Section 9
Implementation and Adaptive Management Plan

9.1 Implementation Overview
The City Beautiful H2O Program Plan (Program Plan) involves a range of operational and administrative services to support implementation of the proposed controls. Four distinct strategies will be implemented under the Program:

▪ An Asset Rehabilitation and Renewal Strategy will entail the continual inspection, assessment, and prioritized renewal of CRW’s wastewater/stormwater assets as part of the overall Asset Management Program. Asset Probability of Failure (POF), a function of remaining service life, and Asset Consequence of Failure (COF), are evaluated based on triple bottom line assessment of the failure of the asset.

▪ A Decentralized Green / Grey Implementation Strategy will continually seek affordable and cost-effective opportunities to implement stormwater controls within the context of related infrastructure and community renewal and redevelopment projects. Selected pilot projects will demonstrate the utility of various green stormwater infrastructure (GSI) control technologies in highly urbanized areas. GSI elements will be incorporated into public works and redevelopment projects by intent and/or through enhanced standardized design requirements/regulations. CRW will evaluate implementing an impervious area-based stormwater fee to provide a fair and true cost of service allocation that provides incentives for non-residential and stormwater-only customers to incorporate stormwater control measures (SCMs) where practicable.

▪ An Asset Operation and Maintenance Strategy will keep CRW’s treatment, collection, and conveyance assets in good working order, free from structural deficiencies, debris, and blockages, allowing them to continue to operate as designed. CRW will also seek opportunities to integrate monitoring and control technologies into its assets as part of rehabilitation projects, with a goal of implementing telemetered surveillance and control where proven to enhance system operation and performance. CRW will determine
the maintenance needs associated with various types of SCMs to guide their maintenance by public agencies and by private entities on private property.

- An **Internal and Intergovernmental Communications and Coordination Strategy** will build implementation partnerships with various stakeholders. CRW will continue to promote effective interagency coordination to define strategic policies and streamline protocols and communication pathways to better align with full-scale GSI implementation. In addition, an Internal Communications Plan to improve synchronization within CRW will be developed. This communications plan will identify and evaluate policy barriers to implement the Program Plan, and will initiate strategies to address these challenges.

**Adaptive Management Process**

Implementation of the Program Plan elements will rely upon an Adaptive Management Process. This adaptive management approach will require flexibility and periodic program assessments throughout the implementation period. Adaptations in the management approaches are expected throughout this period to ensure that compliance goals are met, to optimize and enhance the program, to maximize benefits, and minimize the costs of implementation. Major decisions on management approaches will be made starting in Year 10 and every five years thereafter based on progress toward the goals and will be described in Evaluation and Adaptation Plans (EAPs). These EAPs will also identify specific program modifications. Each EAP will be a comprehensive assessment of CRW’s progress towards full implementation of the approved Program Plan with descriptions of program elements expected to be implemented in the next five-year period. Through CRW’s annual reporting process, continuous updates on the adaptation of the implementation program will be provided to US-EPA and PA-DEP.

**Implementation Schedule**

This section describes the various implementation strategies and the adaptive management processes that will be followed during the execution of the Program Plan. An implementation schedule for carrying out the Program Plan is provided in Section 11.

**9.2 Prioritized Implementation Strategy**

CRW’s Program Plan involves a range of operational and administrative services to support implementation of the controls defined in Section 8. This section describes four distinct strategies to guide Program implementation:

- An **Asset Rehabilitation and Renewal Strategy** involving the continual inspection, assessment, and prioritized renewal of CRW’s wastewater/stormwater assets.

- A **Decentralized Green / Grey Implementation Strategy** that continually seeks affordable and cost-effective opportunities to implement stormwater controls within the context of related infrastructure and community renewal and redevelopment projects.
9.2.1 Asset Rehabilitation and Renewal Strategy

This section describes CRW’s planned approach to identifying, prioritizing, and scheduling asset renewal needs as part of the overall Asset Management Program. CRW’s asset management framework is being implemented based on the US-EPA/Water Environment Research Foundation (WERF) Five Core Question Framework, and thus incorporates asset level risk-based investment prioritization. In this framework, there are two parameters used for prioritization decision-making: 1) Asset probability of failure (POF), and 2) Asset consequence of failure (COF). These two parameters are multiplied together and the resulting product is referred to as Core Risk.

9.2.1.1 Asset Probability of Failure

*Asset probability of failure* is a function of remaining service life and is correlated to the asset’s physical condition and other performance considerations such as the asset’s ability to meet its required demand (e.g., whether the capacity of a reach of gravity sewer pipe can meet the hydraulic demand). Per the EPA Framework, at any given time, there are four major failure modes acting upon an asset. These four major failure modes are defined as shown in Table 9-1.

<table>
<thead>
<tr>
<th>Failure Mode</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Mortality</td>
<td>Physical degradation of asset reduces performance below acceptable level</td>
</tr>
<tr>
<td>Capacity</td>
<td>Volume of demand exceeds design capacity</td>
</tr>
<tr>
<td>Financial Efficiency</td>
<td>Operations and maintenance costs exceed that of feasible alternatives</td>
</tr>
<tr>
<td>Levels of Service</td>
<td>Functional requirements exceed specified performance criteria of the asset (e.g., the treatment technology used for the removal of a pollutant no longer removes enough of the pollutant to meet permit requirements)</td>
</tr>
</tbody>
</table>

While all four major failure modes may be acting on an asset at any given time, the asset will experience its failure due to only one failure mode, referred to as the imminent failure mode. CRW’s approach identifies the imminent failure mode and recommends corrective action to intervene prior to the asset’s failure. In the case of buried infrastructure, influences on physical mortality may include pipe material, age, construction methods, operational environment, external influences such as corrosive soils, and other factors. A condition rating system with a scoring range of 1 to 5 based on scales used by National Association of Sewer Service Companies (NASSCO) for Pipeline Assessment and Certification Program (PACP) is used by CRW, as illustrated in Figure 9-1.
Generally, unless the external environmental demands change, the imminent failure mode is physical mortality. As a result, the failure mode of physical mortality is used predominantly for long term asset renewal decision making. Therefore, an asset’s physical condition is the predominant factor for estimating remaining useful life of an asset. Hydrologic and Hydraulic (H&H) modeling and level of service are used jointly to define the capacity of wastewater/stormwater assets, particularly within CRW’s collection system, and may trigger capacity expansion and/or stormwater management control projects in advance of physical mortality.

At this time, the Advanced Wastewater Treatment Facility (AWTF) and the conveyance system have been assigned a high COF because their possible failure would result in a major, systemwide disruption of wastewater service. As such, AWTF and conveyance system assets found to have a high POF are given the highest priority for implementation under the Program Plan’s baseline level of control. In the collection system, each asset has been assigned a preliminary POF based upon a combination of GIS data and the findings of the rapid assessment described in Section 4. A systemwide CCTV program is being conducted according to priorities based on the preliminary POF, with sewers exhibiting significant to near total deterioration (PACP condition score 4 and 5) evaluated first for potential repair during the immediate implementation phase (first ten years) of this Program Plan.

**9.2.1.2 Asset Consequence of Failure**

Asset consequence of failure is evaluated based on estimating the environmental/ regulatory, financial and social impacts of a defined failure of the asset. These three broad categories of consequence of failure are often referred to as the Triple Bottom Line (TBL) and goes beyond only the assessment of the direct financial consequences of an asset’s failure (e.g. cost to repair or
resource impacts). Assets are assigned COF elemental scores from 1 to 5 for each of seven elements under the three TBL categories. The highest individual score across these elements for each asset is referred to as the dominant COF score and is used in the calculation of the asset Core Risk. The TBL categories and elements used by CRW to define the COF score are shown in Table 9-2.

**Table 9-2: Triple Bottom Line Evaluation Criteria and Relationship to CRW Strategic Goals and Objectives**

<table>
<thead>
<tr>
<th>Triple Bottom Line Category</th>
<th>CRW Strategic Planning Goals</th>
<th>CRW Strategic Planning Objectives (Consequence of Failure Elements)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial</td>
<td>Efficient Use of Resources</td>
<td>Use Financial Resources Efficiently</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Use Energy Efficiently</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Integrate Infrastructure/Operations to Achieve Multiple Objectives</td>
</tr>
<tr>
<td>Infrastructure Stability</td>
<td></td>
<td>Ensure Reliable Operations</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Minimize Construction Difficulty/Risk</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ensure Flexibility, Adaptability, Expandability of New Infrastructure</td>
</tr>
<tr>
<td>Social/ community</td>
<td>Customers and stakeholders</td>
<td>Increase customer and stakeholder satisfaction</td>
</tr>
<tr>
<td></td>
<td>Workforce</td>
<td>Create Employment Opportunities at CRW and in the Community</td>
</tr>
<tr>
<td>Environmental</td>
<td>Public Health and the</td>
<td>Improve Water Quality</td>
</tr>
<tr>
<td></td>
<td>Environment</td>
<td>Support Long-term Community Health</td>
</tr>
</tbody>
</table>

These TBL criteria are similar to those applied in Section 8.5 for evaluating alternative controls strategies, but have been simplified for use in asset management decision making. For vertical assets (e.g. a pump in a lift station), COF elements can be assessed individually (or in groups of similar assets as long as the consequence of the failures are similar within the group). However, doing so for a vast number of pipe segments can be prohibitively time consuming. Therefore, calculating the impact of pipeline failures for the various elements is performed via a spatial analysis of the proxy attributes shown in Table 9-3. Not every attribute shown applies to all of the elements. The attributes that are applicable for a given element are marked with an 'X' in Table 9-3.

9.2.1.3 Risk Management Zones

Assets are assigned elemental COF scores from 1 to 5 for each of the seven elements under the three TBL categories listed in Table 9-2. The highest individual score across these elements for each asset is referred to as the dominant COF score. The dominant COF score ranges from 1 to 5, and when multiplied by an asset’s probability of failure (POF) rating, is used to calculate the Core Risk posed by an asset.

The maximum Core Risk is 25 (POF = 5 and dominant COF = 5).

Core Risk is the metric used to assign assets to risk management zones. Risk management zones and recommended interventions for each zone are illustrated in Figure 9-2. The risk management zone establishes the initial prioritization consideration (prioritization bucket) for asset operations & maintenance (O&M) and capital investment needs.
Figure 9-2: Core Risk Plot with Risk Management Zones

Table 9-3: Proxy Attributes for TBL Consequence of Failure Elements

<table>
<thead>
<tr>
<th>Proxy Attributes</th>
<th>Financial</th>
<th>Social/Community</th>
<th>Environmental</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Use Financial Resources Efficiently</td>
<td>Use Energy Efficiently</td>
<td>Integrate Infrastructure/Operations to Achieve Multiple Objectives</td>
</tr>
<tr>
<td>Critical Customers</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proximity to Roads</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Proximity to Railroads</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Proximity to Environmentally Sensitive Areas</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Proximity to Buildings</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Proximity to Other Utilities</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Repair Costs</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depth of Pipe</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zoning and Land Use</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>
As shown in Figure 9-2, there are five risk management zones. Zone 5 includes the highest risk assets and zone 1 includes the assets with the lowest COF ratings. The risk management zones can be further explained as follows:

- **Zone 5**: Contains assets that represent significant risk to the organization. In general, these assets are approaching the end of their useful life and upon failure, may cause significant social, financial, and environmental impacts.

- **Zone 4**: Contains assets that have high consequence of failure but have not deteriorated enough to be included in the significant risk zone (Zone 5). For vertical assets, increased visual and/or predictive condition assessments (thermal scanning, oil analysis, etc.) may be justified as their condition deteriorates and they move vertically in the graph approaching Zone 5. In the case of pipes, assets in Zone 4 may be candidates for more frequent inspections than the pipes falling in Zones 3, 2, or 1.

- **Zone 3**: Contains assets that would experience failure consequences that are tolerable because they may be managed through designed redundancy and operational mitigation such as spares and condition monitoring. Zone 3 assets can also migrate into Zone 5 and as such, require additional focus by management.

- **Zones 1 & 2**: Contains assets with lower consequences of failure. Applicable management strategies for these assets may be run or manage to failure, maintenance optimization for assets with low COF scores, or standard maintenance practices for assets with low to medium COF scores.

### 9.2.1.4 Asset Prioritization Approach

This section describes CRW's risk-based asset management approach to asset investment prioritization and scheduling given the concepts previously described. In order to prioritize assets that need inspection, repair, replacement, or rehabilitation, the following steps are undertaken:

1. Determine the risk management zone for each asset as described in Section 9.2.1.3, using Core Risk (POF X dominant COF).

2. Identify any assets that are failing from one of the other remaining three failure modes (other than physical mortality). This is performed on a case-by-case basis around specific assets, location, or with the help of a hydraulic model in the case of pipes.

3. Assign assets to respective investment priority levels based on risk and condition (as explained in this Section).

4. Identify mitigation factors that may lessen the probability or impacts of an asset’s failure (e.g., available installed or uninstalled spares, emergency response plans, on-call contracts with external parties that facilitate expedited response times, and implementing a standard operating procedure for manual operations).

5. Merge core risk and mitigation factors to prioritize assets within each priority level, considering geographic location, available funding, and engineering judgement.
Assets are organized into five priority levels, or "buckets" based on the risk management zone into which they fall and their condition ratings.

- **Priority 1**: Assets falling in Risk Zone 5 (core risk is 16 or greater). Schedule for replacement or renewal during immediate implementation phase (next 10 years).

- **Priority 2**: Assets with a COF of 3 AND Condition greater than or equal to 4 (or assets with imminent failure due to one of the non-physical mortality failure modes). Schedule for replacement or renewal during near-term implementation phase (beyond 10 years, as affordable).

- **Priority 3**: Assets with a COF greater than or equal to 3, AND Condition greater than or equal to 3; OR COF equal to 5 and Condition less than 3. High priority for initial condition assessment and frequent re-assessment.

- **Priority 4**: Assets falling in Risk Zone 1 AND Condition equal to 5. Medium priority for initial condition assessment and periodic re-assessment.

- **Priority 5**: All remaining assets with Condition greater than or equal to 4, or COF greater than or equal to 4. Low priority for initial condition assessment and re-assessment.

### 9.2.1.5 Implementation Services

**Table 9-4** lists the services to implement CRW’s Asset Rehabilitation and Renewal Strategy.

#### Table 9-4: Services to Implement CRW’s Asset Rehabilitation and Renewal Strategy

<table>
<thead>
<tr>
<th>Type of Service</th>
<th>Description</th>
<th>Existing Service?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asset Management</td>
<td>Implement and administer Cityworks-based asset operation and condition tracking system.</td>
<td>Yes</td>
</tr>
<tr>
<td>GIS Mapping</td>
<td>Populate and maintain GIS mapping of assets and associated hardware/software.</td>
<td>Yes</td>
</tr>
<tr>
<td>CCTV Inspections</td>
<td>On-going CCTV inspections of underground assets, supplemented with a second CCTV truck/crew beginning in 2018.</td>
<td>Yes</td>
</tr>
<tr>
<td>Engineering Assessment</td>
<td>Routinely review asset management information and develop engineering designs for asset renewal projects.</td>
<td>Yes</td>
</tr>
</tbody>
</table>

### 9.2.2 Decentralized Green / Grey Implementation Strategy

The Program Plan includes a long-term commitment to direct the impervious cover of the City to decentralized green / grey stormwater infrastructure (GSI), as feasible and affordable. Of that total, CRW has determined that it may be affordable to install GSI serving up to 100 impervious acres over the next 20 years following the approval of this Program Plan. This Program Plan describes a number of programmatic themes that CRW would evaluate for implementation potential including:

- Pilot and Demonstration Projects,
- Synergistic Project Opportunities,
- Development-Driven Project Opportunities,
- Incentive-Driven Project Opportunities,
- Opportunities on Public Lands and Rights of Way,
- Vacant Property Re-Utilization Opportunities, and
- Green Parking Lots Initiative.

CRW is developing a *Neighborhood Planning and Concept Development Program* to guide these programmatic themes and otherwise support coordinated investment in GSI and other stormwater management improvements.

### 9.2.2.1 Pilot and Demonstration Projects

Prior to the submission of this Program Plan, CRW prepared its Community Greening Plan, including a significant commitment to demonstrating land-based stormwater management projects in the City. Subsequently, CRW designed and is in position to implement a number of pilot projects aimed at demonstrating the utility of various green stormwater control technologies in highly urbanized areas. These pilot projects are intended to help raise awareness of GSI among City residents and the regulatory community.

Pilot projects are defined as GSI projects designed, constructed, and monitored under controlled conditions to provide information for optimal design and program development. Information from pilot projects will be collected to develop a cost effective GSI program by testing a variety of projects and evaluating them for a number of factors, including:

- Ability to meet performance requirements,
- Ease of implementation for on-street and off-street settings,
- Affordability and cost-effectiveness of various physical conditions,
- Efficiency of various systems,
- Effectiveness of various materials, and
- Ease of maintenance.

GSI pilot projects can take many forms, be located in a variety of settings, and consist of differing technologies. The pilot program is designed to test the feasibility of GSI projects under the full range of potential conditions, captured by numerous variables. An initial list of variables has been organized into the following categories:

- Location,
- Physical Settings,
- Systems,
- Policies and Partnerships,
- Implementation Strategies, and
- Materials/Technologies.
The intent of the pilot program is to design, construct, and monitor several projects for each variable during the course of the ten years leading up to the first EAP delivery. In this way, by year 10, it is expected that the pilot projects will be built and monitoring complete, providing insights into the most cost-efficient designs, locations, maintenance procedures, and partners. This information will be used to continually enhance the program.

9.2.2.2 Synergistic Project Opportunities
Synergistic project opportunities are defined as GSI elements incorporated into other public works projects by intent and/or through enhanced standardized design requirements. CRW will develop a structure that will allow for implementation of GSI through modifications to some of the standard “public works” processes performed by CRW, the City, and PennDOT. During the 20-year planning horizon of this Program Plan, CRW is committed to including GSI elements in an increasing percentage of CRW water and sewer line replacement projects, City/PennDOT paving and streetscaping projects, including installations of street trees. CRW is calling this collective set of tools the “synergistic project opportunities” component of the program due to the opportunity to trigger GSI implementation as a standard procedure as the public works projects are designed and constructed. Although CRW will not have complete control of the number of projects and impervious areas controlled through these projects, the development of standard processes for implementation will decrease the need for stand-alone GSI projects implemented solely and independently by CRW. This Section of the Program Plan describes the “synergistic project opportunities” project concepts, implementation strategies and projections for anticipated GSI.

Commitment to Incorporating Green Stormwater Infrastructure into Water and Sewer Projects
Most CRW infrastructure projects are implemented within the right-of-way and require opening streets. CRW is working to synchronize the traditional infrastructure design process with the GSI design process. Wherever possible, standard infrastructure constructed by CRW will be coupled with GSI at or near the street surface. During the first year of implementation, CRW Engineering will lead the integration of GSI into the design process. CRW Engineering currently evaluates each water and sewer replacement project, and documents opportunities for adding GSI. This process will evolve to a standardized process for adding GSI to this work, accompanied by standard design details and specifications for GSI components and adaptations to traditional infrastructure. As standardization occurs, contractors and design professionals working on water and sewer projects will act with minimal assistance from CRW.

Green Streets Design Manual
Streets and sidewalks are the largest category of publicly-owned impervious cover, accounting for approximately 45 percent of the impervious cover within the City. CRW’s Community Greening Plan recognizes that streets can provide a significant portion of the total target for GSI. To that end, CRW is focusing a great deal of attention on demonstrating various GSI tools in the streets including stormwater tree pits, curb cuts, bump-outs, porous pavement and tree trenches aimed at developing a series of standards and specifications, to be prepared during the immediate implementation phase of the Program Plan. To support this initiative, CRW will develop a Green Streets Design Manual and Complete Streets Handbook during the immediate implementation Phase of the Program Plan. Upon release of this manual, CRW, the City of Harrisburg, PennDOT,
and any others performing work in the streets will begin to use the new Green Streets Design Manual, to guide when and how to apply GSI on street-related projects.

**Streetscaping**

Streetscaping projects may present CRW with an opportunity to utilize creative solutions and go beyond the standard Green Streets implementation toolbox. There are many different partners in the City of Harrisburg that may become involved in streetscaping projects. These may include neighborhood associations, non-Governmental Organizations (NGOs), Business Improvement Districts (BIDs), and others. CRW has been approached by a number of these agents with the request to partner on projects to increase the greening and stormwater management potential for the street design. The Green Streets Design Manual will increase the effectiveness of working with these partners as it provides standard details, specifications, and other information on the review process for those projects.

**Partnership with City Parks & Recreation**

CRW has been coordinating with City Parks & Recreation (CPR) to incorporate GSI elements into scheduled projects to renew City Parks. One of the seven identified pilot projects involves implementation of GSI into four City Parks:

- Fourth and Dauphin Park
- Penn and Sayford Playground
- Royal Terrace Park
- Norwood and Holly Park

These pilot projects will serve as a demonstration of such integration, and will be used to collaboratively seek grants for additional parks improvements projects.

In addition, CRW will work with the City to establish a budget for annual street tree installation, including tree removal/replacement. The program will include standard design details for tree pits, along with language that allows for CRW to add additional designs and specifications for stormwater management tree pits as these are developed. Coordinating with the City's tree planting program offers an opportunity to increase the number of trees planted in the City while piloting various types of stormwater tree pits. This effort will allow different tree pit technologies to be tested to confirm adequacy of designs, constructability, cost, and maintenance requirements. In addition, the opportunity to integrate stormwater tree pits into the more traditional tree planting contracts will be vetted.

**9.2.2.3 Development-Driven Project Opportunities**

Private investment in GSI on private property is a well-established implementation practice nationally, but requires modifications to current CRW/City stormwater regulations focused on Act 167 compliance. As projects are developed in the combined sewer area, some or all of their impervious area could be controlled by GSI through compliance with the regulations. This section describes the current and proposed regulations, the plan review process, and incentives that the CRW plans to develop to encourage the private sector to build GSI, such as a parcel-based billing structure and a stormwater credit program.
**Existing / Proposed CRW-City Stormwater Regulations**

The existing City/CRW Stormwater Regulations are consistent with MS4-compliant model regulations proposed by PA-DEP, and are primarily intended to comply with the Act 167 Plan developed for Paxton Creek (e.g., watershed-wide detention requirements for the 100-year storm event). In addition, current regulations generally control increased runoff when impervious area is increased, yielding little to no reduction in runoff/CSOs/MS4 discharges. Modified regulations are envisioned that would add the following conditions:

- Require control of some or all of the existing impervious area of a development site using GSI, with the level of control dependent upon on-site conditions.
- Providing increased flexibility in integrating GSI within public right-of-way (ROW) to serve development projects.
- Providing incentives for developers to cost-share GSI projects within a development site that is also able to control runoff from adjoining properties/ROW.
- Establishing a fee-in-lieu-of policy to allow developers to implement off-site GSI projects or contribute an equitable share of CRW off-site GSI projects.

Modified stormwater management regulations will be implemented in conjunction with CRW’s anticipated new MS4 permit, which requires certain stormwater regulation updates to be performed by year 4 of the MS4 permit term. CRW’s goal is to work with stakeholders at the City and within the development community to develop modified regulations within this time frame. As a starting point, the following performance standards are envisioned for the modified stormwater regulations:

- **Water Quality**: The first inch of precipitation over directly connected impervious cover must be recharged. Where recharge is not feasible, or limited, any remaining volume is subject to an acceptable water quality practice.
- **Channel Protection**: The 1-year, 24-hour storm must be detained and slowly released over a minimum of 24-hours and maximum of 72-hours.
- **Flood Control**: Development projects throughout CRW’s service area should be required to control the rate of runoff to the capacity of the existing CRW drainage system. In addition, development projects in the Paxton Creek Watershed are subject to an Act 167 planning effort and must follow the model results for flood management districts.
- **Fee-in-lieu-of Requirements**: Development projects unable to achieve CRW regulatory requirements through on-site controls should be required to pay a fee-in-lieu-of equivalent to an equitable share of an equivalent level of control in a CRW stormwater conveyance and/or control project determined through H&H modeling.
- **Non-Structural Site Design**: Projects are required to maximize the site potential for stormwater management through appropriate placement and integration of stormwater control measures.
**Erosion and Sediment Control (E&S) Best Management Practices (BMPs):** Stormwater BMP’s are required for any earth disturbance projects by the Pennsylvania Clean Streams Law regulations, to prevent site soil erosion and reduce sediment pollution in nearby streams. Development or redevelopment projects disturbing more than 5,000 square feet are required to have Dauphin County Conservation District review an E&S Control Plan, and those greater than one acre require an NPDES permit issued by PA-DEP.

**Stormwater Plan Review**

The process and level of review of a private development project varies depending on the size of the earth disturbance associated with the development, the individual watershed requirements based on Act 167 Stormwater Management Plans and special zoning code regulations, and the associated state and federal permit requirements.

CRW’s Stormwater Plan Review is provided by CRW Engineering staff, supplemented by consultant support. Their responsibility is to review Post Construction Stormwater Management Plans for compliance with CRW/City Stormwater Regulations. This plan review process ensures that CRW’s stormwater program meets state and federal requirements while also coordinating with changing regulations in upstream municipalities. The stormwater plan review process will be refined as necessary to include the following phases:

1. **Conceptual Review:** Conceptual plan reviews should occur in the early stages of design to ensure that the SCMs are included in the overall site design. CRW will work with the City to require a signed and stamped Conceptual Approval as one of the required components of a complete zoning application.

2. **Technical Review:** The technical review includes details on the size and function of each individual SCM. The Post Construction Stormwater Management Plan is approved once the site’s design meets Stormwater Regulations, and the SMP will be properly operated and maintained.

3. **Construction and Inspections:** CRW will provide staff to inspect construction sites for compliance with the Post Construction Stormwater Management Plan, and work with Dauphin County Conservation District to inspect for compliance with the E&S Control Plan. Any sub-surface SCM will require a CRW inspector to be present during the installation.

4. **Project Close-out:** In the coming years, CRW will focus on streamlining the Stormwater Plan Review close-out process and creating additional enforcement mechanisms to ensure SCMs are built as designed and approved. The primary component of this requirement is the submission of as-built plans, or record drawings, after SCMs are constructed. CRW staff will work with the City to develop the requirement that as-built plans of SCMs be submitted and approved before the City will issue a Certificate of Occupancy to assist in enforcing this requirement.

**Inventorying GSI Implemented During Development**

The redevelopment rate within the City of Harrisburg is low and is not projected to increase in the future at this time. The number of technically approved plans will be monitored by CRW as a
surrogate for tracking the redevelopment rate. Close monitoring of this process will help to establish short-term goals for the CRW’s capital GSI planning program. The impact of the regulations in terms of total acres developed, area removed from contributing to the sewer system, available slow release and infiltration storage volumes, increase in number of GSI projects (i.e., structural basins, green roofs, porous paving, and rain gardens) will be calculated and tracked in a Project Tracking System. In order to calculate the impervious area served by GSI within private development, CRW must verify the number of sites with technically approved plans that are constructed. GSI projects and impervious area controlled will be counted once SCMs are constructed, inspected and accepted by CRW as functioning. CRW plans to conduct detailed inspections on all constructed approvals to verify that all approved SCM components are properly installed and that the overall systems have been maintained and are properly functioning.

9.2.2.4 Incentive-Driven Project Opportunities

CRW is evaluating the implementation of an impervious area-based stormwater fee to supplement its current water meter based charge for wastewater/stormwater services. The transition from an exclusively meter-based system to a combination meter and impervious area based system results in fees representative of the relationship between the stormwater runoff contribution from a parcel to the sewer collection system or nearby stream. An impervious area-based stormwater fee results in a fair and true cost of service allocation that provides incentives for non-residential and stormwater-only customers to incorporate SCMs where practicable. In addition, customers will become more aware of stormwater runoff impacts and the importance of urban SCMs. Customers are impacted by impervious area-based rates in a variety of ways. In general, properties with a small footprint and large water use, such as hospitals or high-rise residential buildings, will see a rate decrease, while large impervious parcels with little to no water use, such as parking lots, will see a significant increase in their utility bill. This leads to opportunities to implement a range of incentives for customers to implement GSI.

Stormwater Credits

CRW intends to develop a credit system to allow customers to decrease their bills by implementing structural and/or non-structural SCMs on their property, with the value of the credit equivalent to the stormwater services provided by CRW to the property owner. CRW intends to offer free design assistance and site evaluation to the most highly impacted customers to identify potential stormwater management opportunities that might exist on the site, and to perform cost-benefit analyses to help the property owner weigh the cost of the retrofit against the annual savings on the stormwater bill. CRW believes that the Impervious Area-Based fee likely will incentivize some large parcels to retrofit SCMs and receive a credit.

In order to receive a credit, the property owner will be required to prepare and receive approval of a credit application describing the SCMs and how they will be implemented and routinely maintained according to criteria developed by CRW. Any development/ redevelopment that meets CRW’s Stormwater Regulations, to be updated prior to implementing the fee, will be eligible for stormwater credit, and approved development plans will serve as a credit application. Credit applications will be approved if (a) an as-built plan is submitted showing the SCMs are constructed as designed and properly functioning, (b) a long-term Operations and Maintenance
plan is prepared and recorded as a legal instrument tied to the property, and (c) the owner operates and maintains the SCM according to this Plan.

Stormwater credits will need to be renewed periodically. This requirement will create a financial incentive for the land owner to keep their SCMs functioning. CRW will implement an SCM inspection program (see Section 9.2.3) requiring a CRW inspection or self-inspection report for a customer to renew their credit eligibility.

**Other Incentives for Private Green Stormwater Infrastructure Development**

CRW is considering other standards, incentives, and programs to encourage GSI, including:

- **Fast-Track Stormwater Plan Review Project Review**: Projects with 95 percent or more of the impervious area disconnected from the combined or separate storm sewer can qualify for a fast track Green Review in which the stormwater management section of the project will be reviewed within five days of submittal.

- **Free Assistance Program**: CRW proposes to provide free assistance through site inspections and design recommendations for green retrofits that allow customers to obtain fee credits.

- **Stormwater Management Incentive Program**: CRW is considering incentives to private parcel owners to implement stormwater management best practices through both a low-interest loan program and a grant.

- **Residential Rain Barrel Program**: CRW is considering a program to encourage residential participation in stormwater management through a program providing free rain barrels and free installation for residential properties.

CRW intends to convene an advisory committee to examine rate relief options, special rate issues, and revisions to the credits and incentives programs. This customer group will make recommendations to CRW on these and other issues that customers have brought to CRW’s attention. Any changes resulting from these recommendations will be incorporated into the next rate case filing.

**9.2.2.5 Opportunities on Public Lands and Rights of Way**

An important component of the strategy for identifying candidate GSI project sites is to target publicly owned facilities. These include publicly-owned properties, streets and rights-of-way, which constitute more than 45 percent of the impervious cover within the City. Stormwater capture associated with public property is enhanced by routing runoff from areas adjacent to public land and managing that stormwater on the public land. Initial efforts to identify additional projects for the GSI conceptualized project list will focus on publicly owned impervious cover and schools. As implementation progresses, additional programmatic elements will be explored and developed. Pilot and demonstration projects are primarily focused on building the relationships and partnerships needed to support a larger GSI program, and are located on recreation facilities or other properties managed by CRW’s partners. Through this process, CRW is developing a number of tools for implementing GSI based on lessons learned in the GSI Pilot Projects. Project
identification is based partially on following opportunities, existing partnerships, and ease of implementation.

CRW will continue to follow opportunities and collaborative efforts with partners through a number of strategic planning processes for queueing projects. An initial set of strategies for CRW-sponsored projects is described below, including:

- Development of Strategic Green Stormwater Infrastructure (GSI) Implementation Areas,
- Greening of publicly owned facilities,
- Evaluation of vacant lands, and
- Other strategic initiatives.

**Strategic GSI Implementation Areas**

Strategic GSI Implementation Areas (SGIAs) are areas where the potential exists for concentrated contiguous and interconnected use of GSI controls that may offer greater efficiencies than if those same controls were implemented in a non-coordinated manner. Section 8 of this Program Plan suggests specific areas within each planning area for concentrated implementation, specifically within the three planning areas where baseline implementation strategy is unable to achieve the presumptive level of control. Each of these areas will be further evaluated and prioritized as potential SGIA project areas, based on the criteria on the next page.

Once a SGIA has been identified by CRW, staff and/or a consultant may be tasked with completing a comprehensive evaluation and Stormwater Improvements Plan (SIP) for the project area. Each SGIA may be evaluated for potential to meet the following objectives:

- **Stakeholder Involvement**: Success in implementing stormwater improvements in a SGIA will be partly and, in particular cases, largely dependent on effective involvement and participation of key stakeholders. An effective strategy for identifying and coordinating with key stakeholders in a SGIA is required.

- **Coordination with Other Planning Initiatives**: SGIA evaluations should investigate and identify cohesion and potential synergy with planning initiatives within a SGIA as well as with other relevant initiatives.

- **Coordination with Land Development**: SGIA evaluations should investigate and identify cohesion and potential synergy with near and long-term development within a SGIA.

- **Effective Visual Presentation**: All graphics from a SGIA evaluation including maps, renderings, schematics, and other items that require visual representation must be prepared in a highly professional and effective illustrative format.

- **Creativity**: Incorporating creativity such as artistic and/or historic elements into stormwater improvements is important.

- **Feasibility**: In addition to physical considerations, benefits, and costs, other feasibility issues to be considered should include, at a minimum, financing issues, public/private
ownership relationships and interaction, 
operation and maintenance, and area specific 
sensitivities.

- **Comparison and Rating Methodology**: Both for the comparison of different stormwater management improvements in the same physical space and for the combination of stormwater management improvements area wide, an effective comparison and rating methodology must be developed to prioritize and recommend stormwater management improvements for a SGIA. The ability to compare multiple stormwater improvements and various combinations of those improvements to arrive at a selected set is absolutely imperative. Comparison and rating methodology can be flexible but sustainability, multiuse benefits, and triple bottom line benefits are important considerations and should be included.

- **Implementation Strategy**: To make the SGIA Stormwater Improvement Plan more practical, a phasing and implementation strategy should be prepared for the combination of stormwater improvements.

Each Stormwater Improvement Plan will be a combination of text and supporting graphics that demonstrates how the evaluation objectives were addressed and resulting outcomes including the recommended type of stormwater management facilities; approximate sizing, layouts, and placement based upon drainage patterns; the impervious area managed; and the runoff volume managed and cost estimates for implementation. Cost estimates will include estimated project costs as defined by the Association for the Advancement of Cost Engineering Practice No. 18R-97 and present worth costs for operation and maintenance. Detailed concept designs would include a higher level of detail, and would be completed as a next phase.

**SGIA Prioritization Criteria**

**Feasibility/Cost of GSI implementation:**
- Large, contiguous impervious cover
- Topography/surface drainage
- Area served by separate storm sewers
- Land use type
- Open space for GSI installation

**Visibility, Community Gateways:**
- Showcase early successes
- Demonstrations to stakeholder group
- High visibility areas with uniform land ownership (i.e. campus scale)

**Partnership Opportunities:**
- Substantial stakeholder interest
- Favorable partnership opportunities
- Consistency with City master plan

**Social Benefits:**
- Addresses community needs
- Equitable distribution of investment
- Benefits to underserved neighborhoods

**Other Planned Investments:**
- Area of flooding, water-in-basement, or other unauthorized releases
- Areas where other planned water and sewer or GSI investments are needed
- Areas of concentrated development or redevelopment investment

**Existing framework**
- Concentration of properties impacted by parcel based stormwater charges,
- Existing neighborhoods
- Areas of common land use
- Business or industrial districts

**Interagency Collaboration and Synergies:**
- Collaborating with other potential implementation initiatives

**Other criteria yet to be identified**
Greening of Publicly-Owned Facilities and Tax-Exempt Properties

Major public entities within the City include the Commonwealth of Pennsylvania, Harrisburg Public Schools, public parking facilities, Harrisburg-Area Community College, the Harrisburg Housing Authority, and City/County Parks. Hospitals/medical facilities, churches/religious institutions, and railroads make up the majority of non-public tax-exempt properties.

Publicly-owned facilities and tax-exempt properties are highly visible, engage a broad segment of CRW’s rate payers, and are potential partners in public education and “green” job training. As such, they have been afforded a high priority in CRW’s GSI program. Improvements at public/tax exempt institutions are envisioned to utilize an array of stormwater measures such as rain gardens, green roofs, rain barrels, and cisterns. These sites offer significant potential for the incorporation of pervious pavement and tree plantings both on parking and recreational facilities, transforming heat-trapping asphalt zones into more welcoming, cooler, green areas. This initiative will provide educational opportunities for students and instructors, enhanced recreational amenities, aesthetic improvements, and potential reductions to stormwater bills. CRW intends to develop a cooperative implementation approach with these institutions with the following functions:

- Evaluate and prioritize sites based on the following factors: impervious area, provision of additional amenities, maintenance requirements, etc.
- Collaborate with project partners to develop a coordinated implementation process that addresses gaps/inefficiencies in design, outreach, and construction schedules.
- Use community feedback to begin design of stormwater management features on selected school sites, coordinating with project partners at predetermined intervals of the design process.
- Obtain proper easements and/or deed restrictions required for maintenance obligations.

9.2.2.6 Vacant Property Re-Utilization Opportunities

Vacant land, while not all publicly owned, presents an opportunity for stormwater management, both for permanent green redevelopment and for more temporary measures such as the creative use of vacant parcels for management of stormwater from surrounding areas. The challenge, however, is that vacant lands by nature may be vacant only temporarily, and it is often difficult to assess the future potential use of a vacant site. As such, CRW has prioritized larger sites, and plans to continue to consider the opportunities that may exist on smaller sites.

In the Community Greening Plan, vacant parcels within the combined sewer area of Harrisburg were reviewed to identify sites that could manage runoff from both impervious areas within the site and from adjacent streets and sidewalks (see below).

Sites were assigned low priorities if they had unfavorable site characteristics, such as small drainage area, poorly suited topography, structures, severe dumping activity, a long distance to a CRW stormwater inlet, mature trees on site, or potential soil contamination. Sites were eliminated during this initial analysis if they are scheduled for future development. Site visits
Vacant Land Screening Process

Complete a GIS analysis to identify vacant land groupings (adjacent parcels)
- Exclude parcels that are potential pollutant hotspots (those that have known histories of industrial land use)
- Search for sites within 15 feet of a CRW inlet – these are sites that are most likely to be able to collect runoff from the right-of-way (ROW)

Categorize groupings by ownership as public, private or multiple owners
- Public: minimum total site area: 2,000 square feet
- Private: minimum total site area: ¼ acre
- Multiple: minimum total site area: ¼ acre

Phase 1: Desktop Analysis
- Primary consideration: determining the amount of runoff that could be collected from the ROW
- Adjacent drainage areas were calculated including streets and sidewalks along the site
- Potential drainage areas were calculated including areas across the street where appropriate
- Minimum adjacent drainage area: 9,000 square feet – sites not meeting this criterion were eliminated
- The list of potential sites was further refined to exclude sites currently in use, sites with impeding structures or sites with development initiatives underway
- Additional impervious area on site for which runoff could be managed was included in the final potential project area amount.

Phase 2: Perform Site Visits
- Site visits were conducted to verify data or adjust information as needed
- Constraints and opportunities were observed and documented related to topography, on-site structures, dumping and adjacent land uses

were conducted to verify data or adjust information as needed. Potential partners for the re-utilization of vacant land include the Harrisburg Redevelopment Authority (Land Bank) and the Dauphin County Land Bank Authority.

9.2.2.7 Green Parking Lots Initiative

Parking lots constitute approximately 25 percent of the impervious cover in the City and greening them offers significant opportunities to reduce stormwater runoff. The greening of parking lots can improve the appearance of the City’s commercial and business districts. Additionally, the incentives provided by CRW’s Parcel Based Billing initiative may make retrofits aimed at reducing stormwater fees more feasible for private parking lots. A variety of stormwater measures can be used to remediate the effects of parking lot runoff, including vegetative strips, infiltration beds, tree plantings, porous pavement, and the development of green roof areas on parking garages. Benefits to the City of greening parking facilities may include:

- Improved community aesthetics and urban design
- Potential low-cost solutions
- Potential community engagement opportunities
- Reductions to stormwater bills for the parking lot owners
City-owned parking facilities will be targeted as a demonstration of the City’s commitment to using GSI in the role of CSO control. CRW will work with the City to consider Zoning Code and/or additional ordinance enhancements to require green buffers around parking facilities to include the function of a stormwater management measure.

CRW’s green parking lot initiative will evaluate two strategies: depaving and prioritizing public parking lots for incorporating GSI. Some projects may utilize both strategies. Depaving projects would involve the removal of large sections of asphalt, replacing it with GSI such as rain gardens to manage stormwater runoff from the remaining impervious areas. CRW is following a nationwide movement to remove unnecessary impervious surfaces to create urban green space (see www.depave.org). CRW believes depaving projects offer a high benefit-to-cost ratio. These projects may be eligible for grant funding and are of relatively low cost due to little if any design necessary and the potential for volunteer labor to break apart the paving materials. In addition to depaving project areas, one of the goals of the depaving projects is to educate local volunteers and community members about watershed health, by involving them in the design and construction of a collaborative project.

### 9.2.2.8 Implementation Services

Table 9-5 lists the types of services under CRW’s Decentralized Green / Grey Implementation Strategy.

<table>
<thead>
<tr>
<th>Type of Service</th>
<th>Description</th>
<th>Existing Service?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neighborhood Planning and Concept Development</td>
<td>Administer Pilot and Demonstration Projects, integrate GSI into Synergistic Project Opportunities, prepare stormwater improvement plans for Strategic GSI Implementation Areas, evaluate vacant property re-utilization opportunities and green parking lots initiative.</td>
<td>Partial</td>
</tr>
<tr>
<td>Development Review/ Stormwater Control Inspections</td>
<td>Review/approve development/redevelopment plans and credit applications, inspect Stormwater Control Measures.</td>
<td>Partial</td>
</tr>
<tr>
<td>Integrated CRW Regulations/ Technical Guidelines</td>
<td>Enhance and enforce stormwater regulations, prepare guidance documents, typical details, and standard specifications for GSI</td>
<td>Partial</td>
</tr>
<tr>
<td>Stakeholder Engagement Services</td>
<td>Engage stakeholders as necessary to support decentralized green/grey implementation strategy</td>
<td>Yes</td>
</tr>
</tbody>
</table>

### 9.2.3 Asset Operation and Maintenance Strategy

CRW is committed to ensuring that its stormwater/wastewater assets, including SCMs implemented to control CSOs, MS4 discharges, and unauthorized releases, continue to operate as designed. CRW is evaluating and documenting maintenance requirements of green stormwater infrastructure, and plans to prepare a Green Stormwater Infrastructure Maintenance Manual Process Plan. CRW anticipates SCMs both from public and private investments, each requiring ongoing inspection and maintenance. CRW’s GSI maintenance program seeks to:

- Ensure sufficient maintenance of GSI to keep assets performing as designed,
- Develop long-term maintenance and monitoring protocols,
▪ Assess existing organizational capacity for supporting maintenance and monitoring among CRW's partnering organizations, and
▪ Provide feedback loops to inform the GSI design group based on maintenance, inspection and monitoring experiences to improve future designs.

Over the initial implementation phase, CRW will develop guidelines for an expanded maintenance program as the number of GSI sites increases.

9.2.3.1 Monitoring, Controls and Telemetry
Most components of CRW's AWTF and collection system are old and in need of replacement and renewal. Outmoded monitoring and control systems are in need of replacement, a key consideration of the many baseline alternatives to rehabilitate and enhance major systems at the AWTF and two major pumping stations. It is anticipated that modern monitoring and control technologies will be included in these projects.

In addition, the baseline alternative describes a major upgrade to CRW's CSO regulators, replacing existing Brown and Brown regulators with modern gates and controls to better direct wastewater flows to the interceptor, prevent interceptors from surcharging into the regulators, and limit river intrusion. Design of these enhancements will include evaluation of appropriate technologies, and give consideration to technologies that can provide real-time operation and have the capability to be linked into a telemetered system. Pilot testing of monitoring and telemetry of CSO detection devices found promise in such technologies, but observed that technologies are rapidly evolving and a final decision on the level of monitoring, control, and telemetry should be deferred until regulator upgrades are imminent. At this time, CRW will apply its H&H model to evaluate potential operational strategies and further define beneficial uses of available technologies to optimize system operation and minimize CSOs.

9.2.3.2 Maintenance of Public Facilities
CRW intends to maintain publicly funded GSI projects at regular intervals. To do this, CRW needs to determine the maintenance needs associated with various types of SCMs, to better understand maintenance costs, and to gather information needed to establish a long-term maintenance and monitoring program for CRW. CRW anticipates that future SCM design modifications may be influenced by previously built demonstration projects through multiple feedback and communication pathways.

9.2.3.3 Maintenance of Private Facilities
CRW anticipates that SCMs will be designed, built, owned, and operated by the private sector as areas of the City are redeveloped, triggering the City's Stormwater Regulations. CRW needs to develop several mechanisms to ensure that the stormwater management facilities put in place by private entities will continue to function as designed.

The City's Stormwater Regulations will be revised to require that an Operations and Maintenance (O&M) Agreement is recorded against the land deed(s) associated with the development project prior to CRW signing off on a building permit application. The O&M Agreement's purpose is to clearly define the location of the SCMs on the property and to record the proper maintenance practices and schedule for each SCM type.
The O&M Agreements must also provide CRW with the right to inspect SCMs to verify that they are properly functioning and that maintenance is occurring. If a property owner fails to properly maintain the system, the Agreement must provide CRW with the ability to correct deficiencies and charge the costs of repairs to the property owner.

CRW inspects construction sites during the installation of SCMs so that functional problems can be addressed before the maintenance period starts. As-built plans are required after SCMs are constructed and the provision of detailed drawings is important for planning and administering proper maintenance activities.

Maintenance and monitoring activities will remain the responsibility of the private owner or operator. If inspection or monitoring reports indicate that an SCM is no longer functioning, there are several maintenance response mechanisms CRW should have the right to implement. CRW will evaluate the following options to increase enforcement and ensure the long-term maintenance of private GSI:

- Remove the stormwater credit from the property's water bill,
- Perform necessary maintenance or repairs on the SCM and bill the work back to the property owner,
- Work with PA-DEP to enforce compliance with NDPES permits and Post Construction Stormwater Management Plans, and
- Develop a new enforcement procedure in the Harrisburg Stormwater Regulations allowing CRW to issue fines for non-compliance with the approved Stormwater Management Plan.

CRW will use a combination of these approaches to ensure long-term maintenance of private SCMs.

**9.2.3.4 Green Stormwater Infrastructure Maintenance Manual Process**

CRW intends to prepare a Green Stormwater Infrastructure Maintenance Manual Development Process Plan that describes the process leading to the development of the Green Stormwater Infrastructure Maintenance Manual. Described herein are anticipated tasks necessary for developing this deliverable and preparing CRW for development of the Green Stormwater Infrastructure Maintenance Manual.

**Green Stormwater Infrastructure Maintenance Manual Process Plan Development Tasks**

Program support needs will be evaluated as the number of SCMs to be maintained increases. Initial estimates will be based on current staffing and budgeting, with an evaluation of the projected needs as the program evolves.

Quantitative and qualitative data from monitoring reports will be used to determine the appropriate level of monitoring, maintenance and data reporting for each type of SCM in the long-term. Data from on-going maintenance of current publicly-owned SCMs will also provide cost estimates for the maintenance of SCMs and will help CRW determine a budget for SCM maintenance.
CRW intends to compile SCM maintenance protocols from across the country. The compiled information will be used to better understand routine maintenance tasks and their recommended frequency. This research will also help CRW develop standard operating procedures (SOPs) for maintenance and construction processes.

As described in Section 10, CRW is developing a City Beautiful H₂0 Program tracking system to store standard data input forms, process the input data, and connect with the Cityworks Maintenance Management System. The Cityworks system is where maintenance, monitoring and inspection activities will be scheduled and tracked. The tracking system will track information collected during the maintenance process. This system could be used to electronically notify the respective units of projects requiring attention. CRW views this centralized system as a tool for staff and contractors to view equipment needs for the assigned tasks, to view past work on the site, and to download site plans including as-built plans. Reporting and feedback loops between CRW and other agencies for public and private SCM development should be formalized so that maintenance activities are triggered by appropriate monitoring and inspection data.

CRW will continue research to refine SOPs for SCMs, and will determine maintenance schedules and checklists, as appropriate. Maintenance responsibilities specific to each SCM type will be added to the Green Stormwater Infrastructure Maintenance Manual. This will standardize maintenance practices and eliminate the need for details to be located in individual O&M agreements attached to deeds.

The training of maintenance staff and contractors should be integrated with the training of inspection and monitoring staff. This will ensure that all three groups understand how their actions and testing results can trigger actions by another group. Common monitoring and inspection triggers and maintenance responses should be extracted from CRW research and earlier maintenance contract reports. Once the common triggers are identified, monitoring and inspections units must be informed of what to look for and what data to collect. It is also important to ensure that there is communication with property owners adjacent to SCMs to inform them how they may support site maintenance with periodic evaluation for trash removal, by watering of vegetation, and by contacting the appropriate unit within CRW if an issue emerges.

The Private Green Stormwater Infrastructure Inspections program will expand to include periodic post-construction inspections to ensure long-term maintenance of the SCMs. This will require additional staff, training for developers and contractors, and establishment of a defined inspection schedule based on a number of criteria. A framework for this program’s development will be included in the Green Stormwater Infrastructure Maintenance Manual Development Process Plan. A full program description will be included in the Green Stormwater Infrastructure Maintenance Manual.

To formalize the post-construction process to ensure long-term maintenance, CRW is considering the following options:

- Use right-to-access for regular inspections of all sites at least once a permit cycle (every 5 years)
- Random inspections
- Targeted inspections to supplement and enforce a self-inspection program
- On-going inspection program

Table 9-6 lists the types of services under CRW’s Asset Maintenance Strategy.

Table 9-6: Services to Implement CRW’s Asset Maintenance Strategy

<table>
<thead>
<tr>
<th>Type of Service</th>
<th>Description</th>
<th>Existing Service?</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWTF O&amp;M</td>
<td>Operate and maintain CRW’s AWTF</td>
<td>Yes</td>
</tr>
<tr>
<td>Pump Station O&amp;M</td>
<td>Operate and maintain CRW’s pumping stations</td>
<td>Yes</td>
</tr>
<tr>
<td>Interceptor O&amp;M</td>
<td>Operate and maintain CRW’s interceptors</td>
<td>Yes</td>
</tr>
<tr>
<td>Collection System O&amp;M</td>
<td>Operate and maintain CRW’s inlets and collection system</td>
<td>Yes</td>
</tr>
<tr>
<td>Street Sweeping</td>
<td>Perform as necessary</td>
<td>Yes</td>
</tr>
<tr>
<td>Environmental Compliance/ Illicit Discharge Investigations</td>
<td>Administer industrial pretreatment program, enforce pollution prevention and illicit discharge detection/elimination regulations</td>
<td>No</td>
</tr>
<tr>
<td>GSI/SCM inspections and O&amp;M</td>
<td>Inspect private and maintain public GSI/SCMs, including preparation of O&amp;M guidance and plans</td>
<td>No</td>
</tr>
<tr>
<td>Other Operations Management</td>
<td></td>
<td>Yes</td>
</tr>
</tbody>
</table>

9.2.4 Internal and Intergovernmental Communications and Coordination

CRW will continue to promote effective interagency coordination to define strategic policies and streamline protocols and communication pathways to better align with full-scale GSI implementation. In addition, an Internal Communications Plan to improve synchronization within CRW is in development.

9.2.4.1 Strategic Policy and Coordination Program

One of the first steps in the evolution from demonstration to implementation is the initiation of an internal staff evaluation aimed at understanding staffing needs to support programmatic expansion. This Strategic Policy and Coordination Program will identify and evaluate policy barriers to the Program Plan implementation, and will initiate strategies to address these challenges. Many of the priority policy and coordination needs will be identified by CRW Engineering to build the queue of projects for implementation. A liaison position will be created to collect and prioritize policy and coordination needs as they develop, and to ensure that they are evaluated by the Strategic Policy and Coordination staff.

The group also will track local, state and federal policy developments that may affect City Beautiful H₂O Program goals, and will identify strategies to address or respond to them. This group will centralize coordination with other City and Non-City agencies to achieve policy goals and realize opportunities to enhance the City Beautiful H₂O Program.

9.2.4.2 Internal Communications Plan

As described in Section 2, CRW is a large agency with employees that run its various programs and meet compliance obligations. With so many regulatory tasks under its purview, CRW has over the years separated responsibilities among its working groups for the sake of efficiency. In an effort to better understand the responsibilities of these groups, to streamline processes where
possible, and to raise efficiency in tackling implementation commitments, CRW is developing an Internal Communications Plan. This plan will identify key points of contact and clarify roles and responsibilities intended to improve the effectiveness of internal collaboration, maintain a shared vision, and support the realization of Partial Consent Decree (PCD) obligations.

9.3 Implementation Assessment and Adaptive Management Strategy

Implementation of the requirements within the approved PCD will rely upon an adaptive management process. An adaptive management approach requires flexibility and periodic program assessments throughout the implementation period. Adaptations in the management approaches are expected throughout this period to ensure that compliance goals are met, to optimize and enhance the program, to maximize benefits and minimize the costs of implementation. Major decisions on management approaches will be made in year 10 of the Program Plan and every five years thereafter based on progress toward the goals and will be described in EAPs.

9.3.1 Adaptive Management Triggers

This Program Plan outlines an adaptive management process with “decision points”. These decision points are used to evaluate progress towards Program Plan implementation and determine refinements to the implementation approach gained from “lessons learned” and new information acquired during the implementation period. These quantitative targets require the development of a number of policy and infrastructure tools in the first ten years, and in subsequent years, in particular to support GSI implementation within affordability constraints. The GSI component of the Program Plan is intended to provide for the gradual, continual conversion of the hydrologic characteristics of the Harrisburg combined and separate sewer areas that will consequently reduce the frequency and volume of overflows from the combined sewer system and improve the quality of MS4 discharges. The more traditional infrastructure elements of the Program Plan implementation program, including implementation of AWTF and conveyance system upgrades, also should be evaluated to assess their progress toward the process components outlined in the facility concept plans.

9.3.2 Financial Capability Re-Assessment

Financial capability will help determine what programmatic changes will be feasible, necessary, and achievable. Local economic conditions, including changes in household income, revenue, capital spending in response to new regulations or requirements, construction and operating costs, and CRW’s financial position and cost of capital, will be assessed. Adjustments to the program that either increase the rate of progress toward goals or decrease spending to avoid economic hardship will be considered.

9.3.3 Evaluation and Adaptation Plans

To illustrate potential program modifications with approved EAPs, CRW developed a program implementation schedule, presented in Section 11. This schedule is intended to illustrate that a program modification could be made once, at year, 10, 15 or 20 and then not needed again for the life of the program, or a program modification might be incorporated at each decision point, or may never be needed at all. Each EAP will be a comprehensive assessment of CRW’s progress.
towards full implementation of the approved Program Plan with descriptions of program elements expected to be implemented in the next reporting period. Each EAP also should include the following components:

- Performance tracking of the Program Plan using H&H models that have been validated with monitoring data, as described in Section 10 of this Program Plan.

- Up-to-date values for each reporting metric with detailed descriptions of how the reported values are estimated and an assessment of how each metric's reported value compares to the Performance Standards defined in this Program Plan.

- If any reported metric value does not equal or exceed the corresponding Performance Standard, CRW will include in that EAP an adaptive strategy for altering appropriate elements of program implementation. This strategy shall describe how CRW proposes to ensure that the metric will meet the appropriate Performance Standard by the date of the next EAP.

- Up-to-date values for the following additional metrics:
  - Number of decentralized control (green/grey) projects and the impervious area they control.
  - Volume of stormwater (in million gallons per year) managed by new infrastructure, not including decentralized control (green/grey) projects.
  - Volume percent capture for the combined sewer system as a whole.
  - Customer reports of unauthorized releases and SSOs, and detailed plans/schedules for system improvements to address them.
  - CCTV inspection results and collection system assessment findings, defining risks, priorities, and budgets for collection system rehabilitation.

The EAP will include a description of the outcome of adaptive management decisions and changes in implementation for the next reporting period. Any proposed change in priorities or approach for meeting the milestones in the reporting period will be described in this section, including altering approaches to implementing GSI and, if necessary, targeted traditional infrastructure investments or changes in design approaches. The modified approach would provide details on a project or series of projects that would compensate for missed metrics associated with the Performance Standards.

### 9.3.4 Adaptive Management Reporting

Updates on the adaptation of the implementation program will be provided through CRW's annual reporting process. If CRW fails to achieve one or more of the metrics documented in an EAP, the subsequent Annual Reports shall include an update describing progress towards meeting those metrics. Such updates must be provided in subsequent Annual Reports until all the applicable metrics have been achieved.