 Flow Regulation - (old):
Type: **None**
Use:
5.2 Bridges and Culverts: **1** **1** %
5.3 Bank Armoring: **0.0**
5.4 Channel Straightening: **0.0** **0.0**
5.5 Dredging History: **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads	One Side	Both Sides
Road:	**0.0** ft.	**0.0** ft.
Railroad:	**0.0** ft.	**0.0** ft.
Berm:	**0.0** ft.	**0.0** ft.
Improved Path:	**0.0** ft.	**0.0** ft.
Berms and Roads (old):	**0.0** ft.	**0.0**

6.2 Floodplain Development: **0.0** ft. **0.0**
6.3 Channel Bars: **None**
6.4 Meander Migration:
6.5 Meander Width: Ratio: **0.0**
6.6 Wavelength: Ratio: **0.0**

Step 7. Windshield Survey

7.2 Bank Erosion: **0.00 ft.**
7.2 Bank Height: **0.00 ft.**
7.3 Ice/Debris Jam Potential: **Culvert**

4.1	4.2	4.3	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	6.6	7.2	7.3	Total
1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Low	High	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	

Richmond tribs

Phase 1 - Reach Summary Report

Basin: **Winooski**
Stream Name: **Jericho Road Tributary** Reach **R8.S2.04**
Topo Maps: **RICHMOND**
Date Last Edited: **Thu, September 27, 2007**
Watershed: **Winooski River**
Sub-watershed: **Winooski River -- Huntington River to mouth**
Is Reach an Impoundment? **No**

Step 1. Reach Location

1.1 Reach Description: **Parallels Jericho Road for about 2000 feet.**
1.2 Towns: **Richmond**
1.3 Downstream Latitude: **44.42**
1.3 Downstream Longitude: **-72.98**

Step 2. Stream Type

2.1 Elevation Upstream: **680**
2.1 Elevation Downstream: **560**
2.1 Is Gradient Gentle? **No**
2.2 Valley Length: **1889** feet. **0.36** Miles.
2.3 Valley Slope: **6.35** %
2.4.Channel Length: **2101** feet. **0.40** Miles.
2.5 Channel Slope: **5.71** %
2.6 Sinuosity: **1.11**
2.7 Watershed Area: **1** Square Miles
2.8 Channel Width: feet.
2.9 Valley Width: **25** feet.
2.10 Confinement Ratio: **0**
2.10 Confinement Type: **Semi-confined**
2.11 Reference Stream Type: **B**
Bedform: **Step-Pool**
Sub-class Slope: **a**
Bed Material: **Cobble**

Step 3. Basin Characteristics:

3.1 Alluvial Fan: **None**
3.2 Grade Control: **None**
3.3 Dominant Geologic Mat.: **Ice-Contact** **79.0**%
3.3 Sub-dominant Geological Mat.: **Till**
3.4 Left Valley Side **Extremely Steep**
3.4 Right Valley Side **Extremely Steep**
3.5 Soils

Hydrologic Group:	**B**	**87.0** %
Flooding:	**None/Rare**	**100.** %
Water Table Deep:	**6.0**	**76.0** %
Water Table Shallow:	**6.0**	**76.0** %
Erodibility:	**High -**	**88.0** %

7.4 Comments:

Step 4. Land Cover - Reach Hydrology

4.1 Watershed
Historic Land Cover: **Crop**
Current Dominant land Cover: **Forest** **79.0** %
Current Sub-Dominant Land Cover: **Field**
4.2 Corridor
Historic Land Cover: **Forest**
Current Dominant land Cover: **Urban** **73.0** %
Current Sub-Dominant Land Cover: **Forest**

4.3 Riparian Buffer	Left Bank	Right Bank
Dominant:	**>100**	**>100**
Sub-dominant:	**51-100**	**51-100**
Length w/ less than 25 ft.:	**0**	**0**

4.4 Ground Water Inputs: **None**

Step 5. Instream Channel Modifications

5.1 Flow Regulation - (old):
Type: **None**
Use:
5.2 Bridges and Culverts: **1** **3** %
5.3 Bank Armoring: **0.0**
5.4 Channel Straightening: **164** **7 %**
5.5 Dredging History: **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads	One Side	Both Sides
Road:	**0.0** ft.	**0.0** ft.
Railroad:	**0.0** ft.	**0.0** ft.
Berm:	**0.0** ft.	**0.0** ft.
Improved Path:	**766** ft.	**0.0** ft.
Berms and Roads (old):	**0.0** ft.	**0.0**

6.2 Floodplain Development: **766** ft. **36 %**
6.3 Channel Bars: **Side**
6.4 Meander Migration:
6.5 Meander Width: Ratio: **0.0**
6.6 Wavelength: Ratio: **0.0**

Step 7. Windshield Survey

7.2 Bank Erosion: **0.00 ft.**
7.2 Bank Height: **0.00 ft.**
7.3 Ice/Debris Jam Potential: **Bridge**

4.1	4.2	4.3	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	6.6	7.2	7.3	Total
1	2	0	0	0	0	2	0	1	0	0	0	0	0	0	0	6
Low	High	N.S.	N.S.	N.S.	N.S.	High	N.S.	Low	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	

Richmond tribs

Phase 1 - Reach Summary Report

Basin: **Winooski**
Stream Name: **Jericho Road Tributary** Reach **R8.S2.05**
Topo Maps: **RICHMOND**
Date Last Edited: **Thu, September 27, 2007**
Watershed: **Winooski River**
Sub-watershed: **Winooski River -- Huntington River to mouth**
Is Reach an Impoundment? **No**

Step 1. Reach Location

1.1 Reach Description: **The reach extends 900 feet east from Jericho Road.**
1.2 Towns: **Richmond**
1.3 Downstream Latitude: **44.42**
1.3 Downstream Longitude: **-72.98**

Step 2. Stream Type

2.1 Elevation Upstream: **695**
2.1 Elevation Downstream: **680**
2.1 Is Gradient Gentle? **No**
2.2 Valley Length: **844** feet. **0.16** Miles.
2.3 Valley Slope: **1.78** %
2.4.Channel Length: **912** feet. **0.17** Miles.
2.5 Channel Slope: **1.64** %
2.6 Sinuosity: **1.08**
2.7 Watershed Area: **1** Square Miles
2.8 Channel Width: feet.
2.9 Valley Width: **244** feet.
2.10 Confinement Ratio: **0**
2.10 Confinement Type: **Very Broad**
2.11 Reference Stream Type: **C**
Bedform: **Riffle-Pool**
Sub-class Slope:
Bed Material: **Gravel**

Step 3. Basin Characteristics:

3.1 Alluvial Fan: **None**
3.2 Grade Control: **None**
3.3 Dominant Geologic Mat.: **Ice-Contact** **97.0**%
3.3 Sub-dominant Geological Mat.: **Glacial**
3.4 Left Valley Side
3.4 Right Valley Side **Very Steep Hilly**
3.5 Soils

Hydrologic Group:	**B**	**82.0** %
Flooding:	**None/Rare**	**100.** %
Water Table Deep:	**1.5**	**76.0** %
Water Table Shallow:	**0.5**	**76.0** %
Erodibility:	**High -**	**4.0** %

7.4 Comments:

Step 4. Land Cover - Reach Hydrology

4.1 Watershed
Historic Land Cover: **Crop**
Current Dominant land Cover: **Forest** **85.0** %
Current Sub-Dominant Land Cover: **Field**
4.2 Corridor
Historic Land Cover: **Crop**
Current Dominant land Cover: **Forest** **16.0** %
Current Sub-Dominant Land Cover: **Field**

4.3 Riparian Buffer	Left Bank	Right Bank
Dominant:	**>100**	**>100**
Sub-dominant:	**51-100**	**51-100**
Length w/ less than 25 ft.:	**0**	**0**

4.4 Ground Water Inputs: **Abundant**

Step 5. Instream Channel Modifications

5.1 Flow Regulation - (old):
Type: **None**
Use:
5.2 Bridges and Culverts: **0** **0** %
5.3 Bank Armoring: **0.0**
5.4 Channel Straightening: **360** **39 %**
5.5 Dredging History: **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads	One Side	Both Sides
Road:	**0.0** ft.	**0.0** ft.
Railroad:	**0.0** ft.	**0.0** ft.
Berm:	**0.0** ft.	**0.0** ft.
Improved Path:	**0.0** ft.	**0.0** ft.
Berms and Roads (old):	**0.0** ft.	**0.0**

6.2 Floodplain Development: **0.0** ft. **0.0**
6.3 Channel Bars: **Side**
6.4 Meander Migration:
6.5 Meander Width: **11.1** Ratio: **1.0**
6.6 Wavelength: **11.1** Ratio: **1.0**

Step 7. Windshield Survey

7.2 Bank Erosion: **0.00 ft.**
7.2 Bank Height: **0.00 ft.**
7.3 Ice/Debris Jam Potential: **Culvert**

4.1	4.2	4.3	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	6.6	7.2	7.3	Total
0 N.S.	1 Low	0 N.S.	0 N.S.	0 N.S.	0 N.S.	2 High	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	2 High	2 High	0 N.S.	0 N.S.	7

Richmond tribs

Phase 1 - Reach Summary Report

Basin: **Winooski**
Stream Name: **Unnamed Tributary** Reach **R8.S2.05-S1.01**
Topo Maps: **RICHMOND**
Date Last Edited: **Wed, September 19, 2007**
Watershed: **Winooski River**
Sub-watershed: **Winooski River -- Huntington River to mouth**
Is Reach an Impoundment? **No**

Step 1. Reach Location

1.1 Reach Description: **About 1000 feet east of Jericho Road in a mixed forest.**
1.2 Towns: **Richmond**
1.3 Downstream Latitude: **44.42**
1.3 Downstream Longitude: **-72.98**

Step 2. Stream Type

2.1 Elevation Upstream: **900**
2.1 Elevation Downstream: **695**
2.1 Is Gradient Gentle? **No**
2.2 Valley Length: **2600** feet. **0.49** Miles.
2.3 Valley Slope: **7.88** %
2.4.Channel Length: **2639** feet. **0.50** Miles.
2.5 Channel Slope: **7.77** %
2.6 Sinuosity: **1.02**
2.7 Watershed Area: **0** Square Miles
2.8 Channel Width: feet.
2.9 Valley Width: **15** feet.
2.10 Confinement Ratio: **0**
2.10 Confinement Type: **Narrowly Confined**
2.11 Reference Stream Type: **A**
Bedform: **Step-Pool**
Sub-class Slope:
Bed Material: **Cobble**

Step 3. Basin Characteristics:

3.1 Alluvial Fan: **None**
3.2 Grade Control: **None**
3.3 Dominant Geologic Mat.: **Till** **94.0**%
3.3 Sub-dominant Geological Mat.: **Ice-Contact**
3.4 Left Valley Side **Steep**
3.4 Right Valley Side **Very Steep**
3.5 Soils

Hydrologic Group:	**C**	**73.0** %
Flooding:	**None/Rare**	**100.** %
Water Table Deep:	**2.5**	**67.0** %
Water Table Shallow:	**1.5**	**67.0** %
Erodibility:	**High -**	**93.0** %

7.4 Comments:

Step 4. Land Cover - Reach Hydrology

4.1 Watershed
Historic Land Cover: **Forest**
Current Dominant land Cover: **Forest** **94.0** %
Current Sub-Dominant Land Cover:
4.2 Corridor
Historic Land Cover: **Field**
Current Dominant land Cover: **Forest** **53.0** %
Current Sub-Dominant Land Cover: **Field**

4.3 Riparian Buffer	Left Bank	Right Bank
Dominant:	**>100**	**>100**
Sub-dominant:	**None**	**51-100**
Length w/ less than 25 ft.:	**---**	**---**

4.4 Ground Water Inputs: **Minimal**

Step 5. Instream Channel Modifications

5.1 Flow Regulation - (old): **None**
Type:
Use:
5.2 Bridges and Culverts: **0** **0** %
5.3 Bank Armoring: **0.0**
5.4 Channel Straightening: **0.0**
5.5 Dredging History: **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads	One Side	Both Sides
Road:	ft.	ft.
Railroad:	ft.	ft.
Berm:	ft.	ft.
Improved Path:	ft.	ft.
Berms and Roads (old):	**0.0** ft.	**0.0**
6.2 Floodplain Development:	**0.0** ft.	**0.0**

6.3 Channel Bars: **Not Evaluated**
6.4 Meander Migration:
6.5 Meander Width: Ratio: **0.0**
6.6 Wavelength: Ratio: **0.0**

Step 7. Windshield Survey

7.2 Bank Erosion: **Not Evaluated**
7.2 Bank Height: **Not Evaluated**
7.3 Ice/Debris Jam Potential: **Not Evaluated**

4.1	4.2	4.3	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	6.6	7.2	7.3	Total
0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0

Richmond tribs

Phase 1 - Reach Summary Report

Basin: **Winooski**
Stream Name: **Jericho Road Tributary** Reach **R8.S2.06**
Topo Maps: **RICHMOND**
Date Last Edited: **Wed, September 19, 2007**
Watershed: **Winooski River**
Sub-watershed: **Winooski River -- Huntington River to mouth**
Is Reach an Impoundment? **No**

Step 1. Reach Location

1.1 Reach Description: **Small reach in mixed forest east of Jericho Rd. that has a farm field**
1.2 Towns: **Richmond**
1.3 Downstream Latitude: **44.42**
1.3 Downstream Longitude: **-72.98**

Step 2. Stream Type

2.1 Elevation Upstream: **1060**
2.1 Elevation Downstream: **695**
2.1 Is Gradient Gentle? **No**
2.2 Valley Length: **2768** feet. **0.52** Miles.
2.3 Valley Slope: **13.19** %
2.4.Channel Length: **2953** feet. **0.56** Miles.
2.5 Channel Slope: **12.36** %
2.6 Sinuosity: **1.07**
2.7 Watershed Area: **0** Square Miles
2.8 Channel Width: feet.
2.9 Valley Width: **15** feet.
2.10 Confinement Ratio: **0**
2.10 Confinement Type: **Narrowly Confined**
2.11 Reference Stream Type: **A**
Bedform: **Step-Pool**
Sub-class Slope:
Bed Material: **Cobble**

Step 3. Basin Characteristics:

3.1 Alluvial Fan: **None**
3.2 Grade Control: **None**
3.3 Dominant Geologic Mat.: **Till** **92.0**%
3.3 Sub-dominant Geological Mat.: **Ice-Contact**
3.4 Left Valley Side **Very Steep**
3.4 Right Valley Side **Very Steep**
3.5 Soils

Hydrologic Group:	**C**	**64.0** %
Flooding:	**None/Rare**	**100.** %
Water Table Deep:	**2.5**	**41.0** %
Water Table Shallow:	**2.0**	**52.0** %
Erodibility:	**High -**	**92.0** %

7.4 Comments:

Step 4. Land Cover - Reach Hydrology

4.1 Watershed
Historic Land Cover: **Shrub**
Current Dominant land Cover: **Forest** **86.0** %
Current Sub-Dominant Land Cover: **Crop**
4.2 Corridor
Historic Land Cover: **Field**
Current Dominant land Cover: **Forest** **60.0** %
Current Sub-Dominant Land Cover: **Crop**

4.3 Riparian Buffer	Left Bank	Right Bank
Dominant:	**>100**	**>100**
Sub-dominant:	**51-100**	**51-100**
Length w/ less than 25 ft.:	**---**	**---**

4.4 Ground Water Inputs: **Minimal**

Step 5. Instream Channel Modifications

5.1 Flow Regulation - (old): **None**
Type:
Use:
5.2 Bridges and Culverts: **0** **0** %
5.3 Bank Armoring: **0.0**
5.4 Channel Straightening: **0.0**
5.5 Dredging History: **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads	One Side	Both Sides
Road:	ft.	ft.
Railroad:	ft.	ft.
Berm:	ft.	ft.
Improved Path:	ft.	ft.
Berms and Roads (old):	**0.0** ft.	**0.0**
6.2 Floodplain Development:	**0.0** ft.	**0.0**

6.3 Channel Bars: **Not Evaluated**
6.4 Meander Migration:
6.5 Meander Width: Ratio: **0.0**
6.6 Wavelength: Ratio: **0.0**

Step 7. Windshield Survey

7.2 Bank Erosion: **Not Evaluated**
7.2 Bank Height: **Not Evaluated**
7.3 Ice/Debris Jam Potential: **Not Evaluated**

4.1	4.2	4.3	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	6.6	7.2	7.3	Total
1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Low	Low	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	

Richmond tribs

Phase 1 - Reach Summary Report

Basin: **Winooski**
Stream Name: **Stage Rd Tributary** Reach **R9.S2.01**
Topo Maps: **RICHMOND**
Date Last Edited: **Thu, September 27, 2007**
Watershed: **Winooski River**
Sub-watershed: **Winooski River -- Huntington River to mouth**
Is Reach an Impoundment? **No**

Step 1. Reach Location

1.1 Reach Description: **From confluence with the Winooski River to small neighborhood of of Richmond**
1.2 Towns:
1.3 Downstream Latitude: **44.38**
1.3 Downstream Longitude: **-72.94**

Step 2. Stream Type

2.1 Elevation Upstream: **315**
2.1 Elevation Downstream: **310**
2.1 Is Gradient Gentle? **No**
2.2 Valley Length: **781** feet. **0.15** Miles.
2.3 Valley Slope: **0.64** %
2.4.Channel Length: **933** feet. **0.18** Miles.
2.5 Channel Slope: **0.54** %
2.6 Sinuosity: **1.19**
2.7 Watershed Area: **1** Square Miles
2.8 Channel Width: feet.
2.9 Valley Width: **262** feet.
2.10 Confinement Ratio: **0**
2.10 Confinement Type: **Very Broad**
2.11 Reference Stream Type: **C**
Bedform: **Riffle-Pool**
Sub-class Slope:
Bed Material: **Gravel**

Step 3. Basin Characteristics:

3.1 Alluvial Fan: **None**
3.2 Grade Control: **None**
3.3 Dominant Geologic Mat.: **Alluvial** **95.0**%
3.3 Sub-dominant Geological Mat.: **Till**
3.4 Left Valley Side **Steep**
3.4 Right Valley Side **Extremely Steep**
3.5 Soils

Hydrologic Group:	**B**	**95.0** %
Flooding:	**Occasional**	**95.0** %
Water Table Deep:	**3.0**	**95.0** %
Water Table Shallow:	**1.5**	**95.0** %
Erodibility:	**High -**	**4.0** %

7.4 Comments:

Step 4. Land Cover - Reach Hydrology

4.1 Watershed
Historic Land Cover: **Crop**
Current Dominant land Cover: **Forest** **78.0** %
Current Sub-Dominant Land Cover: **Urban**
4.2 Corridor
Historic Land Cover: **Crop**
Current Dominant land Cover: **Urban** **56.0** %
Current Sub-Dominant Land Cover: **Field**

4.3 Riparian Buffer	Left Bank	Right Bank
Dominant:	**0-25**	**26-50**
Sub-dominant:	**26-50**	**51-100**
Length w/ less than 25 ft.:	**418**	**0**

4.4 Ground Water Inputs: **Abundant**

Step 5. Instream Channel Modifications

5.1 Flow Regulation - (old):
Type: **None**
Use:
5.2 Bridges and Culverts: **3** **14** %
5.3 Bank Armoring: **0.0**
5.4 Channel Straightening: **380** **40 %**
5.5 Dredging History: **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads	One Side	Both Sides
Road:	**0.0** ft.	**0.0** ft.
Railroad:	**0.0** ft.	**0.0** ft.
Berm:	**0.0** ft.	**0.0** ft.
Improved Path:	**0.0** ft.	**0.0** ft.
Berms and Roads (old):	**0.0** ft.	**0.0**

6.2 Floodplain Development: **0.0** ft. **0.0**
6.3 Channel Bars: **Multiple**
6.4 Meander Migration:
6.5 Meander Width: **15.3** Ratio: **1.0**
6.6 Wavelength: **15.3** Ratio: **1.0**

Step 7. Windshield Survey

7.2 Bank Erosion: **0.00 ft.**
7.2 Bank Height: **0.00 ft.**
7.3 Ice/Debris Jam Potential: **Culvert**

4.1	4.2	4.3	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	6.6	7.2	7.3	Total
2 High	2 High	2 High	0 N.S.	1 Low	0 N.S.	2 High	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	2 High	2 High	0 N.S.	0 N.S.	13

Richmond tribs

Phase 1 - Reach Summary Report

Basin: **Winooski**
Stream Name: **Stage Rd Tributary** Reach **R9.S2.02**
Topo Maps: **RICHMOND**
Date Last Edited: **Thu, September 27, 2007**
Watershed: **Winooski River**
Sub-watershed: **Winooski River -- Huntington River to mouth**
Is Reach an Impoundment? **No**

Step 1. Reach Location

1.1 Reach Description: **From reach break by small neighborhood to North of I-89.**
1.2 Towns: **Richmond**
1.3 Downstream Latitude: **44.38**
1.3 Downstream Longitude: **-72.94**

Step 2. Stream Type

2.1 Elevation Upstream: **355**
2.1 Elevation Downstream: **315**
2.1 Is Gradient Gentle? **No**
2.2 Valley Length: **635** feet. **0.12** Miles.
2.3 Valley Slope: **6.30** %
2.4.Channel Length: **636** feet. **0.12** Miles.
2.5 Channel Slope: **6.29** %
2.6 Sinuosity: **1.00**
2.7 Watershed Area: **1** Square Miles
2.8 Channel Width: feet.
2.9 Valley Width: **30** feet.
2.10 Confinement Ratio: **0**
2.10 Confinement Type: **Narrowly Confined**
2.11 Reference Stream Type: **A**
Bedform: **Step-Pool**
Sub-class Slope:
Bed Material: **Cobble**

Step 3. Basin Characteristics:

3.1 Alluvial Fan: **None**
3.2 Grade Control: **None**
3.3 Dominant Geologic Mat.: **Alluvial** **39.0**%
3.3 Sub-dominant Geological Mat.: **Till**
3.4 Left Valley Side **Extremely Steep**
3.4 Right Valley Side **Extremely Steep**
3.5 Soils

Hydrologic Group:	**D**	**57.0** %
Flooding:	**None/Rare**	**60.0** %
Water Table Deep:	**3.0**	**39.0** %
Water Table Shallow:	**1.5**	**40.0** %
Erodibility:	**High -**	**60.0** %

7.4 Comments:

Step 4. Land Cover - Reach Hydrology

4.1 Watershed
Historic Land Cover: **Field**
Current Dominant land Cover: **Forest** **79.0** %
Current Sub-Dominant Land Cover: **Urban**
4.2 Corridor
Historic Land Cover: **Shrub**
Current Dominant land Cover: **Urban** **78.0** %
Current Sub-Dominant Land Cover: **Crop**

4.3 Riparian Buffer	Left Bank	Right Bank
Dominant:	**26-50**	**26-50**
Sub-dominant:	**51-100**	**51-100**
Length w/ less than 25 ft.:	**0**	**0**

4.4 Ground Water Inputs: **Minimal**

Step 5. Instream Channel Modifications

5.1 Flow Regulation - (old):
Type: **None**
Use:
5.2 Bridges and Culverts: **2** **66** %
5.3 Bank Armoring: **0.0**
5.4 Channel Straightening: **606** **95 %**
5.5 Dredging History: **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads	One Side	Both Sides
Road:	**0.0** ft.	**0.0** ft.
Railroad:	**0.0** ft.	**0.0** ft.
Berm:	**0.0** ft.	**0.0** ft.
Improved Path:	**0.0** ft.	**0.0** ft.
Berms and Roads (old):	**0.0** ft.	**0.0**

6.2 Floodplain Development: **205** ft. **32 %**
6.3 Channel Bars: **Not Evaluated**
6.4 Meander Migration:
6.5 Meander Width: Ratio: **0.0**
6.6 Wavelength: Ratio: **0.0**

Step 7. Windshield Survey

7.2 Bank Erosion: **0.00 ft.**
7.2 Bank Height: **0.00 ft.**
7.3 Ice/Debris Jam Potential: **Culvert**

4.1	4.2	4.3	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	6.6	7.2	7.3	Total
2 High	2 High	0 N.S.	0 N.S.	2 High	0 N.S.	2 High	0 N.S.	0 N.S.	2 High	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	10

Richmond tribs

Phase 1 - Reach Summary Report

Basin: **Winooski**
Stream Name: **Stage Rd Tributary** Reach **R9.S2.03**
Topo Maps: **RICHMOND**
Date Last Edited: **Thu, September 27, 2007**
Watershed: **Winooski River**
Sub-watershed: **Winooski River -- Huntington River to mouth**
Is Reach an Impoundment? **No**

Step 1. Reach Location

1.1 Reach Description: **From reach break by I-89 to change in slope before a conifer stand**
1.2 Towns: **Richmond**
1.3 Downstream Latitude: **44.39**
1.3 Downstream Longitude: **-72.94**

Step 2. Stream Type

2.1 Elevation Upstream: **380**
2.1 Elevation Downstream: **355**
2.1 Is Gradient Gentle? **No**
2.2 Valley Length: **800** feet. **0.15** Miles.
2.3 Valley Slope: **3.13** %
2.4.Channel Length: **1046** feet. **0.20** Miles.
2.5 Channel Slope: **2.39** %
2.6 Sinuosity: **1.31**
2.7 Watershed Area: **1** Square Miles
2.8 Channel Width: feet.
2.9 Valley Width: **299** feet.
2.10 Confinement Ratio: **0**
2.10 Confinement Type: **Very Broad**
2.11 Reference Stream Type: **C**
Bedform: **Riffle-Pool**
Sub-class Slope: **b**
Bed Material: **Cobble**

Step 3. Basin Characteristics:

3.1 Alluvial Fan: **Yes**
3.2 Grade Control: **None**
3.3 Dominant Geologic Mat.: **Alluvial** **62.0**%
3.3 Sub-dominant Geological Mat.: **Till**
3.4 Left Valley Side **Steep**
3.4 Right Valley Side **Hilly**
3.5 Soils

Hydrologic Group:	**Not Rated**	**62.0** %
Flooding:	**Frequent**	**62.0** %
Water Table Deep:	**2.5**	**19.0** %
Water Table Shallow:	**1.5**	**19.0** %
Erodibility:	**High -**	**36.0** %

7.4 Comments:

Step 4. Land Cover - Reach Hydrology

4.1 Watershed
Historic Land Cover: **Shrub**
Current Dominant land Cover: **Forest** **81.0** %
Current Sub-Dominant Land Cover: **Urban**
4.2 Corridor
Historic Land Cover: **Field**
Current Dominant land Cover: **Urban** **68.0** %
Current Sub-Dominant Land Cover:

4.3 Riparian Buffer	Left Bank	Right Bank
Dominant:	**51-100**	**>100**
Sub-dominant:	**26-50**	**26-50**
Length w/ less than 25 ft.:	**116**	**0**

4.4 Ground Water Inputs: **Minimal**

Step 5. Instream Channel Modifications

5.1 Flow Regulation - (old):
Type: **None**
Use:
5.2 Bridges and Culverts: **1** **8** %
5.3 Bank Armoring: **0.0**
5.4 Channel Straightening: **425** **40 %**
5.5 Dredging History: **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads	One Side	Both Sides
Road:	**0.0** ft.	**0.0** ft.
Railroad:	**0.0** ft.	**0.0** ft.
Berm:	**0.0** ft.	**0.0** ft.
Improved Path:	**0.0** ft.	**0.0** ft.
Berms and Roads (old):	**0.0** ft.	**0.0**

6.2 Floodplain Development: **0.0** ft. **0.0**
6.3 Channel Bars: **Multiple**
6.4 Meander Migration:
6.5 Meander Width: **15.0** Ratio: **1.0**
6.6 Wavelength: **15.0** Ratio: **1.0**

Step 7. Windshield Survey

7.2 Bank Erosion: **0.00 ft.**
7.2 Bank Height: **0.00 ft.**
7.3 Ice/Debris Jam Potential: **Culvert**

4.1	4.2	4.3	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	6.6	7.2	7.3	Total
1 Low	2 High	0 N.S.	0 N.S.	1 Low	0 N.S.	2 High	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	2 High	2 High	0 N.S.	0 N.S.	10

Richmond tribs

Phase 1 - Reach Summary Report

Basin: **Winooski**
Stream Name: **Stage Rd Tributary** Reach **R9.S2.04**
Topo Maps: **RICHMOND**
Date Last Edited: **Thu, September 27, 2007**
Watershed: **Winooski River**
Sub-watershed: **Winooski River -- Huntington River to mouth**
Is Reach an Impoundment? **No**

Step 1. Reach Location

1.1 Reach Description: **From lower reach break the channel parallels Stage Rd. up to the**
1.2 Towns: **Richmond**
1.3 Downstream Latitude: **44.39**
1.3 Downstream Longitude: **-72.93**

Step 2. Stream Type

2.1 Elevation Upstream: **620**
2.1 Elevation Downstream: **380**
2.1 Is Gradient Gentle? **No**
2.2 Valley Length: **3072** feet. **0.58** Miles.
2.3 Valley Slope: **7.81** %
2.4.Channel Length: **3140** feet. **0.59** Miles.
2.5 Channel Slope: **7.64** %
2.6 Sinuosity: **1.02**
2.7 Watershed Area: **1** Square Miles
2.8 Channel Width: feet.
2.9 Valley Width: **20** feet.
2.10 Confinement Ratio: **0**
2.10 Confinement Type: **Narrowly Confined**
2.11 Reference Stream Type: **A**
Bedform: **Cascade**
Sub-class Slope:
Bed Material: **Bedrock**

Step 3. Basin Characteristics:

3.1 Alluvial Fan: **None**
3.2 Grade Control: **Multiple**
3.3 Dominant Geologic Mat.: **Till** **89.0**%
3.3 Sub-dominant Geological Mat.: **Alluvial**
3.4 Left Valley Side **Very Steep**
3.4 Right Valley Side **Very Steep**
3.5 Soils

Hydrologic Group:	**C**	**57.0** %
Flooding:	**None/Rare**	**91.0** %
Water Table Deep:	**2.5**	**57.0** %
Water Table Shallow:	**1.5**	**57.0** %
Erodibility:	**High -**	**90.0** %

7.4 Comments:

Step 4. Land Cover - Reach Hydrology

4.1 Watershed
Historic Land Cover: **Shrub**
Current Dominant land Cover: **Forest** **82.0** %
Current Sub-Dominant Land Cover: **Urban**
4.2 Corridor
Historic Land Cover: **Shrub**
Current Dominant land Cover: **Urban** **61.0** %
Current Sub-Dominant Land Cover: **Forest**

4.3 Riparian Buffer	Left Bank	Right Bank
Dominant:	**>100**	**>100**
Sub-dominant:	**51-100**	**51-100**
Length w/ less than 25 ft.:	**0**	**0**

4.4 Ground Water Inputs: **None**

Step 5. Instream Channel Modifications

5.1 Flow Regulation - (old):
Type: **None**
Use:
5.2 Bridges and Culverts: **3** **6** %
5.3 Bank Armoring: **0.0**
5.4 Channel Straightening: **0.0** **0.0**
5.5 Dredging History: **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads	One Side	Both Sides
Road:	**0.0** ft.	**0.0** ft.
Railroad:	**0.0** ft.	**0.0** ft.
Berm:	**0.0** ft.	**0.0** ft.
Improved Path:	**0.0** ft.	**0.0** ft.
Berms and Roads (old):	**324** ft.	**10 %**

6.2 Floodplain Development: **114.0** ft. **3 %**
6.3 Channel Bars: **Side**
6.4 Meander Migration:
6.5 Meander Width: Ratio: **0.0**
6.6 Wavelength: Ratio: **0.0**

Step 7. Windshield Survey

7.2 Bank Erosion: **0.00 ft.**
7.2 Bank Height: **0.00 ft.**
7.3 Ice/Debris Jam Potential: **Culvert**

4.1	4.2	4.3	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	6.6	7.2	7.3	Total
1 Low	2 High	0 N.S.	0 N.S.	1 Low	0 N.S.	0 N.S.	0 N.S.	0 N.S.	1 Low	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	5

Richmond tribs

Phase 1 - Reach Summary Report

Basin: **Winooski**
Stream Name: **Unnamed Tributary** Reach **R9.S2.04-S1.01**
Topo Maps: **RICHMOND**
Date Last Edited: **Wed, September 19, 2007**
Watershed: **Winooski River**
Sub-watershed: **Winooski River -- Huntington River to mouth**
Is Reach an Impoundment? **No**

Step 1. Reach Location

1.1 Reach Description: **From just east of Stage Rd. where it intersects Blue Rock Rd. up to Bolton, Richmond**
1.2 Towns:
1.3 Downstream Latitude: **44.40**
1.3 Downstream Longitude: **-72.93**

Step 2. Stream Type

2.1 Elevation Upstream: **1400**
2.1 Elevation Downstream: **620**
2.1 Is Gradient Gentle? **No**
2.2 Valley Length: **7444** feet. **1.41** Miles.
2.3 Valley Slope: **10.48** %
2.4.Channel Length: **7721** feet. **1.46** Miles.
2.5 Channel Slope: **10.10** %
2.6 Sinuosity: **1.04**
2.7 Watershed Area: **0** Square Miles
2.8 Channel Width: feet.
2.9 Valley Width: **18** feet.
2.10 Confinement Ratio: **0**
2.10 Confinement Type: **Narrowly Confined**
2.11 Reference Stream Type: **A**
Bedform: **Step-Pool**
Sub-class Slope:
Bed Material: **Cobble**

Step 3. Basin Characteristics:

3.1 Alluvial Fan: **None**
3.2 Grade Control: **None**
3.3 Dominant Geologic Mat.: **Till** **99.0**%
3.3 Sub-dominant Geological Mat.:
3.4 Left Valley Side **Extremely Steep**
3.4 Right Valley Side **Steep**
3.5 Soils

Hydrologic Group:	**D**	**79.0** %
Flooding:	**None/Rare**	**100.** %
Water Table Deep:	**6.0**	**79.0** %
Water Table Shallow:	**2.0**	**79.0** %
Erodibility:	**High -**	**99.0** %

7.4 Comments:

Step 4. Land Cover - Reach Hydrology

4.1 Watershed
Historic Land Cover: **Shrub**
Current Dominant land Cover: **Forest** **89.0** %
Current Sub-Dominant Land Cover: **Urban**
4.2 Corridor
Historic Land Cover: **Shrub**
Current Dominant land Cover: **Forest** **63.0** %
Current Sub-Dominant Land Cover: **Urban**

4.3 Riparian Buffer	Left Bank	Right Bank
Dominant:	**>100**	**>100**
Sub-dominant:	**None**	**None**
Length w/ less than 25 ft.:	**---**	**---**

4.4 Ground Water Inputs: **Minimal**

Step 5. Instream Channel Modifications

5.1 Flow Regulation - (old): **None**
Type:
Use:
5.2 Bridges and Culverts: **0** **0** %
5.3 Bank Armoring: **0.0**
5.4 Channel Straightening: **0.0**
5.5 Dredging History: **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads	One Side	Both Sides
Road:	ft.	ft.
Railroad:	ft.	ft.
Berm:	ft.	ft.
Improved Path:	ft.	ft.
Berms and Roads (old):	**0.0** ft.	**0.0**
6.2 Floodplain Development:	**0.0** ft.	**0.0**

6.3 Channel Bars: **Mid-channel**
6.4 Meander Migration:
6.5 Meander Width: Ratio: **0.0**
6.6 Wavelength: Ratio: **0.0**

Step 7. Windshield Survey

7.2 Bank Erosion: **None**
7.2 Bank Height: **No Data**
7.3 Ice/Debris Jam Potential: **None**

4.1	4.2	4.3	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	6.6	7.2	7.3	Total
0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0

Richmond tribs

Phase 1 - Reach Summary Report

Basin: **Winooski**
Stream Name: **Stage Rd Tributary** Reach **R9.S2.05**
Topo Maps: **RICHMOND**
Date Last Edited: **Thu, September 27, 2007**
Watershed: **Winooski River**
Sub-watershed: **Winooski River -- Huntington River to mouth**
Is Reach an Impoundment? **No**

Step 1. Reach Location

1.1 Reach Description: **From the east side of Stage Rd. where it intersects Blue Rock Rd. up**
1.2 Towns: **Richmond**
1.3 Downstream Latitude: **44.40**
1.3 Downstream Longitude: **-72.93**

Step 2. Stream Type

2.1 Elevation Upstream: **860**
2.1 Elevation Downstream: **620**
2.1 Is Gradient Gentle? **No**
2.2 Valley Length: **2353** feet. **0.45** Miles.
2.3 Valley Slope: **10.20** %
2.4.Channel Length: **2366** feet. **0.45** Miles.
2.5 Channel Slope: **10.14** %
2.6 Sinuosity: **1.01**
2.7 Watershed Area: **1** Square Miles
2.8 Channel Width: feet.
2.9 Valley Width: **15** feet.
2.10 Confinement Ratio: **0**
2.10 Confinement Type: **---**
2.11 Reference Stream Type: **A**
Bedform: **Step-Pool**
Sub-class Slope:
Bed Material: **Cobble**

Step 3. Basin Characteristics:

3.1 Alluvial Fan: **None**
3.2 Grade Control: **None**
3.3 Dominant Geologic Mat.: **Till** **99.0**%
3.3 Sub-dominant Geological Mat.:
3.4 Left Valley Side **Steep**
3.4 Right Valley Side **Hilly**
3.5 Soils

Hydrologic Group:	**D**	**53.0** %
Flooding:	**None/Rare**	**100.** %
Water Table Deep:	**2.0**	**50.0** %
Water Table Shallow:	**0.0**	**50.0** %
Erodibility:	**High -**	**99.0** %

7.4 Comments:

Step 4. Land Cover - Reach Hydrology

4.1 Watershed
Historic Land Cover: **Shrub**
Current Dominant land Cover: **Forest** **81.0** %
Current Sub-Dominant Land Cover: **Urban**
4.2 Corridor
Historic Land Cover: **Forest**
Current Dominant land Cover: **Forest** **68.0** %
Current Sub-Dominant Land Cover: **Urban**

4.3 Riparian Buffer	Left Bank	Right Bank
Dominant:	**>100**	**>100**
Sub-dominant:	**51-100**	**51-100**
Length w/ less than 25 ft.:	**0**	**0**

4.4 Ground Water Inputs: **None**

Step 5. Instream Channel Modifications

5.1 Flow Regulation - (old):
Type: **None**
Use:
5.2 Bridges and Culverts: **1** **4** %
5.3 Bank Armoring: **0 %**
5.4 Channel Straightening: **0.0** **0.0**
5.5 Dredging History: **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads	One Side	Both Sides
Road:	**0.0** ft.	**0.0** ft.
Railroad:	**0.0** ft.	**0.0** ft.
Berm:	**0.0** ft.	**0.0** ft.
Improved Path:	**0.0** ft.	**0.0** ft.
Berms and Roads (old):	**276** ft.	**11 %**

6.2 Floodplain Development: **0.0** ft. **0.0**
6.3 Channel Bars: **Mid-channel**
6.4 Meander Migration:
6.5 Meander Width: Ratio: **0.0**
6.6 Wavelength: Ratio: **0.0**

Step 7. Windshield Survey

7.2 Bank Erosion: **0.00 ft.**
7.2 Bank Height: **0.00 ft.**
7.3 Ice/Debris Jam Potential: **Culvert**

4.1	4.2	4.3	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	6.6	7.2	7.3	Total
2 High	2 High	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	1 Low	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	5

Richmond tribs

Phase 1 - Reach Summary Report

Basin: **Winooski**
Stream Name: **Stage Rd Tributary** Reach **R9.S2.06**
Topo Maps: **RICHMOND**
Date Last Edited: **Thu, September 27, 2007**
Watershed: **Winooski River**
Sub-watershed: **Winooski River -- Huntington River to mouth**
Is Reach an Impoundment? **No**

Step 1. Reach Location

1.1 Reach Description: **Less confined stretch on west side of Stage road.**
1.2 Towns: **Richmond**
1.3 Downstream Latitude: **44.40**
1.3 Downstream Longitude: **-72.93**

Step 2. Stream Type

2.1 Elevation Upstream: **900**
2.1 Elevation Downstream: **860**
2.1 Is Gradient Gentle? **No**
2.2 Valley Length: **1138** feet. **0.22** Miles.
2.3 Valley Slope: **3.51** %
2.4.Channel Length: **1300** feet. **0.25** Miles.
2.5 Channel Slope: **3.08** %
2.6 Sinuosity: **1.14**
2.7 Watershed Area: **0** Square Miles
2.8 Channel Width: feet.
2.9 Valley Width: **120** feet.
2.10 Confinement Ratio: **0**
2.10 Confinement Type: **Very Broad**
2.11 Reference Stream Type: **C**
Bedform: **Riffle-Pool**
Sub-class Slope: **b**
Bed Material: **Cobble**

Step 3. Basin Characteristics:

3.1 Alluvial Fan: **None**
3.2 Grade Control: **None**
3.3 Dominant Geologic Mat.: **Till** **99.0**%
3.3 Sub-dominant Geological Mat.:
3.4 Left Valley Side **Very Steep**
3.4 Right Valley Side **Steep**
3.5 Soils

Hydrologic Group:	**D**	**100.** %
Flooding:	**None/Rare**	**100.** %
Water Table Deep:	**6.0**	**70.0** %
Water Table Shallow:	**2.0**	**70.0** %
Erodibility:	**High -**	**100.** %

7.4 Comments:

Step 4. Land Cover - Reach Hydrology

4.1 Watershed
Historic Land Cover: **Forest**
Current Dominant land Cover: **Forest** **87.0** %
Current Sub-Dominant Land Cover: **Urban**
4.2 Corridor
Historic Land Cover: **Shrub**
Current Dominant land Cover: **Forest** **63.0** %
Current Sub-Dominant Land Cover: **Urban**

4.3 Riparian Buffer	Left Bank	Right Bank
Dominant:	**>100**	**>100**
Sub-dominant:	**51-100**	**None**
Length w/ less than 25 ft.:	**0**	**0**

4.4 Ground Water Inputs: **None**

Step 5. Instream Channel Modifications

5.1 Flow Regulation - (old):
Type: **None**
Use:
5.2 Bridges and Culverts: **1** **4** %
5.3 Bank Armoring: **0.0**
5.4 Channel Straightening: **0.0** **0.0**
5.5 Dredging History: **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads	One Side	Both Sides
Road:	**0.0** ft.	**0.0** ft.
Railroad:	**0.0** ft.	**0.0** ft.
Berm:	**0.0** ft.	**0.0** ft.
Improved Path:	**0.0** ft.	**0.0** ft.
Berms and Roads (old):	**0.0** ft.	**0.0**

6.2 Floodplain Development: **0.0** ft. **0.0**
6.3 Channel Bars: **Not Evaluated**
6.4 Meander Migration:
6.5 Meander Width: **30.0** Ratio: **3.7**
6.6 Wavelength: **180.0** Ratio: **22.5**

Step 7. Windshield Survey

7.2 Bank Erosion: **0.00 ft.**
7.2 Bank Height: **0.00 ft.**
7.3 Ice/Debris Jam Potential: **Not Evaluated**

4.1	4.2	4.3	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	6.6	7.2	7.3	Total
1	2	0	0	0	0	0	0	0	0	0	0	1	2	0	0	6
Low	High	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	Low	High	N.S.	N.S.	

Richmond tribs

Phase 1 - Reach Summary Report

Basin: **Winooski**
Stream Name: **Stage Rd Tributary** Reach **R9.S2.07**
Topo Maps: **RICHMOND**
Date Last Edited: **Thu, September 27, 2007**
Watershed: **Winooski River**
Sub-watershed: **Winooski River -- Huntington River to mouth**
Is Reach an Impoundment? **No**

Step 1. Reach Location

1.1 Reach Description: **Follows Stage Rd. up to headwaters.**
1.2 Towns: **Richmond**
1.3 Downstream Latitude: **44.40**
1.3 Downstream Longitude: **-72.93**

Step 2. Stream Type

2.1 Elevation Upstream: **1000**
2.1 Elevation Downstream: **900**
2.1 Is Gradient Gentle? **No**
2.2 Valley Length: **1800** feet. **0.34** Miles.
2.3 Valley Slope: **5.56** %
2.4.Channel Length: **1853** feet. **0.35** Miles.
2.5 Channel Slope: **5.40** %
2.6 Sinuosity: **1.03**
2.7 Watershed Area: **0** Square Miles
2.8 Channel Width: feet.
2.9 Valley Width: **20** feet.
2.10 Confinement Ratio: **0**
2.10 Confinement Type: **Semi-confined**
2.11 Reference Stream Type: **B**
Bedform: **Step-Pool**
Sub-class Slope: **a**
Bed Material: **Cobble**

Step 3. Basin Characteristics:

3.1 Alluvial Fan: **None**
3.2 Grade Control: **None**
3.3 Dominant Geologic Mat.: **Till** **65.0**%
3.3 Sub-dominant Geological Mat.: **Other**
3.4 Left Valley Side **Extremely Steep**
3.4 Right Valley Side **Extremely Steep**
3.5 Soils

Hydrologic Group:	**D**	**100.** %
Flooding:	**None/Rare**	**100.** %
Water Table Deep:	**6.0**	**65.0** %
Water Table Shallow:	**2.0**	**65.0** %
Erodibility:	**High -**	**65.0** %

7.4 Comments:

Step 4. Land Cover - Reach Hydrology

4.1 Watershed
Historic Land Cover: **Forest**
Current Dominant land Cover: **Forest** **87.0** %
Current Sub-Dominant Land Cover: **Urban**
4.2 Corridor
Historic Land Cover: **Shrub**
Current Dominant land Cover: **Urban** **41.0** %
Current Sub-Dominant Land Cover: **Forest**

4.3 Riparian Buffer	Left Bank	Right Bank
Dominant:	**51-100**	**51-100**
Sub-dominant:	**26-50**	**0-25**
Length w/ less than 25 ft.:	**303**	**0**

4.4 Ground Water Inputs: **Abundant**

Step 5. Instream Channel Modifications

5.1 Flow Regulation - (old):
Type: **None**
Use:
5.2 Bridges and Culverts: **1** **2** %
5.3 Bank Armoring: **0.0**
5.4 Channel Straightening: **0.0** **0.0**
5.5 Dredging History: **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads	One Side	Both Sides
Road:	**325** ft.	**0.0** ft.
Railroad:	**0.0** ft.	**0.0** ft.
Berm:	**0.0** ft.	**0.0** ft.
Improved Path:	**0.0** ft.	**0.0** ft.
Berms and Roads (old):	**83** ft.	**4 %**

6.2 Floodplain Development: **325** ft. **17 %**
6.3 Channel Bars: **Not Evaluated**
6.4 Meander Migration:
6.5 Meander Width: Ratio: **0.0**
6.6 Wavelength: Ratio: **0.0**

Step 7. Windshield Survey

7.2 Bank Erosion: **0.00 ft.**
7.2 Bank Height: **0.00 ft.**
7.3 Ice/Debris Jam Potential: **None**

4.1	4.2	4.3	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	6.6	7.2	7.3	Total
1	2	1	0	0	0	0	0	1	0	0	0	0	0	0	0	5
Low	High	Low	N.S.	N.S.	N.S.	N.S.	N.S.	Low	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	

APPENDIX D

QA/QC SUMMARY

To: Evan Fitzgerald, Fitzgerald Environmental Associates
From: Sacha Pealer, VT DEC River Management
Date: 8/31/07

Richmond Tributaries Phase 1 QA, check 2

Preliminary Reference Stream Type

As you noted previously, there appear to be several reaches in the project area that are either reference stream type A or B, with slope indicating one type and confinement another. In this case, it might be helpful to use subclass slopes or to evaluate the confidence you have in confinement ratios/types. Also, if you observed specific characteristics of a reach in the field that influence your choice of stream type, please describe these in your response. Consider how much of the reach you were able to see. Comments from Evan Fitzgerald in red.

- R8S1.04S1.01. Stream type A with semi-confined (SC) valley is atypical (see Table 2.2, phase 1 protocols, May 2007). Type A streams tend to be narrowly confined (NC). Slope of 12.84% and sinuousity <1.2 (in an area that on topomaps and orthos does not appear straightened) support the type A classification. However, the confinement "trumps" these other factors, suggesting stream type B. This hinges on the accuracy of the valley width. If the slope was not greater than 9.9%, I might suggest Ba. Please comment on your confidence in the confinement ratio.
  I observed the valley width in the field in lower reach to be no less than 20 ft, which would make it SC. However, the steeper sections I did not see are likely more confined. Changed valley width to 14 ft. to make it NC.
- R8S1.04S1.02. As with R8S1.04S1.01, the SC confinement type does not match stream type A. This reach has a lower slope (4.99) although it's still in the A range. It also has a greater chance of having been straightened, so sinuosity may be less helpful. If you are confident in the confinement data, and wish to keep SC, I suggest changing stream type to Ba.
  As with above, upper reach appeared to be less confined in the field (SC type). I am more confident with original confinement on this reach and have changed stream type to Ba.
- R8S1.06. With 5.88% slope, I suggest adding subclass slope to make this stream type Ba. Also, should metadata for 2.11 indicate field observation?
  Changed to Ba per field observation. Metadata updated to indicate it was observed in field.
- R8S1.08. If you are confident in your confinement of SC (and that this is type B and not type A), then I suggest stream type Ba due to slope.
  I could not take any photos of this reach due to property access, but observations suggest that much of reach is B-type. Added subslope a for slope.
- R8.S2.02. Same comment as R8S1.08.
  Many field observations along this reach (and photos). B-type kept with subslope a.
- R8S2.02S1.01. Another A stream with SC confinement type. If you go with this confinement, I suggest Ba.

Valley observed in field was narrower than measure on topo. Have changed confinement to match field observations.

- R8S2.03. Same comment as R8S1.08.
  Many field observations along this reach (and photos). B-type kept with subslope a.
- R8S2.03S1.01. Same comment as R8S1.08.
  Valley observed in field was narrower than measure on topo. Have changed confinement to match field observations.
- R8S2.04. Same comment as R8S1.08.
  Many field observations along this reach (and photos). B-type kept with subslope a.
- R8S2.05S1.01. As I'm sure you know, it's very tough to measure valley width from topos on a stream of this size without overestimating. Stream type A with NW confinement is atypical. Do you think confinement should actually be NC, since slope, sinuousity, and position in the watershed all support an A stream type?
  Agree. Valley width updated to 15ft for NC.
- R8S2.06. Another A stream with SC confinement type. The slope (12.36) certainly indicates an A stream. Since this reach's valley width had to be measured from topos, do think it's possible confinement is actually NC?
  Agree. Valley width updated to 15ft for NC.
- R9S2.02. Revisit metadata. Step 2.9 valley width indicates you measured valley width in the field. Your step 2.11 metadata suggest you were not in the field. I wonder, how confident are you in your confinement ratio, that this is a B stream and not an A stream, even though slope is 6.29%?
  Metadata revised – I did not see this reach in the field. Valley width revised to 30ft for narrow confinement on A type.
- R9S2.04. Should metadata for 2.11 indicate field observation?
  Yes! Revised metadata.
- R9S2.04S1.01. With a slope of 10.10%, stream type A seems more likely than B. What characteristics lead you to choose type B? Are you confident in the confinement type? Do you think what you saw/measured is representative of the whole reach?
  Only the lower portion of the reach observed, where B-type geometry was seen. However, middle/upper reach is likely A-type, and channel/confinement data have been revised to reflect entire reach slope, etc.
- R9S2.06. Why do you think reference bedform is planebed?
  Often an unconfined C-type stream with a slope >3% does not exhibit pool-riffle morphology (see Fig. 6 in Montgomery and Buffington, 1997). I did not see this reach in the field, but its sinuosity is low despite the VB confinement. I am fine with calling it pool-riffle until bedform is observed in field. Changed in DMS.
- R9S2.07. If you are confident in your confinement of NW (and that this is type B and not type A), then I suggest stream type Ba due to slope.
  Valley width remeasured and confinement changed to SC with Ba.

To: Evan Fitzgerald, Fitzgerald Environmental Associates
From: Sacha Pealer, VT DEC River Management
Date: 9/17/07

Richmond Tributaries Phase 1 QA, check 3

This document includes quality assurance notes for phase 1 steps 3 through 7. The notes are in order by step, then reach. **Comments from Evan Fitzgerald in red.**

3.1 Alluvial Fans

- Do you think an alluvial fan is possible in R8S2.01? Note broad terracing of alluvial material on both sides of reach as valley widens. Upstream reach is much more steep and confined. **Yes, there is a possibility of an (inactive) alluvial fan here. It is worth noting in the DMS.**
- R9S2.01. Possible alluvial fan. **With this reach located in the more recent (Holocene) alluvial zone of the Winooski, it is not likely an alluvial fan created by this trib.**
- R9S2.03. Possible alluvial fan. **Yes, there is a possibility of an active alluvial fan here, given the setting and channel planform. It is worth noting in the DMS.**

3.4 Valley Side Slope

- R8S1.01. Not sure how the right slope is "extremely steep." I measure it at hilly or steep at most. **VT YDRODEM data was used to create contours which reflect current valley characteristics due to I-89 side slope.**

4.3 Riparian Buffer

- R8S1.03. On the right buffer, you might go lower than 51-100 for dominant due to road and development on lower portion of reach. Even if you decide to stick with 51-100 for dominant, I suggest changing subdominant; I do not think it is >100 ft. **Changed to 26-50 dominant and 51-100 subdominant.**
- R8S2.01. Do you think there might be more "buffer less than 25ft" on this reach? And did you mean to index only for the left side? Hard for me to tell from the orthos whether there are fallow fields in this location; maybe you have a better sense from field visits. **Additional areas for buffer < 25' added for right banks in lower reach.**
- R8S2.02S1.01. It appears on orthos that there is less than 25 ft of buffer on the uppermost portion of this reach. Were you able to see if a channel was present here? Was it buffered? If not, you would need to index. **This area is buffered more than 25' with unmanaged vegetation.**
- R9S2.07. You've indexed 303 ft of this reach as having <25 ft buffers on the right side. Did you mean to say it's on the left side? **Yes, corrected in FIT.**

4.4 Groundwater inputs

- R8S1.04. Consider "minimum" rather than "none" due to wetlands inventory data. **There are no NWI wetlands mapped in the vicinity of this reach.**
- R8S1.04S1.01. Consider "minimum" rather than "none" due adjacent minor trib. **Changed to minimum.**

- R8S2.05S1.01. Consider “minimum” rather than “none” due adjacent minor trib. **Changed to minimum.**
- R8S2.06. Consider “minimum” rather than “none” due adjacent minor tribs. **Changed to minimum.**

5.1 Flow Regulation

- Have you checked with Water Supply or Facilities Engineering about flow regulation types? All of the reaches currently say “none” for flow type. Are you confident in these types? **Checked with Steve Bushman and Jeff Cueto in Dam Safety and Hydrology and there are no data on flow regulations for these tributaries**

5.2 Bridges-Culverts

- R8S1.01. You’ve got 3 crossings indexed on this reach. Counting the two interstate bridges, I see 5 crossings. Why did you index only three? **The I-89 crossings are elevated well above ground – no bridges/culverts present.**
- R8S1.02. I think there might be two road crossings at the gravel pit, possibly bridges or culverts. Did you forget to index these? **Updated in FIT.**
- R8S1.04S1.01. The e911 data and orthos indicate a possible road crossing ~ 420 ft upstream of the downstream reach break (unnamed road?). Did you mean to index this bridge/culvert? **No. Will update and enter unknown.**
- R8S1.05. Appears to be a driveway crossing roughly 50 ft above the lower reach break. Please index. **Yes, this should be indexed. Updated in FIT.**
- R8S1.07. Why did you select “No Data”? With orthos and topos for metadata, I think you can say “None”. **Updated.**
- R8S1.08. Orthos suggest three driveway crossings on upper portion of the reach (for the houses situated just south of the stream line). Suggest indexing. **Updated in FIT.**
- R8S2.02. Please index both the interstate bridges as separate points. **There is a single culvert under both I-89 lanes, not two.**
- R8S2.02S1.01. I think you missed a driveway crossing about 140 ft downstream from the crossing you already indexed. **Yes, updated in FIT.**
- R9S2.01. Another missed driveway about 160ft below the upper reach break. **Yes, updated in FIT.**
- R9S2.02. Please index both the interstate bridges as separate points. **There is a single culvert under both I-89 lanes, not two.**
- I suspect another driveway crossing about 1150ft below the upper reach break. **Indexed.**

5.3 Bank Armoring

- Can you confirm that you found no bank armoring in the project area? **After reviewing photos, I observed only one small bank armoring area on R9.S2.05. Added to FIT.**

5.4 Channel Straightening

- R8S1.01. I wonder if there should be more straightening associated with the interstate bridges, roadroad, etc. I suspect the stream was straightened to accommodate those multiple crossings in a short area. What do you think? **Agree. Small area of straightening added to FIT.**

- R8S2.05. I suspect this reach was partially straightened to create the pond. USGS topos indicate the pond is an added feature. Consider indexing straightening on this reach. **Agree. Area of straightening added to FIT.**
- R9S2.01. This reach could use more straightening also, especially near the confluence with the Winooski, where Main Street and the railroad cross the stream. It seems likely that more than 50 % of this reach has been straightened. **Agree. Large area of straightening added to FIT.**

5.5 Dredging

- Please confirm that interviews with DEC stream alt engineers did not yield new information on dredging history (ie, all available information indicates the history is "None" for all reaches). **No information available for these small tributaries according to Chris Brunelle.**

6.3 Depositional Features

- Data indicate that depositional features were not evaluated for the following reaches: R8S1.04, R8S1.04S1.01, R8S1.06, R8S1.07, R8S1.08, R8S2.05S1.01, R8S2.06, R9S2.02, R9S2.06, and R9S2.07. Please select "Not Evaluated" for the 6.3 metadata on these reaches. **Updated in DMS.**

6.5/ 6.6 Meander Geometry

- R8S1.03. Your average meander wavelength of 350 ft seems high to me. I couldn't get more than 250 ft average. Please revisit this reach. **Updated to 250'.**
- R8S1.07. I took measurements on this reach, including meanders in the upper portion of the reach (where you didn't) and ended up with an average belt width of 43 ft (ratio 3.7, impact Low) and an average wavelength of 71.8 ft (ratio 6.2, impact Low). Please have a look at this reach again and see what you think. **OK. Updated to 43' and 72' in DMS.**
- R8S2.05. It's possible this reach was straightened to create the pond. The meanders are only at the lower portion of the reach. Consider entering the step 2.8 channel width for both average belt width and average wavelength. **OK. Updated in DMS.**
- R9S2.01. Suggest entering channel width for both average belt width and average wavelength. The reach is likely >50% straightened. **Agree. Updated in DMS.**
- R9S2.02. Meander geometry should be Not Applicable for this reach because it is stream type A. **OK. Updated in DMS.**