QA Project Plan:

Transforming Hyde Park Village Center into a Net Zero runoff Showcase Using Green Stormwater Infrastructure

Job cost code: 0100-323-002

NEI Project code: L-2019-084

QA Code: Q20-004

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Prepared for:

Lake Champlain Basin Program

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March 27, 2020

Ron Rodjenski	03/27/2020
Ron Rodjenski, QA Project Manager, Hyde Park Town Administrator	Date
	3/30/2020
Andres Torizzo, QA Project Officer, Watershed Consulting Associates	Date
Lauren Jenness	3/30/2020
Lauren Jenness, Project Officer, LCBP	Date
Meg Modley	3/30/20
Meg Modley, Quality Assurance Program Manager Designee, LCBP/NEIWPCC	Date

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A – Project Management

A1 – Distribution List

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A2 – Project/Task Organization

NEIWPCC:

Heather Radcliffe, Contract Manager: Manages the contract.

Peter Zaykoski, QA Program Manager: Reviews QAPP and subsequent revisions in terms of quality assurance aspects according to NEIPWCC quality management plan and has QAPP approval authority.

Alexandra Morneau, Administrative Assistant: Receives and inventories all QAPPs.

LCBP:

Meg Modley, QA Program Manager Designee: QA/QC Approval Authority. Reviews and approves QAPP and subsequent revisions in terms of quality assurance aspects.

Lauren Jenness, Project Officer: Overall coordination of the project and point of communication for Watershed Consulting Associates Project Manager and NEIWPCC. Responsible for maintaining and distributing the official approved QAPP.

Town of Hyde Park:

Ron Rodjenski, Grantee, QA Project Manager: oversees project execution. Provides information to Watershed Consulting Associates as needed; has independence from QA Officer who generates data.

Watershed Consulting Associates:

Andres Torizzo, Principal: Project Manager, QA Project Officer: oversee all project tasks, responsible for maintaining the official QA Project Plan. Prepare updated QAPP in accordance with approved workplan.

A3 – Problem Definition/Background

The Hyde Park Net Zero Showcase project will transform the Village of Hyde Park Village Center into a Net Zero Runoff condition by using established Green Stormwater Infrastructure (GSI) practices and exploring incorporation of innovative stormwater collection and treatment systems. This study will provide methods and means to eliminate existing unmanaged and untreated stormwater generated by existing uses along Main Street and anticipate and facilitate future Village Center land development by providing comprehensive stormwater plan elements to be incorporated into private and public land development permits. With a densely developed area, and scoping plans underway for major public capital investments, the Net Zero showcase project will be completed while public infrastructure projects are being constructed (Courthouse Pocket Park) and others are in scoping or preliminary design (sidewalk extensions, wastewater and water supply upgrades, and streetscape improvements in the Village Center centered on Church St and Main St). The Project will be the first step to design and implement a sustainable GSI system for the designated Village Center area within Hyde Park. The Project once implemented will reduce sediment, phosphorus, and stormwater volume to waters within the Lake Champlain Basin, and will help the Town increase resiliency to flooding in the face of more intense precipitation events. The Project goals are unique in the sense that there are no known Village Centers in Vermont that prevent polluted stormwater runoff from flowing to waters of the State. Given that historic village development predates stormwater controls and GSI opportunities are highly constrained in Vermont's villages and cannot easily accept the installation of robust stormwater controls, the planning for new stormwater infrastructure is typically very challenging and guidance for private and public investors will accelerate clean water objectives.

The Town of Hyde Park is in the unique position of currently planning an overhaul of the Village Center's through a Vermont Better Connections Grant. This grant will evaluate economic opportunities related to transportation improvements primarily within the incorporated Village of Hyde Park but also identifying opportunities for the Town to connect with neighboring communities and regional facilities. That current planning project, Connect Hyde Park, involves internal roadway improvements for the Main St corridor with significant public input from stakeholders; more information is here: www.connecthydeparkvt.org. Connect Hyde Park's consultant team, led by Dubois-King, Inc. will produce a Main Street Action Plan to guide capital investments to roadways, including stormwater, and economic development.

However, DuBois-King, Inc. has limited funding to explore stormwater and GSI possibilities, thus the need to seek additional funding at this critical time to define stormwater improvements to partner with upcoming bicycle/pedestrian, streetscape and economic development initiatives. Once the priorities from both planning projects are completed, the Town of Hyde Park and Village of Hyde Park, working with state and federal partners, will be ready to seek implementation funding in one comprehensive Village Center investment strategy.

A4 – Project/Task Description

TASK #	TASK TITLE	OBJECTIVE	DELIVERABLE OR OUTPUT	TIMELINE
1	Develop a QAPP	Tools including the Source Loading and Management Model (WinSLAMM) and HydroCAD will be utilized to size and design the GSI system.	QAPP Approval	November 2019 – February 2020
2	Project Kickoff	Review existing and in-progress engineering studies, notify stakeholders of project and obtain information on high priority concerns in the Village Center	Minutes of Meeting	November 2019
3	Develop Baseplan for Village Center	Meet with landowners to develop a new baseplan that will be the starting point for the GSI design with its project limits being the State-designated Village of Hyde Park Village Center, map attached. CAD/Drafting work will be needed to get the plan into a useable format for this effort.	Baseplan showing preferred transportation alternative	March 2020
4	Existing Conditions Assessment	Conducting an intensive soils investigation will be an important step to understand subsurface geology and limitations.	Soil logs with infiltration testing results	May 2020
5	Runoff Quality and Modeling	Design and Size Stormwater Systems	Modeling Summary	July 2020

		Delineate drainage areas using GIS to predict the pollutant loading, peak discharges and proposed scenarios.		
6	Preliminary Designs	Concept level plans with sufficient information to provide engineering feasibility accommodating transportation elements in Dubois-King Main Street Action Plan	Preliminary plans and details	October 2020
7	Cost Estimate	Engineers opinion of probable costs to be incorporated into private or public stormwater improvement projects	Cost spreadsheet	October 2020
8	Reports	Submit quarterly reports and Compile project summary, plans, maps, articles, photographs.	Quarterly reports and Final Report with Executive Summary	Quarterly reports and December 31st 2020

Task 1. QAPP - Describe quality assurance project plan procedures that will maintain project performance for the Project modeling tools including the Source Loading and Management Model (WinSLAMM) and HydroCAD to size and design the GSI system. Both of these modeling tools have been utilized in prior successful LCBP funded projects.

Task 1. Deliverable: QAPP Approval – November 2019 – February 2020

Task 2. Kickoff – The focus of this project is the state-designated Village Center area encompassing parcels on the north and south side of Main Street and for a short distance along side streets connecting to Main Street; see 2016 Lamoille Tactical Basin Plan, Page 8. Following approval of the QAPP a kickoff meeting with the landowners and the consultant team will be scheduled to review project objectives and timelines and to discuss the status of the Main Street Action Plan being prepared through the Better Connections program by Dubois-King. A review of existing stormwater projects including the VT DEC IDDE - 2012, the 2016 Lamoille County Conservation District sub watershed study and basin installations on Depot Street and the 2018 VTrans Municipal Mitigation Grant (#MM18/CA0539) will allow all stakeholders to assist in eliminating redundancies and clarify community priorities for inclusion in future roadway capital investments.

Task 2. Output: Meeting Minutes – November 2019

Task 3. Baseplan – The concept plan developed for the Main Street Action Plan will be utilized to develop a new baseplan that will be the starting point for the GSI design with its project limits being the State-designated Village of Hyde Park Village Center. CAD/Drafting work will be needed to get the plan into a useable format for this effort. The preliminary plans and concept plans to be developed will include recommendations for future land development within the Village Center to reduce effective impervious surface areas; 2017 Opportunities for Action; Strategy I.C.3, b.

Task 3. Deliverable: Baseplan showing preferred transportation alternative – March 2020

Task 4. Existing Conditions – An intensive soils investigation is proposed within the Project study area. This will be an important step to understand subsurface geology and opportunities/limitations due to infiltration capacity and impacts to existing structure foundations. Based on some prior subsurface work as well as NRCS maps, soils are anticipated to be conducive for infiltration. However, the specific rate of infiltration is unknown and given the goal of infiltrating all runoff the characterization of the soil conditions throughout the study area is critical. During soil investigations and field work within the Village Center, the on-site team will follow the invasive species spread prevention methods and guidance in the 2009 Lake Champlain Basin Rapid Response Action Plan for Aquatic Invasive Species, reporting newly formed or newly found infestations regardless of population size if discovered.

Task 4. Deliverable: Soil logs with infiltration testing results – May 2020

Task 5. Runoff Quality and Modeling – To begin the design of the GSI system drainage areas and land uses will be delineated using GIS. The water quality model, Source Loading and Management Model (WinSLAMM) will be used to predict the pollutant loading of the current Village stormwater system and then the proposed condition. Generators are roadways, sidewalks, County services building (courthouse, sheriff's department, state's attorney, etc.), community service buildings (library, elementary school, post office, opera house), residences and small to mid-size businesses. The hydrologic & hydraulic model HydroCAD will be used to predict peak discharges in the current and proposed scenarios for the highest urban density area; the 2016 Lamoille Tactical Basin Plan identified as a priority for Middle Lamoille basin, Page 55.

Task 5. Deliverable: Modeling summary – July 2020

Task 6. Preliminary Plans – Preliminary concept level plans will be developed for the stormwater system. The plans will include enough information to provide engineering feasibility and will contain key elevations and will also contain key construction details. The preliminary design will accommodate proposed transportation elements provided in the Hyde Park Main Street Action Plan (Dubois-King). The preliminary plans will include concepts for the entire Village Center, applicable in general village settings (roadway and private landowner GSIs), but more detailed plans for specific roadway segments will be applicable to selected recommendations in the Main Street Action Plan. One public meeting will be held during this task to update the community on Project status and receive comment. This Project will assist private landowners in understanding GSI concepts that can be implemented with both private and public landscape investments. Community outreach through the municipal website, this Project's meetings, and by one-on-one property owner connections will facilitate the public input into this Project and produce realistic outcomes for long-term community consideration over the years of Village Center redevelopment. The project designs will incorporate the *2017 Opportunities for Action Plan*, Objective III.B.1.b Task Area – Innovation Development. The preliminary plans and concept plans to be developed will include recommendations for future land development and the implementation of GSI projects within the Village Center to reduce effective impervious surface areas, incorporating the *2017 Opportunities for Action Plan*; Strategy I.C.3, b.

Task 6. Deliverable: Preliminary plans and details – October 2020

Task 7. Cost Estimate – A cost estimate will be developed by itemizing construction materials and installation costs. This cost will be able to be factored into the overall cost of Main Street redevelopment projects on public and private parcels and can be utilized for future grant funding efforts.

Task 7. Deliverable: Cost spreadsheet – October 2020

Task 8. Final Report – **Quarterly reports and** a final summary including all deliverables will be prepared at the completion of the Project. Hyde Park will be able to achieve their goal of eliminating stormwater runoff from the Hyde Park Village Center area by implementing the plans and design developed by this Project. Implementation of the plan will reduce quantified measures including P loading, volume of stormwater, and peak discharge of stormwater. Implementation of the plan will increase unquantified measures such as recharge of groundwater and improve the water quality of downstream brooks and the Lamoille River. This Project's timing creates a natural "two-step" with the LCBP grant schedule able to incorporate the recommendations from Connect Hyde Park, which is due in October 2019, into this Project's Summary Report, due in March 2020. The proposed Project will require working with the Dubois- King team during their on-going work to maintain awareness of the outcomes in their forthcoming Main Street Action Plan. The public input from Connect Hyde Park, and this Project's own public input, will help guide the final stormwater improvement options for a robust GSI based stormwater design that will infiltrate Main Street runoff thereby eliminating at least two highly eroded discharge points and help to restore preexisting hydrology. The process and design will be a model for how other Village centers in Vermont can retrofit our valuable Village Centers using a comprehensive roadway and GSI based approach.

Task 8. Deliverable: - Final Report with Executive Summary – November 2020

A5 – Quality Objectives and Criteria for Measurement Data

Objectives. The project data-quality objective is to collect, provide, maintain, analyze, display, and document valid locational data to accurately map the condition and location of 30% GSI construction engineering designs for Main Street in Hyde Park, VT.

The data that will be collected to support development of 30% engineering designs will meet the quality assurance objectives outlined in this section. Data quality will be measured in terms of accuracy and precision, completeness, representativeness, and comparability.

A. Surveying: In those instances where publicly available data is not complete or of sufficient detail for the design of the three stormwater BMPs, field survey will be completed by the qualified staff of Watershed Consulting (see QAPP section A8 for additional information regarding Watershed Consulting qualifications). For example, if the 1-foot contour data is not sufficient to fully understand flow paths, field-surveyed topographic data would be used to supplement the existing data. Existing stormwater infrastructure, utilities, and features important to the proposed BMP design will need to be located and verified by the survey crew. Watershed Consulting will utilize a total station surveying system, which is designed and calibrated to capture precise X, Y, and Z coordinates for each collected point and this equipment will be used only by trained professionals, ensuring accuracy and precision. The total station is equipped with an on-board computer that collects and stores survey data. This data is then transferred to Watershed Consulting's computers for incorporation into engineering designs. Watershed Consulting will use standard surveying methodologies so that results are complete and comparable to other standard survey data.

B. Soil Assessment and Infiltration Test: A soil assessment and infiltration test may be conducted to verify that soils are of sufficient quality to allow for infiltration as specified under the Vermont Stormwater Management Manual (2017) for Main Street in Hyde Park. Soils will be logged for texture, structure, consistence, moisture content, and redox features. Soils will be assessed using the "Field Book for Describing and Sampling Soils" Version 3.0 published by the National Soil Survey Center Natural Resources Conservation Service, U.S. Department of Agriculture. This book will be referenced during soil characterization by Watershed staff members. Photo documentation will be taken for each soil horizon. Using this standardized methodology, referring to the abovementioned reference book in the field, and taking photo documentation will ensure that soil assessments are accurate, precise, complete, and comparable. The soil assessment will be completed where the proposed BMP will be located, ensuring that the soils assessed are representative of those where the BMP will be constructed.

If a soil assessment is conducted, infiltration testing will be carried out unless the project team notes soil characteristics that make infiltration practices unsuitable using a Constant-Head Borehole Permeameter Test using a Johnson Meter (available from Johnson Permeameter LLC, 190 Whites Lake Blvd, Saluda, NC 28773; Patent number US6938461B1). The result of this testing is a value for the saturated hydraulic conductivity of soils on site. This value measures the movement of water through saturated soils and yields a conservative estimate of infiltration. This value will be used in HydroCAD modeling and will impact sizing of the proposed practice. Using this standard methodology with pre-calibrated equipment ensures accuracy and precision, completeness, and comparability. The infiltration test will be completed where the proposed BMP will be located, ensuring that the infiltration test is representative of the soil infiltration capacity where the BMP will be constructed.

C. Hydrologic Modeling: To support the development of 100% concept designs, hydrologic and hydraulic modeling for these stormwater management practices will be completed in HydroCAD, a computer aided design tool.

The VT DEC STP Calculator (https://anrweb.vt.gov/DEC/CleanWaterDashboard/STPCalculator.aspx) will be used for pollutant load modeling to ensure accuracy, precision, and comparability by VT DEC's pollutant load reduction standards.

This modeling will require acquisition or utilization of the following data, which will be linked to or thoroughly described in the final report to ensure comparability:

- USDA Natural Resources Conservation Service (NRCS) soil data for the Town of Hyde Park (format: ESRI ArcGIS file geodatabase feature class; source: downloaded from the VCGI Open Geodata Portal; use: inputs for HydroCAD models)
- Topography data 1' LiDAR-derived contours. LiDAR data was collected between 10/24/2014 and 4/19/2015 with a 0.7m spatial resolution, quality level 2. Elevation data is used to aid in delineation of BMP drainage areas and for hydrologic and hydraulic modeling, specifically in calculating the time of concentration. (format: ESRI ArcGIS file geodatabase feature class; source: downloaded from the VCGI Open Geodata Portal; use: to inform HydroCAD models and STP Calculator inputs)
- Stormwater infrastructure data, mapped by the VT Department of Environmental Conservation, is also used to aid in delineation of BMP drainage areas. (format: ESRI ArcGIS file geodatabase feature class; source: downloaded from the VCGI Open Geodata Portal; use: to inform HydroCAD models and STP Calculator inputs)

- BMP drainage areas (format: ESRI ArcGIS file geodatabase feature class; source: generated by Watershed staff utilizing existing elevation data and refined during field visits; use: to inform HydroCAD models and STP Calculator inputs)
- National Oceanographic and Atmospheric Administration (NOAA) Atlas 14 precipitation data for Lamoille County, VT. (format: Atlas 14 database embedded into HydroCAD program and accessed via pre-defined lookup tables that define rainfall distribution and rainfall depth; source: NOAA; use: to inform HydroCAD modeling)
- The best available satellite and/or aerial imagery, which may vary from site to site, will be used to generate site-specific landuse classification that will be heads up digitized in ArcGIS 10.7.1. Best available is determined by currency and spatial resolution. (format: server-hosted tiled imagery; source: either VCGI or ESRI depending on location; use: to inform HydroCAD models and STP Calculator inputs)

The modeling software HydroCAD will be used for modeling runoff volumes and for sizing of retrofits for the 30% design plans. HydroCAD v10.0.0 build 25 will be used unless a newer version is available prior to the modeling tasks for this project. In this instance, the software will be updated to the most current version. This program allows for automated modeling of stormwater runoff from small urban drainage areas using TR-20 and TR- 55 modeling algorithms (methods of calculating runoff from small drainage areas were developed by the USDA Soil Conservation Service, now the NRCS). TR-55, a manual method for calculating runoff and peak discharge, used landuse, soils characteristics, and rainfall information for standardized storms. TR-20 was an early computer model that used the unit-hydrograph runoff procedure incorporated in HydroCAD and was adapted from TR-55. HydroCAD expands on the methods and calculations found in TR-20 as it uses automated modeling of the time of concentration, curve-number lookup, hydraulic calculations for outlets, exfiltration calculations, and pond storage calculations. HydroCAD is the industry standard for modeling stormwater BMPs and is well-established and accepted in Vermont for regulatory permitting decisions, ensuring accuracy, precision, representativeness, and comparability.

The HydroCAD model will be calibrated to the region using the best available NRCS soils data and NOAA Atlas 14 precipitation information for the three modeled sites, ensuring that the data used is representative of the sites being modeled. This data is standard for VT DEC regulatory approval and is comparable across stormwater models as such. It has been deemed both accurate and precise enough by the VT DEC for these modeling tasks. The landuse data utilized in the model will be generated for each of the three project locations through on-screen heads-up digitizing completed by qualified stormwater professionals at Watershed using the best available imagery to ensure accuracy and precision. See list of modeling inputs above for more information about these data. This data is readily available, ensuring comparability. See QAPP section A8 for Watershed staff qualifications.

Accuracy and completeness of modeling will be ensured through the QC process to be completed by qualified stormwater professionals at Watershed and is overseen by the QA Officer. Completeness is defined as fully representing conditions (land cover classes) in the drainage area, modeling BMP size and routing, and utilizing the most applicable rainfall data (based on location). Accuracy is defined as representing the conditions found in the drainage area correctly. A review of publicly available GIS and precipitation data via supplied metadata will be completed to ensure that acquired data is representative and is of sufficient quality and detail for the intended use. To be considered complete, publicly available data must cover the drainage area for the proposed practice and be of a sufficient scale to accurately describe the site. For example, contour data at a 20-foot interval would not describe the topography of a site in enough detail to determine stormwater flow paths over the BMP drainage areas for the three practices. However, contour data at a 1-foot interval would be of sufficient detail to allow for identification of flow paths in most cases.

Intended use of the data. The collected data and generated plans will be used by the Town of Hyde Park, and other stakeholders to advance designs to the implementation phase for the three practices.

Performance and acceptance criteria. Generated data pertaining to stormwater BMP plan development will be reviewed internally by Watershed and by the Project QA Officer to determine data accuracy and applicability. Accuracy will be determined by reviewing mapped data to ensure that survey and modeled data matches and reviewing photos of soil horizons to ensure classifications are in line with NRCS soil standards. If any issues are found with the data, revisions will be made as soon as possible by Watershed.

A6 – Special Training Requirements/Certifications

Site survey, 100% engineering designs, and stormwater modeling will be completed by the stormwater management professionals from Watershed. For site survey, training in the use of total station survey equipment is necessary and has been completed. The survey administrator has 20 years of experience in several types of survey including topographic and feature survey. For GIS, the GIS Professional (GISP) from Watershed will provided oversight for all GIS-related tasks and has the necessary training to ensure this consisting of undergraduate work in GIS, a Master of Science degree in which GIS was used extensively, and certification through the GIS Certification Institute. For modeling in HydroCAD, the stormwater professionals have attended special training offered through HydroCAD in how to operate the model.

The Project QA Officer will be responsible for assuring the trained staff from Watershed are qualified and can satisfactorily meet the objectives outlined in this QAPP. Documentation of staff certifications and qualifications are located within Watershed offices and can be provided upon request. Training includes:

- use of Total Station for survey tasks,
- use of Johnson Meter,
- using NRCS guidelines for describing soils, and
- use of HydroCAD modeling program.

A7 – Documentation and Records

Paper and electronic files of data generated for this project will be consolidated at the Watershed Consulting office and electronic files will be backed-up on a daily basis to ensure no data are lost. Digital copies of field sheets and any electronic data collected during the project will be maintained in the Watershed Consulting office throughout the project duration and for a period of three (3) years following completion of the project. Electronic data will be shared as needed with the LCBP Project Officer for review purposes. Copies of all electronic data will be provided to the LCBP Project Officer upon completion of the project.

The LCBP Project Officer will be responsible for distributing current copies of this QAPP to the distribution list of individuals identified in Section A3 of this QAPP. The final report to the LCBP will include a summary and analysis of all data collected for this project. This report will be delivered to the LCBP electronically at the conclusion of the project.

The Project Manager and QC Officer will report any changes or updates to the QAPP to the LCBP Project Officer for review and approval.

B – Measurement/Data Acquisition

B1 – Sampling Process Design

Watershed will complete any field surveying, soils assessments, infiltration tests, and hydrological modeling needed to bring the three 30% engineered designs to completion.

A. Surveying: Watershed will complete necessary additional field surveys using a total station surveying system and document base conditions at the three chosen project sites. The project team will also conduct due diligence regarding utility conflicts in the area, either using previously mapped infrastructure of known quality or via the results of the individual site surveys.

B. Soil Assessment and Infiltration Test: One soil assessment and infiltration test will be conducted at each of the three chosen project sites to verify that soils are of sufficient quality to allow for infiltration as specified under the Vermont Stormwater Management Manual (2017). Soils will be logged by Watershed staff in a secure mobile app hosted by Fulcrum (www.fulcrumapp.com) for texture, structure, consistence, moisture content, and redox features. If soil conditions encountered during testing are found to be variable, this will be accounted for during the design process. Infiltration testing would be carried out unless the project team notes soil characteristics that make infiltration practices unsuitable using a Constant-Head Borehole Permeameter Test using a Johnson Meter (available from Johnson Permeameter LLC, 190 Whites Lake Blvd, Saluda, NC 28773; Patent number US6938461B1). The result of this testing is a value for the saturated hydraulic conductivity (Ksat) of soils on site. This value measures the movement of water through saturated soils and yields a conservative estimate of infiltration. This value will be used in HydroCAD modeling and will impact sizing of the proposed practice.

C. Hydrologic Modeling: HydroCAD will be used to generate peak discharge. It is based on the TR-55 model for small urban watersheds, but also incorporates SCS Unit Hydrograph runoff procedures, and can perform hydraulic calculations. The data layers to be inputted into the model are described in section A7. The model is the most commonly used one in the industry and accepted by the VT Department of Environmental Conservation for BMP design.

B2 – Sampling and Data Acquisition Methods

A. Surveying: Watershed will complete any necessary field surveys and document base conditions, which includes geographically locating the existing conditions on site at the time of survey, on the three chosen project sites to collect the data required to complete the final engineered designs.

Where the data collected during the 30% design process is not of sufficient detail as determined by trained Watershed staff, the following data will be collected by Watershed:

- Building and roadway edges that may influence design of stormwater BMPs or routing of stormwater
- Pipe invert elevations

- Feature locations and elevations including but not limited to locations of large trees that could influence design and evidence of electrical, gas, sewer, water, or other utilities
- Topographic information where LiDAR elevation data is insufficient for design of stormwater BMPs to ensure proper collection, routing, and management of stormwater

The above bulleted information will be collected using standard total station surveying equipment as necessary. A total station is an instrument used for surveying and measures vertical and horizontal angles and the slope distance from the total station to each point that is being surveyed. The total station is equipped with an on-board computer that collects and stores survey data. This data is then transferred to Watershed Consulting's computers for incorporation into engineering designs. If possible, surveys will make use of existing benchmarks to integrate surveyed elevations with known elevations (height above sea level). If there is not an established benchmark to tie in to, survey elevations will be expressed using a relative datum. As there is no intention during this project to establish or impact any property boundaries, a licensed land surveyor is not required. If any of the BMPs were to potentially impact property boundaries, a licensed land surveyor would be required to ensure that the exact property boundary was surveyed and recorded on the engineering plans.

<u>B. Soil Assessment and Infiltration Test:</u> Soil assessments and infiltration testing will be completed at the three chosen project sites to verify that soils are of sufficient quality to allow for infiltration as specified under the Vermont Stormwater Management Manual (2017). Soil assessments and infiltration testing will be assigned a site name, site ID #, and GPS coordinates based on the associated project site. Soils will be logged for texture, structure, consistence, moisture content, and redox features (USDA classification). Infiltration testing will be carried out unless the project team notes soil characteristics that make infiltration practices unsuitable (clay layers, evidence of seasonal high ground water close to ground elevation, etc.) using a Constant-Head Borehole Permeameter Test (USBR 7300-89 Condition I, Deep Water Table or Impermeable layer or USBR 7300-89 Condition II, Shallow Water Table depending on site conditions) using a Johnson Meter. The result of this testing is a value for the saturated hydraulic conductivity (Ksat) of soils on site. This value measures the movement of water through saturated soils and yields a conservative estimate of infiltration. This value will be used in HydroCAD modeling and will impact sizing of the proposed practice.

<u>C. Stormwater Modeling:</u> HydroCAD will be used to generate peak discharge. It is based on the TR-55 model for small urban watersheds, but also incorporates SCS Unit Hydrograph runoff procedures, and can perform hydraulic calculations. The data layers to be inputted into the model are described in section A7. The model is the most commonly used one in the industry and accepted by the VT Department of Environmental Conservation for BMP design.

B3 – Sample Handling and Custody

<u>A. Surveying:</u> All survey data will be obtained using standard total station surveying equipment and maintained in digital file format by Watershed. Data will be stored in their native formats on hard drives. As data is created or downloaded, Watershed staff will file the data in the designated project folder. If a new data file supersedes an existing data file, the old data file will be overwritten or deleted.

Watershed possesses the necessary computer systems, software licenses, and software installations to store, access, and manipulate all required data. No software needs to be installed as the project team already has all the software needed to run all these processes. Data is stored on password protected computers and hard drives.

B. Soil Assessment and Infiltration Test: All soil-related data will be collected in survey forms and maintained in digital format by Watershed. All soil characteristics and infiltration testing results will be entered into a secure mobile app hosted by Fulcrum (www.fulcrumapp.com). No physical samples will be taken during the soil assessment or infiltration test.

C. Stormwater Modeling: All data will be obtained and maintained in digital format by Watershed. Changes made to any dataset will be noted in the dataset's accompanying metadata and reported in the QAPP section of the LCBP final report. Data are also synced to secure Cloud storage from Box (www.box.com). These data are further backed-up daily using Carbonite (www.carbonite.com), a Cloud-based file backup service.

There are a variety of data formats that will be used. They include

- Microsoft Word documents (.docx)
- Microsoft Excel workbooks (.xlsx)
- Portable Document Format documents (.pdf)
- Comma Separated Values documents (.csv)
- ESRI geodatabase files (.gdb)
- ESRI map documents (.mxd)
- HydroCAD projects (.hcp)
- AutoCAD drawings (.dwg)
- Text files (.txt)

Data will be stored in their native formats on the hard drives and cloud services mentioned above. Data will be managed by Watershed. As data is created or downloaded, Watershed staff will file the data in the project folder. If a new data file supersedes an existing data file, the old data file will be overwritten or deleted. Watershed possesses the necessary computer systems, software licenses, and software installations to store, access, and manipulate all required data. No software needs to be installed as the project team already has all the software needed to run all these processes. Data is stored on password protected computers and hard drives. The network where data is transferred between users is password protected. Data transmitted outside of the project team's offices is transferred using a secure file transfer service provided by Box.com.

B4 – Analytical Methods

A. Surveying: Survey points will be collected using a total station. X-Y-Z coordinates will be collected and recorded into the total station's internal memory and transferred to Watershed computers following survey.

B. Soil Assessment and Infiltration Test: If a geotechnical assessment is required, soils will be assessed using the "Field Book for Describing and Sampling Soils" Version 3.0 published by the National Soil Survey Center

Natural Resources Conservation Service, U.S. Department of Agriculture. This book will be referenced during soil characterization by Watershed staff members. Photo documentation will be taken for each soil horizon, reviewed by Watershed staff, and stored in digital format on Watershed's hard drive and cloud and included in the final report.

Infiltration testing will be carried out using a Constant-Head Borehole Permeameter Test (USBR 7300-89 Condition I, Deep Water Table or Impermeable layer or USBR 7300-89 Condition II, Shallow Water Table depending on site conditions) using a Johnson Meter.

C. Stormwater Modeling: Peak discharges will be calculated for drainage areas using the HydroCAD model. The model is proposed to be calibrated using onsite data. The input data will be derived from site-specific conditions and predicted peak flows will be evaluated to assist with general sizing and design. For the VT DEC STP Calculator (https://anrweb.vt.gov/DEC/CleanWaterDashboard/STPCalculator.aspx), pre-loaded pollutant loading information for the applicable lake segment will be relied upon. The goal of utilizing the VT DEC STP Calculator is to obtain a reasonable estimation of Total Phosphorus reductions associated with installation of the stormwater management practices. The STP Calculator is the accepted method of calculating these pollutant reductions in the State of Vermont.

B5 – Quality control Requirements

All data acquired or generated will be fully documented as to original source, quality, and history. All data products will be reviewed by the Project QA Officer to ensure quality. The professional judgment of the Project QA Officer will be relied upon in evaluating results. Corrective action will involve identification of the cause of the failure where possible. Response actions will typically include re-analysis of questionable data, if possible. In some cases, a site may have to be re-visited to achieve project goals. Corrective action and QA process will be included in final report.

A. Surveying: Data collected during the site surveys will be reviewed by members of the Watershed team to ensure that all data is collected to industry standards.

B. Soil Assessment and Infiltration Test: If a geotechnical assessment is required, soils will be assessed using the "Field Book for Describing and Sampling Soils" Version 3.0 published by the National Soil Survey Center Natural Resources Conservation Service, U.S. Department of Agriculture. This book will be referenced during soil characterization by Watershed staff members. Data will be reviewed by Watershed staff trained in soil assessments to ensure that recorded information matches soil characteristics observed in soil horizon photos.

C. Stormwater Modeling: Configurations for the HydroCAD models will be verified by Watershed staff who are trained to run the modeling programs. Outputs will be evaluated for accuracy based on best professional judgement and Watershed's team experience running these modeling programs for hundreds of sites.

B6 – Instrument/Equipment Testing, Inspection, and Maintenance

Field analytical equipment that may be used in this project include a Total Station for survey and a Johnson Meter for the soil assessment. For both pieces of equipment, testing, inspection and maintenance will be conducted in accordance with manufacturer instructions by Watershed staff.

A. Surveying: The Total Station is secured to a sturdy tripod and is used to record X, Y, and Z coordinates, height of the instrument, height of a prism secured to a rod that is moved strategically around the site, and distance. Equipment will be inspected prior to use to ensure that it is in good working order. Any problems will be fixed prior to using the equipment. If required, a maintenance log will be recorded. Any maintenance or servicing of the equipment will be documented. A log entry will be recorded and include the following information:

- Name of person maintaining the instrument/equipment
- Date and description of the maintenance procedure
- Date and description of any instrument/equipment problems
- Date and description of action to correct problems
- List of follow-up activities after maintenance
- Date the next maintenance will be needed

B. Soil Assessment and Infiltration Test: If the soil assessment is completed, a Johnson Meter, an instrument for measuring saturated hydraulic connectivity (Ksat), would be used. Equipment will be inspected prior to use to ensure that it is in good working order. Any problems will be fixed prior to using the equipment. If required, a maintenance log will be recorded. Any maintenance or servicing of the equipment will be documented. A log entry will be recorded and include the following information:

- Name of person maintaining the instrument/equipment
- Date and description of the maintenance procedure
- Date and description of any instrument/equipment problems
- Date and description of action to correct problems
- List of follow-up activities after maintenance
- Date the next maintenance will be needed

C. Stormwater Modeling: HP laptop or desktop computers will be utilized for stormwater modeling in HydroCAD. Computers are maintained and operated by experienced Watershed staff in accordance with manufacturer instructions.

B7 – Instrument/Equipment Calibration and Frequency

A. Surveying: The Total Station is sufficiently calibrated for topographic and feature surveys and no additional calibration will be required.

B. Soil Assessment and Infiltration Test: Infiltration testing equipment is calibrated by the manufacturer and does not require additional calibration.

C. Stormwater Modeling: Computers used for stormwater modeling will not require any calibration.

B8 – Inspection Acceptance of Supplies and Consumables

N/A

B9 – Data Acquisition Requirements for Non-Direct Measurements

A. Surveying: No non-direct measurements will be taken for this task.

B. Soil Assessment and Infiltration Test: No non-direct measurements will be taken for this task.

C. Stormwater Modeling: Existing pertinent GIS data will be acquired and organized in an ESRI file geodatabase. Data will be used to inform BMP design. Associated metadata will be reviewed to ensure data quality. This data includes but is not limited to:

- rivers and streams
- river corridors
- wetlands
- topographic data
- impervious cover
- stormwater infrastructure
- State stormwater permits
- Act 250 permits
- watershed / subwatersheds for the Mad River
- road centerlines
- parcel boundaries
- NRCS soils
- Federal Emergency Management Agency (FEMA) floodplains

Data will be acquired from publicly accessible locations such as the VT Agency of Natural Resources Natural Resource Atlas and downloaded from the VCGI Open Geodata Portal. Data layer sources are described in section A7 and all data sources will be provided in final report.

Precipitation data used for modeling will be from NOAA/National Weather Service. For HydroCAD, rainfall data will be obtained from NOAA Atlas 14, Volume 10, Version 2, point precipitation frequency estimates (http://www.nws.noaa.gov/oh/hdsc/PF_documents/Atlas14_Volume10.pdf). This data (2015 release) is the most current available and is specified in the Vermont Stormwater Management Manual. If newer data compatible to the program of equal or better accuracy becomes available, it will be utilized for this project.

HydroCAD is a well-tested and accepted model that is routinely used for similar BMP design projects. While newer data may marginally improve model performance, the time expenditure and the cost involved in employing a subcontractor to compile this data into a format usable by the modeling software is not within the scope of this project, is infeasible given the project budget, and would not impact the design of the proposed BMPs in any significant way.

B10 – Data Management

Data generated through field activities will be used for developing models as described in previous sections of this QAPP. Watershed QA Officer will be responsible for organization and oversight of data generation, disbursement, processing and storage so that the data will be documented, accessible, and secure for the foreseeable time period of its use. The files will be archived for a minimum of three years following completion of the project.

Instrumentation used to generate, process, and store data will be configured, maintained, and operated in accordance with manufacturer recommendations and accepted industry standards. Generated raw data will be stored in formats compatible with the method or instrument of generation. Processed data will be stored in ESRI Geodatabase, CAD, or HydroCAD format. Electronic data will be stored in project directories on Watershed's computer network and Cloud-based storage repository that is compatible with this software and that is backed up daily. The files will be archived for a minimum of three years following completion of the project.

C – Assessment and Oversight

C1 – Assessments and Response Actions

The Project QA Officer will review all project output. The LCBP QA Program Manager Designee will have the authority to issue a stop work order upon finding a significant condition that would adversely affect the quality and usability of the data. The Project QA Officer will document, implement, and verify the effectiveness of corrective actions, such as an amendment to the QAPP, and take steps to ensure that everyone on the distribution list is notified. Any identified significant conditions or implemented corrective actions will be documented by the Project QA Officer immediately to the LCBP Project Officer and LCBP QA Manager Designee as well as in the quarterly reports and the final report described in section C2. NEIWPCC may implement, at its discretion, various audits or reviews of this project to assess conformance and compliance to the quality assurance project plan in accordance with the NEIWPCC Quality Management Plan.

C2 – Reports to Management

Quarterly reports will be submitted to Lauren Jenness, LCBP Project Officer, per the standard LCBP reporting process for review and approval.

Andres Torizzo, QA Officer will submit quarterly progress reports and a final project report to the LCBP Project Officer. This final report will include a complete discussion regarding the appropriate use and limitations of the data in terms of quality, as well as all datasets developed within the scope of this project. Additional reports or other information related to project status, concerns, completed deliverables, or any other project needs will be provided when requested.

D – Data Validation and Usability

D1 – Data Review, Validation, and Verification Requirements

The data quality will be reviewed for logical consistency and coding errors as identified by experienced professionals trained in all required tasks. The Project QA Officer will be responsible for overall validation and final approval of the data in accordance with project purpose and use of the data.

<u>A. Surveying:</u> Surveyed data will be reviewed by the trained professionals at Watershed to ensure that collected data is in line with existing LiDAR elevation data, aerial imagery, and observed site conditions.

B. Soil Assessment and Infiltration Test: If the soil assessment and infiltration test is required, collected data will be reviewed by experienced and trained professionals at Watershed. Photos of each soil horizon will be reviewed to ensure that classifications represent soil conditions on site. Based on soil characteristics, field-collected infiltration rates will be reviewed by Watershed staff to ensure that the collected rate is in line with the soil texture recorded and represented in photos.

C. Stormwater Modeling: Inputs and results of the HydroCAD modeling will be independently reviewed by at least two water quality specialists at Watershed with advanced training in the model programs. Decisions on whether to accept or reject the data will be based on best professional judgement according to past experience and the specific modeling program guidance, as provided here: http://hydrocad.net/support.htm

D2 – Validation and Verification Methods

The Project QA Officer will provide review and approval of the data before closure of the project. Datasets lacking appropriate metadata will not be used in any analysis or delivered to outside agencies. Documentation of provisional datasets will be reviewed to verify references to the use and limitations of the data.

The Project Manager will review QC reports as applicable to ensure they are acceptable. The Project QA Officer will also compare final datasets with original source information for consistency.

D3 Reconciliation with User Requirements

Once the data results are compiled, the Project QA Officer and Project Manager will review the data quality to determine if it falls within acceptable limits per user requirements. Applicability of the data will be evaluated on a project-by-project basis when necessary. Any known limitations of the data will be discussed with the end user and documented within the project final report. Completeness will be evaluated to determine if the goals of this project has been met. If the quality of the data does not meet the project's requirements, the data may be reevaluated to determine why the data quality did not meet the goals. Efforts will be made to determine inconsistencies in the base data or correct errors in the attribute data. If inconsistencies are found in the quality of the base data, an effort will be made to identify and obtain more accurate base data and will be documented in the final report.

Referenced Methodologies or SOPs

U.S. Bureau of Reclamation (USBR) 7300-89 - Procedure for Performing Field Permeability Testing by the Well Permeameter Method

National Soil Survey Center, Natural Resources Conservation Service, U.S. Department of Agriculture. September 2012. Field Book for Describing and Sampling Soils. Version 3.0. Lincoln, Nebraska.

Blank App Form - Soil Assessment

WATERSHED CONSULTING

Site Name

Created	2020-02-18 14:34:11 EST by Kateri Bisceglio
Updated	2020-02-18 14:41:03 EST by Kateri Bisceglio
Location	44.4565407419991, -73.2179884147581

Site Information

Site Name	Site Name
Pit ID	Pit ID
Site Address	Street Number Street Name City, State Postal Code
Excavation Date	2020-01-01
Start Time	00:00
Assessed by	Assessed by
Sampling Method	Sampling Method
Total Excavated Pit Depth (feet or inches)	Total Excavated Pit Depth (feet or inches)
Depth to Water Table (inches or N/A)	Depth to Water Table (inches or N/A)
Overall Site Notes/Description	Overall Site Notes/Description
Overview Photos of Site and Pit	

No Photo Available

Soil Profile Information

Enter Soil Profile Information Below. Horizon information is recorded in inches from top of pit.

Horizon Start and End (inches or feet)

Horizon Start and End (inches or feet)	Horizon Start and End (inches or feet)

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Soil Horizon Photos (Wet/Dry)

No Photo Available

Soil Structure	Soil Structure
Soil Type	Soil Type
Soil Moisture	Soil Moisture
Soil Color	Soil Color
Redox Features	Yes
Redox Features Coloring	Redox Features Coloring
Redox Features Description	Redox Features Description
Roots Present	Yes
Roots Present Quantity	Roots Present Quantity
Coarse Fragments	Yes
Coarse Fragments Quantity	Coarse Fragments
Coarse Fragment Size (average inches)	0.0
Other Soil Notes	Yes
Other Soil Notes Type	Other Soil Notes Type
Other Soil Notes Description	Other Soil Notes Description

Blank App Form - Infiltration Test

WATERSHED CONSULTING

Site Name

Created	2020-02-18 14:42:32 EST by Kateri Bisceglio
Updated	2020-02-18 14:50:44 EST by Kateri Bisceglio
Location	44.456436986036, -73.2178994397754

Site Information

Site Name	Site Name
Site Address	Street Number Street Name City, State Postal Code
Date	0001-01-01
Time	00:00
Assessed by	Assessed by

Pit ID

Pit ID	Pit ID
General Notes	General Notes
Depth of auger hole (inches)	50
WCU Suspension Height from Bottom of Hole (inches)	8
WCU Suspension Height from Top of Hole (inches)	42
Initial Soil Temperature (degrees C)	35
Soil / Water Temperature at End (degrees C)	37
Photos	

No Photo Available

10

Enter water level (ml) every 10 minutes.

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WATERSHED CONSULTING

Testing for 10 minutes

Testing Time Interval	10
Testing End Time	20
Water level (at start of test or last 10 min reading)	2500
Time of test start for section	00:00
Water Added (1)	Yes
Time Water Added (1)	14:46
Water Level when Adding (1)	500
Volume Added (1)	2000
Drop in Volume (1)	2000
Water Added (2)	No

After 10 Minutes:

Water Level after 10 Minutes	500
Water Drop (1 water addition)	4000