1 Home and Menu Bar

The RainWay tool has several sections to allow homeowners, propery owners and engineers/planners to select GI. The tool consists of the following areas;

1. Homeowners tool that allows property owners to easily select and plan GI projects
2. Engineer's/Planners Tool that allows engineers and planners to use the tool to run various scenarios on selection of GI projects.
3. Regional Map that shows all of the published GI projects
4. Green Solutions an information page on GI projects that can be implemented in the a Pittsburgh area.
5. Green Vendors is a listing of green vendors in the area
6. Help links to the users guide.

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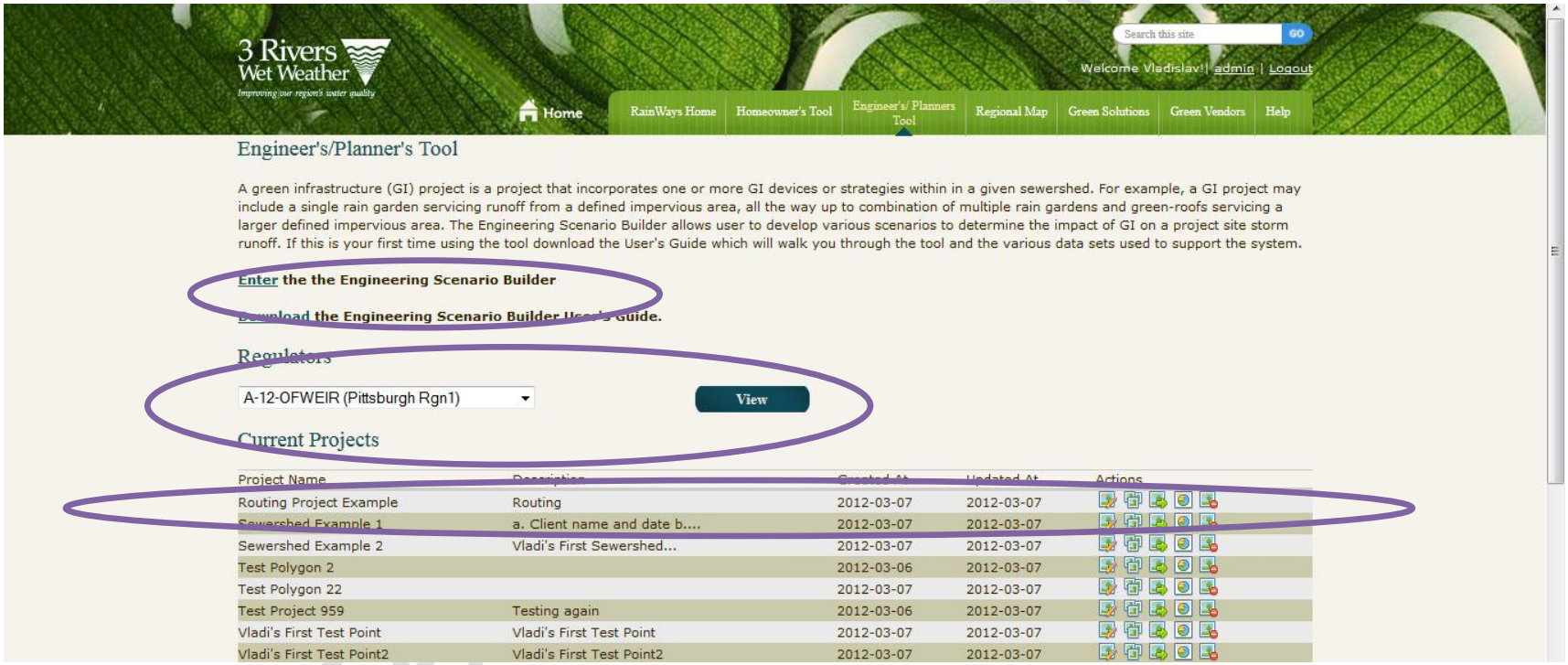
2 Engineering Planning Tool

A GI project is a project that incorporates one or more GI devices or strategies within in a given sewershed. For example, a GI project may include a single rain garden servicing runoff from a defined impervious area, all the way up to combination of multiple rain gardens and green-roofs servicing a larger defined impervious area. The online public interfaces using the web-based map tools will allow user to add a new project and view/edit an existing project, layout local watershed maps.

2.1 Home Page



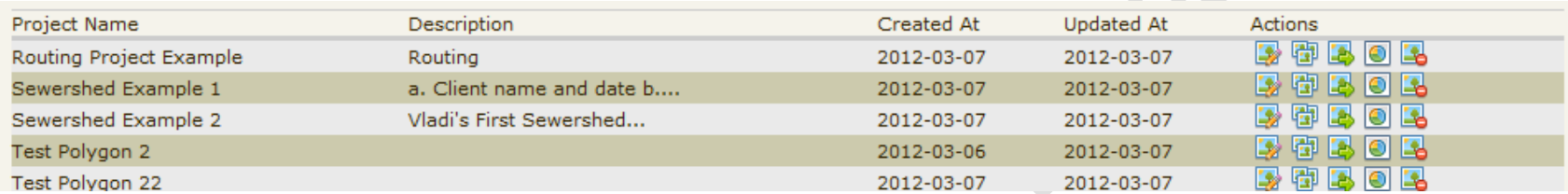
The home page of the tool allows registered users to create project scenarios. A user can either;

1. Enter the Scenario Builder (see Section 3.2)
2. Download the Users Guide

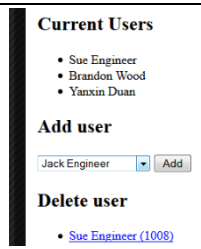
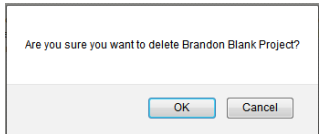
3. Create and View a Regulator Report (see Section 3.4)
4. Edit, Share, Provide Info, Generate Report or Delete an Existing Project.

2.1.1 Current Projects

The current project tables lists all of the projects that are in the system entered in the system and has a user as either an owner or collaborator. A user can either;



Project Name	Description	Created At	Updated At	Actions
Routing Project Example	Routing	2012-03-07	2012-03-07	
Sewershed Example 1	a. Client name and date b....	2012-03-07	2012-03-07	
Sewershed Example 2	Vladi's First Sewershed...	2012-03-07	2012-03-07	
Test Polygon 2		2012-03-06	2012-03-07	
Test Polygon 22		2012-03-07	2012-03-07	

Icon	Description
	Edit – this will open the Scenario Builder window and allow the user to edit an existing project.
	Share – Which allows a user to add a new user or delete existing users. Only the owner of a project can add new users or access share. (See Figure on the left). Use the drop down and Add button and the user will appear in the Current Users List. If user need to delete a user click on the users name below the Delete user list. This will remove the user from the project only not the system. 
	Info links to the Information Forms (see Section 5). This information should be filled out only after a project is active and no longer planned. The form allows users to publish projects to the Green Infrastructure map and add additional information about the project.
	Report links to the report. (see Section 3.3)
	Delete existing projects will remove the project permanently from the system. Only administrators can delete projects. Prior to delete the following pop-up will open and user want to delete the project.  project owners and verify that indeed

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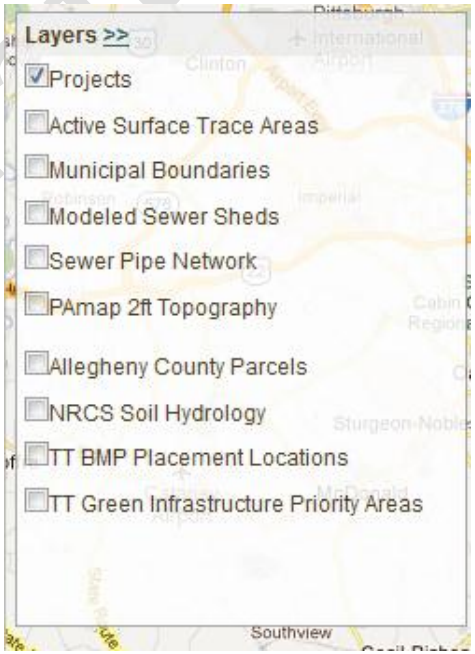
2.2 Scenario Builder

You must be a registered use to enter the Scenario Builder. You can enter the Scenario Builder to either create a new project or edit existing. Once user enter the Scenario Builder interface user will see 2 main windows one is the GI tool frame and the second is the map layers frame. These two panels are the main controls. In addition, the tool has basic Google map controls such as Zoom, Pan, Map/Satellite View and Street View.

2.2.1 Layers Panel

The following GIS data layers are included in the GI Scenario Builder. To view a layer check on the checkbox to the left of each layer name.

Layer	Description
Projects	Listing of all of the projects in the system. You can click on the rain drop icon to view details.
Municipal Boundary	Municipal Boundary to show all of the municipal boundary
Modeled Sewer Sheds	Modeled Sewer Sheds include the approximate 2000 SWMM model sewersheds published by CDM
Sewer Pipe Network	Sewer Pipe Network displays the county sewer network. This layer contains the latest available data for the ALCOSAN waste water system. This layer is a product of a coordinated effort between 3RWW, ALCOSAN, the Regional Basin Planners and the 83 Municipalities within the ALCOSAN service area. This layer is updated every 6 to 9 months.
PAmap 2ft Topography	2 foot topography layer to help users determine site information.
Alleghany County Parcels	Layer to show all of the parcels in the cound
NRCS Soil Hydrology	Soil types for the entire Pittsburgh Area. B, C,D and the quarry/water. The color legend is included to the righ
TT GI Composite Layer	The GI Placement data layer to demonstrate the various GIs that are recommended in a project area. (See Section 6.2)
Green Infrastructure Priority Areas (GIPA)	The Green Infrastructure Priority Areas (GIPA) layer shows the priority areas for GI. (See Section 6.1)



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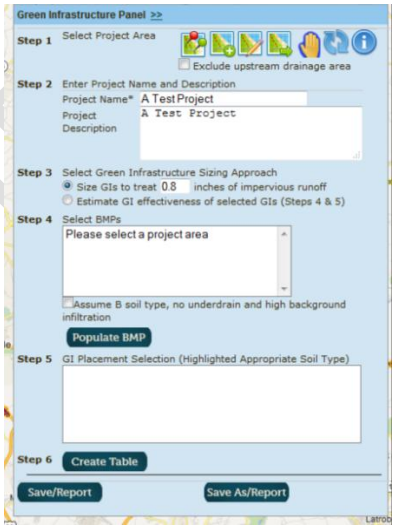
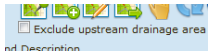
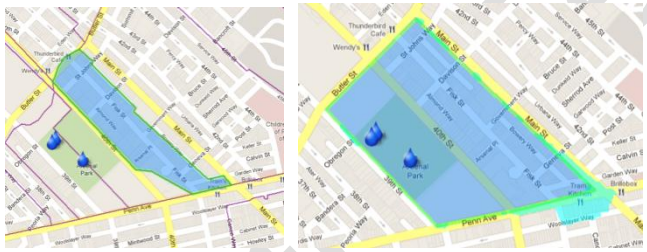
2.2.2 Green Infrastructure Panel



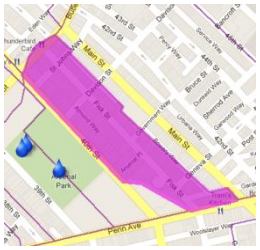
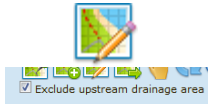
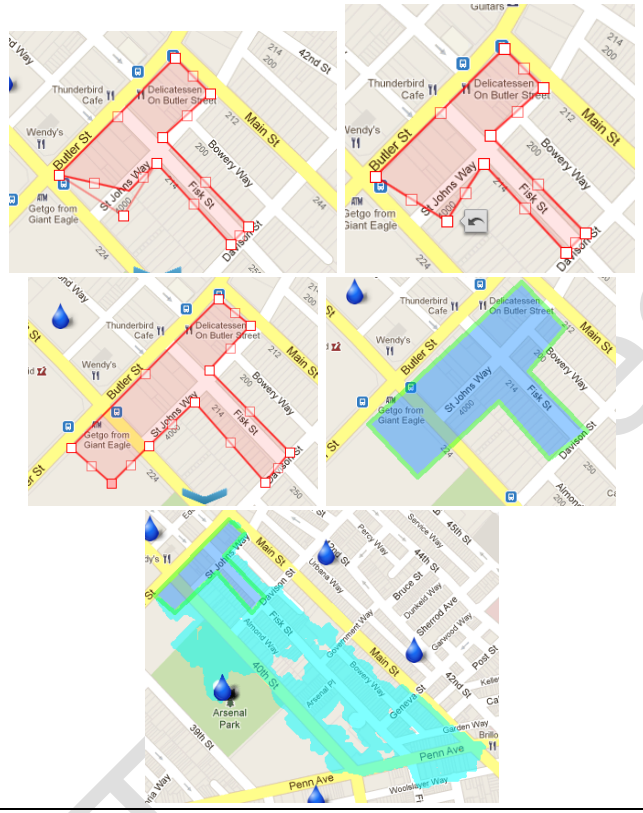
The GI Panel is used to select project area and populate the GI information based on the GI Composite Layer.

1. Step 1. Select your project area by drawing a polygon, selecting a point or selecting a sewershed and determine if you want to exclude upstream drainage.
2. Step 2. Enter Project Name and Description.
3. Step 3. Select whether user would like to treat a specific storm event (1-3 inches) or allow the system to determine the storm event control based on the GI sizes
4. Step 4. Is the list of GIs that returned based on the selected project area.
5. Step 5. Is the specific location and number of GI groupings in a project area.
6. Step 6. The user creates the table to populate the information for drainage quantity to a particular GI.

2.2.2.1 Step 1. The first step is to select your project area.

Icon	Example	Description
		**First step is to determine if user would like to include drainage just inside your project or include both inside and contributing upstream drainage.** This option only applies to when a user draws the project area based on a polygon. The first example inside only the second includes contributing. This step determines the amount of area that drains to various GIs. If user select inside only the drainage from inside the project area will count towards the flow to a GI. If user do not select both the tool will also take into account contributing flow to the project site based on the hydrologic delineated area.
		The first is **delineated based on a small polygon created by the system**. Regardless if the user selects Inside only the system will always return contributing. This option is primarily used to determine flow amounts to a specific GI. The first step is to click the icon and then place on a specific location on the map. Next click dealinate to dealinate the area that drains to that specific spot.

Branch Draft

		The next to **select a modeled sewershed**. Regardless if the user selects Inside only the system will always return inside only because each sewershed is treated as a unique hydrology and therefore do not include contributing. This option is good for planners that want to determine the GI scenarios to control flow within a sewershed. First the user clicks on the icon and then select the sewershed that user would like to work with. Next click delineate to delineate the area.
		**Draw a project polygon** allows the user to draw a polygon around their project area. Note that the inside check only works for this option. First the user clicks on the icon then clicks on the map to draw the polygon nodes. They will be automatically connected as user draw. The user may click on a vertices and move it if it was not placed correctly. Once the user is finished they click the dealinate to dealinate the area. The example on the left shows both inside and contributing calculated.
	See Examples Above	**Once a user selects a project area they click dealinate.** This queries the spatial database and returns the hydrologic response unit distribution and recommended GIs.

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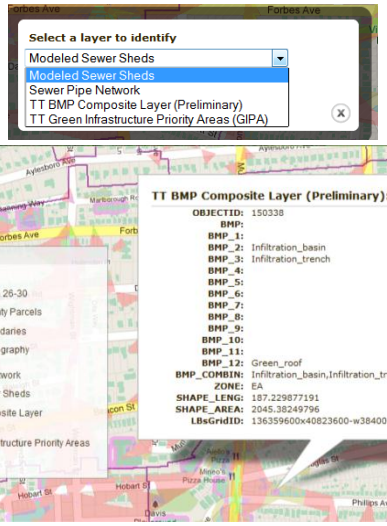
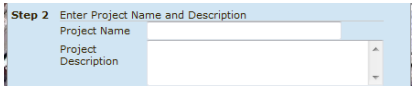
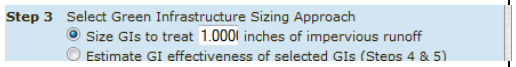
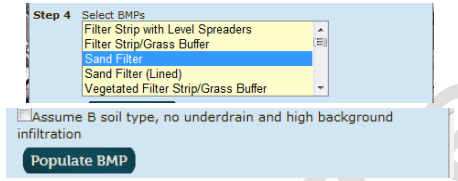
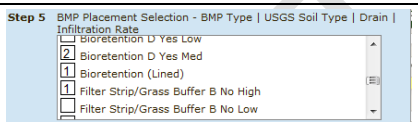
		**The identify button** helps the user view specific data in various layers in the scenario builder. These layers can help in making decision on GI placement or view specific information on the map. Click on the icon, select a layer and click on the map. To switch layers click on the icon again and select a different layer.

2.2.2.2 Green Infrastructure Panel Steps 2-7.

Example	Description
	**Step 2** a user enters in a unique project name, project description and notes. The description should include information about the project and basic information such as; Client Name and Date, Engineering Company Name, Political Subdivision and Assumptions Used/Notes.
	**Step 3** a user can either select a Treatment Depth for a particular storm event or allow the system based on GI sizing to determine the controlled storm event. Following Step 6 when the user creates the table if they choose to determine the GI effectiveness based on size the user will be presented with the chance to enter GI sizes for each GI selected.
	**Step 4** includes the list of GIs to select from. Once user dealinate the project area the listing of GIs will appear. The first highlighted set of GIs are those recommended based on the GI Placement Layer. The rest a user can still select but were not included in the recommendation. Once user select your GIs click Populate GI to fill in the table for Step 5. Finally if a user wishes to use engineering standards only they can select the checkbox underneath the drop down to filter values for B Soil Type, No Underdrain and High Background Infiltration.
	**Step 5** includes the GIs selected based on USGS Soil Type, Drain and Infiltration Rate. Some GIs such as Bioretention Lined, Green Roofs only have a single GI listing. These GIs correspond to the performance curves described Section 6.3. The system filters the list based on the predominant soil type in the selected area. These are listed first and highlighted in green.

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	For each GI the user selected in the previous step the user can enter the number of each type of GI the user would like to include in their project area. Since the tool allows for routing (see Step 7) we recommend that user only include multiple numbers of a specific type if user wishes to route. The tool uses an aggregate approach for GI determination therefore to make scenario building easier the user should aggregate the GIs to make it simpler to route specific volume percentage to those GIs.
	Step 6 is the final step prior to filling out the drainage table. Click create table once user have selected your GIs and entered the number. Note that each time user create the table it will clear out your previous table entries.

Step 7 Drainage Table

Step 7 is the drainage table and where the user routes flow to each GI. The system allows a user to show hide the table by clicking on the arrow highlighted in red below.

1. The table allows a user to specify for each Hydrologic Response Unit (see Section 6.2 for listing) a specific volume percentage. Each HRU is associated with a specific volume which allows the tool to calculate the flow from each HRU.
2. Shows the area in acres for each HRU per a specific sewershed. In the example below the project area spans 2 sewersheds.
3. The columns after the sewershed correspond to the GI Types, Soil, Drain and Infiltration Rate selected in Step 5. The corresponding GI reference numbers helps count the GIs and is used in the routing information.
4. Next the user can route GI flow from one GI to another. This step is more critical when selection the second option under Step 3 since in this step the system always users to size the GI according to the flow it needs to capture. With the first option the GI will always be sized to capture the entire flow going to the GI.
5. Next the user can size GIs, this option is only available if the users selects the second option under Step 3. This allows a user to enter the acres of GI used on the project to determine the size of control.
6. The final step is to route a specific volume percentage per HRU to each GI.
7. As a user is entering the volume percentage in the step above the system shows the remaining overflow percentage existing the project area.
8. Finally each project is divided among the modeled sewersheds. The name of the sewershed is included here.

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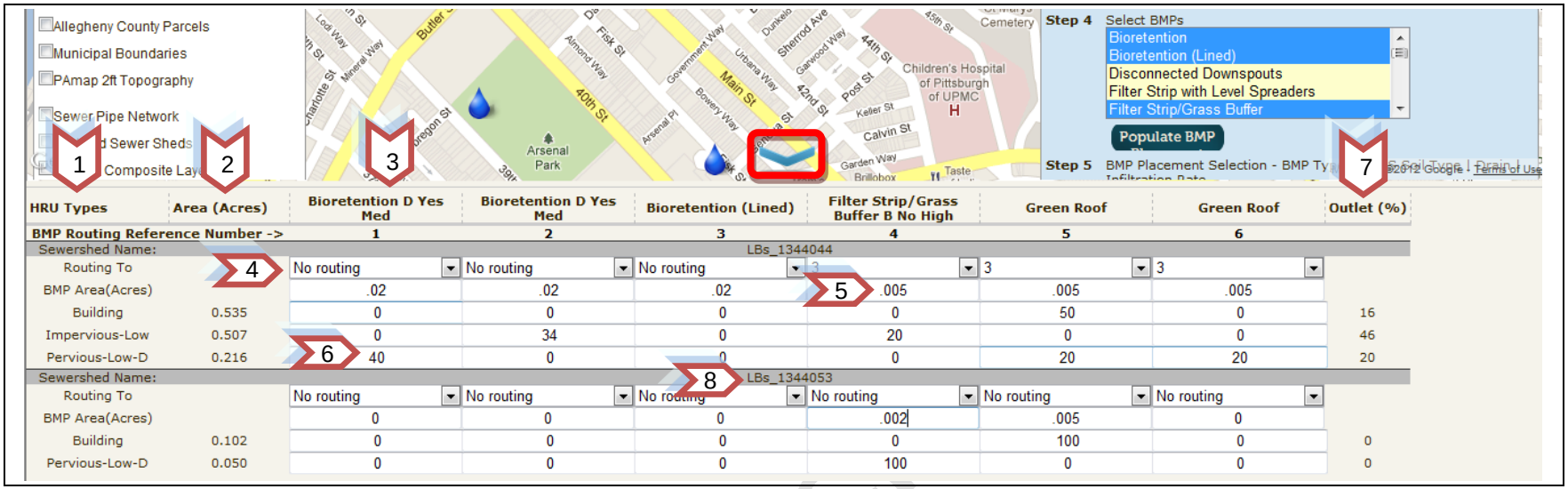
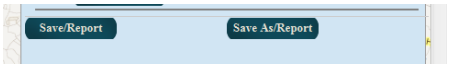


2.2.2.3 Saving Projects

Example	Description
	Once the user has completed the scenario the user has 2 options; either saves the scenario or a save as which will allow the user to save the scenario as a new record to compare the scenario to other scenarios. The system will require the user to rename the project scenario to a unique name. Once the user has clicked the user will open the report and can view/print. See Section 3.3 for report details.

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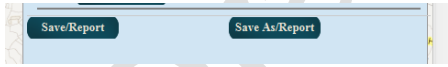
2.3 Project Report

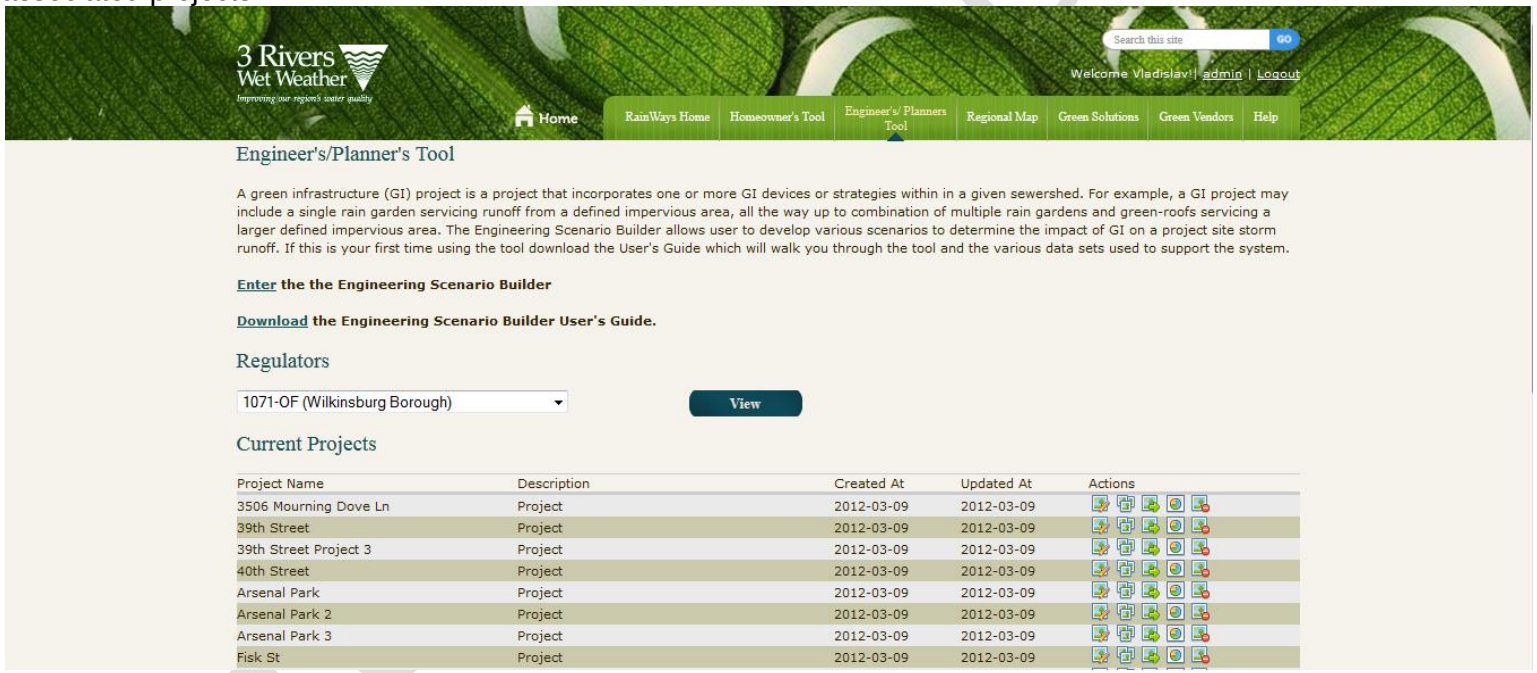
The project report summarizes project information, site characteristics, GI performance and configuration, and cost information. GI performance is calculated based on EPA SUSTAIN derived performance curves for the City of Pittsburgh.

2.3.1 Accessing the Report

There are 2 ways to access the report.



1. Clicking the saves/report or save as/report button on the GI Panel
2. Through the Engineering/Planning Tool home page. Users that collaborate with a project owner can see the report for their associated projects.

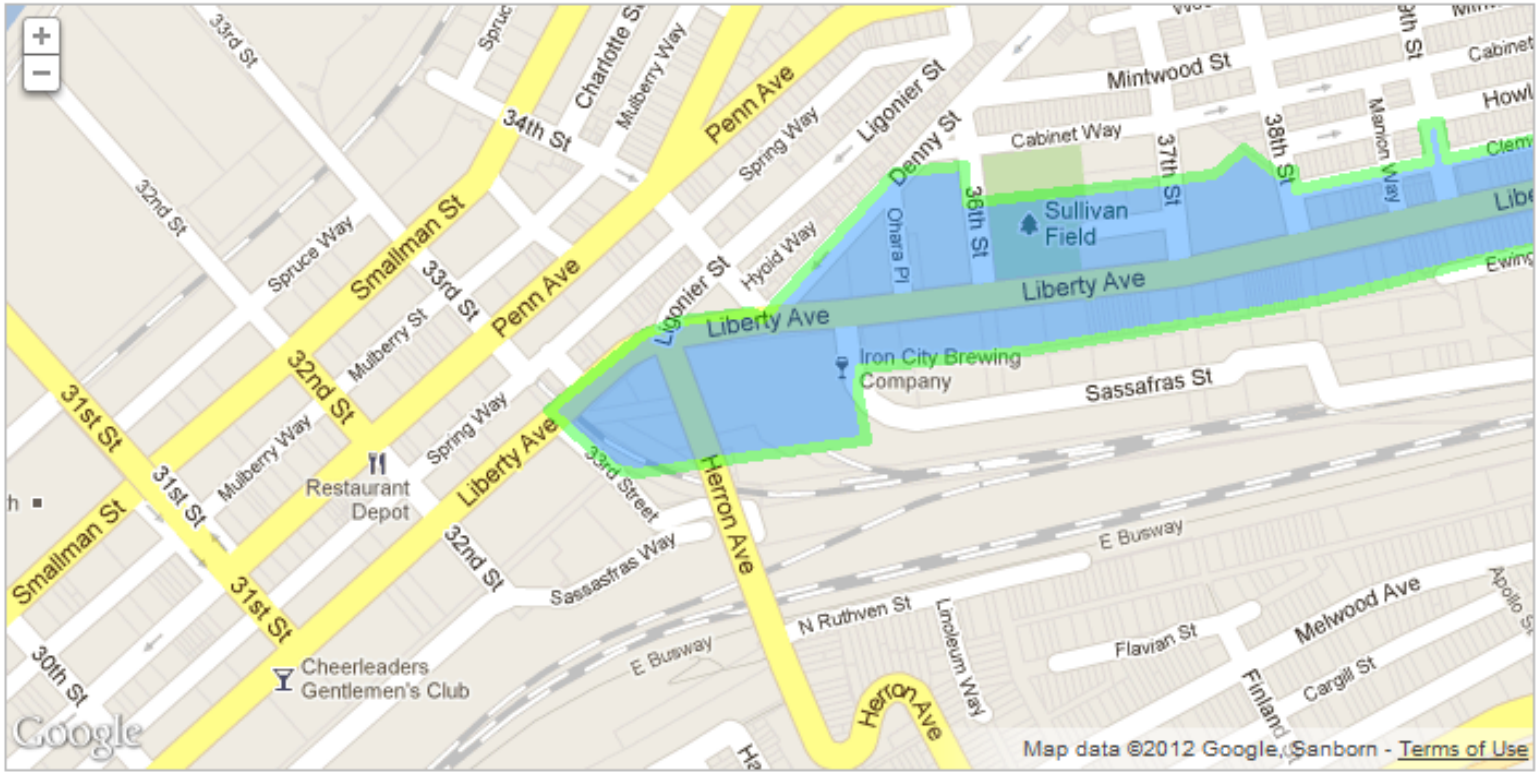


2.3.2 Report Content

Introduction and Project Description
Description and Calculations
The project name will appear at the top of the project report. This name should be descriptive enough to differentiate it from other projects. The user is allowed to define a project description while creating his or her project. Some recommended project descriptions items include: a. Client name and date b. Engineering company name c. Political subdivision d. Assumptions used e. Note
Description and Calculations
Print this page **Sewershed Example 1** **Introduction** The project report summarizes project information, site characteristics, BMP performance and configuration, and cost information. BMP performance is calculated based on EPA SUSTAIN derived performance curves for the City of Pittsburgh. **Description** a. Client name and date b. Engineering company name c. Political subdivision d. Assumptions used e. Notes
Project Setting
Description and Calculations
A project map showing the project area and/or drainage area is displayed below the description.
Screen Shot

Draft

Project Setting



Site Characteristics

Description and Calculations

Site characteristics relate to the selected project area in the engineering tool. These are general cost and spatial facts about the project, including:

a. Project size (area within the sewershed or delineated polygon or point)
b. Total project cost (includes construction and O&M costs for all GIs in present dollars)
c. Priority area ranking (GIPA) **(See Section 6.1 for details)**
d. Treatment depth or equivalent treatment depth

e. Total impervious area within the project area
f. Point of connections (POCs) and regulators that are part of the project area or drainage area
g. Municipalities that are part of the project area or drainage area

The **treatment depth** is the surface runoff depth over the contributing impervious drainage area to the GI. It could be the design depth of first flush that needs to be captured by the green infrastructures. The GI performance curves were developed considering all three factors; impervious drainage area, treatment depth, and GI capacity. The GI capacity is calculated based on the provided impervious drainage area and the treatment depth. If the GI capacity is given then based on the provided drainage area the treatment depth is calculated. All these three factors are dependent to each other.

POCs are shown as their codes with the associated sewershed code in parentheses (e.g. "A-23-00 (LBs_1344156)"). The sewershed code can be found via the identify tool on the scenario builder tool.

Screen Shot

Site Characteristics

Project size: 26.424 acres

Total project cost: $5,400,000

Priority area ranking: Medium-High (5.73/10)

Equivalent design depth: 54.24 inches

Total impervious area: 10.482 acres

POC(s)/Regulator(s): A-23-00 (LBs_1344156)

Municipalitie(s): Pittsburgh Rgn1

Sewershed GI Performance

Description and Calculations

The sewershed GI performance table shows all GIs per sewershed that were selected by the user in the engineering tool. The HRU flow distribution is shown for each HRU and GI in each sewershed and summarized graphically at the end of each line as a small pie chart.

The colors in the pie chart correspond to the GIs and effluent colors shown in the next section's pie chart legend. The screenshot below shows 25% flow allocation to two GIs (blue and yellow) and 50% which is not routed to GIs (green).

Impervious-Mod	0.117	0.3	25% flow	25% flow

Additionally, GI effectiveness and reduction are shown. Effectiveness is calculated to be the percent reduction of the total flow in the sewershed relative to the volume reduction of the GI, regardless of the flow distribution to the GI. For example, if there were a bioretention basin that received 50% of the sewershed's flow and reduced this flow by 50%, the GI effectiveness for that bioretention basin would be 25%.

Screen Shot

Sewershed BMP Performance

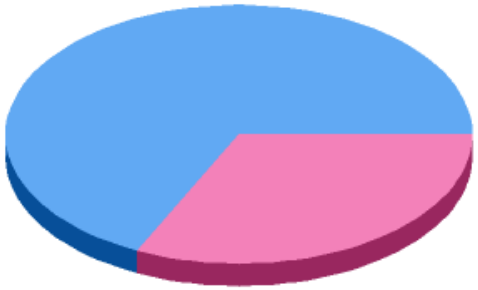
Sewershed	HRU	Acres	Annual flow from HRU (acre-ft)	Bioretention C Yes Med (1)	Bioretention D Yes High (2)
CDM_1348459	BMP Capacity			53765 gallons	53765 gallons
	Impervious-High	0.076	0.2	25% flow	25% flow
	Impervious-Mod	0.117	0.3	25% flow	25% flow
	Impervious-Low	0.115	0.29	25% flow	25% flow
	Pervious-High-D	0.03	0.01	25% flow	50% flow
	Pervious-Mod-D	0.096	0.03	50% flow	25% flow
	Pervious-Low-D	0.115	0.03	10% flow	78% flow
	Percent BMP Effectiveness			25.34%	26.97%
	BMP Runoff Reduction			0.22 acre-ft	0.23 acre-ft
	BMP Capacity			5377 gallons	5377 gallons
	Impervious-Mod	0.11	0.28	0% flow	4% flow
	Pervious-High-D	0.132	0.04	5% flow	6% flow

Project GI Performance

Description and Calculations

Project GI performance summarizes the overall reduction of the project across all selected sewersheds and GIs. If GI flow is being routed between GIs, only GIs routing to no other GI are considered in this overall reduction calculation.

The first chart will always show the volume of runoff that is reduced by the selected GIs and the subsequent net runoff or effluent.



The second chart shows the distribution of reduction across the GIs in addition to flow that routed through the GIs that is untreated by the GIs (effluent). These colors correspond to the HRU flow distribution pie charts in the Sewershed GI Performance table discussed in the previous section.

Screen Shot

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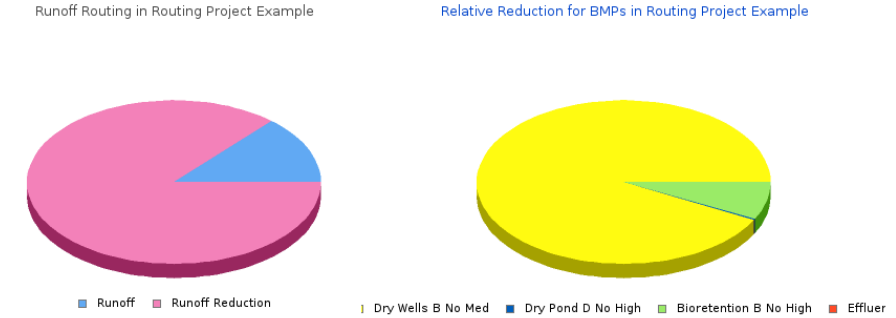


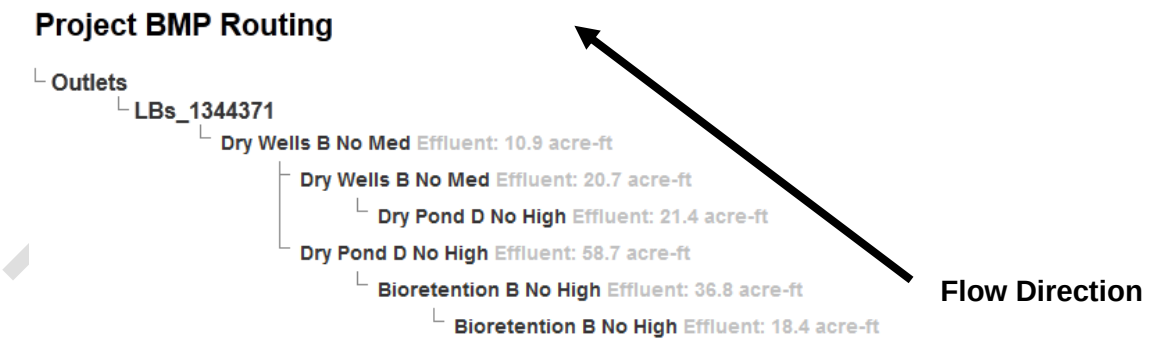
Total Runoff pre-BMP	87.92 acre-ft
Total Reduction	86.6 %
Total Runoff Captured	76.14 acre-ft
Total Outlets	11.78 acre-ft

Project GI Routing

Description and Calculations

The scenario builder allows for the user to route flow between GIs. When flow is routed from one GI to another, 100% of the effluent of the upstream GI is routed to the downstream GI, in addition to any HRU flow contribution to the downstream GI. It is the responsibility of the user that flow is routed in only one direction. This routing is displayed graphically with effluent values routed between GIs in the Project GI routing section. It is important to note that flow is shown in the order of most downstream to most upstream.

Screen Shot



Project Cost

Description and Calculations

Project GI costs are broken down into two categories: construction and operations and maintenance (O&M). Construction costs are based on data from San Diego, California and adjusted by Engineering News-Record (ENR) construction cost index ratios between San Diego and Pittsburgh (this ratio is defined to be 1.14). O&M costs are calculated at present value based on a 3% interest rate and the given GIs design lifespan (typically 20 years).

All costs are based on a unit cost per area and calculated based on GI size. The present value is calculated using the following equation:

$$P = A\frac{(1+i)^N}{\left(i+(1+i)^N\right)}$$

Where *P* is the present value, *A* is the annual O&M cost in present value, *i* is the interest rate or inflation rate and *N* is the number of years or design lifespan of a given GI.

For drainage areas to a GI exceeding 1 acre, a power function is used to account for economy of scale. The coefficients and exponents of this power function are given in the cost Appendix of this manual.

Screen Shot

Project BMP Cost

Sewershed	Green Infrastructure BMP	Construction Cost	O&M Costs (total, present value)	Lifespan (years)	Total Cost
LBs_1344371	Dry Wells B No Med	$1,300,000	$60,000	20	$1,400,000
	Dry Wells B No Med	$1,300	$60	20	$1,400
	Dry Pond D No High	$190	$4	20	$190
	Dry Pond D No High	$190	$4	20	$190
	Bioretention B No High	$1,000	$72	20	$1,100
	Bioretention B No High	$1,000	$72	20	$1,100

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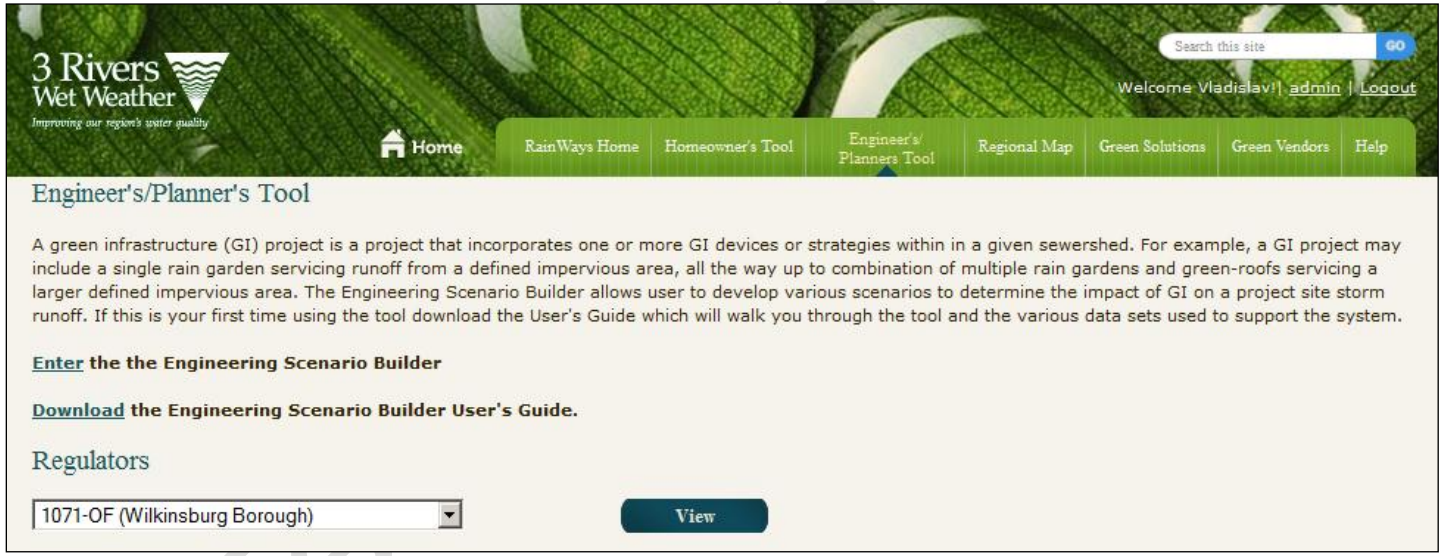
2.4 Regulator Report

In order to aggregate all published projects in the RainWays tool, the regulator report calculates the total reduction of published green infrastructure projects into a high level view on stormwater reduction as it relates to combined sewer overflow (CSO) prevention.

2.4.1 Accessing the Regulator Report

The regulator report can be accessed in the Engineer's/Planner's tool home screen. This lists all regulators that currently have projects associated within them. Additionally, the associated municipality with each regulator is shown in the list. To view a regulator report, simply select a regulator from the drop down and press **View** to bring up the regulator report.



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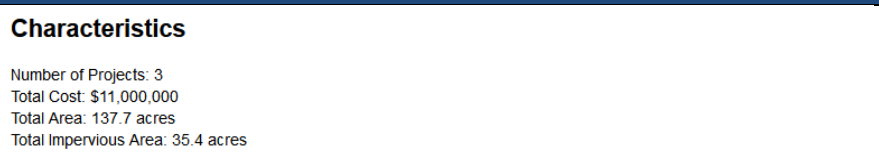
2.4.2 Report Content

Project Setting
Description and Calculations
The name of the regulator appears at the top of the report with a brief description that explains the purpose of the report.
Screen Shot
Site Characteristics
Description and Calculations
The characteristics section provides a high level view of the regulator, including the number of projects within the regulator, the sum cost of those projects (including O&M costs over the project lifespan), total area as well as the total impervious area of the area.
Screen Shot

System Assessment
Description and Calculations
For each regulator, system assessment curves have been developed that estimate the number of CSOs in a given year with various levels of volume reduction. These curves are presented in the system assessment table. Overflows are shown as a function of depth reduction in inches. This curve is then linearly interpolated to estimate the number of CSOs reduced given the green infrastructure project configuration for that regulator.
Screen Shot

System Assessment

POC	Reg. ID	0.00"		0.02"		0.05"		0.10"		0.30"		0.80"	
		Overflows	Volume	Overflows	Volume	Overflows	Volume	Overflows	Volume	Overflows	Volume	Overflows	Volume
A-26-00	A-26-OFWEIR	52	10.00000	51	10.00000	51	10.00000	45	9.47660	36	7.34629	32	4.71887

GI Performance

Description and Calculations

The Green Infrastructure Performance section provides a high level view of each project in a regulator area, including project name, size, total flow, the number of GIs and their overall performance.

This information is then summarized into a total reduction for areas draining to the given regulator. This reduction is then used to estimate the CSO reduction based on the system assessment curve presented in the previous section. Additionally, volume reduction estimates are provided to show the load to the storm sewer network draining to that regulator.

Screen Shot

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Green Infrastructure Performance

Project	Area (acres)	Total Flow (acre-ft)	Number of GIs	GI Reduction (%)	GI Volume Reduction (acre-ft)
Arsenal Park	6.2	2.3	3	78.4	2
Arsenal Park 2	6.2	2.3	3	78.4	2
Arsenal Park 3	6.2	2.3	3	78.4	2
Penn Ave	6.2	2.3	3	78.4	2
40th Street	6.2	2.3	3	78.4	2
Geneva St	6.2	2.3	3	78.4	2
Fisk St	6.2	2.3	3	78.4	2
39th Street	6.2	2.3	3	78.4	2
39th Street Project 3	6.2	2.3	3	78.4	2
Ater Way 2	6.2	2.3	3	78.4	2
My House Project 2	6.2	2.3	3	78.4	2
3506 Mourning Dove Ln	6.2	2.3	3	78.4	2
Total runoff pre-green infrastructure	38 acre-feet				
Total Reduction	98.7 %				
Total Runoff Captured	37.72 acre-ft				
Total Outlets	0.49 acre-ft				
Number of CSOs prevented	52 (100 %)				

Project GI Cost

Description and Calculations

While costs are summarized for all projects in a given area in the regulator characteristics section of the report, specific costs for each project are also presented. These costs are calculated using per unit area costs for each GI in each project, as well as present value O&M costs over the lifespan of the projects.

Screen Shot

Project Costs

Project	Construction Cost	O&M Costs (total, present value)	Total Cost
Arsenal Park	$46,000	$3,200	$49,000
Arsenal Park 2	$46,000	$3,200	$49,000
Arsenal Park 3	$46,000	$3,200	$49,000
Penn Ave	$46,000	$3,200	$49,000
40th Street	$46,000	$3,200	$49,000
Geneva St	$46,000	$3,200	$49,000
Fisk St	$46,000	$3,200	$49,000
39th Street	$46,000	$3,200	$49,000
39th Street Project 3	$46,000	$3,200	$49,000
Ater Way 2	$46,000	$3,200	$49,000
My House Project 2	$46,000	$3,200	$49,000
3506 Mourning Dove Ln	$46,000	$3,200	$49,000

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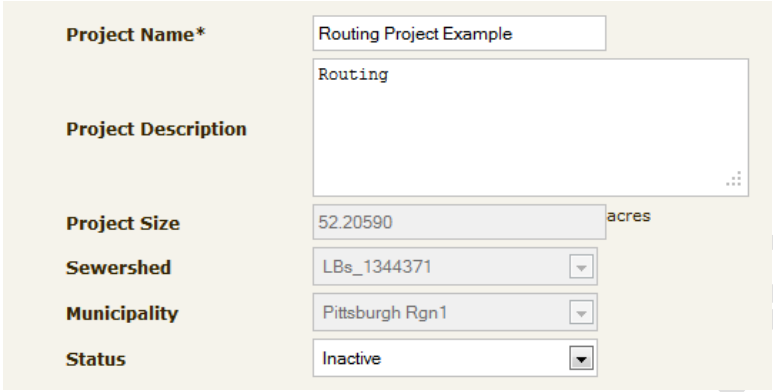
3 Green Infrastructure Metadata Forms

The GI metadata forms allow users to enter additional information about implemented projects that were entered through the homeowners or engineering/planning tool. Users can enter information about either a project or a GI located on the project. Any information collected in the homeowners or engineer tool will be prepopulated in these forms. In addition, administrators can add new projects through the forms that have not been entered in the homeowners or engineering/planning tool.

3.1.1 Project Forms

Screen Shot	Description
	The first section is the project general information. The project name is required. For those projects that were entered through the engineering and homeowners tool the data for project name, project size, sewershed and municipality will already be entered. For these projects the user can only change the project name, project description and status. All other data elements will need to be changed through the engineering or homeowner tool. For new projects both the sewershed and municipality is required. Project name is also required.
	The second section is the contact information for the project.

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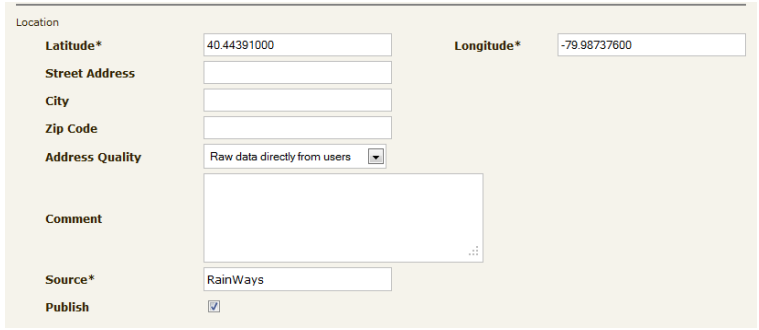
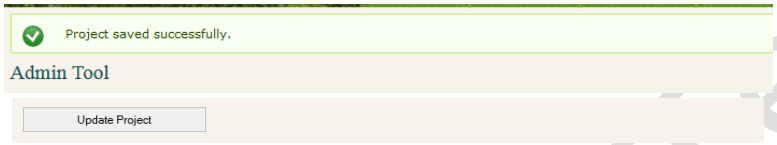
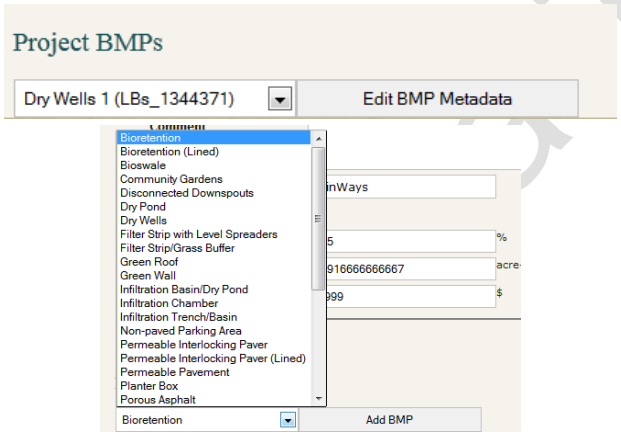
	The third section is the locational information and source. The latitude and longitude will be prepopulated for those projects entered through the engineer and homeowners tool. These fields are required. Address quality refers to how the location of the project was determined. For engineer and homeowners it is always set to Raw data directly from users Comments is a place to enter all of your notes and any additional information Source is the source of the project. For engineers and homeowners it gets set to RainWays but the user can change the default here. This field is required. The last field is whether the user would like to publish the project on the GI Map.
	For those projects entered only through these forms and not through the homeowners and engineering tool the user has the option to enter the reduction percent, reduction volume and a total cost.
	Once user are complete they can save the project. If all required fields are entered into the database and in the correct format user will received a successfully add message. Otherwise the user will receive a message about the errors on the page.
	Once user have added a project if the project was initially created in the engineering or homeowner's tool user will see the GI projects and the ability to edit metadata. Those projects added through the engineering and homeowner's tool cannot have new GIs added but must added metadata to existing GIs in the project. To add a new GI the user must go back to the engineering or homeowner's tool to enter the information. If users are entering projects directly into this form and not through the other tool, once the user click add project the user will see the list of GI to add to the project. Select the GI and add to the project. Once user add it click Edit GI Metadata to enter information about the GI.

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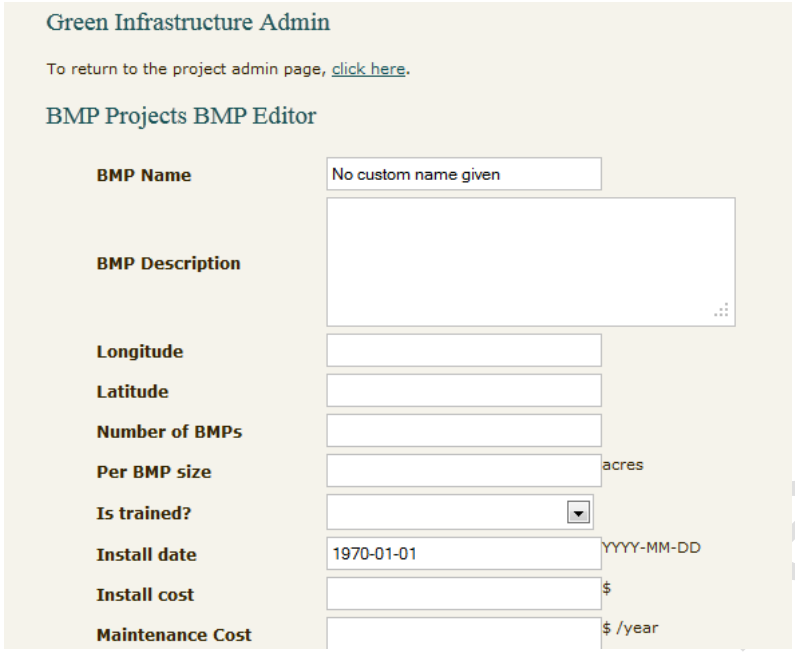
3.1.2 Green Infrastructure Forms

Screen Shot	Description
	Once a user has added a project they are ready to add GIs to the project. The system only requires the GI Name to be added the rest of the data is optional. The longitude and latitude information for a GI is the location of GI on the project site. This is only applicable if multiple GIs exist on a project site. Is Trained is an indicator if the GI is linked together in a treatment train. Installation and maintenance cost should be entered in present value terms.

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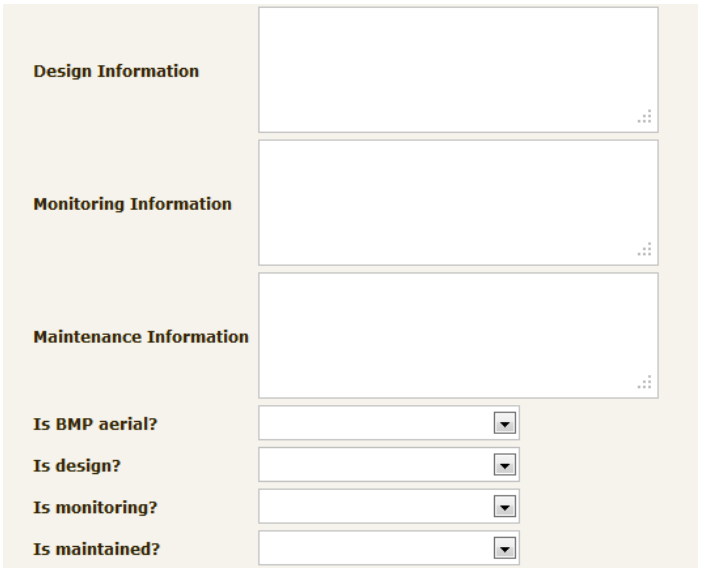
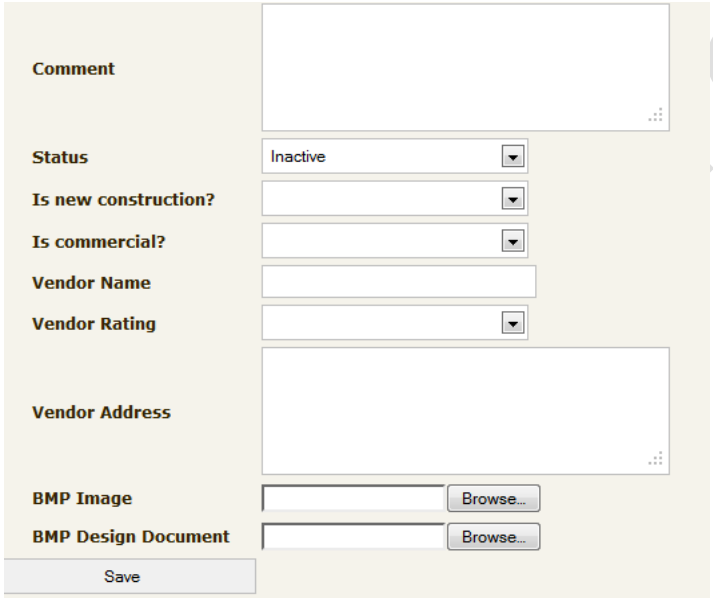


The following is information about the design, maintenance and monitoring for the GI project. The system also allows users to upload design documentation if required.

User can also simply indicate whether;

- The GI was visible by aerial photography
- The GI is designed based on specifications
- The GI is currently being monitored for performance
- The GI is being maintained based on recommended maintenance programs.



The last set of details allow users to enter comment information, the current status of the GI project.

Next the user enters whether this is new construction or retro fit and if it is a commercial or residential GI.

Finally the vendor information is entered.

In addition, to text the system allows a user to upload an image of the GI and any design documentation.

Once the user is done they click Save and then will see a Successfully Submitted message or an error message if something was not properly entered.

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