

# Case Study: Denver

## Green Stormwater Infrastructure in the Right-of-Way



### QUICK DENVER STATISTICS

- **Population:** 716K in 2018
- **19% population increase since 2010**
- **Area:** 153 sq. mi.
- **Separated sewer system**
- **Consent decree:** No
- **MS4 permit:** Yes
- **Storm drainage fee:** Yes
- **Stormwater fee credit program:** No
- **Post-construction stormwater ordinance:** Yes
- **Snow climate:** Yes

### MOTIVATIONS FOR ADVANCING GSI IN THE ROW

**Regulation.** The City and County of Denver (Denver) has a separated sewer system that is regulated by the Colorado Discharge Permit System (CDPS) General Permit for Stormwater Discharges Associated with Municipal Separate Storm Sewer Systems (MS4). The permit requires municipalities to use best management practices (BMPs) to reduce pollutants in stormwater runoff to the maximum extent possible and meet the standards of the Clean Water Act. BMP recommendations include infiltration control measures such as green stormwater infrastructure (GSI) that can capture and filter impervious surface runoff.

Denver is also obligated to reduce specific pollutant load discharges to surface water bodies as assessed by a Total Maximum Daily Load (TMDL) study, which determines the reduction level necessary to meet water quality standards for identified pollutants.

**Linear Projects Requirement.** Streets are one of the largest sources of runoff pollution and simultaneously offer the greatest opportunity for intervention. Denver's Storm Drainage Design & Technical Criteria set a requirement for all development and redevelopment projects disturbing 1.0 acres or more, including linear construction projects such as those in the right-of-way (ROW), to use BMPs to reduce as much runoff as possible from the site. The Department of Transportation & Infrastructure (DOTI), formerly Public Works, created new design guidelines in 2016 for BMPs suitable to the ROW to ensure this opportunity would cease to be missed.

Photo by  
Chris Bartle



## IMPACT OF CLEAN WATER ACT REGULATION

The City and County of Denver has a regulatory obligation to improve water quality by reducing the pollutants entering water bodies in stormwater runoff. This creates opportunities for GSI projects that provide treatment of right-of-way runoff along with other types of infiltration practices.



**Restoring Water Quality.** Denver holds a permit to discharge stormwater from its MS4 in accordance with the Stormwater Management Program requirements defined in the permit. In addition to recommending BMPs like GSI for improving water quality of stormwater runoff, the requirements stipulate that new development and redevelopment projects which disturb more than one acre must prevent or minimize water quality impacts, while projects greater than a half-acre must provide stormwater quantity detention. The latter also often provides water quality improvements. As of June 2020, Denver is in the process of renewing its MS4 permit.

In addition to reducing citywide pollutant loading, the South Platte River, which runs through Denver, is on Colorado's 303(d) list of impaired water bodies and has TMDL

restrictions for specific pollutants. The TMDL study prioritizes control of dry weather flow contamination (which does not include stormwater runoff), identifying control of wet weather flow contamination as a future measure. Denver proactively addresses future TMDL regulations with its green infrastructure program.

### **Water Quality Management Plan.**

Developed under the direction of the Wastewater Management Division of DOTI, the purpose of this 2004 plan is to establish a framework for integrating stormwater management to meet water quality requirements and goals as prescribed by the Clean Water Act. It recommends BMPs that promote on-site infiltration, such as swales and porous pavement, across various land development types including the ROW in dense urban areas.

## POLICIES & PROGRAMS THAT PROMOTE GSI IN THE ROW

**Complete Streets Policy.** The Department of Transportation & Infrastructure (DOTI) issued an internal Complete Streets memo in 2011. While it does not account for green infrastructure, it directs DOTI to review all transportation infrastructure projects for incorporation of Complete Streets. An update to this policy will be completed in 2020 and will include language regarding GSI in the ROW.

## GUIDING PLANS & STRATEGIES FOR GSI

**Green Infrastructure Implementation Strategy.** Issued by DOTI in 2018, the strategy references Denver's Water Quality Scorecard which prioritizes sub-basins for water quality improvement and identifies opportunities for green infrastructure projects. The strategy's identified projects are the basis for guiding a Water Quality Capital Improvement Program that will shape capital projects and policy and program development. It also provides an overview of monitoring and research intended to assess the effectiveness of stormwater control measures that will be implemented in several upcoming redevelopment projects in Denver.

**Blueprint Denver.** Adopted in 2019 and supplemental to the Denver Comprehensive Plan 2040, Blueprint Denver is a land use and transportation plan that establishes citywide policies and strategies for inclusive development of the city. The plan emphasizes creating complete neighborhoods by building quality-of-life infrastructure — referring to nature-based places and elements — throughout

the city. Recommendations for achieving this outcome include creating walkable and green streets, managing stormwater and minimizing flooding, promoting low-impact development, building and expanding parks and open spaces, increasing tree canopy, restoring the parkway and boulevard network, and making environmental justice improvements related to pollution, environmental conditions, and access to healthy food, nature, and daily necessities.

## GOALS & OUTCOMES

- Implement 25 miles of green streets by 2025, where runoff from each street mile is managed by GSI in the ROW. So far, 10 of the 25 miles have been funded, are in design, or have been constructed.
- Improve surface water quality in the most efficient and cost-effective manner possible.
- Move past single objective strategies and implement strategies that provide a host of benefits.

Photo courtesy of Denver DOTI



## ASSOCIATED BENEFITS OF GSI IN THE ROW IN DENVER

As identified by Denver's Green Infrastructure Implementation Strategy and program staff.



### Ecology

- Improve water quality
- Absorb local carbon emissions
- Increase biodiversity and habitat



### Public Health

- Reduce urban heat island effect
- Reduce flood risks
- Improve air quality
- Enhance community livability
- Improve public health outcomes
  - Increased physical activity
  - Reduced stress
  - Improved mental well-being



### Urban Vitality

- Lower traffic speeds
- Make intersections safer for multi-modal mobility
- Increase social cohesion
- Create a sense of place/destination



### Economy

- Reduce energy demands
- Improve water infrastructure system

## GUIDELINES FOR DESIGNING GSI IN THE ROW

### Ultra-Urban Green Infrastructure Guidelines.

Created in partnership between DOTI and the Mile High Flood Control District in 2016, the guidelines provide design standards and details for site-scale green infrastructure BMPs suitable for dense urban environments – including the public right-of-way – to guide developers and city agencies in project design and implementation.

### Storm Drainage Design & Technical Criteria.

Issued by the DOTI Wastewater Management Division and Engineering Division and amended

in 2013, the criteria require that all development and redevelopment projects, including linear construction projects in transportation corridors, must reduce site runoff to the maximum extent possible using BMPs as detailed within the criteria. Due to the limited options for BMPs in denser urban areas like the ROW, DOTI created the Ultra-Urban Green Infrastructure Guidelines to supplement the criteria.

### Mile High Flood District Urban Storm Drainage Criteria Manual.

The Mile High Flood District creates technical design standards for stormwater management and floodplain protection for jurisdictions across the Denver metro area. Much of the Denver-specific policies are adopted from this regional criteria manual.

## COLLABORATION & PARTNERSHIPS

### LEAD AGENCY

**Green Infrastructure Group, Department of Transportation & Infrastructure (DOTI)**

Utilities Division, DOTI  
Wastewater Management, DOTI

### SUPPORTING MUNICIPAL AGENCIES

**Transportation and Mobility, DOTI.** Role: is a funding partner on GSI projects that include transportation elements like intersection improvements.

**Department of Public Health & Environment.** Role: monitors projects for efficacy.

**Parks and Recreation.** Role: partners on regional water quality projects and some ROW maintenance needs.

**Community Planning and Development.** Role: aligns GSI projects with citywide and neighborhood planning initiatives.

**Climate Action, Sustainability and Resiliency Office.**

**Development Services.** Role: reviews private developments.

### EXTERNAL PARTNERS

**Colorado Department of Public Health and Environment (CDPHE).** Role: oversees the MS4 permit.

**Mile High Flood Control District.** Role: partners and provides funding on projects and initiatives to meet water quality goals; assists in monitoring; provides technical support.

**Colorado Department of Transportation (CDOT).** Role: partners on and funds road projects under CDOT jurisdiction.

## FUNDING & FINANCING

Denver uses a combination of sources to fund green infrastructure projects in the right-of-way:

- Revenue from storm drainage fee (which is based on a property's impervious surface area)
- Funds through interagency collaboration
- Funding from external partnerships (CDOT)

## GSI MAINTENANCE RESPONSIBILITIES

**Subsurface maintenance:** Department of Transportation & Infrastructure (DOTI).

**Surface maintenance:** DOTI maintains the hard infrastructure.

**Vegetation maintenance:** All GSI vegetation is initially under contractor warranty for an establishment period. Additional vegetation maintenance including trash removal and irrigation is performed by Business Improvement Districts or Maintenance Improvement Districts where applicable, and by outside contractors elsewhere.

Maintenance plans for the near future include:

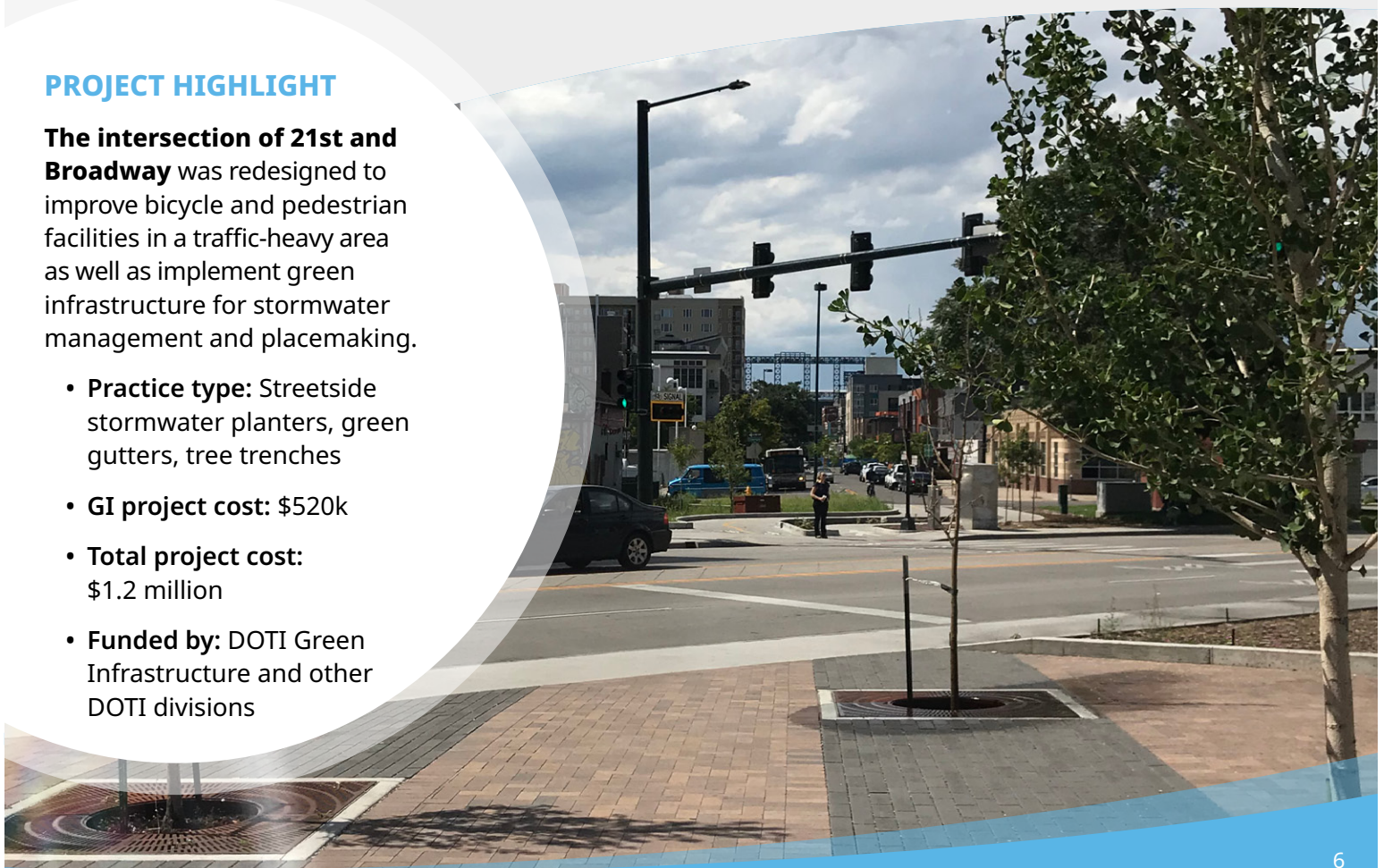
- Tree maintenance by Denver Parks and Recreation Forestry Office
- Establishing a Vegetation and Enhancement Management Program for DOTI to maintain vegetation internally

Photo courtesy of Denver DOTI

## PROJECT HIGHLIGHT

**The intersection of 21st and Broadway** was redesigned to improve bicycle and pedestrian facilities in a traffic-heavy area as well as implement green infrastructure for stormwater management and placemaking.

- **Practice type:** Streetside stormwater planters, green gutters, tree trenches
- **GI project cost:** \$520k
- **Total project cost:** \$1.2 million
- **Funded by:** DOTI Green Infrastructure and other DOTI divisions



## LESSONS LEARNED & KEYS TO SUCCESS

**Lessons learned:** Due to the lack of experience among local design and construction firms implementing GSI in the ROW, initial projects saw replicated design drawings from Denver's Ultra-Urban Green Infrastructure Guidelines with little or no variation. Providing more design guidance such as facility tributary areas and site context while also leaving room for the facility details to

be designed more thoughtfully is a critical balance to strike in a city that is new to GSI in the ROW.

**Keys to success:** Aligning GSI with other capital projects that will already be disrupting the ROW is the most effective way to get small, site-scale facilities installed. It is more difficult to latch onto small capital projects that are only performing surface work.

## SPECIAL THANKS

to the Erb Family Foundation and the City and County of Denver Department of Transportation & Infrastructure for making this case study possible.

## PROTECTING WATER, SUSTAINING LIFE

The Alliance for the Great Lakes is a nonpartisan nonprofit working across the region to protect our most precious resource: the fresh, clean, and natural waters of the Great Lakes. Learn more at [greatlakes.org](https://greatlakes.org).