Halfway Brook Watershed Management Plan

August 2000

Warren County Soil & Water Conservation District

Washington County Soil & Water Conservation District

The Halfway Brook Watershed Assessment Plan

Prepared by:

Jim Lieberum, Water Resources Specialist
Dave Wick, District Manager
Warren County Soil & Water Conservation District

Joe Driscoll, District Manager
Washington County Soil & Water Conservation District

Scott Fitscher,
USDA-NRCS, Washington County

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Linda Hare	Adirondack Community College
Town of Queensbury	
Town of Fort Ann	
Town of Kingsbury	
Village of Fort Ann	
City of Glens Falls	

Executive Summary

In 1998, the Warren and Washington County Soil and Water Conservation Districts (SWCD's), with support of the local communities, applied for grant funding from the EPA for a watershed wide study of Halfway Brook. Historically Halfway Brook had been a successful trout fishery in the area, but with land use changes, the water quality of the brook was suspected to have declined. In an effort to determine the cause of the decline and suggest recommendations for improvement, the NYS Department of Environmental Conservation and the Environmental Protection Agency awarded the Warren and Washington SWCD's funding for a study on the watershed.

The Halfway Brook watershed is located in Warren and Washington Counties, and is a subwatershed within the southern end of the Lake Champlain drainage basin. The headwaters are located on the USGS Lake Luzerne Topographic Quadrangle map, and the outlet is at the Champlain Canal in the Fort Ann Quadrangle map. The Halfway Brook watershed is approximately 56,430 acres with an elevation at the headwaters of 1295 feet above sea level and an elevation of 120 feet above sea level at the confluence of the Champlain Canal, a difference of 1175 feet. On the Warren County side of the watershed, Halfway Brook is listed as a class AA(T), and in Washington County the majority of the stream is class A(T).

Stormwater runoff has been identified as a concern with the water quality of Halfway Brook, with phosphorus being the main concern. Lake Champlain is becoming eutrophic, and it is suspected that phosphorus plays a major role. This study was implemented to identify areas of concern within the watershed, evaluate what is causing the concern and recommend specific solutions for the potential problems.

In order to determine the areas of concern, site investigations along with the use of a Geographic Information System (GIS) were utilized. Halfway Brook was monitored during the time period of October 1998 to May of 2000. Eight locations on the stream were selected for biological and chemical water monitoring. The samples were analyzed at the Darrin Fresh Water Institute in Bolton Landing. In the fall of 1998 and 1999 locations along Halfway Brook were sampled for macroinvertebrates and fish through the NYSDEC's Rotating Intensive Basin Survey (RIBS).

Analysis of the water quality data indicated the levels of phosphorus increase from the headwaters to the confluence with the canal. There are numerous land use changes including development and agriculture that add non-point source pollutants to the brook, which accounts for much of the increase. From the headwaters to the confluence, nitrogen levels decrease, Total Suspended Solids increase and fecal coliform bacteria levels vary depending on the season and sampling location. Fish and macroinvertebrates are impacted throughout the stream, and both noticeably affected by stormwater between Route 9 and Meadowbrook Road.

Agricultural Environmental Management and Nutrient Management Plans were developed for the farms that participated in the watershed management plan. Stormwater impacts in the developed areas of the Halfway Brook watershed were documented and potential recommendations were given that would likely reduce the impacts of stormwater runoff. The recommendations include cost, benefits and potential problems.

Overall, Halfway Brook water quality is influenced by runoff from both developed areas and agricultural lands. Reduction of non-point source pollutants would likely lead to an increase of water quality and aquatic habitat available to the organisms. Working with municipalities and agencies to improve Halfway Brook would benefit the local area, possibly increasing the use of Halfway Brook and its surrounding watershed, while reducing phosphorus loading into Lake Champlain.

Introduction

Butler Reservoir, Queensbury, NY

Water is a precious resource, which we manage to the best of our abilities in developed areas. Because water is so important for everyday life, it follows that we must help protect and conserve one of our largest watersheds in the area: the Halfway Brook watershed. This watershed management plan contains information and recommendations on how we can do just that.

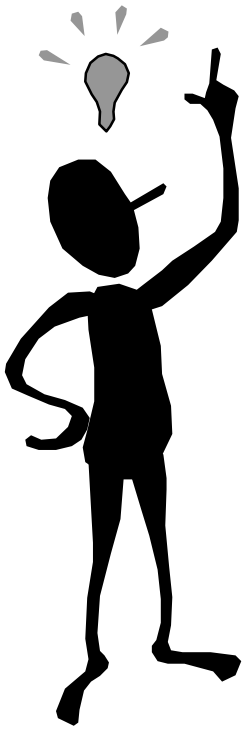
A watershed is the area that drains into a receiving waterbody. The Champlain Canal in Fort Ann is the receiving water body for 56,000 acres that are found within the watershed. Currently, there is great concern regarding the water quality and the overall health of Lake Champlain. Stormwater, agricultural run-off and land development are all suspected to be contributing to the decline of water quality of the lake. Like any waterway with development within the watershed, Halfway Brook is directly influenced by water running off the land located within its watershed. Chemicals, bacteria and sediments are a few of the pollutants carried to the lake from the watershed. These pollutants, which originate from development and other human activities, largely have no well-defined source. Runoff from farm fields or roads, sediments from unstable stream banks, and fertilizers from golf courses and lawns are examples of pollutant sources that cannot be easily defined and eliminated. Termed "non-point source pollution", it is these sources that are the primary targets for this study.

Residents within the Halfway Brook watershed rely on it for drinking water and recreation. While some regulations are in place to protect our water resources, it is largely up to individuals and organizations to pay attention to their activities and ensure that their day to day activities do not contribute to non-point source pollution that degrade water quality. Your use of the "best management practices" described in this book will help protect the future and quality of the Halfway Brook watershed.

In completing a watershed management plan, we must recognize that water does not abide by political boundaries. Numerous municipalities make up the Halfway Brook watershed and it is vital that we work together as towns, villages and counties to adopt policies that will help maintain water quality. To this end, the Halfway Brook Watershed Steering Committee was created of local residents and municipal representatives in the various municipalities within the watershed. The committee's goal is to work together to maintain and improve the water quality of the Halfway brook watershed. The committee encourages residents to become involved in issues affecting the watershed. Participation with local government is a positive avenue to accomplish some of the watershed plan objectives.

This plan is intended to provide information on what watershed residents can do to help protect water quality. This book contains many "best management practices" that you can use as well as some general information about living in the Halfway Brook watershed. Also provided is a list of resources and contacts for those wishing for more information about these subjects.

Purpose of the Plan



The purpose of the Halfway Brook Watershed Plan was to assess the areas of non-point source pollutants, examine the impacts on the watershed and to provide general comment and viable recommendations for improving the water quality of the watershed. Stormwater Assessment Plans as well as Agricultural and Comprehensive Nutrient Management Plans were completed in the fall of 1999, a summary write up is included for the watershed management plan. This document is intended for use by the various municipalities in the watershed as background information and justification for future funding for implementation of projects and programs recommended by this plan.

Each project listed in the recommendations will need site specific planning and engineering. In addition, many of the recommendations for improvement are relatively costly as they cover comparatively large drainage areas. Funding from State and Federal agencies is available to offset the costs of undertaking these improvements, and many local resources are available to assist with developing grants to obtain this money. Many new technologies have been developed to remove pollutants from stormwater runoff, and utilization of these technologies with more traditional solutions could improve the quality of Halfway Brook and its tributaries.

While this planning effort closes out in July 2000, it is hopefully only the beginning of the effort to protect and improve the quality of Halfway Brook for now and into the future.

Historical Information

"It rises in the Luzerne Mountains, west of Glens Falls, and running a tortuous but generally easterly course, receiving the waters of many small tributaries on the way, it empties into Wood Creek in the town of Fort Ann, Washington County, NY." - A. W. Holden (1874)

Halfway Brook was so named because it was located halfway between the military fortresses located in Fort Edward and Lake George. It was the site of many skirmishes and a massacre during the French and Indian Wars, where it earned the name of "Bloody Brook". There was a fortress was on the banks of the stream in Queensbury, which could hold 800 soldiers with cannons. Redoubts, rifle pits, and earthworks were found there and prisoner exchanges took place in the area. After the American Revolution, as Glens Falls started to grow, Halfway Brook was a favorite spot in the area attracting many people from the surrounding countryside. Several ponds located on the stream were used for hydroelectric power, ironworks, a sawmill and production of bricks. It has been known locally throughout the years by a variety of names; Bloody Brook, as noted above, Shone Creek, Scoune Creek, Forks Creek, Halfway Run, Seven Mile Creek and Clear River.

Presently Halfway Brook is largely used for recreation and drinking water for both humans and animals. Over these years however, the water quality has declined in Halfway Brook and many people have become concerned with serious degradation possibly occurring.

In 1981 Halfway Brook was identified as a waterbody of concern in Warren County and was listed in the NYS Department of Environmental Conservation (DEC) Stressed Segment Analysis study.

Sediment loading, nutrient loading, oxygen demand, thermal stress, hydrologic interference and biological agents were all identified as potential problems within the brook.

To take a closer look and come up with some solutions to these problems, the Warren and Washington County Soil and Water Conservation Districts received funding in 1998 for a two-year study to assess the Halfway Brook watershed. Non-point source pollution, including stormwater runoff and agricultural runoff, was the primary suspect in declining water quality. Since Halfway Brook is a tributary to the Lake Champlain Canal, phosphorus loading in the brook is a concern in regard to the eutrophication of the south basin of Lake Champlain. Reduction of phosphorus and other non-point source pollutants would likely result in an improvement of the water quality in the Lake Champlain Canal and the South Basin of Lake Champlain. This report is a compilation of the two-year study's findings.

Halfway Brook Steering Committee

When working on a project that involves a variety of issues and that impacts a number of people, representatives of the public should be included. A steering committee comprised of persons with different ideas and interests in the region helps to guide a project through the objectives. In addition, having a diverse committee ensures that many concerns and questions are addressed. The Halfway Brook Watershed Steering Committee was created for just this purpose.

The Committee is comprised of twenty-four people from Warren and Washington Counties. Members of the committee are volunteers and represent a diverse cross section of the local community (see the membership roster below). New members remain welcome at any time; the only prerequisite being an interest in the brook and its surrounding watershed.

As in any project of this nature, at first there was a sense of uneasiness among the community, as some individuals perceived the project as a vehicle to potential future regulations. This concern was eased as members began to discuss watershed issues and educate each other about their perspectives at the bi-monthly meetings. At the last committee meeting at the conclusion of the two-year study, the group decided that the effort was indeed very worthwhile and that the committee structure needed to stay intact. At least semi-annual committee meetings will be held in the future as a means of maintaining momentum and accountability in implementing the watershed plan. A true conservation partnership has been developed that engages critical stakeholders to a common theme. This watershed plan simply laid the groundwork for all parties to proceed with implementing recommendations and action items for the betterment of Halfway Brook.

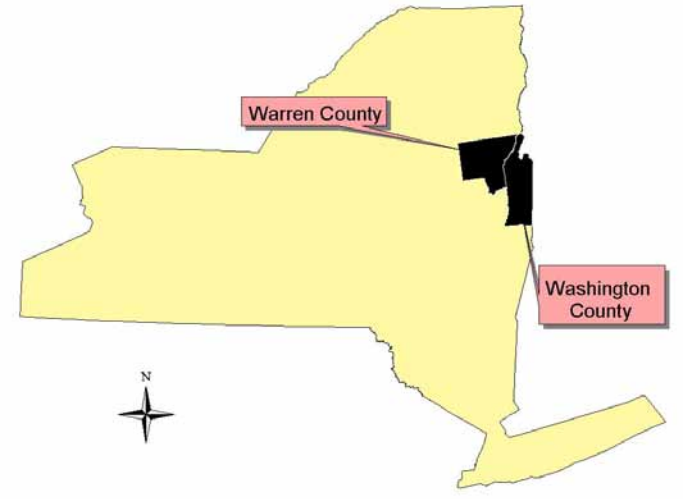
Halfway Brook Steering Committee- Tour of Halfway Brook Watershed, 1999.

Halfway Brook Steering Committee Members

Name	Affiliation
Dave Wick	Warren County Soil and Water Conservation District (co-chair)
Joe Driscoll	Washington County Soil and Water Conservation District (co-chair)
Harold Fuller	Fort Ann Councilman/dairy farmer
Malcolm Vaughn	Kingsbury Councilman/dairy farmer
Robert Mattison	Fort Ann Farmer
Inez Mattison	Town of Fort Ann Councilwoman
Rob Brooks	Washington County Planning Department
Aaron Gabriel	Washington County Cornell Cooperative Extension
Scott Fitscher	USDA Natural Resource Conservation Service
Bill Lupo	NYS Department of Environmental Conservation
Joe Racette	NYS Department of Environmental Conservation
Betty Monahan	Former Queensbury Town Councilwoman
Laura Moore	Queensbury Planning Department
John Braico	Trout Unlimited – Adirondack Chapter
Don Coalts	Glens Falls Water & Sewer Superintendent
John Aspland	Town of Fort Ann Supervisor
John Dickinson	Ideal Dairy Farm
Bill Loeb	Former City of Glens Falls Councilman
Holly Ahern	Adirondack Community College, Associate Professor

Watershed Characteristics

Various characteristics of the Halfway Brook watershed including land use, topography, soils, fisheries, geology, hydrology and vegetation were summarized for this assessment using the most recent data available. This information is necessary for understanding and interpreting the interactions that occur within the Halfway Brook watershed. Watershed information was collected from a variety of sources including existing maps and fieldwork, and computer mapping of this information was conducted using a Geographic Information System (GIS). GIS coverages were obtained from the following of sources; NYS DEC, NYS Museum, Adirondack Park Agency, Warren County Planning Department, Washington County Planning Department, Town of Queensbury, Warren County Soil and Water Conservation District and the Washington County SWCD. The culmination of this information is presented below.



Location of Warren and Washington Counties

Watershed Location

The Halfway Brook watershed is approximately 56,400 acres (88.13 sq. miles) and is found stretched over Warren and Washington Counties, within the following municipalities: Towns of Fort Ann, Kingsbury, Queensbury, Lake George, City of Glens Falls and Village of Fort Ann. There are approximately 26,000 people living within the watershed boundary. Approximately 22,900

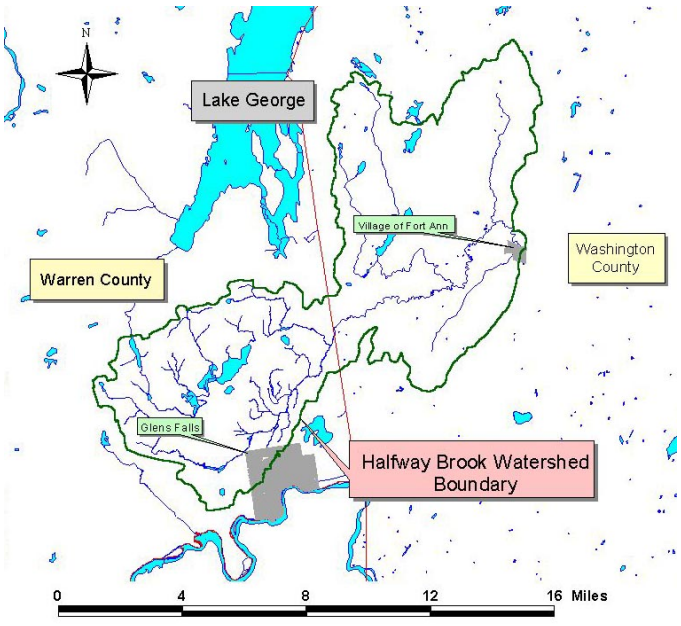
residents live in Warren County, and on the Washington County side there are approximately 3,100 people residing in the watershed.

The headwaters of the Halfway Brook watershed originate from Wilkie Reservoir, found in the Luzerne Mountains. The western most section of the watershed is bounded by the Luzerne Mountains, which divides the Lake Champlain and Hudson River drainages in Warren County. The watershed line approaches the city of Glens Falls and essentially cuts Glens Falls in half. In the City of Glens Falls, subsurface drainage is a key consideration. After meeting with Donald Coalts III, Superintendent of Water for the city, a delineation of overland flow was created within the city and the watershed line was altered to take this flow into consideration.

Within the watershed there are nineteen named lakes and ponds and numerous smaller unidentified ponds. Several of these lakes have substantial shoreline development including Glen Lake and Lake Sunnyside in Warren County, Hadlock Pond in Washington County. A watershed plan has been developed for Glen Lake and Lake Sunnyside, with recommendations for water quality improvement projects.

Stream Location

The main branch of Halfway Brook is 26 miles long, and is located in Warren and Washington Counties. The headwaters of Halfway Brook flow into Wilkie Reservoir, found in the Luzerne Mountains, on the west-side of Queensbury New York. The main stem of Halfway Brook flows generally west to east from Warren County through Washington County. After its 26 mile run, the brook empties into the Lake Champlain Canal, at the Village of Fort Ann in Washington County. The Champlain Canal then flows northward to the South Bay of Lake Champlain.

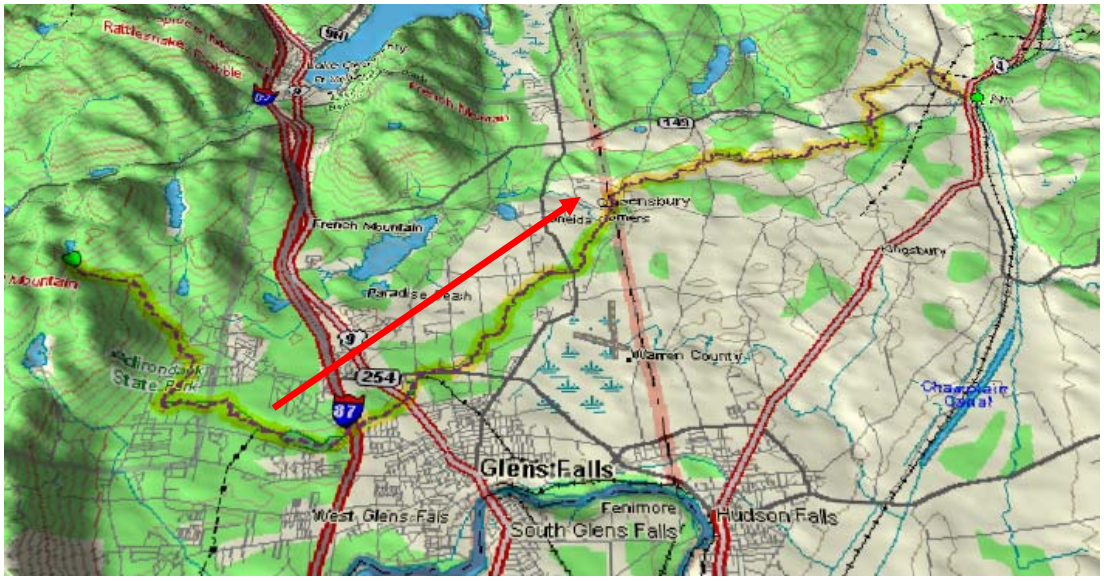


Halfway Brook watershed location map

Water Quality Designation

Halfway Brook is listed as a class AA(T) waterbody by the NYSDEC in Warren County and part of Washington County. An AA(T) classification declares that the best use of this water shall be for “drinking, culinary or food processing purposes; primary and secondary contact recreation; and fishing. These waters shall be suitable for fish propagation and survival.” (NYSDEC, 1992). In this case the (T) is specified for trout propagation and survival. Around Pattens Mills Road in Washington County, the classification changes to A(T), again best use as “drinking, culinary or food processing purposes;

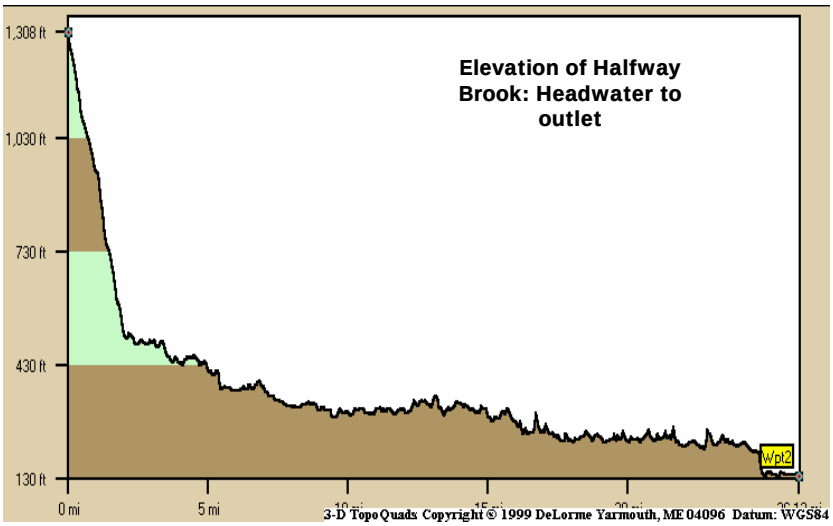
primary and secondary contact recreation; and fishing. These waters shall be suitable for fish propagation and survival." (NYSDEC, 1992).



Halfway Brook; highlighted in yellow, travelling wets to east

As the stream enters the Village of Fort Ann, the classification is C with the best use of the waters being for fishing, with the water being suitable for fish propagation and survival.

Topography



There is a wide range of topography within the Halfway Brook watershed. The mainstem of Halfway Brook, originating at the Wilkie Reservoir outlet is 1308 feet above mean sea level. The outlet, at the Village of Fort Ann is 136 feet above mean sea level. The resulting slope for the mainstem is 0.85%, a relatively flat slope. The highest elevation in the watershed is Pilot Knob, on the Northwest watershed boundary line, a 2163 feet above mean sea elevation. In Warren County, the Luzerne Mountains dominate the landscape on the western most section of the watershed. After Halfway Brook crosses West Mountain Road, the total change in elevation to the county boundary is approximately 210 feet.

After the initial drop in elevation (806 feet, 7% slope) from the Wilkie intake Reservoir to West Mountain Road, Halfway Brook travels through the gently sloping land south of the Adirondack Mountains. Large areas of flat topography dominate in the Queensbury-Glens Falls area, with many wetlands bordering the stream. As it crosses the county line, it begins to travel through a deeper valley, with sides in some instances as high as 40 to 50 feet.

Topography of the Halfway Brook watershed

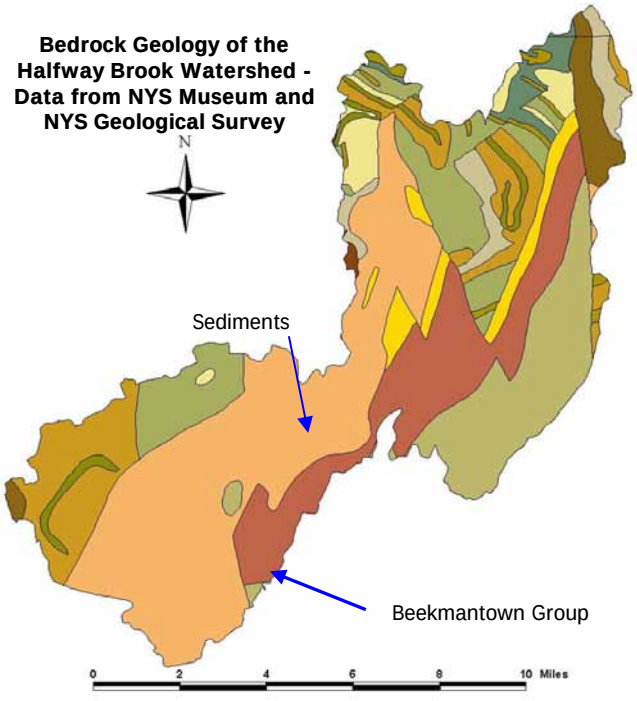
It continues its course until reaching South Bay Road (Washington County Route 16), in the Town of Fort Ann. As it travels east of South Bay Road, a waterfall of approximately 40 feet (Kane Falls) occurs. At the bottom of the falls the stream travels approximately 1.4 miles (elevation change from the top of the falls to the canal is 49 feet, 0.7% slope) to the confluence of the Champlain Canal, in the Village of Fort Ann.

Overall both gentle and severe slopes are found within the watershed. Most of the steepest slopes can be located in Washington County, on the northern edge of the watershed, while the gentle slopes are found throughout the main stream corridor of Halfway Brook.

Geology

(Adapted from Fisher, 1984)

The Halfway Brook watershed is comprised of many types of bedrock geology. The geology of the region dates to around 1,400 million years ago (mya) with sediments in the area developing about 1,100 mya. Sands, clays, lime muds and other mixtures built up on a continental shelf, where they eventually turned to sandstones, shales, limestones, and other mixtures of these rock formations. The two most common bedrock materials are discussed below.



Sediments

Sediments, which make up a significant portion of the watershed, are located in the areas where the bedrock geology is uncertain. They are light

brown, tan and gray gravels, sands, silts and clays in the forms of kames, morraines, outwash plains, terraces and tills. The gravels and sands are excellent to good aquifers with the outwash deposits being the most productive. Lake clays and tills are relatively impermeable, but yield water slowly and are poorly drained. Gravel and sands are used for construction purposes and concrete. Some swamps and bogs are potential sources of peat for local agricultural needs.

Beekmantown Group**,** *undifferentiated dolostones and limestones.*
The groundwater yields are generally good for domestic or small commercial supplies, but can vary locally depending on location of open joints and cavities; groundwater is generally hard. Soil material from the Beekmantown Group is used for road aggregate, rip-rap and fill. Historically, some of the soils have been used as building stones and canal lock material, and others have been used for making stone tools and projectile points (spearheads).

The bedrock material that is found in each county lends itself to the soils found there. The sandy outwashed soils that are common in Warren County are result of the sand sediments laid long ago. In Washington County, clay soils deposited from an inland sea are found.

Soils

(Adapted from USDA et al., 1989)

There are two basic types of soil in the watershed. In Warren County, sandy soils such as Oakville, Bice and Warham occur. In Washington County, clay soils such as Kingsbury, Vergennes and Rhinebeck are prominent.

Typical sandy soil of Warren County, NY

Warren County

The sandy soils of Warren County that are on the hillsides and above the floodplains are well drained and deep. They allow water to permeate into the ground rapidly, and have little capacity to hold water. The slope on these soils is generally between 0 and 15% in the watershed. Soils in the floodplains are poorly drained and have severe land use limitations.

The following is a brief description of 3 predominant soil types that are representative of the soils in Warren County, in the Halfway Brook watershed.

Oakville loamy fine sand**:** This soil is formed in sandy outwash deposits on terraces and plains. Generally the slope is 0 to 8%, and permeability of water through the soil is rapid. These soils are mainly found in the urbanized areas, some areas have been used for farming. These soils are well suited to recreation, but lack the ability to maintain good grass cover due to low amounts of nutrients found in this soil.

***Bice fine sandy loam*:** This soil is formed in glacial till from granite type bedrock. Slope ranges from 3 to 45%, but is dominantly 8 to 35%. The soil is well drained and moderately coarse textured, and permeability of water through the soil is moderate. Large stones and boulders are common at the surface. This soil type is located at the foothills of the Adirondacks in the Luzerne Mountain area. Most areas of the soils are in forestlands. Limitations such as droughtiness, slope, rock outcrops and stoniness reduces the use of this soil for agriculture and development.

***Wareham loamy sand*:** This soil is somewhat poorly drained and very poorly drained. It is found in depressions on sandy plains and low benches in valleys. The slope range is generally from 0 to 3%, and permeability of water through the soil is rapid. A seasonal high water table is found between the surface and a depth of 1.5 feet most of the year. Most areas of this soil are forested. The soil is poorly suited to recreation and urban uses due to the high water table. Bedrock is generally found below 6 feet.

There are many considerations to be made when dealing with the sandy soils of Warren County. The suburban-urban characteristics of the area have the potential to deliver non-point source pollutants to ground and surface waters. Sandy soils, while generally beneficial in allowing water to permeate into the ground, on occasion allow the water to travel too rapidly. Septic systems that are placed in an inappropriate location may also contaminate ground and/or surface waters, if the time of treatment is not sufficient. Inspection of site locations for on-site septic systems and stormwater treatment facilities would be needed in order to reduce the likelihood of potential problems.

Washington County

Clay soils of Washington County.

Very near the county boundary on Halfway Brook, the soils change dramatically. The sandy soils of Warren County are replaced by more clay dominant soils of Washington County. The clay soils of Washington County, like Warren County, are the result of glaciation. Vergennes and Kingsbury soils formed from lake laid deposits from what was once an estuary of the Champlain Sea.

The Rhinebeck soils are also laid lake deposits resulting from ancient lakes.

The clay soils of the county are found on broad plains that are nearly level or gently sloping, ranging from 0 to 12% grade. Permeability can range from moderately well drained to somewhat poorly drained. A seasonal high water table perched on a very impermeable subsoil at a depth of 6 to 18 inches is common. The three commonly found soils in the watershed follow:

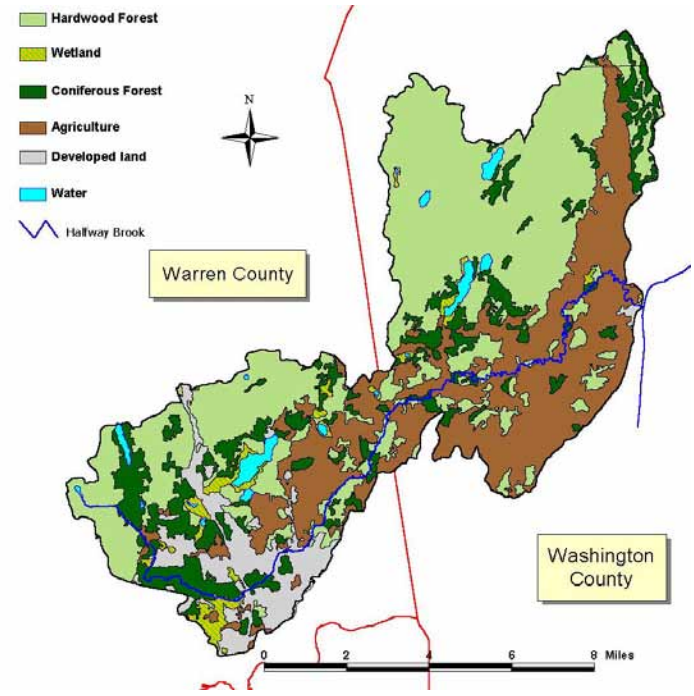
***Vergennes silty clay loam*:** This soil is fine textured and moderately well drained. Slopes are gentle to very steep and convex. Permeability is moderate in the top 18 inches. A perched water table occurs in the spring and the fall at a depth of 18 to 24 inches at a dense clay layer. Permeability is very slow through the clay layer. The soil is medium to high in lime content, and the ability to supply phosphorus and nitrogen is medium, but potassium is high. Most areas are used for agricultural production. The seasonal high water table limits farm and non-farm uses.

***Kinsbury silty clay*:** This soil is fine textured and somewhat poorly drained. It is nearly level to gently sloping and is found where run-off is slow or where water accumulates. Permeability is very slow. A firm clay layer restricts downward movement of water at a depth of 6 to 18 inches. Plant roots are mainly limited to the upper 15 to 20 inches. The soil is high to medium in lime, the content of nitrogen and potassium is high, while phosphorus is medium. The seasonal wetness limits farm and non-farm uses. This soil is generally suited to hay pasture and woodland; row crop production is difficult unless drained.

***Rhinebeck silt loam*:** This soil is medium textured and somewhat poorly drained. Soils are nearly level and gently sloping. Seasonal high water table is perched on a slowly permeable subsoil at a depth of 6 to 18 inches. Rooting depth is mainly in the top 18 inches. Soils are medium to high in lime, with capacities to supply nitrogen and phosphorus medium, and potassium high. The soil is generally used for row crop production, and when adequately drained it is considered prime farmland.

Agriculture dominates the landscape of Washington County because of these soil types. The clay soils of the watershed are some of the most productive soils in the county, but management of these soils can be difficult. Moisture content of the soils is the single most important factor when performing tillage operations. Working these soils under wet conditions creates clods, compaction and destroys soil structure. The erosiveness of the clay may create turbid runoff and contribute suspended solids into the water, thereby decreasing water quality. Best management practices used by farms, can minimize or eliminate the negative aspects of these soils.

Land Use



Halfway Brook watershed land use

"The land ethic simply enlarges the boundaries of the community to include soils, waters, plants, and animals, or collectively: the land. "
-Aldo Leopold

Hardwood Forest: 25,964 acres (46% of the watershed)

Coniferous Forest: 7,642 acres (13.6 %)

Wetland: 1,304 acres (2.3 %)

Agriculture: 16,263 acres (28.8 %)

Developed Land: 4,169 acres (7.4 %)

Water: 965 acres (1.7 %)

Within the Halfway Brook watershed there is a wide variety of land use. Warren County land use ranges from large, relatively undisturbed forests to highly impervious developed areas to flat floodplains, which are along the main stem of Halfway Brook. Washington County has large areas of agricultural land (including meadows and fallow fields) and forestland.

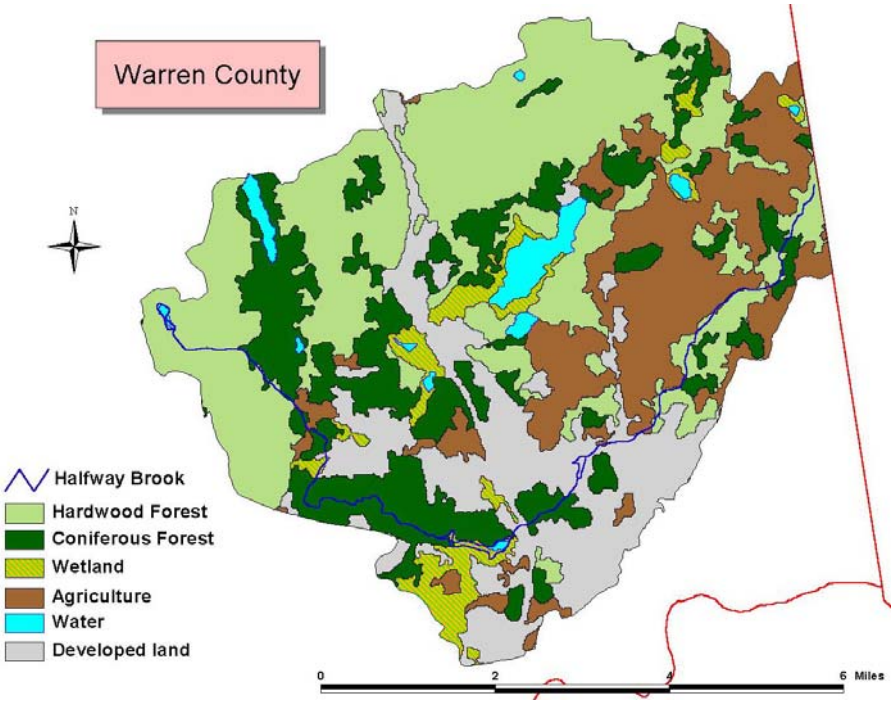
Why do we care about land use within a watershed? The answer is that different land uses can have different impacts to the waterbodies, which they surround. Runoff from developed areas or agricultural lands may carry pollutants, which are not present in runoff from undisturbed or forested lands. Knowing the land use breakdown can enlighten us as to specific locations where streams may be receiving pollutants.

In New York State, non-point source pollution is of great concern. Unlike point sources where pollutants are discharged directly into a waterbody from an easily identified source such as an outflow pipe from a factory, non-point water pollution comes from a variety of sources that are not easily identified or confined to one particular point or location. As land gets developed, road networks built and open space diminished, the hydrology of the land area changes. With increased development, whether it is construction of buildings or clearing of ground for agricultural purposes, we see increases in the runoff to streams and lakes. The more land area that becomes impervious to water, which once infiltrated into the ground, the more now runs off carrying dissolved materials, suspended particles and increased water volumes. When this type of situation occurs, we generally see the water quality of the runoff decline. Rainwater that once landed on forests and fields now lands on parking lots and roads. This water from a rainstorm (stormwater) will fall onto these areas and pick up whatever materials happen to be on this impervious area, and eventually outlet into the nearest waterbody. If there happened to be any gas or oil which leaked from a car in a parking lot, or excess sand from winter sanding operations, this material also gets transported into the stream or lake. As a result, the quality of water in these waterbodies declines and the aquatic ecosystem, which at one time was pristine, now has become impaired. Fisheries habitat in some cases becomes non-existent, and the water quality impaired to such a state that it is not safe for contact recreation.

As mentioned previously, there is a great difference in land use throughout the Halfway Brook watershed. The following is a breakdown of the land uses within the encompassing municipalities.

Warren County

Warren County contains the most heavily developed area of the watershed. This may be beneficial to the economic industry, but it does have impacts on the environment. As mentioned previously, water quality generally declines when there is an increase in stormwater runoff. However, there are ways in which these situations may be remediated.



Halfway Brook watershed land use

NAME	LAND USE	ACREAGE	PERCENT OF LANDUSE IN LOCAL
City of Glens Falls	City	595 Total Acres	
	Hardwood Forest	.04	.01
	Coniferous Forest	41.6	7
	Agriculture #	31	5.2
	Developed	522	87.7

# indicates Glens Falls Cemetery property

NAME	LAND USE	ACREAGE	PERCENT OF LANDUSE IN LOCAL
Queensbury	Town	21,415 Total Acres	
	Hardwood Forest	7,855	36.7
	Coniferous Forest	4,452	20.8
	Wetland	1,059	4.9
	Agriculture ##	4,068	19
	Water	525	2.5
	Developed	3,455	16.1

indicates open land included (vacant, fallow, fields and meadows)

NAME	LAND USE	ACREAGE	PERCENT OF LANDUSE IN LOCAL
Lake George	Town	716 Total Acres	
	Hardwood Forest	556	77.7
	Coniferous Forest	47	6.6
	Agriculture ###	8	1.1
	Water	11.9	1.7
	Developed	92.6	12.9

indicates open land included (vacant, fallow, fields and meadows)

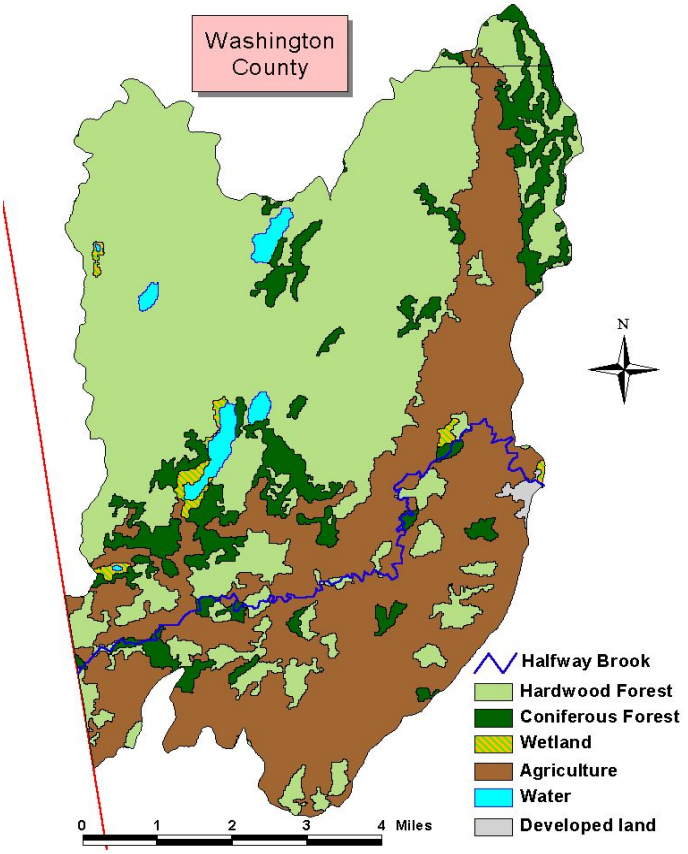
Within the Town of Queensbury, zoning regulations indicate that commercial development along the Halfway Brook corridor exceeds residential development. This may be an important feature to understand. With commercial development, generally large areas of impervious surfaces are created (i.e. roofs, parking areas), which can contribute to stormwater runoff. This is the heaviest developed and populated area of the watershed and is believed to contribute large amounts of untreated stormwater runoff into the mainstem of Halfway Brook. There are areas of open space found throughout the developed area, and the potentially useable areas for cleaning up or infiltrating this stormwater are identified in the Halfway Brook Stormwater Assessment Plan.

The most heavily developed area occurs in Glens Falls and spreads north-northwest. Developed areas make up approximately eighteen percent of the watershed in Warren County. Glens Falls is predominately developed. By having so much of the land area developed, impervious surfaces are increased, leading to an increase in stormwater runoff. There are areas of potential treatment found in the Halfway Brook Stormwater Assessment and Management Plan, available at the Warren County Soil & Water Conservation District. The stormwater management recommendations included in this document are a subsection of that more comprehensive stormwater plan conducted for the watershed.

U.S. Route 9 is a major thoroughfare in the area as it travels north from the heart of Glens Falls north, out of the watershed in the Town of Lake George. As it travels northward, there are large areas of impervious surface, partially due to the amount of commercial development. As it passes Sweet Road, the watershed breaks and the drainage goes to Glen Lake.
The Glen Lake sub-watershed of Halfway Brook is approximately 7000 acres. A Glen Lake Watershed Management Plan had been completed in 1998, by the Glen Lake Watershed Technical Advisory Committee, which dealt with the concerns of stormwater runoff and nutrient loading in that basin. The report is available at the Town Of Queensbury Planning Department and the Warren County Soil & Water Conservation District.

Even with almost twenty percent of the watershed developed, forestland in the Warren County part of the watershed makes up fifty-nine percent of the total land. The forested areas on the western side of the Halfway Brook watershed are a bonus to the area. Owned mostly by the City of Glens Falls for the drinking water supply for the city, these lands provide high infiltration rates and the recharging of the aquifers. There are a few unimproved roads that travel through these mixed hardwood-softwood forests (mainly maples (*Acer sp.*) and pines (*Pinus. Sp.*)) which helps in minimizing water quality impacts to the brook. Recreation is not allowed on the properties, partly for safety concerns, but also for keeping the area as pristine as possible.

Generally, north of Quaker Road and east of Route 9, there are residential homes, forested lands and agricultural land (eighteen percent of the watershed) that has gone fallow. There are no active farms in the Warren County portion of the watershed, but there are locations where farms have gone out and the land remains open. Under this classification, open land is considered agricultural land. There are also areas near the county border that are utilized as cropland by farmers in Washington County. Improved roads cross through the area, but there are treatment areas for stormwater runoff by settling out solids and infiltrating water. There are a few golf courses found within the watershed.



Halfway Brook watershed land use

Washington County

Washington County contains the main portion of active agricultural land in the watershed. With the exception of the Village of Fort Ann, there are no large areas of commercial-industrial development. Residential houses dot the quiet countryside as the brook heads east towards the Village. In Washington County there are only two main land uses in the county's portion of the watershed, - forestland and agricultural land.

Forestland makes up approximately sixty-one percent of the land area. The majority of this area can be found within the Adirondack Park boundary in the Town of Fort Ann. The area west of South Bay Road that borders the Park, east of South Bay

Road, south of the Park and scattered parcels in Kingsbury make up the remainder of forestland. Hardwoods dominate these lands throughout with large stands of Sugar Maple (*Acer saccharum*), oaks (*Quercus sp.*) and American Beech (*Fagus grandifolia*). In this type of habitat large numbers of wildlife can be seen. White-tailed deer, fox and coyote are several of the mammals that may be seen.

The remainder of land use is mainly agricultural. Agricultural land makes up approximately thirty-six percent of the watershed on the Washington County side. In recent years however, several large farms have become inactive and their fields remain fallow. If they continue to remain fallow they will eventually succeed to a forestland again. The majority of the active agricultural land is found as cropland and pastures. Concerns of agricultural runoff from fields are addressed in the Agricultural Management Plans (AEM's). Even though development is not yet a major land use within the Washington County portion of the Halfway Brook watershed, agricultural run-off can have effects similar to urbanized runoff.

NAME	LAND USE	ACREAGE	PERCENT OF LANDUSE IN LOCAL
Fort Ann	Village	150 Total Acres	
	Agriculture ##	65.87	43.9
	Wetland	0.42	0.3
	Developed	83.65	55.8

indicates open land included (vacant, fallow, fields and meadows)

NAME	LAND USE	ACREAGE	PERCENT OF LANDUSE IN LOCAL
Fort Ann	Town	27,651 Total Acres	
	Hardwood Forest	16,546.8	59.84
	Coniferous Forest	2,809.8	10.16
	Wetland	244.9	0.89
	Agriculture ##	7,456.6	26.96
	Water	427.5	1.55
	Developed	15.65	0.06

indicates open land included (vacant, fallow, fields and meadows)

NAME	LAND USE	ACREAGE	PERCENT OF LANDUSE IN LOCAL
Kingsbury	Town	5,901 Total Acres	
	Hardwood Forest	976.9	16.6
	Coniferous Forest	290.7	5.9
	Agriculture ##	4,632.9	78.5

indicates open land included (vacant, fallow, fields and meadows)

The Village of Fort Ann has the highest rate of development in the watershed in this county. Stormwater runoff concerns are moderate, as there are no known stormwater treatment devices in the area and it is a heavily traveled area. The concerns are addressed in the recommendation section of the plan.

In summary, the overall predominant land use of the Halfway Brook watershed is forestland. Agricultural land ranks second and is followed by developed land. It is not unreasonable to surmise that in the near future, developed land will continue to grow and deduct portions of the forested areas and agricultural land. As mentioned previously the number of farms in both counties in the watershed have declined. Some of this land may revert to forest or be developed, that is yet to be seen. This should be closely watched, as we know development changes hydrology, sometimes for the good, sometimes for the bad. If land changes are monitored, environmental impacts can be reduced so that both the communities involved and the surrounding environment may benefit from the changes.

Examination of the land uses in the entire watershed reveals the following breakdown:

NAME	LAND USE	ACREAGE	PERCENT OF LANDUSE
Halfway Brook Watershed		56,308 Total Acres	
	Hardwood Forest	25,964	46.1
	Coniferous Forest	7,642	13.6
	Wetland	1,305	2.3
	Agriculture ##	16,263	28.9
	Water	965	1.7
	Developed	4,169	7.4

indicates open land included (vacant, fallow, fields and meadows)

Vegetation

Within the Halfway Brook watershed there is a wide variety of vegetation found. Forestland dominates the Halfway Brook watershed, and within that land there are many different varieties of vegetation found.

Eastern White Pine

Background

After World War II, a plan to reforest the Glens Falls watershed property was initiated. A total of 2.4 million trees were planted, to turn the former farmland back into a forested watershed. Sixty years later the Glens Falls property remains a thriving forest. The forest is intensively managed to produce high quality timber.

Name	Scientific Name	Number Planted
Eastern White Pine	*Pinus strobus*	2.1 million
Norway Spruce	*Picea abies*	145,000
Red Pine	*Pinus resinosa*	60,000
Scotch Pine	*Pinus sylvestris*	35,000
White Spruce	*Picea glauca*	15,000
Balsam Fir	*Abies balsamea*	10,000
Black Locust	*Robinia pseudoacacia*	1,000
	Total Planted	**2,377,000**

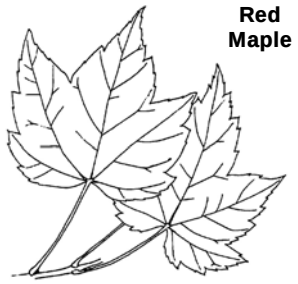
Travelling downstream, from the Wilkie Reservoir toward the Halfway Brook Reservoir, one can see that there are indeed many conifers that are currently found on the municipal watershed property. Heading east the vegetation starts to change, as there have been influences from the American beaver (*Castor canadensis*). More water tolerant vegetation is found in the low, flat areas of Queensbury. Red Maple (*Acer rubrum*), Silver Maple (*Acer saccharinum*), Quaking Aspen (*Populus tremuloides*), Big-Toothed Aspen (*Populus grandidentata)*, Speckled Alder (*Alnus rugosa*) and members of the willow genus (*Salix sp.)* are commonly found.

Halfway Brook, Queensbury, NY

In the city of Glens Falls, several species of Elms (*Ulmus sp.*), Silver Maples and Box –elder or Ash-leaf Maple (*Acer negundo*) are commonly found. Residents in the city also plant a wide variety of plants, both woody stemmed and herbaceous (i.e. pachysandra).

Bluets in the spring

After the crossing of Meadowbrook Road, in the Town of Queensbury, the vegetation changes quite dramatically. Up until this point, there had been open channel and large woody stems. After the crossing however, low-lying shrubs (i.e. alders, honeysuckle (*Lonicera sp.*)) begin to dominate the corridor, and in many cases cover the stream. Many types of wetland flowers can be seen in the areas before Ridge Road: Cardinal Flower, bluets, Jack in the Pulpit, trilliums and lilies are just a few that are easily seen amongst the shrubbery.



As the mainstem of the brook travels through Washington County, topography changes. Higher banks allow for drier soil tree species to be found. Eastern Hemlocks (*Tsuga canadensis*), Northern Red Oak (*Quercus rubra*) and American Basswood (*Tialia americana*) are found. Since agriculture makes up approximately 36% of the land use in Washington County, agricultural fields are seen from the brook. Hedgerows and riparian zones are found in most areas along the brook, with a mixture of woody and herbaceous vegetation. Small maples, honeysuckle and raspberries (*Rubus sp.*) are the woody materials and wildflowers and grasses are the groundcover. Old pastureland that remained fallow is currently turning back into forestland, providing ideal areas for wildlife.

When Halfway Brook passes over Kane Falls, lowland vegetation is seen once again. With the influence of the Champlain Canal on the area below the falls, plants that are able to withstand wet soils and ice damage flourish. Upon entering the canal, roadside plants, Staghorn Sumac (*Rhus typhina*), Silver Maple, and varieties of wildflowers are seen.

The overall watershed is similar to the changes in the stream corridor. As mentioned in the Land Use section, a mixed forest of pines and maples dominate the Warren County side of the watershed, while in the Washington County side, oaks, American Beech and Sugar Maples are commonly found. There are many exceptions that may be found in this diverse watershed and a vegetation inspection on the entire watershed would not be feasible. If there are any questions, please contact Warren County SWCD, Washington Co. SWCD, Cornell Cooperative Extension or the NYS DEC, for further information.

Discussion

What is the importance of knowing what vegetation is in the watershed? Vegetation plays many roles in the environment and, in the case of Halfway Brook, water quality and quantity are two important aspects.

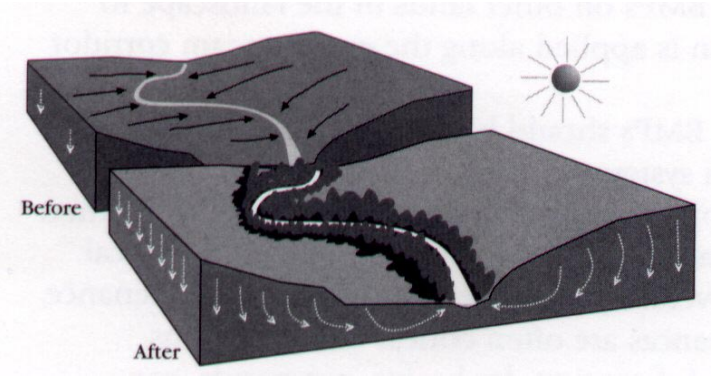
Not all vegetation will grow in the same areas. White Oaks will generally not survive in the constant wet soil of the wetland, nor will a marsh marigold survive on a dry, sandy upland soil. Examining the vegetation of areas can help in the site evaluation, or said another way, the health and tolerances of that area. Soils, shade, nutrients, moisture and temperature all play roles in vegetation management.

When surveyed on whether or not there was an adequate buffer strip between Halfway Brook and the surrounding land, an overwhelming majority of people decided that there was an adequate strip. This is probably true for most areas of the watershed, since it is heavily forested, but not in all. Areas that would benefit from installation of buffers strips or improvement of strips are located around lawns and impervious surfaces which border Halfway Brook or one of its tributaries.

Plants help filter nutrients out of water as it passes over and through them. By doing so, they help in the reduction of nutrients entering a water body, which improves the water quality. Nutrients, which are removed from the water, are taken up by the plants for their own use. When there is a specific use of vegetation, such as a detention basin or grass-lined swale, mowing and removal of the cuttings may be done. Whatever the management, having the proper vegetation will help in the reduction of non-point source pollution.

Vegetation also helps control the amount of water that enters a waterbody and the rate at which it enters. If the proper vegetation is there, the vegetation will slow down the flow of water to a waterbody, thereby creating a longer period of time for the water to flow. With an increased time of flow, the force of the water is reduced, which helps in reducing erosive forces. Banks remain stable and the waterbody has less sediment entering it from overland flow (surface runoff). Water that is in contact with the vegetation for an extended period of time may also infiltrate into the ground at a higher rate than water that flows across an unvegetated strip. Because of this, erosive forces are reduced and water quality is increased.

A third benefit from vegetation in the watershed is the shade and protective cover that it may provide. As solar radiation is absorbed by water, the temperature of the water increases. With an increase of temperature, organisms are affected in different ways. Some of the less tolerant organisms may disappear, while a more general organism thrives, but the system is then changed. Having vegetated areas growing around waterbodies helps in directly shading the waterbody and incoming sources, thereby reducing thermal impacts. Lastly, understanding the water quality benefit that vegetation gives is an important step in maintaining healthy, diverse areas of vegetation. Besides the direct water quality benefits from vegetation as mentioned above, there is value placed on plants for aesthetics, noise reduction ability and wildlife habitat.



Vegetation management (The Federal Interagency Stream Restoration Working Group, 1998)

Vegetation as a whole in the Halfway Brook watershed is very good and diverse. In order to maintain and improve the water quality, an understanding of the vegetation needs to be created for all activities involved in the watershed. With a growing population, education of landowners about their own property's vegetation and what can be done to improve it would be a benefit.

Landowner Survey

Purpose

Agricultural fields in Kingsbury, NY

A task, which was set forth for the steering committee, was the development of a landowner survey within the Halfway Brook watershed. A sub-committee was formed to create a survey and to develop a database of landowners that the survey would be sent to. After several meetings the subcommittee had completed its tasks and presented the results to the entire steering committee.

The purpose of the survey was twofold. The first was to understand what the major concerns were within the watershed from the people that are directly affected by it. Understanding the concerns is important to focusing future efforts and monies toward areas which would improve or enhance the water quality of Halfway Brook. The second purpose was to educate the public of this plan and of water quality. Halfway Brook is a stream that in the past has been a productive fishery, brick making area, water supply, fortress and recreational swimming area. Many people within the watershed are unsure where Halfway Brook is located, much less where it flows. The committee wanted to inform the public of concerns that the committee had about the possible degradation of this stream. It is important in the watershed to educate the populace of water quality concerns as there are many high quality waters in the area which need to be maintained.

In January and February of 1999, the survey containing twelve questions was sent out to landowners that own property on Halfway Brook and several of its major tributaries, with the exception of agricultural producers in Washington County. The committee decided the information that was being provided in the Agricultural Environmental Management Plans (AEM's) from the agricultural producers would suffice. A total of 186 surveys were sent and 49 were returned, this was a twenty six percent return rate.

Results

(Top three categories selected and number responses)

Question one: How do you utilize Halfway Brook?

a. Aesthetics (25)
b. Wildlife Viewing (25)
c. Fishing (21)

Question two: In general what are your concerns of Halfway Brook as it relates to your property?

a. Bank Erosion (25)
b. Stormwater runoff from other sources than your property (23)
c. Development, other than your property (18)

Question three: What best describes your property?

a. Primary Residence (30)
b. Woodlot (13)
c. Vacant, i.e. field, meadow (9)

Question four: Do you have any types of livestock on your property?

Yes (6)
No (40)

Question five: Do you feel that there is an adequate buffer strip between fertilized areas of your property and Halfway Brook?

Yes (41)
No (3)

Question six: Have you noticed any deterioration in the water quality of Halfway Brook?

a. Not sure (18)
b. In the last 5-10 years (8)
c. No change in water quality (8)

Question seven: Overall, in your opinion, what may be a concern within the Halfway Brook watershed?

a. Highway stormwater runoff (24)
b. Streambank erosion (18)
c. Over-development near stream (18)

Question eight: Referring to question #2 and #7, what are your suggestions for addressing your identified concerns?

Question nine: What type of wastewater treatment system do you have?

a. On-site septic (33)
b. Sewer (11)
c. Other (2)

Question ten: Generally septic tanks are pumped out every three to five years, based on the size of the tank and the amount of use. If you are on septic, how often is your tank pumped?

a. Every three to five years (14)
b. More than five years (9)
c. Every one to two years (4)

Question eleven: Would you or your group be interested in helping in a stream cleanup day? Yes (12)

Question twelve: Please indicate what county that your property is located in.
a. Washington County (21)
b. Warren County (27)

Discussion

The survey was a success as it achieved its goals of learning what the local concerns of the people in the watershed were and educating people about the plan and water quality.

Question and Response Evaluation

Question one: It appears that many people utilize Halfway Brook for relaxation. Being an area that has a high amount of wetlands and riparian vegetation along most of its banks, it is ideal for wildlife habitat. Many species of birds may be seen throughout the year as well as many types of mammals, making the brook and fantastic area to view wildlife. Fishing is also popular as it receives yearly stockings of trout from the state and the Warren County hatchery.

Question two: Bank erosion is something that many landowners may notice. When a disturbance occurs and affects the bank of their property, many become concerned. Loss of property, erosion of soil into the stream and possible unsafe conditions around the stream usually concern the landowner. What the public may not be aware of is the potential nutrients that may be added to a system from eroding soil and the effects of it on the system. These are areas that can be addressed with the plan if they are in fact legitimate problem areas, which could be determined by site visits.

A. Stormwater runoff from outside sources may be a concern for a variety of reasons.
B. Sedimentation into a water body can reduce water quality and decrease fish survival. The addition of chemicals such as petroleum and salts will also decrease water quality and affect aquatic organisms. A stormwater management plan has been done on the developed areas of the Halfway Brook watershed and prioritizes the top thirteen areas of concerns and lists possible recommendations for remediation of the stormwater.
C. Development was the third rated concern. Improper building can lead to serious environmental consequences. Stormwater that leaves a site may carry solids to a drop inlet structure or empty directly into a waterbody. Erosion may be a large concern if proper control techniques are not used. The Glens Falls-Queensbury section of Halfway Brook continues to grow rapidly and proper development strategies will need to be used in order to reduce its role in non-point source pollution.

Question three: The majority of respondents to the survey used their property as a primary residence. These are the people that are most likely affected and have the most to gain from a watershed management plan.

Question four: This question was posed to find out if any persons on the brook had any livestock on the brook, which would not be covered under an Agricultural Environmental Management (AEM) plan.

Question five: We attempted to find out if people felt that there was enough buffer strips on the brook, in both the agricultural and non-agricultural areas. The answer by a large majority was yes. Halfway Brook appears to have good buffer areas in many locations. However, in certain developed sections of the corridor, it is extremely lacking. The areas of concern on the Warren

County side of the watershed are noted in the Halfway Brook Aquatic Habitat Improvement project that Warren County SWCD will be undertaking in the fall. Locations of concern in the agricultural areas of the brook have been noted in the AEMs with participating farmers.

Question six: According to the respondents, many people are not sure if or when the water quality of Halfway Brook has declined. In fact the next three highest selected responses suggest that there is a great difference of opinions. Eight people answered that the water quality has deteriorated in the last 5-10 years, and also eight people responded that there has been no change in water quality. An interesting figure was that six people answered the water quality actually has improved. What does the conflicting opinions suggest? A series of educational programs on water quality might be appropriate to provide the public with a basic understanding of what exactly water quality relates to. Public interest would be needed to put this series together and have it be effective.

Question seven: As opposed to question two, question seven referred to the entire Halfway Brook watershed, not just the respondents property. Highway stormwater run off is very visible during storm events and spring melts. Many people understand that stormwater running into the brook can cause problems. The water may be discolored or have an oily sheen to it, people observing this understand that something is going into the waterbody, but might not totally realize the impacts.

As with question two, development within the watershed by the stream is a concern. Any activity that can be identified such as the bulldozing of an area, trees being felled or concrete being poured is sometimes viewed as having a negative impact on the environment. It is imperative to understand that development and growth will not be stopped. With this understanding agencies, municipalities and citizens need to work reducing the impacts to the environment. As mentioned before, proper plans for development are needed in order to minimize effects of development on the environment.

Streambank erosion is disturbance that is easily viewed. This was the top concern in question two, so it seems to be an overall concern throughout the entire area. As mentioned in the discussion of question two there are several basic concerns with streambank erosion. Areas that are susceptible to erosion should be monitored for disturbances or activities that may induce bank erosion. When erosion does occur it is a many times extremely difficult to control. The AEM plans that were developed in Washington County and the Aquatic Habitat grant that Warren County received addresses areas of bank erosion and steps are being taken to remediate the situations.

Question eight: A variety of suggestions were mentioned for this question, with the suggestions relating to the top answers in questions two and seven. Keeping untreated stormwater out of the brook, controlling development and education on the importance of healthy streambanks were several repeated ideas. As mentioned previously, public education on these topics would be one of the best solutions.

Questions nine and ten: The majority of people had their own on-site septic system, and they were reportedly pumped out every three to five years. Educational programs on groundwater, septic systems and nutrients would be a reasonable solution to potential problems.

Question twelve: This question helped to indicate that there was interest within both counties on the management plan. In order to have a completed plan that will be useful in the future there needs to be support in the locals. Having the returns nearly match in each county leads to the belief that the study will benefit the environment, and in fact the community, as projects are identified and completed.

Overall the survey did accomplish the identified goals, mentioned in the purpose. The responses that were received shows that in general the public is interested in at least part of the study and would like to see action taken to enhance or improve problems within the Halfway Brook watershed. Continued public exposure of this plan will be needed to fully realize the potential that this study can have in future planning.

Water Sampling

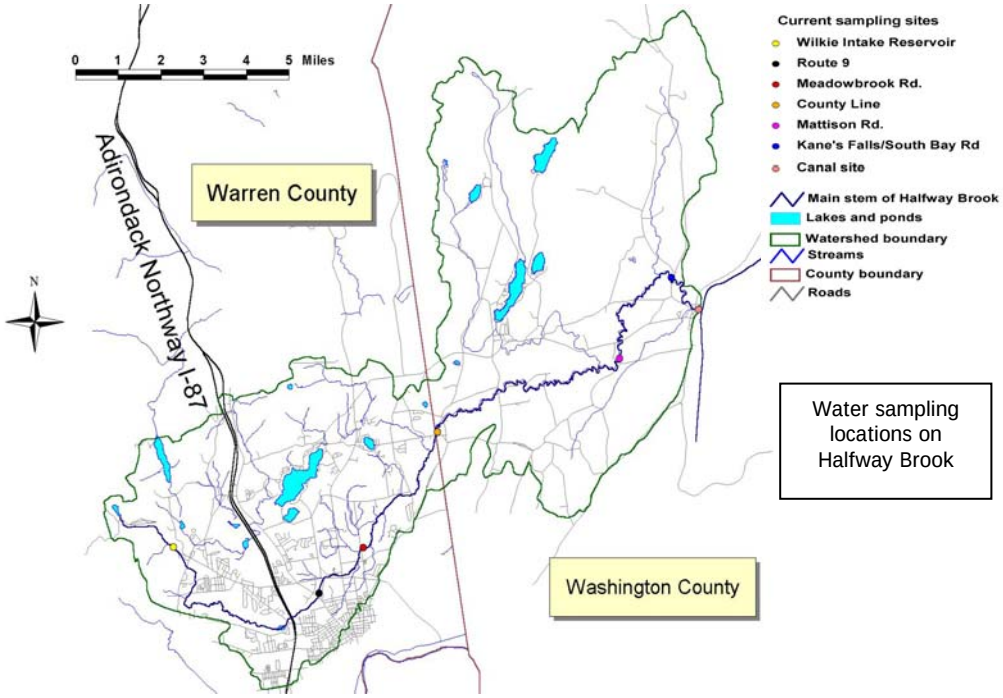
Introduction

In order to understand how land use influences a stream or lake, the water's chemistry needs to be understood. Land use changes influence the hydrology of the watershed and may add stormwater that can contribute pollutants. Phosphorus has been identified as a major pollutant of concern, since it is a limiting nutrient in nature.

A task set forth in the Plan was to determine if there were any effects from stormwater runoff on the water quality of Halfway Brook. There have not been any studies done in detail with baseline data on Halfway Brook, therefore data would need to be gathered to determine stormwater effects. Sampling locations were set up to maximize the funding resources available and what would be useable data.

Methodology

There were eight selected sampling locations throughout Halfway Brook. The following gives brief descriptions of the surrounding sites.



Water sampling locations on Halfway Brook

Wilkie Intake Reservoir: Baseline site established at this location. It is heavily forested and non-developed (watershed property for City of Glens Falls).

Route 9: Highly developed land with commercial properties. Large areas of impervious surfaces convey runoff to Halfway Brook.

Meadowbrook Road: Less development than Route 9, but three tributaries affected by runoff join the mainstem of Halfway Brook upstream of this sampling location.

County Line: Located in a low developed area of the watershed. Forested in the upper areas and large areas of wetlands along the brook.

Mattison Road: First sampling location below agricultural areas of the brook. Farms, forest and wetlands dominate land.

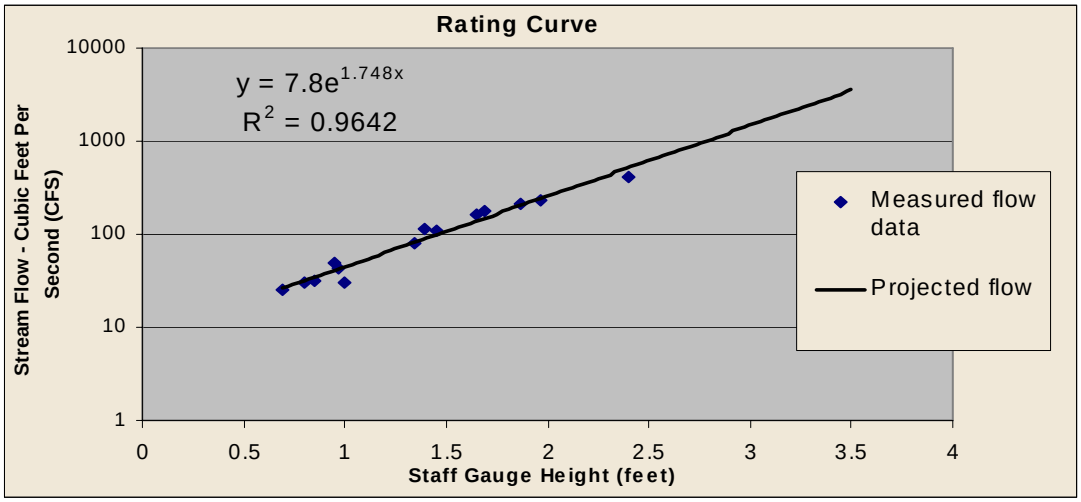
Kane Falls: Heavily managed for agricultural use. Large area of watershed drains to this location. Last sampling location not affected by the water level in the Champlain Canal.
Fort Ann Tributary: Last tributary to enter Halfway brook before the Champlain Canal. High amounts of agriculture and stormwater potentially impact stream.
Canal: Samples taken just before confluence with the Champlain Canal.

At Meadowbrook Road and at the County Line sampling sites, Telog Model 2100 stream level recorders were placed. At Kane Falls, a Stevens Recorder was placed with a corrugated metal stilling well, which also measured stream level. At those three locations and at Mattison Road, a staff gauge was mounted for visual observation of the stream's level (stage).

Stage Rating Curves

The depth and velocity of a stream or river is constantly changing. Some of the change is relatively small (evaporation throughout the day), while storm events may turn a small meadow stream a raging torrent. In order to determine the flow without measuring it every time, a stream rating curve needs to be developed. The stream flow (discharge) and staff gauge heights (water surface elevations) are plotted against one another and regression line is created. When the formula is produced, and a reading from the staff gauge is used, the stream's discharge can be determined without actually measuring the flow.

Staff gauge at Meadowbrook Road



Stage rating curve for Kane Falls, Fort Ann, NY

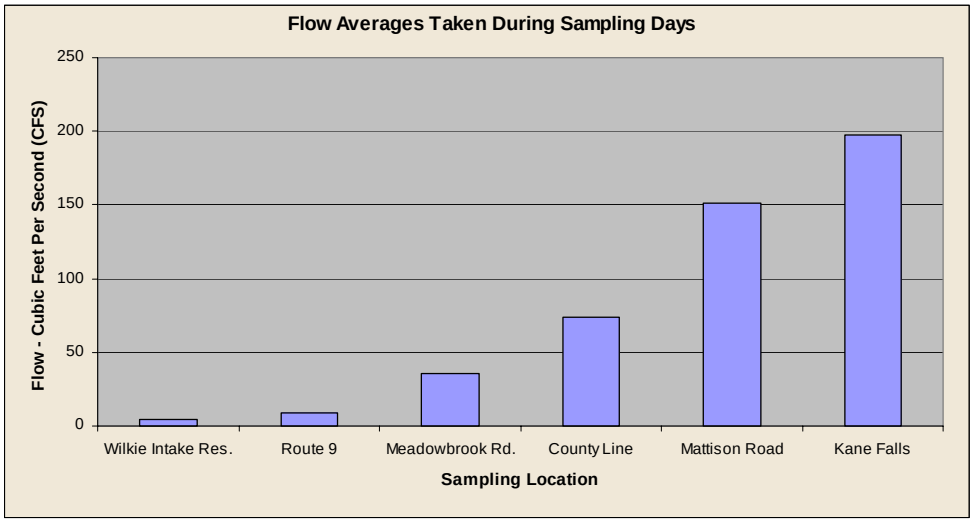
Water Chemistry

High flow and low flow events were calculated from April of 1999 to July of 2000, and water samples were taken at those times. Samples were taken to Darrin Freshwater Institute, in Bolton Landing, NY and analyzed. Total Suspended Solids (TSS), Nitrate (N), Orthophosphate (OP),

Total Phosphorus (TP) and fecal coliform bacteria tests were run, conductivity was run in the field.

Sampling sites were set up according to land use and geographic location in order to determine where areas of concern were located. By comparing the results of the water chemistry from the sampling locations, areas of higher pollutant loading to the brook can be identified and the problems addressed.

The following charts reflect the flows of Halfway Brook and some of the pollutant concentrations at the various sampling locations.

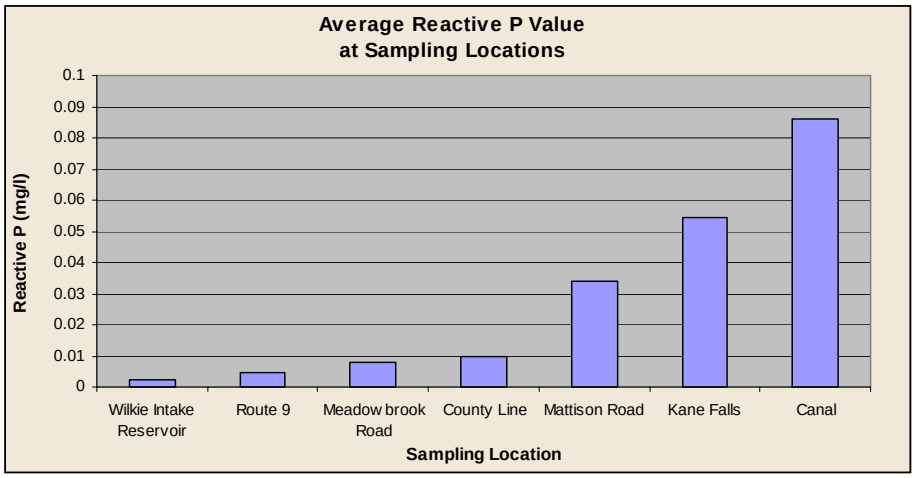


Phosphorus

Phosphorus is a naturally occurring nutrient that is rare in the environment. It is referred to as a "limiting nutrient", meaning that it is a nutrient that can control plant growth. Having an excessive amount of phosphorus can lead to an over abundance of plants, while in a waterbody with low phosphorus rates there may be very limited amounts of vegetation.

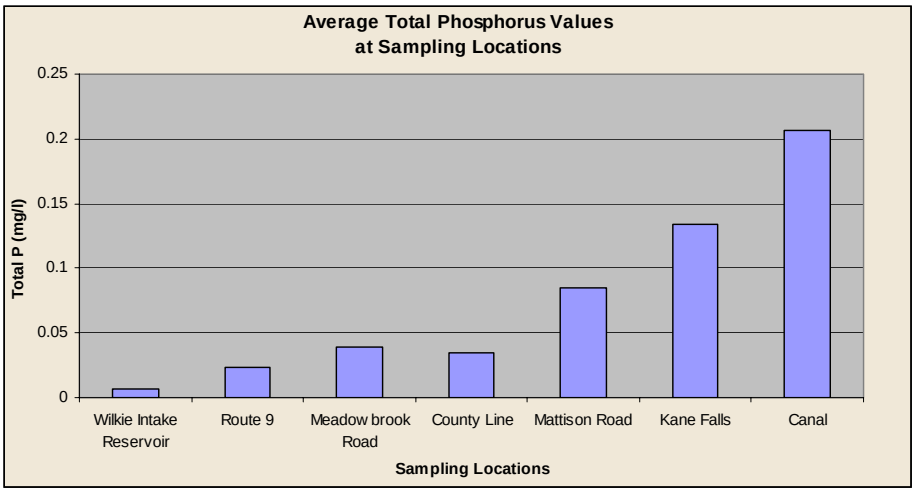
A common form of phosphorus in nature is phosphate and it occurs in an organic and inorganic form. The organic form is bound in plant and animal tissues and not readily available to plants. The inorganic (also known as reactive phosphate or orthophosphate), is usable by plants (Behar, 1997). Phosphates tend to move down a stream system with the decomposing plants, animal tissue and soil particles (which the phosphates are attached to), moved by the current. Because phosphates bind strongly to soil particles, soil that is transported to a lake may contain high rates of phosphates. If that is the case the lake may become phosphorus rich and become eutrophic. In Lake Champlain, phosphorus is a major concern and Halfway Brook is a contributor of this phosphorus. It is generally considered that any concentration over 0.05 mg/L will likely have an impact, and any concentrations over 0.1 mg/L would certainly have an impact on the water (Behar et al., 1997).

Reactive Phosphorus



Reactive phosphorus levels increase from the headwaters of the brook to the end. Land use changes may play an important role in this situation. Concentrations of the first five sampling sites are under the 0.05 mg/l level. The two lower locations are below most of the watershed drainage and accept larger quantities of water. Agriculture is the main active land use from the County Line site downstream. As mentioned in the Soils section of the plan, clay soil is found in Washington County. Clay soils tend to carry a higher amount of phosphorus, due to the strong chemical bond that is formed between the particles. During an event, levels of reactive phosphorus at Kane Falls may increase up to fifteen times that of the average sampling level. At the Canal location reactive phosphorus levels increase ten times.

Total Phosphorus

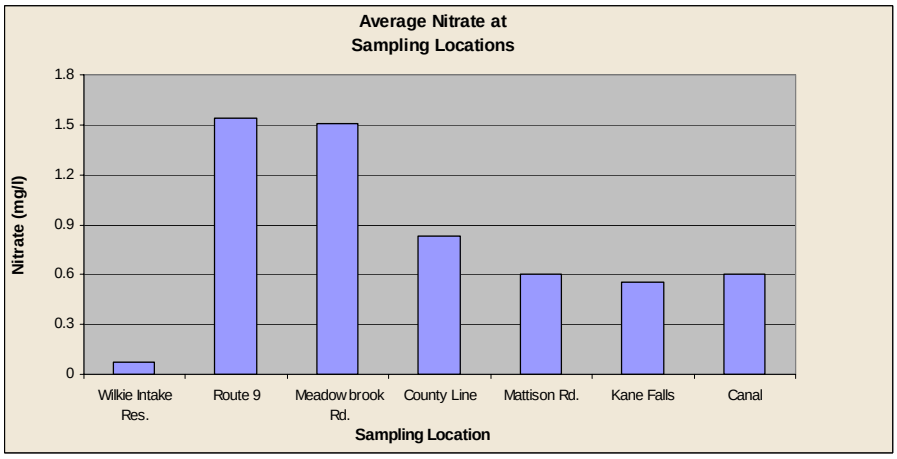


As with the reactive phosphorus levels, total phosphorus levels increase towards the confluence of the canal. In this case they are above the .05 mg/L level at Mattison Road. During events, levels of total phosphorus increase at Kane Falls two and one half times that of the average sample. The Canal is around two times the average sample. There is an increase at the at the Meadowbrook Road site, which likely results from stormwater runoff influences from the upstream developed areas. As Halfway Brook travels to the County Line sampling site, there may be a dilution of total phosphorus due to lower stormwater impacts between the sampling points. Proper land management will reduce the amount of total phosphorus entering the brook, thereby reducing the amount of reactive phosphorus available to plants.

Nitrate

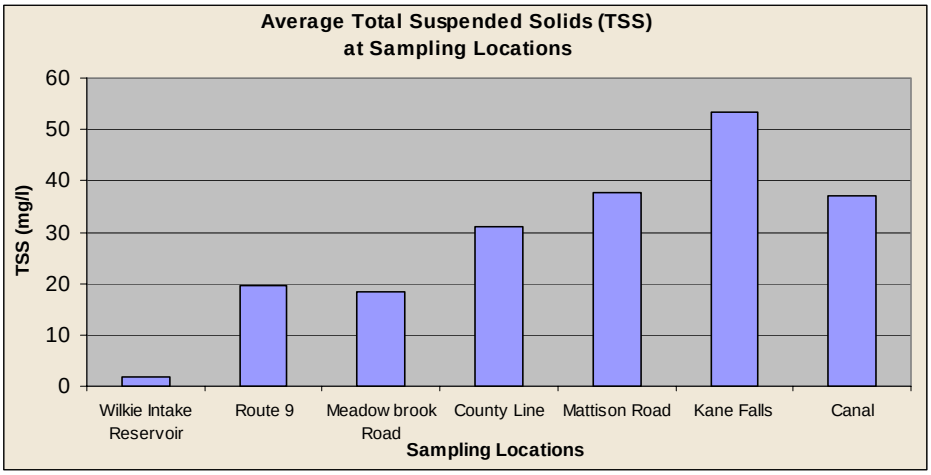
Nitrate is the form of nitrogen that is essential for plant and animal growth (Behar et al., 1997). Excessive nitrates can cause a dramatic increase in plant growth and affect the health of aquatic organisms. Sources of nitrates include; the soil, animal wastes, fertilizers and decaying

vegetation. Animal wastes include human waste (sewage, failing septic), pet waste and barnyards (Behar et al., 1997).



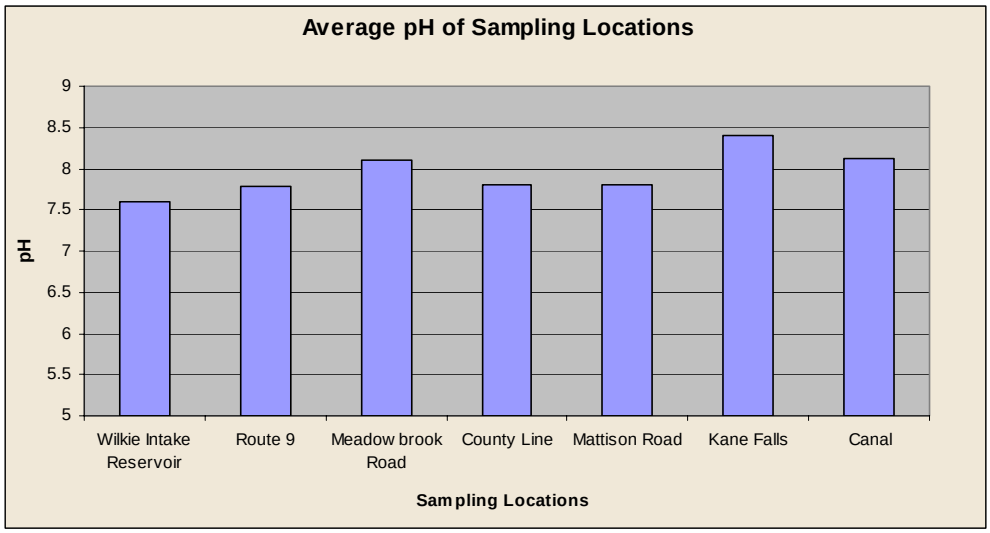
The NYSDEC accepted nitrate level is 10 mg/l (NYSDEC, 1992) while natural levels of nitrates are typically less than 1 mg/l (Behar et al., 1997). The average highest concentration is 1.54 mg/l from the sampling days. During water events (rain and snow melt) however, the concentrations were increased almost 2.5 times the average. Two areas that are highest in concentration are directly impacted from stormwater due to the large areas of impervious surfaces, which convey untreated stormwater directly to Halfway Brook. Nitrate levels decrease towards the Canal sampling location, there are a few possible explanations as to this occurrence. First there is an increase in the volume of water that is being carried in the brook, which may suggest dilution of the nitrate in the lower sampling locations. Secondly, nitrate may change to another form- nitrite. Nitrite is generally rare in freshwater systems though, as bacteria quickly oxidizes it back into nitrate. A form of nitrogen may still be there, but it may not be nitrate.

Total Suspended Solids



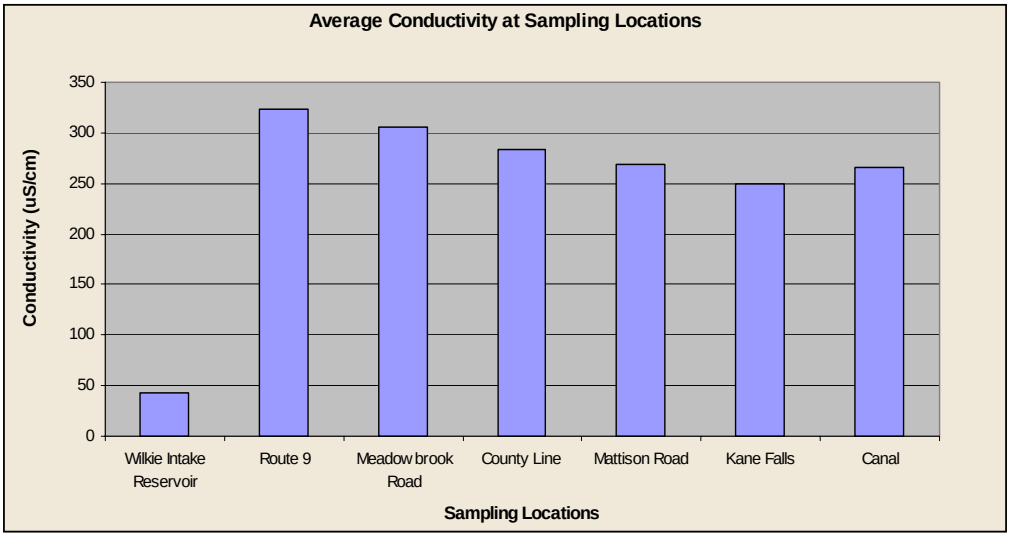
Total suspended solids (TSS) is a measure of the amount of particulate matter in the water. These materials include soil particles, phytoplankton, and organic debris (Adirondack Aquatic Institute et al., 1998). High concentrations of TSS in rivers and streams are often caused by erosion within the watershed and erosion of the stream banks. Agricultural activities and increased runoff from developed lands can accelerate erosion. In the Washington County sampling sites, clay soils are found. An increase in the amount of clay particles in the water, due to erosion or run off may increase the amount phosphorus (see reactive phosphorus) in the water. If this occurs, the phytoplankton living in the stream will utilize this and their population levels will expand. Reducing erosion within the watershed would likely reduce the TSS levels at the lower sampling locations, as well as reduce phosphorus levels.

pH



pH is a is defined as the measure of the acidity of a solution. The range of a pH scale is 0 to 14, with 0 to 7 being acids and 7 to 14 being bases, neutral is recorded at a pH of 7. Acid rain, wastewater discharges, mine drainage and the surrounding soils and bedrock can influence the pH of a waterbody (Behar et al., 1997). pH can affect many chemical and biological processes in water, and influence what organisms are found there. Most aquatic organisms prefer a range of 6.5 to 8.0 (Behar et al., 1997). Halfway Brook's average pH is between 7.6 and 8.4, which is within normal parameters.

Conductivity



Conductivity is the ability of water to pass an electrical current (Behar et al., 1997). It is useful as a general measure of water quality, but it does not identify specific compounds in the water. Each stream or river tends to have a range of values that once established can be used as a baseline for comparing with other future measurements (Behar, et al., 1997). Conductivity is affected primarily by the geology of the area and by the presence of naturally occurring electrolytes (i.e. salts) (Behar et al., 1997). Streams with granite predominating the geology of the region tend to have lower conductivity, while streams with high amounts of clay have higher conductivity. Sources that are not naturally occurring which would affect conductivity; failing septic discharges, discharge of heavy metals or water runoff from developed areas or agricultural land. The general range in the United States for conductivity is from 50 to 1500 μS/cm (microsiemens per centimeter) (Behar et al., 1997). Waters that have a good mixed fishery have a range between 150 and 500 μS/cm (Behar et al., 1997). The range for Halfway Brook falls well under the typical high range of 1500. According to the data, conductivity increases dramatically downstream of the Wilkie Intake Reservoir and runoff is the likely source for the increase.

Fecal Coliform Bacteria

Fecal coliforms are thermo-tolerant coliform bacteria, which are closely associated with human and animal wastes. The presence of fecal coliforms in a water sample indicates that other, more pathogenic species of intestinal-dwelling microbes, such as those that cause the enteric diseases cholera, typhoid, or hepatitis, may also be present in the water. Low levels of fecal coliforms (10-100 fecal coliforms per 100 ml of water) are not cause for concern, but at higher levels (2000-3000/100 ml), use of water even for recreational purposes could be dangerous and public beaches would be closed (Glen Lake Watershed Technical Advisory Committee, 1998).

Presence of the coliform bacteria found within the brook may indicate a problem with the runoff that is coming into the brook. The fecal coliform sampling results varied throughout Halfway Brook. At the downstream sampling locations there was not a discernable pattern, except that fecal coliform bacteria were found to be higher than at the pristene sampling location. High flow and low flow storm run off events produced both high and low sampling results. Generally the average highest levels of fecal coliforms were from two tributaries that were suspected of contributing non-point source pollutants (see below). There were spikes at the other sampling locations, usually during storm events.

Elevated levels of coliforms may reduce the ability of Halfway Brook to be used for recreation. Futher sampling of fecal coliforms will be needed to recognize trends and to identify possible sources of the fecal bacteria.

Tributary Data

Two tributaries were examined during this study. The first tributary studied originates in Crandall Park (Crandall Park tributary), in the City of Glens Falls and the second originated in the Town of Kingsbury, and flowed into Halfway brook in the Village of Fort Ann (Fort Ann tributary). These tributaries were suspected as being low in water quality as development is dominant in Glens Falls and agricultural land dominates in Kingsbury. Both of these areas have been identified as important stormwater locations for non-point source pollutants.

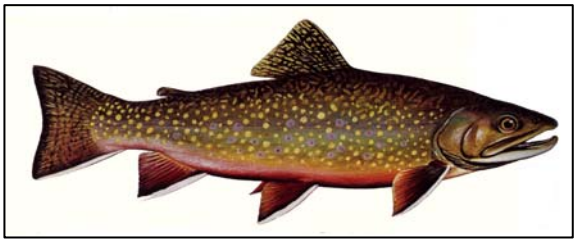
The average phosphorus (P) levels in both tributaries for reactive and total P were above the average of the mainstem of Halfway Brook. For the Crandall Park tributary, the reactive P level was about 1.5 times the average and the Fort Ann tributary about 5.5 times the average level of the mainstem of Halfway Brook. Nitrate levels from the Crandall Park tributary were about 2.5 times the average of the mainstem, while the Fort Ann tributary was under the average. The Fort Ann tributary had nearly 2 times the TSS concentration of the mainstem and a higher conductivity by 1.5 times. The Crandall Park tributary was under the average with TSS and was approximately 2 times the conductivity average.

As mentioned previously, fecal coliform results were generally highest at these two tributaries. The Crandall Park tributary receives both groundwater and stormwater from the city of Glens Falls at the locations sampled. Over the past twenty five years, the Glens Falls Water and Sewer Department has removed a number of Combined Sewer Overflow (CSO's) and replaced them with sanitary and stormwater lines. This reduces the amount of fecal coliforms that are entering the streams, but there may be other CSO's that have not been identified as of yet due to the age of the systems. Continued cooperation between the Warren County SWCD and the Glens Falls Water and Sewer Department, with future funding, would likely lead to a successful reduction in the fecal coliforms from this area.

The Fort Ann Tributary's high fecal coliform counts are likely agricultural influences. Nutrient Management and Agricultural Management Plans have been developed for local farms that may impact this tributary. Stormwater recommendations from developed sections of the Village have been created and, if funded, implementation of the plans would likely reduce fecal coliform and other non-point source pollutants.

Overall the sampling results indicate that there may be runoff pollution problems in these tributaries which ultimately affect Halfway Brook. Further review of the upland sources of these pollutants is needed and a plan put together for remediation.

Fisheries Assessment



Brook Trout (Sternbreg, 1987)

Historically Halfway Brook and many of its tributaries supported brook trout (*Salvelinus fontinalis*). As the area became more settled the land use changed and the resulting changes caused the decline of the fishery. However, all is not lost. With the Clean Water Act of 1972 and an increased environmental awareness that has evolved, people have become more environmentally conscious.

Halfway Brook is classified as supporting trout, and in actuality it has a wide variety of fish species that are found in its waters. Trout, which are considered cold water species, are found for most of the entire length of the stream, with brook trout commonly found on the Warren County side and the brown trout (*Salmo trutta*) predominating in Washington County.

Brown Trout (Sternberg, 1987)

Fishing at Kane Falls

Largemouth bass (*Micropterous salmoides*) and the chain pickerel (*Esox niger*) are two other main sportfish (and generally considered warmwater species) found on the Warren County side. Many minnows are found here, which supports the predatory fish and birds. Currently the Warren County Fish Hatchery stocks 1,500 brook trout into Halfway Brook, in the Town of Queensbury for put and take purposes. Closer examination in the brook reveals that there is a population of holdover trout and possibly reproduction in some areas.

On the Washington County side of the stream, the water changes dramatically. Gone is the clear water from sandy soils and found is turbid water from the clayey soils. The stream is wider and deeper, perfect habitat for the brown trout, which can tolerate warmer temperatures than brook

trout. Largemouth bass, small mouth bass (*Micropterous dolimieu*), chain pickerel and other warm water species are found throughout Washington County. The stream is still classified as supporting trout and the New York State Department of Environmental Conservation stocks approximately 1,630 brown trout in the brook. Below Kane Falls, any fish that is found in the Champlain Canal may be present. Brook silversides (*Labidesthes sicculus*), yellow perch (*Perca flavescens*) and brown bullheads (*Ictaluris nebulosus*) occur, and many others may be found.

There are two municipal parks that are used for fishing in Halfway Brook. The first is Crandall Park in the City of Glens Falls. Crandall Park is a heavily forested area that also has open fields for recreational sports. It is intensely used by the public for a wide variety of activities. The main stem of Halfway Brook travels through the northern part of the property, and many people that fish take advantage of this opportunity. There is plenty of public access to the stream at this location, and trails that spread through the park provide an enjoyable walk. This access has been improved in the past years by many clearing and habitat improvements projects conducted by Trout Unlimited in cooperation with the City of Glens Falls, the NYS Dept. of Corrections, Warren Co. SWCD and local Boy Scouts troops.

Brook trout from the Warren County Fish Hatchery

A second park open for recreation is Hovey Park, found in the Town of Queensbury. Hovey Pond, located in the park was poor quality wet area, with low potential for fish and waterfowl habitat. Construction of the pond was completed in 1994, with a stream by-pass to allow for cooler stream water to flow freely around the impoundment. Hovey Park is intensely used by local communities for many purposes such as touring the gardens, walking the paths, fishing (handicapped accessible) and ice-skating. A tributary that flows into Halfway Brook originates from the ponds on the lower section of this property and is open to all anglers, but the primary encouraged use is for senior citizens, children under 16 years of age and handicapped anglers.

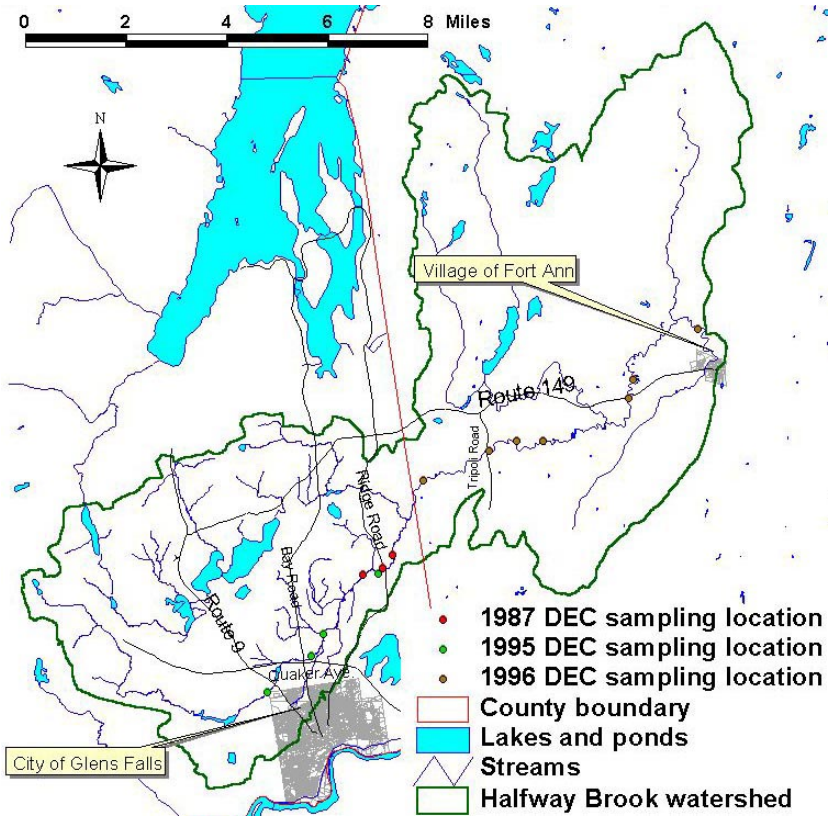
Outside of these areas, there are many other opportunities to fish the stream along its 26 mile length. Private and Town owned properties are scattered along the stream, and permission should be obtained from landowners before setting out to fish.

DEC Fish Sampling

The DEC has conducted sampling for fisheries information in the past. A brief summary of the sampling follows.

May 1987; Three locations in the Town of Queensbury were sampled around the Haviland Road-Ridge Road area. The species most commonly caught was the Tessellated Darter (*Etheostoma olmstedi*), a member of the perch family. A mixture of forage fish (minnows, chubs) was found, as well as brook trout.

August 1995;
Four locations in the Town of Queensbury were sampled. Site one was located upstream of Ridge Road.
Site two was upstream of Meadowbrook Road.
Site three was behind what is presently Lowe's Home Improvement Center on Bay Road.
Site four was Fire Road in Crandall Park.



Tessellated darters were again found in high quantities as in 1987, but the central mudminnow (*Umbra limi*) was slightly more abundant. Brook trout, largemouth bass and chain pickerel were the dominant sport fish. An American eel (*Anguilla rostrata*), 20 inches in length, was captured at the Meadowbrook Road site. Three of the four sites were classified as having 0% to 20% in-stream habitat, the fourth site rated 21% to 40% in-stream habitat.

May and August, 1996
Seven locations in Washington County were sampled.
Site one- downstream of lower Farley Road crossing
Site two- Upstream of upper Farley Road crossing.
Site three- downstream of Tripoli Road.
Site four- downstream of Pattens Mills Road.
Site five- (August) downstream of County Route 16 (South Bay Road).
Site six- (August) upstream of Goodman Road.
Site seven- (August) upstream of Mattison/Bentley Road.

Longnose dace (*Rhinichthys cataractae*) were four times more commonly caught than the next abundant fish species. Cutlips minnow (*Exoglosum maxilingua*), eastern blacknose dace (*Rhinichthys atratulus*) and tessellated darters were commonly found throughout the sites. Brown trout and largemouth bass were the sport fish captured. Six of the sites were classified as having between 0% and 20% in-stream cover. Site five was reported as in-stream cover of greater than 40%.

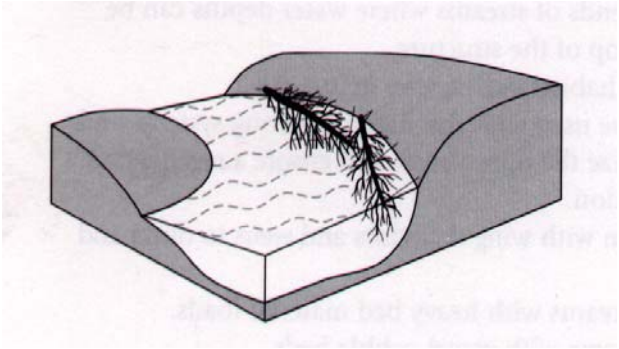
From the DEC samples it appears that although there are not a lot of game fish present, there is diverse fish species throughout the stream. As mentioned previously, Warren County appears to support more of a cold-cool water fishery, while Washington County has a cool-warm water species. The lack of aquatic habitat in many sections of the brook is likely a cause for the lower

fish populations, as seen in the in-stream cover results. More intensive sampling would need to be completed to support this interpretation of the results, in order to say in certainty that they are accurate.

Aquatic Habitat

Sand from winter road de-icing operations in the watershed enters the stream in various areas and is filling in the gravel beds that are necessary for trout propagation. Once habitat has been impacted by pollution or excess sediment, it is easier for a fish species that is considered a generalist species (one that can live in a variety of waters) to outcompete the native fish. In more heavily impacted areas of Halfway Brook (the developed areas of Glens Falls and Queensbury), there is almost no suitable spawning habitat to support propagation of any type of game fish. Currently, Halfway Brook is listed in the NYS DEC's Priority Waterbodies List (PWL), with fish propagation precluded and fish survival stressed. The sand bedload, which is dominant in the watershed, provides little cover for fish and insects in regards to survival and reproduction.

In August 2000, the Warren County Soil & Water Conservation District received funding from the NYS Department of Environmental Conservation for the implementation of aquatic habitat improvement structures in Halfway Brook. In-stream structures such as log shelters and wing deflectors are planned. Tree plantings are recommended in the floodplain to reduce thermal pollution and for bank stabilization in identified areas. Over 50 habitat improvement structures are planned to be constructed in the Brook, with the purpose being the improvement of spawning areas, fish cover, and thermal impact reduction.



Tree Cover Structure (The Federal Interagency Stream Restoration Working Group, 1998)

In order to complete this project, various groups and agencies such as Warren County SWCD, NYSDEC, Trout Unlimited and the Town of Queensbury will be working together to place and maintain the structures for habitat improvement. Construction of these structures will begin in the fall of 2000.

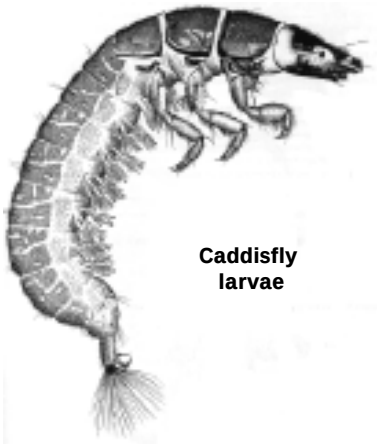
Rotating Intensive Basin Survey (RIBS)

The RIBS is a program which uses the presence of biological organisms such as fish and aquatic insects to indicate the fisheries and macroinvertebrate health at various locations in a stream. In the fall of 1998, the NYS DEC's Rotating Intensive Basin Survey (RIBS) was conducted on Halfway Brook in the Village of Fort Ann. In the summer of 1999, it was conducted again, sampling various locations of the brook. At this time the final report from the DEC had not yet been completed.

The description of overall stream water quality based on biological parameters uses a four-tiered system of classification. Level of impact is assessed for each parameter and then combined for all parameters to form a consensus determination. The following is a brief interpretation of results that are currently available.

Macroinvertebrates
(Adapted from Bode et al., 2000)

Several values are used in determining the health and/or quality of the macroinvertebrate (insects, crayfish, mussels) population of a waterbody, below is a description of the parameters. Using these parameters help in determining the water quality in Halfway Brook.


Caddisfly larvae

Species richness. The total number of species or taxa found in a sample.

EPT value. EPT denotes the total number of species of mayflies (Ephemeroptera), stoneflies (Plecoptera) and caddisflies (Tricoptera) found in an average 100-organism sub-sample. These are considered to be mostly clean-water organisms, and their presence generally is correlated with good water quality.

Biotic Index. The Hilsenoff Biotic Index is a measure of the tolerance of the organisms in the sample to organic pollution (sewage effluent, animal wastes) and low dissolved oxygen levels.

Percent Model Affinity. A measure of similarity to a model non-impacted community based on percent abundance in 7 major groups of organisms.

Fish
(Adapted from Bode et al., 2000)

Sampling: Sampling in wadeable streams consists of electrofishing for approximately 20 minutes, attempting to sample one pool and one riffle. A backpack electroshocker is used. All fish are identified and enumerated at the site and released.

Analysis of data: Reviewing various created indices provides an overall assessment of the aquatic health of the stream.

Species Richness, Weighted: Species richness is weighted by stream size. Species richness in smaller streams is weighted more heavily than larger streams.

Percent Non-tolerant Individuals. This is the percentage of the total individuals that are species considered intolerant or intermediate to environmental perturbations; this measure is the inverse of percent tolerant individuals. Percent Model Affinity, by trophic class. This is the highest percentage similarity to any of five models of non-impacted fish communities, by trophic class.

Results

The macroinvertebrate population in Halfway Brook appears to be slightly impacted throughout most of the brook. In the headwaters area and at Route 9, the organisms are borderline no impact – slight impact. The interpretation of slightly impacted suggests good water quality and that water quality is usually not limiting to fish survival, but may be limiting to fish propagation. As mentioned previously, the primary concern from the NYSDEC PWL was the propagation of fish

in Halfway Brook. While fish are able to survive, fish reproduction may not occur. The inventory suggests throughout Halfway Brook fish are generally slightly impacted.

Non-impacted results indicate that there is very good water quality, high insect diversity, high EPT values, a biotic index of 4.5 or less and a percent model affinity is greater than 64. Water quality should not be limiting to fish survival or propagation. Slightly impacted results are defined as indicating good water quality, the insect community is slightly, but significantly altered from the pristine state, species diversity is between 4.51-6.50 and percent model affinity is 50-64. Water quality is usually not limiting to fish survival, but may be limiting to propagation.

Downstream of Route 9, the stream macroinvertabrate populations are representative of a moderately impacted stream. The water quality drop at the Meadowbrook Road site may be an effect of stormwater inputs. Between the two sampling locations (appox. 1.75 linear miles) there are three tributaries that enter Halfway Brook. All three carry stormwater runoff from developed areas to a degree, and this may influence the insect population.

The survey was conducted during the 1999 summer sampling season, which was one of the driest in the past century. Sampling was conducted shortly after Tropical Storm Floyd, which contributed significant rainfall to the region. The data collected in 1998 at Fort Ann closely follows the samples obtained in 1999. This suggests that the extreme weather patterns that were experienced did not affect the samples.

Overall it appears that there is a generally a good fishery and concentration of macroinvertebrate specimens located throughout Halfway Brook with some exceptions. Areas that have been identified as impacting the brook may not support a healthy fishery in that area, as the RIBS study suggests. Remediation of the impacting areas and improvement of the habitat in the needed locations would likely benefit the organisms in the stream and possibly restore populations of native fish.

Agriculture in the Halfway Brook Watershed

Demographics

The Halfway Brook watershed encompasses approximately 56,000 acres. From the Warren-Washington County line to the Champlain Canal, nearly 12,000 acres support some form of agriculture. The watershed is also home to approximately 8,000 livestock animal units. The majority of agricultural land and 95% of these animal units support dairy farming. Many of these dairies are concentrated along the Halfway Brook corridor itself, south to the Town of Kingsbury and north to the South Bay area of Fort Ann.

Some of the heaviest concentration of livestock and agricultural nutrients occur along the west side of Route 4, just south of the Village of Fort Ann. The results of water quality monitoring conducted along the brook sampling points attempt to correlate certain water quality characteristics with land use and nutrient concentration located in close proximity to sampling locations.

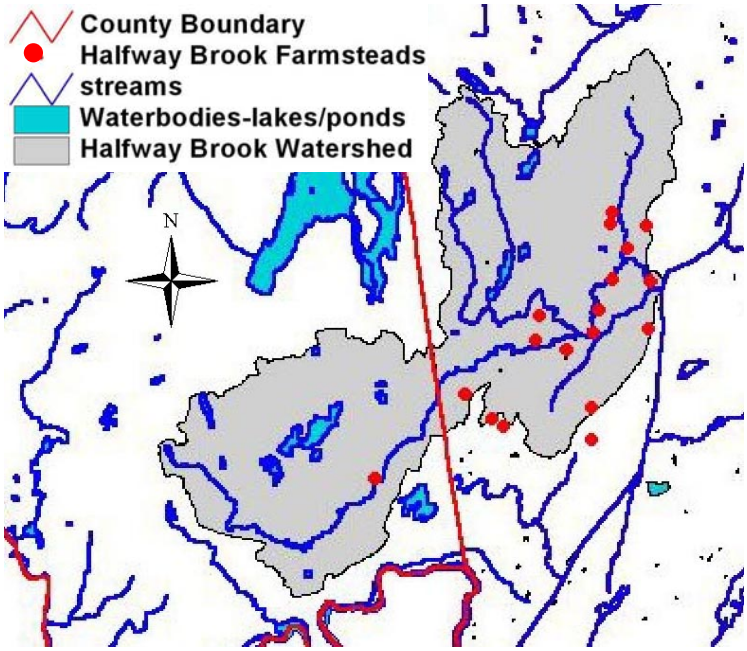
Inventory and Assessment

The Halfway Brook Watershed Agricultural Planning Team consists of the following individuals:

Scott Fitscher - USDA-NRCS, District Conservationist
Joe Driscoll - Washington County SWCD, District Manager
Bill Keating - USDA-NRCS, Soil Conservation Technician
Bob Kalbfliesh - Washington County SWCD, Technician
Aaron Gabriel - CCE Washington County, Agronomist

In order to create a farm-by-farm database for the agricultural impact in this watershed while also planning for future Best Management Practices and funding needs, our team conducted Tier I and Tier II farm assessments as prescribed by the New York State Agricultural Environmental Management (AEM) method.

Tier I assessments were completed by farmers and returned by mail to planning team contacts. Tier II assessments were conducted during 2-4 hour farm visits scheduled with farmers during the lower workload season from November through March. Of the 32 landowners identified with farming interests of some degree, 19 dairy farms were selected as operations having the potential to significantly impact nutrient levels in the watershed. Fourteen of those farms responded to Tier I questionnaires and 12 farmers agreed to complete Tier II farm assessments. The results of the Tier II farm assessments were compiled into a Tier II watershed summary which ranked the following potential agricultural pollution sources as having the highest level of concern from highest to lowest.



Halfway Brook farmstead locations

Manure Management - Lack of documented nutrient management plans or record keeping pertaining to manure application.

Milk Center Wash Water - Most farms have little or no treatment of effluent, and surface discharges are common.

Silage Storage - No leachate collection systems exist in some areas where leachate enters nearby surface waters.

Petroleum Storage - No farms have installed secondary containment around petroleum tanks which have the potential to leak or spill near wells or surface waters.

Barnyards - Eight farms have barnyard discharges that could effect receiving surface waters.

Pasture Management - Seven farms regularly graze livestock in Halfway Brook or primary tributaries.

Forest Management - Five farms conduct timber harvests without the benefit of forest management plans or erosion control measures.

Explanation of Best Management Practices (BMPs)

Manure Management (Ag Waste Storage Facility) - A comprehensive nutrient management plan can minimize risks associated with spreading and handling manure. In addition, properly sized storage structures allow flexibility in timing land applications to maximize crop utilization of nutrients and minimize applications at times of high surface runoff.

Milk Center Wash Water - A wash water disposal system must be properly designed and managed to prevent contaminants such as ammonia, nitrate, detergents, phosphorus and bacteria from entering surface water, ground water or a well.

Storage (Silage Leachate Control) - Silage harvested at a high moisture content may have seepage or runoff escape from the silo. Collection systems prevent high concentration of nutrients and acid from contaminating surface and ground waters.

Petroleum Storage/Containment - A containment system for petroleum tanks prevents leaks from contaminating the farmstead drinking supply. The system also prevents damage in the event of a complete tank failure.

Barnyard Water Management - Livestock waste contains high levels of nitrate, degradable organic materials and bacteria. When concentrated, as it is in barnyards, the danger of pollution to surface or ground water increases. A properly designed barnyard water management system will decrease delivery of pollutants from manure to the water resources. Concrete pads and roof gutters are often components of Barnyard Management Plans.

Pasture Management (pasture fencing, riparian exclusion) - Over grazing and access to streams can cause environmental degradation. Establishing riparian areas and fencing can ensure optimum grazing for the livestock and prevent soil erosion and water quality contamination as well.

Planning - AEM and Nutrient Management

Upon completing and summarizing Tier II farm evaluations, this information became the basis for Tier III and/or IIIA farm plans. All 12 farmers participating in AEM Tier II were also encouraged to develop comprehensive nutrient management plans or, at a minimum, waste utilization plans which prescribe appropriate manure application rates in accordance with soil test levels and hydrologic sensitivity of lands where the manure is applied.

Of the 12 farmers completing Tier II evaluations, 7 expressed an interest or willingness to proceed with the planning process and develop either whole farm plans or Tier IIIA plans which address immediate high level concerns.

Farm plan components were identified through an interactive approach where planners and farmers discussed concerns and needs, and suggested alternatives to meet these needs.

Farmers then selected preferred alternatives. Final plan formulation was completed by compiling preferred alternatives, and scheduling implementation based on priority, cash flow and availability of funding assistance.

Planned BMPs and Funding Incentives

The seven farm plans completed planned the following BMPs: Ag Waste Storage Facility, Silage Leachate Control, Barnyard Water Management, Milking Center Waste Control, Petroleum Storage/Containment, Pasture Fencing (Riparian Exclusion), Nutrient Management Planning, and Manure Composting.

New York State Funding Assistance

In order to achieve a high level of farmer participation in implementing the planned BMPs in a timely manner, the Washington County SWCD prepared a funding request through Round VII of the New York State Ag Nonpoint Source Abatement Program. A total of $573,470 was requested for Halfway Brook watershed in August of 1999; in July of 2000, formal notification of a grant award of $163,000 was received.

USDA Funding Assistance (Environmental Quality Incentives Program-EQIP)

Since the proposal for state cost-share assistance in the Halfway Brook watershed was only funded at $163,000, less than 1/3 of the requested amount, additional BMP implementation funds were sought through the USDA's EQIP. Once again the information generated by AEM Tiers I and II farm evaluations and the Tier III farm plans were used to identify watershed priorities. Based on the needs identified for implementation, technical assistance and education, $326,100 of EQIP funding was requested for the Halfway Brook watershed in May of 2000.

Planning Follow-Up & BMP Implementation

The Halfway Brook Watershed Agricultural Planning Team will continue to follow-up with agricultural landowners in the watershed. This work will include the following:

- Planning and design of specific BMPs.
- Technical assistance with BMP construction and implementation.
- Continuous efforts to secure funding for BMP implementation and nutrient management planning.
- Updating plans in order to address farm business needs and environmental concerns.
- Post implementation visits to insure function and operation of BMPs.

Nutrient Management Plans

Background

In Washington County, Halfway Brook meanders through dairy farms that use the adjacent land for growing pastures, hay, and corn. Fertilizers and manure is spread on this land to provide fertility for crop production. These are normal and recommended practices but do have the potential to contaminate surface waters with nitrogen, phosphorus, and pathogens. Nutrient management plans were developed to help farmers manage fertilizer and manure for crop production without contaminating Halfway Brook.

Objectives

The nutrient management plans were designed to provide an easy-to-follow guide for farmers to produce healthy crops and protect the environment. Plans provided the following information to farmers:

1. An accurate measure of manure spreader capacity.
2. An estimate of the amount of manure needed for crop production and the amount of manure actually produced by the dairy herd.
3. A manure spreading plan that gives the proper amount and timing of manure applications for each field.
4. A form to record when, where, and how much manure is applied.
5. Fertilizer recommendations for each field to accompany manure for meeting crop nutrients needs.

Results

Eleven farms in the watershed were contacted and given the opportunity to have a nutrient management plan developed. Eight farms requested a plan. Six of them received a completed plan and two received partial plans, because not all the necessary information was available. About 3,000 acres are covered by the eight nutrient management plans.

Recommendations

It is relatively easy to prescribe fertilizers for crop production and environmental management. The big challenge is managing manure. Large quantities are produced on dairy farms and the appropriate time and place to apply it may be very limiting. It is not recommended to apply manure over snow or to fields that are wet. Therefore, every farm needs some way to store manure for 4 months minimum. Many factors, like weather, may demand a longer storage. It is recommended that resources be used to help farmers manage manure by storing it when conditions are not right for spreading it.

Stormwater Runoff Summary

Halfway Brook and its tributaries flow through the developed areas of Glens Falls, Queensbury, and Fort Ann before outleting into the Champlain Canal. This brook has been listed by the NYS Department of Environmental Conservation as being impaired by stormwater runoff, to the point

where fish spawning in certain areas is impossible due to silting of the spawning beds. The fisheries habitat is also noted as being impacted by this runoff, due to higher temperature runoff from roads following a storm event and sand from winter road de-icing operations. The focus of this part of the study was to determine where the most significant impacts to Halfway Brook and its tributaries are, and to provide recommendations to alleviate some of these impacts.

Methodology

In order to create a comprehensive stormwater plan for the Halfway Brook watershed, it was necessary to understand the stormwater drainage system in areas which impacted Halfway Brook. This was done using extensive fieldwork and research of state, county and town drainage plans. Upon location and identification of storm sewer systems, it was necessary to map this information in order to be more readily usable. All maps included in this plan were generated using the data collected and transcribing it onto Geographical Information System (GIS) software. Areas in need of improvements in stormwater control were then pinpointed, and recommendations were then formed and mapped, creating the stormwater management plan.

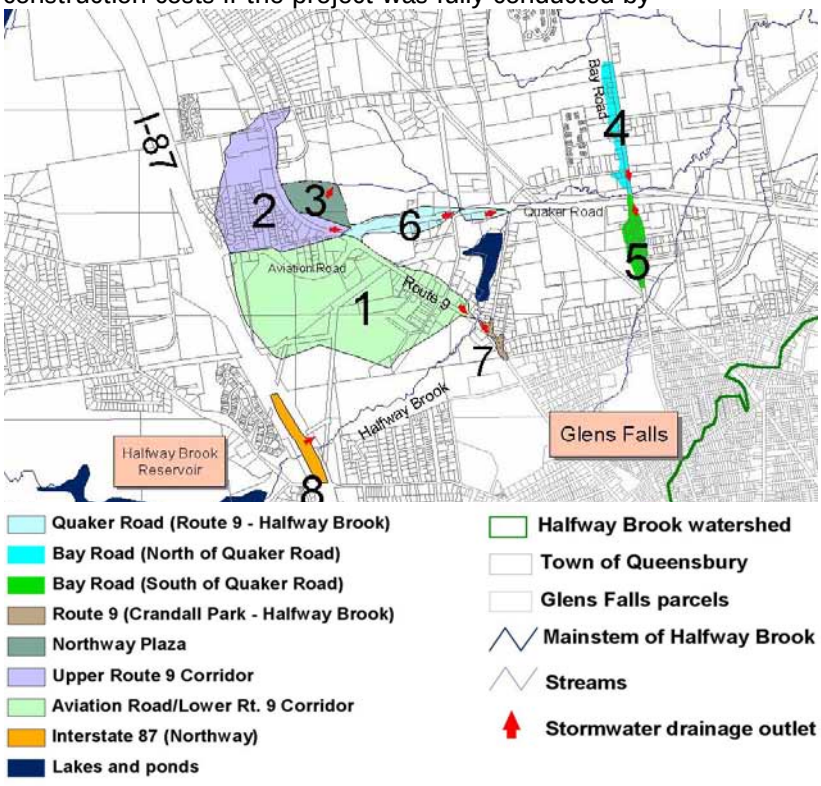
Water Quality Improvement Recommendations

The following recommendations are set forth as a guide to improve the quality of stormwater flowing into Halfway Brook, largely from developed areas. Inherent in this task is the issue of the limited space that is available for permanent remediation structures due to the high market value of properties in the developed areas of Queensbury and Glens Falls. These recommendations are primarily based on the availability of land to install these improvement structures, coupled with the viability and cost effectiveness of undertaking the work. Each of the following recommended practices is located on a map included in this document, showing approximate location and drainage area to be routed into these new water quality improvement structures. All cost estimates include survey, design, and construction costs if the project was fully conducted by consulting firms and private contractors. Many of the costs could likely be reduced with the use of municipal equipment and town forces.

Queensbury Stormwater Improvement Project Recommendations

1. Aviation Road/Lower Route 9 Corridor

Overview: The most significant problem found with stormwater impacts to Halfway Brook comes from the route 9 corridor in Queensbury. Stormwater from the Aviation Mall area on Aviation Road flows down to the intersection of Aviation Road and Route 9, entering the Route 9 drainage line. From this



Stormwater location maps - Queensbury, NY

intersection, stormwater flows south along Route 9 to the northeast culvert at the intersection of Halfway Brook and Route 9 across the street from Price Chopper. This entire area has been developed primarily with commercial properties, and open space is extremely limited. The stormwater drainage area from the following two combined drainages is over 170 acres, all of which outlets into Halfway Brook through a 48" culvert. To improve the stormwater in this area, the drainage area should be divided into two parts: Aviation Road and Lower Route 9. This division is necessitated by the lack of available area for stormwater improvement structures on the lower Route 9 corridor.

Recommendation - *Aviation Road*: Stormwater flows down Aviation Road and outlets into the Route 9 drainage line at the intersection of Aviation and Route 9. To improve the water quality coming from this Aviation line, the undeveloped space between Burger King and Mobil Gas on the southern side of Aviation Road could be used as a treatment area. There is approximately 120 feet by 40 feet of grass area that is undeveloped, potentially available for the installation of one or more underground structures in series (i.e. Vortechnics or similar structure). This would capture approximately 80 % of the stormwater on Aviation Road and treat it. Although these type of underground stormwater improvement structures do little to remove dissolved pollutants, a large amount of road sand, trash, and debris will be removed from the stormwater.

Potential Problems: There are underground utilities and overhead lines in the undeveloped area. Secondly a cross-connecting culvert would be needed to take stormwater from the north side of Aviation Road and divert it towards the treatment area. The land is privately owned and an easement would need to be obtained.

Probable Cost: Depending on easement cost, the design and construction of such a solution would likely be approximately $100,000 or so. However if work was conducted in the Lower Route 9 corridor, this project may become unnecessary, as it would be covered under that one.

Recommendation - *Lower Route 9 Corridor (Aviation Road down to Halfway Brook)*: Field work and mapping have shown that there is very limited area to undertake stormwater improvements in this area due to the high level of development and high market value of the land. There are two options for stormwater improvement in this area.

Option 1: Niagara Mohawk Power Line right-of-way. This area, located between the Red Lobster and the Valvoline Oil Change would be a potential site to construct a stormwater improvement wetland, which would be able to receive water from both Aviation Road and lower Route 9. This solution would provide water quality improvement in terms of both sediment removal and nutrient removal.

Potential Problems: Niagara Mohawk (NiMo) has a general policy of not granting easements to receive stormwater on their right of ways due to maintenance issues. Further conversations with higher level NiMo representatives will need to take place for this solution to happen. Also, the new fiber optic line has just been installed in close proximity to the area that would become the wetland, causing issues with construction.

Probable Cost: Expensive. If approval to construct this wetland was granted, design and construction costs would likely be in the range of $200,000 - $300,000.

Option 2: Open space/grass area - Price Chopper.
There is an open grass area located between the Price Chopper parking lot and Halfway Brook that is approximately 60 feet by 30 feet in dimension. This area could be utilized for a large underground retention structure which would slow the stormwater and allow it to settle out any solids and debris. More innovative stormwater improvement structures could be installed which would remove these components and possibly some of the nutrients and organics. This structure (or structures) would accept all of the stormwater from the large drainage area above and treat it before it was outleted into Halfway Brook, alleviating the most significant stormwater problem in the watershed.

Potential Problems: The landowner (Price Chopper) would need to provide a permanent easement on that section of property, and the DOT would need to reroute the largest stormwater drain on the highway over to the other side of the road. Technical problems relating to sizing and spacing of the new drainage line and the new structure would also need to be overcome.

Probable Cost: Design and construction costs associated with this effort would likely be in the $100,000 - $200,000 range. If DOT assumed the costs of rerouting their drainage line, it would save approximately $25,000.

Option 3: Roadside catchments at drop inlet locations.
By installing roadside catch basins (sediment traps) where the drop inlets are located, a large amount of sediment can be removed before it enters the brook. At various locations to be determined along Route 9, these structures could be installed at approximately every other drop inlet location which would provide for pollutant removal from stormwater runoff before it reaches the brook. This solution would only remove heavy solids and trash, and would not address lighter solids and dissolved nutrients.

Problems: Obtaining approval from the NYS DOT for major roadside structural improvements would take time, and maintenance of these structures would be relatively high if they were to work properly.

Probable Cost: Varying, depending upon the number of catch basins installed. The cost of each basin would be approximately $10,000 - $15,000 each.

2. Upper Route 9 Corridor (Sweet Road to Quaker Road)

Overview: Route 9 stormwater from the upper boundary of Sweet Road to the lower boundary of Aviation Road flows south along this ¾ mile section, then turns east at the Quaker/Aviation intersection and enters the roadside ditch on Quaker Road. This ditch outlets into Cemetery Brook which outlets into Halfway Brook shortly after. Within this Route 9 section there is a Wal-Mart and an Ames department store with large impervious parking areas, as well as many other smaller commercial businesses.

Option 1: Using the grass covered state property located in front of Monroe Muffler, a series of underground structures may be installed to control stormwater quality and quantity from this subsurface culvert. Available space in this area is approximately 40 feet wide by 200 feet long, which would be sufficient to control for stormwater quality using the proper structures.

Problems: Obtaining easement rights from New York State DOT for use of the property.

Probable Cost: Design and construction of in-line subsurface structures such as Vortechnics® would likely be $100,000 - $200,000.

Option 2: Utilizing the front of the Queensbury Cemetery property, a vegetated stormwater detention basin could be constructed to accept the stormwater from this same section of Route 9. This basin could be vegetated with selected species of plants to allow for improved nutrient uptake, which would improve upon the subsurface structure recommendation above. However, the winter and spring dormant plant season will not be able to provide this benefit.

Potential Problems: The Queensbury sewer system is in the vicinity, and engineering will be a concern. Also, as a surface structure, the cemetery board may have concern over aesthetics of the property resulting from this project.

Probable Cost: Design and construction of this structure would be in the $50,000 - $80,000 range, depending upon possible relocation of existing utilities and easement costs.

3. Northway Plaza stormwater drainage

Overview: The Northway Plaza, a large strip-type mall in the Town of Queensbury has a very large parking area associated with it which currently has no stormwater improvement system incorporated into its facilities. The drainage area associated with this development is approximately 17 acres, with the strong majority of it being impervious. Currently, all of the stormwater from this development ties into one major drainage line which outlets into a low quality wetland area in the back of the plaza. This wetland drains directly into Cemetery Brook, a major tributary to Halfway Brook.

Recommendation: Create a high quality stormwater wetland at the site of the current outlet, and build enough capacity in this wetland to allow it to have water quality improvement qualities. A berm/riser system could be built at the exit of this wetland to provide for larger capacity and retention time, allowing for nutrient uptake and sediment removal.

Potential Problems: Accessibility to this site may be difficult as it is down a steep incline on the backside of the plaza. Landowner issues and easements would need to be taken care of, and maintenance of this wetland would need to be accounted for.

Probable Cost: Much of this cost is tied to excavation of the wetland and plantings of new species, which are more suited to nutrient uptake. Design and construction of this solution would likely range from $50,000 - $100,000.

4. Bay Road (North of Quaker Road)

Overview: Approximately ½ mile of Bay Road north of Quaker Road drains directly into Halfway Brook just north of the intersection of these roads. In this stormwater drainage area (13 acres) there is a substantial amount of development and impervious area. There are two

stormwater drainage pipes emptying into the Brook at this location; one on the west side of Bay Road and one on the east side. A solution is recommended which will eliminate this direct drainage and allow for pollutant and debris removal before it outlets into Halfway Brook.

Recommendation: There is a fairly extensive floodplain for Halfway Brook in front of the Lowe's Warehouse, which could be utilized as a filter for stormwater. The two drainage pipes could be rerouted to outlet into this floodplain, where the stormwater would spread out across this vegetated area and infiltrate into the soil. Building a low berm before the stormwater flow reached the bank of Halfway Brook would allow for a longer retention and infiltration time. This solution would be a relatively simple means to address this issue at this location.

Potential Problems: The drainage line on the western side of Bay Road would have to be cross connected to the eastern side, and the Warren County DPW would need to approve this work. Also, a drainage easement would need to be obtained from the landowner of the floodplain lands, and a temporary construction easement for work on the floodplain would need to be obtained. There is a new fiber optic line very close to this site which would have to be located and avoided.

Probable Cost: The cost of this recommendation is largely dependent upon the willingness of the Warren County DPW to do the drainage modifications. If they were not, and the work was contracted out privately, it likely would cost about $20,000 - $40,000.

5. Bay Road (South of Quaker Road)

Overview: Approximately ¾ mile of Bay Road south of Quaker Road drains directly into Halfway Brook at the intersection of these roads. Much of this stormwater drainage area (11 acres) is roadway, which is heavily traveled and sanded in the winter. There are two drainage pipes which outlet into Halfway Brook, one on the east side of Bay Road and one on the west.

Recommendation: There is a fairly extensive floodplain for Halfway Brook in front of the Lowe's Warehouse, which could be utilized as a filter for stormwater (much like item 6 above). The two drainage pipes could be rerouted to outlet into this floodplain, where the stormwater would spread out across this vegetated area and infiltrate into the soil. Building a low berm before the stormwater flow reached the bank of Halfway Brook would allow for a longer retention and infiltration time. This solution would be a relatively simple means to address this issue at this location. This section of Bay Road drains somewhat of a smaller area than the northern section, and the development is less intensive. To undertake one of these two projects, we would recommend undertaking the northern section (item 6 above).

Potential Problems: The drainage line on the western side of Bay Road would have to be cross connected to the eastern side, and the Warren County DPW would need to approve this work. Also, a drainage easement would need to be obtained from the landowner of the floodplain lands, and a temporary construction easement for work on the floodplain would need to be obtained.

Probable Cost: The cost of this recommendation is largely dependent upon the willingness of the Warren County DPW to do the drainage modifications. If they were not, and the work was contracted out privately, it likely would cost about $20,000 - $40,000.

6. Quaker Road (Route 9 to Halfway Brook)

Overview: Drainage from this section of Quaker Road primarily flows off the road and into grassed swales and ditches. There are only a few drainage lines running along this section, which makes it somewhat difficult to determine a solution as there is no specific outlet to the stormwater. This sheeting of stormwater into grassed swales and ditches in many cases is a positive situation in that it allows for increased infiltration into the ground as well as decent sediment removal as the flow filters through the grass. However, there are still areas of concern which merit a closer look and some improvements to improve the quality of runoff into Halfway Brook. On the negative side, many of the commercial developments in this area do not have stormwater control structures in place on their properties, and it is not likely that these developments will retrofit their existing drainage systems to install these structures.

Recommendations:

1. Hannaford Plaza – the stormwater detention area which was created for control of stormwater coming off of this development could be easily improved at a minimal cost. The outlet culverts are at approximately the same elevation as the inlet culverts, providing for very little capacity in this basin. By installing a simple riser structure at the outlet, the retention time of this basin and its infiltration capabilities would be significantly improved.
2. CVS property – the same problem with the Hannaford Plaza detention basin exists with the CVS detention basin. With a riser structure installed, this basin would have much more capacity and provide for water quality improvement of the stormwater coming off of this development. Very easy to install and minimal cost.
3. Increase road sweeping operations – much of the concern from the Quaker Road corridor is related to winter road sanding operations. Spring runoff carries this sand into the drainage channels and ultimately into the Brook. Warren County DPW should make this ¾ mile section of Quaker Road a priority for road sweeping when the time is suitable for this activity.
4. Retrofit roadside drop inlets to convert them to sediment traps – Most of the drop inlets, which take the stormwater off of Quaker Road, have no storage capacity and simply convey the stormwater to an outlet. By converting these structures to sediment traps, each of the smaller drainages can be controlled for in terms of sedimentation. Site specific selection of these drop inlets would need to be made based on the scope of the funds available.

7. Route 9 between Crandall Park and Halfway Brook

Overview: This section of Route 9 drains north from approximately the location of the YMCA up where it outlets into Halfway Brook near the Price Chopper. It is approximately 1/8 mile long and this road section drains land which includes both commercial and residential properties as well as the section of Route 9 totaling approximately 3 acres. Concerns for stormwater in this section include primarily road sanding, but also potential runoff contaminants from a gas station and an auto repair center.

Recommendation: The flow from this drainage goes under the Sunoco station adjacent to Halfway Brook. Installing a subsurface stormwater improvement structure at this location (either on the Sunoco lot or in the DOT right of way) would control for almost all of the flow from this three-acre section. With the potential for petroleum-laden runoff from the gas station and an auto repair center, a solution, which can improve water quality relating to these contaminants (such as Aquashield™), would be recommended.

Potential Problems: Obtaining permission from the Sunoco property owner to install this structure below their pavement would be a potential issue if it was located on their property. Working around the existing subsurface facilities in this location might also provide a challenge.

Probable Cost: Design and installation of a stormwater improvement structure which controls for petrochemical laden runoff would likely cost in the range of $40,000-$80,000.

8. Interstate 87 (Northway) drainage into Halfway Brook

Overview: There is a section of the Northway approximately ½ mile long which drains off this highway and out through a culvert which outlets approximately 30 feet from the main stem of Halfway Brook. Winter road sanding operations on the Northway produce large amounts of excess sand, which flow off the road and into the Brook through this culvert.

Recommendation: At the outlet of the culvert which drains the Northway, a berm could be constructed which would route the stormwater and any sediment away from the Brook and into the surrounding woods. There is plenty of area to have this stormwater dissipate into these woods whereby essentially no stormwater would enter the Brook from the Northway. This would be a very simple and quick fix to a primary stormwater input into the Brook.

Potential Problems: As this is a NYS DOT right-of-way, it would just take some effort to get them to include this project in their project schedule. Otherwise, no problems are anticipated with this simple project.

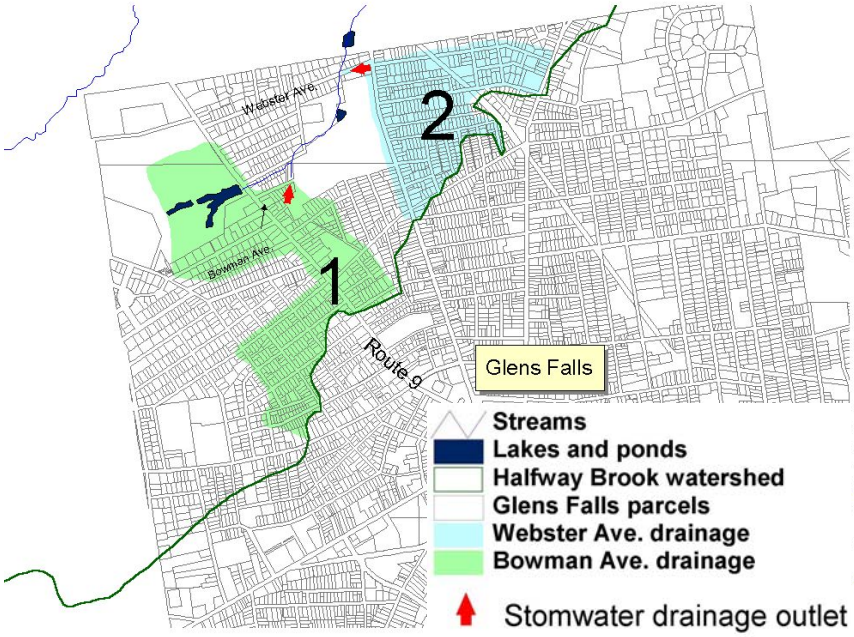
Probable Cost: If the NYS DOT decides to undertake the project, there would be no local cost associated with it. Essentially this project would just entail some time on a backhoe or excavator, with minimal materials cost.

Glens Falls Stormwater Improvement Project Recommendations

1. Bowman Avenue stormwater outlet

Overview: Outleting at the end of Bowman Avenue, this drainage of approximately 130 acres of the City of Glens Falls empties into the Crandall Park tributary. Much of the land use in this area is city residential, with an extensive road network. This stormwater drainage has been identified as the most significant impact on Halfway Brook water quality coming from the city of Glens Falls.

Recommendations:
There is a parcel of undeveloped land owned by the city of Glens Falls which is approximately 30 feet by 30 feet in dimension located at the end of Bowman avenue. This parcel which is adjacent to the outlet of this major stormwater drainage could be utilized for stormwater improvement. Placement of underground water quality improvement structures in this area would increase the detention time and would reduce the stormwater impacts into the Crandall Park tributary to Halfway Brook.



Stormwater location maps – Glens Falls, NY

Potential Problems: Restructuring the old stormwater drainage line, and residential concerns during construction may be potential issues. These could be solved relatively easily however. There is also a limited area to have heavy machinery available to work, which may be a concern.

Probable Cost: Design and construction costs would likely be in the $100,000 - $200,000 range, based on initial findings of site applicability.

2. Webster Avenue stormwater outlet

Overview: Approximately 74 acres of city property (primarily dense residential and commercial) drains to an outlet on Webster Avenue. This stormwater system outlets into the Crandall Park tributary, which then flows into Halfway Brook approximately ½ mile downstream. This stormwater drainage has been identified as the second most significant impact on Halfway Brook coming from the city of Glens Falls.

Recommendation: Webster Avenue is adjacent to Glens Falls Cemetery and there is a strip of lawn approximately 20 feet wide and 300 feet long which is owned by the city. The stormwater drain line runs parallel to Webster Ave on the southern side of the street directly under this grassed laneway. This drainage line could be cut into and routed into a series of underground detention structures, which would remove sand, debris, and trash before the stormwater outlets into the tributary.

Potential Problems: There may be a need for utility relocation if there are any located in this area. Also, there is a long row of white cedar trees between the road and the cemetery fence, which would have to be avoided during construction.

Probable Cost: With a series of two to three in-line underground structures, the design and construction costs would likely be in the $80,000 - $120,000 range.

Fort Ann Stormwater Improvement Project Recommendations

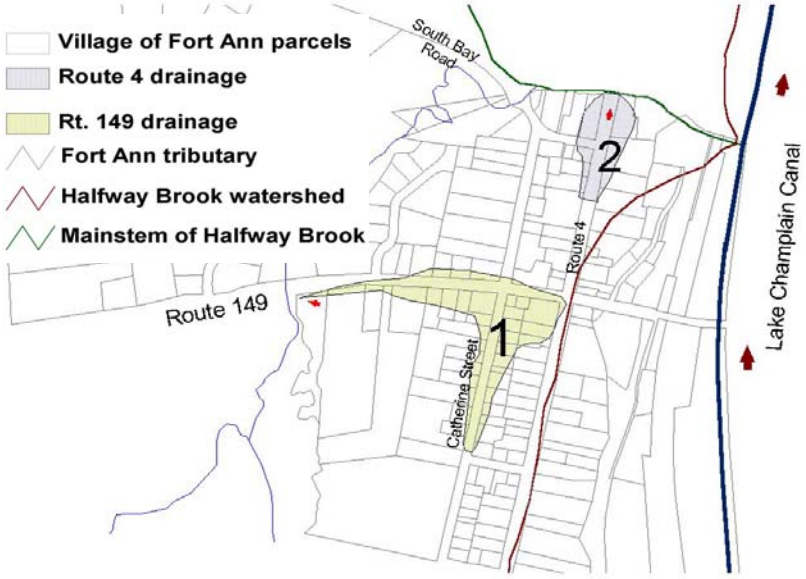
1. Route 149 drainage (between Route 4 and the Fort Ann tributary)

Overview: The primary concern for stormwater impacts to Halfway Brook in Fort Ann is on Route 149 as it enters the Village from the east. This section of Route 149 is approximately 1/3 of a mile long and is heavily developed with roadways and private residences. Stormwater from this section of roadway flows directly into the Fort Ann tributary, which then outlets into the mainstem of Halfway Brook shortly thereafter.

Recommendation:

Road sand and other potential contaminants from stormwater currently flow unabated into the tributary, but the drainage system could be modified to flow into a sediment retention pond in the open field area adjacent to the tributary.

This field area has enough space available (~30 feet by 40 feet) to create a settling pond with a riser structure which will allow the stormwater to infiltrate and settle out any silt and debris.



Stormwater location map – Fort Ann, NY

The outflow from this settling pond would then be a direct outlet into the tributary.

Potential Problems: Landowner easement issues to construct and maintain the pond.

Probable Cost: Design and construction of this settling pond would be approximately $10,000 - $20,000, but with municipal workers this cost could be cut substantially.

2. Route 4 drainage (between Rte 149 and the Halfway Brook bridge)

Overview: This section of Route 4 is approximately ¼ mile long and drains approximately three acres of highway and commercial property. The primary concern here is road sanding operations with the degree of sand required to keep this highway clear. The road drainage on this section drains directly into Halfway Brook at the bridge location through a culvert on both sides of the road.

Recommendation: The two final drop inlets which remove stormwater from Route 4 could be converted to catch basins which would retain any road sand, trash and debris that flows off of this section of highway. Although the installation of a standard catch basin structure would alleviate much of the sedimentation resulting from this section of road, a more effective solution would be a stormwater technology such as Vortechnics® or a similar device that has a much higher pollutant removal efficiency.

Potential Problems: Obtaining permission from NYS DOT to retrofit their existing drainage structures.

Probable Cost: If NYS DOT could be convinced of the project's merit, they could likely retrofit this section of road under their capital projects or standard maintenance program. If so, there would be no local cost to undertake these improvements. This solution would likely be the standard catch basin solution and not the more efficient stormwater technology. To undertake this better solution, the primary cost would be design time and purchase of the structures, which would likely range from $30,000 - $60,000.

Conclusion

The Halfway Brook watershed is a large and diverse area found in Warren and Washington Counties. There are many land uses in the watershed and it is used for a wide variety of activities, both commercial and recreational. Development of the land has led to an increase of non-point source pollutants that affect the water quality of Halfway Brook.

Non-point source pollutants are of concern in Halfway Brook for the local area, as well as Lake Champlain. A successful reduction of these pollutants in Halfway Brook would likely lead an improvement of the water quality of the Lake Champlain canal, and Lake Champlain proper. In order to accomplish this, water quality improvement projects need to be undertaken in both developed and agricultural areas of the watershed.

Results of a water sampling program indicated that Halfway Brook's water chemistry is impacted, most likely from stormwater runoff in the developed and agricultural areas of the watershed. Fish and macroinvertebrates that live in Halfway Brook are also impacted, as determined by the NYS DEC's Rotating Intensive Basin Survey.

The results identify that there is a need for future funding for the implementation of the recommendations included in this document. The Halfway Brook steering committee members and the associated organizations are committed to this task. By working together as a committee on these projects, the water quality of Halfway Brook would be improved to benefit to both the environment and people living within its boundaries.

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