

Chapter 1

INTRODUCTION

Protecting and enhancing water quality has long been an important objective in the City and County of Denver (Denver). Additionally, Denver is obligated under penalty of law to comply with the requirements of its Colorado Discharge Permit System (CDPS) municipal stormwater discharge permit. A stronger push towards clean water in Denver has been prompted by recent changes such as:

- ▶ Current and anticipated federal and state regulatory and CDPS permit requirements.
- ▶ The water quality improvement goals of Mayor Hickenlooper and his Administration.
- ▶ Increased recognition of the economic, ecological and social importance of water features for Denver residents, businesses and visitors.
- ▶ The need to protect natural resources, including preservation of open space, due to population growth.
- ▶ Recognition of the public health, safety and welfare implications of stormwater management programs and facilities.
- ▶ Proliferation of new approaches for protecting and improving water quality.

When looking at Denver as a whole, a key influence on stream and lake water quality is urban stormwater runoff from rainfall and snowmelt—the water that runs off streets, parking lots, buildings, ball fields, industrial/commercial sites, residential neighborhoods, etc. Without control measures, or Best Management Practices (BMPs), urban runoff typically adversely affects the physical, chemical and biological characteristics of streams, lakes and wetlands. For example, without mitigation, increased runoff volumes and peak discharges commonly associated with urbanization often cause stream channels to degrade through widening, deepening, accumulation of unsightly sediment deposits, significant modification to aquatic habitat, and other impacts. Elevated concentrations of substances such as gasoline and diesel fuel, oil, grease, fertilizer, heavy metals,

EXHIBIT 1.1
THE SOUTH PLATTE RIVER: AN URBAN AMENITY



Source: The Greenway Foundation.

pesticides, and pet waste can be harmful to aquatic life, native plants and wildlife and/or impair the ability of waterways to support recreation, industrial and municipal water supply, and other beneficial uses.

This chapter defines the purpose, approach, guiding principles, opportunities and challenges, overview, and scope limitations of this Plan, which has been developed to create a framework to enable Denver to address current and future challenges posed by urban runoff.

PURPOSE AND GOALS

The purpose of this *Denver Water Quality Management Plan* (Plan) is to advance a framework for better integrating stormwater management and water quality protection into planning, engineering, and infrastructure management for Denver. This Plan will serve as a common authoritative reference identifying Denver’s commitments, priorities, and strategies for protecting its rivers, streams, lakes, and wetlands from the adverse impacts of urban stormwater runoff. In addition, the Plan provides a practical initial strategy for managing stormwater runoff quality in the near term, while laying the groundwork for a long-term vision. This Plan is relevant to Denver staff, land developers undertaking new or redevelopment projects, other parties conducting activities that impact urban runoff, and citizens who want to support water quality protection in the Denver area. The primary goals of this Plan follow.

EXHIBIT 1.2 PLAN GOALS

DEVELOP A FRAMEWORK AND SHARED VISION FOR MEETING DENVER’S STORMWATER QUALITY REQUIREMENTS AND GOALS

DEVELOP BMP STRATEGIES THAT WORK IN VARIOUS DENVER SETTINGS

DEVELOP A COMMON FOUNDATION FOR INTERDEPARTMENTAL UNDERSTANDING OF STORMWATER QUALITY REQUIREMENTS AND THEIR ROLE IN THE PLANNING PROCESS

DEVELOP A FRAMEWORK AND PRIORITIES FOR FUTURE WORK NEEDED TO MEET GOALS

Goal 1: Develop a Framework and Shared Vision for Meeting Denver’s Stormwater Quality Requirements and Goals

As is the case in many cities, decision-making in Denver is shared across multiple departments and guided by many rules and regulations with inherently different goals and priorities. Water quality-related issues have historically been addressed primarily through departments such as Public Works and Environmental Health; however, due to the advent of the Phase I stormwater regulation¹, water quality-related issues are increasingly relevant to Parks and Recreation, Community Planning and Development, Asset Management, and other Denver departments.

¹ The U.S. Environmental Protection Agency (EPA) issued the Phase I stormwater regulations requiring National Pollutant Discharge Elimination System (NPDES) point source permit coverage for stormwater discharges from: (1) “medium” and “large” Municipal Separate Storm Sewer Systems (MS4s) generally serving populations of 100,000 or greater; (2) construction activity disturbing 5 or more acres of land; and (3) 10 categories of industrial activity.

A primary goal of this document is to develop a shared vision for achieving Denver’s water quality protection requirements under its CDPS stormwater permit. This permit identifies specific requirements intended to decrease the adverse impacts of stormwater discharged from Denver’s municipal separate storm sewer system (MS4). This permit clearly identifies binding provisions and serious penalty clauses if violated and essentially states that Denver must aggressively address the problems caused by urban stormwater discharges. State stream standards help to assess whether receiving waters in Denver meet their designated uses such as recreation, aquatic life, and water supply. In the event that streams receiving stormwater discharges from Denver do not meet state-designated stream standards, Denver will likely be required to enter into a more comprehensive regulatory process with additional requirements under the Total Maximum Daily Load (TMDL) process (as discussed in Chapter 3).

In addition to purely regulatory-driven requirements, water quality protection and improvement has been identified as an important goal in the *Denver Comprehensive Plan 2000* (Denver 2000), *Cherry Creek Greenway Corridor Master Plan* (BRW 2000), *Natural Areas Program Field Guide* (Denver Parks and Recreation 2004), *Design Guidelines for Stapleton Water Quality* (Denver 2001), and others. For these reasons, water quality protection and improvement are not only legal requirements, but also high priorities for a city known for its natural beauty. Developing a shared citywide vision and framework will help Denver to achieve its water quality protection goals.

Goal 2: Develop BMP Strategies that Work in Various Denver Settings

Denver’s Phase I stormwater permit requirements are based on both structural and non-structural BMPs to minimize the impacts of urban runoff. Design criteria for stormwater management practices appropriate for Denver have been clearly defined in the *Urban Storm Drainage Criteria Manual, Volumes 1 through 3* (UDFCD 1999, 2001) and adopted into Denver’s *Storm Drainage Design and Technical Criteria Manual* (Denver 1992). While these documents provide sound engineering guidance on designing these BMPs, less information has been provided on how to best integrate these types of BMPs into specific settings likely to be found in Denver. The *Design Guidelines for Stapleton Water Quality* were successful in helping achieve an integrated water quality plan for the Stapleton Redevelopment area; therefore, this Plan has used a similar approach to provide BMP implementation guidelines for the entire city. To achieve the goal of developing BMP strategies that work in various settings, this Plan assesses a

EXHIBIT 1.3
KENNEDY SOCCER COMPLEX DETENTION BASIN



The final Phase II storm water regulations were published in December 1999 and require NPDES permit coverage for construction activities that disturb 1 to 5 acres and for regulated small MS4s.

variety of existing and new BMPs and identifies implementation strategies appropriate for development types in Denver. These BMP strategies build on the *Urban Storm Drainage Criteria Manual, Volumes 1-3* (UDFCD 1999, 2001), providing additional information on how BMPs can best be integrated into and be more effective for various development types. To the extent possible, the development types in this Plan are consistent with those found in the city's planning document, *Blueprint Denver* (Denver 2000).

Goal 3: Develop a Common Foundation for Interdepartmental Understanding of Stormwater Quality Requirements and Their Role in the Planning Process

In order for any water quality protection strategy to be effective, it needs to be clearly documented, understood, accepted, and implemented across city departments. The strategies in this Plan have been developed based on input from multiple city departments to identify concerns and priorities related to water quality. Early integration of water quality requirements into site designs has been identified as critical for development and redevelopment projects. This Plan is intended to provide a common base of understanding across city departments to facilitate more effective integration of water quality requirements. This Plan also contains a glossary of key terminology to facilitate a common understanding of key concepts by users with varied backgrounds. Concurrent with development of this Plan, the development review process was undergoing review and revision; therefore, additional work will likely be needed to ensure that the priorities of this Plan are integrated into the development review process.

Goal 4: Develop Framework and Priorities for Future Work Needed to Meet Goals

The Wastewater Management Division's initial vision for this Plan identified many potential topics to be addressed. It was not possible to cover all of these topics in detail; therefore, a key goal of this Plan has been to identify topics and issues that will be important to the future of Denver's water quality management strategy, but that were beyond the scope of this document. Recommendations and an initial implementation plan for future work on these topics have been included in the Chapter 9 of this Plan. Representative topics include a watershed-by-watershed assessment of water quality conditions, identification of specific locations for potential future regional water quality treatment facilities, and exploration of funding alternatives for providing regional water quality facilities.

APPROACH

This Plan has been developed using a multi-faceted approach to ensure that a practical and innovative strategy for addressing water quality is developed for Denver. Multiple interviews and meetings were conducted with key Denver staff to develop a Plan that will be beneficial to many Denver departments. Key aspects of the project approach include:

- ▶ **Extensive collaboration among multiple city departments.** Acceptance and use of this Plan across city departments is critical to the success of this Plan. This document has been developed through close collaboration and frank discussion among multiple

departments within Denver including Public Works, Parks and Recreation, Community Planning and Development, Environmental Health, and the City Attorney's Office. By working together to prepare this Plan, a more unified position and vision for stormwater quality management has emerged.

- ▶ **Identification and review of regulations and existing Denver planning documents affecting or interfacing with stormwater quality management strategies in Denver.** Many existing and proposed federal, state and local water quality regulations directly influence stormwater quality management in Denver. Key regulations were inventoried and described in order to provide a common basis for understanding stormwater quality management requirements. Similarly, Denver has many excellent planning documents and programs that help guide planning and watershed management decisions. In order to avoid reinventing the wheel, a review of these key documents was completed.
- ▶ **Review of similar efforts in communities with advanced stormwater programs.** Communities throughout the country are reassessing their approach to stormwater and watershed management. Early in the development of this Plan, five communities were identified to explore their approaches, successes and difficulties in addressing urban runoff. Interviews and review of key documents were conducted for these communities: Portland, Oregon; San Diego, California; Austin, Texas; Prince George's County, Maryland; and Snohomish County, Washington. Findings from this research have been taken into account in development of this Plan with regard to general approach, as well as for recommendations for specific BMPs.
- ▶ **Identification of stormwater BMPs that have been both successful and unsuccessful in the Denver area.** The Project Team spent several days in the field visiting BMP sites in Denver. The strengths and weaknesses observed at these sites have been taken into account in the recommendations and strategies identified in this Plan. Photographs of many of these BMP sites (both good and bad) are interspersed throughout this Plan.
- ▶ **Review of new stormwater BMP technology and approaches for potential applicability to Denver.** Policy statements on new BMP technology such as underground proprietary treatment devices have been developed and provided in Chapter 6. Approaches that manage runoff close to the source and promote infiltration through landscape-based strategies are explored for more extensive application in the Denver area. Terms commonly used for these approaches include Minimizing Directly Connected Impervious

**EXHIBIT 1.4
STORMWATER BMPs SHOULD BE DESIGNED AND
MAINTAINED TO PROTECT PUBLIC HEALTH AND
AVOID NUISANCE CONDITIONS**



Area, Smart Growth for Clean Water, and Low Impact Development. Circumstances under which new approaches may be considered are also identified.

- ▶ **Development of practical stormwater quality BMP implementation guidelines.** As a result of the initial project tasks described above, the most significant need identified was practical guidance for implementing and managing stormwater quality in Denver. Chapters 6 and 7 provide this guidance. Representative questions considered as part of development of this guidance are summarized in Exhibit 1.5
- ▶ **Accommodation of periodic updates and revisions.** Denver recognizes and intends that this Plan will be a “living” document that will need to be updated periodically to reflect changes in the Denver area, BMP technology, and various regulations and policy shifts. These updates will be posted on Denver’s web site, www.denvergov.org. The principles of adaptive management apply to this plan, as is the case for many related Denver planning documents.

EXHIBIT 1.5 QUESTIONS CONSIDERED DURING PLAN DEVELOPMENT

- ▶ What stormwater quality requirements apply to development and redevelopment sites?
- ▶ What are the key regulatory requirements that are prompting mandatory implementation of BMPs on new development and redevelopment sites? Are these requirements anticipated to change in the future and, if so, in what ways?
- ▶ What factors influence BMP selection for a given site?
- ▶ What selection process should be utilized to determine the most appropriate BMP plan for a particular site?
- ▶ What performance criteria or standards apply, if any?
- ▶ How do stormwater quality requirements interface with more traditional drainage and flood control requirements?
- ▶ To what extent can Denver parks and natural area open spaces be utilized for stormwater quality management? What precautions need to be taken to assure that stormwater management does not impair intended park or natural area open space uses?
- ▶ How can BMPs be planned, designed and maintained to be viewed as community assets rather than liabilities?
- ▶ How should the BMP selection and design process account for issues such as public safety, maintenance, environmental permitting, and others?

PRINCIPLES AND POLICIES

Early in development of this Plan, the Project Advisory Committee and the Project Team agreed on several foundational principles and policies, including:

- ▶ All new and redevelopment projects must address water quality in their development plans, complying with the stormwater policies and design criteria specified in the *Urban Storm Drainage Criteria Manual, Volumes 1-3* (UDFCD 1999, 2001) and in Denver’s CDPS permit. Particularly critical is the four-step BMP planning process that requires:
 1. Implementing stormwater runoff reduction practices.
 2. Providing treatment of the Water Quality Capture Volume.
 3. Implementing streambank and channel stabilization techniques for any drainageways within or adjacent to a project site.
 4. Providing additional treatment for pollution “hot spots.”
- ▶ Under Denver’s CDPS permit, adverse impacts to receiving waters posed by urban stormwater discharges must be minimized to the “maximum extent practicable.” Examples of these adverse impacts can include increased pollutant loading, increased runoff rates and volumes, channel instability, modification of aquatic habitat and increased sediment loading, both during and after construction. It is essential to recognize that, despite the best efforts to control stormwater runoff, there will be some change in receiving water characteristics due to development; therefore, a “zero impact” policy is not realistic or attainable. As a result, Denver advocates management of stormwater through the implementation of BMPs designed in accordance with the guidelines established by UDFCD (UDFCD 1999, 2001), as summarized above.
- ▶ Denver will continue to advocate the use of multiple BMPs, including non-structural measures, source controls, and structural BMPs, to reduce stormwater pollution. Whenever practicable, combining BMPs in series can be very effective in reducing stormwater pollution.
- ▶ Urban stormwater management must be an integral part of site design and take into consideration multiple objectives. As stated in the *Urban Storm Drainage Criteria Manual, Volume 1* (UDFCD 2001), the many competing demands placed on space and resources require that stormwater management strategies take into account water quality enhancement, groundwater recharge, recreation, wildlife habitat, wetland protection, protection of landmarks/amenities, control of erosion and sediment deposition, and creation of open space. In addition, the appearance of BMPs is particularly important; Denver will expect to receive site development plans that feature attractive BMPs that will be viewed as assets by the community. Denver will encourage multi-purpose usage of BMPs; however, compatibility among uses must be demonstrated (e.g., compatibility between recreational areas and detention areas).

- ▶ Planning for water quality must proceed hand-in-hand with drainage planning for quantity (rate and volume). In urban areas, these two planning efforts are inseparable (UDFCD 2001). When these issues are addressed together and early in the site planning process, more efficient, economical and attractive land uses generally result.

- ▶ Water quality must be addressed in the very beginning of the site development process to ensure that water quality BMPs are incorporated into the site design. Benefits of this practice include better site designs and more cost-effective BMPs.

- ▶ Denver will continue to review BMP designs for public safety and maintenance accessibility, maintainability, documentation of maintenance requirements and schedule, and assured long-term funding for maintenance. Proper maintenance is fundamental to public safety and long-term effectiveness of stormwater BMPs.

- ▶ Denver strongly prefers managing and treating stormwater quality on the ground surface, rather than in subsurface, vault-type treatment devices. Nevertheless, Denver recognizes that there are some cases where the use of such facilities is necessary. For example, this approach may be acceptable in cases of extreme space constraints that occur on smaller redevelopment sites, which are essentially completely impervious in their current condition, such as some locations in the downtown area. Chapter 6 provides specific guidance on the conditions under which these types of treatment devices may be considered.

- ▶ The same stormwater quality management expectations and practices that apply to projects in the private sector also apply to projects that are the responsibility of Denver, such as buildings, parks, streets, utilities, etc. When Denver is preparing plans for any such projects or managing, maintaining and/or upgrading existing facilities, potential adverse stormwater quality effects must be evaluated and suitably mitigated.

**EXHIBIT 1.6
ATTRACTIVE GRADE CONTROL STRUCTURE ON
THE SOUTH PLATTE RIVER HELPS TO REDUCE
THE IMPACTS OF URBANIZATION**



Source: The Greenway Foundation.

OPPORTUNITIES AND CHALLENGES

A primary goal of this Plan is to develop a framework for managing runoff water quality in a manner that is not only effective, but that also takes into consideration the goals of the many city departments and citizens. For these reasons, the Project Team worked closely with an interdepartmental advisory committee and conducted multiple interviews to identify key concerns and priorities of various city departments. As a result, several key opportunities and challenges emerged for this Plan that are summarized in Exhibit 1.7 and discussed in more detail below. This Plan provides a framework for addressing these challenges.

Address Water Quality Issues

Portions of the South Platte River, Sand Creek, Berkley Lake, and other Denver waterbodies do not currently meet state stream standards for one or more constituents, resulting in “listing” of waterbodies on the state’s 303(d) list. (See Chapter 3 for more information.) In addition, continued growth will apply increasing pressure on water quality. Working towards attainment of water quality standards and complying with Denver’s stormwater CDPS permit are high priorities for Denver and have been strongly emphasized by the Public Works Department and the Mayor’s office.

Chapters 6 and 7 of this Plan provide structural and non-structural BMP strategies that can be used to help Denver improve the quality of urban runoff. In addition, stormwater quality BMP implementation guidelines for a variety of land use types are provided to aid developers and planners in selecting strategies that work in various settings.

Recommendations regarding future watershed-by-watershed assessments of water quality are also identified in Chapter 9 as an important step to developing and/or advancing basin-specific approaches to water quality issues facing Denver.

Improve Interdepartmental Cooperation With Regard to Water Quality

Stormwater quality treatment requirements are best integrated into the early stages of site design. In many cases, stormwater treatment requirements have

EXHIBIT 1.7

STORMWATER QUALITY MANAGEMENT OPPORTUNITIES AND CHALLENGES

ADDRESS WATER QUALITY ISSUES (E.G., 303(D) LISTED SEGMENTS, STREAM STANDARDS)

IMPROVE INTERDEPARTMENTAL COOPERATION WITH REGARD TO INTEGRATING WATER QUALITY INTO SITE DEVELOPMENT

COORDINATE COMPATIBLE USES BETWEEN PARKS AND WATER QUALITY FACILITIES

ENHANCE COMPATIBILITY BETWEEN URBAN DESIGN GOALS AND WATER QUALITY FACILITIES

IMPLEMENT EFFECTIVE, SUSTAINABLE, ATTRACTIVE, MULTI-PURPOSE, SAFE AND WELL-DESIGNED BMPS

ENSURE LONG-TERM BMP OPERATION AND MAINTENANCE

DEVELOP FINANCING AND INSTITUTIONAL STRATEGIES FOR REGIONAL BMPS

not been considered early in the site design, resulting in few effective options for treatment, or installation of unattractive, unsafe, and unmaintainable facilities that become public nuisances, rather than amenities. Community Planning and Development, Parks and Recreation, and Public Works all recognize the importance of early discussion regarding water quality treatment requirements and plans. The stormwater quality BMP implementation guidelines provided in Chapter 6 will help provide developers and planners with reasonable approaches to stormwater treatment that take into consideration multi-departmental goals.

Interdepartmental communication and understanding regarding the legal obligations that Denver has under its CDPS stormwater permit are vitally important to encouraging departments to work cooperatively toward meeting these requirements. Chapter 3 of this Plan provides a common foundation regarding Denver's obligations under its stormwater permit, along with implications of anticipated future regulatory changes.

Coordinate Compatible Uses Between Parks and Water Quality Facilities

Parks, golf courses and natural areas open space are often viewed as opportunities for stormwater detention; however, it is critical that the uses of these areas be taken into account to ensure that usage conflicts are minimized. For example, areas used as soccer fields or golf courses need to drain within a reasonable timeframe to prevent soggy fields that are incompatible with recreational use. Other park and BMP conflicts may relate to safety in areas used for child play, West Nile virus concerns, and/or protection and enhancement of wildlife. This Plan recognizes that conflicts between parks and stormwater BMPs exist in some locations in Denver and care must be taken in the future when selecting, designing, and maintaining BMPs in parks. Public input and acceptance of stormwater BMPs in parks is particularly important, as is public education on the purposes of BMPs. The BMP fact sheets provided in Chapter 6 identify considerations to be taken into account when choosing various BMPs and can provide a starting point to reduce conflicts between park and BMP functions.

Enhance Compatibility Between Urban Design Goals and Water Quality Facilities

Blueprint Denver (Denver 2000) provides a clear vision for Denver's development goals. The Community Planning and Development Department, with the assistance of other Denver departments, has the responsibility of moving Denver towards meeting these goals. In some cases, stormwater BMPs can be difficult to fit into site designs that conform with these design goals. For this reason, interdepartmental agreement regarding BMP design and integration into various settings is important. Chapter 6 provides templates of possible site layouts with BMPs integrated into the designs of various development types. In some cases, on-site stormwater facilities are challenging due to space constraints; in these cases, opportunities for regional stormwater facilities should be explored. Chapter 8 provides conceptual-level locations where regional facilities warrant further exploration.

Implement Effective, Sustainable, Attractive, Multi-purpose, Safe, and Well-Designed BMPs

Denver’s CDPS stormwater permit, Denver’s *Storm Drainage Design and Technical Criteria Manual* (Denver 1992) and other documents specify water quality treatment requirements for new development and redevelopment projects. In addition to meeting the technical requirements for these BMPs, the Project Advisory Committee and city department staff interviewees agreed that these BMPs also must be sustainable, attractive, multi-purpose, safe, and well-designed (Exhibit 1.8). Ensuring that these requirements and goals are met and that BMPs are maintained on a long-term basis is critical for Denver to successfully minimize the impacts of urban runoff.

Many examples of BMPs that do and do not meet these criteria were identified and visited during the development of this Plan. Early consideration of water quality requirements in the site design can help prevent water quality BMPs from being an “afterthought,” which may result in poor BMP design and implementation. Chapter 6 identifies specific considerations when selecting BMPs that provide a foundation for more sustainable, attractive, multi-purpose, safe and well-designed BMPs.

EXHIBIT 1.8
SAFE, ATTRACTIVE, MAINTAINABLE
INFILTRATION BASIN



Ensure Long-term BMP Operation and Maintenance

Even when BMPs are thoughtfully designed and properly installed, they can become eyesores, breed mosquitoes, and cease to function if not properly maintained. BMPs can be more effectively maintained when they are designed to allow easy access for inspection and maintenance and take into consideration factors such as property ownership, easements, visibility from easily accessible points, slope, vehicle access, and other factors. Clear, legally-binding written agreements assigning maintenance responsibilities and committing adequate funds for maintenance are also critical. Chapter 3 describes Denver’s requirements for BMP maintenance, and Chapter 6 provides BMP maintenance recommendations. In addition, Chapter 5 describes how other communities such as Portland, Oregon have invested in easy-to-understand guidance documents for BMP maintenance that are useful for both private and public owners of BMPs.

Develop Financing and Institutional Strategies for Regional BMPs

The concept of regional stormwater facilities is supported across Denver departments, particularly in redevelopment areas where land is unavailable or at a premium cost. The challenges to implementing regional BMPs lie in three key areas: 1) institutional constraints, 2) land availability, and 3) financing. Chapter 8 provides a conceptual-level assessment of Denver drainages where regional facilities may be realistic. In order to take advantage of these

opportunities, a sound financing strategy must be developed. This can be challenging, particularly in areas where development is phased over a number of years. Chapter 9 recommends future work to help develop financing strategies for regional BMPs, including a discussion of institutional opportunities and constraints.

SCOPE LIMITATIONS

In order to develop a meaningful document, the “width” of this Plan’s scope has been limited to enable increased “depth” on key subject areas. Related water quality and watershed management topics that are not covered or are only briefly covered in this document include:

- ▶ **Construction site stormwater management.** Construction site stormwater management is a critical component of protecting receiving waters and a key requirement of Denver’s stormwater CDPS permit. Strong existing guidance on construction site stormwater management is provided by UDFCD, Denver, the Colorado Department of Public Health and Environment (CDPHE), and numerous other entities and is not repeated herein; instead, the focus of this Plan is on permanent, post-development stormwater management strategies.
- ▶ **Sanitary wastewater discharges and sanitary sewer overflows.** Although sanitary wastewater discharges and sanitary sewer overflows (SSOs) are critical aspects of addressing water quality issues in receiving waters, these discharges are believed to be effectively addressed through CDPS permits. For specific water quality problems caused by a combination of wastewater, stormwater, and nonpoint source discharges, an interface with sanitary wastewater discharges will be required under pollutant load allocations under the TMDL process. (See Chapter 3 for more information.)
- ▶ **Detailed design criteria for stormwater BMPs.** This document is not intended to be a design manual. To the contrary, excellent BMP design guidance exists in Volume 3 of the *Urban Storm Drainage Criteria Manual* (UDFCD 1999), along with other references (e.g., WEF and ASCE 1992 and 1998; CASQA 2003; City of Portland 2002).
- ▶ **Stream channel morphology, sediment transport and channel stabilization and restoration practices.** Topics excluded from discussion include use of turf reinforcement mats, geotextiles, and other comparable materials in drainage channels, other channel stabilization measures including “bioengineering” techniques, hydraulic structures such as energy dissipaters downstream of bridge and culverts, grade control structures, drop structures, etc. Many of these practices either directly or indirectly contribute to stream channel stability and favorable water quality; however, they were deemed to be beyond the scope of this document.
- ▶ **Detailed regional water quality facility master planning.** Although an initial glimpse of potential regional water quality BMPs that could be used in Denver’s primary drainage areas is provided in Chapter 8, it was beyond the scope of this Plan to address facility master planning in detail. Follow-up work needed for such an effort is defined in Chapter 9.

- ▶ **Receiving Water Impact Assessment.** Detailed guidance on this topic is beyond the scope of this Plan. This Plan assumes that in most cases involving typical urban stormwater discharges from development and redevelopment sites, site-specific impact assessments will not be necessary, provided that practices specified in the *Urban Storm Drainage Criteria Manual* (UDFCD 1999, 2001) are implemented.
- ▶ **Development of Financing Strategies for Regional BMPs.** Realistic and well-thought-out financing strategies for regional BMPs are necessary for the success of any regional BMP. Exploration of these financing strategies was beyond the scope of this document, but has been recommended as a future task in Chapter 9 of this Plan.
- ▶ **Life Cycle Cost Analysis.** Detailed BMP cost data were not included in this Plan. The concept of life cycle costs for BMPs is relevant to BMP selection because it takes into consideration the design, construction, maintenance and rehabilitation costs of the BMP over its expected lifetime. The reader is referred to references for more information on BMP costs in Chapter 6 of this Plan.

PLAN OVERVIEW

Given the purpose, goals, approach, foundational policies, and scope limitations that evolved during the course of this project, the Project Team and Advisory Committee determined that this Plan should address these topics:

- ▶ Overview of key drainage basins in the Denver area.
- ▶ Discussion of basic tenets of urban runoff impacts.
- ▶ Discussion of key current and future regulatory drivers affecting stormwater and receiving waters.
- ▶ Identification of key documents (e.g., *Urban Storm Drainage Criteria Manual Volumes 1-3*, *Blueprint Denver*) that this Plan must interface with in order to be effective.
- ▶ Identification of strategies that are successfully being used in other communities to address urban runoff.
- ▶ Development of stormwater BMP implementation guidelines identifying how these BMPs can be integrated into various development types in Denver.
- ▶ Development of BMP fact sheets, implementation details, and maintenance guidelines that identify how BMPs can be better implemented and maintained in Denver.
- ▶ A broad-level assessment of potential regional water quality facility locations in Denver.
- ▶ Identification of future tasks that need to be completed in order for Denver to achieve its water quality objectives.

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