Stormwater Retrofit Cost-Effectiveness and Feasibility (RCEF) Analysis Methods and Timing

The 2014 *Highway Runoff Manual* (HRM) *Section 3-4.1* requires projects in the Puget Sound basin that have TDAs that exceed runoff treatment or flow control thresholds to retrofit existing impervious surfaces and existing pollution generating impervious surfaces (PGIS) for runoff flow control and treatment. Projects can retrofit existing impervious surfaces and existing PGIS up to a cost equal to 20% of the cost of meeting stormwater requirements for the new impervious surfaces and new PGIS (i.e., *20% cost obligation*). Projects also have the option to meet the 20% cost obligation as much as feasible and transfer funds equivalent to the unmet balance to fund offsite standalone stormwater retrofit projects. Medium and low priority retrofit project have a third option which is to transfer the full 20% cost obligation to fund stand-alone stormwater retrofit projects. Projects must use this assessment process (referred to as the "RCEF analysis") to determine the amount of money to request during scoping and again during the design phase. As such, it has two distinct phases:

- **Phase 1** occurs during project scoping. This phase involves estimating how much additional funding needs to be programmed by the project to meet the requirements of retrofitting the existing impervious surfaces and existing PGIS falling within the project limits.

- **Phase 2** occurs during project development near 60% project design completion. This phase refines the cost estimate generated in Phase 1. This information will be used to help further refine the percentage factors used to generate estimates in Phase 1. In addition, this information will be used to:
    - Determine if treating the existing impervious surfaces and existing PGIS within the project limits is feasible and cost effective; or
    - If not feasible or not cost effective, determine how much flow control and runoff treatment for existing impervious surfaces and existing PGIS can be done on the project up to the *20% cost obligation*; or
    - If not feasible or not cost effective and the project is in a medium or low priority stormwater retrofit location, determine how much funding will be transferred to the standalone stormwater retrofit fund.

This procedure, prepared under the direction of the Stormwater Policy Committee (SPC), provides guidelines for complying with mandatory retrofit requirements for the Puget Sound Basin described in *Section 3-4.1* of the HRM.

RCEF Phase 1 (SCOPING)

The *RCEF Phase 1* Analysis generates an estimate of the amount of funding that should be added to the total project cost to meet the requirements of *Section 3-4.1* of the HRM. The scoping team shall use *Equation 1* during the project's scoping phase to calculate the amount of funding to commit to meet the project's stormwater retrofit obligation. The cost amount determined from *Equation 1* shall be added to the scoping estimate and reported in the project summary.

$$\left(\frac{(A\times B)\text{urban}}{100}+\frac{(A\times B)\text{semi-urban}}{100}+\frac{(A\times B)\text{rural}}{100}\right)\ \text{x C} = \textit{additional stormwater retrofit cost} \quad \textbf{\textit{(Equation 1)}}$$

A = Predominant land use percentage factor (see Table 1)
B = Percentage of total project area
C = Project's total PE, Construction, and ROW estimated cost

Table 1 Predominant Land Use Percentage Factor

Percentage Factor	Project's Predominant Land Use
0.02	Urban
0.01	Semi-urban
0.005	Rural

Urban refers to areas within city limits. *Semi-urban* refers to areas beyond the city limits, but within an Urban Growth Area (UGA). *Rural* refers to areas outside the UGA. The UGA is available in ArcGIS on the environmental workbench.

RCEF Phase 2 (Project Level)

The project office will complete the *RCEF Phase 2 Analysis* for all projects prior to completing the Master Deliverables List (MDL) Milestone PE.PD.22.05 "*Hydraulic Report Approved*", which generally occurs around the 60% project design completion per the *Deliverable Expectations Matrix* found at: (http://www.wsdot.wa.gov/publications/fulltext/ProjectMgmt/DEM/DE_Matrix.pdf).

The *RCEF Phase 2 Analysis* prepares an estimate of the total cost for providing flow control and runoff treatment for the project's *new impervious surfaces and new PGIS* and the total cost for providing flow control and runoff treatment for the *existing impervious surfaces and existing PGIS* within the project limits. Both estimates are based on meeting the project's HRM Minimum Requirements. Refer to HRM *Section 3-4.1* for minimum requirements and retrofit obligation information.

The *RCEF Phase 2 Analysis* shall include costs for items in the project for the stormwater flow control and runoff treatment BMP design as well as those conveyance costs directly related to the stormwater design. It shall also include stormwater costs associated with preliminary engineering (PE), construction, and right of way (ROW). Stormwater conveyance costs include bid items associated with the conveyance of stormwater to the BMP and to the eventual discharge point. For example, costs would include the catch basins, pipes, and excavation for those structures conveying stormwater to the BMP and then to the eventual discharge location, which could be a city or county conveyance (e.g., storm sewer) system (pipe or ditch), receiving water body, dispersion area, or infiltration BMP.

Costs to exclude from the *RCEF Phase 2 Analysis* include those dealing with the designs of culverts passing off-site flow, pipe and ditch systems passing offsite flow, and fish passage barriers.

For projects in high, medium, and low stormwater retrofit priority locations[1], the project team shall use the *RCEF Phase 2 Analysis* to determine if sufficient funds exist in the project budget to meet the project's retrofit obligation (see *Example 2*). The project will need to submit a funds request if the amount programmed into the project as a result of the *RCEF Phase 1 Analysis* is insufficient. If the amount of money programmed into the project as a result of the *RCEF Phase 1 Analysis* exceeds that which is needed to fulfill the project's retrofit obligation, then the project office would follow standard procedures for posting positive budget variances.

The project team shall include the *RCEF Phase 2 Analysis* results in the project's hydraulic report. The project office shall submit the below information directly to the HQ Hydraulics Office, Attention: Highway Runoff Program Manager (mail stop 47329):

- Total estimated cost (sum of the preliminary engineering, right of way, and construction costs) from the original Project Summary,
- Total cost of providing flow control and runoff treatment for the new impervious surfaces and new PGIS in the project (determined in RCEF Phase 2)
- Total cost of providing flow control and runoff treatment for the all of the existing impervious surfaces and existing PGIS in the project (determined in RCEF Phase 2)
- Total cost of project at the beginning of PS&E which is the sum of the engineer's estimate, preliminary engineering, and right of way

As more *RCEF Phase 2 Analyses* become available, the SPC will review the RCEF results and determine whether adjustments need to be made to the *Percentage Factors* in *Table 1*.

Transferring Funds to the Subprogram I-4, Stormwater Retrofit

Funds can be transferred from the project to the Subprogram I-4 Stormwater Retrofit Account when the project is in a medium or low priority stormwater retrofit area and when it is not feasible or cost effective to treat the existing impervious surfaces and existing PGIS within the project limits. The transfer of funds shall occur when the project goes to AD. The project office initiates the funds transfer process by contacting the Region's program management office and specifying how much money needs to be transferred and when the transfer should happen.

Example 1 (Scoping Level): Semi-Urban/Rural Highway Roundabout Project

RCEF Phase 1 Analysis

[1] Contact the HQ ESO Stormwater and Watersheds Program for a list of high, medium, and low priority stormwater retrofit locations.

Scenario: Total project cost estimate at scoping (i.e., PE, Construction, and ROW phases) = $6,500,000. The project's predominant land uses are semi-urban (40%) and rural (60%), the project limits lie within the Puget Sound Basin in a low priority stormwater retrofit location, and the project (assume only 1 TDA) will add more than 35,000 square feet of new impervious surface.

Determine the total additional cost that needs to be added to the scope of work to meet the Puget Sound stormwater retrofits obligation per the HRM.

Solution: Select the appropriate percentage factor in *Table 1* based on the predominant land use results in the following calculation:

$$\left(\frac{(0.02\times 0)\text{urban}}{100}+\frac{(0.01\times 40)\text{semi-urban}}{100}+\frac{(0.005\times 60)\text{rural}}{100}\right) \text{ x } \$6{,}500{,}000 = \$45{,}500$$

$45,500 needs to be added to the scoping estimate to account for the Puget Sound stormwater retrofit obligation (i.e., runoff treatment and flow control) for the existing impervious surfaces and existing PGIS on the project.

Example 2 (Scoping and Project Level): Urban/Semi-urban Highway Roundabout Project

RCEF Phase 1 Analysis (Scoping)

Scenario: Total project cost estimate at scoping (i.e., PE, Construction, and ROW shown on the Project Summary) = $6,500,000. The project's predominant land uses are *Urban* (60%) and *Semi-Urban* (40%), the project limits lie within the Puget Sound Basin in a medium priority stormwater retrofit location, and the project (assume only 1 TDA) will add more than 35,000 square feet of new impervious surface.

Determine the total additional cost that needs to be added to the scope of work to meet the Puget Sound stormwater retrofit obligation per the HRM.

Solution: Select the appropriate *percentage factor* in *Table 1* based on the predominant land use results in the following calculation:

$$\left(\frac{(0.02\times 60)\text{urban}}{100}+\frac{(0.01\times 40)\text{semi-urban}}{100}+\frac{(0.005\times 0)\text{rural}}{100}\right) \text{ x } \$6{,}500{,}000 = \$104{,}000$$

$104,000 needs to be added to the scoping estimate to account for the Puget Sound stormwater retrofit obligation (i.e., runoff treatment and flow control) for the existing impervious surfaces and existing PGIS on the project. This amount shall be verified in the *RCEF Phase 2 Analysis*.

RCEF Phase 2 Analysis (Project)

Scenario: Assume the total cost for runoff treatment and flow control (i.e., stormwater management) of the new impervious surfaces and new PGIS on the project (30,000

square feet) per HRM Minimum Requirements = $600,000. Assume the total cost for runoff treatment and flow control of all existing impervious surfaces and existing PGIS on the project (70,000 square feet for full retrofit) = $150,000. The total cost for treating the new plus the existing impervious and PGIS (100,000 square feet) is $750,000.

Determine the following:

1) Is the amount scoped in the *RCEF Phase 1 Analysis* adequate? If not, secure additional funding.
2) Is the full retrofit feasible and cost-effective? See HRM *Section 3-4.1* if a full retrofit is not feasible or cost-effective.

Solution: Providing a full retrofit for the existing impervious surfaces and existing PGIS within the project boundary **is feasible;** however, providing a full retrofit for the existing impervious surfaces and existing PGIS on the project **is not cost-effective** (i.e., ratio of total cost of existing/total cost of new must be less than 0.2**.**

Cost-Effective stormwater management = (Total stormwater management cost for existing impervious and existing PGIS)/(HRM Minimum Requirement stormwater cost for new impervious and new PGIS) < 0.2

$150,000/$600,000 = 0.25 (therefore, not cost-effective)

Since the full retrofit is not cost-effective, the additional funds the project office needs to request from program management is ($600,000 x 0.2) – $104,000 = $16,000. This is the additional funding needed to make up the shortfall between the amountof money determined in *RCEF Phase 1Analysis* vs. the cost determined in *RCEF Phase 2 Analysis*.

The full retrofit is feasible, but not cost-effective. Following *HRM Section 3-4.1*, the designer has three options:

1. Retrofit the amount of existing impervious surface and existing PGIS within the project limits that can be retrofitted for the amount of money equal to 20% of the cost to meet the HRM requirements for the new impervious surfaces and new PGIS, as outlined in the paragraphs above. For this example, provide flow control and runoff treatment for as much existing pavement as possible for ($600,000 x 0.2) = $120,000.

2. Transfer an amount of money, equal to 20% of the cost to meet the HRM requirements for the new impervious surfaces and new PGIS ($600,000 x 0.2 = $120,000), as outlined in the paragraphs above, to fund stand-alone stormwater retrofit projects (*Subprogram I-4 Stormwater Retrofit Account*). This funds transfer shall happen when the project goes to AD. Note this option is not available for projects in high priority stormwater retrofit locations.

3. Retrofit as much as possible to the extent feasible within the project limits and transfer funds equivalent to the unmet balance of the 20% cost obligation to fund

stand-alone stormwater retrofit projects (*Subprogram I-4 Stormwater Retrofit Account*). This funds transfer shall happen when the project goes to AD.

Engineering and Economic Feasibility Evaluation Process for Stormwater Retrofit Projects

The following sections are intended for use to determine whether construction of stormwater facilities is feasible within the immediate highway right of way (typical for stand-alone stormwater retrofit projects) or proposed right of way (typical for project triggered stormwater retrofit projects). Factors and questions are listed below to help you determine the feasibility of constructing stormwater treatment and flow control BMPs based on site conditions.

Collect Project Site Data to Identify Limiting Factors

Depending on the complexity of the project or site conditions, some of the data listed below may not be required. Consult with the Region Hydraulics Engineer to determine applicable items.

1. Locate the proposed ROW and/or easement available for stormwater facilities.
2. Determine the topographic and land cover characteristics of contributing basin areas.
3. For project-triggered stormwater retrofit projects, estimate the required runoff treatment and flow control by completing the Stormwater Design and Documentation Spreadsheet: http://www.wsdot.wa.gov/nr/rdonlyres/6de749bc-209c-4bfd-80d9-bcc86dcb868a/0/stormwaterdesigndocumentation.xls
4. Determine the proximity of the project site to water bodies and locate existing outfalls.
5. Identify water bodies designated as "impaired" under the provision of Section 303(d) of the federal Clean Water Act.
6. Identify water supply well locations and associated well protection zones.
7. Identify wildlife hazard management zones around airports.
8. Determine the soil properties at the proposed stormwater facility location. For infiltration facilities, verify the site meets the requirements in Section 4-5.1, Site Suitability Criteria.
9. Locate critical public infrastructure relative to the existing (or proposed if applicable) ROW.
10. Identify and locate the existing land use in and adjacent to the ROW, including:
    - Protected cultural resources, historical sites, parklands, or wildlife and waterfowl refuges (Department of Transportation Act of 1966 §4[f] properties).
    - Areas designated as sensitive by a federal, state, local, or tribal government. These areas include, but are not limited to: designated "critical water resources" as defined in 33 CFR Part 330, Nationwide Permit Program, "Critical habitat" as defined in Section 3 of the Endangered Species Act of 1973, and areas identified

in local critical area ordinances or in an approved basin plan. (Additional items are described in the soil suitability criteria).

11. Identify location(s) of established structure(s) on or adjacent to the existing (or proposed if applicable) ROW.
12. Identify slopes and location(s) of unstable slopes on or adjacent to the existing (or proposed if applicable) ROW.
13. Identify the presence and location of hazardous or dangerous materials on or adjacent to the existing (or proposed if applicable) ROW.
14. Identify and locate any old-growth or otherwise significant upland forest areas.
15. Identify and locate any well-established riparian tree canopies or vegetative buffers on or adjacent to the existing (or proposed if applicable) ROW.
16. Identify the presence and distribution of 100-year floodplains on or adjacent to the established or acquirable ROW.

Infrastructure Limitations to Construction Feasibility

Consider the following questions when determining whether infrastructure or right of way limits the feasibility of designing and constructing stormwater BMPs within or adjacent to the right of way. Each element evaluates potential fatal flaws that would preclude the feasibility of constructing stormwater management facilities within the right of way.

1. Will stormwater facility construction relocate critical publically-owned infrastructure or facilities, such as schools, fire stations, police facilities, or major utility lines/ infrastructure?[2]
2. Can a flow control treatment BMP be designed to fit in the existing (or proposed if applicable) ROW?
3. Can a runoff treatment BMP be designed to fit in the existing (or proposed if applicable) ROW?
4. Will the designated stormwater management area disturb or trespass on designated historical/archaeological sites or other significant cultural resources?[3]
5. Is it feasible to purchase adjoining properties?

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[2] When you identify the location and nature of the critical public infrastructure(s), you are required to provide documentation to justify not constructing the BMP in the right of way.

[3] Review any projects involving disturbance of ground surfaces not previously disturbed for cultural resource study needs (such as site file searches at the Washington State Office of Archaeology and Historic Preservation, on-site surveys, and subsurface testing). Federal involvement (such as funding, permits, and lands) requires compliance with Section 106 of the National Historic Preservation Act and implementation of regulations in 36 CFR 800.

Geographic and Geotechnical Limitations to Construction Feasibility

A project's topography and/or proximity to wetlands, sensitive water bodies, shorelines, riverfront areas, or steep slopes may physically or structurally preclude construction of BMPs on site within required engineering standards. In situ geotechnical conditions can also limit the feasibility of constructing BMPs within the right of way (for example, the project is on unstable slopes, high shrink/swell soils, or karst topography). Refer to Section 4-5 of the HRM to determine whether geography or geotechnical limits affect the feasibility of designing stormwater BMPs within the ROW.

Hydraulic Limitations to Construction Feasibility

Hydraulic limitations can include the lack of hydraulic head necessary for BMPs to operate under gravity flow conditions. Some reasons that could limit the amount of available hydraulic head include:

1. having a high ground water table at the feasible BMP location
2. the feasible BMP location is near or in the floodplain

Environmental or Health Risk Limitations to Construction Feasibility

Areas with intensive historic levels of industrial or commercial activity may have significant levels of soil, water, or fill contamination, which would prevent highway construction work from being conducted in a safe manner (as specified in the Washington Industrial Safety and Health Act or federal Occupational Safety and Health Administration regulations), or may be the subject of overriding Resource Conservation and Recovery Act (RCRA), state Model Toxics Control Act (MTCA), or Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) regulations. Such significant safety, health, and environmental limitations would generally preclude construction of stormwater facilities on a particular site.

Consider the following questions for all sites:

1. Does the proposed stormwater management area contain soils or materials designated as Hazardous/Dangerous Waste or require cleanup action as defined by RCRA or MTCA regulations?

   Generally, it is not feasible to construct stormwater facilities in these locations without putting a worker's health in jeopardy; the site may release acutely toxic substances to surface waters during construction and impact groundwater. Infiltration of stormwater may mobilize or accentuate the migration of hazardous material located below the facility even if soils at the surface or near the surface are clean or removed.

2. Will construction of stormwater control facilities require removal of well-established riparian tree canopies or vegetative buffers?

   Consider benefits to the environment if trees are retrained to include water storage, sequester water/pollutants, and shade streams.

3. Will construction of stormwater control facilities require removal of critical habitat for listed endangered and threatened species?

Removal of critical habitat will, at a minimum, require a Section 7 Consultation and may result in a take of endangered or threatened species, making the proposed location not feasible.

4. Will construction of stormwater BMPs be located within a 100-year flood plain?

   Determine whether it is feasible to install stormwater control facilities within the flood plain.

Maintenance Factors to Construction Feasibility

Maintenance is essential to the performance of runoff treatment and flow control BMPs. The maintenance of the proposed BMPs needs to be discussed and reviewed with the local maintenance office. Maintenance considerations to address include: specific site restrictions that prevent access, long-term operation and maintenance costs, and necessary equipment and training. Complete the Maintenance Checklist found on the HRM website and review it with the area maintenance office. The conversations with the local maintenance office may guide BMP selection.

Cost Factors to Construction Feasibility

Critical cost factors found to affect stormwater management costs include the location and setting of projects relative to neighborhoods, unavailable right of way, streams, wetlands, and environmentally sensitive areas. In addition, projects with poor soil conditions or high water tables generally have considerably higher costs for treating stormwater. For project-triggered stormwater retrofits in a high priority retrofit location, the project office may choose to do as much required stormwater retrofit onsite as feasible then then transfer the remaining balance to the I-4 Stormwater Retrofit account. For stand-alone stormwater retrofit projects, if a section of highway is determined to be too expensive based on the critical cost factors mentioned above, that portion of the stormwater retrofit project may be placed on a deferred list of stormwater retrofits to be taken care of at a later time. Please see the Stormwater Retrofit Management Plan for a description of the deferred retrofit list.