Summit Lake Reservoir Watershed Assessment

Prepared by the
Warren County Soil & Water Conservation District

For the
Columbia County Soil & Water Conservation District

March 2014

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Introduction

In 2013 the Warren County Soil and Water Conservation District was contacted by the Columbia County SWCD for assistance with a sediment and erosion assessment of the Agawamuck Creek upstream of the Summit Lake Reservoir. The Warren County SWCD has extensive experience in stormwater runoff assessment and stormwater retro-fit recommendation and this assessment report will provide the Columbia County SWCD a number of options to present to the Village of Philmont, who has a growing concern over a delta forming at the inlet of the reservoir.

Location

The Summit Lake Reservoir Watershed is located in central Columbia County New York. The 21.3 square mile watershed covers portions of four towns. The percentages of the watershed included in each of the towns are: Hillsdale (39%), Austerlitz (29%), Claverack (25%) and Ghent (7%). The waters of Agawamuck Creek and its lesser tributaries flow into the Summit Lake Reservior. The outfall of Summit Lake continues on as Agawamuck Creek and merges with Claverack Creek, which joins with Kinderhook Creek and becomes Stockport Creek which empties into the Hudson River at the Village of Stockport approximately four miles north of the city of Hudson NY.

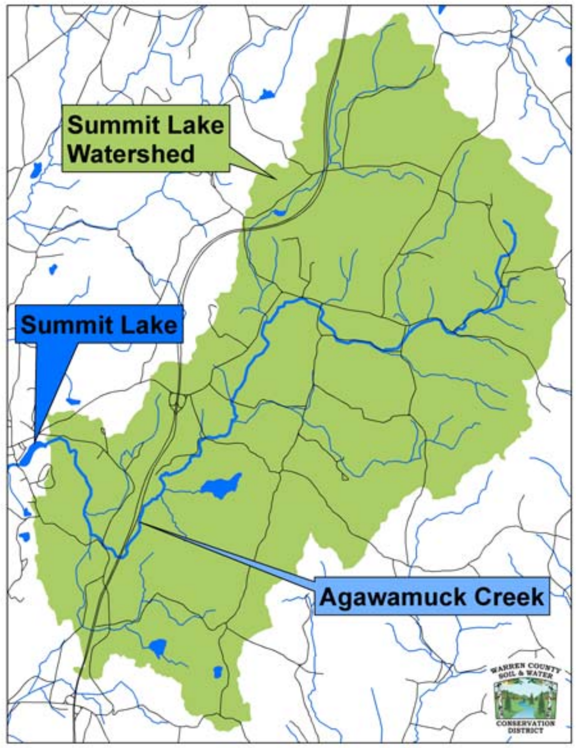
Summit Lake Watershed Study area within Columbia County

Assessment Methodology

This report is a stormwater examination of the Summit Lake Watershed, which covers a portion of the Towns of Hillsdale, Austerlitz, Claverack and Ghent. This consisted of a review of the stormwater runoff from the conveyance system along the roads and Agricultural fields within the Agawamuck Watershed as well as the limited cost effective recommendations available to reduce the stormwater pollutants and sediment input to the stream and reservoir.

District staff used Geographic Information System ArcView 9.3 (GIS) to assist with mapping of the roads and agricultural fields from existing data. These maps were referenced throughout the project as a guide and layout for final stormwater identification mapping. Each of the roads were driven, documenting the stormwater network, outfalls and storm drain inlets along with any point and non-point source pollution within the watershed. Data was collected using a Global Positioning System (GPS) Trimble Juno SB. Data was logged and photographed to document the physical conditions of stormwater runoff from the conveyance system. The information collected was processed in the office and the GPS data was differentially corrected and exported as shapefiles for utilization in GIS maps.

Hydrology



Agawamuck Creek and Summit Lake Watershed

The waters that form Summit Lake are a product of its watershed. Rainfall and snowmelt within the watershed flow to the small streams which empty directly to the Agawamuck. Precipitation within the watershed that does not directly flow into the Agawamuck or its lesser tributaries is absorbed into the soils; these waters form the groundwater table. Groundwater contributes to the reservoir in two ways; it emerges as bottom springs within Summit Lake and by recharging the waters of Agawamuck Creek, which allows for flow even during the driest periods. Within the watershed there are four major unnamed tributaries that flow to the main branch of the creek. The creeks watershed covers an area of 21.4 square miles, of which 2% or less than ½ square mile is considered urban use; approximately 21% is agricultural use land and the remaining 77% is forested. There are approximately 12 miles of stream corridor that makes up the 2 main branches of Agawamuck creek, and another 12.5 miles of stream from the four major tributaries empting to the creek. Of the 24.5 miles of stream corridor for Agawamuck Creek and its tributaries, over 7.25 miles (30%) of the stream runs through or within 50' of cultivated fields. The NYSDEC has designated Agawamuck Creek a C(T) trout stream with a majority of the stream designated C(TS); the C(TS) rating means the stream is highly suitable for trout reproduction. The classification AA or A is for waters that can be used as a source of drinking water. The classification B indicates waters for swimming and other contact recreation, but does not meet the requirements for drinking water. Classification C is for waters supporting fisheries, but is not suitable for contact activities. Waters with classifications A, B, and C may also have a standard of (T), indicating that it may support a trout population, or (TS), indicating that it may support trout spawning (TS).

Soils in the Watershed

Soils within a watershed and along a shoreline lay the framework that all land uses are based upon. They have a direct correlation to the type of land uses that may be suited for a particular location. A group of soils having the same runoff potential under similar storms and cover conditions are considered to be a *Hydrologic group*. Hydrologic soil groups are used in equations that estimate runoff from rainfall. Soil properties that influence runoff potential are those that influence the minimum rate of infiltration for a bare soil after prolonged wetting and when not frozen. The soils of the U.S. are placed into four groups A, B, C, D. Definitions of the classes are as follows:

A. Soils with low runoff potential. Soils having high infiltration rates even when thoroughly wetted and consisting chiefly of deep, well drained to excessively well-drained sands or gravels.

B. Soils having moderate infiltration rates even when thoroughly wetted and consisting chiefly of moderately deep to deep, moderately well drained to well drained soils with moderately fine to moderately coarse textures.

C. Soils having slow infiltration rates even when thoroughly wetted and consisting chiefly of soils with a layer that impedes downward movement of water, or soils with moderately fine to fine textures.

D. Soils with high runoff potential. Soils having very slow infiltration rates even when thoroughly wetted and consisting chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. (*From* [*www.nesoil.com*](http://www.nesoil.com))

Very sandy soils (A) have a high infiltration rating allowing precipitation to pass quickly through the soil layers to the groundwater table. Soils with high clay content (D) have the opposite issue in terms of infiltration. The runoff potential is very high with clay soils because its fine particulate sizes reduces the interstitial space preventing water from filling the voids and passing to ground water table. This section briefly evaluates the soils within the watershed of Summit Lake to summarize some of the potential concerns with land use and water quality within the lake. After an analysis of the watershed using the NRCS soils survey map (Figure 8), it was noted that over 70% of the soil types listed are in the C or D Hydrologic Soils Group (HSG). When you add in soil groups that have a duel rating (A/D, B/D or C/D) meaning when soils are thoroughly wetted they perform like D rated soils, the percentages rise to over 83%. Soils with a high runoff potential and a slow infiltration rate lead to a decreased lag time for stormwater runoff throughout the watershed. Lag time is the period between precipitation hitting the ground and its flow to a waterway.

Please note that this is only a brief summary of the soil conditions, and much more detailed information and maps are available in the Columbia County Soil Survey available through the Columbia County Soils & Water Conservation District.

Urban Stormwater Runoff

A concern in any watershed is the impact of stormwater runoff on the nearby water bodies. Along roadways, driveways, rooftops and parking areas, runoff is often channeled into drains and pipes, which frequently outlet into a stream or a lake. Impervious surfaces such as concrete, asphalt or compacted soils do not allow water from precipitation or snowmelt to infiltrate into the ground. As the water courses across these surfaces, it can collect sediment, phosphorus, de-icing materials (sand and salt), petrochemicals, fertilizers, herbicides and other pollutants.

Roadside ditches also contribute to stormwater runoff issues when improperly installed or poorly maintained. A poor roadside ditch can contribute to increased stormwater runoff velocity leading to increased erosion and sedimentation. During warmer months, this runoff can also be significantly warmer than the stream's water, causing thermal pollution affecting the stream's aquatic communities.

Stormwater discharges are a major contributor to stream sedimentation and delta formation in lakes, and can also have significant negative impacts on aquatic communities. Calcium from road salt can create improved conditions at the mouths of streams suitable for the colonization of zebra mussels. Phosphorus transportation by sediments create multiple problems including the eutrophication of water bodies, increased habitat for invasive aquatic plants and animals and cause a general reduction in water quality.

This runoff directly affects the stream systems long-term stability. As land becomes more developed, whether from urbanization or expanded agricultural use typically more water runs off the land into nearby streams very quickly following a precipitation event. This large volume of water entering a stream in a short period of time can cause an over widening of the stream channel in order to accommodate the increased volume of water. These channel widening processes occur through accelerated stream bank erosion, and ultimately more downstream deposition (deltas).

Agricultural Land Best Management Practices

Best Management Practices (BMP's) on agricultural land are very important to water quality in our lakes and streams. Soil health and water quality go hand in hand, as a healthy soil leads to reduced erosion, increased infiltration and a greater water holding capacity that will be more resilient against drought. BMP's will reduce runoff of topsoil and nutrients from entering our waterbodies and causing pollution issues such as sedimentation of streambeds, delta formation in lakes and nutrient loading leading to the eutrophication of waters.

It is important to use properly designed BMPs to reduce runoff and erosion from agricultural land. Proper drainage design can reduce the transportation of sediment and pollutants. Vegetated ditches with rock check dams will reduce stormwater velocity, allow for increased infiltration, take up nutrients and collect sediment behind the check dams allowing for ease of ditch maintenance (Figure 6). Proper planning for subsurface drainage and outlet protection are also important to water quality and runoff during larger storm events (Figure 7). Providing a stabilized outlet will reduce runoff and erosion to waterbodies.

Soil health management systems listed at the Natural Resources Conservation Service (NRCS) website (www.nrcs.usda.gov), detail the specifics of these management systems. The implementation of these management systems such as cover crops, no till, mulch tillage and mulching will lead to increased soil health as well as increased water quality through reduced wind and water erosion of soil and nutrients. Cover crops provide immediate water quality benefits to agricultural fields through holding soil in place during periods of exposed fields throughout the year when stormwater and wind erosion are highest on a farm. Cover crops also allow reduced soil compaction improving infiltration while preventing stormwater head cuts and sheet flow. In addition there is an increase in the organic matter and humus which are biotic glues that hold soil together and in place. Also, your local Soil & Water Conservation District will have an Agricultural Environmental Management Program (AEM) designed to work with farms offering technical assistance to assist in the planning and implementation of agricultural land BMPs.

Streambank/In-stream

A stream is the transportation mechanism within a watershed for two major constituents: water and sediment. In an undisturbed watershed a stream will achieve a balance; its course will move gradually with erosion of its banks and stream bottom during high flows and sediment deposition with the gradual slowing of the flow. These changes will occur slowly over long periods of time. Changes in the flow path will occur both horizontally and vertically depending on the slope and substrate of its route and the condition of the native vegetation along its banks. Streams meander through a watershed in order to reduce the velocity and the amount of sediment carried by stream is tied directly to the streams velocity. When streams become disconnected from their flood plains or when changes within its watershed increase the amounts of water running off the surrounding landscape, the ability of a stream to reduce its velocity is severely limited.

A stream with floodplain disconnection, stormwater impacts and debris. Courtesy of the EPA

Flood plains are depositories of large amounts of inorganic and organic materials carried by streams during periods of high flow. For this reason, flood plains become highly desirable areas for agricultural development with their fertile soils. Compound the loss of flood plains with the removal of native vegetation within the riparian zone (the area adjacent to the land –water interface) that secured the stream banks and mitigated stormwater runoff within the watershed and created a stream channel that is out of balance. The loss of multiple flood plains within a single watershed can cause vast amounts of damage to a stream channel. Increased stream velocities will deepen a stream channel as faster moving water transport sediment from the streambed downstream. This situation is known as a degrading stream channel. Bank failure occurs when banks become too high and unstable or are undermined and the bank sloughs into the stream channel, creating a wider and shallower stream channel. The addition of more sediment than a stream can transport will cause an aggrading stream channel. The sediment that is transport downstream gradually rebuilds the streambed in its effort to reach equilibrium. Both of these situations occur when changes, whether natural or man-made happen within a watershed.

Watershed Recommendations

Stormwater runoff is considered to be one of the largest water quality impacts in any Watershed. This report will provide the Village of Philmont with the ability to identify opportunities to address stormwater issues and their impacts within the Agawamuck Creek Watershed upstream of the Summit Lake Reservior. The Village of Philmont is concerned with an ever growing sediment delta forming at the mouth of Agawamuck Creek in Summit Lake. Aerial photographs of Summit Lake starting in 1994 and progressing through November of 2011 shows the incremental growth of the delta at the mouth of Agawamuck Creek (Figure 1). Though the increase in deposition of sediment can be seen through 2009, a vast majority occurred after the 2011 tropical storms Irene and Lee. With the urbanized area of this watershed being so small, and the outfall of the Village of Philmonts' stormwater system being downstream of the reservoir, this is not the major consideration of this report. Roadside runoff at stream/road crossings also contributes to the sediment loading. A majority of this creek flows through private property and is not accessible without direct landowner permission. It will be necessary to survey Agawamuck Creek and its tributary stream channels to locate similar situations as those shown. It is estimated that 77% of this watershed is in a forested condition, agriculture at 21% and only 2% is classified as urban development. It is important to understand what areas are identified with the land uses as the 2% or urban may contribute more impacts than the 21% from agriculture.

Roadside Stormwater

A majority of this creek is located well away from most of the public roads in the watershed. Where it does approach public roads, a well maintained buffer exists in most cases. In general most of the road system for this watershed appears not to have major effects on the creek with untreated stormwater. However, spring runoff events, water *volume* may be an issue.

By following Best Management Practices (BMP) laid out in the New York State Department of Environmental Conservations' publication "*New York State Standards and Specifications for Erosion and Sediment Control"* (http://www.dec.ny.gov/chemical/29066.html), as well as publications such as: "*Cornell Local Roads Program"(*www.clrp.cornell.edu*)*, *"The Vermont Better Backroads Program"* (www.vtransengineering.vermont.gov) and the "*Massachusetts Unpaved Roads BMP Manual"* a further reduction of roadside runoff may be achieved within the watershed. The following are uses of BMP's that would aid in the reduction of sediment to Agawamuck Creek. The proper maintenance and construction of roadside ditches and stormwater conveyance systems is an important consideration. Roadside ditches should be vegetated if the slope is less than 5%; with a slope of greater than 5% the use of filter fabric and broken stone will be necessary to reduce the scouring of the ditch during high flows (Figure 4). The use of rock check dams in ditches will reduce flow velocities and minimize erosion of the unprotected ditches.

Taconic State Parkway
Eroding Ditch

The timing of roadside ditch maintenance is very important; excavation to the ditch should be completed early enough in the year to allow for re-vegetation of the ditch either naturally or by hydroseeding. In general it is good not to construct or maintain more linear feet of ditch in one day, than can be stabilized before the end of the work day. The use of turnouts in ditches to vegetated or wooded areas should be considered as a way to reduce stormwater from impacting waterways. On unimproved roads in the watershed the proper crowning of a road will allow for timely removal of stormwater and a reduction of road surface deterioration such as rutting and potholes. An example where BMPs' could effectively be integrated is along the section of Agawamuck Creek and the Taconic State Parkway (Figure 2).

Approximately 8 of the Taconic State Parkways' drop inlets are transporting stormwater runoff by culverts to steep banks along stretches of the creek. Erosion of the unarmored water paths are causing sediment loading to this section of the creek. The use of filter fabric and broken rock from the culverts outfall to the streambed would reduce the velocity and erosive properties of the runoff and limit the sediment input to the creek (Figure 5).

Agricultural Recommendations

While conducting field investigations on the road networks, District staff noted that there were two locations in agricultural areas that appear to be contributing erosion and sediment to a tributary of Agawamuk Creek.

Unprotected drainage ditch

Site 1

This site is located on Prach Road and is an unstable outlet section that coveys water from large field and stabilized waterway into a tributary of Agawamuk Creek. The current depth of the ditch would suggest that at times of heavy precipitation or during spring runoff, a considerable volume of water flows to this tributary. The day that the Warren County staff did a watershed evaluation, the side slopes were vertical, suggesting that this ditch is maintained by mechanical means. In the stream crossing to the north of this site (downstream), there was a significant amount of bedload material that had piled up in the stream channel. This material may be coming, in part from this unprotected drainage way.

This drainage way could have its vertical sides cut to a 3:1 slope and vegetation planted on the exposed soil to reduce scouring to the unprotected edges. This may be a candidate for several programs offered by USDA-NRCS for the establishment of riparian buffers. In addition, it appears that the placement of stone as armoring would be necessary to reduce runoff velocities and sediment carried to the creek.

Site 2

The second location of concern is at the Hawthorne Valley School. There appears to be a farm crossing that is impacting the sediment load and hydrology of the creek. District staff have not had an opportunity to visit this site, but from the image provided it appears that this is not a stabilized crossing, or is a crossing in need of repair.

Unstabilized Stream Crossing

If this is a heavily utilized crossing, it would be in the best interest of the farm to develop a plan to address this location. This may be in the form of a hardening of the crossing or the placement of a bridge. The use of properly constructed farm access stream crossings as laid out by the Columbia County SWCD or NRCS office will also aid in minimizing the introduction of sediment to the creek (Figure 3).

An important recommendation would be to continue to encourage agricultural landowners to participate in the SWCD's AEM programs in an effort to implement agricultural Best Management Practices to reduce the loss of soil, increase the farms productivity and decrease the nonpoint source impacts to nearby streams.

Failing Stream Bank

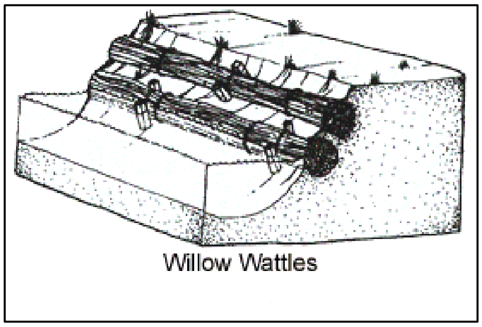
<u>Streambank/In-stream Recommendations</u>

Streambank restoration within the watershed may reduce the amount of sediment now being deposited in Summit Lake Reservoir. The riparian zone has been diminished with increases in agricultural development; this has a two fold affect on the creek. With a narrower buffer between the open cultivated fields and the creek, greater amounts of stormwater runoff now flow directly from the fields to the creek and the amounts of sediment being carried with also increases. The expansion of the buffer between cultivated field and the stream bank would allow for greater absorption of stormwater and filtration of the sediments being carried by the runoff. The enlarged riparian buffer comprised of native vegetation will also enhance stream bank stability.

Coir Log Bank Repair
IWT-Cargo-Guard

In areas already affected by failing banks, restablishing stabilized banks can be achieved by several methods. By cutting back the slope of exposed banks and hydroseeding or allowing native vegetation to re-establish, the amount of exposed soil open to higher flows is decreased. The use of coir logs or willow bundles to protect the toe of exposed stream banks. The use of cross vanes, deflection weirs or J Hooks to deviate flow from exposed banks will decrease the erosion occurring during periods of high flow.

Re-establishing the flood plains and cutting benches into the banks would further reduce high flow stream velocities which would lead to a decrease in the amount of soil entering the stream. The Delaware County SWCD "Post-Flood Stream Intervention Training Manual" is a tremendous resource for potential remedies for exposed banks such as the one pictured here.



Wattle Diagram courtesy of anokanatural resources

Planning Considerations

With the growing pressure of development within the watershed, the need for appropriate infrastructure planning, green development and low-impact design is essential for the reduction of stormwater runoff; whether the pressure comes from increased urbanization or expanded agriculture.

Working with the state, county and local highway departments to upgrade the storm water conveyance systems on public roads using the *New York State Standards and Specifications for Erosion and Sediment Control"* (Blue Book) and "*Cornell Local Roads Program"* for improved storm water runoff control will aid in the reduction of sediment to the waterways. The proper construction and maintenance of rock lined ditches, vegetated swales, outfall protection at existing culverts and the installation of drywells or stormwater infiltration systems will further improve the quality of the water entering your local lakes and streams.

It is important that the agricultural community works with the Columbia County SWCD and its agricultural programs and utilize resources such as the Natural Resources Conservation Service (NRCS) to improve the quality of surface runoff from agricultural lands. The promotion of access road improvements, riparian setbacks, increased buffer zones, conservation tillage, cover crops and proper field drainage will assist in both soil retention for agricultural lands and a reduction of sediment in the waterways.

If there is an increase in second home development, there may be a need to mitigate stormwater runoff from compacted soils due to heavy machinery use during construction, expanded driveways, roof tops or enlarged lawns. Construction activities are generally considered to be the largest sources of nonpoint source pollutants.

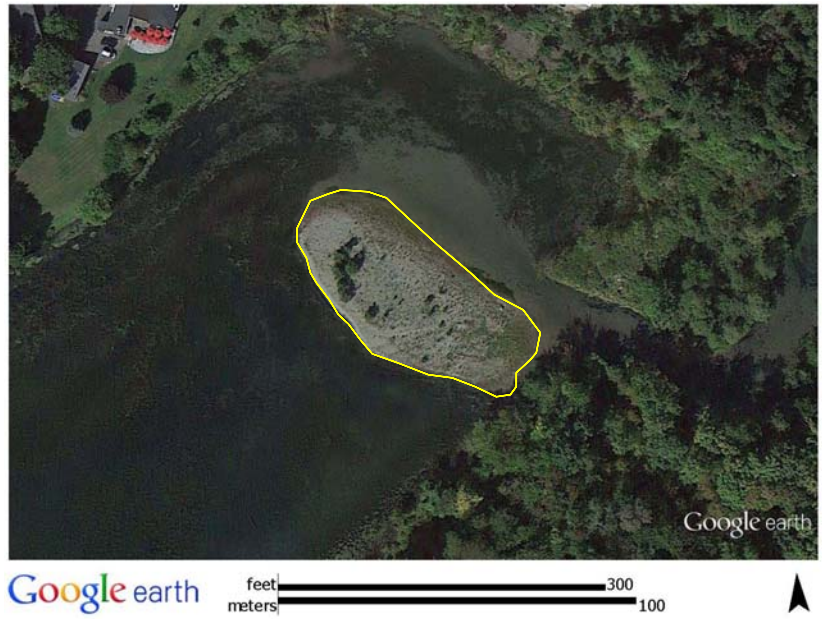
Whether the pressure is coming from construction in urban or single home development, expanded agricultural uses or improvements to transportation infrastructure; working with property owners to help them understand the importance of a healthy waterway is important not only to landowners downstream, but for the protection of their property as well.

Conclusions

The growing delta at the mouth of Agawamuck Creek in Summit Lake is the primary concern that is driving this assessment for the Village of Philmont. As stated in the report, streams function as a transportation mechanism for water and sediment. Building the dam has produced the perfect location for the creek to deposit the sediments carried from throughout the upper watershed, as water velocities are reduced and sediment more easily fall out of suspension. Simply stated, the creek wants to fill in the reservoir and continue its path to the Hudson River and finally the Atlantic Ocean. The process can be slowed, but it can not be stopped. By following the recommendations outlined in this document a reduction of sediment entering the lake can likely be achieved and can provide an overall improvement in water quality. However the creek will continue to fill this reservoir over time.

As stated in the soils section, over 70% of the soils within the watershed have either a slow infiltration rating or high runoff potential. While conducting the site surveys, numerous landowners commented on how quickly the stream stage rose during precipitation events. The landowners are observing the high rates of stormwater runoff within the watershed which leads to elevated waters within the creek and the potential for increased erosion tares and deposition of material into the reservoir.

The question has been raised about removing the sediment from the reservoir. This is a possibility and will require some research. There are permit



considerations that must be investigated, a design developed that will include methods and volume to be removed (and associated costs), access agreements developed, a disposal site identified, identifying who will be doing in the work and what type of equipment will be necessary. We did not have the availability to get onto the delta, due to the winter weather conditions, however we can estimate using an image from Google Earth that and assuming a final 4.0' water depth that approximately 4,600 cubic yards of material would need to be removed (250' x 100' x 5' depth / 27 cuft/cu yd). The Warren County SWCD has experience with these types of projects and would be amendable to assisting the Columbia County SWCD with a further investigation of this project.

In general though, Philmont and Columbia County can begin to improve this situation by working with municipal highway departments, home developers and the farming community to address the impacts from stormwater. Utilizing strategies such as low-impact development practices and assisting with the reduction of potential agricultural sources of sediment is the way to return the creek to a more balanced state and possibly reducing some of the growth of the delta.

Figure 1- Aerial Photographs Google Earth Summit Lake Inlet from 1994 to 2013

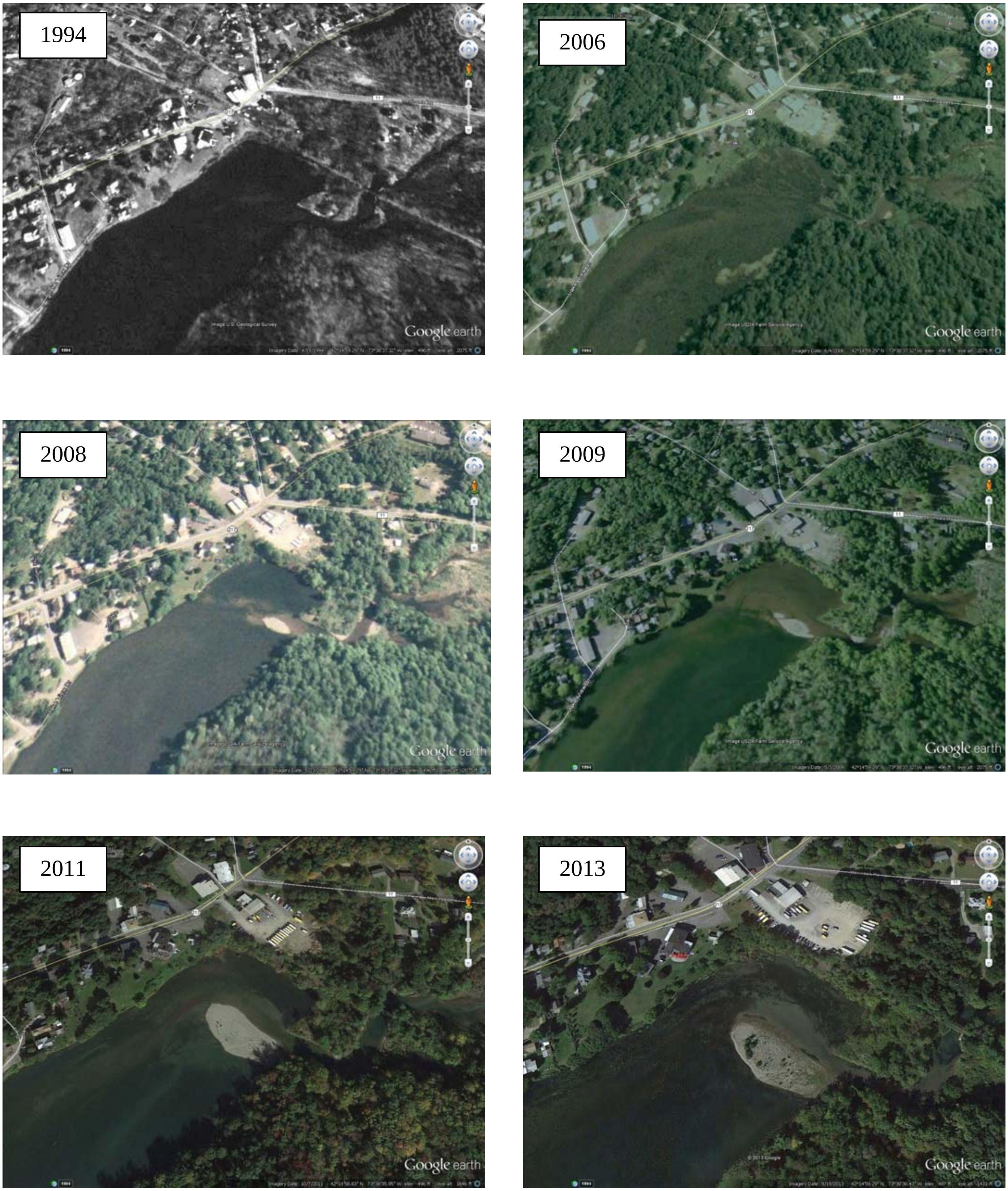


Figure 2-Area of Concern Taconic State Parkway

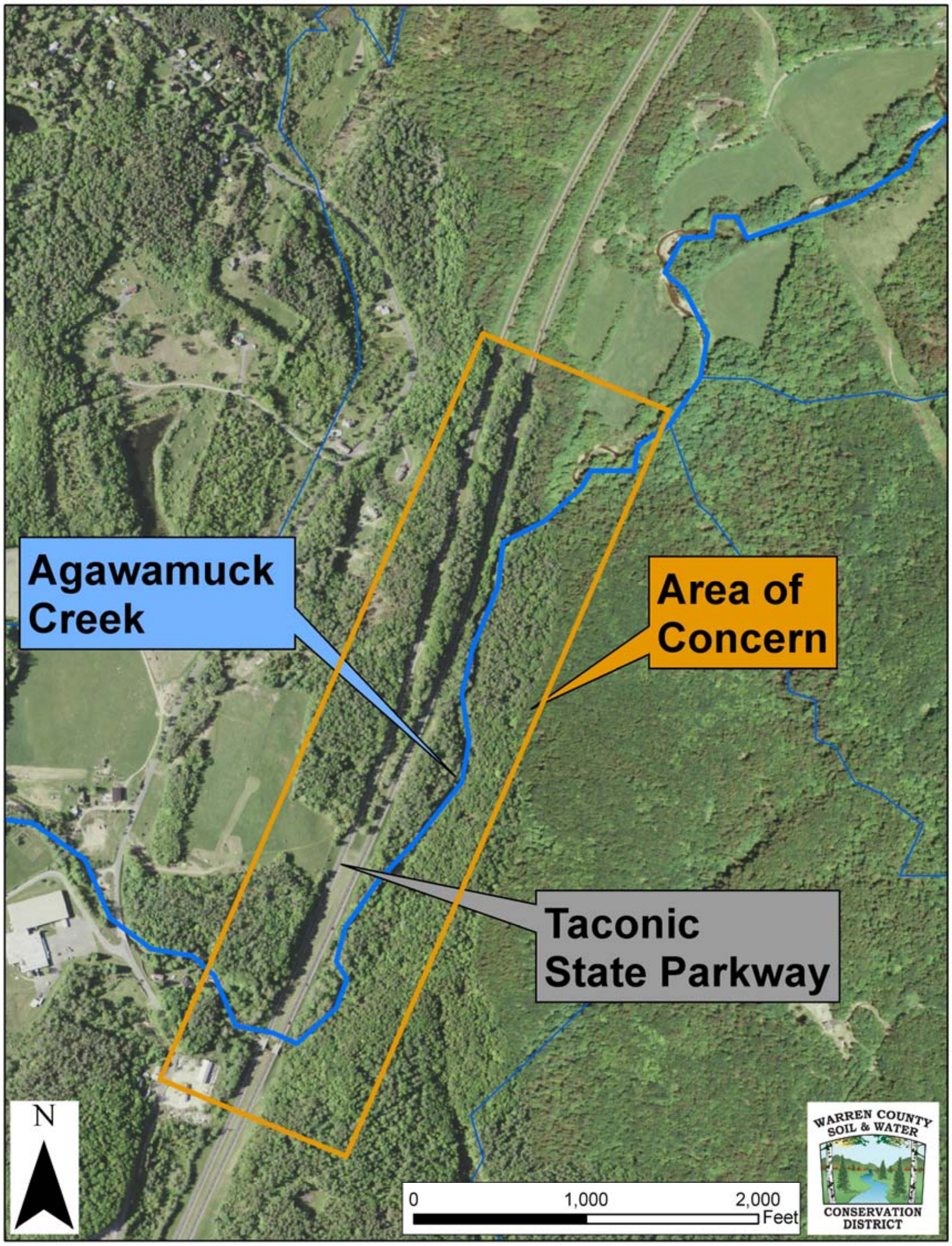


Figure 3-NRCS Stabilized Stream Crossing

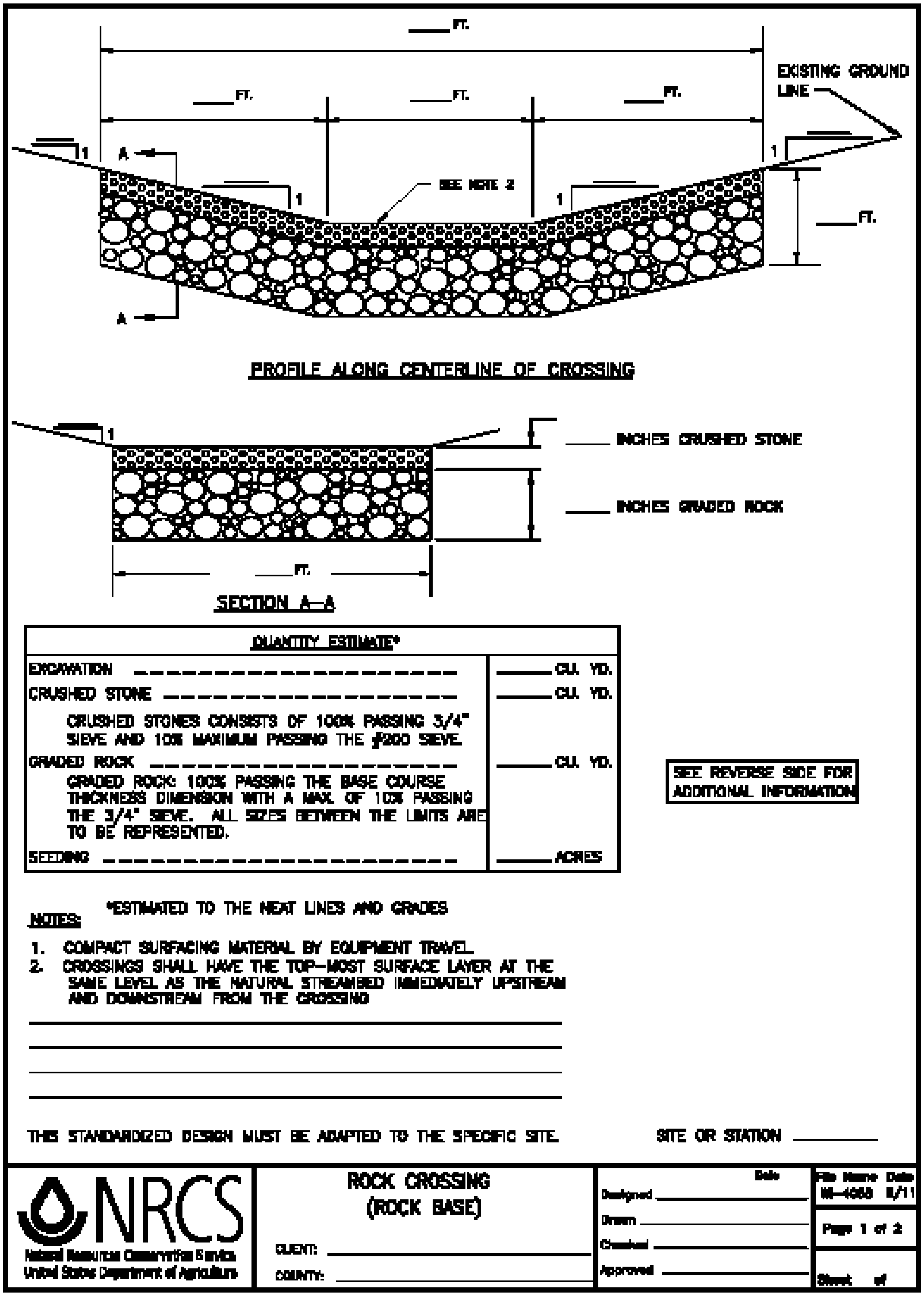


Figure 4- Vegetated Waterway Design
Go to http://www.dec.ny.gov/chemical/29066.html
for complete the BMP practice sheets

STANDARD AND SPECIFICATIONS FOR VEGETATING WATERWAYS

Definition

Waterways are a natural or constructed outlet, shaped or graded. They are vegetated as needed for safe transport of runoff water.

Purpose

To provide for the safe transport of excess surface water from construction sites and urban areas without damage from erosion.

Conditions Where Practice Applies

This standard applies to vegetating waterways and similar water carrying structures.

Supplemental measures may be required with this practice. These may include: subsurface drainage to permit the growth of suitable vegetation and to eliminate wet spots; a section stabilized with asphalt, stone, or other suitable means; or additional storm drains to handle snowmelt or storm runoff.

Retardance factors for determining waterway dimensions are shown in Table 5B.1 and "Maximum Permissible Velocities for Selected Grass and Legume Mixtures," are shown in Table 3.6.

Design Criteria

Waterways or outlets shall be protected against erosion by vegetative means as soon after construction as practical. Vegetation must be well established before diversions or other channels are outletted into them. Consideration should be given to the use of synthetic products, jute or excelsior matting, other rolled erosion control products, or sodding of channels to provide erosion protection as soon after construction as possible. It is strongly recommended that the center line of the waterway be protected with one of the above materials to avoid center gullies.

1. Liming, fertilizing, and seedbed preparation.
   - A. Lime to pH 6.5.
   - B. **The soil should be tested to determine the amounts of amendments needed.** If the soil must be fertilized before results of a soil test can be obtained to determine fertilizer needs, apply commercial fertilizer at 1.0 lbs/1,000 sq. ft. of N, P_2O_5, and K_2O.
   - C. Lime and fertilizer shall be mixed thoroughly into the seedbed during preparation.
   - D. Channels, except for paved section, shall have at least 4 inches of topsoil.
   - E. Remove stones and other obstructions that will hinder maintenance.
2. Timing of Seeding.
   - A. Early spring and late August are best.
   - B. Temporary cover to protect from erosion is recommended during periods when seedings may fail.
3. Seed Mixtures:

Mixtures	Rate per Acre (lbs)	Rate per 1,000 sq. ft. (lbs)
A. Birdsfoot trefoil or ladino clover[1]	8	0.20
Tall fescue or smooth bromegrass	20	0.45
Redtop[2]	2	0.05
	30	0.70
OR		
B. Kentucky bluegrass[3]	25	0.60
Creeping red fescue	20	0.50
Perennial ryegrass	10	0.20
	55	1.30

[1] Inoculate with appropriate inoculum immediately prior to seeding. Ladino or common white clover may be substituted for birdsfoot trefoil and seeded at the same rate.

[2] Perennial ryegrass may be substituted for the redtop but increase seeding rate to 5 lbs/acre (0.1 lb/1,000 sq. ft).

[3] Use this mixture in areas which are mowed frequently. Common white clover may be added if desired and seeded at 8 lbs/acre (0.2 lb/1,000 sq. ft.)

Figure 5- Rock Outlet Protection Design
Go to http://www.dec.ny.gov/chemical/29066.html
for complete the BMP practice sheets

STANDARD AND SPECIFICATIONS FOR ROCK OUTLET PROTECTION

Definition

A section of rock protection placed at the outlet end of the culverts, conduits, or channels.

Purpose

The purpose of the rock outlet protection is to reduce the depth, velocity, and energy of water, such that the flow will not erode the receiving downstream reach.

Scope

This standard applies to the planning, design, and construction of rock riprap and gabions for protection of downstream areas. It does not apply to rock lining of channels or streams.

Conditions Where Practice Applies

This practice applies where discharge velocities and energies at the outlets of culverts, conduits, or channels are sufficient to erode the next downstream reach. This applies to:

1. Culvert outlets of all types.

2. Pipe conduits from all sediment basins, dry storm water ponds, and permanent type ponds.

3. New channels constructed as outlets for culverts and conduits.

Design Criteria

The design of rock outlet protection depends entirely on the location. Pipe outlet at the top of cuts or on slopes steeper than 10 percent, cannot be protected by rock aprons or riprap sections due to re-concentration of flows and high velocities encountered after the flow leaves the apron.

Many counties and state agencies have regulations and design procedures already established for dimensions, type and size of materials, and locations where outlet protection is required. Where these requirements exist, they shall be followed.

Tailwater Depth

The depth of tailwater immediately below the pipe outlet must be determined for the design capacity of the pipe. If the tailwater depth is less than half the diameter of the outlet pipe, and the receiving stream is wide enough to accept divergence of the flow, it shall be classified as a Minimum Tailwater Condition; see Figure 5B.12 on page 5B.25 as an example. If the tailwater depth is greater than half the pipe diameter and the receiving stream will continue to confine the flow, it shall be classified as a Maximum Tailwater Condition; see Figure 5B.13 on page 5B.26 as an example. Pipes which outlet onto flat areas with no defined channel may be assumed to have a Minimum Tailwater Condition; see Figure 5B.12 on page 5B.25 as an example.

Apron Size

The apron length and width shall be determined from the curves according to the tailwater conditions:

Minimum Tailwater – Use Figure 5B.12 on page 5B.25
Maximum Tailwater – Use Figure 5B.13 on page 5B.26

If the pipe discharges directly into a well defined channel, the apron shall extend across the channel bottom and up the channel banks to an elevation one foot above the maximum tailwater depth or to the top of the bank, whichever is less.

The upstream end of the apron, adjacent to the pipe, shall have a width two (2) times the diameter of the outlet pipe, or conform to pipe end section if used.

Figure 6- Check Dam Design

Go to http://www.dec.ny.gov/chemical/29066.html

for complete the BMP practice sheets

STANDARD AND SPECIFICATIONS FOR CHECK DAM

Definition

Small barriers or dams constructed of stone, bagged sand or gravel, or other durable material across a drainage way.

Purpose

To reduce erosion in a drainage channel by restricting the velocity of flow in the channel.

Condition Where Practice Applies

This practice is used as a temporary or emergency measure to limit erosion by reducing velocities in small open channels that are degrading or subject to erosion and where permanent stabilization is impractical due to short period of usefulness and time constraints of construction.

Design Criteria

Drainage Area: Maximum drainage area above the check dam shall not exceed two (2) acres.

Height: Not greater than 2 feet. Center shall be maintained 9 inches lower than abutments at natural ground elevation.

Side Slopes: Shall be 2:1 or flatter.

Spacing: The check dams shall be spaced as necessary in the channel so that the crest of the downstream dam is at the elevation of the toe of the upstream dam. This spacing is equal to the height of the check dam divided by the channel slope.

Therefore:

$$S = h/s$$

Where:

S = spacing interval (ft.)
h = height of check dam (ft.)
s = channel slope (ft./ft.)

Example:

For a channel with a 4% slope and 2 ft. high stone check dams, they are spaced as follows:

$$S = \frac{2\text{ ft}}{.04\text{ ft/ft.}} = 50\text{ ft.}$$

Stone size: Use a well graded stone matrix 2 to 9 inches in size (NYS – DOT Light Stone Fill meets these requirements).

The overflow of the check dams will be stabilized to resist erosion that might be caused by the check dam. See Figure 5A.9 on page 5A.24 for details.

Check dams should be anchored in the channel by a cutoff trench 1.5 ft. wide and 0.5 ft. deep and lined with filter fabric to prevent soil migration.

Maintenance

The check dams should be inspected after each runoff event. Correct all damage immediately. If significant erosion has occurred between structures, a liner of stone or other suitable material should be installed in that portion of the channel.

Remove sediment accumulated behind the dam as needed to allow channel to drain through the stone check dam and prevent large flows from carrying sediment over the dam. Replace stones as needed to maintain the design cross section of the structures.

Figure 7- Subsurface Drainage Specifications
Go to http://www.dec.ny.gov/chemical/29066.html
for complete the BMP practice sheets

STANDARD AND SPECIFICATIONS FOR SUBSURFACE DRAIN

Definition

A conduit, such as tile, pipe, or tubing, installed beneath the ground surface, which intercepts, collects, and/or conveys drainage water.

Purpose

A subsurface drain may serve one or more of the following purposes:

1. Improve the environment for vegetative growth by regulating the water table and groundwater flow.
2. Intercept and prevent water movement into a wet area.
3. Relieve artesian pressures.
4. Remove surface runoff.
5. Provide internal drainage of slopes to improve their stability and reduce erosion.
6. Provide internal drainage behind bulkheads, retaining walls, etc.
7. Replace existing subsurface drains that are interrupted or destroyed by construction operations.
8. Provide subsurface drainage for dry storm water management structures.
9. Improve dewatering of sediment in sediment basins. (See Standard and Specification for Sediment Basins in Section 5A).

Conditions Where Practice Applies

Subsurface drains are used in areas having a high water table or where subsurface drainage is required. The soil shall have enough depth and permeability to permit installation of an effective system. This standard does not apply to storm drainage systems or foundation drains. Regulatory restrictions may apply if wetlands are present.

An outlet for the drainage system shall be available, either by gravity flow or by pumping. The outlet shall be adequate for the quantity of water to be discharged without causing damage above or below the point of discharge and shall comply with all state and local laws.

Design Criteria

The design and installation shall be based on adequate surveys and on-site soils investigations.

Required Capacity of Drains

The required capacity shall be determined by one or more of the following:

1. Where sub-surface drainage is to be uniform over an area through a systematic pattern of drains, a drainage coefficient of 1 inch to be removed in 24 hours shall be used; see Drain Chart, Figure 5B.22 on page 5B.48.

2. Where sub-surface drainage is to be by a random interceptor system, a minimum inflow rate of 0.5 cfs per 1,000 feet of line shall be used to determine the required capacity. If actual field tests and measurements of flow amounts are available, they may be used for determining capacity.

   For interceptor subsurface drains on sloping land, increase the inflow rate as follows:

Land Slope	Increase Inflow Rate By
2-5 percent	10 percent
5-12 percent	20 percent
Over 12 percent	30 percent

3. Additional design capacity must be provided if surface water is allowed to enter the system.

Figure 8- Hydrologic Soils Map

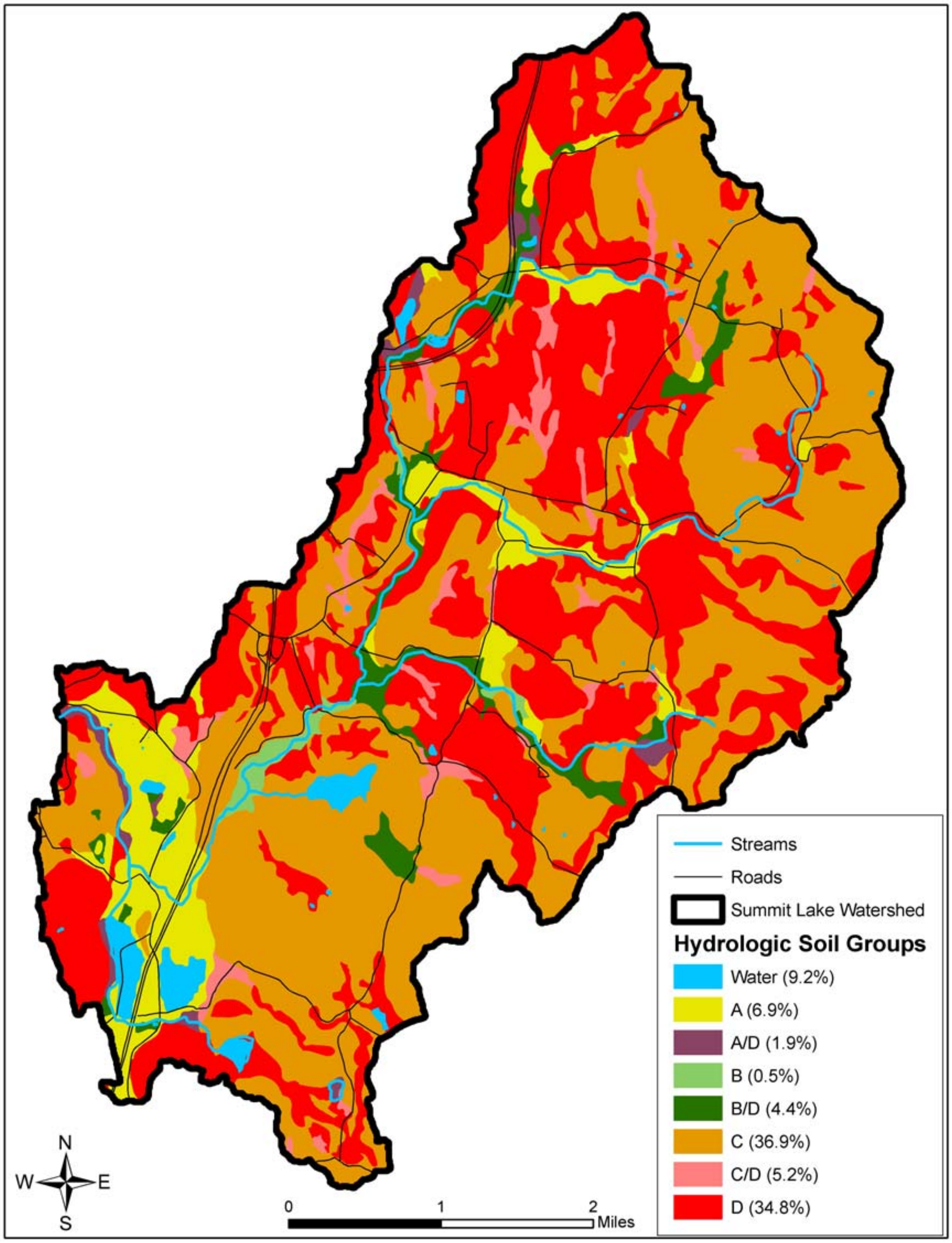


Figure 9- Stormwater Resource Websites

- DEC Division of Water Stormwater Webpage:
  http://www.dec.ny.gov/chemical/8468.html
  - New York State Standards and Specification for Erosion and Sediment Control ("Blue Book") Current Version: August 2005
  - New York Stormwater Management Design Manual Current Version: August 2005
- Warren County Soil & Water Conservation District:
  http://www.warrenswcd.org/
- The Lake George Association:
  http://www.lakegeorgeassociation.org/
- The Fund For Lake George:
  http://www.fundforlakegeorge.org/
- Soil & Water Conservation Society - Empire State Chapter:
  http://www.swcsnewyork.org/
- SUNY-ESF Continuing Education - Stormwater Management Program:
  http://www.esf.edu/outreach/stormwater/
- Center For Watershed Protection:
  http://www.cwp.org/
- EPA Stormwater Homepage:
  http://cfpub.epa.gov/npdes/home.cfm?program_id=6