ROCHESTER, VERMONT
Stormwater Master Plan
2018

WATERSHED CONSULTING ASSOCIATES, LLC

ROCHESTER VERMONT 1781

WHITE RIVER PARTNERSHIP

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I. Disclaimer

The intent of this report is to present the data collected, evaluations, analyses, designs, and cost estimates for subwatersheds in Rochester under a contract between the White River Partnership and Watershed Consulting Associates, LLC. Funding for the project was provided by a Vermont Department of Environmental Conservation, Clean Water Fund grant. The plan presented is intended to provide the watershed's stakeholders a means by which to identify and prioritize future stormwater management efforts. This planning study presents a recommended collection of Best Management Practices (BMPs) that would address sediment loading to the White River, localized flooding in the downtown area, and concerns about nitrogen pollution in the Connecticut River to which the White River drains. Although there are other BMP strategies that could be implemented in the watershed, these are the sites and practices that project stakeholders believe will have the greatest impact and probability of implementation. These practices do not represent a regulatory obligation, nor is any property owner within the watershed obligated to implement them. This stormwater master plan, and therefore its resultant strategies, will be included in a list of recommended actions in the White River Tactical Basin Plan, as submitted for consideration by the White River Partnership. This will put the BMP strategies in queue for state final design and implementation funding.

II. Glossary of Terms

Best Management Practice (BMP)- BMPs are practices that manage stormwater runoff to improve water quality and reduce stormwater volume and velocity. Examples of BMPs include detention ponds, gravel wetlands, infiltration trenches, and bioretention practices.

Buffers- Protective vegetated areas (variable width) along stream banks that stabilize stream banks, filter sediment, slow stormwater runoff velocity, and shade streams to keep waters cool in the summer months.

Channel Protection Volume (CPv)- The stormwater volume generated from the one-year, 24-hour rainfall event. Management of this event targets preventing stream channel erosion.

Check Dam- A small dam, often constructed in a swale, that decreases the velocity of stormwater and encourages the settling and deposition of sediment. They are often constructed from wood, stone, or earth.

Detention BMP- A BMP that stores stormwater for a defined length of time before it eventually drains to the receiving water body. Stormwater is not retained in the practice. The objective of a detention BMP is to reduce the peak discharge from the basin to reduce channel erosion and settle out pollutants from the stormwater. Some of these practices also include additional water quality benefits. Examples include gravel wetlands, detention ponds, and non-infiltration-dependent bioretention practices.

Drainage Area- The area contributing runoff to a specific point. Generally, this term is used for the area that drains to a BMP or other feature like a stormwater pipe.

Hydrologic Soil Group- A Natural Resource Conservation Service classification system for soils. They are categorized into four groups (A, B, C, and D) with "A" having the highest permeability and D having the lowest.

Infiltration/Infiltration Rate- Stormwater percolating into the ground surface. The rate at which this occurs (infiltration rate) is generally presented as inches per hour.

Infiltration BMP- A BMP that allows for the infiltration of stormwater into the subsurface soil as groundwater, which returns to the stream as baseflow. Mapped soils of Hydrologic Group A or B (sandy well drained soils) are an indicator of infiltration potential. Infiltration reduces the amount of surface storage required. Typical Infiltration BMP practices include infiltration trenches, bioretention practices, subsurface infiltration chambers, infiltration basins, and others.

Outfall- The point where stormwater discharges from a system like a pipe.

Sheet Flow- Stormwater runoff flowing over the ground surface in a thin layer.

Stabilization- Vegetated or structural practices that prevent erosion from occurring.

Stormwater/Stormwater Runoff- Precipitation and snowmelt that runs off the ground surface.

Stormwater Master Plan (SWMP)- A comprehensive plan to identify and prioritize stormwater management opportunities to address current and prevent future stormwater related problems.

Stormwater Permit- A permit issued by the State for the regulated discharge of stormwater.

Swale- An open vegetated channel used to convey runoff and to provide pre-treatment by filtering out pollutants and sediments.

Total Maximum Daily Load (TMDL)- A TMDL is a calculation of the maximum pollutant loading that a water body can accommodate and still meet Vermont Water Quality Standards. The term TMDL also refers to the regulated management plan, which defines how the water body will be regulated and returned to its acceptable condition. This includes the maximum loading, sources of pollution, and criteria for determining if the TMDL is met.

Total Phosphorus (TP)- The total phosphorus present in stormwater. This value is the sum of particulate and dissolved phosphorus. It includes both organic and inorganic forms.

Total Suspended Solids (TSS)- The total particulate matter suspended in the water column that is larger than 2 microns.

Total Nitrogen (TN)- The total nitrogen present in stormwater. This value is the sum of nitrate, nitrite, and total kjeldahl nitrogen (ammonia, organic and reduced nitrogen)

Watershed- The area contributing runoff to a specific point. For watersheds like the White River, this includes all of the area draining to the point where the river discharges to the Connecticut River.

Water Quality Volume (WQv)- The stormwater volume generated from the first inch of runoff. This runoff is known as the 90th percentile rainfall event and contains the majority of pollutants.

1 Introduction

1.1 The Problem with Stormwater

Stormwater runoff is any precipitation including melting snow and ice that runs off the land. In undeveloped areas, much of the precipitation is soaked into the ground, taken up by plants, or evaporated back into the atmosphere. However, when human development limits or completely prevents this natural sponge-like effect of the land, generally through the introduction of impervious areas such as roads, parking lots, or buildings, the volume of stormwater runoff increases, sometimes dramatically. In addition to the increased volume of stormwater runoff, the runoff is also frequently laden with pollutants such as sediment, nutrients, oils, and pathogens. These stormwater runoff related issues decrease aquatic habitat health, increase flooding and erosion, threaten infrastructure, and prevent human use and enjoyment of water resources. Historically, stormwater management techniques have relied heavily on direct conveyance to surface waters (i.e. streams, rivers, ponds, lakes, and coastal waters). Although this approach is effective at reducing flooding risk in developed areas, it does not address water quality concerns and has been shown to increase other deleterious effects such as in stream erosion. As stormwater management has matured, it has expanded to address both volume and quality as well as integration with other ecosystem services such as wildlife habitat and heat island mitigation in urban areas. Much of the development in Vermont predates this improved approach to stormwater management, leaving many areas without adequate surface runoff treatment and the subsequent impacts to surface waters. The specific development causing damage to surface waters remains unidentified and lacks regulatory controls to instigate improvement.

1.2 Stormwater Master Planning

Stormwater Master Planning is a standard methodology to assess a watershed, Town, or property for stormwater impacts, rank those areas based on relative influence on water quality, and move toward design solutions that address the most pressing stormwater challenges in an area. The resulting list of projects and associated modeling information allows prioritization of state funds based on potential water quality impact, cost, and feasibility.

Given the complexity of current stormwater issues, the development of the Stormwater Master Planning process provides communities with a range of possibilities for stormwater mitigation from small-scale (i.e. individual parcels), to large-scale (i.e. community-wide). Stormwater rarely follows political or parcel boundaries and tackling this problem from a strategic perspective is key to preventing future problems and addressing current sources of water quality degradation. Because much of the urban area within the state of Vermont predates regulatory requirements for stormwater management, unmanaged development across the state are contributing to the impairments of surface waters with no regulatory framework for improvement. These unmanaged stormwater discharges can be identified and addressed through this stormwater master planning process. The process allows for assessment and prioritization of the areas most in need of mitigation while acknowledging that, for many areas, these types of stormwater retrofits are voluntary. Public awareness of both stormwater problems and stormwater management practices are critical to the stormwater master planning process. As such, working with municipal officials, project stakeholders, and community members is key to implementation of and support for these plans. Stormwater master planning involves analysis of current and anticipated future conditions, and seeks to prioritize stormwater solutions, maximizing the potential for water quality improvement, flood mitigation, erosion reduction, and pollution prevention using a variety of best management practices (BMPs) and allocating limited funds in a planned and methodical way.

2 Project Overview

In May 2013, the State of Vermont Department of Environmental Conservation (VT DEC) issued a document titled *Vermont Stormwater Master Planning Guidelines*, designed to provide VT communities with a standardized guideline and series of templates. Since then, this document has been updated in 2016 and 2018. The document assists communities in planning for future stormwater management practices and programs. Our Plan is a combination of Templates 2A: Hybrid site & community retrofit approach with green stormwater infrastructure (GSI) stormwater management, and 3A: Large watershed or regional approach with planned build out analysis and traditional (end of pipe or centralized) stormwater management. While the area of focus in the Rochester Stormwater Master Plan is small, the particular focus on flooding and the downtown's proximity to the White River makes the focus of the plan align with some end-of-pipe solutions.

Vermont has had stormwater regulations in place since 1978, with updates concerning unified sizing criteria made in 2002, and again in 2017. Recognizing that stormwater management can be a costly endeavor, the new guidelines are written to help identify the appropriate practices for each watershed, community, and site in order to maximize the use of funds.

The guidelines encourage each stormwater master plan (SWMP) to follow the same procedures, and include:

- Problem Definition
- Collection of Existing Data
- Development of New Data
- Existing and Proposed Program, Procedure, or Practice Evaluation
- Summary and Recommendations

In keeping with these guidelines, we have prepared the following report.

3 Background

3.1 Problem Definition

The Town of Rochester is located in Windsor County. The entirety of the Town drains to the White River either directly or via one of several sub watersheds. The White River is one of the last free flowing River in Vermont and is a significant drainage to the Connecticut River to which it is the longest undammed tributary. Most of the Town of Rochester is within the Upper White River subwatershed but the eastern corner of the Town drains to the Third Branch.

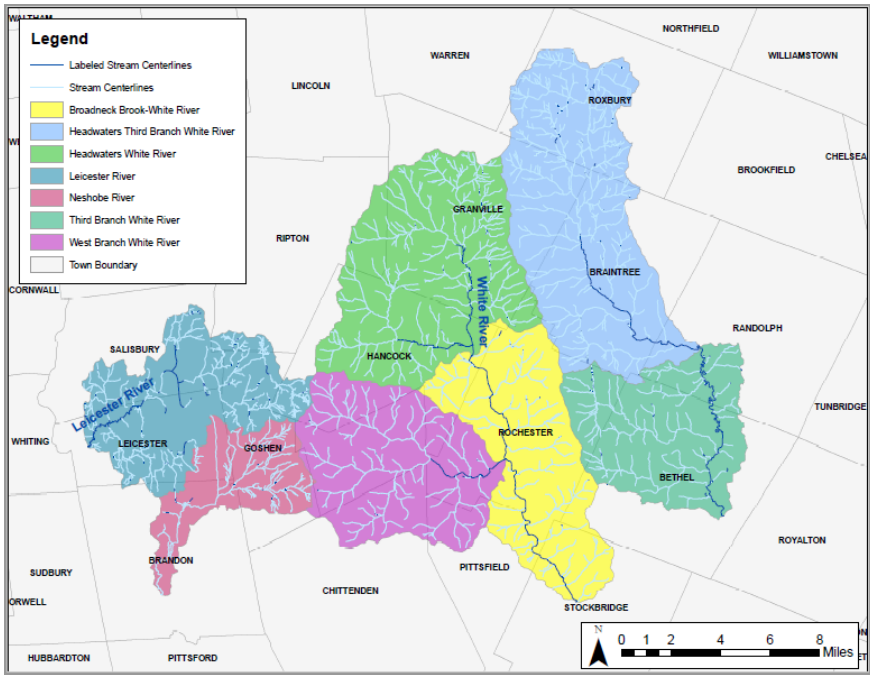

Figure 1. The Town of Rochester drains to the White River.

A 2007 Upper White River Corridor plan indicates that 78% to 100% of the river has been historically straightened. Channelization has restricted access of the river to its floodplain, causing high flows to have significant erosive power with no safe attenuation in meander belts or floodplain flow. The Upper White has highly erodible bank material, making riparian restoration with vegetated cover critical to reduce continued bank destabilization.

In August 2011, Tropical Storm Irene hit areas of Vermont with over 10 inches of rain over a short period of time. The resulting floods and erosive damage was devastating to the Town – rendering damage to Rochester among the worst in the State. The Town was temporarily cut off from adjacent communities as sections of major roads and bridges were destroyed. While this was an extreme weather event, businesses and homes in Rochester's village center frequently experience flooding in smaller storms as well. The topography of the area makes it vulnerable as it sits adjacent to the White River surrounded by steep valley walls. Development patterns further exacerbate the flooding challenge as roadways serve as surface conduits for stormwater with few alternative paths – catch basins fail to intercept surface flow due to insufficient grading and perched inlets where their elevation is higher than the surface of the pavement.

Stressors to the River (as defined in the 2013 White River Tactical Basin Plan) include encroachment, channel erosion, nuisance and invasive species spread prevention, land erosion, pathogens, thermal stress, acidity, and flow alteration. Not mentioned in the Basin Plan but an additional consideration due to ultimate drainage to the Connecticut River and the nitrogen-limited Long Island Sound, is nutrient pollution from agriculture, stream bank erosion, and urban runoff. The River is an important resource for recreation including swimming, boating, and fishing as well as a high-quality fishery with continuous aquatic organism passage due to the lack of dams.

High value agricultural land is focused in the White River Valley, presenting some use conflicts where runoff and denuded river banks impact water quality and restoration activities would capitalize large swaths of valued production land. This is an ongoing challenge for the region to address and one that is a leading concern for the Upper White River.

Development patterns in Rochester are naturally controlled by the steep topography that limits building. Much of the concentrated development is located within the historic village center along Main Street (VT Route 100) representing the dense core of the Town. Stormwater infrastructure in the center of Town consists of a series of connected catch basins and underground storm sewer lines draining runoff from the gas station at Bethel Mountain Road to the North where it discharges from a culvert on the west side of Main Street into the Town's Riverside Park. Runoff to the South of Bethel Mountain Road drains further south before being discharge to the west into an open, vegetated drainage channel that ultimately meets the White River. The stormwater runoff draining to the North represents the majority of the stormwater in the Town, including the hillside to the East and developments in the roadways that fall to the east (between the White river and a small feeder stream that drains the east side of the Village). The stormwater from the downtown is discharged, untreated, to River Brook Park and into an eroded vegetated channel before discharge to the White River just South of the Route 100 bridge. Surface runoff that does not enter the stormwater infrastructure, sheet flows to the west where it intercepts homes, businesses, driveways, and toxic substance storage sites before either collection in an open channel and discharge through a culvert to the White River behind the Town garage or runs over ground intercepting the Town's sand pile that sits on the River's banks.

The human-influenced stressors in the watershed include agricultural uses, river encroachment and channel straightening, uncontrolled stormwater discharges from developed lands, and invasive species spread. The White River and its tributaries have experienced extreme flooding in the recent past, and these flood events are expected to occur more frequently due to the predicted increased frequency and intensity of extreme weather events associated with climate change. The stormwater management practices investigated here seek to protect local river resources and the larger Connecticut River Watershed in which it is nested.

3.2 *Existing Conditions*

Rochester is the most northwesterly Town in Windsor County, abutted by eight towns and three other counties. The Towns Village Center sits to the east of the White River in a narrow valley flanked by mountain ranges on both sides. In total, the town is roughly 36,000 acres including an expanse of the Green Mountain National Forest, making it a tourist destination for camping, hiking, biking, and outdoor sports. The White River valley has exceptional farm land but a shift in land use in recent years leaves just one remaining dairy farm in the Town - making this land use in continuous decline since the Town's chartering in 1781.

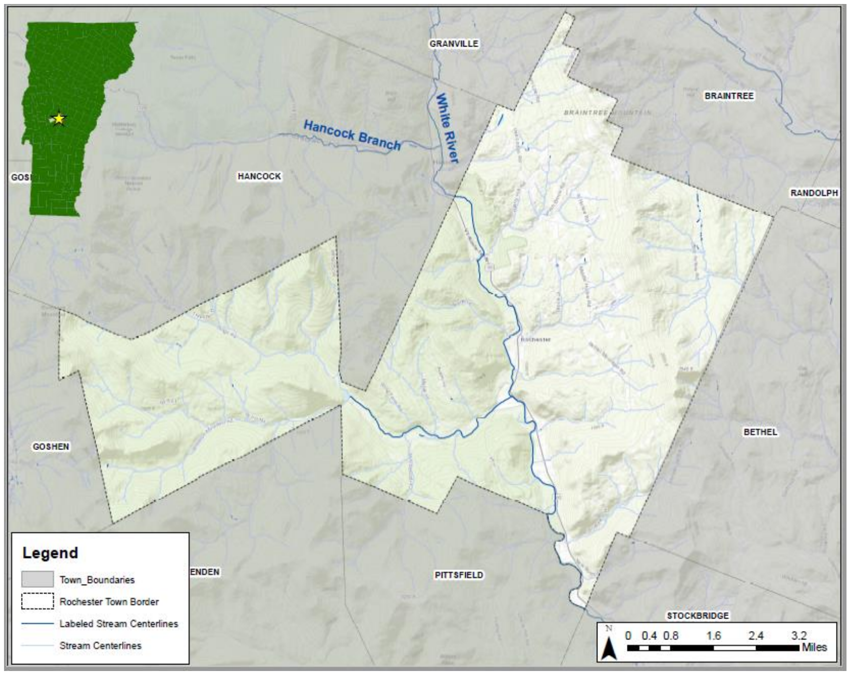

Figure 2. Rochester sites in the northwest corner of Windsor County, roughly in the middle of the state.

Rochester's population at the time of the 2010 census was 1,139 down slightly from the two preceding census decades. The largest portion of the population (48%) is between 50 and 69 years old. 20-24-year-olds make up just 3.5% of the Town's population showing a trend similar to many small Vermont towns where young people move away after high school for educational and economic opportunities. Rochester's population is aging with 14% of residents over 70 years of age.

The Rochester 2018 Town Plan indicates goals to protect environmental integrity and the water quality in the White River and West Branch while allowing active and sustainable use of agricultural resources. Damage caused by Tropical Storm Irene has strengthened an interest in the Town for more regulations on development within river floodplains given the devastation to riverside development in 2011. The Town Plan also refers to support for concentration of development in the Village area where there are existing services. This approach will reduce new impervious cover and protect existing expanses of forest land and natural areas. The intent of the Town to encourage tight development patterns and avoid river encroachment will strengthen resiliency and protect water quality.

While centralized development can result in reduced impervious surfaces as arterial roadway miles are avoided, the growth center of Rochester Village sits adjacent to the White River and existing development has limited or no stormwater treatment. In order to sufficiently manage runoff from new developments, no matter their location in relation to the village center, stormwater treatment standards are needed in conjunction with stormwater treatment from existing development.

Soils analyses indicate that while most (>78%) of the mapped acres in the Town are classified as hydrologic soil groups C and D (lowest infiltration potential), A and B soils (highest infiltration potential) are concentrated in the village center and along the White River, accounting for a total of 21.5% if the Town's mapped soils. The location of soils with high infiltration capacity where development is focused in the village center provides opportunity for excellent stormwater infiltration capacity and treatment rather than direct discharge to river. The natural capacity of the soils to infiltrate stormwater should be balanced with the sensitivity of the receiving waters to excess nitrogen. Because some dissolved forms of the nutrient readily move through soil profiles, quickly infiltrating runoff with high nitrate levels could result in subsurface discharge to the White River – worsening the pollution problem in the receiving water. Practices that provide subsurface saturation to allow for denitrification can overcome this limitation and allow infiltration to be used effectively as a treatment method without concern for nitrate impacts.

4 Methodology

4.1 Identification of All Opportunities

4.1.1 Kickoff Meeting and Initial Data Review:

The White River Partnership and the Town of Rocehster led a tour of project focus area preceding the SWMP announcement. In that tour, issues related to runoff in the village center were highlighted as well as the impact to the River. Based on the needs of the Town and the aquatic resource, a focus area for the SWMP was identified as the Rochester Village Center (Figure 3).

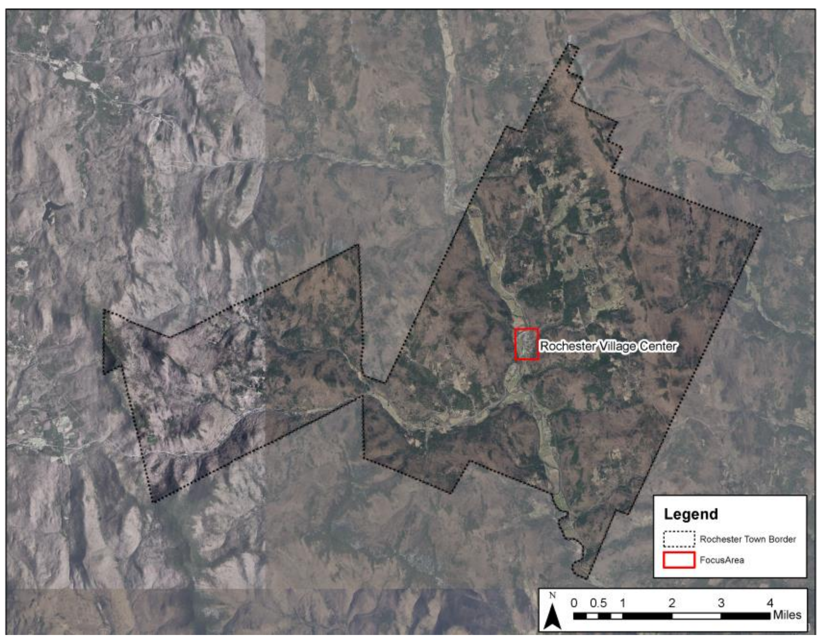

Figure 3. The Rochester SWMP focuses on the area of the Village Center.

Relevant prior watershed studies and work previously completed in the Town was reviewed in the context of this SWMP study. This includes the 2013 White River Tactical Basin Plan, the 2015 Upper and Middle White River Corridor Plan, the 2014 Middle White River and Third Branch Stream Geomorphic Assessment, a 2016 Road Erosion Risk Map for the Town of Rochester, a summary of water quality data in the White River from 2016, VT DEC 2015 Stormwater Mapping Project of the Town, a 2017 Bicycle and Pedestrian Study, the 2018 Rochester Town Plan, VT DEC River Corridor maps, and Floodplain maps prepared by the Federal Emergency Management Agency.

Relevant Geographic Information System (GIS) data was drawn from a variety of public resources including the Agency of Natural Resources' Atlas, Vermont Center for Geographic Information Open Geodata Portal, and data created by the University of Vermont's Spatial Analysis Lab. A file geodatabase was created to ensure organization and for ease of use. These data represent the "best available" data at the time of data collection (2018). See Appendix A – Data Review.

Prior to the start of the project, Watershed participated in the site walk with the White River Partnership (WRP) in 2017 where the stormwater and water quality challenges of the Town were discussed. As a result, the project team was aware of the technical site considerations prior to the official project kickoff. The project team met by phone with the WRP to officially kick off the project on January 12, 2018. In that meeting, the team discussed the general steps associated with a SWMP and what the WRP could expect at each phase. On May 22, 2018, Town representatives met with watershed staff to discuss known problem areas in Town and suitability of public parcels for potential treatment prior to field assessment. During this meeting, a list of potentially important sites was discussed, including the sensitivity of the Town Park due to its historic significance. Further discussion topics included the Town's current effort to create improved pedestrian access through the Village and the location of buried infrastructure near the new Park and Ride facility. These areas were noted and included in the areas that were assessed in the field on the same day.

4.1.2 Desktop Assessment and Digital Map Preparation

4.1.2.1 Desktop Assessment

A desktop assessment was completed to identify additional potential sites for stormwater BMP implementation. This process involved a thorough review of existing GIS resources and associated attribute data, as well as other resources.

One such resource was the Rochester Stormwater Mapping Report and accompanying maps completed by the VT DEC in 2015. These stormwater infrastructure mapping projects provided current drainage maps and potential locations of BMP stormwater retrofit sites that are helpful for identifying likely areas to focus for stormwater treatment.

A road erosion inventory (REI) of Rochester was completed in 2016 and indicated areas of the town with steep roadways and uncontrolled stormwater as areas at high risk for erosion. The REI assessment was conducted by the Two River-Ottauquechee Regional Commission (TRORC) to help the Town prepare for compliance with the Municipal Roads General Permit (MRGP). The assessment looks at how well hydrologically-connected, 100-meter road segments comply with MRGP standards such as road crown, berm issues, ditches, cross culverts, driveway culverts, outfalls, and presence of rill or gully erosion. The extent of the SWMP assessment extends beyond the roadway itself and aims to identify the source of erosional forces that may originate outside the road right-of-way. Further, because this SWMP focused on the area of Rochester's Village Center where roadways are not steep and are well paved, there was limited consideration of specific roadway issues in this investigation but rather a more comprehensive assessment of the ultimate discharge point at the White River.

Relevant GIS data in the Town was reviewed and included in analysis. These datasets include (but are not limited to): storm sewer infrastructure, soils classifications, parcel data, impervious cover data, wetlands, and river corridors. These data were used to identify and map stormwater subwatersheds with high impervious cover, stormwater subwatersheds that are more directly connected to water bodies (direct pipes to streams or via overland flow), and areas that may have worsening stormwater impacts in the future as a result of uncontrolled stormwater from impervious cover, erodible soils and steep slopes and/ or proximity to surface waters. A point location was created for each identified site or area for assessment in the field. [Grab your reader's attention with a great quote from the document or use this space to emphasize a key point. To place this text box anywhere on the page, just drag it.]

During this initial BMP identification and after incorporating problem areas noted by the Town, a total of 19 locations were identified for field investigation.

4.1.2.2 Basemap and Mobile App Creation

In order to maximize efficiency in the field and better understand site-specific conditions, digital base maps were created for the Town. The maps show parcel boundaries, stormwater infrastructure, hydrologic soils groups, river corridors, hydric soils, and wetlands. This information was used in the field to assess potential feasibility issues for proposed practices and to better identify preliminary BMP locations.

The base layers were pre-loaded into a project-specific mobile app that was customized for this project using the Fulcrum platform. The app was also pre-loaded with the pre-identified point locations for the potential BMP sites. These points allowed for easy site location and data collection in the field (Figure 4).

The app was used to collect information including site suitability, photographic documentation, follow-up notes, and other pertinent data. All collected data was securely uploaded to the Cloud for later use.

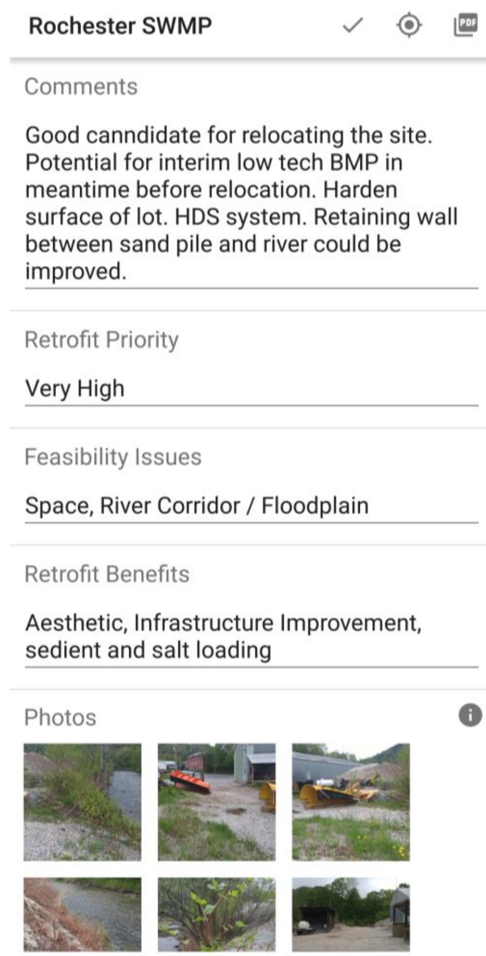

Figure 4. Digital application for field data collection used for Rochester SWMP

4.1.3 Field Data Collection:

All of the nineteen (19) sites identified by the project team were assessed in the field and potential BMP locations were evaluated (Figure 5*)*. Data were collected about each site in the mobile app. A large map of these sites with associated site names and a list of these sites including potential BMP options and site notes can be found in Appendix B - Initial Site Identification.

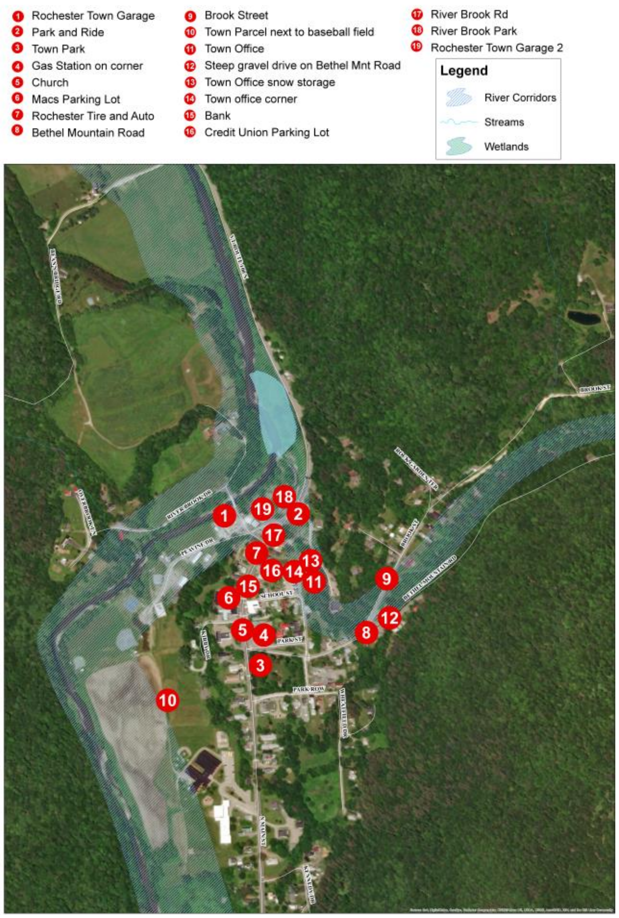

Figure 5. Field-assessed sites in Rochester SWMP

Through the course of these field visits, some site locations were excluded from further analysis due to lack of confirmed stormwater issues on site or specific site conditions that would restrict further design. Effort was prioritized for management at sites that had potential for significant water quality improvement with retrofit and was focused on sites in the downtown areas of Rochester

A final list of fifteen (15) potential BMP sites in Rochester were included in the ranking exercise.

4.2 Preliminary BMP Ranking

After the initial field visits were completed and the project list was updated, a preliminary ranking system was utilized to prioritize the 15 project sites (See Appendix C – Preliminary Site Ranking). The goal of this ranking was to identify the five (5) sites that would provide the greatest water quality benefit and have a high likelihood of implementation. This prioritization was accomplished by completing an assessment of project feasibility and benefits including drainage area size, pollutant load reduction potential, proximity to water, ownership, and feasibility issues. See Appendix C - Preliminary Site Ranking for the complete list of factors utilized in the preliminary ranking. Also included in Appendix C is the completed ranking for each potential site, and one-page field data summary sheets with initial ranking information.

The ranked list of BMP sites was distributed to the Town of Rochester, the WRP, and the VT DEC grant administrator. Feedback on the ranked list was received via email and an in-person meeting to discuss the ranked list on July 11, 2018. The feedback informed a final list of the top 5 projects for additional investigation. During the July 11 meeting, the stakeholders discussed the ranked sites and provided feedback regarding feasibility, site ownership, and future plans in the Town that may influence BMP installation. The team discussed future plans to relocate the Town Garage site and recognition that that plan may not materialize for a decade or more. Additional discussion regarding deed restrictions and the conservation easement on the land at River Brook Park indicate some potential challenges in using the site for stormwater treatment. The Top Five list was shared with the Town Selectboard for comment and a subset of projects was provided to the Vermont Agency of Commerce and Community Development, the Ottaquechee Planning Commission, Vermont Emergency Management, Vermont Housing and Conservation Board, and the River Scientist for the region for comment regarding the buyout and easement details and state permitting review. The Top Five sites are listed in though the sites remain the same.)

Table 1. (Note that the proposed practice types indicated in Table 1 evolved in the next phase of the project based on further field evaluation, modeling, and preferences of the property owners. As a result, the ultimate BMP types that advanced to design are different than what is indicated in the table though the sites remain the same.)

Table 1. Top Five BMPs selected for the Rochester SWMP

BMP ID	Project Name	Proposed Practice Type(s)
7	Rochester Tire and Auto	Improved site management (non-structural)
18	River Brook Park	Subsurface chambers Lined linear treatment feature (dry streambed)
13	Town Office (Snow Storage Area)	Bioretention, Subsurface chambers
2	Park and Ride	Subsurface chambers
1	Rochester Town Garage	Hydrodynamic separator, improved transport swales, filtration

4.3 *Feasibility Investigation – Arriving at the Top Three BMPs*

The Top Five ranked BMP locations were investigated for feasibility from a soils/ site conditions, permitting, and property ownership perspective in order to arrive at the final three sites for 30% design (Figure 6). The Rochester Tire and Auto site is privately owned and a known issue for the Town. Practices to address pollutant loading from this site are largely non-structural and based on improved site management. As a result, no engineering design is necessary at this site. The Town indicated that they would follow-up with the owners with recommendations for improved management. Management on this site should focus on covering barrels and sources of toxic chemicals, reduced leakage of oil and gasoline from vehicles on site by capture and disposal, and general site maintenance to reduce surface flow to areas that are possible sources of contamination.

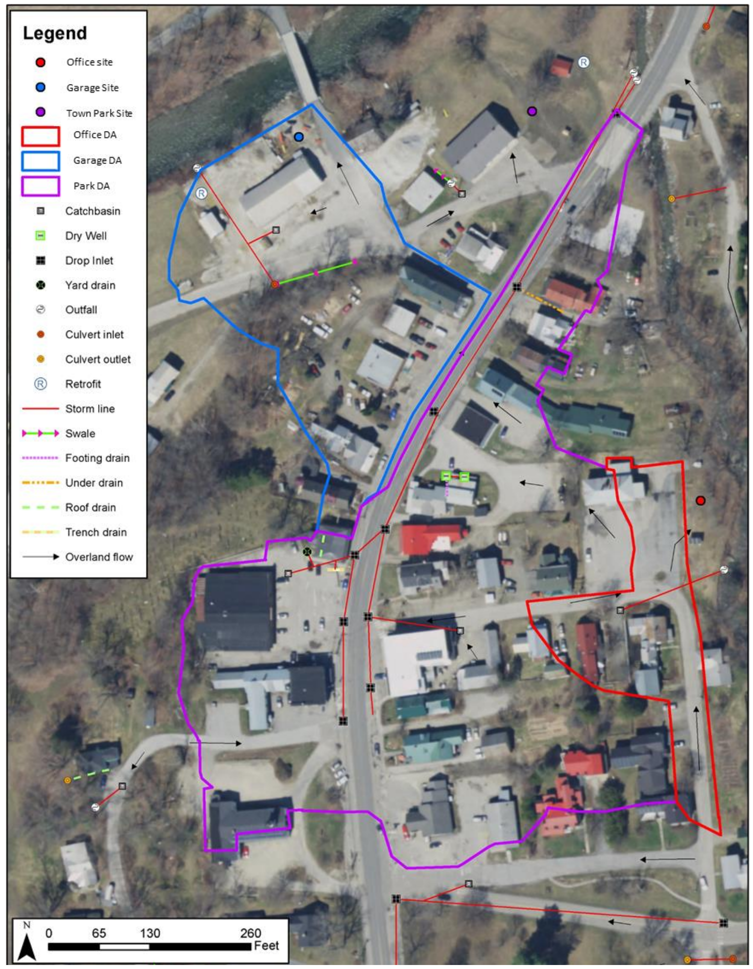

Figure 6. Top Three project locations and drainage area delineations.

The River Brook Park (also referred to as Town Park) site ranked #2 overall due to its potential capacity to capture existing drainage of much of the Village. Concerns regarding the potential of the river floodplain site to become inundated and clogged lead to an alteration in the exact location of the practice, choosing to move it upland slightly and towards existing infrastructure and altering the BMP type to an underground chamber system to allow sufficient volume capture without changing the aesthetics or use of the site. After some alteration of the treatment location and elevation, this site was retained for treatment in the SWMP and proceeded to soil and infiltration assessment and design.

The Town Office snow storage area was further investigated and determined to be a site needed for vehicle turning on site. As a result, the existing hardscape adjacent to the River could not be completely eliminated for a surface vegetated treatment area. Therefore, this site was preserved in the ranked sites for additional design but was targeted as a subsurface practice with potential addition of improved stream bank vegetation.

Initially, the Park and Ride location ranked #4. However, location of infrastructure as well as the potential to treat the same volume across the street at River Brook Park rendered this site duplicative and unnecessary for design. Lastly, the Rochester Town Garage site is owned by the Town and represents a significant impact to the River with the location of sand and salt piles in the floodway as well as existing flow of water from Main Street through the site transporting particulate and grease to the waterway. This location was identified as a priority site to move forward to preliminary design.

The final Top Three Sites to move forward to preliminary design include: River Brook Park, Town Office Snow Storage Area (AKA Town Office), and Town Garage.

Soils assessment and infiltration testing was completed at each site. Soils information for each site is summarized in section 6: 30% Design.

Modeling was completed for each of the Top Three sites (Table 2). This modeling allowed for accurate sizing of the proposed practices as well as an understanding of the water quality and quantity benefits. The contributing drainage area of each of the BMPs was defined and land use/land cover was digitized using the best available topographic data and aerial imagery. Drainage areas were refined based on field observations (see Appendix D – Top Three Sites for drainage area delineations). Each of the sites was modeled in HydroCAD to determine the appropriate BMP size and resultant stormwater volume reductions. Each of these sites was also modeled using the Source Loading and Management Model for Windows (WinSLAMM) to determine the annual total suspended solids (TSS), total phosphorus (TP), and nitrate loading from the drainage area of each site (Table 2).

Table 2. Modeled drainage area runoff characteristics for the Top Three BMP areas.

Project Name	Drainage Area (acres)	Runoff Volume (ft^3/ year)	Total Suspended Solids (lbs/ year)	Total Phosphoru s (lbs/ year)	Nitrate (lbs/year)
River Brook (Town) Park	6.6	424,500	17,743	6.7	21.4
Town Office	1.05	48,520	1,315	.85	2.33
Town Garage	2.5	34,525	1,260	.92	1.47

Pollutant load reductions from the BMPs associated with River Brook Park and the Town Office site were modeled and estimated using the Source Loading and Management Model for Window (WinSLAMM). Pollutant reduction potential from the Town Garage hydrodynamic separator was determined by applying a conservative estimate of TSS and TP removal taken from the New Jersey Corporation for Advanced Technology (NJCAT) - a public/private non-profit corporation that evaluates and verifies stormwater treatment devices. To avoid overestimation of performance, we assumed a particle size distribution in runoff from the site that included 60% of the TP associated with particles smaller than 3 µm and therefore not efficiently removed with an HDS system. High quality nitrogen removal modeling estimates are not provided by a third party at this time, so that load reduction was omitted for this practice. All of the modeled volume and pollutant loading reductions are shown in Table 3. Complete modeling results are provided in Appendix E - Top Three Sites Modeling.

Table 3. Modeled volume and pollutant load reductions/ year for the Top three BMPs.

Project Name	Volume Managed (ac-ft)	TSS Removal (lbs/yr)	TSS Removal (%)	TP Removal (lbs/yr)	TP Removal (%)	Nitrate Removal (lbs/yr)	Nitrate Removal (%)
River Brook (Town) Park	0.584	17,577	99.1	6.6	98.9	21.1	98.6
Town Office	0.055	1,309	99.6	0.85	99.6	2.32	99.6
Town Garage*	0	630	50	0.37	40	N/A	N/A

**Hydrodynamic separators (the technology selected for this site) do not directly manage volume. Rather, they remove sediment via swirl separation and release the same volume of water that was delivered to it. As a result, volume managed is indicated as '0' here. The design includes a perforated pipe connecting the new catch basin to the hydrodynamic separator. If soils allow, there may be some infiltration capacity at this site. The method used for modeling pollutant removal from the HDS system is more conservative than the others to avoid overestimation of the device.*

4.4 *Project Cost Estimation*

Project cost was calculated for each BMP using a spreadsheet-based method. The methodology for determining these planning level costs was first developed for the City of South Burlington by the Horsley Witten (HW) Group as part of the Centennial Brook Flow Restoration Plan development. The HW Memorandum describing this methodology is provided in Appendix F – Cost Estimation Basis. Note that a variation of this method was used for this plan. This methodology provides consistent budgetary cost estimates across BMPs.

Cost estimates are based on average costs for conceptual level projects and deviation from these estimates are expected as projects move forward with engineering design. Note that costs are not adjusted for inflation. There are differences between project cost estimates presented in the plan and actual project bid costs. The BMP cost estimates presented in the plan are based on limited site investigation. This methodology, while providing consistency in budget cost estimating, may fail to accurately reflect project cost impacts associated with actual site conditions and constraints. Therefore, the BMP cost estimates presented are suitable for planning purposes only, and not detailed program budgeting. The BMP cost estimates were developed based on the following assumptions:

Design Control Volumes: Design control volumes were based on the estimated runoff volume associated with the CPv or WQv storm events for underground, or GSI-type practices. Runoff volumes for all storm events were determined based on HydroCAD model results that rely on the Soil Conservation Service (SCS) TR-55 and TR-20 hydrologic methods.

Unit Costs and Site Adjustment Factors: Unit cost for each BMP and site adjustment factors were derived from research by the Charles River Watershed Association and Center for Watershed Protection, as well as from experience with actual construction[1] and modified for this project to reflect the newest cost estimates available. Underground filtration chamber systems were typically designed using Stormtech MC-3500™ chamber systems and the HDS system specified herein is Hydro International 6' Downstream Defender model D6GA. Cost adjustment factors were used to account for site-specific differences typically related to project size, location, and complexity. The values used to estimate BMP costs are summarized in Table 4.

[1] Horsley Witten Group, Inc. 2014. Centennial Brook Watershed: Flow Restoration VTBMPDSS Modeling Analysis and BMP Supporting Information. Memorandum dated January 9th, 2014.

Table 4. BMP unit costs and adjustment factors modified to reflect newer information

BMP Type	Base Cost ($/ft^3)	Site Type	Cost Multiplier
Porous Asphalt	$5.32	Existing BMP retrofit or simple BMP	0.25
Infiltration Basin	$6.24	Large above ground basin projects	0.5
Underground Chamber (infiltration or detention)	$6.25	New BMP in undeveloped area	1
Detention Basin / Dry Pond	$6.80	New BMP in partially developed area	1.5
Gravel Wetland	$8.78	New BMP in developed area	2
Infiltration Trench	$12.49	Difficult installation in highly urban settings	3
Bioretention	$15.46		
Sand Filter	$17.94		
Porous Concrete	$18.07		

Site-Specific Costs: Cost of significant utility or other work related to the construction of the BMP itself. Site-specific costs are variable based on past experience.

Base Construction Cost: Calculated as the product of the design control volume, the unit cost, and the site adjustment factor.

Permits and Engineering Costs: Used either 20% for large above-ground projects or 35% for smaller or complex projects.

Land Acquisition Costs *(Modified)*: A variation from the HW method was applied. Based on prior studies completed by Watershed, the land acquisition cost was calculated as $120,000 per acre required for the BMP when located on private land. It should be noted that this value is based on a limited estimate and not necessarily an expected cost per acre. At this time, no land acquisition costs were built into the costs provided for the Rochester SWMP as the Town is the owner of all sites identified for design.

Total Project Cost: Calculated as the sum of the base construction cost, permitting and engineering costs, and land acquisition costs.

Cost per Impervious Acre: Calculated as the construction costs plus the permitting and engineering costs, divided by the impervious acres managed by the BMP.

Operation and Maintenance: The annual operation and maintenance (O&M) was calculated as 3% of the base construction costs, with a maximum of $10,000.

4.5 Top Three BMPs

Selection of the Town's Top Three sites considered the results from WCA's initial site investigations, preliminary modeling and ranking, input from municipal officials concerning project priorities, the willingness of landowners to voluntarily participate in this plan, allowance by state permitting standards, and other parcel-based regulations. The Top Three sites are listed in Table 5.

Table 5. Top Three BMP sites for the Town of Rochester

Rank	Site ID	Address	Proposed Practice Type
1	River Brook (Town) Park	205 N Main Street	Underground Storage/ Infiltration Chambers
2	Town Office	67 School Street	Underground Storage/ Infiltration Chambers & Riparian vegetation
3	Town Garage	84 Peavine Drive	Hydrodynamic Separator & Riparian vegetation

5 Priority BMPs

The selected Top Three BMP implementation sites are briefly described below. These opportunities are all located on property owned by the Town. Individual drainage area maps are provided in Appendix D.

BMP Rank: 1
Project Name: River Brook (Town) Park
Description: The drainage area to this site includes most of the Town's village center to the south up to Park Street. Currently, stormwater drains via surface flow to a network of catch basins and underground storm sewer pipes to an outfall at the southeast corner of the park. It then flows on the surface in a wide swale to the White River to the west. The original concept to manage runoff from this site was to retain and treat it in a surface feature within the existing swale. After modeling the extent of the drainage area to consider appropriate sizing and considering the potential for inundation flooding from the river at that site, it was determined that the necessary size of the practice would alter current use of the park and the risk of clogging was too great to be practical. A series of underground chambers at the site eliminates both of these concerns, providing the same aesthetic and use of the park that the Town currently enjoys and none of the clogging concerns of a surface feature. The underground chambers scoped for this site will provide capture and treatment of the water quality volume (WQv) and the Channel Protection volume (CPv). Soils are a mixture of hydrologic class B and unrated by NRCS, indicating some areas of known high infiltration capacity and others that need to be defined. Soils investigation by Watershed indicated good infiltration capacity and suitable conditions for stormwater infiltration on site.

Figure 7. From left to right: River Brook Park looking southeast towards the outfall near the roadway; a slightly different view point more southerly facing with the firehouse visible; view from the middle of the park to the west towards the White River. Note the mown grassy area for open space usage by residents and visitors is prioritized to remain intact.

Outreach: Contact was made with the regional river scientist, Gretchen Alexander, in regard to the allowability of a treatment system at this site in proximity to the river. After running a model approximating potential erosional risk area for the site, Ms. Alexander determined that it was allowable from a river regulation point of view, but additional design may require some minor shifting to accommodate river movement. She further indicated that care should be taken to keep the practice as close to the roadway as possible to avoid inundation and erosional risks. Contact was also made regarding the existing easements on this site with the DEC Director of Grants Management and the manager of the Disaster Recovery Program, Ann Karlene Kroll. Ms. Kroll indicated that it appeared that treatment in the Park would be allowable under the current deed and that she would like to review and approve a final design. 30% designs for this site were sent to Ms. Kroll who passed them along to Kevin Geiger at Two Rivers Ottauquechee Regional Commission for his response. Mr. Geiger reviewed the easement on the site as well as guidance from FEMA referenced in the easement language. He indicated that there is no restriction on the placement of underground chambers at the site and tree removal is allowable but should be minimized with replacement of removed trees preferred. Following Mr. Geiger's comments, Ms. Kroll indicated that additional review may be necessary from the State Hazard Mitigation Officer, Lauren Oates. A summary of the project was sent to Ms. Oates for comment and we are currently awaiting response. Record of the email correspondence can be found in Appendix L. Town Officials and a representative from White River Partnership (Mary Russ) stressed the importance of coordination of this stormwater project with the current planned sidewalk project in the Town as there are likely synergies that could be used for funding and construction.

BMP Rank: 2
Project Name: Town Office
Description: The Rochester Town Office building is located on School Street, adjacent to a stream that drains to the White River on the other side of Route 100. The eastern portion of the parking lot and a section of School street to the south and west of the site and the associated houses and driveways drain to catch basins and through underground storm pipes to discharge directly to the stream on the southern portion of the Town Office parcel (adjacent to the solar panels on site). Much of the building roof and the rest of the parking lot discharges as surface flow to the stream further north on the parcel, directly to the east of the office building. There is no vegetated buffer to the stream along this reach and lawn waste and snow storage along the stream banks is evident. Erosion, uncontrolled invasive plant species, and sediment loading is degrading stream quality. To address these concerns, the proposed concept at this site includes changes to snow storage so that it is not piled in the riparian zone, re-vegetation of the river bank and buffer area, installation of an underground chamber system at the current snow storage site,

and rerouting of the culvert carrying street runoff to tie into the chamber system (eliminating a pipe outfall and surface flow paths to the waterbody). This system is designed to manage the WQv and CPv. In the event of an extreme event, the system would surcharge to the surface for overland flow through the vegetated buffer to the stream (Figure 8). Soils lack NRCS hydrologic classification at this site, but soils analysis done on site do show good soils for infiltration.

Figure 8. Image on the left shows the stream bank with lawn waste material and no vegetated buffer at the stormwater discharge point. Other photos illustrate the view from the edge of the parking lot looking toward the stream with indication of stream bank erosion and signs of winter snow storage and the mown grassy lawn adjacent to the waterbody. The proposed practice would be placed in the current snow storage location (shown in the bottom two images above).

Outreach: Contact was made with Rochester's Selectboard Administrative Assistant, Joan Allen, who shared information about the project with the Selectboard for feedback. The proposed location and practice type was approved by Town officials with the understanding that vehicular turning would not be restricted at the site as it is currently used for accessing an office at the east side of the building. Allowance of this practice in close proximity to the river was discussed with regional River Scientist, Gretchen Alexander, who initially had some concerns with the placement of the chambers. Watershed altered the proposed location to accommodate Ms. Alexander's comments and subsequently received confirmation that the final placement would be allowable under state river rules.

BMP Rank: 3
Project Name: Town Garage
Description: The Rochester Town Garage parcel sits in the floodplain of the White River. With limited space for storage and work, sand and salt are currently piled on the river banks. The Town has made efforts to control the export of material into the river through the use of stacked concrete blocks at the top of the river bank, but the size of the material piles dwarfs the blocks making them ineffective for the

purpose. In addition to the sites constraints due to the location of the river, surface drainage of the Village Center and the parcel's parking area result in excess flow over the site where storage and use of chemical solvents and petroleum products are a part of standard operations. These pollutants as well as salt and sand stored on site are subject to increased transport due to uncontrolled surface runoff from the village. The site is not well suited for its current use and the Town has acknowledged the challenges and aims to relocate to a different parcel when they are able. Such a move is costly and takes considerable planning and time. In the interim, the proposed plan for this site includes addition of a catch basin on the northwest corner of the garage building to route surface runoff to an online hydrodynamic separator (Downstream Defender®) to remove sediment and oils before controlled discharge through an existing culvert to the White River. This plan would improve the water quality of the discharged flow by eliminating suspended solids from flow and redirecting existing surface flow to a pipe system to avoid interaction with the sand and salt piles on site and reducing transport of sediment as a result (*Figure 9*). Revegetation of the river bank on the site's northwest corner will provide filtration of additional surface flow. Soils at this site are mapped as hydrological class B (good infiltration capacity) but the soils testing done on site indicate poor soils, perhaps from fill and we could not access soils under the sand pile. More investigation is necessary at this site to confirm soil conditions accurately.

Figure 9. The back side of the garage serves as sand and equipment storage. The proposed project includes vegetated buffer development at the northwest corner of the lot coupled with a new catch basin to direct surface flow at that corner of the building to a new online hydrodynamic separator before discharge to the White River through an existing outfall.

Outreach: This site is owned by the Town who have expressed their acknowledgement of the challenges associated with the close proximity to the river. Town officials confirmed an interest in an interim solution to reduce impact to the river that could be accomplished with minimal capital investment and construction work done by Town crew members.

5.1 Priority BMP Summary

When implemented, these three BMPs would treat over 10 acres; 68% (6.9 acres) of which is impervious. Modeled pollutant reductions for each of the projects, indicate that these BMPs will prevent approximately 19,516 lbs of TSS, 7.82 lbs of TP, and >23.42 lbs of nitrate from reaching receiving waters annually.

Site surveys and soils analyses were completed for each of the Top Three sites, and existing conditions plans were developed. These plans were used as the basis for the 30% proposed condition plans for each site. See Appendix H - Existing Conditions Plans.

6 30% Designs

30% engineering designs were completed for each of the Top Three sites. Site-specific concepts are discussed in the following sections. All 30% designs can be found in Appendix I - 30% Designs.

6.1 River Brook (Town) Park

6.1.1 30% Concept Design Description

Currently, all drainage from the Rochester Village Center is unmanaged and flows over the surface of the River Brook Park from a culvert outlet directly to the White River. This section of the river is active and subject to erosion (as indicated by the region's River Scientist). The significant volume flowing to the park could be retained and treated before discharge. Conveniently, the Town owns the park land providing a potential for treatment on publicly owned land without an disturbance of current use.

The proposed retrofit for this site is a subsurface storage and filtration system in the park. The subsurface nature of the practice will allow consistent continuation of site usage as open space and picnic areas. The placement of the chambers at this site would require the removal of a few mature trees. It was confirmed that this is allowable in the current easement language but replacement of those trees closer to the river channel should be prioritized after construction completion.

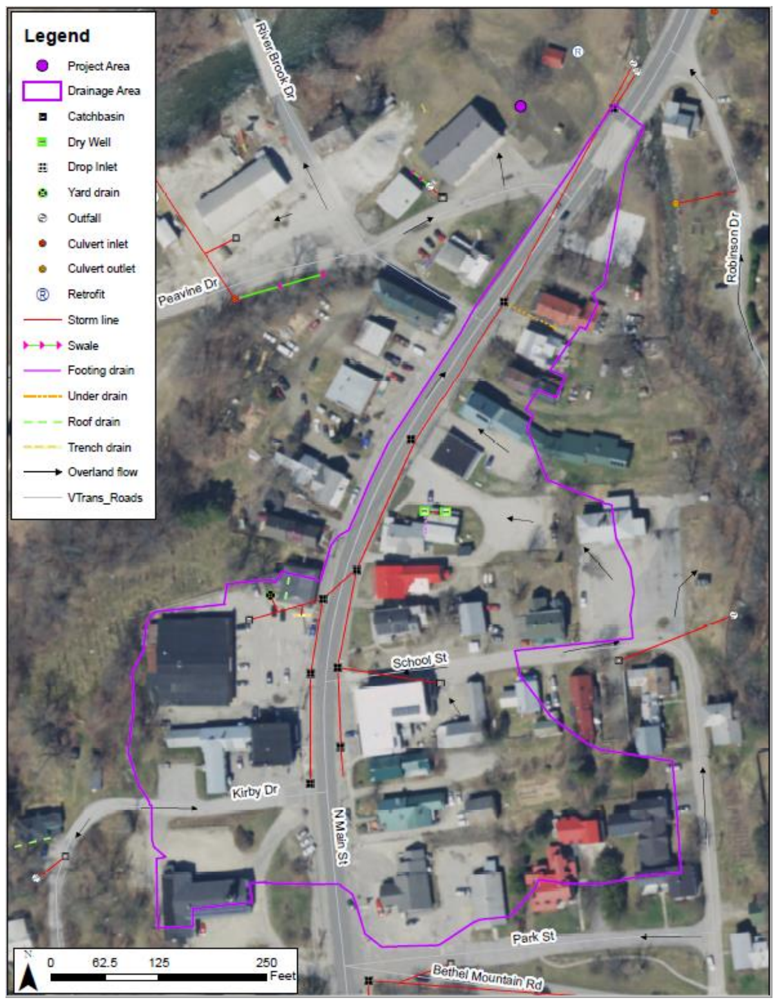

Figure 10. River Brook Park drainage area. Approximate BMP location is indicated with a purple dot at the site.

Soils at River Brook Park were investigated via a 90-inch-deep test pit. Soils consisted largely of fine sands until hitting a 10-inch gravel layer at a depth of 42 inches followed by a silt layer from 52-90-inch depth. No seasonable high ground water table was present, and an infiltration test performed at a depth of 30 inches resulted in a permeability rate of .45 inches/hr.

The design standard used for this retrofit is treatment and control of the Channel Protection volume (CPv), equal to 32,974 ft^3.

A 30% design plan is provided in Appendix I - 30% Designs.

6.1.2 Pollutant Removal and Other Water Quality Benefits

This practice has the potential to prevent 17,577 lbs of TSS, 6.6 lbs of TP, and 21.1 lbs of nitrate from entering receiving waters (Table 6).

Table 6. River Brook (Town) Park benefit summary table

Total Suspended Solids Removed / yr	17,577 lbs
Total Phosphorus Removed / yr	6.6 lbs
Nitrate Removed / yr	21.1
Impervious Area Treated	4.54 acres
Total Drainage Area	6.6 acres

6.1.3 Cost Estimates

The provided costs are very preliminary. Initial cost projections can be found in Table 7. The estimated cost for implementation of this project is $307,000.

- The cost per pound of phosphorus treated is $46,515
- The cost per pound of nitrate treated is $14,550
- The cost per impervious acre treated is $67,621
- The cost per cubic foot of runoff treated is $0.53

Table 7. River Brook (Town) Park project initial construction cost projection

VTrans Code	Description	Unit	Quantity	Unit Price	Amount
Site Preparation					
	Mobilization	LS	1	$ 10,000.00	$ 10,000.00
653.55	Project Demarcation Fencing	LF	437	$ 1.17	$ 511.29
652.10	EPSC Plan	LS	1	$ 5,000.00	$ 5,000.00
649.51	Geotextile for silt fence	SY	130	$ 4.13	$ 536.90
652.20	Monitoring EPSC Plan	HR	40	$ 37.22	$ 1,488.80
	Construction Staking	HR	8	$ 90.00	$ 720.00
				Subtotal:	$ 18,256.99
Chambers - Costs					
	MC3500		132	$ 400.20	$ 52,826.40
	MC3500 PLAIN END CAP		10	$ 300.15	$ 3,001.50
	MC3500 24B END CAP		2	$ 404.23	$ 808.45
	MC3500 18T END CAP		10	$ 404.23	$ 4,042.25
	18" TEE		8	$ 230.01	$ 1,840.09
	18" 90 BEND		2	$ 144.80	$ 289.59
	18" COUPLERS		28	$ 23.54	$ 659.13
	18" N12 FOR MANIFOLD (AASHTO)		80	$ 14.35	$ 1,148.16
	24" N12 for Isolater Row (AASHTO)		20	$ 21.67	$ 433.32
	601TG to wrap system (SY)		2000	$ 0.75	$ 1,495.00
	315WTM for scour protection (SY)		1000	$ 0.82	$ 816.50
	6" INSERTA TEE		4	$ 86.32	$ 345.28
	6" RED HOLE SAW		1	$ 132.43	$ 132.43
	12" INLINE DRAIN		4	$ 310.50	$ 1,242.00
	6" N12 (AASHTO)		20	$ 2.70	$ 54.05
				Subtotal:	$ 69,134.16
Materials and Excavation Costs					
604.20	Concrete Catch Basin	EACH	1	$ 3,387.59	$ 3,387.59
203.15	Common Excavation	CY	2600	$ 35.00	$ 91,000.00
629.54	Crushed Stone Bedding	CY	578	$ 50.00	$ 28,888.89
601.0920	18" CPEP	LF	20	$ 70.00	$ 1,400.00
651.35	Topsoil	CY	116	$30.96	$ 3,577.60
653.20	Temporary Erosion Matting	SY	100	$ 2.20	$ 220.00
651.15	Seed	LBS	5	$7.66	$ 38.30
				Subtotal:	$ 128,512.38
Subtotal:					$ 215,903.53
	Construction Oversight	HR	80	$ 150.00	$ 12,000.00
	Construction Contingency - 20%				$ 43,180.71
	Incidentals to Construction - 5%				$ 10,795.18
	Minor Additional Design Items - 5%**				$ 10,795.18
	Final Design	HR	80	$ 150.00	$ 12,000.00
	Permit Review and Applications (exclusive of permit fees)	HR	16	$ 150.00	$ 2,400.00
Total (Rounded)					**$ 307,000.00**

6.1.4 Next Steps

The Town owns the River Brook Park parcel but there are limitations on the use of the site because of its proximity to the river and deed restrictions associated with the easement. As an element of further design, a complete legal review of the deed language should be completed by a qualified professional. Detailed review to the proposed location of the chambers should also be completed by the VT Rivers Program at DEC as well as representatives of the VT Disaster Recovery Program. Upon initial review, no major issues were noted by these offices, but they should continue to be engaged as the design and project progresses. Further design will involve refinement of the design details with respect to size, outlet, and routing to ensure that CPv can be safely stored and filtered and that larger storms can pass through the system safely. Because implementation at this site could influence the Town's sidewalk project, coordination between the two efforts in terms of funding, grading, and material transport should be prioritized to reduce costs and eliminate avoidable duplication of work.

6.1.5 Permit Needs

A project readiness screening worksheet has been completed for this project and is included in Appendix J - Permit Review Sheets. In summary:

Stormwater Permit

The site should qualify for an Erosion Prevention and Sediment Control permit (3-9020) under the Low Risk categorization if the following guidelines are followed:

- Less than 2 acres of disturbance at any one time.
- All soils must be stabilized (temporary or final) within 7 days.
- Runoff from the site must pass through a 50' vegetated buffer prior to entering any Water of the State.

Local Permitting
No local permits are anticipated.

Other Permits
This site should be reviewed by the Act 250 Coordinator prior to final design. The siting of the practice is close to the River and therefore review by the state's floodplain manager and the region's river scientist and wetland ecologist is necessary to proceed. Addition of a chamber system within the footprint in the design likely does not constitute a violation of wetland or river corridor rules. However, permitting is anticipated for this project.

6.2 Town Office

6.2.1 30% Concept Design Description

Stormwater from portions of School Street and the eastern portion of the Town Office parking lot and rooftop drain directly to an adjacent stream via a combination of point discharge from a stormwater outfall and surface sheet flow. The stream is stressed from excess flow, degradation of vegetated buffer, invasive species spread, and snow and lawn waste disposal on its banks. The proposed design prioritizes a change in practices at the site to eliminate snow storage adjacent to the stream and lawn waste onto banks and the restoration of a healthy, native vegetated buffer. The proposed retrofit for this site includes the elimination of the current stormwater outfall in lieu of treatment in a subsurface chamber system at the northeast corner of the lot (Figure 11) The chambers will be located outside of the defined river corridor.

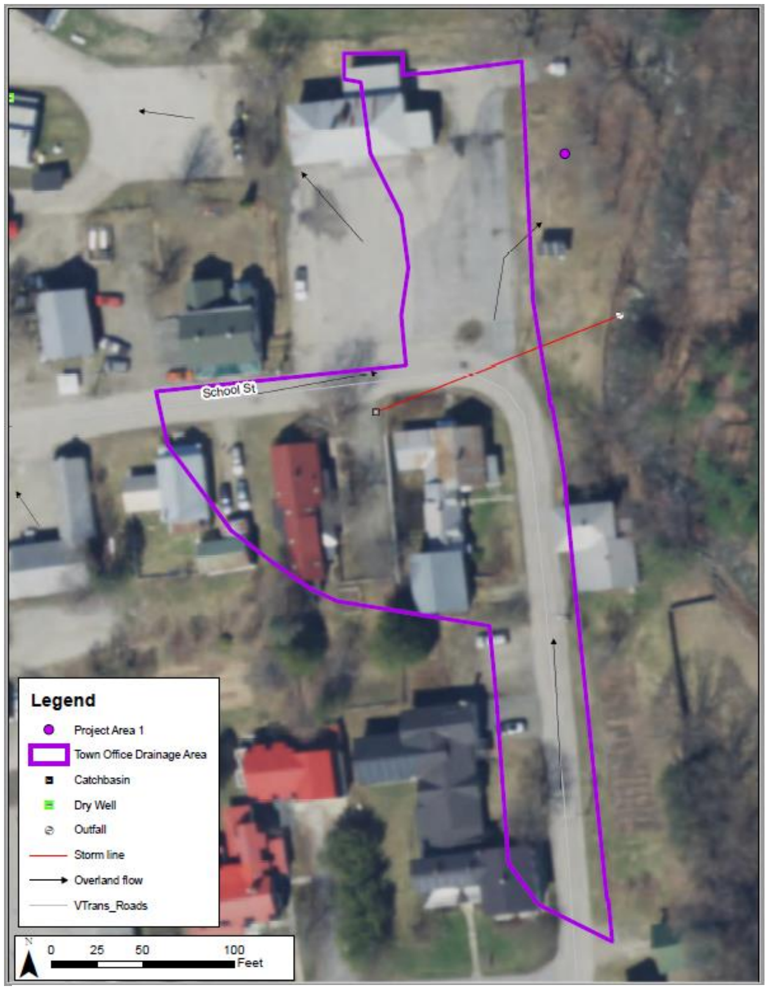

Figure 11. Drainage area for the chamber system at the Town Office. Note that the chambers will be located just north of the purple dot on the map above and the new storm line will run south to north to eliminate the current line and outfall to the stream.

Soils at the town office location were investigated via a 90-inch deep test pit. Soils consisted largely of fine sands with many large rocks and boulders throughout. Riverbed was hit at a depth of 76 inches, indicated by a gravel layer with many large rocks. A seasonal high ground water table was not located, and an infiltration test could not be complete due to the heavy presence of rocks and gravel.

The design standards used for this retrofit is treatment and control of the Channel Protection volume (CPv) equal to 5,270 ft^3 of runoff.

A 30% design plan is provided in Appendix I - 30% Designs.

6.2.2 Pollutant Removal and Other Water Quality Benefits

A retrofit of this site has the potential to prevent 474 lbs of TSS and .87 lbs of TP from entering receiving waters annually as a direct influence of the chambers and an additional 32,400 lbs of TSS and 11.5 lbs TP from reduced erosion in channels currently carrying the full unmanaged volume of runoff (Table 8).

Table 8. Town Office benefit summary table.

Total Suspended Solids Removed / year	1,309 lbs
Total Phosphorus Removed / year	0.85 lbs
Nitrate Removed / year	2.32 lbs
Impervious Area Treated	0.725 acres
Total Drainage Area	1.05 acres

6.2.3 Cost Estimates

Note that these costs and benefits are preliminary. Initial cost projections can be found in Table 9Table 9. The estimated cost for implementation of this project is $118,000.

- The cost per pound of phosphorus treated is $138,825
- The cost per pound of nitrate treated is $50,862
- The cost per impervious acre treated is $162,759
- The cost per cubic foot of runoff treated is $22

Table 9. Town Office project initial construction cost projection

VTrans Code	Description	Unit	Quantity	Unit Price	Amount
Site Preparation					
	Mobilization	LS	1	$ 10,000.00	$ 10,000.00
653.55	Project Demarcation Fencing	LF	437	$ 1.17	$ 511.29
652.10	EPSC Plan	LS	1	$ 5,000.00	$ 5,000.00
649.51	Geotextile for silt fence	SY	130	$ 4.13	$ 536.90
652.20	Monitoring EPSC Plan	HR	40	$ 37.22	$ 1,488.80
	Construction Staking	HR	8	$ 90.00	$ 720.00
				Subtotal:	$ 18,256.99
Chambers - Costs					
	MC3500		12	$ 400.20	$ 4,802.40
	MC3500 PLAIN END CAP		2	$ 300.15	$ 600.30
	MC3500 24B END CAP		3	$ 404.23	$ 1,212.68
	MC3500 12T END CAP		3	$ 362.25	$ 1,086.75
	12" TEE		1	$ 109.70	$ 109.70
	12" 90 BEND		2	$ 57.10	$ 114.20
	12" COUPLERS		7	$ 8.29	$ 58.04
	12" N12 FOR MANIFOLD (AASHTO)		40	$ 7.45	$ 298.08
	24" N12 for Isolater Row (AASHTO)		20	$ 21.67	$ 433.32
	601TG to wrap system (SY)		1000	$ 0.75	$ 747.50
	315WTM for scour protection (SY)		500	$ 0.82	$ 408.25
				Subtotal:	$ 9,871.21
Materials and Excavation Costs					
604.20	Concrete Catch Basin	EACH	4	$ 3,387.59	$ 13,550.36
203.15	Common Excavation	CY	565	$ 35.00	$ 19,786.67
629.54	Crushed Stone Bedding	CY	60	$ 50.00	$ 3,000.00
601.0920	15" CPEP	LF	140	$ 70.00	$ 9,800.00
651.35	Topsoil	CY	15	$30.96	$ 472.43
653.20	Temporary Erosion Matting	SY	114.444	$ 2.20	$ 251.78
651.15	Seed	LBS	3	$7.66	$ 22.98
	Paving	SY	33	$75.00	$ 2,500.00
				Subtotal:	$ 49,384.21
Subtotal:					$ 77,512.41
	Construction Oversight	HR	40	$ 150.00	$ 6,000.00
	Construction Contingency - 20%				$ 15,502.48
	Incidentals to Construction - 5%				$ 3,875.62
	Minor Additional Design Items - 5%				$ 3,875.62
	Final Design	HR	60	$ 150.00	$ 9,000.00
	Permit Review and Applications (exclusive of permit fees)	HR	16	$ 150.00	$ 2,400.00
Total (Rounded)					**$ 118,000.00**

6.2.4 Next Steps

This site is located on town property and as such, the Town does not need approval from a third party to proceed. Further design will involve refinement of the concept with respect to size, outlet design, and routing to ensure that CPv can be completely managed and larger storms can safely recharge to the surface for surface flow to the adjacent stream.

6.2.5 Permit Needs

A project readiness screening worksheet has been completed for this project and is included in Appendix J - Permit Review Sheets. In summary:

Stormwater Permit
It is not expected that a stormwater permit will be required at this time.

The site should qualify for an Erosion Prevention and Sediment Control permit (3-9020) under the Low Risk categorization if the following guidelines are followed:

- Less than 2 acres of disturbance at any one time.
- All soils must be stabilized (temporary or final) within 7 days.
- Runoff from the site must pass through a 50' vegetated buffer prior to entering any Water of the State.

Local Permitting
No local permits are anticipated.

Other Permits
The region's State River Scientist and Floodplain Manager should be kept apprised of this projects progress as it sits in close proximity to the channel and the chambers' location was adjusted based on river scientist recommendation. It should be noted that this proposed practice will eliminate a point discharge to the stream and will relocate snow storage away from the river as well as improve riparian vegetation along at the site.

6.3 Town Garage

6.3.1 30% Concept Design Description

The Town Garage is located in close proximity to the White River. Site constraints have resulted in the Town's sand pile placed in the river's floodway and its instability has led to sediment loading to the river. The proposed BMP for this site includes revegetation of a portion of the river bank to the north, installation of a new catch basin and underground pipe to transport flow to a new hydrodynamic separator (HDS) along the existing storm line on the south side of the building before discharge to the White River through an existing outfall replaced with a version of smaller diameter. HDS systems are devices used in storm drainage systems for improved removal of suspended particles. They commonly take the form of cylindrical chambers with a tangential inlet flow to promote vortex action of incoming water within the chamber. The spiraling action of the water causes increased settling of gross solids by gravity and allows discharge of cleaner water to the effluent pipe. While the proposed improvements to the site will not address volume to the river, it will reduce sediment and surface pollutant transport, improving water quality and providing an interim solution to the concerns at the site prior to a relocation away from the river bank.

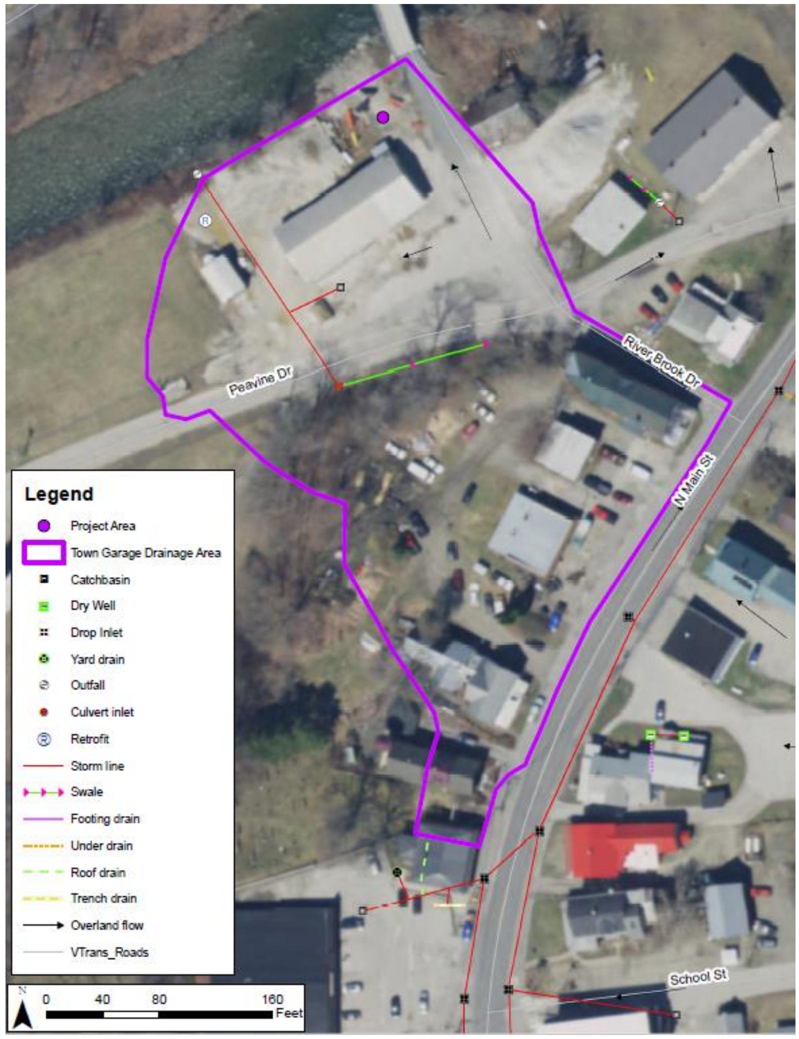

Figure 12. Town Garage BMP drainage area. The new catch basin will be located roughly where the purple dot in the above map indicates while the HDS system will intercept the current storm line to the west.

Soils testing at the town garage was inconclusive given the large quantity of old infrastructure debris present in the test pit. A pocket of water was exposed by the excavator and filled the test pit, further disturbing the soil analysis. This was not concluded to be groundwater given the pits close proximity to the White River and its elevation above the stream. Further design should investigate the soils further at this site to determine source of subsurface water and potential toxics due to current use as a garage.

The drainage area for this proposed BMP is 2.5 acres, approximately 64% of which is classified as impervious. This practice will provide a water quality benefit (Table 10).

A 30% design plan is provided in Appendix I - 30% Designs.

6.3.2 Pollutant Removal and Other Water Quality Benefits

A conservative estimate of the retrofit potential at this site, is the prevention of more than 630 lbs of TSS and 0.37 lbs of TP from entering receiving waters annually (Table 10).

Table 10. Town Office benefit summary table.

Total Suspended Solids Removed / yr	630 lbs
Total Phosphorus Removed / yr	0.37 lbs
Impervious Area Treated	1.60 acres
Total Drainage Area	2.5 acres

6.3.3 Cost Estimates

Note that these costs and benefits are very preliminary. Initial cost projections can be found in Table 11. The estimated cost for implementation of this project is $67,000

- The cost per pound of phosphorus treated is $18,108
- The cost per impervious acre treated is $41,875

Table 11. Town Garage project initial construction cost projection.

VTrans Code	Description	Unit	Quantity	Unit Price	Amount
Site Preparation					
	Mobilization	LS	1	$ 2,000.00	$ 2,000.00
653.55	Project Demarcation Fencing	LF	383	$ 1.17	$ 448.11
652.10	EPSC Plan	LS	0.5	$ 1,000.00	$ 500.00
652.20	Monitoring EPSC Plan	HR	10	$ 37.22	$ 372.20
	Construction Staking	HR	6	$ 90.00	$ 540.00
				Subtotal:	$ 3,860.31
Chambers - Costs					
	Hydro Downstream Defender (6')		1	$ 13,000.00	$ 13,000.00
				Subtotal:	$ 13,000.00
Materials and Excavation Costs					
604.20	Concrete Catch Basin	EACH	2	$ 3,387.59	$ 6,775.18
203.15	Common Excavation	CY	225	$ 35.00	$ 7,881.48
629.54	Crushed Stone Bedding	CY	28	$ 50.00	$ 1,407.41
601.0920	18" CPEP	LF	190	$ 70.00	$ 13,300.00
				Subtotal:	$ 29,364.07
Subtotal:					$ 46,224.38
	Construction Oversight	HR	20	$ 150.00	$ 3,000.00
	Construction Contingency - 20%				$ 9,244.88
	Incidentals to Construction - 5%				$ 2,311.22
	Minor Additional Design Items - 5%**				$ 2,311.22
	Final Design	HR	20	$ 150.00	$ 3,000.00
	Permit Review and Applications (exclusive of permit fees)	HR	8	$ 150.00	$ 1,200.00
Total (Rounded)					**$ 67,000.00**

6.3.4 Next Steps

As this site is owned and operated by the Town of Rochester, it is recommended that the Town proceed with further design and implementation of this retrofit. Further design will require refinement of the retrofit with respect to size, outlet design, and routing to the HDS system to allow for larger storms to safely pass through the system without risk of scour.

6.3.5 Permit Needs

A project readiness screening worksheet has been completed for this project and is included in Appendix J - Permit Review Sheets. In summary:

Stormwater Permit
It is not expected that a stormwater permit will be required at this time.

The site should qualify for an Erosion Prevention and Sediment Control permit (3-9020) under the Low Risk categorization if the following guidelines are followed:

- Less than 2 acres of disturbance at any one time.

- All soils must be stabilized (temporary or final) within 7 days.
- Runoff from the site must pass through a 50' vegetated buffer prior to entering any Water of the State.

Local Permitting
No local permits are anticipated.

Other Permits
The region's River Scientist and Floodplain Manager should be kept apprised of this project as it progresses as it is in close proximity to the river and any alteration to the retaining wall currently on site to provide structure to the sand pile will likely require a permit.

Final Recommendations

The results of this SWMP have identified a number of potential BMP concepts and locations that would have a positive impact on water quality in the White River. Although designs were only advanced for the top three projects, this plan serves to highlight other opportunities throughout the Village area and additional sites scoped as part of this SWP should be considered for additional investigation, design, and implementation when the Top 3 are complete.

The White River Tactical Basin Plan indicates a need and intention to "raise awareness of aquatic invasive plants…and spread prevention in the basin." In Rochester, there are severe Japanese knotweed infestations along the River, in particular behind the Town Garage and along the tributary adjacent to the Town Offices. Due to the severity of the outbreak, this locale could benefit from an action plan to reduce the invasive population beyond an awareness campaign. Current uses at the Town Garage include storage of sand and salt piles on the river bank while the Town Offices use the buffer for snow storage. Improved practices in these locations could improve conditions if coupled with aggressive invasive species removal and control measures. Implementation of a revegetation plan for the sites with native plant palette will further discourage invasive species spread.

It is our recommendation that the Town, in partnership with the White River Partnership move to implement the top three practices, but also to move forward with additional design and implementation of other projects presented in this plan. As these practices are the result of a stormwater master planning effort under a VT DEC Clean Water Fund grant, they are well-suited as candidates for implementation grants from this same source. We recommend the following steps in proceeding with to final design and implementation:

- For priority projects already at the 30% concept level, consider grant request for final design and implementation.

- Following implementation of the priority projects, submit grant funding requests for higher scoring projects that may include both preliminary and final design.

Where some of the project sites are road related, funding to implement those practices could include the VTRANS Better Roads grants. Communication with the Basin Planner for the region (Danielle Owczarski) can help to confirm the best source of funding given changing priorities and grant program rules associated with each.

It is further recommended that a stormwater-specific ordinance be developed for the Town of Rochester. A stormwater-specific bylaw could work in concert with other Town goals (such as improved pedestrian access in the Village Center). The VT League of Cities and Towns has developed a model stormwater bylaw for use by Towns. Further information can be found here: https://dec.vermont.gov/sites/dec/files/wsm/erp/docs/2015-LID-GSI-VLCT%20model-bylaw.11-2015.pdf.

The Vermont Agency of Transportation (VTrans), as part of their Transportation Separate Storm Sewer System (TS4) General Permit, will be completing their own retrofit assessment of VTrans-owned impervious surfaces in Rochester. Projects identified in this plan that involve VTrans drainage should be coordinated with the VTrans TS4 permitting efforts to allow for potential collaboration. Notably, this includes anything along the Route 100 corridor through the village center that was identified as a contributor of sediment to surface waters. Implementation of sidewalk sections should include (to the extent possible) some stormwater treatment within the sidewalk and greenspace width. As this project moves to implementation, any opportunities to adjust the slope of the roadway and elevation of the catch basins in the center of town to improve capture and conveyance of stormwater will result greater performance of the existing and proposed stormwater system elements.

6.4 Potential Funding Sources

Moving these projects to final design and implementation will require securing additional funds. Below are some options that may provide the needed resources.

- Department of Environmental Conservation - Ecosystem Restoration Program (ERP) Grants through the Clean Water Initiative Program (CWIP)
    - Requirements for this grant change frequently, so applicants are encouraged to check in with program staff and/or their Basin Planner before developing a detailed proposal. Currently, these grants are being issued quarterly and proposals are received on a rolling basis. Projects must meet a $25,000 minimum funding level. Priority is given for projects on public land. While match is not required for projects outside of MS4 permitted communities, points in proposal ranking are provided where match is offered.
    - In general, Clean Water funding through ERP like the Block Grants are good funding opportunities for nitrogen and sediment removal projects. Unlike the quarterly grants, the block grants require some match.
    - For more information: http://dec.vermont.gov/watershed/cwi/grants

- VT Agency of Transportation (VTrans) – Transportation Alternatives Program, Municipal Highway and Stormwater Grant Program, and others
    - The Municipal Highway and Stormwater Grant Program will fund stormwater projects with a highway link. These may include planning studies and the installation of physical infrastructure as well as repair to culverts and stream banks damaged from runoff. Municipalities are the only eligible entity for this grant and must be used for projects that treat highway road runoff. Match is required for these grants and must be from a non-federal source.

- Insofar as the Town Office project site is collecting some state highway runoff and improving treatment prior to discharge to a state ditch, this could be a good source of funds. While not one of the Top-3 projects, the Route 100 sidewalk project could add a stormwater treatment element, as suggested in this SWMP, using funds from VTrans Municipal Highway and Stormwater Grant Program.
- For more information: http://vtrans.vermont.gov/highway/local-projects/transport-alt

6.5 Potential Partners

Rochester and the White River Partnership (WRP) are obvious partners on the projects in this plan as they have been leaders in its development and are intimately aware of the details. Having the grant writing and project management expertise of the WRP coupled with the local knowledge and connections of Town staff make an excellent combination for successful implementation. There may be additional local watershed groups or environmentally-focused Town councils to offer additional support. These groups can be valuable partners in garnering local support as well as offering outreach and education elements to complement a large implementation project such as the ones proposed in this plan. Including residents and downtown business owners in the process of project development and educating them about options for retaining roof and driveway runoff could have added benefits and increase community support and understanding of the Town's effort on stormwater.