# 1 INTRODUCTION AND BACKGROUND

## 1.1 THE CITY OF PHILADELPHIA COMBINED SEWER OVERFLOW (CSO) LONG TERM CONTROL PLAN UPDATE (LTCPU)

The City of Philadelphia has undertaken an update to its CSO Long Term Control Plan (LTCP) commitment – first adopted in 1997. This LTCPU builds on the solid foundation established by the LTCP and furthers the City's commitment to watershed based planning and implementation. The Philadelphia Water Department (PWD) has adopted a restoration strategy that acknowledges the inseparable linkage between land use and water resource protection. When cities invest in green stormwater infrastructure and other innovative, cost-saving strategies to manage their stormwater, they are not only ensuring the rebirth of the ecological resources of the City's waterways but are also striving to provide a host of other environmental, social and economic benefits that will preserve the vitality of our nation's cities.

*What is different about this LTCPU?*

PWD's implementation approach has been developed to integrate the management of Philadelphia's watersheds into a larger context such that the program is designed to provide multiple benefits beyond the reduction of combined sewer overflows, so that every dollar spent provides a maximum return in benefits to the public and the environment. The City of Philadelphia's LTCPU seeks to meet the regulatory requirements of the National CSO Control Policy ("the Policy") through a comprehensive watershed-based approach, such that the CSO program is just one piece of their larger Integrated Watershed Management Planning Program. The Policy acknowledges the importance of watershed planning in the long-term control of CSOs and lays the groundwork for PWD's commitment to watershed-based planning as initiated in the City's original LTCP commitment in 1997. The City of Philadelphia's LTCPU is additionally fortified by the recent green infrastructure guidance and policy documents developed by the United States Environmental Protection Agency (US EPA). With this vision, the LTCPU takes the emphasis off of capital investments that are implemented out of the public view (*i.e.*, underground or in pipes) and instead focuses a program on specific benefits to the residents of the City of Philadelphia by restoring environmental amenities for our constituents and "greening" our City.

To that end, PWD has contracted with a top economic consulting firm to undertake what is called a "triple bottom line" analysis to assess the environmental, social, and economic benefits of the program. This triple bottom line accounting presents a means of expanding traditional cost-benefit analyses to take into account the additional ecological and social benefits in order to provide information for a more comprehensive cost and benefit analysis. Triple bottom line accounting attempts to describe the social and environmental impact of PWD's proposed infrastructure investment such that they can account for not only the water quality benefit that the infrastructure would produce, but also the additional environmental and societal benefits generated by the various implementation approaches. Understanding the full societal costs and benefits is important in justifying the program with the ratepayers, who will ultimately pay for this large public works project. In fact, PWD's *Green City, Clean Waters* program represents the largest green stormwater infrastructure program ever envisioned in this country.

*Green City, Clean Waters* is the vision developed by PWD to convey the goals of several long-term planning initiatives aimed at improving the environment of the Philadelphia area while addressing combined sewer overflow reductions. Central to all these planning programs is a commitment to

greening, sustainability, open space, waterfront revitalization, outdoor recreation, and quality of life. Incidental to compliance with the policy is that this LTCPU will also help to further the challenge set forth in 2007 by the Mayor of Philadelphia, Michael A. Nutter that the City of Philadelphia becomes the "greenest city in America."

### 1.1.1 Philadelphia Water Department

PWD is well suited to undertake the development and implementation of a watershed approach to CSO control. PWD owns and operates the City of Philadelphia's sanitary sewers, storm sewers, combined sewers, and wastewater treatment plants. In cooperation with the Philadelphia City Planning Commission, PWD regulates stormwater management during the construction and post-construction phases of most development and redevelopment projects.

Through a reorganization in January 1999, PWD integrated three historically separated programs: Combined Sewer Overflow, Stormwater Management, and Source Water Protection. PWD's mission is to preserve and enhance the health of the region's watersheds through integrated wastewater and stormwater services and the adoption of a comprehensive watershed management approach that achieves a sensible balance between cost and environmental benefit and is based on planning and acting in partnership with other regional stakeholders.

PWD is committed to a balanced "land-water-infrastructure" approach to achieve its watershed management and CSO control goals. Where appropriate, this method includes infrastructure-based approaches, but focuses on implementation of a range of land-based stormwater management

**PWD *Green City, Clean Waters* Vision:**

PWD's vision *Green City, Clean Waters* is to unite the City of Philadelphia with its water environment, creating a green legacy for future generations while incorporating a balance between ecology, economics, and equity.

This long-term vision for the City of Philadelphia integrates CSO and water resources management into the socioeconomic fabric of the City by creating amenities for the people who live and work here. This vision includes:

- Large-scale implementation of green stormwater infrastructure to manage runoff at the source on public land and reduce demands on sewer infrastructure
- Requirements and incentives for green stormwater infrastructure to manage runoff at the source on private land and reduce demands on sewer infrastructure
- A large-scale street tree program to improve appearance and manage stormwater at the source on City streets
- Increased access to and improved recreational opportunities along green and attractive stream corridors and waterfronts
- Preserved open space utilized to manage stormwater at the source
- Converted vacant and abandoned lands to open space or redeveloped responsibly
- Restored streams with physical habitat enhancements that support healthy aquatic communities
- Additional infrastructure-based controls when necessary to meet appropriate water quality standards

techniques and physical reconstruction of aquatic habitats where appropriate. The ultimate goal of PWD's approach is to regain the resources in and around streams that have been lost due to urbanization, both within the City of Philadelphia and in the surrounding counties, while achieving regulatory compliance objectives in a cost-effective manner.

## 1.2 EVOLUTION OF PWD'S CSO IMPLEMENTATION COMMITMENTS

In 1997 PWD committed to a LTCP that included a strategy to attain water quality improvement goals in three primary phases: aggressive implementation of a comprehensive program for Nine Minimum Controls (NMC); planning, design and construction of 17 capital projects that further enhance system performance and reduce CSO volume and frequency; and, commitment of up to $4 million in services and resources toward comprehensive watershed based planning and analyses that will identify additional, priority actions to further improve water quality in Philadelphia area water bodies. Within this section is a brief description of accomplishments based on these commitments set forth in the 1997 LTCP.

In preparation for the 1997 commitment, PWD submitted a "System Inventory and Characterization," to Pennsylvania Department of Environmental Protection (PADEP) and US EPA on March 27, 1995. This document included an inventory of overflow points and hydraulic control points. PWD also submitted a "System Hydraulic Characterization," to PADEP on June 27, 1995. This document included a system description, discussion of a technical approach to CSO modeling, and hydraulic analysis results. Both of these reports are available for download at http://www.phillyriverinfo.org/CSO.

### 1.2.1 Document Implementation of the NMC (Phase 1)

In the first phase of PWD's CSO strategy, and in compliance with its Non-Point Discharge Elimination System (NPDES) permits, PWD submitted "CSO Documentation: Implementation of Nine Minimum Controls," to the PADEP on September 27, 1995. The NMC are low-cost actions or measures that can reduce CSO discharges and their effect on receiving waters, do not require significant engineering studies or major construction, and can be implemented in a relatively short time frame. To provide information needed for the development of the NMC program, PWD instituted a $6.5 million project to upgrade its comprehensive system flow monitoring network. This program provides information necessary to identify and eliminate dry weather overflows, monitor system performance and operation, and configure and calibrate computer hydraulic models needed to develop the NMCs and long-term CSO control plans. This information provided the basis for the "System Hydraulic Characterization" report and provided the technical basis for the development of the NMC plan. The NMCs are:

1. Review and improvement of on-going operation and maintenance programs
2. Measures to maximize the use of the collection system for storage
3. Review and modification of PWD's industrial pretreatment program
4. Measures to maximize flow to the wastewater treatment facilities
5. Measures to detect and eliminate dry weather overflows
6. Control of the discharge of solid and floatable materials
7. Implementation of programs to prevent generation and discharge of pollutants at the source
8. Public notification of CSO impacts
9. Comprehensive inspection and monitoring programs to characterize and report overflows and other conditions in the combined sewer system

### 1.2.2 Technology Based Capital Improvements - Long Term CSO Control Plan (Phase 2)

The second phase of PWD's CSO strategy focused on technology-based capital improvements to the City's sewerage system to further increase its ability to store and treat combined sewer flow, reduce inflow to the system, eliminate flooding due to system surcharging, decrease CSO volumes and improve receiving water quality. This amounted to a commitment of just under $50 million. The recommended capital improvement program was the result of a detailed analysis of a broad range of technology-based control alternatives.

The capital improvement plan encompassed the three major areas of the City that are affected by CSOs: the Northeast, Southeast and Southwest Drainage Districts. Table 1-1 provides a status update on the 17 capital projects selected by PWD to provide significant CSO load reduction. The total expenditures toward implementation of these capital projects to date are in excess of $128 million.

**Table 1-1 Summary of Phase II Capital Projects**

| Project | LTCP Estimated Costs (based on 1997 estimate costs) | Construction Costs (based on original contract) | Status |
|---|---|---|---|
| **Real Time Control (RTC) Program** | | | |
| RTC - Main Relief Sewer Storage (R-7 through R-12) | $650,000 | $5,029,919 | Completed in 2007 |
| RTC - Tacony Creek Park Storage (T-14) | $450,000 | $4,500,000 | In-progress as of 2008 |
| RTC - Rock Run Relief Sewer Storage (R-15) | $490,000 | $3,665,000 | Completed in 2008 |
| Establish Real Time Control (RTC) Center | $350,000 | $1,000,000 | Completed in 2006 |
| RTC & Flow Optimization (Southwest Main Gravity Interceptor, Cobbs Creek Cut-Off, and Lower Schuylkill West Side) | $1,750,000 | $4,657,690 | In-progress as of 2008 |
| **Outfall Elimination** | | | |
| Eliminate Outfalls: Dobson's Run Phase I | $6,200,000 | $7,040,000 | Completed in 1998 |
| Eliminate Outfalls: Dobson's Run Phase II & III | $12,400,000 | $38,500,000 | In-progress as of 2008 |
| Eliminate Main & Shurs Overflow (R-20) | $12,000,000 | $46,000,000* | In-progress as of 2001 |
| Eliminate 32nd & Thompson Outfall (R-19) | $1,500,000 | $2,400,000 | Completed in 2003 |
| **Collection System Improvements** | | | |
| Upgrade Frankford Siphon | $10,000 | $50,000 | Completed in 1997 |
| Somerset Interceptor Sewer Conveyance Improvements | $300,000 | $273,867 | Completed in 1998 |
| Cobbs Creek Low Level (CCLL) Conveyance Improvements | $444,000 | $1,500,000 | Completed in 2000 |
| Cobbs Creek Low Level (CCLL) Control Project | $2,500,000 | $3,647,540 | Completed in 2000 |
| **Other Capital Programs and Projects** | | | |
| WPCP Wet Weather Treatment Maximization Program | $150,000 | $334,180 | Completed in 2001 |

| Project | LTCP Estimated Costs (based on 1997 estimate costs) | Construction Costs (based on original contract) | Status |
|---|---|---|---|
| Targeted Infiltration/Inflow Reduction Programs | $2,000,000 | $13,610,000 | On-going since 1999 |
| Solids & Floatables Control Program | $380,000 | $526,690 | Completed in 2005 and On-Going |
| 85% CSO Capture Pennypack Watershed (P1 through P5) | $230,000 | $7,339,796 | Completed in 2004 |
| **Total** | **$41,804,000** | **$140,074,662** | |

* Estimated cost to complete

### 1.2.3 Watershed-Based Planning and Implementation (Phase 3)

The third component of the City's 1997 CSO strategy involved a substantial commitment by PWD to watershed planning. This process was structured for the identification of long-term improvements throughout the watersheds, including identification of potential CSO controls, which would result in further improvements to water quality and, ultimately, the attainment of water quality standards. The need for this watershed initiative is rooted in the fact that prior to PWD's detailed watershed assessments, insufficient physical, chemical and biological information existed on the nature and causes of water quality impairments, sources of pollution, and appropriate remedial measures for these urban systems. The watershed planning included various tasks ranging from monitoring and resources assessment to technology evaluation and public participation. The watershed plan development process was detailed in the 1997 CSO LTCP as outlined as follows:

**Step 1: Preliminary Reconnaissance Survey**

- Data collection and assessment
- Preliminary water quality assessment
- Land use and resource mapping
- Inventory of point and non-point sources
- Definition of regulatory issues and requirements
- Preliminary biological habitat assessment
- Reconnaissance stream survey
- Preliminary problem assessment

**Step 2: Watershed Work Plan and Assessment**

- Monitoring, sampling and bioassessment
- Quality assurance/quality control and data evaluation
- Watershed modeling
- Waterbody modeling
- Problem definition and water quality goal setting
- Technology evaluation
- Economic assessment and funding requirements
- Public involvement
- Development of IWMP

**Step 3: Watershed Plan Implementation**

- Institutional arrangements
- Implementation programs
- Monitoring and measures of success

It is the advancement of this watershed approach that has afforded PWD with the experience and knowledge necessary to develop its current *Green City, Clean Waters* vision and this LTCPU commitment.

## 1.2.3.1 Integrated Watershed Management Plans, River Conservation Plans and Source Water Protection Plans

### 1.2.3.1.1 Integrated Watershed Management Plans (IWMPs)

The City of Philadelphia had originally committed to developing an IWMP for each of the 5 major waterways that drain to the City of Philadelphia, including the Cobbs, Tookany/Tacony-Frankford, Wissahickon, Pennypack and Poquessing in PWD's CSO and Stormwater Permits. This commitment has now been amended to include IWMP development for the in-City portions of the much larger Schuylkill and Delaware River Watersheds as well, so that all areas of the City are covered by watershed-based visions and implementation commitments.

PWD's IWMP planning process is based on a carefully developed approach to meet the challenges of watershed management in an urban setting. It is designed to meet the goals and objectives of numerous water resources related regulations and programs, and it utilizes adaptive management approaches to prescribe implementation recommendations. IWMPs focus on attaining priority environmental goals in a phased approach, making use of the consolidated goals of the numerous existing programs that directly or indirectly require watershed-based implementation. IWMPs are designed to meet the goals and objectives of numerous water resource related regulations and programs and draw from the similarities contained in many watershed-based planning approaches authored by the PADEP and the US EPA. Further, watershed planning is mandated by the CSO Policy and guidance documents and also is consistent with the Clean Water Act (CWA) and its regulations, as well as the priorities announced by US EPA's Office of Water (See EPA's Watershed Approach Framework, Office of Water, June 1996).

As PWD has developed IWMPs, a defined planning approach has evolved based on refinements that have come with each new watershed. Four major planning elements have been defined, each with multiple tasks specific to the needs of the given watershed as follows:

- Data collection, organization and analysis
- Systems description
- Problem identification and development of plan objectives
- Strategies, policies and approaches

These elements are captured within three planning steps documented in Figure 1-1.

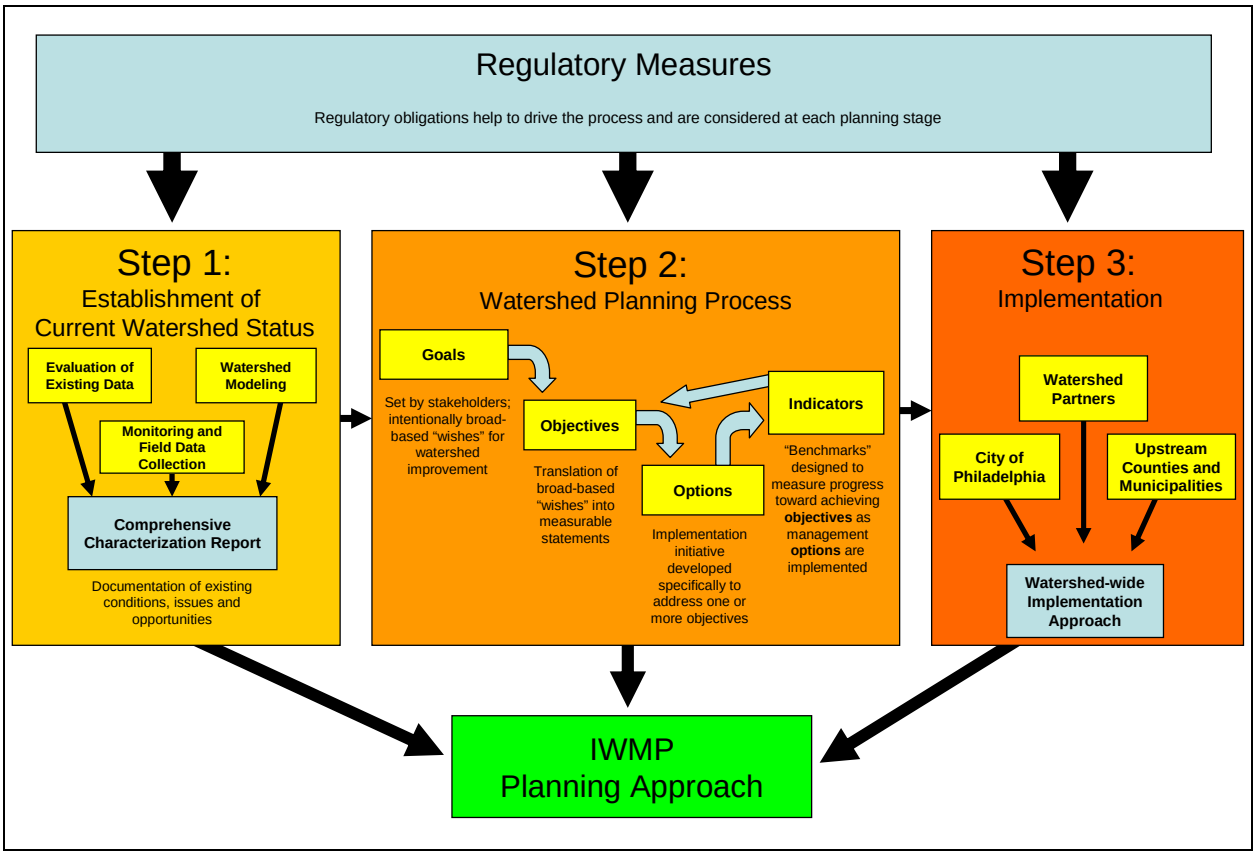



**Figure 1-1 PWD's IWMP Development Process**

*Step 1: Establishment of Current Watershed Status*

The first step in the planning process involves the collection and organization of existing and new data on surface water hydrology and quality, wastewater collection and treatment, stormwater control, land use, stream habitat and biological conditions, and historic and cultural resources in order to gain an understanding of what data already exists and where there may be gaps worth filling. Additionally, existing ordinances, regulations, and guidelines pertaining to watershed management at federal, state, basin commission, county, and municipal levels must be examined for coherence and completeness in facilitating the achievement of watershed planning goals. Data are collected from various agencies and organizations in a variety of forms, ranging from reports to databases and Geographic Information System (GIS) files.

The planning approach for an urban stream must focus on the relationship between the natural watershed systems (both groundwater and surface water) and the constructed systems related to land use that influence the hydrologic cycle, such as water supply, wastewater collection and treatment, and stormwater collection. A critical step in the planning process is to examine this relationship in all its complexity and to explore the adequacy of the existing regulatory structure at the federal, state, county, and municipal level to properly manage these natural and anthropogenic systems. Significant savings can be achieved through coordination of the programs and the development of one comprehensive plan for a watershed that meets multiple needs.

In urban watersheds, the natural systems are, by definition, influenced by the altered environment; existing conditions reflect these influences. It is not, however, always obvious which constructed systems are having the most influence or what that influence is. Analyzing and understanding the

water resources and water supply/wastewater/stormwater facilities and their interrelationship provides a sound basis for subsequent planning, leading to the development of a realistic set of planning objectives. All data collected and analyzed lead to an understanding of the existing conditions within the watershed area – known as the systems description.

Problem Identification

Existing problems and issues of water quality, stream habitat, and streamflow related to the urbanization of the watershed can be identified through previously described analyses of:

- Prior studies and assessments;
- Existing data;
- New field data;
- Stakeholder input.

Problems and issues identified through data analysis must also be compared with those brought forward by stakeholders. Ultimately, this will allow the prioritization of goals based on scientifically justified issues in the watershed.

*Step 2: Watershed Planning Process*

Development of Plan Goals, Objectives, Indicators and Options

The development of a preliminary list of goals and objectives for the watershed can be initiated simultaneously with the development of the systems description. A watershed-wide goal setting process involves the development of a "base set" of goals for the region – incorporating when available all information produced by other plans and reports. A base set of goals are then presented to the stakeholder group for evaluation. A facilitated discussion is held during which the partners are invited to add to this list of goals and finally to adopt this master list as the initial goal set for the watershed area.

Often times, this stakeholder insight may reveal "information gaps" not addressed by problem analysis that requires additional data collection. Ultimately, with stakeholder collaboration, a final list of goals is established that should reflect the multitude of stakeholder interests in the watershed.

The following example clarifies the difference between a goal and an objective:

> **Goal:** These are to be general and not specifically measurable. Goals represent a series of "wishes" for the watershed.
>
> *e.g., Improve stream habitat and aquatic resources*
>
> **Objective:** Objectives translate the goal statements into measurable parameters. The objective should lead toward the establishment of a target value and could help to establish a trend over time. There can be multiple objectives for a single goal.
>
> *e.g., Restore "x" miles of stream channel and habitat using Natural Stream Channel Design (NSCD) principles* (Note: "x" to be filled in for the given watershed based on restoration needs)

Based on the preceding descriptions, each of the goals in the master list needed to be further evaluated and *translated* into objectives so that progress would be measurable as management options are implemented in the future.

As previously noted, the Systems Description results in the identification of existing problems within the watershed area; these problems are then presented to watershed stakeholders in order to re-evaluate the master list of goals and prioritize those that directly address problems identified.

> **Management Option:** A management option is a technique, measure, or structural control that addresses one or more objectives (e.g., a stormwater best management practice (BMP) that is installed, an ordinance that gets passed, an educational program that gets implemented).
>
> *e.g., Utilize NCSD principals to restore stream corridors*

Once the final list of goals and objectives are defined, each objective is evaluated for the identification of potential management options that could be implemented to achieve the given objective. The product of this process is a comprehensive list of potential options that will need to be individually evaluated for feasibility under the conditions of a given watershed area.

> **Indicator:** Indicators can be used to characterize the current condition of a watershed area and can be used to measure progress toward goals as management options are implemented.
>
> *e.g., Macroinvertebrate and fish population diversity*

A list of indicator measures is developed to address each of the objectives so that as management options are implemented, progress can be measured toward attainment of the watershed goal. An indicator has been developed for each of the watershed objectives.

Screening of Management Options

Clear, measurable objectives provide guidance for developing options designed to meet the watershed goals. Lists of management options are developed to meet each of the goals and objectives established for the watershed and once evaluated, only those options deemed feasible and practical are considered in the final list of management options. Options were developed and evaluated in three steps:

> **Development of a Comprehensive Options List:** Virtually all options applicable in the urban environment are collected. These options are identified from a variety of sources, including other watershed plans, demonstration programs, regulatory programs, literature, and professional experience.
>
> **Initial Screening:** Some options can be eliminated as impractical for reasons of cost, space required, or other considerations. Options that are already planned and/or committed to, are mandated by another program, or are agreed upon as vital are chosen for inclusion in the final list as not needing further evaluation. The remaining options are screened for applicability to

the watershed as well as for their relative cost and the degree to which they meet the project objectives. Only the most cost-effective options are considered further.

**Detailed Evaluation of Structural Options:** Structural best management practices for stormwater management are subjected to a modeling analysis as necessary to assess effects on runoff volume, peak stream velocity, and pollutant loads at various levels of coverage.

*Step 3: Implementation Planning*

Development of planning goals through the IWMP process led to the establishment of three targets for watershed improvement and restoration based on consideration of ecology and human health in dry weather. These targets were devised in light of the fact that achievement of the intent of the CWA – including the fishable and swimmable criteria would necessitate breaking the end goal into achievable pieces.

Additionally, through PWD's experience in working with stakeholder groups in goal prioritization and option evaluation, what often emerges is that stakeholder priorities differ from those identified by the data driven problem identification process, for example stakeholders might place priority on problems associated with aesthetics, litter, dumping, etc, as opposed to macroinvertebrate diversity. PWD's target based implementation approach is able to address and show progress toward achievement of high priority stakeholder concerns while simultaneously addressing the scientifically defined priorities.

Targets are specifically designed to help focus plan implementation. By defining these targets, and designing alternatives and an implementation plan to address the targets simultaneously, the plan will have a greater likelihood of success. They also make possible the realization of accomplishing measurable progress on some of the objectives within a relatively short time frame, providing positive incentive to the stakeholders to continue to support the initiative, while also providing immediate benefits to the residents of the watershed.

The three IWMP planning targets are defined as follows:

Target A: Improvement of Stream Quality, Aesthetics and Recreation During "Dry" Weather

Streams should be aesthetically appealing, free of unpleasant odors, be accessible to the public, and be an amenity to the community. Target A was defined with a focus on trash removal and litter prevention, and the elimination of sources of sewage discharge during dry weather. Access and interaction with the stream during dry weather has the highest priority, because dry weather flows occur about 60-65% of the time during the course of a year. These are also the times when the public is most likely to be near or in contact with the stream. The water quality of the stream in dry weather, particularly with respect to bacteria, should not be impacted by human contribution of bacteria.

Target B: Preservation and Enhancement of Healthy Living Resources

Improvements to the number, health, and diversity of the benthic macroinvertebrate and fish species needs to focus on habitat improvement and the creation of refuges for organisms to avoid high velocities during storms. Fluvial geomorphological studies, wetland and streambank restoration/creation projects, and stream modeling should be combined with continued biological monitoring to ensure that correct procedures are implemented to increase habitat heterogeneity within the aquatic ecosystem.

Improving the ability of an urban stream to support viable habitat and fish populations focuses primarily on the elimination or remediation of the more obvious impacts of urbanization on the stream. These include loss of riparian habitat, eroding and undercut banks, scoured streambed or excessive silt deposits, channelized and armored stream sections, trash buildup, and invasive species. Thus, the primary tool to accomplish Target B is stream restoration.

Target C: Improvement of Wet Weather Water Quality and Quantity
The third target is to restore water quality to meet fishable and swimmable criteria during wet weather. Improving water quality and flow conditions during and after storms is the most difficult target to meet in the urban environment. During wet weather, extreme increases in streamflow are common, accompanied by short-term changes in water quality. Where water quality and quantity problems exist, options may be identified that address both. Any BMP that increases infiltration or detains flow will help decrease the frequency of damaging floods; however, the size of such structures may need to be increased in areas where flooding is a major concern. (Reductions in the frequency of erosive flows and velocities also will help protect the investment in stream restoration made as part of the Target B.)

Target C must be approached somewhat differently from Targets A and B. Full achievement of this target means meeting all water quality standards during wet weather, as well as elimination of flood related issues. Meeting these goals will be difficult, expensive, and will require a long-term effort. A rational approach to achieve this target includes stepped implementation with interim goals for reducing wet weather pollutant loads and stormwater flows, along with monitoring for the efficacy of control measures.

### 1.2.3.1.2 River Conservation Plans (RCPs)

The Pennsylvania Rivers Conservation Program is administered by the Pennsylvania Department of Conservation and Natural Resources (PA DCNR). This program is intended to conserve and enhance river resources through locally initiated plans. PA DCNR provides Rivers Planning Project grants to groups seeking to develop a RCP for a given watershed area. This funding is for completion of a RCP via identification of significant natural, recreational and cultural resources. Issues, concerns and threats to river resources and values are determined locally as part of planning, as well as recommending methods to conserve, enhance and restore Pennsylvania's many streams and rivers. Once approved by the PA DCNR, RCPs are placed on the State Rivers Registry and become eligible for PA DCNR's implementation funding.

PWD has played the roll of both lead and supporting partner in RCP planning initiatives undertaken in the regional watersheds that drain to the City of Philadelphia (Table 1-2). These plans facilitate PWD's understanding of stakeholder interests and concerns and are extremely valuable in highlighting recreational opportunities and constraints within the watersheds. And, because these plans are often initiated at least a year or so before an IWMP process, they are instrumental with bringing grassroots partners into PWD's stakeholder partnerships (described in Section 1.2.3.2).

**Table 1-2 Watershed Management Planning Status**

| Watershed | RCP | IWMP | Implementation Commitment Status |
|---|---|---|---|
| **Delaware River (tidal, non-tidal)** | Initiated in 2008 by PWD; to be completed 2010 | Initiated in 2009 | To be developed in 2009/2010 |
| **Cobbs Creek** | Darby RCP completed in 2005 by Darby Creek Valley Association | Completed 2004 | 1st 5-year Implementation Plan developed and committed to; 2006-2011 |
| **Pennypack Creek** | Completed in 2005 by PWD | Initiated in winter 2008, to be completed by 2010 | To be developed 2010/2011 |
| **Poquessing Creek** | Completed in 2007 by PWD | Initiated in 2009 | To be developed 2011/2012 |
| **Schuylkill River (tidal, non-tidal)** | Completed in 2001 by the Academy of Natural Sciences, Natural Lands Trust, and the Conservation Fund | Initiated in 2009 | To be developed 2009/2010 |
| **Tacony-Frankford Creek** | Completed in 2004 by PWD | Completed 2005 | 1st 5-year Implementation Plan developed and committed to; 2006-2011 |
| **Wissahickon Creek** | Completed in 2000 by Fairmount Park Commission | Initiated in 2005, anticipated completion of planning process for City of Philadelphia portion of the watershed 2010. | 1st 5-year Implementation Plan developed currently in development; it will cover time period from 2010-2015 |

### 1.2.3.1.3 Source Water Protection Plans (SWPPs)

The mission of PWD's Source Water Protection Program is to enhance, protect, and preserve the surface waters of the Schuylkill and Delaware Rivers to ensure a high quality and sustainable source of drinking water for future generations of Philadelphia residents. The accomplishment of this mission depends on a holistic watershed approach, a sense of common commitment and responsibility felt by all who work and reside in the watershed boundaries, and a respect for the interconnectedness between source water protection concerns, upstream land and water use, and the need to maintain a healthy aquatic ecosystem which nurtures habitat and inspires low-impact recreation. The program develops watershed protection plans, implements projects, and engages in public education programs to preserve, protect, and improve the water quality of both rivers.

In order to accomplish this mission, a 5-year strategy has been developed which is centered on the following categories:

1. Source Water Quality Enhancement and Protection – Activities that ensure long-term, sustainable improvements to the health of the Schuylkill River and Delaware River Watersheds
2. Early Warning Notifications and Event Communication – Efforts to improve notification and communication surrounding water quality events which may threaten water supply and recreational safety.

3. Drinking Water Treatment Support – Research on technologies and methods for treatment optimization, problem diagnosis, predictive analyses, vulnerability assessments, and improvements to local water quality.

PWD's Source Water Team completed a SWPP for the Schuylkill River Watershed in 2006 and for the Delaware River in 2007. PWD's source water assessment process has received an award from the US EPA and the PADEP has formally recognized both plans.

### 1.2.3.1.4 Additional Plans that Further the City's Greening Goals

A number of stakeholder groups and community development corporations (CDCs) have embarked on planning initiatives that also support the concept of "greening" the City of Philadelphia. Several of these larger plans are highlighted below, but PWD is also working with numerous stakeholders on identifying opportunities for collaborating and producing synergies by working together to accomplish our respective goals in plans both large and small.

**Greenworks Philadelphia** – the City's sustainability plan, released in April of 2009. This plan builds upon the work of the 2007 Local Action Plan for Climate Change that was produced by the Mayor's Sustainability Working Group – a task force of more than 50 municipal employees. The goal of that work group was to establish a plan to reduce greenhouse gas emissions by 10% by 2010. The Greenworks Philadelphia Plan considers sustainability through five goals including: energy, environment, equity, economy and engagement. Each of these goals has associated with it a number of measurable targets to be achieved by 2015. This plan also incorporates the goals of the City's soon-to-be-adopted open space plan – GreenPlan Philadelphia.

**GreenPlan Philadelphia** – the City's blueprint for sustainable open space, is Philadelphia's first comprehensive plan for its parks, recreation areas, and open space. GreenPlan Philadelphia will guide and inform decision-making about open space use, acquisition, development, funding, and management. It will ensure that open space continues to enhance the environmental, social, and economic well-being for the City of Philadelphia.

### 1.2.3.2 Creation of Watershed Partnerships and Stakeholder Networks

As previously described, central to PWD's comprehensive approach to urban water resources management is development of IWMPs. The IWMPs, developed in cooperation with stakeholder partnerships, are based on a carefully developed approach to meet the challenges of watershed management in an urban setting. Stakeholder support is critical to the ultimate success of a regional planning initiative. A diversity of stakeholder perspectives must be involved with the development of each stage in the planning process in order to ensure that the plan is representative of stakeholder interests. The watershed partnerships are designed to provide a forum for stakeholders to work together to develop strategies that embrace the dual focus of improving stream water quality and the quality of life within their communities. The partnership is charged with driving the process and ensuring that the process remains representative of the diversity of stakeholder perspectives. The partnerships discuss priorities and the actions necessary to make the plan successful. These actions become a part of the implementation strategy, and address the desire to improve the water and land environment through a number of avenues. The ultimate goal is to cultivate a partnership committed to implementing the plan once completed. Recognizing this, PWD has committed a great deal of resources toward establishing and supporting watershed-based stakeholder partnerships within each watershed where an IWMP is initiated.

At a minimum, PWD's watershed partnerships are comprised of representatives from each of the following: federal, state, and local government (both municipal and county) agencies, industries, local businesses, non-profit organizations and watershed residents, as well as additional interested stakeholders in the watershed.

PWD has initiated stakeholder partnerships in six of the watersheds that drains to the City of Philadelphia and also supported the large-scale Schuylkill Action Network and its "work groups". Information on each of these stakeholder partnerships is presented in Table 1-3.

### 1.2.3.3 Detailed Watershed-Based Monitoring and Assessment

As prescribed by the 1997 LTCP, PWD implements a detailed monitoring program in each watershed in which it develops an IWMP. This monitoring program includes chemical, biological and physical assessments to characterize the current state of the watershed and identify existing problems and their sources. The need for this watershed monitoring effort is rooted in the fact that prior to PWD's monitoring program, insufficient physical, chemical and biological information existed on the nature and causes of water quality impairments, sources of pollution, and appropriate remedial measures.

The purpose of the survey is to review existing information, gain a good, understanding of the physical, chemical and biological conditions of the water bodies, understand the character of the watershed land uses that will drive wet weather water quality conditions, and build a common understanding of these factors among all stakeholders. From this understanding more detailed monitoring, modeling, mapping, and analytical work can be better scoped and scheduled to meet the specific needs of the watershed.

*Comprehensive Characterization Reports (CCRs)*

A compendium document is produced following the analysis of all collected data for a given watershed; this CCR serves to document the watershed baseline health prior to implementation of any plan recommendations, allowing for the measure of progress as implementation takes place upon completion of the IWMP. The CCR is shared with watershed partners for comments and feedback.

CCRs have been completed for the Cobbs Creek Watershed in 2004, the TTF Creek Watershed in 2005 and the Pennypack Creek Watershed in 2009 (Table 1-4). These CCR documents are available on the partnership website at http://http://www.phillyriverinfo.org.

**Table 1-3 PWD Supported Watershed Stakeholder Partnerships**

| Watershed Partnership | Initiated | Status and Accomplishments |
|---|---|---|
| **Darby-Cobbs Watershed Partnership** | 1999 | PWD continues to convene the Darby-Cobbs Watershed Partnership Steering Committee and Public Education and Outreach Committee on a quarterly basis.<br><br>This partnership has collaborated on a number of on-the-ground implementation initiatives and demonstration projects including porous pavement installation at a municipal basketball court and a parking lot at a municipal complex, as well as the greening of a street that forms the "gateway" between the City of Philadelphia and Delaware County. |
| **Tookany/Tacony-Frankford (TTF) Watershed Partnership** | 2000 | As of 2007 this partnership had evolved into an independent 501(c)3 non-profit organization with a mission of implementing the IWMP for the TTF Watershed.<br><br>This partnership has collaborated on a number of initiatives – including demonstration projects on the property of Awbury Arboretum as well as Cliveden Park and Waterview Recreation Center. |
| **Pennypack Creek Watershed Partnership** | 2004 | PWD originally initiated this partnership for the development of a RCP in 2004; this group has been re-convened in 2008 for the development of an IWMP. |
| **Wissahickon Creek Watershed Partnership** | 2005 | PWD initiated this partnership in 2005 for development of an IWMP for this watershed, which had recently been the recipient of a total maximum daily load (TMDL) for nutrients and siltation. PWD continues to convene the Wissahickon Watershed Partnership Steering Committee and Public Education and Outreach Committee.<br><br>PWD has supported a number of watershed-wide data gathering and on-the-ground demonstration projects in this watershed. PWD will be putting together an implementation commitment to address the requirements of the siltation TMDL; over the coming months PWD will be finalizing their implementation commitments to this watershed |
| **Poquessing Creek Watershed Partnership** | 2006 | PWD initiated this stakeholder partnership in 2006 in support of the RCP planning process. That plan was completed and posted in 2008. PWD will be reconvening this stakeholder partnership in 2009 for the development of an IWMP. |
| **Delaware Direct Stakeholder Partnership** | 2007 | PWD initiated this stakeholder partnership in 2007 to support development of a RCP for the Delaware Direct drainage area of the City of Philadelphia. In 2009, PWD has requested that this stakeholder group remain on board to drive the development of an IWMP commitment for this watershed. |
| **Schuylkill Action Network** | 2003 | PWD has worked with the US EPA and PADEP as well as the Partnership for the Delaware Estuary to support large-scale stakeholder initiatives. |

**Table 1-4 Monitoring and Comprehensive Characterization Report Status for the City's Watersheds**

| Watershed | Preliminary Reconnaissance | Detailed Monitoring Program | CCR Production |
|---|---|---|---|
| **Delaware River (tidal, non-tidal)** | N/A* | N/A* | N/A* |
| **Cobbs Creek** | 2000/2001 | 2003 | 2004 |
| **Tacony-Frankford Creek** | 2000/2001 | 2004 | 2005 |
| **Pennypack Creek** | 2002 | 2007-2008 | 2009 |
| **Schuylkill River (tidal, non-tidal)** | N/A* | N/A* | N/A* |
| **Poquessing Creek** | 2001 | 2008-2009 | 2010 |
| **Wissahickon Creek** | 2001 | 2005-2006 | 2006 |

* A CCR will not be produced for the Delaware and Schuylkill Rivers; monitoring and data collection are ongoing in both rivers.

### 1.2.3.4 Fluvial Geomorphologic Assessment (FGM) and Streamside Infrastructure Inventory

*FGM*

PWD has committed to completing a fluvial geomorphologic assessment for the five smaller planning watersheds that drain to the City of Philadelphia, including the Cobbs, TTF, Wissahickon, Pennypack and Poquessing. Due to the size of the Schuylkill and Delaware River Watersheds, FGM assessments will not be completed on them.

The purpose of conducting the fluvial geomorphologic assessment is to document existing conditions within the waterway using Rosgen methodologies to measure channel geometry and stability parameters to determine stream classification. Additionally, a comprehensive habitat survey is completed for each watershed. Together, the measured geomorphologic channel survey and the habitat survey provide the implementers of the IWMP with a baseline for evaluating effects of urbanization, a land use and/or planning tool, a rating method specific to the watershed, potential stream and habitat restoration sites, and appropriate potential restoration strategies. This tool has the potential to help outline high priority segments of the waterway for restoration.

*Streamside Infrastructure Mapping*

PWD has additionally committed to a streamside infrastructure inventory/mapping initiative that compliments the FGM assessment. This is a watershed-wide infrastructure process that includes field survey of the entire waterway from the headwater tributaries outside the City of Philadelphia through the mainstem and tributaries in the City to the confluence with the Delaware River. Data collected as a part of this inventory process includes points such as stormwater and sanitary sewers, manholes, dams, outfalls, pipes of any kind, culverts, abutments and constrictions. Data is collected using global positioning system (GPS) coordinates and plotted into various data layers.

This assessment process has helped to identify high priority restoration projects including sites where erosion has exposed infrastructure, making it vulnerable to large debris coming downstream during storm events.

All data collected outside the City of Philadelphia has been shared with the City's partner municipalities.

### 1.2.3.5 Wetlands Assessments

PWD has completed development of wetland assessments for the Cobbs, TTF, Pennypack and Poquessing Creek Watersheds. The purpose of the assessment is to evaluate existing wetlands, evaluate select stormwater outfalls, and identify potential wetland creation sites throughout these watersheds.

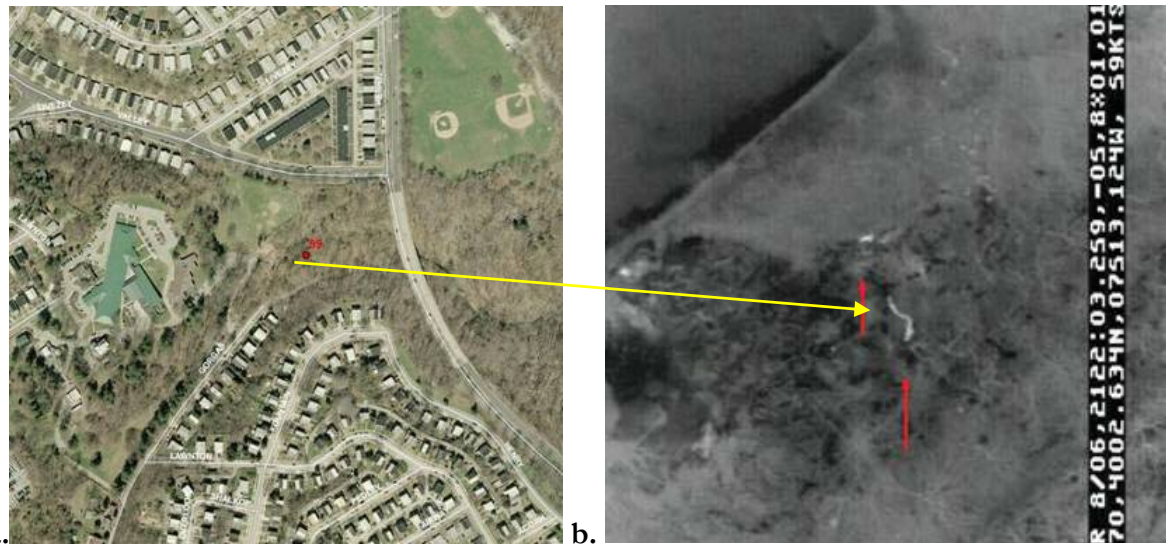
For the TTF Watershed, the assessment included the entire watershed drainage in Montgomery and Philadelphia Counties. In total, 79 sites were investigated for either the presence of wetlands or the potential for wetland creation. All sites investigated were located along one of the major waterways in TTF Watershed including tributaries. The assessment was conducted from 2001-2003 with the final report completed in 2006.

For the Cobbs Creek Watershed, the assessment included the entire watershed drainage in Delaware, Montgomery, and Philadelphia Counties. In total, 89 observation sites were investigated for either the presence of wetlands or the potential for wetland creation. All of the wetlands were located along one of the major waterways in Cobbs Creek Watershed or a tributary. Within the city limits, 11 sites were associated with wetlands. The assessment was conducted from 2001-2003 with the final report completed in 2006.

Completed wetland assessments are available online at http://http://www.phillyriverinfo.org.

### 1.2.3.6 Aerial Infrared Thermography

The purpose of this technology is to identify thermal anomalies potentially indicative of liquid contamination of the surface water. This technology utilizes aerial flyovers to pinpoint potential environmental problems such as discharges from stormwater outfalls, illicit connections to stormwater drainage systems, sanitary collection system failures/seepages, illegal dumping to streams/rivers, and other potential anomalies that may be contributing to the pollution of waterways. The resulting data set is compared with the infrastructure data in order to analyze the potential sources of thermal change in the waterway (Figures 1-2 and 1-3).



a. b.

**Figures 1-2(a) Aerial Photo and (b) Aerial Infrared Thermography Photo of Point 99**

**Figure 1-3 Point 99 – View from the Ground; Gorgas Run (Near the Intersection of Valley and Henry Ave)**

PWD embarked on a demonstration initiative to pilot this technology in several of the City's waterways to assess its effectiveness in identifying "hot spots" for illicit cross connections and compromised infrastructure. The City initiated flyovers of the Wissahickon, Cobbs and TTF waterways in winter, 2006. Flyovers were conducted watershed-wide from headwaters outside the City of Philadelphia through the confluence with the Schuylkill/Delaware. Table 1-5 shows the extent of the findings of this initial demonstration initiative.

**Table 1-5 Areas Surveyed with Aerial Infrared Thermography**

| Watershed | Area Surveyed |
|---|---|
| Tacony-Frankford Creek Watershed | Stream miles - 31 miles total (6 miles inside Philadelphia and 25 miles located outside of Philadelphia) |
| Wissahickon Creek Watershed | Stream miles - 125 miles total (21 miles inside Philadelphia and 103 miles located outside of Philadelphia) |
| Cobbs Creek Watershed | Stream miles - 17 miles total (10 miles inside Philadelphia and 7 miles located outside of Philadelphia) |

As a result of the assessment, PWD tracked and inspected 43 anomalies that are within or in close proximity to City limits. Of these anomalies, only three were confirmed sewage leaks, others were determined to be encapsulated streams or spring fed. Analyzed data was packaged and shared with each of the municipalities outside the City of Philadelphia through the Watershed Partnerships.

Due to the low cost and high quality of data produced through this initial demonstration program, PWD has committed to replicating this program again in 2010. In 2010, the Cobbs, TTF and Wissahickon will be re-flown for a second round of data collection and the Pennypack and Poquessing Creek Watersheds will be assessed for the first time.

## 1.2.4 Stormwater Management Requirements and Incentives

### 1.2.4.1Stormwater Regulation Changes

The adoption of city-wide stormwater regulations as of January 1, 2006 enabled the City of Philadelphia to review plans for both new and redevelopment sites ensuring that water quality and quantity are part of the management plan. The regulations focus on the Post-Construction Stormwater Management Plan (PCSMP), which addresses more than the typical peak rate controls

previously required. Through these regulations, stormwater management addresses smaller more frequent storms in terms of water quality volume and channel protection for all development projects throughout the City. Philadelphia's stormwater regulations are available online at http://www.PhillyRiverInfo.org.

The stormwater regulations have been enacted to address the following technical components:

> *Water Quality*: The first inch of precipitation over directly connected impervious cover must be recharged. Where recharge is not feasible or limited, then 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*: Watersheds that have been part of an Act 167 planning effort are to follow the model results for flood management districts.
>
> *Non-Structural Site Design*: Projects are required to maximize the site potential for stormwater management through appropriate placement and integration of stormwater management practices.

Implementation of the stormwater regulations will continue to improve stormwater quality and quantity impacts as redevelopment and development continues across the City. PWD is tracking the stormwater management practices implemented by private development to address the regulations. Of particular interest are green approaches that encourage the return of rainfall back to the hydrologic cycle through evapotranspiration or distributed infiltration.

The impact of the regulations in terms of total acres developed, area removed from contributing to the sewer system, volume of water quality managed, volume of stormwater infiltrated, increase in number of green infrastructure projects (*i.e.*, structural basins, green roofs, porous paving, and rain gardens) will be calculated and tracked.

### 1.2.4.2 Commitment to Act 167 Stormwater Management Planning

Recognizing the adverse effects of excessive stormwater runoff resulting from development, the Pennsylvania General Assembly approved the Stormwater Management Act, P.L. 864, No. 167 on October 4, 1978. Act 167 provides for the regulation of land and water use for flood control and stormwater management purposes. It imposes duties, confers powers to the PADEP, municipalities and counties, and provides for enforcement and appropriations. The Act requires the PADEP to designate watersheds, develop guidelines for stormwater management, and model stormwater ordinances. The designated watersheds were approved by the Environmental Quality Board July 15, 1980, and the guidelines and model ordinances were approved by the Legislature May 14, 1985.

Each county must, in consultation with its municipalities, prepare and adopt a stormwater management plan for each of its designated watersheds. Each municipality is required to adopt or amend stormwater ordinances as laid out in the plan. These ordinances must regulate development within the municipality in a manner consistent with the watershed stormwater plan and the provisions of the Act.

The City of Philadelphia has taken the lead in the development of Act 167 Stormwater Management Plans for each of the watersheds that drain to the City, through the provision of staff resources and

funding to ensure the creation of regional, watershed-based plans including:

- Cobbs Creek
- Darby Creek
- Delaware River
- Pennypack Creek
- Poquessing Creek
- Schuylkill River
- Tacony/Frankford Creek
- Wissahickon Creek

To that end, the City of Philadelphia supported the Delaware County Planning Department for the development of the Darby-Cobbs Act 167 Stormwater Management Plan – completed in 2004. The City of Philadelphia led the Act 167 Stormwater Management Planning Process for the Tookany/Tacony-Frankford Watershed – plan completed in 2008. Additionally, the City of Philadelphia signed a Phase 1 Agreement with the PADEP in July, 2008 committing to the completion of a city-wide Act 167 planning process. This city-wide Act 167 Plan will be largely based on the City of Philadelphia Stormwater Regulations. PWD is considering modifications to the current regulations, including to lower the threshold of disturbance that triggers the regulations for compliance with the regulations from the current level of 15,000 $ft^2$ to a level of disturbance of 5,000 $ft^2$. The city-wide plan will lay the groundwork for additional watershed-basin specific planning to be initiated including Pennypack Creek Watershed (initiated in fall 2008), the Poquessing Creek Watershed (to be initiated in fall 2009) and the Wissahickon Creek Watershed (to be initiated in fall 2010).

### 1.2.4.3 Storm Flood Relief Program

PWD has initiated a large-scale project to analyze and reduce property damage from flooding and basement backups including work on multiple fronts to both understand the causes of flooding as well as to start implementation of items that would be helpful to flood prone properties.

PWD has investigated, evaluated, analyzed, and looked for solutions to these problems. As part of this effort PWD has begun and will continue to:

- Inspect sewers in flood prone areas to determine if there are any obstructions and schedule appropriate maintenance where problems are found or schedule capital projects if structural problems are observed
- Collect and update data from property owners impacted by flooding
- Analyze the sewer system by hydraulically modeling the system to determine how the sewer system responds to storm events
- Coordinate with other government entities and enhance the legal framework for managing stormwater
- Provide possible remedies/solutions based upon the modeling information, which in turn is based on all of the data collected

Basement flooding has been brought to the highest priority for PWD. This is a complex problem without a quick fix, and will require a considerable amount of time and resources to analyze the problem, determine possible alternatives, and finally implement chosen solutions. PWD is committed to analyzing the problem, and searching for and implementing solutions. Information

regarding flooding is critical to understanding the problem and finding the appropriate solution. A system has been developed to collect information from residents experiencing flooding; this information is used to better understand the sewer system and how it responds to wet weather events. Flood prone areas will be modeled, analyzed, and flood management solutions/alternatives will be identified.

### 1.2.4.4 Parcel-Based Billing – Rate Reallocation

Traditionally, PWD has recovered the costs for the operation and maintenance of its stormwater system components (pipes, storm drains, pump stations, treatment facilities, and billing) through a service charge related to the customers' water meter size. This method was considered a reasonable means to approximate the contribution of a property to stormwater runoff.

However, as the City's stormwater management costs have increased, it has become more important to recover the costs of management on a basis that is the most fair and reasonable to all properties that benefit from the sewer systems. In the 1990s, PWD convened a Citizens Advisory Group (CAC) to make a recommendation to the City about more equitable stormwater charges. After a two year deliberation, the CAC came to a consensus and recommended that PWD transition from a water meter-based stormwater management charge to one that was property based. At the time, PWD was unable to implement this recommendation due to technology limitations. That has since changed. Today, PWD has the information necessary to develop a more equitable program consistent with the principles recommended by the CAC, including GIS, detailed aerial photography, database coordinates, etc.

Based on recommendation of the 1996 Stormwater Citizens Advisory Council, the City has developed a stormwater charge with a formula based upon the gross size of a customer's property and the imperviousness of the property, as these two factors are most important in determining the stormwater runoff contribution of individual properties. Because the impervious factor is the most dominant factor in calculating stormwater runoff, the CAC recommended that 80% of the stormwater costs should be charged and recovered based on a property's impervious area and 20% of the stormwater costs should be based on the property's gross area.

The CAC also recognized that providing a detailed analysis of each of the City's 450,000 residential properties would be expensive and not provide a significant improvement in the fairness of property based charges. They recommended that the City's residential properties be treated as a single parcel with total gross area and impervious area factors. The total costs would be divided among all residences. This recommendation was implemented in the FY 2002 tariff and resulted in a decrease in stormwater costs to residences and other smaller meter customers.

However, at the time when the FY 2002 rates were being developed, the City did not have accurate or adequate parcel information to transition from a meter based charge to a property based stormwater charge among its larger customers. Accordingly, the meter based charge was maintained to distribute the stormwater-related costs among larger customers. In early 2006, PWD began the process of validating the City's parcel data information with the Board of Revision of Taxes database and orthographic (impervious) information. This information was available from the 2004 contracted flyover of the City. PWD staff can now analyze the approximately 40,000 non-residential accounts to determine, on an individual customer basis, the stormwater runoff contribution of each large customer parcel, in order to apply the 80/20 impervious/gross area formula. This work has been completed and is available for the next rate new tariff and planned for a multi-year period beginning in FY 2010.

PWD has proposed to transition stormwater charges among its large meter, non-residential customer base over a four year period beginning in FY 2010. This transition will result in more equitable stormwater charges that closely match the cost of managing stormwater runoff from each property. Current calculations show that the majority of large meter customers will see a reduction or otherwise minor impact on the stormwater component of their water and sewer bills. For those customers that will see noticeable increases in their stormwater fees, the department will identify opportunities on their property to decrease the amount of their impervious area and thus decrease their stormwater fees.

PWD has also evaluated properties that do not presently have a water/sewer account. These parcels also generate stormwater runoff that is managed by the City and therefore should be reasonably charged for such service. These current non-customers include parking lots, utility rights-of-way and vacant land. Current large meter customers have recognized this discrepancy, and in prior rate hearings have demanded that we charge parcels, such as parking lots, to share the cost burden of stormwater management. PWD applied the same 80/20 impervious/gross area formula to these properties to identify appropriate charges. Once the identification and corresponding stormwater calculations for these parcels are complete, stormwater costs can be spread out and shared over a larger customer base, resulting in a decrease for all current customers.

The CAC also encouraged the City to provide a means for customers to ease the burden of property based stormwater charges. Customers who have the ability to decrease the amount of directly connected impervious area (hard surfaces that direct runoff to the City's sewer system) on their property may do so using any number of stormwater management practices (rain gardens, infiltration islands, porous asphalt and sidewalks, vegetated swales, green roofs). Once a property has been retrofitted with any of these features, PWD would reevaluate its stormwater fees based on the 80/20 impervious/gross area formula.

A property based stormwater management charge will result in a fair "cost of service" that provides incentives for non-residential and stormwater only customers to incorporate green building practices, where practicable, into their sites. In addition, all customers will be more aware of the impact they have and the importance of urban stormwater management practices.

### 1.2.5 Commitment to Demonstration Projects

PWD's implementation commitment for each watershed with a completed IWMP includes a substantial commitment to demonstration projects in the first five years of the implementation planning cycle. These demonstration projects include both land based programs such as low impact development (LID) and stormwater BMPs as well as water based or in-stream work – aimed at restoring the habitat through NSCD principles.

*LID/BMP Demonstration Projects*

PWD has made a significant commitment to implementing land based demonstration projects within the City's urban drainage systems. This has been critical to PWD's understanding of the function and effectiveness of these practices under the specific conditions found within the City of Philadelphia. Table 1-6 lists the completed demonstrations projects led or substantially supported by PWD, implemented within the City of Philadelphia. Table 1-7 lists additional demonstration projects that PWD has planned and will be constructed in 2010.

**Table 1-6 Completed-Land Based Demonstration Projects Led by PWD**

| Project Name | BMPs | Watershed |
|---|---|---|
| Columbus Square Streetscape | sidewalk planter | Delaware Direct |
| Liberty Lands | rain garden, cistern | Delaware Direct |
| Police Forensic Science Center Parking Lot | curbs cuts, vegetated swales | Delaware Direct |
| Models for Stormwater Management on Reclaimed Vacant Land (North Philadelphia) - PHS | retentive grading; vacant lot restoration | Delaware Direct |
| Herron Playground | basketball court subsurface infiltration | Delaware Direct |
| East Falls Parking Lot | bioinfiltration system | Schuylkill |
| School of the Future - Green Roof (PSD) | green roof, new construction | Schuylkill |
| School of the Future - Cistern/Reuse (PSD) | stormwater harvesting/reuse | Schuylkill |
| Wissahickon Charter School (WCS) Harmony Garden | rain gardens, porous pavers, subsurface infiltration | Schuylkill |
| 47th & Grays Ferry - Street Runoff Rain Garden | rain garden; street runoff | Schuylkill - Tidal |
| Greenfield School | rain gardens, porous pavers, porous safety surface | Schuylkill - Tidal |
| Clark Park Basketball Court | subsurface infiltration; off-site runoff | Schuylkill - Tidal (Mill Creek) |
| Mill Creek Porous Basketball Courts | porous asphalt | Schuylkill - Tidal (Mill Creek) |
| Mill Creek Urban Farm | street inlet disconnection, vegetated swale, retentive grading, green roof, cistern | Schuylkill - Tidal (Mill Creek) |
| Mill Creek HOPE 6 | subsurface pipe detention with slow release/infiltration | Schuylkill - Tidal (Mill Creek) |
| North 50th Street Projects | retentive grading; vacant lot restoration; rain barrels; street trees | Schuylkill - Tidal (Mill Creek) |
| West Mill Creek - Ogden/Ramsey Tree Trench | tree trench; porous pavers; modified street inlets to subsurface infiltration | Schuylkill - Tidal (Mill Creek) |
| Penn Alexander School | subsurface infiltration, pervious asphalt, rain garden | Schuylkill (Mill Creek) |
| Sulzberger Middle School Outdoor Classroom | disconnected rain leader, vegetated swale, rain barrel/cistern | Schuylkill (Mill Creek) |
| Awbury Arboretum | street run-off diversion, bioswale | Tacony-Frankford |
| Bureau of Laboratory Services: Turf to Meadow Conversion | native meadow; turf replacement | Tacony-Frankford |
| Cliveden Park Stormwater Project | vegetated extended detention basin; off-site runoff | Tacony-Frankford |
| Waterview Recreation Center | tree trench, street runoff diversion, disconnected rain leader, rain barrel cistern | Tacony-Frankford |
| Monastery Stables | basin modification, bioswales | Wissahickon |
| Saylor Grove Stormwater Treatment Wetland | stormwater wetland | Wissahickon |
| Springside School | disconnected rain leader, rain garden, planter box | Wissahickon |
| Allens Lane Art Center | Porous basketball court | Wissahickon |

**Table 1-7 Land-Based Demonstration Projects (Planned for Construction in 2010)**

| Project Name | BMPs | Watershed |
|---|---|---|
| Cobbs Creek Park / Blue Bell Tavern Rain Garden | trench drain, street inlet disconnection, vegetated swale | Cobbs |
| Bureau of Laboratory Services Green Streets | stormwater tree trenches, planters | Tacony-Frankford |
| Wakefield Park Street Runoff Diversion | trench drain, street inlet disconnection, vegetated swale, rain gardens | Tacony-Frankford |
| Harpers Hollow Street Runoff Diversion | trench drain, street inlet disconnection, vegetated swale, rain gardens | Tacony-Frankford |
| Kemple Park Street Runoff Diversion | trench drain, street inlet disconnection, vegetated swale, rain gardens | Tacony-Frankford |
| Belfield Green Street (Wister Woods) | trench drain, street inlet disconnection, vegetated swale, rain gardens | Tacony-Frankford |
| Awbury-Cliveden Model Neighborhood Green Streets | stormwater tree trenches, vegetated curb extensions | Tacony-Frankford |
| Queen Lane Green Street | vegetated curb extensions | Schuylkill |
| Belmont Treatment Plant Green Street | vegetated curb extensions, vegetated swale | Schuylkill |
| Barry Playground Green Streets | stormwater tree trench | Schuylkill - Tidal |
| Passyunk Avenue Rain Gardens | trench drain, street inlet disconnection, rain gardens | Schuylkill - Tidal |
| Cherry Street Connector | stormwater tree trench, rain garden vegetated swale, subsurface infiltration | Schuylkill - Tidal |
| Benjamin Franklin Parkway Green Street | street inlet disconnection, subsurface infiltration | Schuylkill - Tidal |
| Clemente Playground Green Streets | stormwater tree trenches, vegetated swale | Schuylkill - Tidal |
| Passyunk Square/South Philadelphia Model Neighborhood Green Streets | stormwater tree trenches, vegetated curb extensions | Schuylkill - Tidal |
| Lancaster Avenue Green Street | stormwater tree trenches, vegetated swale | Schuylkill - Tidal (Mill Creek) |
| Clark Park Green Streets | trench drains, vegetated swales, disconnected inlets, subsurface infiltration | Schuylkill - Tidal (Mill Creek) |
| 39th & Olive Playground | stormwater tree trenches, porous surfaces, rain garden | Schuylkill - Tidal (Mill Creek) |
| Dickinson Square Green Street | stormwater tree trenches, planters | Delaware Direct |
| Columbus Square Rain Garden | rain garden, disconnected inlet | Delaware Direct |
| Columbia & Thompson Green Street Intersection | vegetated curb extensions | Delaware Direct |
| Big Green Block Green Streets | stormwater tree trenches | Delaware Direct |
| Bodine High School Green Streets | stormwater tree trenches | Delaware Direct |
| Hartranft School Green Streets | stormwater tree trenches | Delaware Direct |
| Welsh School Green Streets | stormwater tree trenches | Delaware Direct |
| Northern Liberties Model Neighborhood Green Streets | stormwater tree trenches, vegetated curb extensions | Delaware Direct |

*Rain Barrel Program:*
Rain barrels are storage containers that collect rain water from downspouts. Downspouts lead the rain water from the roof to the ground or storm sewer. Rain barrels usually consist of a plastic storage container with lid, a system that diverts water into the barrel, an overflow that diverts water away from the house, a screen to keep out debris, and a water spigot to which a hose can attach. The rain barrel is connected to the downspout system, in order to capture and store some of the rain water. Figure 1-4 includes the images used to explain rain barrel installaion.

PWD has piloted a city-wide rain barrel giveaway program to provide rain barrels to residents free of charge after taking workshop, in order to promote the reduction of stormwater flows to our sewer system and creeks. The PWD Rain Barrel pilot project was initiated in 2002 in the TTF Watershed where PWD was able to give away 215 rain barrels to watershed residents. This program has now been expanded city-wide as of 2006, and to date, over 1,200 rain barrels have been given to residents.

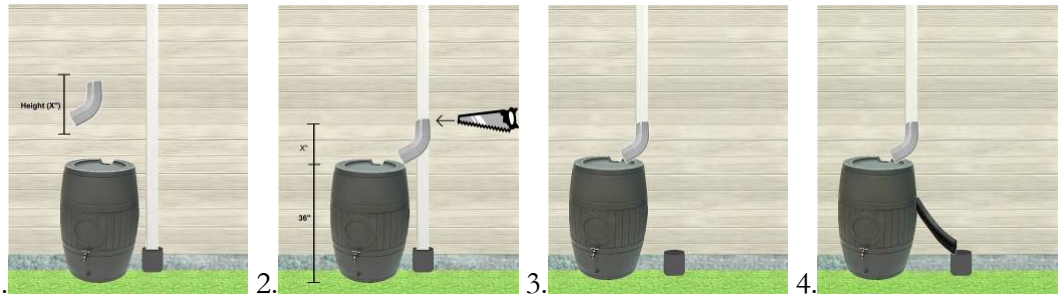



**Figure 1-4 The Four Steps for Installation of a Rain Barrel as Presented at PWD Workshops**

In order to receive their free rain barrel, Philadelphia residents must attend a training workshop to learn about the benefits of rain barrels as well as how to install and use them on their own properties.

For additional information, PWD has a website for this rain barrel program; it can be accessed at http://www.phillywatersheds.org/rainbarrel.

*Stream Restoration*
Through PWD's IWMP implementation commitments, the City has committed to the use of NSCD principles for the restoration of the mainstem (and tributaries where possible) of the Cobbs and TTF waterways.

PWD implemented their first stream restoration demonstration project on the Cobbs Creek at Marshall Road. This project involved the restoration of 900 linear feet of stream with the installation of j-hook vanes and rock vanes, constructed riffles, boulder bank stabilization, abutment removal and sewer protection. The restoration project at Marshall Road was a priority for PWD because the erosive flows within the creek had exposed the Cobbs Creek interceptor sewer, making it vulnerable to large debris that might be swept downstream with large storm events. This project was constructed in 2004. Figures 1-5, 1-6, and 1-7 show the Cobbs Creek before, during and after the Marshal Road restoration project.

**Figure 1-5 Marshall Road Pre-Restoration (Note Exposed Interceptor)**

**Figure 1-6 Marshall Road Under Construction – 2004**

**Figure 1-7 Marshall Road Post-Construction – 2006**

*Watershed Mitigation Registry*
Since 1997, the City of Philadelphia has invested millions of dollars in creating watershed management plans to advance the restoration of riparian environmental resources. This planning work identifies numerous stream and wetland enhancement opportunities, which are being compiled into a Watershed Mitigation Registry. Projects in the registry offer the potential to mitigate for wetlands and open water impacts that result from development and redevelopment.

Philadelphia's Watershed Mitigation Registry takes a watershed approach to aquatic resource protection by acknowledging the complex ecological relationships of the entire riparian corridor. This approach is consistent with federal guidelines for wetlands mitigation. Implementation of projects organized within a comprehensive watershed management framework would help achieve greater environmental benefit at reduced cost by addressing environmental, regulatory, and local community concerns in an integrated fashion.

The project registry is designed to function in a similar manner to wetland mitigation banks, with two important differences. Unlike mitigation banks that consist of completed wetland projects ready for purchase, the mitigation registry presents conceptual plans for projects ready to be designed and constructed. These plans encompass a range of riparian corridor improvements, including new and restored aquatic habitats, streambanks, wetlands, and flood and stormwater management. Although much research has been conducted to characterize the relative effectiveness of different wetlands in performing a range of environmental functions, no single method provides a technique for assessing the effectiveness of integrated riparian corridor improvements in mitigating impacts to wetlands from development and redevelopment projects.

Presently, the registry includes over 200 targeted stream and wetland improvement locations in the Philadelphia area. These targeted areas include potential stream restoration, stream daylighting, wetland enhancement/creation, and fish passage projects.

### 1.2.5.1 Establishment of the Waterways Restoration Team (WRT)

In 2003 PWD created the WRT, which consists of crews devoted to removing trash and large debris (*e.g.*, cars, shopping carts and appliances) from the streams and tributaries within the City. The team also performs restoration work around PWD's storm and combined sewer outfalls, eliminating plunge pools and streambanks eroded around outfall headwalls. The team works in partnership with Fairmount Park staff and the various "Friends of the Parks" groups to maximize resources and the positive impacts to our communities. The team performs stream clean up work in the City's streams – Cobbs, Wissahickon, Tacony, Pennypack, and Poquessing Creeks, and their tributaries, in addition to the Manayunk Canal. Table 1-8 lists a number of completed restoration and stabilization projects implemented by the WRT since their inception in 2003.

## 1.2.6 Additional Programs in Support of PWD's Watershed Planning Initiatives

PWD has developed a number of web-based tools and applications for the sharing of information about the City's watersheds, related programs, public events and ways to get involved with supporting the watershed approach. PWD has also created a number of web-based tools for tracking of water quality events and providing public notification of events when necessary.

**Table 1-8 WRT Restoration Projects Completed or Planned as of April 2009**

| Project | Watershed | Constructed by WRT | Description |
|---|---|---|---|
| Pennypack Rock Ramp | Pennypack Creek | Yes | Improvement of fish passage |
| Indian Creek | Cobbs Creek | Yes | Interim stabilization implemented; future large-scale restoration project to be completed by a contractor |
| Wises Mill Run | Wissahickon Creek | Yes | Lower segment; interim stabilization |
| Gorgas Run | Wissahickon Creek | Yes | Interim stabilization; infrastructure protection with boulders |
| Crescentville Outfall | TTF Creek | Yes | Plunge pool removal and culvert restoration with boulders |
| Maxwell Place Outfall | Pennypack Creek | Yes | Plunge pool removal |
| Adams Ave Fish Ramp | TTF Creek | Yes | Improvement of fish passage |
| Awbury Stream Daylighting | TTF Creek | Yes | Phase I implementation; included development of a bioswale and daylighting of a spring/stream on Arboretum property |
| Bingham Street Sewer Crossing | TTF Creek | Yes | Plunge pool removal |
| Cobbs Creek 61st Street Repair | Cobbs Creek | Yes | Emergency streambank restoration after a sewer line rupture |
| Marshall Road Restoration Work | Cobbs Creek | Supported | Stream restoration where erosion had exposed a combined sewer interceptor |
| Rex Avenue Restoration | Wissahickon | Yes | Stabilization and habitat creation along the west bank of the Wissahickon Creek mainstem. |
| Carpenters Woods Outfalls | Wissahickon | Yes | Stabilization of stormwater outfalls including stream restoration using NSCD principles. |

### 1.2.6.1 Watershed Information Center

The 1997 LTCP committed to the development of a watershed technology center that would utilize and extend the modeling, GIS and technology resources developed by PWD throughout its CSO planning effort. The watershed technology center was intended as a resource to facilitate the development and dissemination of information to others involved in watershed planning in the Philadelphia area watersheds. PWD has undertaken the development of this commitment, calling it the Watershed Information Center and has continued to evolve this system from a web resource intended to centrally locate technical, management, and administrative tools and capabilities to support those involved in watershed planning (Figure 1-8).

The goal of information center is to create a single, central location for the collection and dissemination of southeastern Pennsylvania watershed-related information. All plans, reports, meeting announcements, presentations, minutes produced by PWD and their watershed partnerships are posted on this site for public dissemination. The Watershed Information Center website can be accessed at http://www.phillyriverinfo.org.

The information center is continually evolving. A new website will be launched in the fall of 2009 at http://www.phillywatersheds.org, although the old URL will remain active. PWD also envisions a

virtual technology center at the Fairmount Water Works Interpretive Center that will enable the department to share documentaries and presentations in each of the key components of our IWMPs.

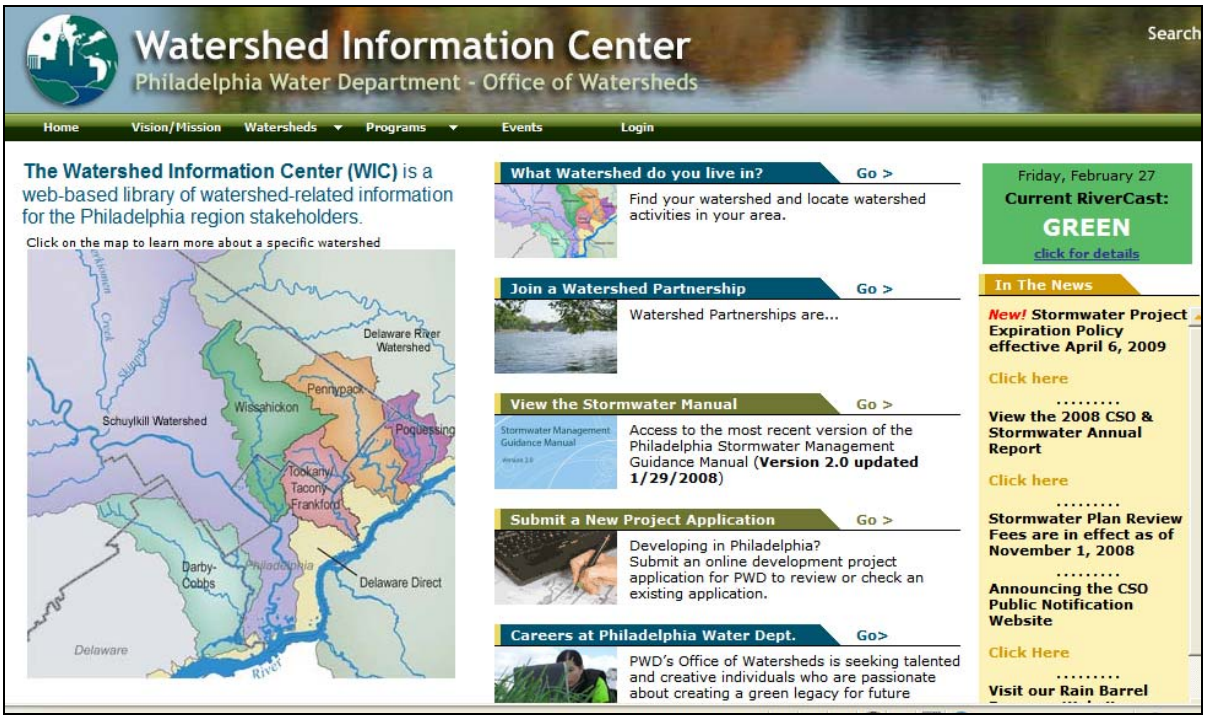



**Figure 1-8 PWD's Watershed Information Center Website**

## 1.2.6.2 The History of Philadelphia's Watersheds and Sewers

PWD has hired a historical research consultant to compile information on each of the City's watersheds, including the history of the sewer system – which often replaced many of the historic tributary streams to the larger stream systems. This fascinating information is presented to watershed partnerships as well as stakeholder public meetings, and often helps to present stakeholders with a more comprehensive understanding of the function of the complex system of pipes and sewers beneath the City. Figure 1-9 shows the homepage of the information available on PhillyH2O. com.

Historical presentations, articles, photos and additional content have been posted on the web and can be accessed at http://www.phillyh2o.org.

## 1.2.6.3 Establishment of Public Notification Systems

Early notification of changes in river water quality is important to public water suppliers with drinking water intakes on both the Schuylkill and Delaware Rivers, as well as to the public using the rivers for recreation. Several systems have been developed.

*Delaware Valley Early Warning System (EWS)*

The Delaware Valley EWS is an integrated monitoring, notification, and communication system designed to provide advance warning of surface water contamination events in the Schuylkill and lower Delaware River watersheds. The EWS was developed in 2002 with funding provided by the PADEP and the US EPA and was deployed as a fully functional system in 2004. PWD initiated the

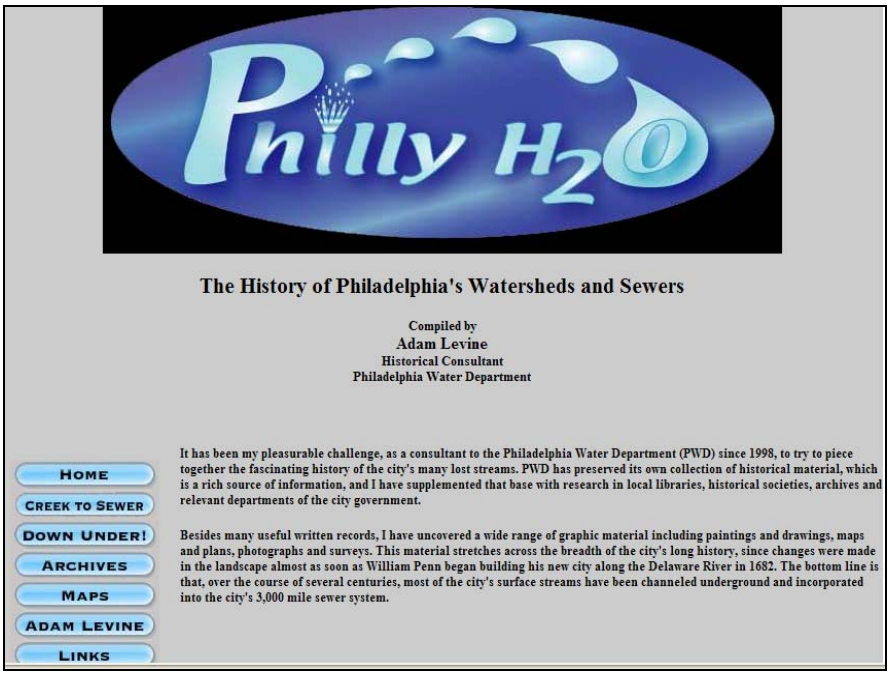



**Figure 1-9 PhillyH2O Website Homepage**

development of the EWS after identifying the need for such a system while collaborating with upstream treatment plant operators for the completion of the source water assessments for the Schuylkill and Lower Delaware Rivers between 1998 and 2000. The Delaware Valley EWS covers the entire length of the Schuylkill River as well as the Delaware River from Chester, PA (just downstream of Philadelphia) to the New York state boarder.

The EWS is comprised of four principal components:

1. EWS Partnership
2. Notification system
3. Monitoring network
4. Web-based database and portal

The EWS Partnership is comprised of stakeholders in the EWS and includes representatives from both public and private drinking water treatment plants in the coverage area, industries who withdraw water from the Schuylkill and Delaware rivers for daily operations, and representatives of government agencies from both PA and NJ. The notification system includes a spill model to track water quality changes and predict arrival times at intakes, and both automated telephone notification and web-based notification capabilities for intakes that are predicted to be affected by the water quality event. The monitoring network is comprised of on-line water quality and flow monitoring stations located at U.S. Geological Survey sites and water treatment plant intakes throughout both watersheds. The website and database portal are the backbone of the EWS and are fully integrated with the notification system and monitoring network.

The Delaware Valley EWS has become an international model for water quality early warning systems through its sophisticated integration of monitoring, notification, and website technologies, its usefulness for daily plant operations, and through the strength of its partner network.

*RiverCast*

The Schuylkill River, like all working rivers, is not a pristine body of water and is subject to contamination from many sources and activities that either discharge directly, or enter the river during rain events. Because rivers are vulnerable to such contamination, recreation in or upon any body of water has with it an inherent risk of illness and infection for the individual involved.

PWD developed a unique, web-based water quality forecasting system for the Schuylkill River called RiverCast. Based on real-time turbidity, flow, and rainfall data, it provides up-to-the-hour public service information on the estimated current fecal coliform concentrations in the river and the acceptable types of recreation based on those conditions. The system is designed to maximize accuracy while avoiding recommendations that suggest water quality is better than it is likely to be (avoidance of false positives). The Philly RiverCast operates for the stretch of the river between Flat Rock Dam and Fairmount Dam (Figure 1-10). The Philly RiverCast can be accessed at: http://www.phillyrivercast.org/

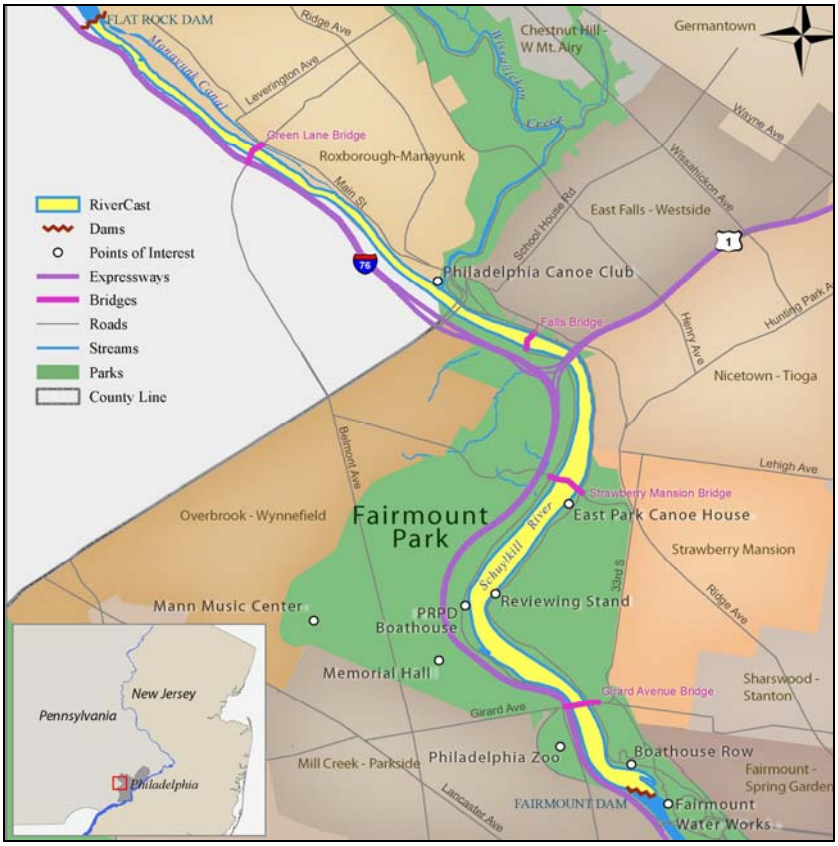



**Figure 1-10 RiverCast Coverage Zone Map**

*CSOcast*

In order to expand upon the public notification program established through the RiverCast, PWD has developed another internet-based notification system called CSOcast, which reports on the overflow status of combined sewer outfalls throughout the combined sewer system. The purpose of this notification system is to alert the public of possible CSOs from Philadelphia's combined sewer system outfalls. When a combined sewer outfall is overflowing, and up to a period of 24 hours following the rainfall event, it is unsafe to recreate in the water body due to possible pollutant contamination. The data on the website is updated daily.

PWD has maintained an extensive flow monitoring network since 1995. The level sensors record data throughout the combined sewer system. PWD currently operates and maintains monitoring equipment at, or near, the 164 CSOs throughout the City. This public notification system is based on PWD analysis of monitoring network data which is used to determine the likelihood of combined sewer overflows.

Flow monitoring data presented on this webpage is validated with the Philadelphia watershed and wastewater conveyance model. The model was developed through US EPA's Storm Water Management Model (SWMM). Real time rainfall data is taken from the PWD rain gage network and run through the SWMM model to estimate where and when overflows are occurring. Model output is then used to validate the monitoring data, ensuring a second level of accuracy. The data on this site is updated daily. If an outfall reports that no overflow is occurring, but it is still raining, there is the potential that an overflow is indeed occurring. It is always safest to avoid aquatic recreation during rainfall events.

When users visit the website, they will see a series of gray circular points as well as triangles on the map of Philadelphia. The gray circular points indicate an outfall location. The triangles indicate overflow status, where "green" indicates that no overflow has occurred in the past 24 hours, "yellow" indicates that an overflow has occurred in the past 24 hours, and "red" indicates that the outfall is currently overflowing (Figure 1-11). The CSOcast can be accessed at: http://www.phillywatersheds.org/csocast/

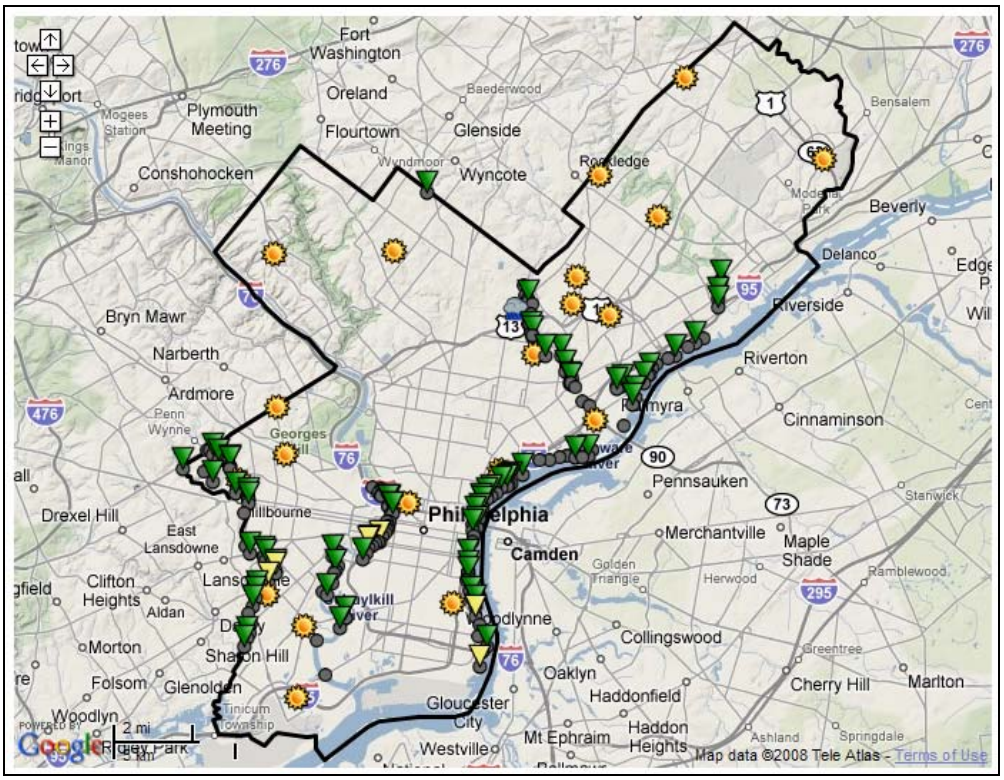



**Figure 1-11 Image of CSOcast Website**

## 1.3 PWD LTCPU

For the past decade, PWD has been creating, testing and implementing new integrated strategies which promote the economic and social growth of the City while meeting the environmental, ecological and business missions of the utility. In August 2008, PWD entered into a consent order and agreement with the PADEP, which reiterated the process for development of an update to PWD's LTCP commitments as originally included in PWD's NPDES permit. This LTCPU represents the plan as set forth by PWD to address their obligations under the CWA for the combined sewer system within the City of Philadelphia.

Our strategy is to implement the goals of our long-term planning initiatives with a focus on improving the water resources and revitalizing the City of Philadelphia. Commitments made in this plan will lay the foundation for a sustainable Philadelphia by greening our neighborhoods, restoring our waterfronts, improving our outdoor recreation spaces, and enhancing our quality of life.