1.0 INTRODUCTION

This engineering report presents the results of an investigation of the Stevens Brook and the Rugg Brook watershed. The investigation addresses long-standing concerns regarding flooding and flood-related damages as well as impaired water quality within the floodplain of these two brooks.

Primary components of this report identify and document problems within the watershed; and develop specific recommendations for implementation measures to address the problems.

The report is organized to present a background discussion on historical issues, a statement of objectives and goals, and the study methodology. The following are the results of this investigation.

1.1 Background

Stevens Brook and Rugg Brook are two separate perennial streams that flow through the Town of St. Albans and the City of St. Albans. In addition, the Stevens Brook flows through the southern corner of the Town of Swanton, near Exit 20 on Interstate 89. Rugg Brook also flows through a portion of the Town of Georgia, Vermont.

Flooding of the Collins-Perley Sports Complex on June 5, 2002.

Stevens Brook discharges into the St. Albans Bay, Lake Champlain. Rugg Brook discharges into Mill Brook, which then discharges into the St. Albans Bay. The total drainage area of the Stevens Brook, at its confluence is approximately 14.3 square miles. The total drainage area of Rugg Brook at its confluence with Mill Brook is approximately 6.4 square miles. The location of these streams, along with their respective watershed drainage boundary is illustrated on Figure 1 on page 4.

These streams are relatively small in size, and the drainage area of each one is approximately three square miles in the areas where much of the flood damages occur, notably near the western City limits. Despite this small size, there is a long history of flooding and flood related damages along their floodplain corridors. Indeed, significant out-of-bank flooding occurred several times in June 2002.

There is also a growing concern with the water quality of these two streams. Stormwater runoff, which transports many types of pollutants from the surrounding watershed, has degraded the water quality to the point where the streams are now included on the State of Vermont, Department of Environmental Conservation's (VT DEC) 303d list of impaired waters. Table 3

in Section 1.6 of this report provides detail regarding pollution type and extent of the impaired waters.

To address the two issues of flooding and water quality facing property owners within the watershed, the Northwest Regional Planning Commission (NRPC), in partnership with the City of St. Albans (City), Town of St. Albans, Town of Georgia, and Town of Swanton (Towns) initiated a study of the watershed. The objectives and goals of this study are expressed in detail later in this report, but as indicated previously, the primary purpose is to:

- Identify watershed problems and
- Identify implementation measures

The NRPC retained the professional services of DuBois & King, Inc., a consulting engineering firm in Randolph, Vermont, to assist with the development of this study and prepare the engineering report. DuBois & King's role is to provide the lead planning and engineering services associated with this project. Jeffrey W. Tucker, P.E., was the principal watershed investigator and prmiary author of this report on behalf of DuBois & King.

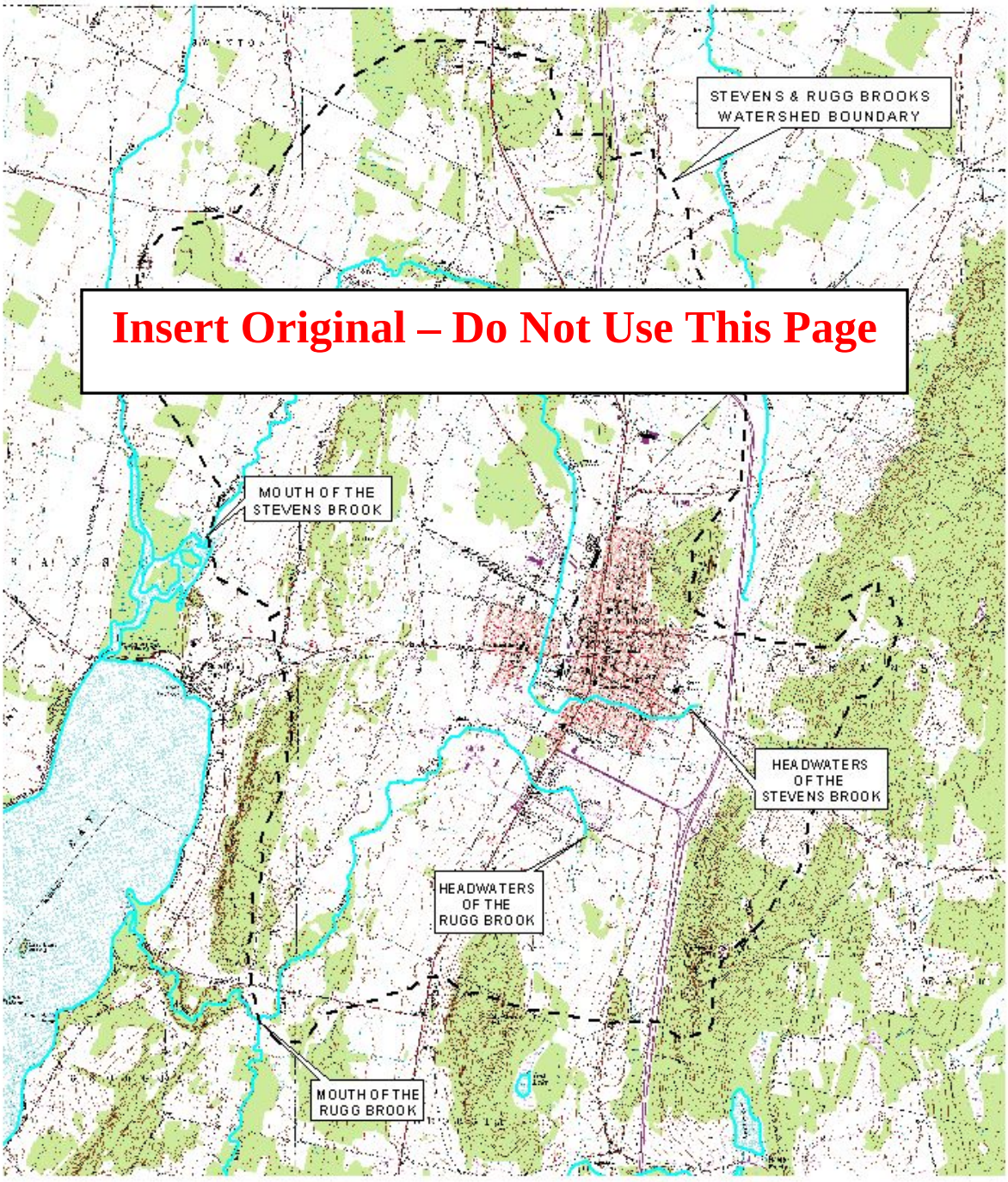
A Steering Committee was formed at the beginning of this project to provide support and overall guidance to the technical team. The role and function of the committee is discussed in greater detail in Section 3.1 of this report. Additional technical support and historical insight was provided by a number of individuals from several state and federal agencies. They include representatives from the Vermont Agency of Natural Resources (VANR) and the United States Department of Agricultural, Natural Resources Conservation Service (NRCS).

A special Thank-You is extended to each of the people who volunteered their time in the advancement of this project. The following table shows the names of the people who served on the Steering Committee.

Table 1
Steering Committee Members

Name	Organization	Title
Karen Bates	VT Dept. of Environmental Conservation	Watershed Coordinator
Jeff Bean	Mapmaker Photogrammetric Services	Owner
Dick Benoit	St. Albans City	Resident
Leon Berthiaume	St. Albans Cooperative Creamery	Manager
Jack Brigham	Farmer & Selectboard Member	Town of St. Albans
Chris Brunelle	VT Dept. of Environmental Conservation	River Management Program
Connie Burns	USDA Rural Development	
Barry Cahoon	VT Dept. of Environmental Conservation	Director, River Management Program
Fred Campbell	Town of Georgia Conservation Commission	
Bill Cioffi	City of St. Albans	Manager & Resident
Rick Hopkins	VT Dept. of Environmental Conservation	Director, Water Quality Division
Dave Hoyt	USDA Natural Resources Conservation Service	District Conservationist
Bob Johnson	Town of St. Albans	Select Board Member
Dave Kimel	Collins Perley Sports Center	Manager
Jane Kiser	City of St. Albans	Community Development Director
Kathy Lavoie	State of Vermont & Town of Swanton	State Representative & Planning Commission
Dan Lindley	Town of St. Albans	Town Administrator
Miranda Lescaze	Lake Champlain Basin Program	Technical Coordinator
Angela Magara	Vermont Emergency Management	State Hazard Mitigation Officer
Mitch Montagne	Town of St. Albans	Farmer & Planning Commission
Gil Newbury	Vermont Agency of Transportation	District 8 Transportation Administrator
William Nihan	Town of St. Albans	Planning Commission and Select Board
Jim Pease	VT Dept. of Environmental Conservation	Water Quality Division
Staci Pomeroy	VT Dept. of Environmental Conservation & Town of Georgia	Water Quality Division & Conservation Commission
Cindy Rutkowski	St. Albans City	Resident
Brian Searles	City of St. Albans	City Manager
Tim Smith	Franklin County Industrial Development Corporation	Executive Director
Dick Thompson	Town of Swanton	Town Administrator
Bonnie Waninger	Northwest Regional Planning Commission	Special Project Planner
Doug Williams	Town of Georgia	Town Administrator

Figure 1
Site Location Map



1.2 Purpose of Watershed Assessment

Historical development in the Stevens Brook and Rugg Brook watersheds has largely occurred on an individual basis, without the benefit of long-term planning and coordination. The effect of this development has been significant and has resulted in continued problems in many areas of the watershed. These problems can be seen in terms of:

- flooding
- flood damages
- threats to people and property

In addition, there has been severe environmental degradation to the riverine system and the aquatic habitat. Much of this degradation is a result of uncoordinated development in the watershed, which has resulted in a significant change in the hydrology and pollution filtering capacity.

The problems within the watershed are interrelated and historical. The short and long-term solutions require an integrated, consensus based approach. One of the first steps in addressing the problems is to identify and evaluate them on a watershed-wide basis and to identify the inter-relationships between those problems. Implementation solutions can then be developed to address specific problems, but with regard to its potential impacts on other areas of the watershed.

One of the first steps in addressing the problems is to identify and evaluate them on a watershed-wide basis and to identify the inter-relationships between those problems.

The Watershed Improvements Implementation Plan developed by this study will assist in resolving flooding and water quality problems and preserve community vitality within the watershed.

The primary purpose of this study is to evaluate the causes, effects, and extents of flooding and water quality issues within the Stevens and Rugg Brook watershed, and to develop viable solutions to these issues. The culmination of this study is the presentation of a Watershed Improvements Implementation Plan.

1.3 OBJECTIVES AND GOALS STATEMENT

The primary objective of this study is to define watershed problems and identify implementable solutions that can be used by the communities to address and correct the problems. The first step is to clearly define the goals and objectives of this study. The communities, along with support from the state and regional officials, have established the following objectives and goals:

1.3.1 Objectives

1. Identify, assess and document the causes and effects of current water resource problems in the Stevens and Rugg Brooks.

2. Identify, assess and document Watershed Implementation Measures which address and correct these causes, and which restore and repair the effects.

3. Identify the interrelationships between the implementation measures.

4. Provide opportunity for the public to provide input on this project.

1.3.2 Goals

1. Create public awareness and education of the problems within the watershed.

2. Initiate meaningful discussion at the community level regarding a short and long-term vision (goals and objectives) of how the watershed should function.

3. Create public interest and involvement in the identification of opportunities to correct the problems.

Create a Watershed Implementation Plan that can be used by City and Town officials for prioritization of watershed management and planning.

One important objective is to educate people of the direct relationship between land use activities throughout the watershed and the flooding and water quality responses that exist in the brooks.

1.4 Watershed Description

The following is a description of the watershed for the Stevens and Rugg Brooks:

1.4.1 Stevens Brook

Stevens Brook Headwaters:

The Stevens Brook headwaters originate along the ridgeline located east of Interstate 89. The peak hilltop in this area is known locally as French Hill, with an approximate elevation of 1,304 feet. Two (2) primary channels convey runoff from French Hill, the main stem of Stevens Brook, and Grice Brook. Grice Brook is an intermittent tributary of Stevens Brook. VT Route 36 extends east to west through this area and approximates the divide between the upper portion of the Stevens Brook and the Grice Brook drainage areas.

The land use throughout the headwaters of the Stevens Brook is predominately rural, with some residential housing and supporting roadways. The majority of this area is wooded with some open meadow. The topography is very steep, with an approximate slope of 18 percent. At the downstream border of the headwaters defined by I-89, there is a definitive change in the slope of the terrain.

The total drainage area of Stevens Brook at its primary crossing under I-89 is approximately 1.1 square miles. The Grice Brook drainage area at I-89 is 0.3 square miles (162 acres). Therefore, the total headwater drainage area is approximately 1.4 square miles, which is 9-percent of the overall drainage area of Stevens Brook at its mouth, the confluence with Jewett Brook.

Westerly view from upper watershed

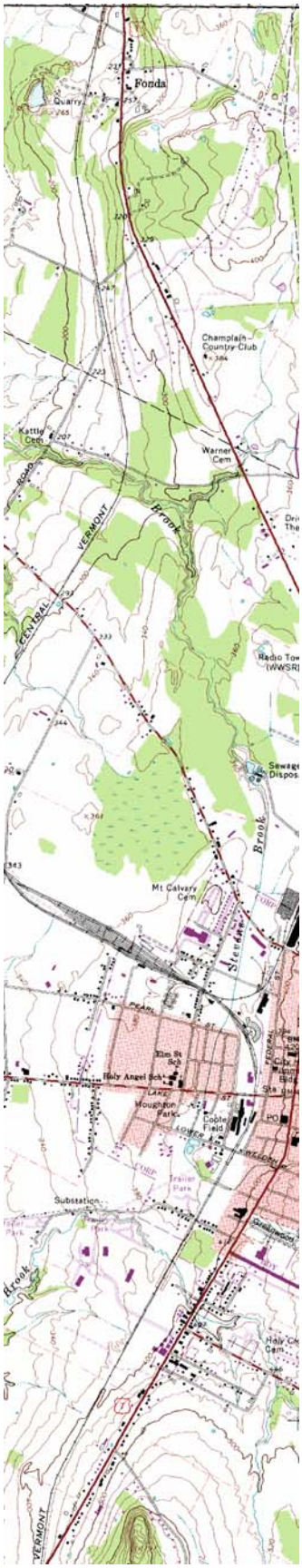
Stevens Brook Mid-watershed:

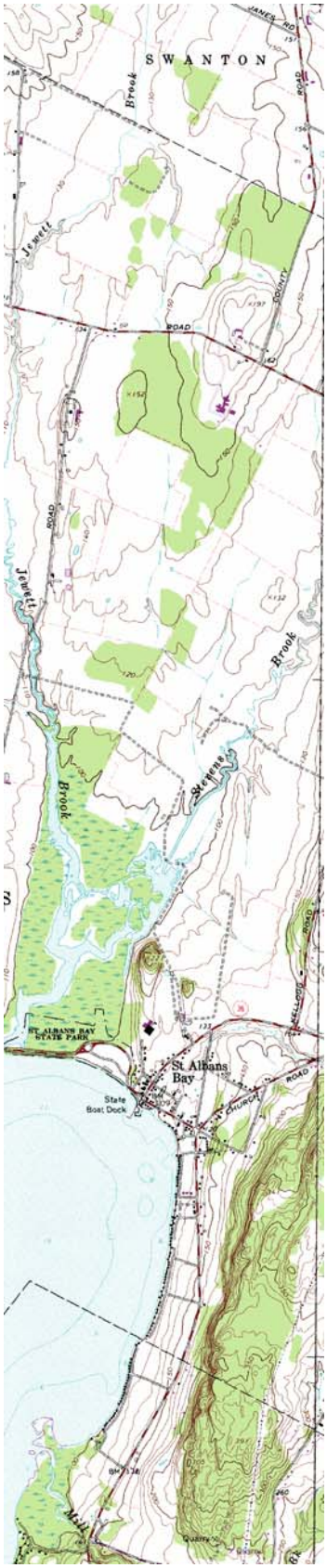
The middle section of the watershed is bounded at its upstream limit by I-89 and downstream near the St. Albans Wastewater Treatment Facility. The wastewater treatment facility is located on Rewes Road, north of the City of St. Albans limits. The vast majority of the City is located in this section of the Stevens Brook watershed. In addition, a portion of the Town of St. Albans, which is the area along the VT 104 corridor north of Exit 19 is also located within this section.

Typical developed area in the watershed.

The land use in the center section of the watershed is predominately urban. Medium to high-density residential development dominates the land use in the upstream (eastern) portion. Commercial and high-density residential land use exists from US 7 (Main Street) downstream to the wastewater treatment facility. The drainage area of Stevens Brook at Main Street is 1.8 square miles.

Also included in this section of the watershed are the lands of the Central Vermont Railroad. The railroad facilities included within this land are mainline railroad tracks, side yards, switching stations, turntables, the roundhouse, and areas for equipment and material storage. In total there are approximately five miles of railroad track within the drainage area of the Stevens and Rugg Brooks. Currently, there is an environmental remediation effort being conducted at the Central Vermont Rail Yard. The remediation efforts include a collection system comprised of drains, extraction wells, and an interception trench. The objective of this remediation system is to contain and remove the contamination while preventing it from entering the Stevens Brook. The environmental consulting engineer for Central Vermont Railroad prepares a quarterly report of the activities on the site during the previous quarter. The report discusses the volume and type of contaminant recovered on the site, as well as the maintenance and operation details for the remediation system. This report is available through the Vermont Agency of Natural Resources Solid Waste Division.





The wastewater treatment facility, located at the downstream limits of this section, processes approximately 20-million gallons of influent per day. The influent consists of a combination of sanitary wastewater from buildings, ground water infiltration into the collection lines and a portion of the stormwater collection system.

The total drainage area of Stevens Brook at the wastewater treatment facility is 3.9 square miles or approximately 2,500 acres. The Mid-watershed accounts for approximately 18-percent of the total drainage area of the Stevens Brook watershed.

Stevens Brook Lower-watershed:

The lower section of the watershed is the area located downstream of the City wastewater treatment facility. The land use is predominately agricultural, with a majority of the area used for active crop (hay, corn) fields and wood lots. Supporting infrastructure, such as roadways and low-density residential development is also located in the area. A higher density of development exists in St. Albans Bay, including the municipal offices, residences and public parks.

The topography is mild, with an average slope of less than 1-percent. The effect of the shallow slope on the stream's planform is evident by the number and frequency of meanders located in this section. In these meander sections, it is quite common for the stream to change course creating a new channel and abandoning a portion of the previously occupied channel.

Stevens Brook discharges into the marsh area that serves as the confluence of the Stevens and Jewett Brooks, approximately ½ mile upstream from the shoreline of St. Albans Bay. The marsh area and Jewett Brook were not included in this study, and therefore their drainage area is not included with the Stevens Brook drainage area. The drainage area of Stevens Brook at its mouth, upstream of the confluence of Jewett Brook, is approximately 14.3 square miles.

1.4.2 Rugg Brook

Rugg Brook Headwaters:

The Rugg Brook headwaters originate along the ridgeline located east of Interstate 89. The peak hilltop in this area is Bellevue Hill, at an elevation of 1,300 feet. Bellevue Hill is also the site of the former U.S. Air Force radar tracking facility. The headwaters extend from Bellevue Hill downstream slightly west of Interstate 89 to the housing development on Clyde Allen Drive.

Easterly view of the Rugg Brook headwaters. Note the Interstate in middleview and the abandoned radar station in the background.

There are two primary branches of the Rugg that convey runoff though the headwaters, which are referred to in this report as the North Branch and the South Branch. The North Branch collects drainage primarily from the area east of Exit 19 of I-89 and joins the South Branch at Clyde Allen Drive. The South Branch is comprised of several small tributaries originating on Bellevue Hill and the farmland located on the Town of St. Albans and Fairfield town lines.

The historical land use has been predominately agricultural. However, commercial and residential development has been rapidly expanding along VT 104, near Exit 19, and is significantly changing the land use. It is expected that within a few years, the predominate land use will be residential with supporting commercial facilities. The coverage in this area is a combination of woodland and open meadow, with scrub brush and active farming. The topography of the hillside east of I-89 is very steep, with an average slope of approximately 15-percent. The slope contributing farmland area along VT 104 is milder, with an approximate slope of less than 5-percent.

The drainage area of Rugg Brook at Clyde Allen Drive is 1.5 square miles or approximately 943 acres. The North Branch contributes 33-percent (311 acres) and the South Branch contributes the remaining 67-percent (632 acres). In total, the headwaters of the Rugg Brook account for 23-percent of the 6.4 square miles of the entire Rugg Brook watershed.

Rugg Mid-watershed:

The middle section of the watershed is bounded at its upstream limit at Clyde Allen Drive and downstream at the St. Albans Diversion Structure. The Diversion Structure is located on Nason Street south of the City of St. Albans limits. The Diversion Structure is a large earth cut and fill channel designed and built in the 1970's. The purpose and function of the Diversion Structure is to divert excess discharges from the Stevens Brook into the Rugg Brook to prevent flooding along the western portions of the City. Additional information on the diversion structure is discussed later in this Section.

The land use in the middle section of the watershed is dominated by commercial and medium to high-density residential development. Residential housing developments are located on the banks of the Rugg Brook throughout the majority of this section of the watershed. In addition, the Town of St. Albans Industrial Park is located in the middle section of the watershed. The industrial park includes the manufacturing and industrial facilities of companies such as Ben & Jerry's Homemade, Inc., Barry Callebaut, Peerless Clothing USA, Inc., and others.

The total drainage area of the Rugg Brook at the Diversion Structure is 2.9 square miles or approximately 1,858 acres. The drainage areas at several other points are tabulated below. This section accounts for approximately 45-percent of the total drainage area of the Stevens Brook watershed.

Rugg Lower-watershed:

The lower section of the watershed is the area located downstream of the Diversion Structure. The land use is predominately agricultural with a majority of the area active agricultural crop fields, with supporting infrastructure such as roadways and low-density residential development.

The topography is very mild, with an average slope of less than 1-percent. The shallow slope of the stream has a similar effect as on the Stevens Brook. Numerous meanders are located on this reach of the stream. In these meander sections, it is quite common for the stream to change course creating a new channel and abandoning a portion of the previously occupied channel.

Rugg Brook discharges into the Mill River, approximately two miles upstream from the shoreline of St. Albans Bay. The total drainage area of Rugg Brook at its mouth is approximately 6.4 square miles.

Table 2
Summary of Drainage Areas at Select Points Along the Stevens and Rugg Brooks

LOCATION	AREA (sq. mi)	LAND USE
Stevens Brook		
Interstate 89	1.1	Un-Developed Woodland & Meadow
VT Route 104	1.2	Agricultural
Quinton Court	1.5	Medium Density Residential & Commercial
Main Street	1.8	High Density Residential
Confluence of Grice Brook	2.4	Medium Density Residential & Commercial
Diversion Structure	2.5	Medium Density Residential & Commercial
Lower Newton Street	3.2	Medium Density Residential & Commercial
St. Albans WWTF	3.9	Agricultural
Kellogg Road	7.5	Agricultural
Mouth (St. Albans Marsh)	14.3	Agricultural
Rugg Brook		
Clyde Allen Drive	1.5	Medium Density Residential
Main Street	2.7	High Density Residential
Diversion Structure	2.9	Mix Residential & Commercial
Mouth (at Mill Brook)	6.4	Agricultural

1.5 Flooding History

There is a long history of flooding and flood related damages in the Stevens Brook floodplain corridor. As noted below, flooding and related damages were a significant enough issue over one hundred years ago, when in 1900, there was a State Legislative Action regarding the diversion of flood discharges from the Stevens into the Rugg Brook.

According to the City of St. Albans Flood Insurance Study dated December 1977, significant flooding occurs on average every 5 years. This report states that many areas in the residential section east of US 7 and the commercial section towards Newton Road are susceptible to flooding. A majority of the flooding was characterized as frequent out-of-bank flooding throughout the urban areas, associated with spring snowmelt and summer rainfall events. Larger, fluvial floods resulted in basement and first floor flooding of homes and businesses, inundation of local streets and roads, and washing out riverbanks and culverts.

Mr. William G. Cioffi, former St. Albans City Manager has indicated that the frequency of out-of-bank flooding appears to have increased significantly over time. Several examples that were cited include surcharging of the City-owned storm drain system has occurred approximately six times over the past 18-years, resulting in localized flooding. Recent storm events that resulted in significant flooding in the City include the 1998 ice storm event and the June 2002 fluvial event.

Insert Orthophoto “Drainage Area Map”

The precipitation which occurred during the June 11–12 storm event was measured to be 4.33-inches of rainfall. A 2.91-inch rainfall preceded this the week before on June 5, 2002. The June 11 – 12 storm was estimated to be between the 30-year and 40-year rainfall recurrence frequency, resulted in flood damages throughout the City and portions of the Town of St. Albans. The two adjacent graphs illustrate the temporal distribution of the rainfall.

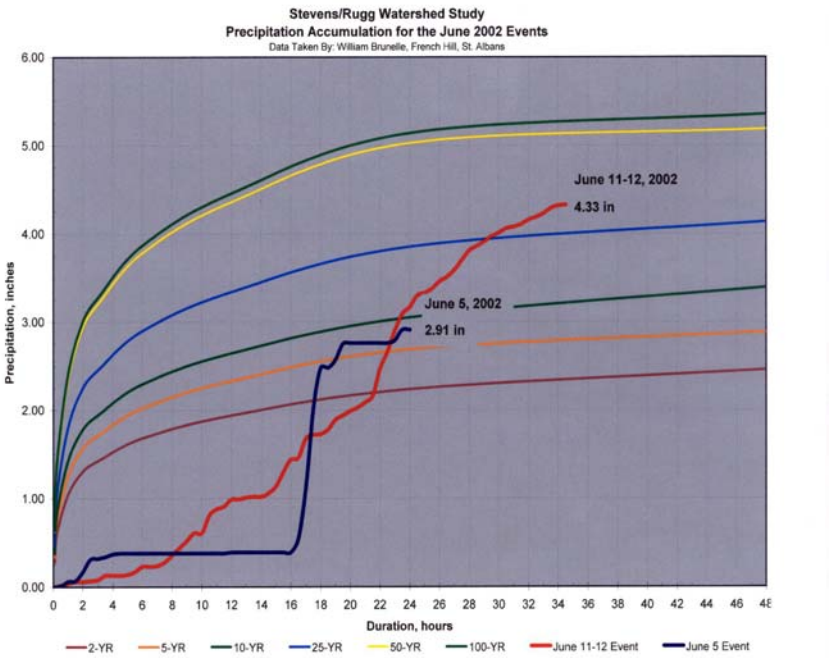
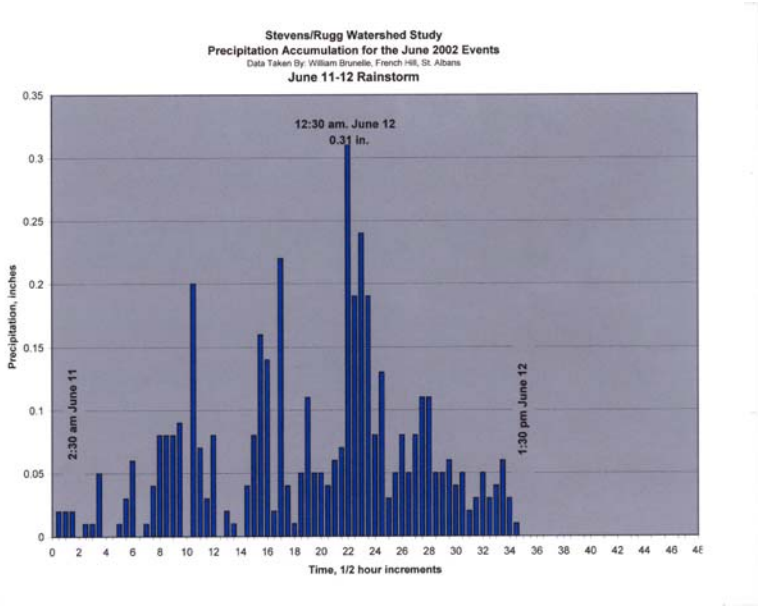


Figure 3: Precipitation Tables



During the June 2002 flood, a large number of homes experienced flooding and flood damages to basements and yards. Flooding of streets and inundation of large portions of lands also occurred. For example, Lower Weldon Street, near the intersection with North Elm, near Houghton Park was inundated as a result of out-of-bank flooding and storm sewer surcharging. Erosion and deposition of silts and gravels and flood borne debris was commonplace along the floodplain corridor following these events.

City averages expenditures of over $50,000 annually for flood related damages.

Other information sources indicate that the City has expended more than $600,000 over the past 12 years addressing flooding and flood related damages. This is approximately $50,000 on average in annual damages, and clearly demonstrates the problem has not been resolved.

1.6 Diversion Structure

According to information contained in the Stevens-Rugg Watershed Project (P.L. 566) Report dated December 5, 1972, flooding issues were a concern over 100 years ago. In 1900, the City was authorized by an act of the State Legislature to divert floodwaters from Stevens Brook into Rugg Brook; however, no action was taken for over 50 years.

Following a significant spring storm in 1955, renewed action was taken by the City, Town and the Franklin County Soil Conservation District to re-initiate the diversion of floodwaters. Planning assistance applications were made and the U.S. Department of Agriculture was authorized to initiate specific improvement studies.

Previous studies document significant flooding every five years. Storm drain systems charges, ice storms and fluvial events results in erosion and deposition of silts, gravel, and debris along the floodplain corridor.

Inlet to diversion structure

A revised work plan was developed in 1957, which detailed the project. However, the project was once again shelved, this time for nearly 10 years, because land rights could not be secured to construct the diversion structure.

Then in 1967, the SCS was again requested to restart the project. The work plan was pulled off the shelf and updated. This effort resulted in a detailed work plan, and a report was issued in 1975. This time, all issues were addressed and right-of-ways were secured. Construction of the diversion structure was completed several years after that date and it remains in operation today.

The purpose of the Diversion Structure is to divert floodwaters from the Stevens Brook to the Rugg Brook to reduce flooding along an approximate one-mile long corridor floodplain of Stevens Brook, between Lower Weldon Street and Lower Newton Street. This area includes residential and commercial development along Lake Street, Elm Street, LaSalle Street, Pearl Street and other local neighborhoods that abut the brook.

The Diversion Structure is an earth channel within an overall length of the channel is approximately 2,000 feet. Its typical cross-sectional geometry is trapezoidal, with 1 vertical to 2 horizontal side slopes, an approximate depth of 7-feet and a bottom width that varies between 45-feet to approximately 150-feet. The upstream third of the channel is contained with earth dikes on each side, and the lower two-thirds of the channel length is cut into ground.

The diversion structure represents a unique opportunity to improve stormwater in an urban area. It can be modified to function as an extended detention basin, enhanced to filter and reduce polutants. This will reduce flooding and contribute to improved water quality.

Water is diverted into the channel when flood stages at its inlet on Stevens Brook reach a certain level. Water flows along the channel until it discharges over an outlet control weir, then under Nason Street, where it then enters Rugg Brook.

Outlet from the diversion structure.

The Diversion Structure has been effective according to some local officials. The frequency of flooding has definitely been reduced in the historical flood plain since the structure was constructed. However, several City officials have stated that the structure was not installed as originally intended, and that not enough water is diverted into the channel. Conversely, others have reported that the channel is not functioning as intended because too much water is diverted into Rugg Brook, which has resulted in accelerated erosion and associated impacts to the stream banks along Rugg Brook.

City officials have stated that maintenance on the structure has been minimal to none since it was constructed. However, Mr. William Cioffi indicated that in the summer of 2002, the City of St. Albans reportedly removed several thousand cubic yards of accumulated silts and sediments from the channel.

1.7 Water Quality History

The quality of the water has been in decline for a number of years in the Stevens Brook and the Rugg Brook as well as St. Albans Bay. St. Albans Bay has long been the focus of water quality improvement studies and restoration efforts. Phosphorous and nitrates have been historical pollutant concerns, as these nutrients have caused serious problems in the Bay.

This includes a decade long (1980 to 1990) effort between the Natural Resource Conservation Service (NRCS) and individual property owners through the Rural Clean Water Program (RCWP) to install Best Management Practices (BMP's) on many of the farms in the area.

There are two (2) distinct water quality issues and sources of pollutants in this watershed:

Section 303(d) of the Clean Water Act

Under Section 303(d) of the 1972 Clean Water Act, states, territories, and authorized tribes are required to develop lists of impaired waters. These impaired waters do not meet water quality standards that states, territories, and authorized tribes have set for them, even after point sources of pollution have installed the minimum required levels of pollution control technology. The law requires that these jurisdictions establish priority rankings for waters on the lists and develop TMDLs for these waters.

1. Agricultural runoff that enters the Stevens and Rugg Brooks. Runoff from agricultural lands carries with it sediments rich with nutrients (phosphorus and nitrates) and organics.

2. Stormwater runoff from the urban, developed areas. Pollution of impervious areas (roads, parking lots, roof tops, etc) includes toxics (metals and organics), oil, grease, hydrocarbons and sediment.

The United States Environmental Protection Agency (EPA) has, under Section 303d of the Clean Water Act required that individual states identify water bodies (streams, lakes, etc) that do not meet Water Quality Standards. The Act also requires that the states develop a plan for cleaning up the water. The program to develop the clean up plan is called the Total Maximum Daily Load (TMDL) Program. This program provides a process for determining pollution budgets for impaired waters with the intention that once implemented, will result in meeting the Clean Water Act.

The Stevens Brook and the Rugg Brook are both identified as impaired waters and are included on the VTDEC's 303d list. The segments of the streams that are impaired are identified through sampling, testing and monitoring by the VTDEC.

The identified impairments and the location are summarized on the following table. The source of this information is the State of Vermont, Draft 303d List of Waters, July 15, 2002, Part A – Impaired Surface Waters in Need of TMDL, Interim List – Waters for Section 303d "De-Listing."

Insert DEC List of Waters

2.0 STUDY METHODOLOGY

The process of developing an understanding of the problems and opportunities that exist in the watershed is complex, and involves social, political and technical issues. In order to advance this understanding, a Technical Work Program (study methodology) was developed at the beginning of this study. The objective was to develop a process that would result in an unbiased understanding of the issues faced in this watershed.

The work program has been framed around three (3) basic steps that allows for clear definition of the tasks to be performed with associated milestones and deliverables, as outlined below, followed by a discussion of each:

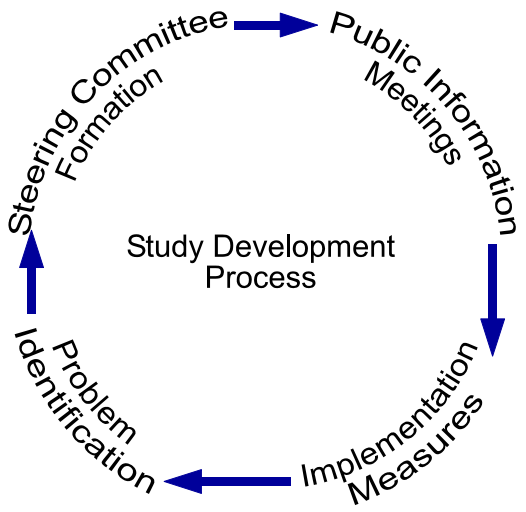
2.1 Steering Committee Formulation

The first step, prior to the initiation of the study, was the assembly of a Project Steering Committee. The purpose of this Committee was to assist in the solicitation of public and municipal input for the project, to review draft documents generated by the Principal Investigator, provide guidance and recommendations for content and provide a recommendation to the Board of Commissioners with regard to the approval of this report.

The Steering Committee assisted in soliciting project input, document review, and guidance and approval.

The Committee consisted of a number of people, resulting in a wide background and expertise variety. Community leaders from the City and Towns, concerned citizens, river management experts and watershed planners from local and state agencies, and representatives from the Natural Resource Conservation Service were the composition of the Committee. A list of the people who served on this committee is included in Section 1 of this report.

Figure 4
Interaction Diagram



The study was developed following an interactive process. Problems were identified and solutions generated. Steering Committee and Public Information meetings were held throughout the study, ensuring interaction and input from a number of sources.

Six (6) Steering Committee meetings were conducted over the course of this project. Representatives from the Northwest Regional Planning Commission chaired the meetings. DuBois & King provided a project status and initiated discussion on project issues, followed then by a round table discussion by committee members. Minutes of these meetings are available at the Regional Planning Commission's office. A brief summary of each meeting is outlined below:

Table 4
Steering Committee Meetings Summary

Steering Committee Meeting	Date	Purpose / Summary of Meeting
1	June 2002	*Discussion focused on the methodology of developing this project and represented the initiation of this project*
2	December 3, 2002	*Presentation of the Problem Identification Matrix (found in Appendix B). Discussion centered on the information contained in the matrix and the overall format.*
3	January 16, 2003	*Discuss the draft list of Watershed Implementation Measures developed by DuBois & King, which addresses the previously defined problems. Outcome was refinement of implementation measures and identification of several additional ones.*
4	March 6, 2003	*Discuss the draft Watershed Improvement Implementation Plan developed by DuBois & King, prepared following input on previously developed implementation measures. Comments were presented for incorporation into report.*
5	April 22, 2003	*Conduct initial discussions regarding priorities of the Watershed Implementation Plan that had been previously submitted. Issues such as what implementation measures would be considered to be short versus long term were discussed along with their associated priority for implementation.*
6	June 23, 2003	*Discuss priorities of the Watershed Implementation Measures.*

2.2 Public Information Meetings

Three (3) Public Information Meetings were conducted during the duration of this study. There were several objectives of these meetings, including:

- Provide a forum for the public to become informed about the watershed study, its purpose and methodology of development,
- Allow opportunity for direct public input on watershed problems and potential solutions for improvement,
- Provide project status and direct question and answer dialog with Study participants.

All meetings were held at the St. Albans Town Education Center, and were conducted between 7:00 pm and 9:00 pm. Ms. Bonnie Waninger, Special Projects Manager for the Regional Planning Commission initiated each meeting. Jeffrey W. Tucker, P.E., Principal Watershed Investigator for DuBois & King presented each study.

PowerPoint presentations and handouts were used to convey the watershed study, input, and potential solutions.

Table 5
Public Information Meeting Summary

Public Information Meeting	Date	Summary
1	September 10, 2002	*Study participants provided an overview of the project purpose and the methodology to be followed during its development. Approximately 30 people attended the meeting and significant discussion occurred throughout the meeting.*
2	January 9, 2003	*Project progress report was given to the attending public, including the presentation of the Problem Identification Matrix. Discussion of the June precipitation events and potential solutions also took place. Approximately 20 people attended and most contributed to discussion of the issues.*
3	June 5, 2003	*Primary purpose was to present the findings and conclusions of the Study to the public. A secondary objective of the meeting was to discuss the primary recommendations with the public and answer any questions that arose. Approximately 20-people attended this meeting and as with the first 2 meetings, most people in attendance contributed to the discussion of the issues.*

Each of the three meetings was well represented by City and Town officials, state and regional officials and interested local citizens. Each meeting lasted the entire scheduled two hours and many of the participants contributed to the discussion.

2.3 Phased Study Development Process

The Study Development Process occurred over three phases:

- Identification and compilation of the primary problems in the watershed and their associated impacts to the communities.
- Development of the *Watershed Improvement Implementation Plan*, which would provide short- and long-term solutions to the identified problems.
- Preparation of this report, titled *Watershed Study Report.* As indicated above, the purpose of this report is to summarize and present the results of Phases I and II as well as a overview of the Steering Committee Public Information Meetings.

The following is a discussion of each phase followed in the development of this Study.

2.3.1 *Phase I: Watershed Assessment and Problem Definition*

The purpose of Phase I is to identify and summarize the general existing condition of each watershed, and the primary problems that exist. Prior to this Study, there has been no overall compilation of information on the problems and what impacts they are having on the riverine system and to the communities within the watershed. Without a summary, it is difficult to create a vision of potential solutions on an overall watershed basis.

The watershed problems were identified and evaluated using a combination of techniques, which include:

- Site Reconnaissance to View Problems and Site Conditions
- Interviews with People having First Hand Knowledge
- Review of Historical Information
- Watershed Assessments

2.3.1.1 Site Reconnaissance and Interviews

DuBois & King water resource engineers conducted approximately six site visits as part of assessing the principal water resource problems. This included touring several key flood prone areas with City and Town officials shortly after the June 2002 flood storm events. In addition, discussions and interviews were conducted on-site with several people, including a local developer, farmer, manager of a large facility and state official in responsible charge of the state transportation system in the region. Insight to the problems facing the watershed was obtained as a result of this effort.

Straightened channels and lack of vegetated buffer reduces ability to filter pollutants from parking lots and contributes to flooding.

DuBois & King water resource engineers also walked most of the accessable areas of each brook, and observed and took photographs of the areas visited. Representatives from the State Department of Environmental Conservation, River Management Section, the City Public Works Department and the Town Selectboard also participated in several of the site reconnaissance's and provided valuable historical insight regarding the changes that have occurred and with the assessment of the existing conditions.

2.3.1.2 Review of Historical Information

DuBois & King water resources engineers conducted a comprehensive review of available historical information. The historical information was reviewed to establish background and a baseline for the Watershed Assessment. The information reviewed included:

Severely constricted channels and structures trap flood borne debris, causing flooding.

- FEMA Flood Insurance Studies for the City of St. Albans (September 1977) and the Town of St. Albans (June 1988),
- FEMA flood damage reports for recent flood events (1996 and 1998),
- Stormwater runoff studies conducted by third parties,
- Stormwater analysis conducted for recent and future commercial and residential development,
- Stormwater analysis conducted by the State of Vermont Agency of Transportation for future and current highway projects,
- Federal design documentation for the Diversion Structure.

2.3.1.3 Watershed Assessments

DuBois & King water resource engineers conducted a limited Fluvial Geomorphic Assessment with assistance from representatives of VANR-River Management Division. An estimate of basic geomorphic parameters was obtained for the Stevens Brook, using VANR Stream Geomorphic Assessment (April 2002)

protocols. The estimate of the parameters was the result of a Phase I Stream Geomorphic Assessment.

The following tasks completed the Phase I Assessment:

- Representative stream reaches were chosen for initial evaluation,
- Field measurements, including cross-section geometry, were taken during a field visit,
- The obtained field data was entered into the VANR Database,
- The database returned preliminary conclusions which was evaluated for consistency with physical observations, and
- The final conclusions were obtained from the database and confirmed by VANR personnel.

Results achieved during this assessment were used to quantify and qualify reaches of concern or reference within the watershed. The results of the analysis aided in the identification of the watershed problems. In addition, the results were considered during the development of the Watershed Improvement Implementation Plan.

2.3.1.4 Problem Identification Matrix and Project Mapping

The preparation of a *Watershed Problem Identification Matrix,* located in Appendix B was the first milestone delivery for this phase of the study.

This matrix provides a description of the watershed problems on a reach-by-reach basis along both brooks. Information on the matrix included:

- Reach identification number and landmark description
- Description of the existing land use
- Bulleted summary of problems, the morphologic condition, the riparian condition and the water quality classifications.

A Reach Identification Map of the watershed was also prepared. This map illustrates the approximate boundaries of the watershed of each brook and identifies each reach corresponding with the matrix. In addition, the map illustrates other key information such as land and natural features and political boundaries.

The Glossary of Terms, the Problem Identification Matrix and Study Base Map are located in Appendix A, B and D of this report.

A Glossary of Terms provides the reader with an explanation of most of the technical terms used in the study. Every effort was made to present Study results

(including this report) in clear, user friendly English. However, some technical terms, such as floodplain, morphology and other terms were necessary.

Although identified as a problem based matrix, many of the entries in the matrix are actually observed symptoms of a larger problem. For example, in reach five, the intersection of Lower Weldon and South Elm Street identifies a problem of street and basement flooding. This is a historical flood prone area identified by City officials as being one of the first areas to experience flooding during a storm event. Flood water backs up in the City storm sewer, then is forced up the manhole, resulting inundation of the street. This inundation requires the City to close the road and the re-routing of local traffic.

While this is an ongoing problem for the City, the reasons that the streets are inundated is simply because there is too much floodwater entering the system. Water has no place to go, except for up and into the road. The root problem is that too much water is running off the watershed during a storm event. The watershed has lost much of its ability to absorb rainfall into the ground, so the excess runoff enters the system, overwhelms it and results in street flooding.

The Problem Identification Matrix was presented to the Steering Committee for review and comment. A follow-up Steering Committee meeting was held on December 3, 2002 to discuss this information. Several revision recommendations were made and the matrix was updated to reflect the comments.

Increased development in the watershed has reduced absorption of rainfall into the ground. Excess runoff overwhelms drainage systems and results in serious flooding.

The principal watershed problems can be summarized as:

1. Excessive runoff during storm events. Excessive runoff has resulted from long-term development within the watershed, converting pervious land to impervious lands with drainage systems connected directly to the streams.

2. Land use practices. Development into the riparian buffer occurs in all segments of the watershed, including residential (mowing lawns right to the edge of brook), agricultural (plowing fields to the brooks edge), commercial and industrial (filling in floodplain)

3. Continued construction of facilities within the flood zone, thus increasing damages.

4. Inadequate (too small) bridges and culverts and supporting drainage systems.

The symptoms of the problems can be summarized as:

1. Increased flooding and flood related damages during periods of excessive runoff. Flooding of homes, public buildings, municipal infrastructure and commercial and industrial areas. Closure of local roads and bridges.

2. Degraded water quality.

3. Increased erosion from all areas of the watershed, transporting sediment and silts into the brooks. Pollutant laden sediments (runoff from parking lots, as an example) is degrading water quality.

4. Stream channel instability, severe stream bank erosion, loss of riparian buffers.

Other problems and associated systems are identified in the Problem Identification Matrix, which is included in Appendix B.

2.3.2 *Phase II: Watershed Improvement Implementation Plan*

The purpose of Phase II is to build upon the information generated in Phase I and identify and summarize areas where opportunities exist to improve or achieve sustainable watershed functions and values. The objective or output of this phase is a document that can be used by local, regional and state decision makers for the implementation of watershed improvement measures.

The result of this effort is a detailed *Watershed Improvement Implementation Plan*, which is presented in Appendix D.

This Plan includes over twenty (20) specific implementation measures, which in their own way, will provide for short- and long-term improvements to the watershed. The primary measures contained in the plan are ones that address:

- Long-term planning of the watershed, for the purpose of providing Municipalities with a way to develop criteria and review future land development proposals at sustainable levels.

Insert Final Implementation Summary Table

Insert Final Implementation Summary Table

- Watershed hydrology, including measures to reduce existing stormwater runoff and the associated volume of water, for the purpose of reducing flooding and flood related damages.

- Flood control by protecting flood prone areas with structural measures for the purpose of reducing flood related damages.

- Water quality, for the purpose of improving existing conditions both along the brooks and also throughout the watershed to the maximum reasonable extent and for providing the municipalities with a way to maintain water quality standards in each brook.

- Public education, because it is critical that all people who live and work in the watershed understand that individual actions, even if physically far removed from the brook and flood prone areas, directly contributes to the success or failure of a sustainable, healthy and safe watershed.

Examples of quality vegetated buffers do exist on the Stevens and Rugg brooks, and should be protected from future development.

- Future watershed management, for future management of development within the watersheds, for restoration of impaired habitat and riparian buffers and for public outreach and education, with recommendations for reducing runoff from significant impervious areas (retrofit storm water systems).

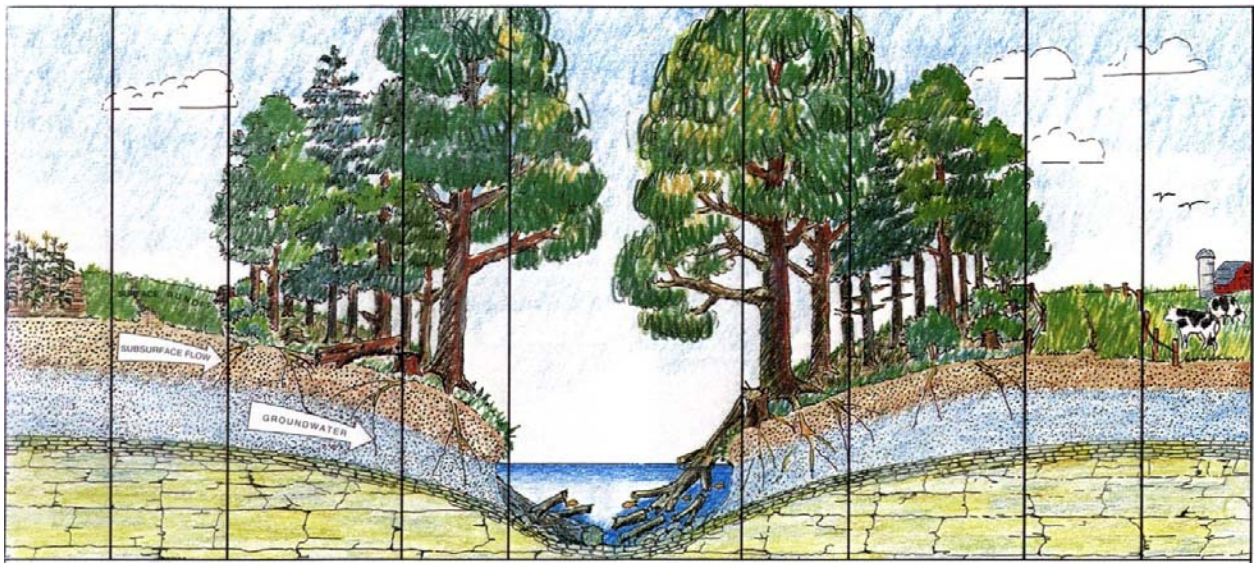
- Watershed hydrologic and hydraulic flood forecasting model. A summary of the implementation measures in presented in Table 6. This summary indicated the priority, approximate costs and time implementation of each measure.

  One implementation measure that had near universal support from the public, steering committee members and state and federal technical people is the development of a detailed watershed runoff computer model. This model, if prepared as envisioned by DuBois & King, will be a valuable tool for municipal officials in the evaluation of proposed development, and in the evaluation of proposed implementation measures, such as detention facilities.

  This model will estimate and quantify stormwater runoff under existing conditions in the watershed. Then, as new development is proposed, the municipalities can enter the proposed development into the model and estimate the impacts to runoff and flooding. This model will provide planning and

regulatory officials with specific hydrologic information regarding a development project and allow them to determine if the project will, or will not, impact flooding further downstream. This implementation measure is discussed further in Appendix D.

Figure 5
Idealized Riparian Buffer



Source: USDA

3.0 CONCLUSIONS and SUMMARY

The intent of this study is to identify problems in the watershed and to identify and evaluate solutions that will result in the short and long term resolution of the problems. The results address long standing concerns regarding flooding, flood related damages and impaired water quality. In addition to providing the results of the investigation, this report is intended to serve a planning document for Local and State planners, developing a sustainable growth plan for the St. Albans community.

This study concludes that there are a number of water resource problems in the watershed. These problems are real, well documented, and will continue to grow as development continues. As indicated above, these problems are documented in Appendix B of this report.

One critical point to make is that the problems are watershed wide, and are not restricted to the floodplain corridor along the brooks. The fact is, land use activities everywhere in the watershed contribute to the problems. It is only the symptoms that are most visible along the brooks.

Also critical is the fact that there is growing development pressures in the watershed, particularly in the middle to upper reaches in St. Albans Town. There are a number of large development projects that are expected to be presented to the Town for approval in the near future. It is very

important that these projects be located in non-flood prone areas, and that the stormwater systems be designed to mitigate the conversion of undeveloped lands to impervious areas.

This study also concludes that there are a number of specific implementation measures that can address the problems. Many of these measures are inexpensive and do not require significant expenditures of funds to implement. Changing land use habits, such as disconnection of roof drains into the drainage systems, or the restriction of most activities in the riparian buffers are several examples. Some of the implementation measures are not simple, and will require long term planning and extensive funding, such as large detention basins. However, it is the coordinated implementation of a combination of large and small measures that will result in the long term, sustainable use in this watershed.