# CHAPTER 10: SUSTAINABILITY, INFRASTRUCTURE, AND RESOURCES

## 10.1 - INTRODUCTION

The Fulton Corridor Specific Plan Area has a mostly complete utility infrastructure network, with the ability to adequately service existing development per existing zoning. However, many of these utility networks are aging and in need of upgrades to ensure proper long-term function for existing users, as well as accommodate economic growth and business expansion.

Much of the existing water distribution system is over 50 years old, and improvements are needed to strengthen the sufficiency and reliability of aging infrastructure, as well as provide adequate water supplies from replenishing sources. Projected population growth and densification also require improvements to the water supply and distribution system to provide adequate fire flow. In addition, current City-wide water consumption trends are straining the City's available sources of water, highlighting the need for increased conservation measures and the development of alternative water resources.

Sewer capacity upgrades are also needed to accommodate the projected population growth and associated wastewater generation increases. To offset water demand for non-potable uses, plans are currently underway to expand and further establish the City's Recycled Water System, including the installation of tertiary treatment facilities.

Regarding stormwater, the Downtown area is characterized by large impervious areas, is susceptible to localized flooding, and would benefit from additional local retention facilities to mitigate flood hazards.

As the City of Fresno moves toward a resource efficient future, the manner in which infrastructure integrates into the framework of the Downtown area will be critical to the success, viability, and continued growth of these unique places and facilities. The vision, goals, and policies contained herein describe Fresno's intention for the role of infrastructure within the context of its resource portfolio and how infrastructure can be used to support economic vibrancy and promote efficiency and natural resource protection. The City aims to achieve these goals while providing high quality utility services to residents and visitors.

*Permeable paving allows stormwater to percolate and infiltrate through areas that are traditionally impervious, such as large parking lots.*

*Rain gardens – planted depressions to capture rainwater runoff – allow stormwater to soak into the ground locally instead of flowing into storm drains.*

*Renewable power generation systems such as photovoltaics decrease dependence on natural resources for energy.*


*Irrigating with recycled water for landscapes and non-potable applications decreases dependence on groundwater pumping and imported water sources.*

## 10.2 - INFRASTRUCTURE STRATEGIES

Downtown Fresno is serviced by a network of utilities that provide for the community and its businesses (**Figure 10.2A** and **Figure 10.3A**). The physical and economic vitality of the Plan Area is dependent on this network and the availability of adequate resources to allow Downtown to grow. As the districts within the Plan Area continue to grow, the City's focus will be on providing an improved level of service with relatively fewer resources. This will be manifested through the development and implementation of effective and efficient infrastructure at all scales to support the functionality of Fresno's Downtown. This strategy is based upon the following key principles:

1. **Enable the downtown area to thrive without having to significantly increase the delivery of outside water resources.**

   Intensive water conservation is the first step in enhancing existing water supplies, followed by alternative methods such as water in the Downtown Area.

2. **Bolster the City's burgeoning recycled water program and supplement its alternative water resources.**

   The City's proposed recycled water system will provide a valuable resource to Downtown as a way to offset the increased water demand. The Downtown can also generate recycled water to support non-potable uses within Downtown.

3. **Implement Low Impact Development stormwater design guidelines that integrate into complete streets, open space, and high density development.**

   This will enhance the existing infrastructure network of the Fresno Metropolitan Flood Control District and reduce localized flooding, improve water quality, provide community amenities, and enhance aquifer recharge throughout the City.

4. **Promote local renewable power generation. Develop a more energy independent community and reduce the carbon footprint of the Plan Area.**

   Optimize the energy resources available to the community by providing allowances for on-site energy generation and efficiency. Financial incentives, solar access easements, and property tax abatements can be used to help fund and promote renewable power generation at various scales.

5. **Minimize resource consumption by all new structures, renovated buildings, and infrastructure facilities to reduce costs and support the local economy, and improve the natural environment.**

   To the extent possible, limit the consumption of natural resources through green building, resources conservation, and resource recovery.

6. **Ensure collaboration between the City of Fresno and outside utility agencies such as PG&E and the Fresno Metropolitan Flood Control District (FMFCD).**

   Frequent and organized communication between agencies and utility providers that share the public realm will ensure that planning efforts and utility capacity studies are aligned. Synergies, cost savings, and facility sharing can be realized through shared construction efforts and easements.


*Pervious paving within parking areas provides on-site stormwater infiltration and reduces runoff.*

*An example of how on-site renewable power generation such as photovoltaics can be integrated into the massing of a building.*

## 10.3 - DOMESTIC WATER INFRASTRUCTURE

The City's potable water transmission and distribution system consists of:

1. **Regional Transmission Main (RTM) System.** Pipes 24 inches in diameter or greater that convey water from the Northeast Surface Water Treatment Facility (NESWTF) to the TGM.
2. **Transmission Grid Main (TGM) System.** 16 inch diameter water mains that convey potable water to the distribution system.
3. **Distribution System.** A 1,740 mile pipe network ranging in size from 6 inches to 14 inches in diameter that serves individual customers.

Water is supplied from up to 265 operational groundwater wells, the 30 mgd NESWTF, storage facilities, and booster pump facilities. A 60 inch raw water gravity main is also being constructed from the Friant-Kern Canal, one mile of which is already completed. There is over 40 feet of elevation difference between the outlet from the Friant-Kern Canal into the 60 inch raw water pipeline and the lower elevation outlet to the headworks of the NESWTF. Currently the Department of Public Utilities, Water Division is planning to construct a low-head hydropower generation plant on the low-end of the pipeline at the NESWTF to take advantage of the elevation difference and provide alternative energy electrical power directly for the operation of the NESWTF.

The Downtown Area, which includes Fulton Corridor, relies on a large number of six-inch water mains over 60 years old that cannot provide appropriate fire flow according to current fire flow standards. In the Fulton Corridor area alone, over 18,000 feet of pipe is known to have been installed before 1950, and another 20,000 feet of pipe is suspected to have been installed in the same time period. This approximately 38,000 feet of water main either are approaching or have already exceeded the end of their useful life-cycle. In order to continue to provide the current level of service downtown and before providing service upgrades required for development, these pipes will need to be replaced.

In 2009 West Yost and Associates (WYA) completed a Hydraulic Evaluation that found the capacity of current infrastructure to be insufficient for the incremental growth projected by the 2025 General Plan. Additional supply was created by a plan to upgrade wells to the north and west of Downtown to full capacity and construct transmission mains from these wells to the Fulton Corridor. Additionally, a 3 million gallon tank is planned for the Plan Area to supplement the main distribution system to accommodate peak demands and required fire flow. Recent analysis identified the well as an operationally critical system component; while the new tank and main provide some safeguard in the event the well fails, the water system would still be unable to meet fire flow demands for the Plan Area. This plan is temporary as the City intends to construct the Southeast Surface Water Treatment Facility (SESWTF) as recommended in the MWRMP, to meet city-wide water requirements.

This Specific Plan proposes increased density in Downtown, bringing more people and water consuming activities into the area. With this intensification, water demand will increase throughout the next 25 years. This plan quantifies these land use changes and the City's ability to provide for the anticipated increase in water demand. In the sections below this Specific Plan documents these existing water resources as well as those that must be developed in order to meet future demands. See **Chapter 11** (Implementation) for more information on the mix of funding sources, public and private, that can be directed to pay for these investments.

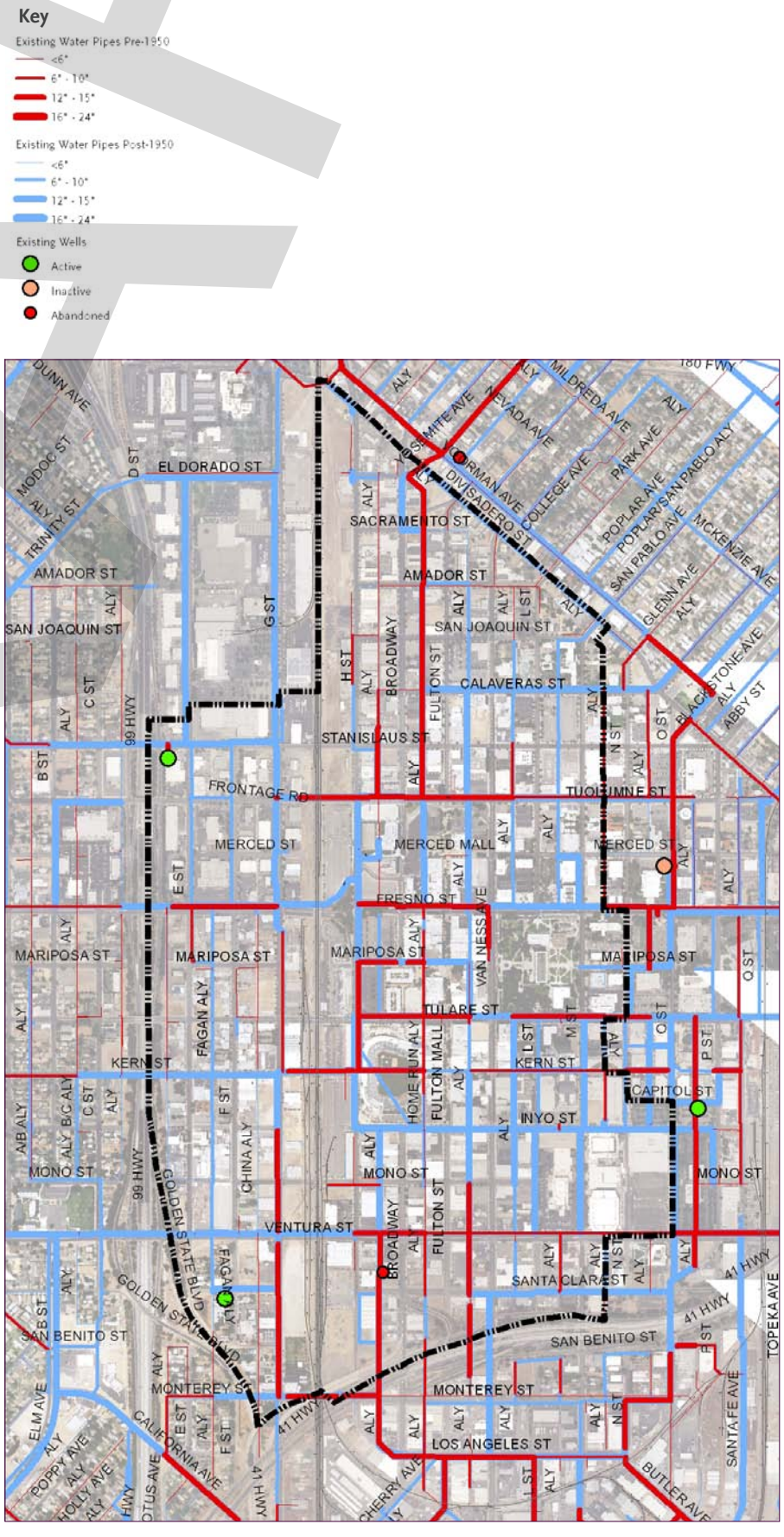



**Figure 10.3A - Existing Water Distribution System**

# 10.3 - DOMESTIC WATER INFRASTRUCTURE (continued)

## A. WATER FRAMEWORK

As outlined in the Fresno Department of Public Utilities Water Division's Metropolitan Water Resources Management Plan (MWRMP) and Urban Water Management Plan (UWMP), the City is committed to adopting a sustainable water management program that minimizes its dependence on groundwater and diversifies its water portfolio. The City is currently unable to tap into the full potential of its available surface water resources due to insufficient treatment capacity and aging infrastructure. Improvements to the water supply and distribution system are thus needed in order to:

- Optimize utilization of the City's current water resource portfolio;
- Strengthen the efficiency and reliability of aging infrastructure; and
- Provide adequate fire flow for projected population growth and densification within the Plan Area.

The following goals and policies will enable the Downtown area to thrive without having to increase the delivery of outside water resources. Mandatory policies are required by all users of this Plan and are denoted by a '►'.

**Goal 10-1. Optimize access to existing water resources through the construction of new facilities, upgrades to distribution infrastructure, and ongoing conservation incentive programs.**

**Policies**

► **10-1-1.** Expedite full implementation of the City's MWRMP and UWMP.

► **10-1-2.** Implement the City's pipe replacement program in accordance with the MWRMP.

► **10-1-3.** Upgrade pipes and appurtenances to ensure adequate fire flow where necessary in conjunction with future major street improvements and when major redevelopment projects occur.

► **10-1-4.** Implement a tiered rate structure to encourage water conservation trends.

► **10-1-5.** Adopt a 5-year CIP rate plan which meets, or exceeds, the infrastructure and resource management goals outlined in the 2011 Utility Advisory Committee Report to Council.

► **10-1-6.** Develop a policy to implement a rolling 5-year CIP plan and associated rate increases as needed to supplement mandatory minimum annual rate increases tied to an Index.

## 10.4 SEWER INFRASTRUCTURE

The City of Fresno is the Regional Sewer Agency for the Fresno-Clovis Metropolitan Area (FCMA), and owns and maintains the wastewater collection system that serves the City and the following agencies: County of Fresno, Pinedale Public Utility District, and Pinedale County Water District. Additionally, the City owns and maintains the sewer trunk system that serves the City of Clovis. The City's wastewater collection system consists of:

- 23,005 manholes
- 15 lift stations
- Nearly 2 miles of force mains
- 54 junction structures, and
- Approximately 1,498 miles of gravity sewer pipes ranging from 6" to 84" in diameter.

The City also owns and operates the Fresno/Clovis Regional Wastewater Reclamation Facility (RWRF). The wastewater collection system conveys wastewater primarily by gravity to the RWRF located southwest of the City limits. Generally, wastewater flows from the northeast to the southwest. The RWRF currently provides secondary treatment and has a rated capacity of 80 million gallons per day (mgd), with equipment redundancy to accommodate maintenance schedules or equipment failures. Effluent disposal occurs primarily through a combination of infiltration beds located at the RWRF and agricultural irrigation.

Based on its 2006 Wastewater Collection System Master Plan, the City has an on-going program to address the age and existing challenges in the collection system, notably the corrosion of existing concrete sewers due to high sulfide levels. These improvement projects fall into several different categories:

- Infill Projects
- Sewer Replacement Projects
- Rehabilitation Projects
- Relief Sewer Projects

Some of these improvement projects have already been completed or are underway.

According to the 2025 General Plan, the City's population will increase from about 482,000 in 2000 to 790,000 in 2025. The growth will occur through population densification as well as new developments. The collection system must be expanded to accommodate the resulting increased flow within the City's current collection system and to provide service to new developments. Assuming a treatment design demand of 130 gpcd, the RWRF would need to provide a base treatment capacity of 103 mgd to serve the projected population in 2025 (increase of 27 mgd). While the RWRF facility is the regional treatment and reclamation facility, alternatives for future capacity include sub-regional facilities located in the Southeast Growth Area presented by the 2025 Fresno General Plan.


Figure 10.4A - Existing Sewer System

### A. SEWER FRAMEWORK

The following goal and policy enable continued excellent sewer service for Downtown.

**Goal 10-2. Promote recycled water programs and use in order to reduce loads on the sewer system.**

**Policy**

▶ **10-2-1.** Enhance the City's capability to recycle and reuse wastewater in accordance with the policies and actions in **Section 10.5**.

## 10.5 RECYCLED WATER INFRASTRUCTURE

Currently, wastewater flow from the Copper River Ranch and the area immediately to the south of Copper Avenue flow to the North Fresno Water Reclamation Facility (NFWRF) for treatment and are used to irrigate the nearby golf course. Except for incidental and evaporative losses, the total wastewater volume treated at the RWRF is currently either used to directly irrigate farmland or sent to incidental percolation basins. After this water percolates into the groundwater basin, a portion of this water is then pumped and discharged into the Fresno Irrigation District (FID) canal system as part of the Wastewater Recycle Exchange Agreement with FID. The City plans to expand its recycled water use to include landscape irrigation and non-potable applications, which would require the construction of additional tertiary treatment facilities. The expansion of the recycled water system is described in the City's Recycled Water Master Plan (RWMP) and would enable the City to offset potable water use, enhance the sustainability of the water supply, and reduce current dependency on percolation ponds to handle effluent discharge. As part of the RWMP, the City intends to adopt [change "intends to adopt" to "has adopted" once adopted] a Recycled Water Ordinance to further support recycled water development by encouraging, or in some instances, requiring recycled water use.

Per the 2010 MWRMP, the City intends to provide 25,000 afy of recycled water for landscape irrigation and other non-potable applications to offset potable demands by 2025. Corresponding treatment and storage facility upgrades should be strategically sited so that recycled water can be efficiently distributed to targeted landscape and developed areas, with minimal impacts to transportation corridors, streetscape aesthetics, and community amenities.

The Specific Plan proposes landscaped parks and street plantings within the Plan Area (See **Figure 10.5A**), in addition to the previously identified opportunities for recycled water use within the Plan Area. These sites will create a larger demand for irrigation that can be addressed by reclaimed water. See **Chapter 11** (Implementation) for more information on the mix of funding sources, public and private, that can be directed to pay for these investments.

### A. RECYCLED WATER FRAMEWORK

In conjunction with the City's forthcoming [delete "forthcoming" once adopted] Recycled Water Master Plan, establishing a recycled water system within Downtown will allow the Plan Area to proactively decrease its dependence on groundwater pumping and external water sources. The following goals and policies bolster the City's burgeoning recycled water program and supplement its alternative water resources.

**Goal 10-3 Develop a downtown recycled water plant adjacent to the water tower at Eaton Plaza and distribution network to offset potable water being used for non-potable purposes, to be integrated into the City's future Recycled Water Master Plan.**

**Policies**

- **10-3-1.** As economically feasible, supply recycled water to street improvements and planting areas within the Plan Area.
- **10-3-2.** As economically feasible, supply recycled water to both public and private large irrigation users.
- **10-3-3.** Allow for recycled water use for mechanical plumbing applications, such as cooling tower makeup demands, unless otherwise prohibited by local, State, or Federal regulations.

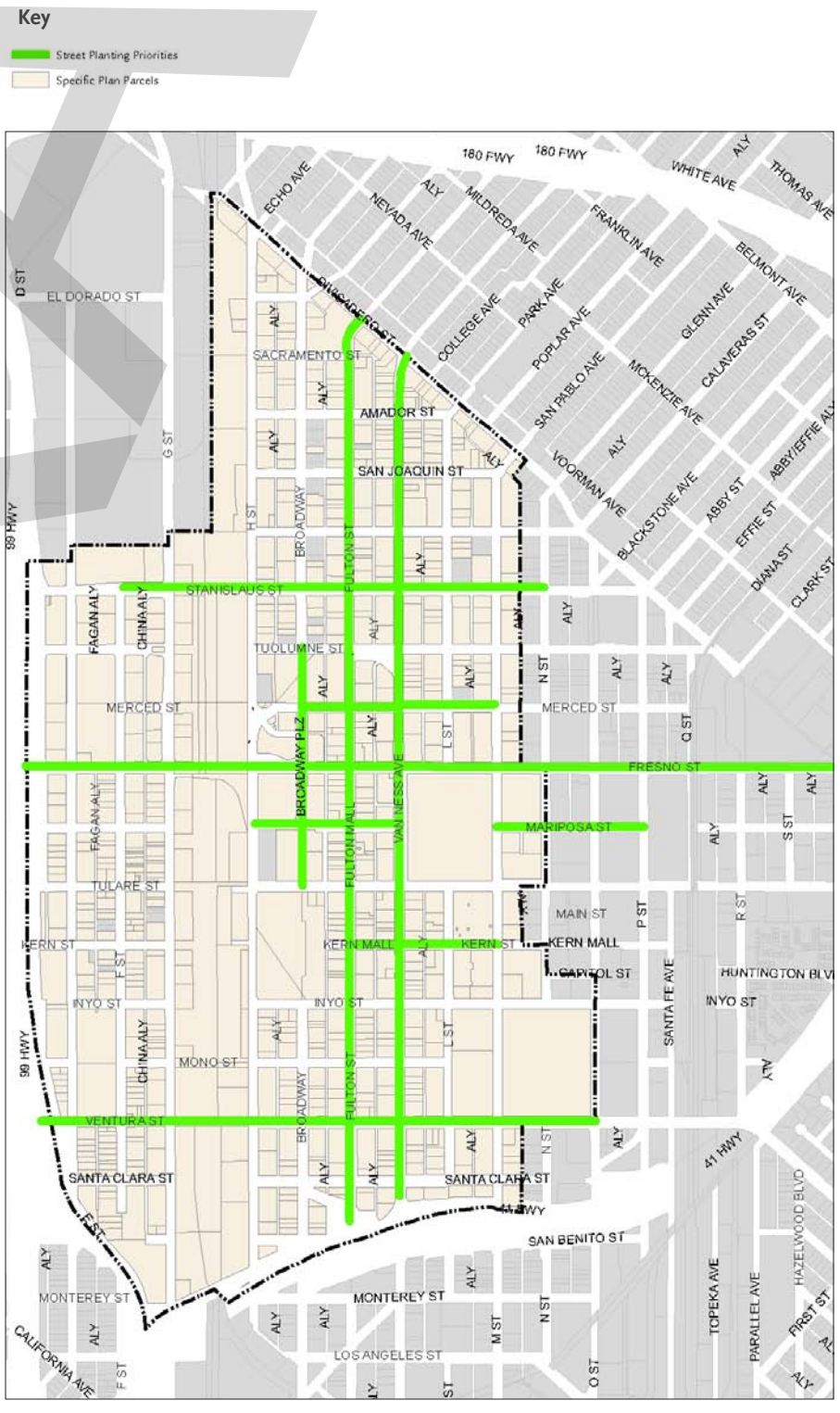



**Figure 10.5A - Landscape for Streets Plan**

# 10.6 UTILITY SYNERGIES

## A. UTILITY FRAMEWORK

The following goals and policies have been developed to accommodate projected levels of growth in Downtown and to ensure inter-agency collaboration. Projected growth levels will require maintenance and some updates to the City's water, wastewater, recycled water, and storm drainage infrastructure to continue adequate service, safety, and reliability to the community.

In addition, an important aspect of managing ongoing utility service in Downtown will be collaboration between the City and outside utility agencies, such as PG&E and the Fresno Metropolitan Flood Control District (FMFCD). Frequent and organized communication between agencies and utility providers that share use of the public realm for distribution infrastructure will be important to ensure that planning efforts and utility improvement schedules are aligned. Shared construction efforts and easements also have the potential to create synergies, cost savings and more efficient facility sharing. See **Chapter 11** (Implementation) for more information on the mix of funding sources, public and private, that can be directed to pay for these investments.

**Goal 10-4 Collaborate with other agencies.**

**Policies**

- **10-4-1** Collaborate with other agencies during the planning and schematic design phases of each Capital Improvement Project.
- **10-4-2** Meet regularly with capital improvement departments of the FMFCD, the City of Fresno Public Works, and the Public Utilities Department.

**Goal 10-5 Maintain and enhance the City's existing infrastructure systems.**

**Policies**

- **10-5-1** Implement the City's pipe replacement program in accordance with the City's MWRMP, Sewer System Management Plan, Recycled Master Plan, and the FMFCD's Storm Drainage and Flood Control Master Plan.
- **10-5-2** Upgrade pipes and appurtenances for water distribution and wastewater collection systems as required by the hydraulic modeling results for this Specific Plan, whenever major street improvements occur. See **Chapter 11** (Implementation) for more information including potential funding sources.
- **10-5-3** Update the City's Capital Improvement Projects to include and prioritize infrastructure upgrades required to support development and economic growth rates projected by this Specific Plan. See **Chapter 11** (Implementation) for more information including potential funding sources.

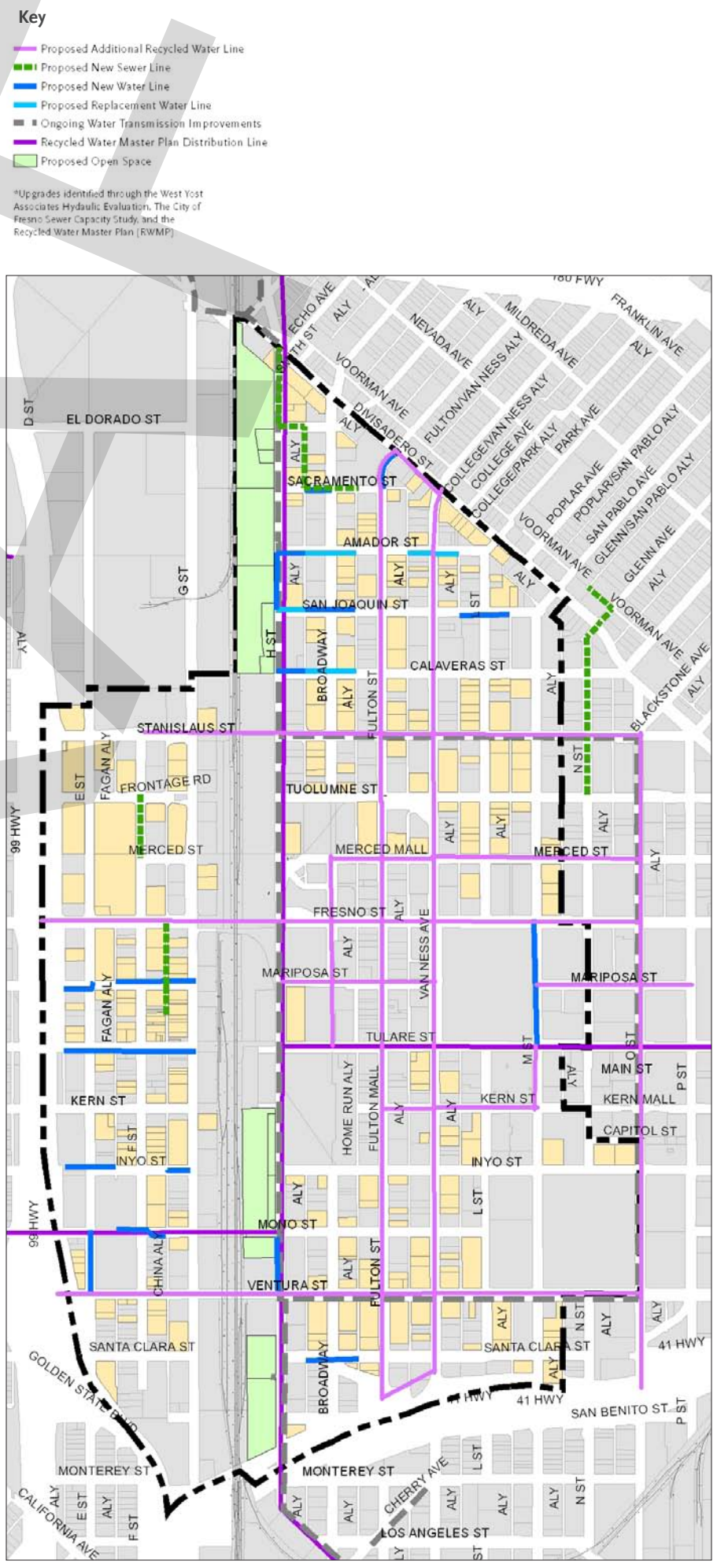



**Figure 10.6A - Utility Synergy Map.** *See Chapter 11 (Implementation) for more information.*

# 10.7 STORMWATER INFRASTRUCTURE

The Fresno Metropolitan Flood Control District (FMFCD or the District) is responsible for managing urban stormwater runoff in the Fresno metropolitan area. The District boundary is located in the north-central portion of Fresno County, between the San Joaquin River and the Kings River, and is authorized to control stormwaters within a combined urban and rural watershed of approximately 400 square miles. The watershed extends eastward into the Sierra Nevada foothills to an elevation of approximately 4,500 feet above sea level, covering an area collectively referred to as the Fresno County Stream Group.

Storm water collection in the project area begins in the street gutters that convey runoff to existing storm drain inlets. The gutters, as well as all public streets and sidewalks, are maintained by the City of Fresno Street Maintenance Division, which is responsible for cleaning and the removal of debris that can clog storm drain facilities. The FMFCD storm water system begins at the storm drain inlets and includes all downstream drainage facilities. These facilities include the underground pipes and pump stations that convey runoff to District-owned infiltration basins, which dispose of most annual runoff through percolation into the underlying groundwater table. All of the runoff from the Downtown Area is recharged to the groundwater table. The existing drainage system is shown in **Figure 10.7A**. When storms generate larger volumes of runoff than these basins can handle, it overflows into a network of relief channels that discharge to either the San Joaquin River, its tributary streams or local agricultural canals.

Within the City of Fresno, FMFCD's Storm Drain Master Plan divided the District into local drainage areas of one to two square miles. All inlets, pipes and pumping stations within each drainage area are maintained by the District, except for those located in the Fulton Mall Area, which is currently maintained for the District by the City under a system of work authorizations. It is expected this maintenance arrangement will remain in place for the foreseeable future, so the City will continue to maintain that portion of the Plan Area's storm drain infrastructure that it currently maintains throughout the life of the proposed redevelopment plan.

Many areas throughout the City currently lack complete or adequate storm drain systems. This makes them prone to frequent localized flooding that damages properties and inconveniences residents, resulting in lower property values and higher insurance costs for both homeowners and businesses. Many of these areas have not historically generated sufficient tax revenue to fund the construction of modern drainage facilities, so a number of storm drain improvements are now being constructed with funding provided by the American Recovery and Reinvestment Act (ARRA). One of these projects is located on Divisadero Street, adjacent to an approximately twelve block area with no storm drain facilities that extends south from Divisadero into the Plan Area. These improvements will provide little direct relief for this neighborhood, but they will make it feasible to relieve existing flooding conditions by extending this system in the future.

A second part of the Plan Area, totaling about 50 acres in the south corner, also lacks an existing storm drain network. No facilities are currently planned for this area, but it is assumed that storm drains will eventually be needed to support the scale and character of redevelopment now being considered. It is expected these new facilities would be connected to the major storm drain lines that now serve the central portion of the Plan Area or to the lines that serve the neighborhood located immediately north of Divisadero Street. Although there are no indications of significant drainage problems within the areas now served by these facilities, shallow, nuisance flooding has been reported after heavy rains, leaving standing water that has damaged pavement and inconvenienced both drivers and pedestrians. It is expected the addition of runoff from any newly served areas would exacerbate these problems, potentially limiting the Plan Area's development potential. As a result, any increase in runoff resulting from storm drain extensions may also trigger the need for capacity upgrades on the District's collection facilities.

## A. EXISTING POLICY IMPLICATIONS FOR WATER RESOURCES

It is noted that any stormwater control programs that would potentially increase the amount or change the location of percolation within the Plan Area would have to first consider its potential impact on the Kings Subbasin aquifer. As part of a designated EPA Sole Source Aquifer, the Kings Subbasin is the principal drinking water source for the City of Fresno. If the aquifer becomes contaminated, particularly within an area that contains many existing potable supply wells, it could significantly affect the City's ability to meet its water supply commitments and/or create a significant hazard to public health. The EPA designation also prohibits the provision of federal assistance for any projects that may cause the quality of the groundwater supply to deteriorate. Therefore, Low Impact Development (LID) measures proposed for implementation within the Plan Area should include alternatives designed to address concerns related to groundwater quality. For example, City personnel report that contamination plumes have been identified underneath some parts of the Plan Area, and have expressed concerns that increased percolation in their proximity could push the contaminants toward the supply wells' zone of withdrawal. If these reports are verified, proposed LID percolation areas could be equipped with underdrains that ultimately discharge the collected runoff to the storm drain system (described below as "flow-through planters"). This would preserve the detention storage and filtration components of the facilities, while eliminating the potential interaction with the underlying contamination plume.

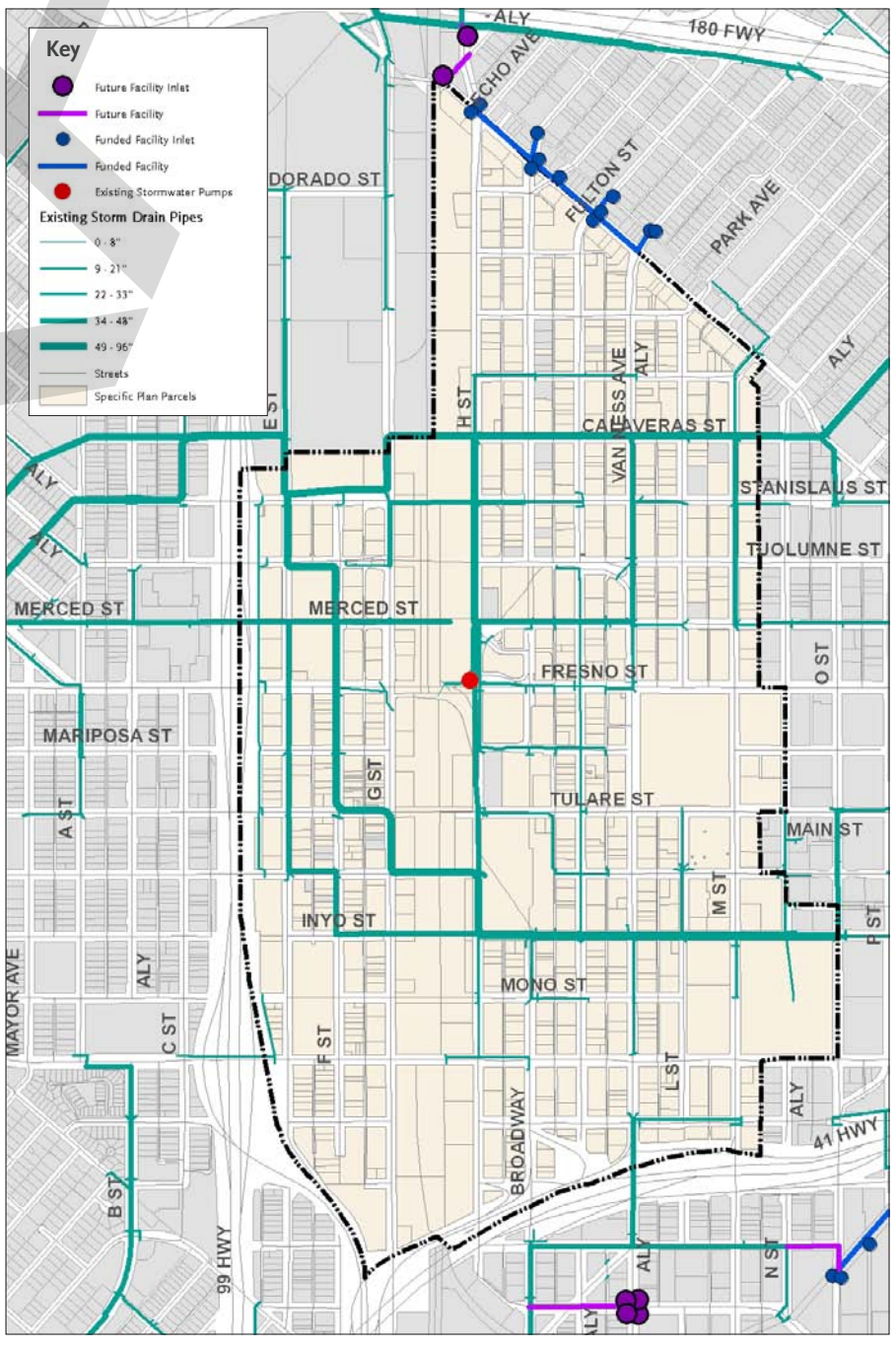



**Figure 10.7A - Existing Downtown Storm Drain System**

## B. APPROACH TO STORMWATER MANAGEMENT

Rainwater is often considered a waste product and nuisance; therefore, traditional strategies have targeted removing runoff from a site as quickly as possible. Within developed areas, impervious surfaces such as streets, sidewalks, driveways, parking lots, and buildings prevent stormwater from infiltrating into the ground, so the rate and total volume of runoff is increased in relation to natural conditions. These flows are collected into storm drain infrastructure that often cannot handle peak flows, converting what would otherwise be dispersed, minor flooding into concentrated pockets of major flooding when they overflow. In addition, in the City of Fresno and throughout the FMFCD, higher runoff volumes result in more frequent overflows of the existing network of infiltration basins and increased discharges to local surface waters. As noted in the previous section, the storm drain system that serves the Plan Area lacks the capacity needed to accommodate peak runoff during major storm events, so improvements are needed to fully support the level of redevelopment now under consideration. These improvements could potentially include each element of the existing storm drain network: pipe lines, pumping stations and infiltration basins.

Although it is possible to address storm drain deficiencies through capacity improvements, an alternative approach involves treating rainwater as a resource, facilitating a return to sustainable, more natural conditions, even within an urban setting. Low Impact Designs (LID) mimic the natural hydrologic process by allowing rainfall to slowly infiltrate into plants and soils near where it falls, rather than immediately routing it into storm drains. This process:

- Reduces the burden on storm drains and downstream discharge points (thereby addressing both existing and future capacity constraints);
- Improves the quality of runoff by filtering out many of the pollutants it picks up when flowing across paved surfaces, helping to reduce the concentration of pollutants within the District's infiltration basins, as well as improving the quality of water that is discharged to the San Joaquin River and its tributary streams; and
- Increases percolation into and recharge of the aquifer that underlies Fresno and serves as its principal water source.

Appropriate LID techniques and mitigation measures designed to increase control of stormwater at the source, and which are suitable for implementation within both the public and private realm, are presented in the following sections. These measures have been selected to ensure they are consistent with and supplement the County's National Pollutant Discharge Elimination System (NPDES) permit and Stormwater Management Plan.

Much of the City's surface parking and street network within the Downtown area is oversized and underutilized. These areas will be redefined and reconstructed as part of the transportation and landscape improvements associated with the Specific Plan. These changes will create an opportunity to convert currently paved surfaces into pervious planted areas and prospective LID stormwater treatment sites. Potential benefits include increased infiltration, reduced runoff, and an alleviation of flooding. Locations where sustainable stormwater measures could be integrated into the streetscape vision are identified and described in following sections.

## C. SUSTAINABLE STORMWATER FRAMEWORK AND DESIGN PRINCIPLES

The following goals and policies will enhance the existing infrastructure network of the FMFCD and reduce localized flooding, improve water quality, provide community amenities, and enhance aquifer recharge throughout the City. They focus on minimizing impervious surfaces, improving the quality of stormwater runoff, and reducing negative effects on downstream water bodies. A key strategy for sustainable stormwater design is mimicking predevelopment site hydrology. This means using site and infrastructure design techniques that filter, store, infiltrate, evaporate, and detain runoff, while also adding urban greenery. These types of efforts can enhance the existing infrastructure network of the FMFCD by separating stormwater from piped underground drainage systems, decreasing infrastructure costs, improving potential capacity deficiencies, and reducing potential pollution and hydrologic impacts from storm drain overflows.

**Table 10.7A** on the following page describes the most relevant and practical types of Low Impact Development (LID) strategies. **Tables 10.7B - 10.7E** show where these LID strategies can be introduced whenever right-of-way improvements are made within the Plan Area.

**Goal 10-6. Reduce hydrologic impacts by minimizing impervious surfaces and graded areas.**

**Policies**

- ▶ **10-6-1** Decrease the use and/or surface area of typical impervious engineering materials such as concrete and asphalt to help reduce initial and long-term infrastructure costs.
- ▶ **10-6-2** Use alternative materials such as native plants, soil and crushed rock where applicable to reinforce a landscape aesthetic within the urban setting.
- ▶ **10-6-3** Manage stormwater at the source and on the surface by providing increased opportunities for rainfall to soak into the ground within nearby landscaping.
- ▶ **10-6-4** Promote infiltration after treatment whenever possible, without compromising groundwater quality, to help recharge the groundwater basin.
- ▶ **10-6-5** Integrate the stormwater system as habitat, passive recreational space, and/or landscaped areas. Use plants and soil to absorb, slow, filter, and cleanse runoff.
- ▶ **10-6-6** Design stormwater facilities that are simple, cost-effective, and enhance community aesthetics.
- ▶ **10-6-7** Collect and reuse stormwater for landscape or agricultural purposes where feasible.
- ▶ **10-6-8** Design stormwater facilities, at a minimum, to provide water quality treatment for the "first flush" of runoff (typically about 1/4 of an inch).

**Goal 10-7 Improve stormwater quality and minimize associated runoff.**

**Policies**

- **10-7-1** Promote the use of LID stormwater design guidelines to treat stormwater.
- ▶ **10-7-2** In conformance with the Downtown Development Code, require infill development in revitalization areas to adhere to LID design guidelines.
- ▶ **10-7-3** Align implementation of LID stormwater measures and retrofits with priority street improvements projected in the Plan Area.
- ▶ **10-7-4** Apply LID strategies, as shown in **Table 10.7A**, when right-of-way improvements are made.
- ▶ **10-7-5** Promote the development and implementation of reproducible and low cost pilot projects.

## Table 10.7A - Menu of Sustainable Stormwater Strategies

### Stormwater Planters (Infiltration and Flow-Through)

Within an urban context, planters are typically small, vegetated areas situated within an area of otherwise impervious hardscape, such as inside curb islands or cut into a sidewalk against a building wall. Given these locational characteristics, stormwater management planters often receive runoff from a discrete, dedicated source, such as a rainwater leader or a tightly defined section of sidewalk or roadway pavement. The two types of planters used for this purpose are infiltration and flow-through. Infiltration planters depend on native soil conditions that allow runoff to soak into the underlying soil. Flow-through planters are completely contained systems that only allow runoff to soak through the planter's imported soil bed and then into underdrains that are connected to the storm drain system. Both types reduce the rate of stormwater runoff, which eases the burden on local storm drain facilities, but infiltration planters are more desirable because they also reduce the total volume of runoff. Flow-through planters are appropriate where native soil conditions are unfavorable to infiltration, at locations above underground structures, where there is underlying soil contamination, and/or where the seasonal high water table is within 10 feet of the landscape surface. Stormwater planters are easily incorporated into retrofit conditions and in places where space is limited.

### Pervious Paving Systems

Pervious paving systems allow rain water to pass through their surface and soak into the underlying ground. Pervious paving must be designed not only to manage stormwater runoff adequately, but also meet the load bearing requirements of the proposed application and provide a level of durability equivalent to conventional paving. Urban plazas, parking stalls or other low traffic areas are typically ideal for the application of pervious paving, as opposed to heavily loaded or high traffic volume areas. Runoff from streets and parking areas should be treated for water quality before infiltrating through permeable pavers and into the ground.

### Swales

Vegetated swales are long, narrow landscaped depressions, with a slight longitudinal slope. They are primarily used to convey stormwater runoff on the land's surface while also providing water quality treatment. As water flows through a vegetated swale, it is slowed by the interaction with plants and soil, allowing sediments and associated pollutants to settle out or be adsorbed by the plant material. In addition, there is generally some reduction in the volume of runoff, because water that soaks into the soil is taken up by plants or percolates into deeper strata if native soils are well drained. The remaining water that continues to flow downstream travels more slowly than it would through pipes in a traditional stormwater conveyance system, which further reduces peak flow rates. To maximize vegetative contact, vegetated swales are typically built very shallow and contain runoff that is only a few inches deep. Vegetated swales are relatively low-cost, simple to construct, easy to maintain, and widely accepted as a stormwater management strategy. They can be planted in a variety of ways, ranging from mown grass to a diverse palette of grasses, sedges, rushes, shrubs, groundcover, and trees.

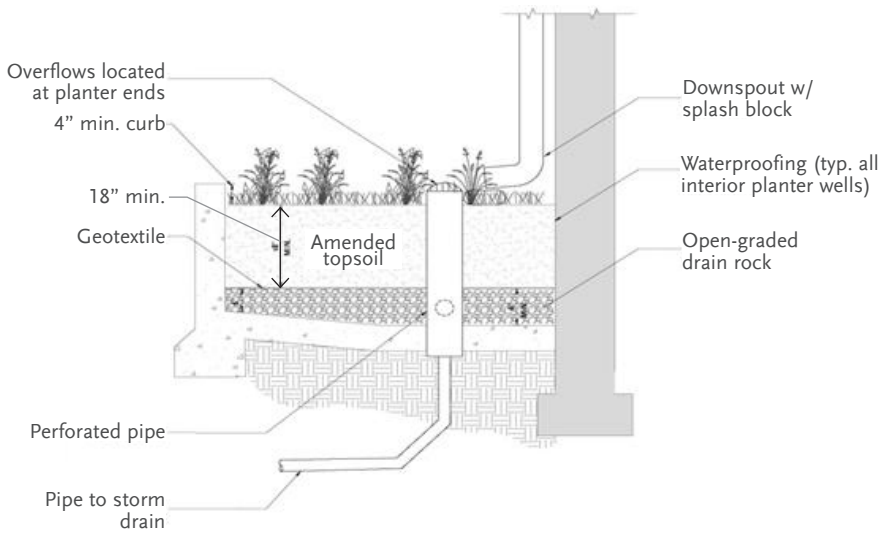
### Rain Gardens

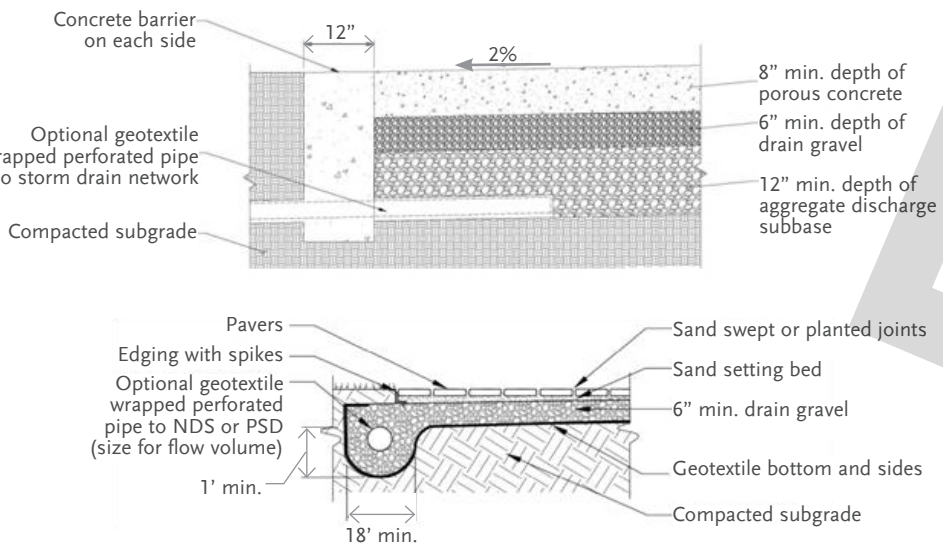
Rain gardens are large, shallow, vegetated depressions in the landscape. They can be any size or shape, and are often molded to fit in "leftover" spaces in parking lots, along street frontages, and in situations where streets intersect at odd angles.

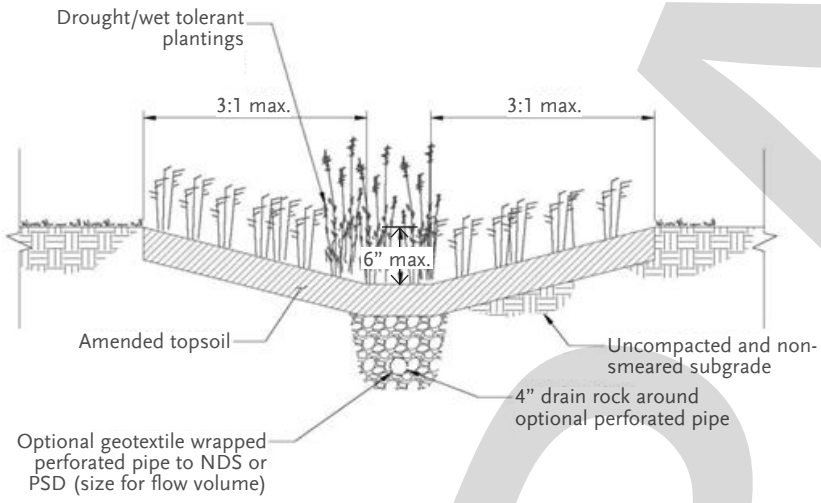
Rain gardens retain stormwater, thereby attenuating peak flows and overall volume. They can also allow for infiltration, depending on the capacity of the native soil. Although rain gardens can share certain characteristics with swales and planters (they can be designed with vertical curbs or side slopes), they differ from swales in that their primary function is the maximum storage of runoff, not conveyance. Accordingly, they are typically designed to be flat-bottomed without any longitudinal slope in order to maximize stormwater storage potential.

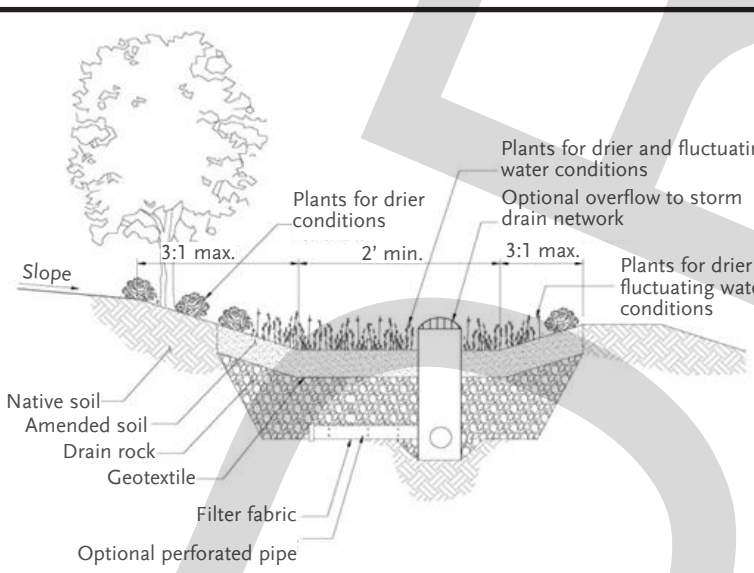
### Curb Extensions

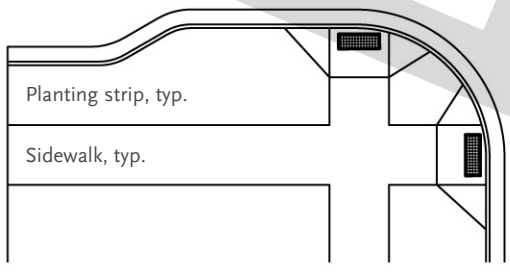
Stormwater curb extensions are landscape areas that extend into the street and capture stormwater runoff. Conventional curb extensions (i.e., bulb outs, chokers, chicanes) are commonly used to increase pedestrian safety and help calm traffic. Stormwater curb extensions share these same attributes and add a stormwater benefit by allowing water to flow into landscape space. This landscape space can be designed with the physical characteristics of vegetated swales, planters, or rain gardens depending on the available space and specific site conditions. Stormwater curb extensions are particularly advantageous in retrofit situations because they can often be added to existing streets with minimal disturbance. The small footprint of these features allows for an efficient stormwater management system that often performs very well for a relatively low implementation cost. Stormwater curb extensions can be planted with a variety of trees, shrubs, grasses and ground covers, depending on site context and conditions.


Overflows located at planter ends
4" min. curb
18" min.
Geotextile
Amended topsoil
Perforated pipe
Pipe to storm drain
Downspout w/ splash block
Waterproofing (typ. all interior planter wells)
Open-graded drain rock


Concrete barrier on each side
12"
2%
Optional geotextile wrapped perforated pipe to storm drain network
Compacted subgrade
8" min. depth of porous concrete
6" min. depth of drain gravel
12" min. depth of aggregate discharge subbase
Pavers
Edging with spikes
Optional geotextile wrapped perforated pipe to NDS or PSD (size for flow volume)
1' min.
18' min.
Sand swept or planted joints
Sand setting bed
6" min. drain gravel
Geotextile bottom and sides
Compacted subgrade


Drought/wet tolerant plantings
3:1 max.
3:1 max.
6" max.
Amended topsoil
Uncompacted and non-smeared subgrade
4" drain rock around optional perforated pipe
Optional geotextile wrapped perforated pipe to NDS or PSD (size for flow volume)


Plants for drier conditions
Plants for drier and fluctuating water conditions
Optional overflow to storm drain network
3:1 max.
2' min.
3:1 max.
Slope
Plants for drier and fluctuating water conditions
Native soil
Amended soil
Drain rock
Geotextile
Filter fabric
Optional perforated pipe


Planting strip, typ.
Sidewalk, typ.

## 10.7 STORMWATER INFRASTRUCTURE (continued)

### Table 10.7B - Parking Lot Retrofit

| PARKING LOT RETROFITS | Potential LID Measures | | | | |
|---|---|---|---|---|---|
| | Flow-Through and Infiltration Planters | Swales | Rain Gardens | Curb Extensions | Tree Planting |
| **Criteria / Properties** | | | | | |
| Land use designated by planning program is to remain parking. | ✓ | ✓ | ✓ | ✓ | ✓ |
| Drive aisles are greater than 24' wide. | ✓ | ✓ | ✓ | ✓ | ✓ |
| Presence of underutilized medians and/or 'dead' striping zones. | ✓ | ✓ | ✓ | ✓ | ✓ |
| Long, linear, continuous configuration. | ✓ | | ✓ | | |
| Large footprint (i.e. for shopping malls, big box stores). | ✓ | | ✓ | ✓ | ✓ |
| **Example Locations** | | | | | |
| Stadium Lot - H Street (between Mono Street & Kern Street) | ✓ | ✓ | ✓ | ✓ | ✓ |
| Lot - Homerun Alley @ Inyo Street | ✓ | ✓ | ✓ | ✓ | ✓ |
| 2 Lots- H Street (between Fresno Street & Stanislaus Street) | ✓ | ✓ | ✓ | ✓ | ✓ |
| Fresno Met Lot - Calaveras Street @ Van Ness Avenue | ✓ | | ✓ | ✓ | ✓ |

Parking lots represent a substantial fraction of impervious surface within the Plan Area and offer opportunities for implementing LID techniques. To ensure that adequate parking is made available on-site while also minimizing the impact of impervious paved surfaces, optimal parking lot design can be achieved by narrowing drive aisles. Savings in paved areas can then be replaced by LID water quality treatment applications using strategically placed vegetated swales, rain gardens, or infiltration/flow-through planters that either percolate into underlying soil or are hard piped into the City's existing drainage system. Opportunities for increased tree planting would also improve the shade canopy and reduce heat island effects.  Area made available by streamlining parking could also potentially be used to install solar arrays to offset energy demands of nearby buildings and public spaces.

### Table 10.7C - Street Buffer Treatment

| STREET BUFFER TREATMENT | Potential LID Measures | | | | |
|---|---|---|---|---|---|
| | Flow-Through and Infiltration Planters | Swales | Rain Gardens | Curb Extensions | Tree Planting |
| **Criteria / Properties** | | | | | |
| Non-pedestrian medians and/or islands. | ✓ | | ✓ | | ✓ |
| Non-pedestrian traditional curb extensions. | ✓ | | ✓ | ✓ | ✓ |
| Streets with over-abundant permanent parallel parking stalls. | ✓ | ✓ | ✓ | ✓ | ✓ |
| Streets with angled parking stalls. | ✓ | | ✓ | ✓ | ✓ |
| Leftover landscape and/or asphalt space. | ✓ | ✓ | ✓ | ✓ | ✓ |
| Dead striping zones, such as for "No Parking". | ✓ | | ✓ | ✓ | |
| **Example Locations** | | | | | |
| Intersection - H Street @Tulare Street | ✓ | | ✓ | ✓ | ✓ |
| Intersection - F Street @ Mariposa Street | ✓ | | ✓ | | ✓ |
| Sidewalk - Calaveras Street @ Van Ness Avenue | ✓ | | ✓ | ✓ | ✓ |
| Medians & islands - Broadway @ Fresno Street | ✓ | | ✓ | | ✓ |

As with parking lots, LID techniques can be integrated into streetscapes and roadways to reduce the extent of paved surfaces and stormwater runoff pollution.  Large areas of unused or inefficiently used spaces, such as concrete medians, islands, and unnecessarily wide roadways or sidewalks, can all be transformed into planted areas that facilitate infiltration, reduce runoff, and alleviate the burden on the City's drainage system.  These planted treatment areas can take shape as vegetated swales, infiltration planters, rain gardens, or curb extensions.

Leftover landscape and asphalt spaces are also prime candidates for LID retrofits.  For areas where on-street parking is fully utilized, smaller stormwater curb extensions, spaced more frequently, can be used to minimize parking loss to any individual property.  Streets striped with "no parking" zones could be converted into stormwater curb extensions without any loss of parking.  Existing curb extensions paved with concrete or landscaped can be redesigned as either infiltration or flow-through planters.  Stormwater curb extensions can also be constructed on streets with an angled parking configuration.

**Table 10.7D - Inlet Rain Garden Retrofit**

| INLET RAIN GARDEN RETROFIT | Potential LID Measures | | | | |
|---|---|---|---|---|---|
| | Flow-Through and Infiltration Planters | Swales | Rain Gardens | Curb Extensions | Tree Planting |
| **Criteria / Properties** | | | | | |
| Not adjacent to critical utility structures (i.e., *hydrant*, *electrical box*). | ✓ | ✓ | ✓ | ✓ | ✓ |
| Near non-pedestrian traditional curb extensions. | ✓ | | ✓ | ✓ | |
| Near existing landscape area or underutilized open space. | ✓ | ✓ | ✓ | ✓ | ✓ |
| Coincide with street buffer intersection locations fitting criteria above. | ✓ | | ✓ | ✓ | ✓ |
| **Example Locations** | | | | | |
| 3 Inlets - F Street @ Kern Street | ✓ | | ✓ | ✓ | |
| 2 Inlets - F Street @ Mariposa Street | ✓ | | ✓ | ✓ | |
| Inlet -Tuolumne Street @ Fulton Street | ✓ | | ✓ | ✓ | |
| Inlet -Stanislaus Street @ Fulton Street | ✓ | | ✓ | ✓ | ✓ |

The drainage system within the Plan Area is currently designed so that untreated surface runoff flows overland and is collected at curb inlets or in hardscape areas, where it enters the City's storm drain network. Without the capacity to treat at least the first flush of runoff, infiltration basins and receiving water bodies are more likely to accumulate pollutants such as grease, household chemicals, construction debris, and litter. To avoid this, existing inlets can be relocated or reconfigured to sit inside rain gardens, so that stormwater runoff is first routed through landscaped detention or bio-retention facilities, allowing pollutants to be filtered out by soil and plant material.

**Table 10.7E - Plaza Retrofit Treatment**

| PLAZA RETROFIT TREATMENT | Potential LID Measures | | | | |
|---|---|---|---|---|---|
| | Flow-Through and Infiltration Planters | Swales | Rain Gardens | Pervious Pavers | Tree Planting |
| **Criteria / Properties** | | | | | |
| Within existing pedestrian mall corridors. | ✓ | | ✓ | ✓ | ✓ |
| Areas with limited or prohibited vehicular traffic. | ✓ | | ✓ | ✓ | ✓ |
| Not adjacent to critical utility structures (i.e., hydrant, electrical box). | ✓ | | ✓ | ✓ | ✓ |
| **Example Locations** | | | | | |
| Merced Pedestrian Plaza | ✓ | | ✓ | ✓ | ✓ |
| Mariposa Pedestrian Plaza | ✓ | | ✓ | ✓ | ✓ |
| Kern Pedestrian Plaza | ✓ | | ✓ | ✓ | ✓ |
| Fulton Pedestrian Plaza | ✓ | | ✓ | ✓ | ✓ |

Pedestrian plazas are prime opportunity areas for replacing otherwise impervious surface cover with permeable pavers, which promotes infiltration and reduces stormwater runoff. By reducing the footprint of required stormwater treatment measures, pervious paving is often the only viable option in ultra-urban areas that are served by internal drainage systems. Runoff from streets or parking lots should be treated for water quality before infiltrating through permeable pavers into the ground. It is important to note that pervious pavers along pedestrian walkways must be ADA-compliant and not cause tripping hazards. Pavers are available in a variety of materials and finishes, and may be chosen to complement the streetscape palette or to enhance wayfinding.

# 10.8 SUSTAINABLE INFRASTRUCTURE - GENERAL

## A. GENERAL SUSTAINABLE INFRASTRUCTURE FRAMEWORK

To ensure its future viability, the Plan Area needs to be as energy and financially efficient as possible in the short term as well as the long term. Financial incentives, solar access easements, and property tax abatements can be used to help fund and promote renewable power generation at various scales.

In addition, resource consumption by all new structures, renovated buildings, and infrastructure facilities should be minimized to support the local economy, reduce costs, and improve the natural environment.

The following goals and policies provide methods for reducing energy use and limiting resource conservation.

**Goal 10-8 Promote green building principles.**

**Policies**

▶ **10-8-1** In conformance with the Downtown Development Code, introduce buildings that employ passive cooling and heating strategies, including frontage types (porches and arcades), architectural elements (overhangs, awnings, shutters, louvers, canopies, and trellises), and strategically-placed shade trees to minimize or increase solar heat gain according to the season.

**10-8-2** Develop Incentive Programs for voluntary LEED (Leadership in Energy and Environmental Design) certified projects (LEED-NC, -ND, -EB).

**10-8-3** Work with PG&E to improve and increase city-wide energy conservation programs, including city-owned facilities.

**Goal 10-9 Promote local renewable energy generation.**

**Policies**

**10-9-1** Optimize resources available to the community by providing allowances for on-site energy generation and energy efficiency retrofits/ weatherization incentives in conjunction with the Downtown Development Code.

**10-9-2** Encourage and ensure solar access by implementing solar energy allowances and incentives in conjunction with Fresno Green.

**Goal 10-10 Minimize natural resource consumption.**

**Policies**

▶ **10-10-1** Require on-site solid waste separation (compost, recycle, landfill) for all land uses within the Plan Area.

▶ **10-10-2** Require developers to limit emission pollution from excessive material transport and waste disposal during construction.

▶ **10-10-3** Require “Smart” sub-metering of all utilities for New Construction and a timeline for existing building “Smart” sub-metering.