PHASE I STREAM GEOMORPHIC ASSESSMENT

Conducted on the Upper Otter Creek

by the RUTLAND REGIONAL PLANNING COMMISSION,
and HILARY SOLOMON

with support from
the RUTLAND NATURAL RESOURCE CONSERVATION DISTRICT,
the UPPER OTTER CREEK WATERSHED COUNCIL

REPORT and DATA

Study Completed between January, 2005 and September, 2005
Report Completed between October, 2005 and November, 2005

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FIGURES

SPECIAL THANKS to Mary Trombley, Jami Westerhold and Steve Schild, Rutland Regional Planning Commission; Fred Nicholson, Vermont DEC Stream Alterations Engineer; Kristen Underwood, South Mountain Research and Consulting and Shannon Hill, Vermont DEC River Management Section, for project technical support and quality assurance.

INTRODUCTION

Fluvial geomorphology is the study of the interaction between streams and the landscape through which they travel. The phase 1 geomorphic assessment specifically looked at how changes on the landscape have translated to potential changes within the Otter Creek stream channel. This study was completed through use of remote sensing tools such as maps, public records and files, aerial and orthophotos and digital mapping programs to survey the mainstem of the Otter Creek in Rutland County.

This study was conducted using the Vermont Geomorphic Assessment Protocols (April, 2004), which were designed to standardize geomorphic assessments conducted by different organizations around the state. Steps 1-4 of this study looked at deterministic watershed characteristics such as valley width, stream channel slope and prevailing soil types. Steps 5 and 6 looked at changes that have occurred on the landscape through human activities such as development, berms and roads and rip-rap placed along the creeks. Step 7 included a field survey of the Otter (reaches 14-33) during the 2004 buffer assessment. Information from the field survey was to verify the remote sensing information used in this assessment.

An additional and more in-depth field survey, or a phase 2 geomorphic survey, was conducted on selected reaches of the study area during November, 2005. For more information on the phase 2 field survey, please contact the Rutland Natural Resource Conservation District (RNRCD).

Results from both the phase 1 and phase 2 studies will provide much needed baseline data about the current conditions in the Upper Otter Creek subwatershed. In addition, the Addison County Regional Planning Commission is currently completing a Phase 1 assessment of the lower portion of the Otter Creek as well as many of its tributaries. This data will be used to provide recommendations for future restoration project locations, planning decisions, tree planting sites and the types of restoration projects that may be successful along the creek.

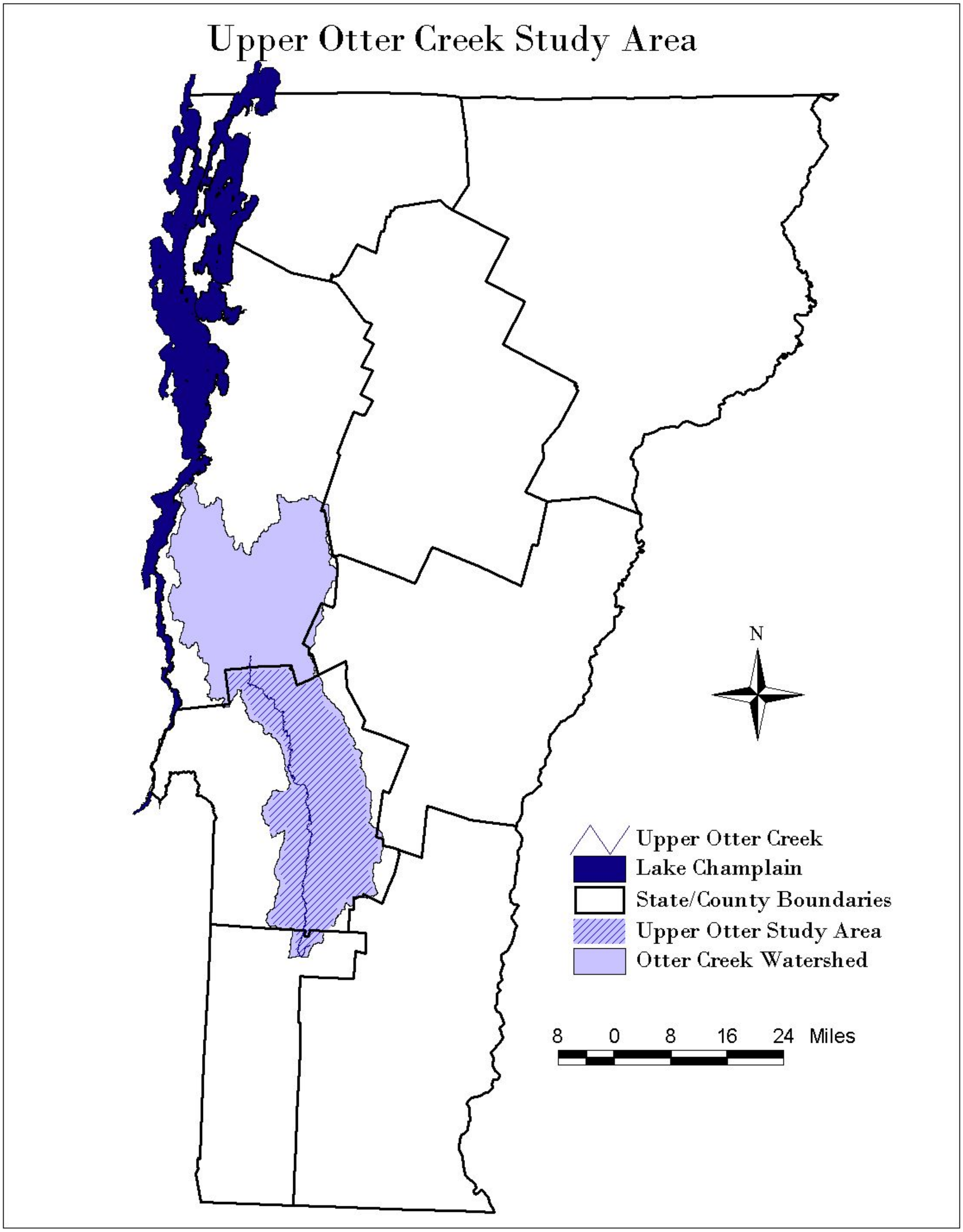
Funding for the Upper Otter Creek Phase I geomorphic assessment was provided by Vermont's Clean and Clear Initiative (Corridor Management Grants from Vermont's Department of Environmental Conservation (DEC)) and a US Environmental Protection Agency (EPA) Clean Water Act section 319 grant.

The study was conducted by the Rutland Regional Planning Commission and contractor Hilary Solomon, with support from the Rutland Natural Resource Conservation District (RNRCD), Vermont DEC and South Mountain Research and Consulting (SMRC).

Remote sensing data used in this study was obtained from the Vermont Center for Geographic Information (VCGI), Vermont DEC, the Rutland Natural Resource Conservation Service (RNRCS) and the Rutland Regional Planning Commission (RRPC).

The following map depicts the location of the study area.

Map 1: Watershed Location within the State of Vermont and Rutland and Bennington Counties



UPPER OTTER CREEK WATERSHED: STUDY AREA BACKGROUND

The Upper Otter Creek Watershed is a political subdivision of the Otter Creek Watershed. The Upper Otter Creek Watershed is primarily located in Rutland County, with a small section in northern Bennington County. The Otter Creek begins in Dorset township and flows northerly through Rutland and Addison Counties to Lake Champlain. According to the phase 1 ArcView extension, the Stream Geomorphic Assessment Tool (SGAT), the Upper Otter Creek watershed is approximately 487 $miles^2$, with a stream length of approximately 67 miles.

Over the past several years, several assessment projects have been conducted within this watershed. This work has been largely driven by RNRCD conservation interests, Vermont ANR basin planning efforts and RRPC regional planning efforts. The UOCWC, for example, is a project initiated by the RNRCD and Vermont ANR. The group formed in May of 2003, after a series of public forums, at which many issues and concerns were identified. Since then, the UOCWC, the District and/or RRPC have received funding to assess riparian buffers along the Otter Creek and geomorphic conditions along the Otter Creek and many of its significant tributaries.

In addition, the UOCWC/RNRCD has recently completed its second season of water quality monitoring through analytical support from the LaRosa Laboratory (VT DEC) in Waterbury. The RNRCD and the UOCWC are currently monitoring total phosphorus, E. coli, nitrogen, total suspended solids and turbidity on the Otter Creek and many of its tributaries. This monitoring will provide background data and are the result of a grant provided by Vermont DEC's environmental laboratory, where water samples collected by volunteers are taken for analysis.

For more information about any of these studies please contact the RNRCD.

Flood History

The Otter Creek generally has good access to its floodplain and floods at least once each year at spring runoff. Between 1929 and 2000, the only flow greater than 50 year flood stage was recorded in 1938. A 25 year flow was recorded in 1973 and 10 year flows have been recorded in 1947, 1949, 1976, 1977 and 1987 (Vermont ANR, 2004, VSGA app L, Flood History of Vermont Rivers).

According to local residents, the flood waters have been rising more quickly than in the past and in recent years appear to be causing more damage to crop lands (Grembowicz, 2005). Changes in the flood interval and the rates at which flood waters rise are of concern to local residents and should be documented in subsequent area studies.

METHODOLOGY

This assessment was completed using the methodologies outlined in the Vermont Geomorphic Assessment Phase I Handbook, dated April 2004 (plus subsequent updates). Computer mapping functions were completed by RRPC's Steve Schild through the automated GIS extension/tool, Stream Geomorphic Assessment Tool (SGAT), version 3. Post-SGAT steps were completed by Hilary Solomon. All data resulting from this study has been entered into Vermont DEC's online Data Management System (DMS) and checked for quality by qualified Vermont DEC staff.

DATA INPUTS/STUDY RESULTS

The results of this study are derived from the following data inputs: watershed location; valley and channel characteristics; soils data; land use and riparian buffer data; post-settlement changes to the channel, floodplain, stream corridor and watershed and a comparison of the expected stream channel characteristics to the measured characteristics. All of the phase 1 data (drawn upon in the following summaries) can be found in Appendix A or may be accessed through the Vermont DEC geomorphic assessment Data Management System (DMS).

<u>Reach Location</u>

The Otter Creek was divided into 40 reaches for the purposes of this study. This report describes reaches 13-40, from the Rutland/Addison County line to the headwaters. The first 12 reaches are located in Addison County, while the Rutland County portion of Otter Creek was divided into 23 reaches and the Bennington section was divided into 5 reaches. Each reach is a like area studied as one geologic unit. Please refer to Appendix A, report 1, for a complete list of the reaches and their characteristics. The following map details the location of each reach and a representation of its subwatershed area, while table 1 denotes the location and length of each reach.

Map 2: Otter Basin Subwatersheds by Reach

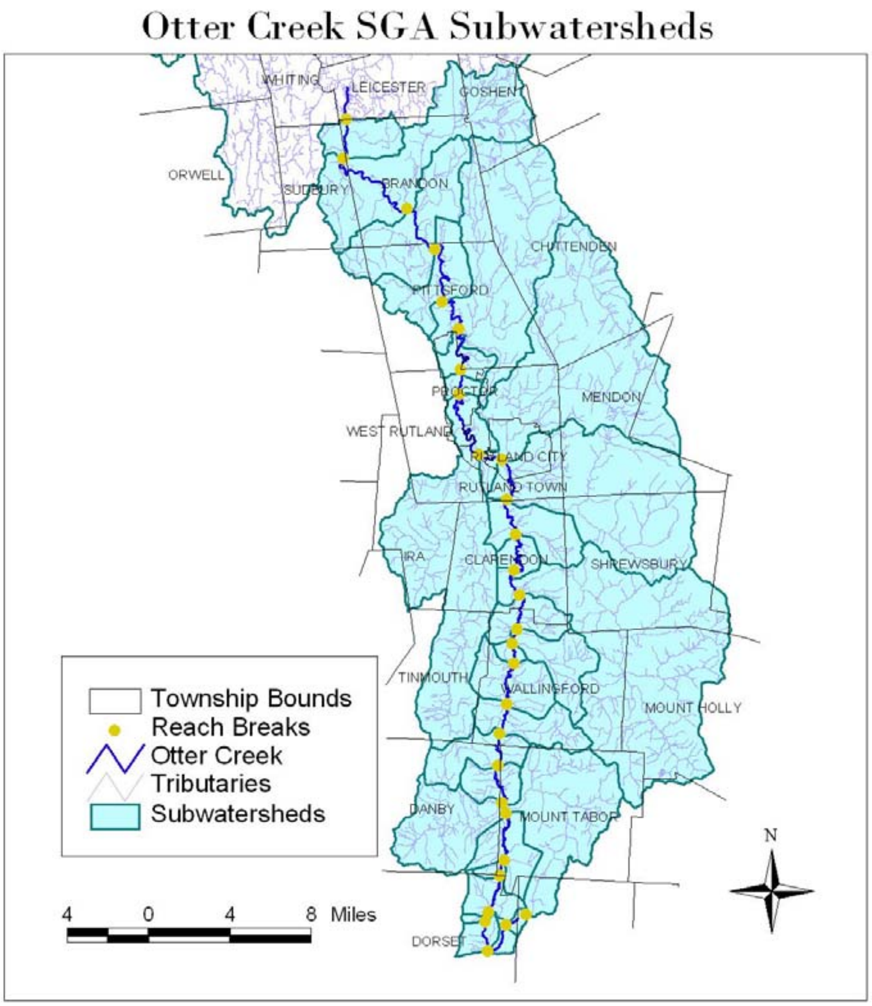


Table 1: Reach locations and lengths

Reach	Description	Length (Mi)
14	North of Rte 73	6.28
15	Neshobe confluence	2.98
16	New valley under Rail Road trestle	4.35
17	Kendall Rd bridge downstream of confinement	2.83
18	Furnace Brook confluence	3.28
19	Proctor falls to where the valley narrows	1.38
20	Upstream of Proctor until the valley opens	6.00
21	Clarendon River confluence	1.37
22	East Creek confluence	2.91
23	Cold Creek confluence	2.71
24	Unnamed tributary north of Pierces Corner	4.27
25	Up against valley wall	1.96
26	Mill Creek confluence	2.33
27	Upstream of Wallingford	0.83
28	Roaring Brook confluence	1.14
29	Valley opens south of Wallingford	3.83
30	Valley closes north of S. Wall (gravel pit)	1.71
31	Valley opens south of S. Wallingford	2.04
32	Valley closes near OCWMA- Danby TWP	3.12
33	Below all creeks- Danby/Mt. Tabor	0.83
34	Wetland area north of Mt. Tabor	0.83
35	South End	3.78
36	Confinement ends south of South End	1.06
37	Emerald Lake	2.35
38	Upstream of Emerald Lake	1.80
39	Entering Green Mountains	1.87
40	Steep headwaters in the Green Mountains	1.15

Stream Types

All stream reaches in this study were classified as Rosgen (1996) and Montgomery Buffington (1996) stream types A, B, C or E.

Stream type “A”- steep, cascading, headwater reaches
Stream type “B”- include moderately steep, step-pool streams
Stream type “C”- include less-steep, pool-riffle streams with floodplain access.
Stream type “E”- low-gradient, highly sinuous streams with floodplain access

The “E” stream type predominated, with only 4 reaches being classified differently. “E” streams are generally low gradient (gently sloped) streams that meander liberally through wide valleys, wetlands and/or marshes. They are often comprised of sand or silt substrate and show riffle-dune patterns along the river bottom (University of Oregon, 1998; Leopold, 1992). This type of channel appears to have little tendency to form pools and riffles, which may be attributable to the high width to depth ratio associated with non-cohesive bank materials (Leopold, 1992).

Basin Characteristics: Geology and Soils

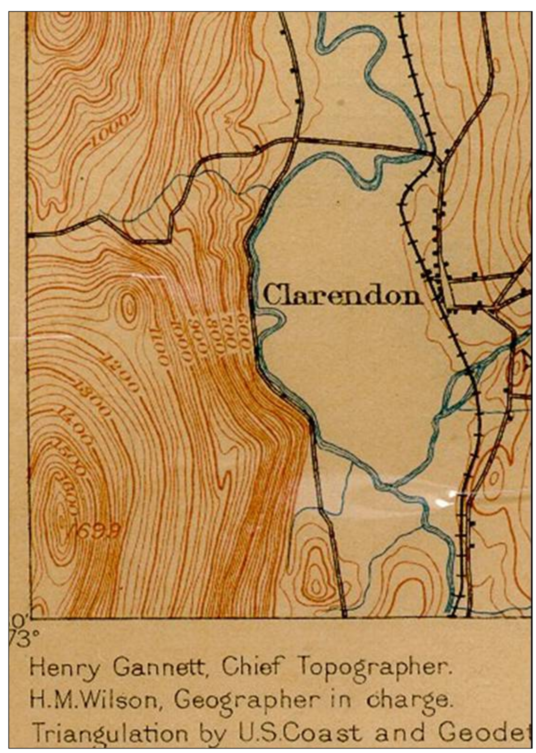
As stated in the Vermont DEC protocols, "A stream carries not only water but also sediment. Geology determines the source material that the river is carrying, the way that material is carried and the rate of channel adjustments." For an in-depth study of the geologic character of the Otter Creek, please refer to the phase 2 assessment report.

Based on the phase 1 results, the dominant geological parent materials in the Otter Creek watershed are alluvial and the subdominant materials are ice-contact. *Alluvium* is sediment deposited by a stream and may include boulders, cobbles, sand or silt. Alluvial deposits in flood plains are often composed of fine sand or silt. All alluvial deposits in Vermont postdate the last glacial period. *Ice-contact* deposits are formed of sediments that accumulated in lakes, ponds or streams in contact with glacial ice. Unlike till material, these sediments show evidence of sorting and layering due to the action of flowing water. Particles range in size from silt and clay up to boulders, but most of the material is sand-size or coarser (Vermont ANR, 2004, VT SGA App F, Geologic Information).

The characteristics of the dominant soil types in the watershed show occasional flooding, and only slight to moderate erodability. The erosion potential throughout much of the watershed may be relatively low due to the moderate slope found throughout the valley.

Land Cover and Reach Hydrology

Landuse in the watershed is mainly forested, with forest cover in each subwatershed ranging from 78.6 (M13) to 95.5 (M40) percent of land area. Historically, a much higher percent of the watershed was cleared for pasture and croplands. The following picture is from an 1893 USGS topographic map (Rutland, southwest quadrant, UNH). Historic maps like this can help us understand changes on the landscape over time and how these changes may be affecting current stream condition and adjustment processes.



Landuse in the stream corridor is a mix of forested land, crops and fields and occasionally, urban areas and wetlands. Forested landuse in the corridors ranges from 7.5 percent in M35 to 88.1 percent in M35. Crops and fields make up approximately 30% of the landuse in reaches M16-18 and M22-24. Urban areas make up as much as 66.5 percent of the landuse along reach M21 in Rutland, 40.8 percent of the landuse along M19 in Proctor and 27.6 and 31.3 percent respectively in reaches M27 and M28 in Wallingford.

Woody vegetative buffers of less than 25 feet in width dominate much of the watershed, with most reaches downstream of M31 having less than 25 feet dominate on one or both sides of the creek. Many of the reaches had long stretches of minimal vegetation along fields, roads or railroads.

Groundwater and wetland inputs were abundant throughout the basin.

Instream Channel Modifications

Instream channel modifications include the impact or frequency of bridges and culverts, bank armoring, channel straightening and dredging on the river.

Because the exact location of stream alteration permits was not usually available, information on bank armoring was not collected during the phase 1 survey. Information for the 20 reaches that have already undergone the buffer assessment has been added to the phase 1 data tables. As discovered during the buffer assessment, for reaches assessed, riprap along the stream bank varied between 0.7% of the length of the reach (M32) to 21% of the length of the reach (M20). Often the areas with rip-rap showed increased erosion up- and downstream from the riprap or, in several cases, the riprap had failed and was in the stream channel.

Reach ID	Percent Straightened
M15	83
M17	65
M19	59.5
M21	68
M22	71.8
M23	56.2
M25	60.2
M28	80.0
M31	52.0

Many reaches showed high impacts from channel straightening including M25 (83%), M28 (80%), M17 (65%) and M21 (68%). Table 1 lists all reaches with greater than 50 percent of the reach listed as straightened in the phase 1 assessment. Much of this channelization is historic and was visible on NRCS's 1942 aerial photos.

According to NRCS district conservationist, Bill Forbes, no dredging has been reported along the mainstem of the Otter Creek.

Floodplain Modifications and Planform Change

Floodplain modifications include roads, berms and development within the floodplain that alter the ability of the river to migrate in response to changes within the system. Planform changes include depositional features, meander migration and a deviation (usually a decrease) in the sinuosity of a river from the predicted or reference condition.

Most reaches had high impacts from roads and berms. M28 had 99% of the reach impacted by roads, while most reaches showed over 50% of their length impacted by roads. Only four reaches (M13, M23, M33, and M34 (M40 was unknown)) did not show high impacts due to constrictions caused by roads or significant lengths of roads in the stream corridor.

Except in 6 reaches (M19-22 and M26-27), development impacts were listed as low or not significant. These reaches are associated with Proctor, Rutland and Wallingford.

The planform changes, which include in-stream depositional features, meander migration and a deviation from expected sinuosity, show adjustments within the system that appear to be in response to historic land clearing, channelization and bank armoring. Much of the meander migration along the Otter Creek appears to be occurring at an accelerated rate because the buffers within the stream corridor are insufficient to stabilize eroding stream banks.

Windsheild Survey

The windshield survey provided a means of limited field verification of the phase 1 data. Most of the mainstem was floated during the summer of 2004 in conjunction with the Buffer Assessment. Brief observations were also taken at select points of vehicular and/or public access along the creeks in the study. The windshield survey was not a comprehensive field verification and the results of the phase 1 study should be considered preliminary.

DATA ANALYSIS

Impact Ratings

The following table lists impact ratings by reach. These impact scores combined with local knowledge of the area were used to determine which reaches received a phase 2 field assessment. Due to limited funds, only eight (nine, if time and/or financing permits) reaches were selected for phase 2 assessments during the 2005 field season. Additional reaches (see priority rating) may be targeted for phase 2 field assessments during the 2006 field season.

Most of the impact scores along the mainstem were similar with exceptions being the headwater reaches of Otter Creek (M33-M40) and reach M13 in the Brandon Swamp. These reaches were protected by mountainous or wetland settings and showed fewer impacts from changes on the landscape.

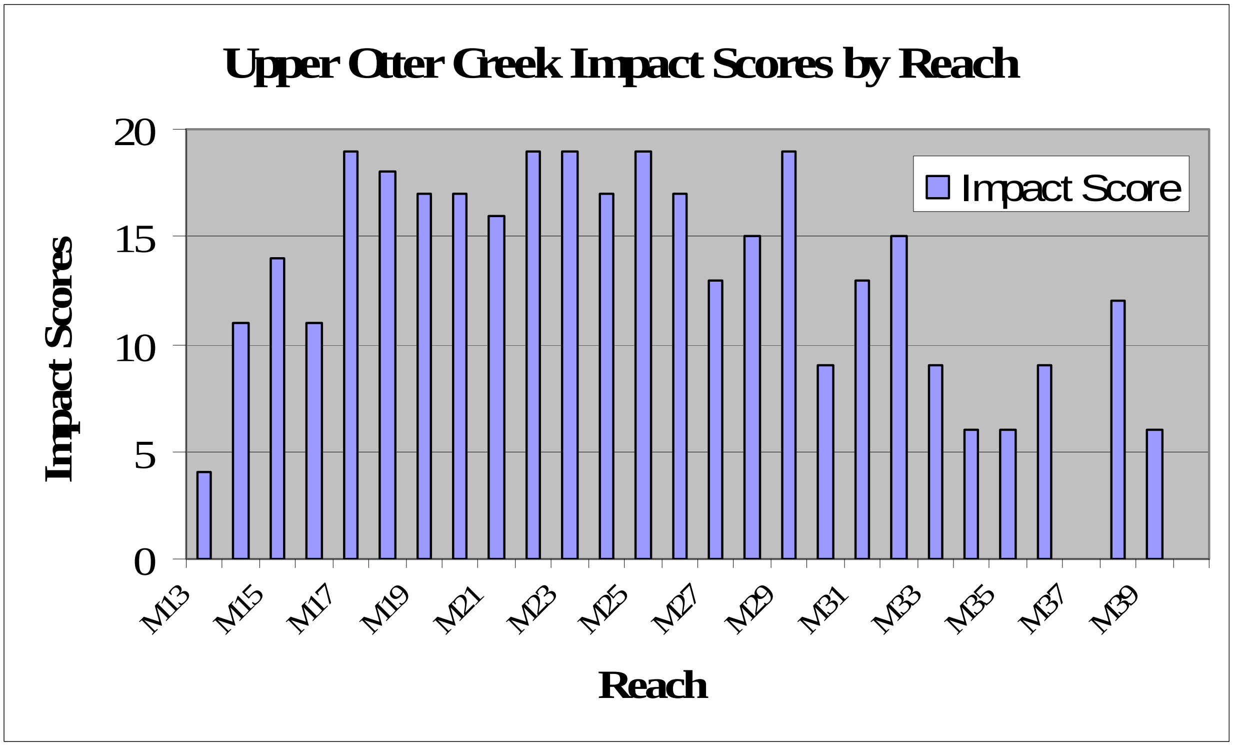
Table 2: Stream and Watershed Provisional Impact and Priority Rankings

Reach ID	Stream Name	Impact Score	Priority Ranking*	Comments:
M13	Otter Creek	4	3	
M14	Otter Creek	11	2	
M15	Otter Creek	14	2	
M16	Otter Creek	11	2	
M17	Otter Creek	19	1	Phase 2 proposed
M18	Otter Creek	18	1	Phase 2 proposed
M19	Otter Creek	17	2	
M20	Otter Creek	17	1	Phase 2 proposed
M21	Otter Creek	16	2	
M22	Otter Creek	19	1	Phase 2 complete
M23	Otter Creek	19	1	Phase 2 complete
M24	Otter Creek	17	1	Phase 2 complete
M25	Otter Creek	19	1	Phase 2 complete
M26	Otter Creek	17	1	Phase 2 complete
M27	Otter Creek	13	2	
M28	Otter Creek	15	1	Possible phase 2
M29	Otter Creek	19	1	Possible phase 2
M30	Otter Creek	9	2	
M31	Otter Creek	13	2	
M32	Otter Creek	15	1	Possible phase 2
M33	Otter Creek	9	2	
M34	Otter Creek	6	3	
M35	Otter Creek	6	3	
M36	Otter Creek	9	2	
M37	Otter Creek	Excluded	3	
M38	Otter Creek	12	2	
M39	Otter Creek	6	3	
M40	Otter Creek	0	3	

*1 = high priority; based on high impact scores and our knowledge of the area, we elected to complete phase 2 work along these reaches and plan to apply for a project scoping grant next year to help us implement projects along these reaches.
2 = medium priority; we MAY seek funding to gather field data in hope of eventually implementing projects along these reaches.
3 = lower priority; we have little reason to believe that projects are necessary in these reaches.

The following graphic depicts the reach impact scores from upstream (right) to downstream (left) along the Upper Otter mainstem (M13-M40). This graphic can be used to visualize the locations of the high impact areas along the creek. Additional information can be gained by comparing the reach impact scores to the locations of the reaches on topographic maps.

Graph 1: Impact scores along Otter Creek



<u>Adjustment processes</u>

Please refer to Table 2, located at the end of this report. Many of the scores for the adjustment process categories were high, but did not seem to show a trend within the mainstem. The potential trend based on this preliminary data, would be that certain reaches of the Otter Creek mainstem are aggrading. The lowest scores among the adjustment process categories were for widening. The scores are explained more fully below.

Degradation is the process of channel downcutting or scour that can result from increased slope, velocities or lack of floodplain access. Many of the reaches scored relatively high in this category. The highest score was reach M19 in Proctor with a score of 11.

Aggradation is the process of building up the channel bed through deposition of sediments. Again, many of the scores were high, with M17, M18, M23, M24 and M29 all scoring 10. In these reaches landowners have complained about sediments building up on their fields and in their ditches adjacent to the channel (Grembowicz, 2005 and Ruane, 2004).

Widening is the process of increasing the width of the channel through erosion on both banks, often until a new floodplain forms within the old, widened channel. Usually this happens when a creek is cut off from its original floodplain. The scores in this category were the lowest of the adjustment process scores for this system and were especially low in the headwaters and wetland areas. By definition "E" channels have access to their floodplain and they have relatively narrow, deep channels. In fact, the phase 2 study found that in many cases the Otter Creek channel was narrower than would have been predicted by the watershed size alone (Underwood, 2005).

Planform Changes include changes to the path or the sinuosity of the creek over time. The scores in this category were relatively high with reaches M19 and M20, having the highest scores (11 and 10, respectively).

Twenty of the twenty-seven reaches scored "fair" or "poor" for *reach condition* as compared to others within the project area. Compared to the statewide scores, these reaches along the Otter scored slightly better, ranging primarily from "fair" to "good".

Most reaches showed high *sensitivity* to changes occurring on the landscape. Only reach M30, which is confined within steep valley walls (South Wallingford) showed a moderate sensitivity to change. Several reaches, where bed material data was not collected, were not rated for sensitivity to change. This high sensitivity to change throughout the system could explain some of the high adjustment process scores along many reaches in this area.

CONCLUSIONS

Overall, the Otter Creek mainstem is adjusting to changes on the landscape. Scores for degradation, aggradation and planform change were relatively high, with aggradation having slightly higher scores overall.

Degradation is often accompanied by increased sediment transport as the bed and banks are scoured and the sediment carried away. This sediment most likely contributes to the sediment and associated nutrient enrichment problems in Lake Champlain. Projects that restore the streams natural planform and floodplain connection, thereby providing storage of sediment within the channel and floodplain should be considered.

Conversely, aggradation scores for Otter Creek were also high, perhaps higher than degradation scores. This shows that much of the sediment being lost from farm fields and streambank erosion may be deposited before it reaches Lake Champlain. More study should be made of these depositional areas and trends with attention paid to how the deposition affects landuse along the creek.

Planform change scores for the Otter Creek, again, were high, which explains some of the erosion and meander migration noted throughout this study. These lateral adjustments may be a reflection of the streams response to historic channel straightening. The stream is attempting to regain the sinuosity. Where this is the case, the stream's belt-width corridor should be made available and the stream should be allowed to adjust to the reference condition.

Another cause for increased levels of meander migration may relate to increased hydrology from stormwater or other inputs from increased impervious surfaces resulting from development in the headwaters. Studies that quantify the amount of development in tributary corridors, changes in the Otter's hydrograph over time and/or that assess the floodplain connectivity and wetland function in the hadwaters would help to quantify this influence.

Though most historic state permit records do not record the location or length of rip-rap installed along the channel, the reaches surveyed during the buffer and phase 2 assessments showed that the occurrence of rip-rap along the Otter mainstem is relatively common. In many places, where rip-rap had been applied to the banks, it has failed. Alternative forms of bank stabilization or system stabilization may prove effective in decreasing erosion and sediment transport, while maintaining the width of the channel and floodplain access. According to NRCS, revetments that are installed along the banks of the Otter will need to withstand extensive ice-scour (Eugair, 2005).

Many of the reaches in the river valleys showed long stretches with minimal buffers, which contributes to the increased sediment and potentially increased nutrient levels in the water from erosion and runoff. Tree planting and other buffer enhancement projects in these areas are recommended.

While the effect of berms and roads on the channel morphology appears to be high, the pressures from development are not yet significant in many reaches. Implementing planning measures along the river corridors can help preserve or improve the functionality of the stream system in the basin. Planning within the Otter Creek watershed could include decreasing runoff from impervious surfaces, managing runoff for nutrients and planting riparian buffers.

Based on the results of the phase 1 geomorphic assessment, the RNRCD in concert with our phase 2 contractor, Kristen Underwood, SMRC, decided to conduct phase 2 assessments on eight (nine, if time and finances permit) reaches of the Otter Creek. These reaches included M17, M18, M20, M22-26 and M29. The results of this study will be available upon request.

Additional Studies

The RNRCD, Vermont ANR and the City of Rutland are involved in several studies of the Moon and Mussey Brooks in Rutland, Rutland Town and Mendon. Both Brooks underwent phase 1 & 2 assessments over the past year and the results are currently being synthesized. Additional studies will include a feasibility study to restore the Mussey Brook, where it runs through the Rutland County Fairgrounds. The Moon and Mussey Brooks are currently on the state's impaired waters list for urban stormwater runoff issues.

As part of a pre-disaster mitigation grant from the state of Vermont, the Rutland Regional Planning Commission has partnered with the RNRCD to conduct phase 1 and phase 2 studies on selected tributaries along the Otter Creek. This study is currently underway.

Funding for the above studies is provided through Clean and Clear, the Pre-Disaster Mitigation Fund, as well as Stormwater Improvement Funds administered through Vermont DEC. The RNRCD and its partners hope to continue to assess the tributaries in the basin and to implement projects that will address local water quality concerns.

Due to concerns raised by local landowners, future studies should try to address the impression that flood-related damages along the Otter have intensified over time. Other concerns include areas of erosion and/or meander migration at locations which are perceived to have sufficient buffers. A study to review the hydrologic record available for the Otter Creek gage stations and document any significant changes in the discharge over time should be completed. Two gage stations are available on the Otter Creek in Center Rutland (76 years of record) and Middlebury (90 years of record) which should provide appropriate data to determine the changes in discharge in recent time. If any changes are documented, studies that quantify development trends and impervious surfaces in the headwaters and tributaries may be appropriate. Other studies may focus on wetland loss or wetland functions in these areas.

Local landowners also wish to quantify the effect that the Route 4 bypass has on upstream properties (Grembowicz, 2005). If feasible, additional gauging stations may be installed on the upstream section of Otter Creek or its major tributaries.

Finally, the RNRCD and many partners plan to continue monitoring the water quality of the Otter and many of its tributaries in Rutland County. This monitoring is conducted through a grant from Vermont DEC's LaRosa Environmental Lab in Waterbury, VT.

Appendices

Appendix A- Phase 1 Data Reports
Appendix B- Quality Assurance (QA) form
Appendix C- US EPA approved Quality Assurance Project Plan (QAPP)

Table 3: Step 9, Predicted channel adjustment and reach condition preliminary scores

Reach ID	Confine Type	Stream Type	Bed Material	Bedform	W/S Area	Total Impact	Predicted Adjustment Scores Degrad.	Aggrad.	Widen.	Planf.	Reach Condition Project	Statewide	Reach Sensitivity
M13	VB	E	Sand	Dune-Ripple	486.8	4	0	3	0	0	Reference	Reference	High
M14	VB	E	Sand	Dune-Ripple	479.8	11	3	4	0	1	Good	Reference	High
M15	VB	E	Sand	Dune-Ripple	444.9	14	7	6	3	6	Fair	Good	High
M16	BD	E	Sand	Dune-Ripple	424.9	11	7	8	3	6	Fair	Good	High
M17	BD	E	Sand	Dune-Ripple	413.8	19	9	10	5	7	Poor	Fair	High
M18	VB	E	Sand	Dune-Ripple	365.8	18	7	10	5	7	Poor	Fair	High
M19	VB	E	Sand	Dune-Ripple	362.0	17	11	8	5	11	Poor	Fair	High
M20	VB	E	Sand	Dune-Ripple	360.3	17	8	8	5	10	Poor	Fair	High
M21	BD	E	Sand	Dune-Ripple	307.8	16	9	6	3	8	Fair	Good	High
M22	BD	E	Sand	Dune-Ripple	244.9	19	9	6	3	8	Fair	Good	High
M23	VB	E	Sand	Dune-Ripple	196.6	19	7	10	5	9	Poor	Fair	High
M24	VB	E	Sand	Dune-Ripple	186.9	17	5	10	5	7	Fair	Good	High
M25	VB	E	Sand	Dune-Ripple	183.1	19	9	8	5	9	Poor	Fair	High
M26	VB	E	Sand	Dune-Ripple	110.1	17	9	8	5	9	Poor	Fair	High
M27	NW	E	Gravel	Dune-Ripple	103.5	13	8	6	3	6	Fair	Good	High
M28	VB	E	Sand	Dune-Ripple	94.5	15	7	6	3	6	Fair	Good	High
M29	VB	E	Sand	Dune-Ripple	93.3	19	6	10	5	8	Poor	Fair	High
M30	VB	B	Gravel	Dune-Ripple	83.8	9	7	5	3	3	Fair	Good	Moderate
M31	SC	E	Not Eval	Dune-Ripple	75.3	13	7	6	3	6	Fair	Good	
M32	VB	E	Sand	Dune-Ripple	66.9	15	6	7	5	6	Fair	Good	High
M33	VB	E	Gravel	Dune-Ripple	62.0	9	0	2	0	0	Reference	Reference	High
M34	VB	E	Sand	Dune-Ripple	18.8	6	2	2	0	2	Reference	Reference	High
M35	VB	E	Sand	Dune-Ripple	11.0	6	3	2	0	1	Reference	Reference	High
M36	VB	E	Not Eval	Dune-Ripple	10.1	9	5	5	3	6	Fair	Good	
M38	VB	C	Not Eval	Riffle-pool	5.0	12	7	6	3	6	Fair	Good	
M39	SC	B	Not Eval	Step-pool	2.2	6	4	3	0	0	Good	Reference	
M40	NC	A	Not Eval	Cascade	0.80	0	2	0	0	0	Reference	Reference	

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