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4.9 Water Resources

This section discusses water resources within the project area including the physical, chemical, and biological characteristics of the South Platte River. The South Platte River is an important resource to the local residences in the project area and the Denver Metropolitan Area. The South Platte River and the surrounding corridor provide important urban wildlife habitat, recreation, park areas, and aesthetics that improve quality of life. This section also addresses storm sewer drainage and groundwater resources within the project area that directly influence the water quality of the South Platte River.

This section provides an overview of the existing water resources conditions (surface and groundwater) and the potential impacts from the system alternatives, which include System Alternatives 1, 2, 3, and the Preferred Alternative. Key elements in the understanding of the South Platte River include the South Platte River Drainage Basin, a historical perspective of the river, designated water uses, existing water quality conditions, and water quality regulations.

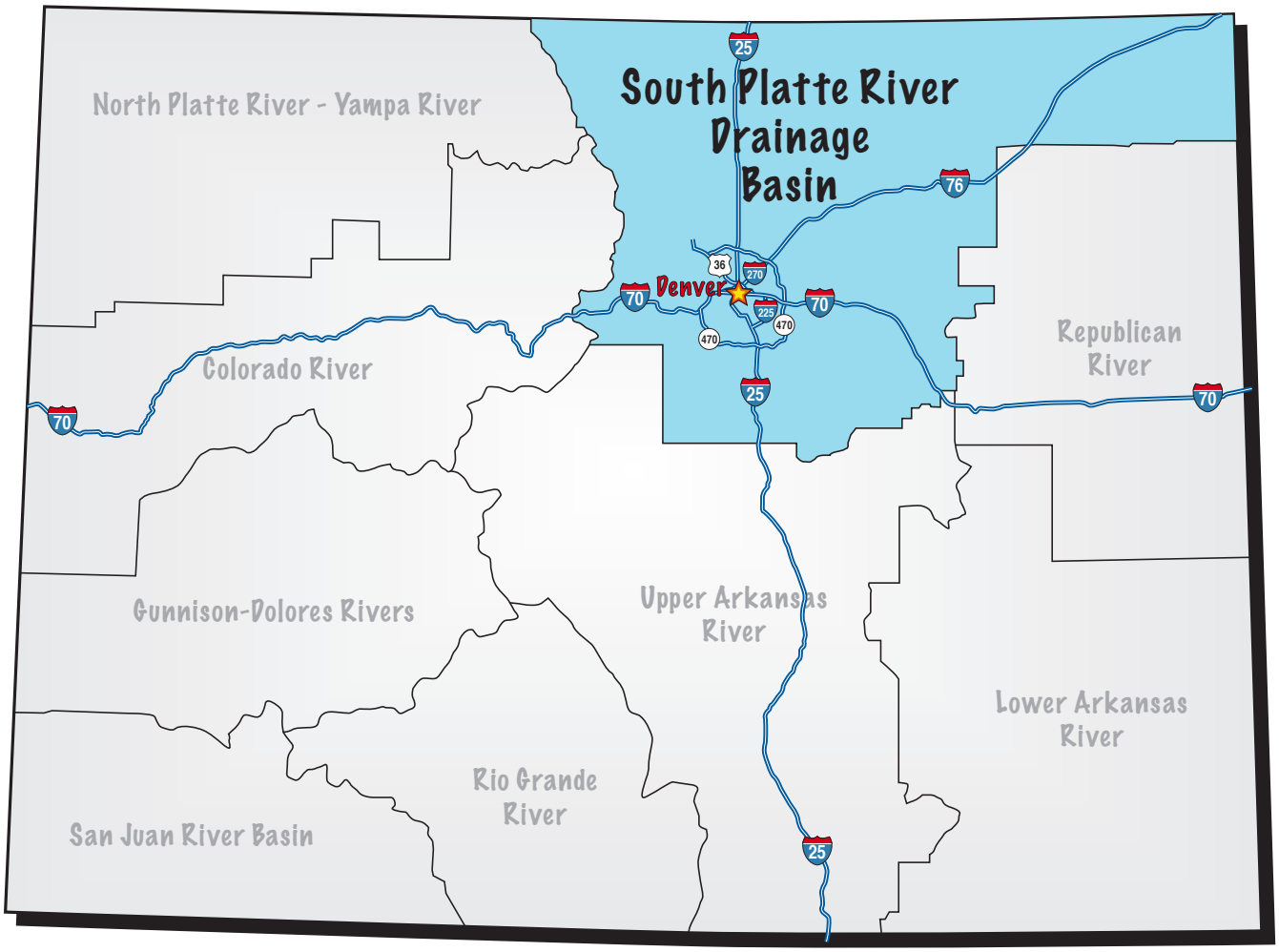
4.9.1 Current Conditions

This section describes the environmental setting and provides a historical overview of water resources in the Denver area. It also describes surface water and groundwater resources and storm sewer drainage within the project area. Drainage information, including runoff flow rates, is provided for key segments of the project area, including the areas along US 6, the I-25/US 6 interchange, Alameda Avenue, and the I-25/Broadway interchange. More detailed information is provided in the *Water Resources Report* and Addendum (FHU and Muller Engineering, 2005g; 2006f), which are available at the locations identified in **Chapter 9** *Availability of Technical Reports*.

4.9.1.1 Environmental Setting and Historical Overview

South Platte River Basin

The Valley Highway project area lies within the South Platte River Basin of Colorado, and the mainstem of the South Platte River lies immediately adjacent to the I-25 mainline through a portion of the project area. The physical and cultural characteristics of the South Platte River Basin are diverse. The headwaters of the basin start at an altitude of more than 14,000 feet along the Continental Divide near Fairplay, Colorado. Between the mountains and the plains is a transition zone, where the largest population centers of the basin are located, including the Denver Metropolitan Area. The basin extends eastward across the Great Plains, where agriculture is both the predominant land use and water consumer (U.S. Geological Survey [USGS], 1998). On the plains, the basin continues 270 miles to Nebraska to the Platte River and ultimately to the Missouri River. Overall, the South Platte River Basin drains 24,300 square miles in parts of three states; 79 percent of the basin is located in Colorado (see **Figure 4.9-1**).



North

South Platte River Basin

Valley Highway - Logan to 6th Ave. Environmental Impact Statement (EIS)

Figure 4.9-1

The South Platte River Basin is characterized by a continental-type climate having a wide temperature range (-30°F to 100°F) and irregular seasonal and annual precipitation patterns. Precipitation patterns across the basin depend upon altitude, where the greatest amount of precipitation falls as snow in the mountain areas (greater than 30 inches annually). Annual precipitation on the plains is less than 15 inches; most precipitation on the plains is from thunderstorm events from April to September (USGS, 1998). The Denver area generally receives 12 to 16 inches of rain per year (EPA, 2002).

There are three main aquifer systems in the South Platte River Basin: the South Platte Alluvial System, the High Plains Aquifer, and the Denver Basin Aquifer System (which includes the Dawson, Denver, Arapahoe, and Laramie-Fox Hills aquifers) (USGS, 2002a). Groundwater levels in the alluvial aquifers in the plains fluctuate in response to the application of irrigation water to fields, which result in the highest levels between July and September.

Water quality in the South Platte River Basin is a result of the environmental setting and hydrologic conditions. Environmental conditions that affect water quality include natural factors such as geology, climate, physiography, and soil type. Water quality is also affected by human factors such as land use, urban drainage, population, water use, and water management practices. Approximately 65 percent of the population of Colorado is concentrated in a 30 mile wide strip along the South Platte River, beginning 18 miles south of Denver and extending 80 miles northwest (EPA, 2002). Because of the high population centers in the semi-arid portions of the basin, human activity can have an especially high impact on water quality.

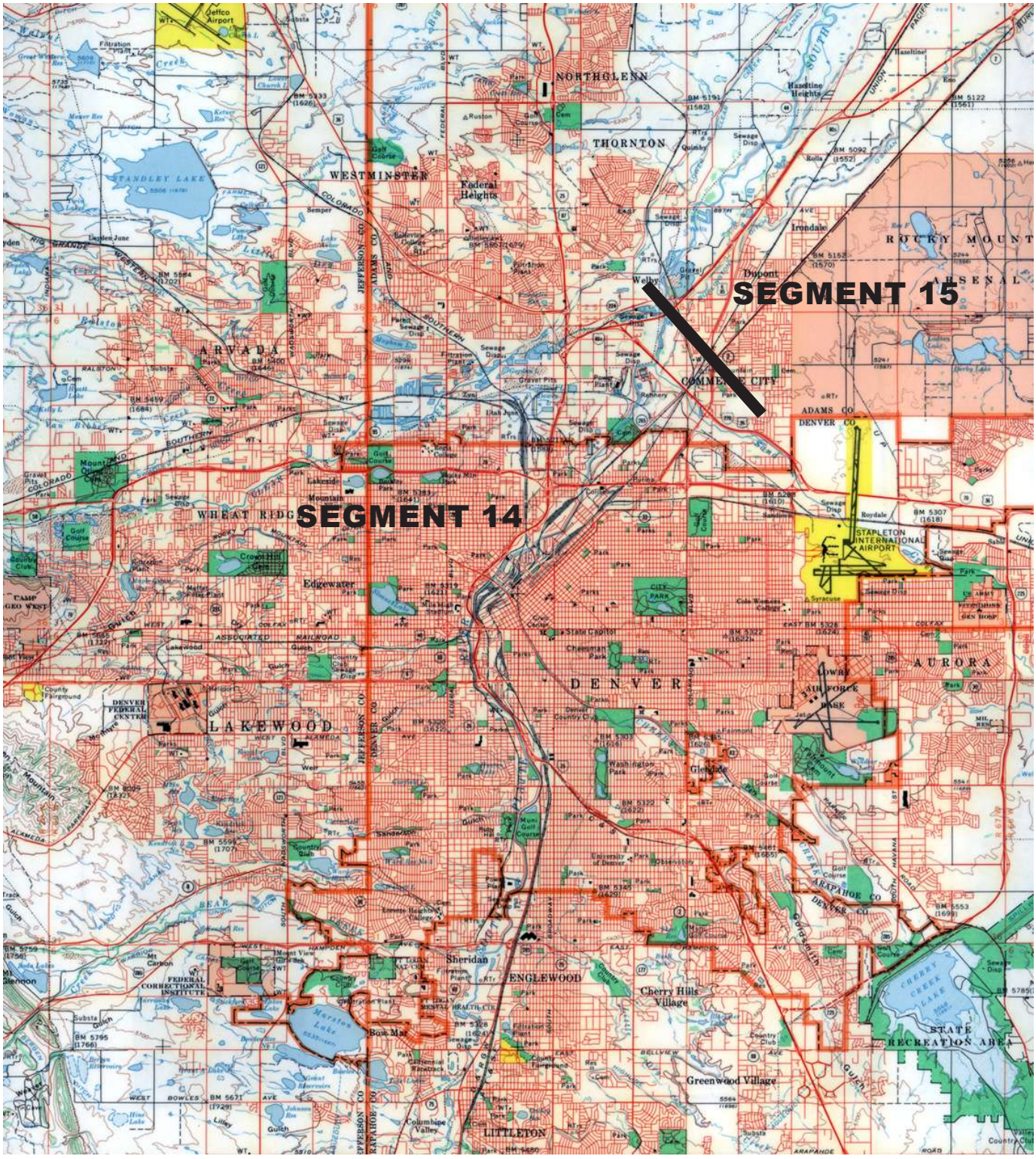
The demand on water resources in the basin is very high and general overappropriation of available water supply involves the following issues (USGS, 1998):

- Allocating water between urban and agricultural uses
- Managing growth without impacting water quality
- Restoring degraded riparian areas
- Developing future water supplies without impacting water quality
- Protecting existing drinking water supplies

The South Platte River is a critical water resource for the State of Colorado. The South Platte River in the plains is dominated by irrigation but is also used as a drinking water source (USGS, 1998). Snowmelt from the mountains is collected and stored by several reservoirs to support drinking water demands in the metropolitan areas. Chatfield Reservoir, built and operated by the U.S. Army Corps of Engineers, is the main reservoir in the Denver Metropolitan Area that contains and stores the South Platte River for flood control. Low-flow conditions are most common from July to October and high flows generally occur during the spring from May to June (EPA, 2002).

The Colorado Water Quality Control Commission defines two South Platte River segments in the Denver area:

- Segment 14 (see **Figure 4.9-2**) begins at Bowles Avenue in Littleton (just downstream of Chatfield Reservoir) and extends through the Valley Highway project area north to the Burlington Ditch Headgate in Commerce City
- Segment 15 flows north from the Burlington Ditch to Fort Lupton, Colorado



North

South Platte River
Segments 14 and 15

Figure 4.9-2

History of the South Platte River Corridor

Table 4.9-1 summarizes historical events associated with the South Platte River. The South Platte River corridor is rich in history that encompasses the arrival of early French trappers who named the river "Riviere la Platte" (broad shallow river), the Pawnee Native Americans who settled on its river banks, and the railroads that dramatically changed the City of Denver to the now thriving metropolitan area. Native Americans called the river "Nithbaska" meaning "river that spreads out in flatness." The river was characterized by intermittent flow with little or no flow during summer to fall months (Camp, Dresser, McKee [CDM], 1994).

In the late 1800s, the railroads reached the Denver area, spurring economic growth near the South Platte River. Dams, reservoirs, and irrigation ditches were constructed in an effort to provide sufficient water for farming. The irrigation systems turned arid land into productive farmland. At that time, the South Platte River began to experience extreme water pollution problems (Jefferson County, 2001). Also at that time, the South Platte River began to flow continuously throughout the year, due to an increase in impervious surfaces, a high number and volume of waste discharges, and massive irrigation.

From 1860 until the late 1930s, the South Platte River received large amounts of raw domestic and industrial waste. The main corridor of the South Platte River was occupied by slaughter houses, smelters, and rail yards, which used the river as a convenient sewer. Health concerns prompted some action by imposing certain restrictions on waste discharges. Separate sewer systems were established in the 1880s primarily to control odor.

Table 4.9-1 Summary of Historical Water Quality Events

Date	Historical Event
1600	Native Americans (Pawnee) occupy South Platte River area
1739	South Platte River "discovered" by French traders
1850	Gold discovery in Colorado leads to a substantial increase in European-American population
1872	Separate sewer systems developed in Denver to control odor
1900	Railroads extend into Denver area, helping to spur industrialization within the area
1933	Funding for the Denver Northside Treatment Plant is approved
1938	Denver Northside Treatment Plant operational
1947	Colorado Department of Health established
1958	Valley Highway completed; short section of the South Platte River relocated
1965	South Platte River floods Denver area
1970	Chatfield Reservoir and Cherry Creek dams constructed by U.S. Army Corps of Engineers
1976	South Platte River Greenway Foundation formed
1980	Water quality control commissions set numeric standards for South Platte River
1987	Metropolitan Denver Sewage Disposal District central treatment system operational

Sources: Gibson, 2003; CDM,1994

The Valley Highway was conceptualized and designed in the 1940s, just before World War II. Due to the war effort, construction did not commence until the early 1950s. The Valley Highway was located near the South Platte River, due to the availability of land and close proximity to industry and commercial businesses.

In 1965, the South Platte River flood occurred. This was the worst disaster in the history of Denver. The flood killed 23 people and caused $325 million in damage, destroying 2500 homes and 750 businesses. The flood was a turning point in the cleanup of the South Platte River. The

City and County of Denver and the Greenway Foundation led the way to improve the quality of the river corridor. Trash and debris were removed from the stream bank areas, and park areas were established (Gibson, 2003).

The South Platte River Commission was established to develop and implement a vision to renovate the river. The commission made vast improvements to the corridor by developing new parks and recreation areas, improving the bike path system, establishing natural riparian vegetation, and improving streamflow conditions in the summer months (Mueller, 1999). The South Platte River Greenway Preservation Trust, formed in 1974, was instrumental in restoring several stream locations and establishing new recreation areas along the river, including Confluence Park (Shoemaker, 2000).

Improvements in waste treatment have been realized since the 1930s. Larger and more efficient waste treatment facilities were constructed to meet more stringent water quality standards. New river management approaches were put into place, which attempt to take into account water quality, water quantity, aquatic resources, and aquatic and riparian wildlife habitats, as well as flood control and streambank stabilization. Water quality management approaches also took into account the overriding factor of water rights and water appropriation. The development of the arid west was built on the necessity to share and manage the limited water resources of the South Platte River (CDM, 1994).

4.9.1.2 SURFACE WATER RESOURCES

The South Platte River is an important water resource to the Denver metropolitan area and to local residences in the project area (see **Figure 4.9-3**). The river corridor provides a recreational resource in terms of urban park aesthetics and recreation. The South Platte River Trail parallels the river through the project area. The river contributes to the quality of life for local residents by providing a place to view and enjoy the river, riparian vegetation, and urban wildlife. The river corridor also supports urban wildlife that depends upon the wetlands and riparian habitat for survival.

The City and County of Denver continues to improve the recreational value of the corridor by establishing and implementing management plans to enhance urban wildlife, improve recreation, and protect water quality (City and County of Denver [CCD], 2000a). At present, there are no additional plans for in-stream or stream corridor improvements to the portion of the South Platte River within the project area.

Valley Highway, 02-069, 10/27/2004

0 0.25 0.5 1 Miles

Surface Waters

Valley Highway - Logan to 6th Ave. Environmental Impact Statement (EIS)

Figure 4.9-3

South Platte River Classification

Segment 14 of the South Platte River passes through the Valley Highway project area. Under *Water Quality Control Commission Regulation 38*, the Colorado Water Quality Control Commission has established the following specific stream classifications and water quality standards for Segment 14 (CDPHE, 2002a):

- **Class 1 Warmwater Aquatic Life** - Designates that the stream is able to support a wide range of aquatic life that can withstand warmer temperatures in the lower plains. Segment 14 of the South Platte River has the potential of sustaining limited trout populations, especially near Chatfield Reservoir where the discharge water is colder. Downstream, the temperature increases and fish populations become dominated by warmwater species.
- **Recreation 1a** - Designates the water is suitable for recreational activities that require body contact with the water, including swimming, kayaking, canoeing, and rafting. Water quality limits for this designation are less than 126 fecal coliforms per 100 milliliters (CDPHE, 2002a).
- **Water Supply** - Designates that the water is suitable for domestic drinking water supplies.
- **Agriculture** - Designates that the surface water is suitable for livestock drinking water.

In the project area, there are no major tributaries entering the South Platte River. Inputs to the river are dominated by storm sewer discharges during storm events.

Existing Water Quality Conditions

The stream channel of the South Platte River has been altered over the years to accommodate railroad development, flood prevention measures, and I-25 construction. To improve storm sewer drainage and reduce potential flooding, the South Platte River has been channelized. As a result, the South Platte River has become an urban type river that does not support a high quality recreational fishery or a swimming recreational resource. Storm sewer outfalls and hydrologic modification structures are located throughout the river corridor. Flood control activities, such as channelization, cementing of banks, and grade control structures (hard-lining) designed to facilitate the transport of storm flows, affect the growth and function of in-stream habitat and riparian vegetation (CCD, 2003d).

Fish present in Segment 14 include red shiner, bigmouth shiner, and brassy minnow. Some game fish are present in Segment 14 near Bowles Avenue (upstream of the project area). It is believed that no game fish spawn in the project area due to high temperatures (CDPHE, 2002a). Ammonia, which is toxic to fish, is a concern in the river from nitrogenous waste discharged from wastewater treatment plants. The largest National Pollutant Discharge Elimination System (NPDES) permitted discharger in Segment 14 is the upstream Littleton/Englewood Wastewater Treatment Plant. Since 1994, Littleton/Englewood Wastewater Treatment Plant began using a denitrification process, and nitrate is currently the largest concern.

Ambient Water Quality Conditions and Studies

A number of studies have been performed on Segment 14 to establish ambient water quality conditions for physical, chemical, and biological parameters. These include broad-based watershed studies, local water quality management monitoring, and stream total maximum daily load (TMDL) studies.

Stream impairment studies on the South Platte River (Segments 14 and 15) were performed as part of the *Metropolitan Denver TMDL/Watershed Project Draft Work Plan* (Brown and Caldwell, 1994b). **Table 4.9-2** provides information about key pollutants identified in Segment 14, based on historical monitoring studies.

Table 4.9-2 Summary of Key Pollutants in Segment 14

Pollutant	Major Source	Stream Impairment Potential
Oxygen	WWTP, storm sewer	High
Unionized ammonia	WWTPs	Low
Nitrate	WWTPs, groundwater	Medium
E. coli.	Storm sewer	High
Copper, lead, zinc and cadmium	WWTPs, storm sewer, upstream sources	High
Silver, mercury and selenium	Storm sewer	Medium
Chromium, nickel, arsenic, manganese and beryllium	WWTPs, storm sewer	Low
Suspended solids	Storm sewer	Medium
Organic priority pollutants (pesticides, volatiles, PAHs)	Storm sewer	Low
In-stream flow	Storm sewer diversions, channelization	Low
Sedimentation	Storm sewer diversions, channelization	Medium
In-stream habitat	Storm sewer diversions, channelization	Low

Source: DRCOG, 1983
WWTP - wastewater treatment plant

DRCOG developed a *Clean Water Plan* for the South Platte River (DRCOG, 1994) to serve as a water quality management planning document for the Denver Metropolitan Region. The plan evaluated water quality conditions for Segment 14 and predicated that water quality standard violations would occur for ammonia, which would limit fish populations in the segment. The report warned that the lack of consistent control of nonpoint source pollution in a rapidly growing area could lead to serious problems in Segment 14.

A non point assessment report identified increasing concentrations of sediment, phosphorus, and nitrates in Segment 14 (Brown and Caldwell, 1994a). Consistent with many urban areas studied under the National Urban Runoff Program in the late 1970s, concentrations of lead, copper, zinc, and cadmium exceeded water quality criteria in Segment 14 during storm events (DRCOG, 1983).

Stormwater data compiled by the Urban Drainage and Flood Control District (UDFCD) in Segment 14 and 15 indicate elevated concentrations of several water quality constituents. These concentrations are above ambient or baseline conditions. Water quality parameters of most are total suspended solids, fecal coliform, phosphorus, and nitrogen compounds (UDFCD, 2003).

The USGS regularly samples the South Platte River Basin as part of the National Water Quality Assessment Program, a long-term water quality program to identify regional and national water quality trends. USGS has performed numerous other water quality studies on the South Platte River. Fish tissue analysis showed elevated concentrations of dichlorodiphenyltrichloroethane (DDT) and chlordane in the lower South Platte River as opposed to the concentrations found in the mountainous portions of the watershed. Concentrations of these pesticides are related to land use practices in the lower portions of the river (USGS, 2002b).

Water quality data were collected from Segments 14 and 15 as part of the South Platte River water quality study performed by the City and County of Denver Department of Environmental Health from 1995 to 2002. **Table 4.9-3** provides a summary of the general water quality conditions, based on results of that study.

Table 4.9-3 General Water Quality Conditions for South Platte River Segment 14 (1995-2002)

Water Quality	Approximate Median	General Range
Temperature	16°Celsius	10-22°Celsius
Dissolved oxygen	9 mg/L	5-13 mg/L
pH	7.6	7.4 to 8.5
Conductivity	700 µS/cm	300-1000 µS/cm
Total ammonia	0.5 mg/L as nitrogen	2-.2 mg/L as nitrogen
Nitrate	8 mg/L as nitrogen	1-14 mg/L as nitrogen
Alkalinity	140 mg/L as $CaCO_3$	100-180 mg/L as $CaCO_3$
Hardness	220 mg/L as $CaCO_3$	140-290 mg/L as $CaCO_3$

Sources: CCD, 2003d; CCD, 1997
$CaCO_3$ – calcium carbonate
mg/L – milligrams per liter
µS/cm – micro-Siemens per centimeter

USGS studies from 1980-1992 indicate that total suspended solids concentrations increase downstream from Littleton (Segment 14) to Henderson (Segment 15). The range of sediment loading ranged from 3 to 40 tons per day (8 tons per day median) in Segment 14 near Littleton. Total suspended solids loading in Segment 15 (Henderson) ranged from 10 to 100 tons per day, with a median of 20 tons per day (USGS, 1995a).

Biological monitoring data were collected to determine the results from improved ammonia removal by the Littleton/Englewood Wastewater Treatment Plant in the upper portions of Segment 14. Results concluded that in-stream biota improved downstream in Segment 14 after implementation of the upgrade.

The City and County of Denver's Department of Environmental Health has conducted a water quality monitoring program on the South Platte River since approximately 1984 to identify and remove illicit connections at storm sewer outfall points. The study currently focuses on identifying direct storm sewer discharge conveyances (culverts, storm sewer outfalls) and on detecting contaminated groundwater entering the South Platte River, either directly or through storm sewer lines. These groundwater plumes become evident during dry weather and low-flow conditions (CCD, 1997). Chemical and biological testing is being used to identify "hot spot" areas and assess potential impacts.

The South Platte River receives contaminated groundwater from the General Chemical hazardous waste site, which is undergoing remediation as part of the CDPHE Voluntary Clean-up Program. General Chemical is located adjacent to the South Platte River just north of Alameda Avenue. According to the City and County of Denver, there is believed to be a direct discharge of a contaminated groundwater plume to surface water at this site. The plume discharges high concentrations of pollutants into the South Platte River. Surface water samples collected in March 2001 (Harding ESE, 2001) identified the presence of total aluminum (21.0 milligrams per liter [mg/L]), barium (0.05 mg/L), cadmium (0.01 mg/L), chromium (0.003 mg/L), copper (0.48 mg/L), lead (0.007 mg/L), and zinc (2.19 mg/L). This site is considered to be one of the highest priorities for CDPHE for groundwater investigations and sampling efforts (CCD, 1997). Moderate impacts to biological communities in this immediate area were found by the City and County of Denver during hot spot monitoring.

Water quality sampling was conducted by the City and County of Denver under a Section Grant from EPA between 1993 and 1996. The study established various types of chemical and biological baseline data. The *319 Nonpoint Source Grant Final Report* provided a number of conclusions, some of which are directly relevant to Segment 14 and the Valley Highway Project area along the South Platte River (CCD, 1997):

- Impacts from petroleum products and metals on macroinvertebrates need more study
- Aquatic habitat was found not to be a limiting factor for the low biological survey results (using rapid biological protocols established by EPA)
- Groundwater contamination may be the cause for low biological survey results
- Hot spots were identified and prioritized for future water quality monitoring
- Groundwater may be the primary nonpoint source that impacts the South Platte River
- Continued biological sampling will be used to isolate potential hot spots to improve water quality conditions in the South Platte River

Water quality monitoring on the South Platte River is also conducted by the South Platte Coalition for Urban River Evaluation (CURE). This group is made up of municipal, industrial wastewater treatment providers, municipal stormwater agencies, local health departments, and municipal drinking water providers. CURE performed water quality monitoring and modeling studies to support TMDL studies and long-term water quality management.

Total Maximum Daily Loading

TMDL analysis is a water quality study that is required under the Clean Water Act to be performed on surface waters failing to meet water quality standards. CDPHE is responsible for performing TMDL studies to determine how impacted streams can be improved to achieve water quality standards. These TMDL studies are reviewed and approved by EPA. In the 1990s, TMDL studies were performed on the South Platte River (Segment 14 and 15) by DRCOG and the South Platte River Watershed TMDL Advisory Committee. Additional TMDL studies continue to be performed by CDPHE for E. coli. and fecal coliform.

Segment 14 achieves water quality standards for most of the stream classification designated uses. Segment 14 fails to meet water quality standards for nitrate (drinking water use), fecal coliform (Recreation 1a), and e-coli (Recreation 1a). The State of Colorado has placed Segment

14 on the TMDLs Colorado 303(d) List (water quality limited segment) and listed Segment 14 as a high priority for TMDL analysis (CDPHE, 2002b). Stream parameters on the 303(d) List requiring TMDL studies on Segment 14 are not associated with highway operations.

The Colorado 303(d) List (*Water Quality Limited Segment Still Requiring TMDLs)* also lists surface waters that may be impaired, but for which supporting documentation does not meet the standards for credible evidence. Stream segments on this list require additional water quality monitoring and analysis to determine if water quality standards are being met. Segment 14 of the South Platte River is on this list for copper (CDPHE, 2002b).

The sources of copper in Segment 14 have not been extensively studied. Some stormwater studies performed have suggested that the sources of copper are wastewater treatment plants and storm sewers. Concentrations above the copper water quality standard have been identified during storm events (Brown and Caldwell, 1994a). A water effects ratio has been applied to copper in Segment 14 indicating that there is not an exceedence during non-storm events. Storm sewer discharges from highway surfaces may contribute to increased stream concentrations of copper (Kayhanian et al., 2003), although no specific stormwater monitoring for copper has been performed in the project area. Automobiles are a known source of heavy metals, including copper from braking systems and from other mechanical parts. It is difficult to estimate potential water quality impacts from copper when concentrations in stormwater are unknown and when mass loading (pounds of copper per day) cannot be determined.

Water Resource Issues Associated with CDOT Highway Operations

The Alameda Pump Station is located at the southwest quadrant of the I-25/Alameda Avenue interchange and is maintained by CDOT. The sump within the pump station collects stormwater through a drainage system below the underpass where I-25 passes beneath Alameda Avenue. The drainage system also collects some groundwater that bypasses or seeps through a buried sheet pile cofferdam that encircles the depressed portion of I-25. Water quality of the discharge into the South Platte River from the sump is not well characterized, and no discharge permit currently exists. Analytical data from sump samples collected in 1988 indicate the presence of arsenic, cadmium, chromium, lead, and mercury in sludge/solid material (Arvada Pump, 2003).

The South Platte River also receives chemical input from CDOT highway maintenance operations. To maintain transportation safety along the I-25 corridor during winter months, CDOT uses anti-icing and deicing chemicals. During the 2002 to 2003 winter months, CDOT maintenance personnel used approximately 13,000 gallons of 30% magnesium chloride, 7,300 gallons of cold-weather magnesium chloride, and 839 tons of Ice-Slicer in the project area. Anti-icing and deicing agents have been extensively used by CDOT to reduce the usage of traction sand, which contributes to the formation of fine air particulates, causing air pollution problems. Traction sand increases the sediment load to the South Platte River and clogs inlets and storm sewer pipes.

Anti-icing and deicing agents contain salt material (magnesium and chloride ions). Some chemical agents are modified with corn-processing byproducts. Anti-rusting additives are also incorporated into these chemicals. Anti-icing/deicing chemical agents are required to conform to CDOT magnesium chloride specifications for heavy metals and nutrients (CDOT, 2002b). No water quality impacts have been noted or observed in the South Platte River from these chemical agents during winter or spring streamflow periods.

CDOT Phase I Municipal Separate Stormwater Sewer System (MS4) Permit

CDOT received authorization from the CDPHE-Water Quality Control Division to discharge stormwater under the Colorado Discharge Permit System (CDPS) in accordance with the Colorado Water Quality Control Act (CDPHE, 2001a). The permit, dated January 15, 2001, allows for discharge of stormwater from the municipal separate storm sewer system (MS4) owned and maintained by CDOT.

The CDOT Phase I MS4 permit authorized new or existing discharges composed entirely of stormwater and allowable non-stormwater discharges from CDOT's MS4. The permit authorizes the discharge of stormwater commingled with flows contributed by process wastewater and stormwater associated with industrial activity, provided these discharges are permitted under separate CDPS permits. The CDOT Phase I MS4 permit covers areas with a population greater than 100,000, which include Denver, Aurora, Colorado Springs, and Lakewood.

The MS4 permit required CDOT to develop several stormwater management programs. Development and implementation of these eight management programs help prevent future exceedances of water quality standards.

The New Development and Redevelopment Planning Program and the Construction Sites Program are the CDOT Stormwater Management Program elements most directly relevant to the Valley Highway Project. According to the MS4 permit, CDOT will develop and implement a program that ensures that new highway projects and significant modifications are reviewed for the need to include permanent stormwater best management practices (often called BMPs).The purpose of this program is to ensure that permanent BMPs to protect surface water are included in appropriate highway projects.

The New Development and Redevelopment Planning Program is required of any project that requires an EIS or EA, will disrupt greater than one acre, or will result in water quality impacts that will affect the chemical, biological, or physical integrity of any state water, especially sensitive waters. The Construction Sites Program is responsible for reducing the discharge of pollutants from CDOT construction sites.

4.9.1.3 GROUNDWATER RESOURCES

General Groundwater Conditions

Groundwater resources in the project area consist of both shallow alluvial aquifers and deeper bedrock aquifers including the Denver, Arapahoe, Laramie-Fox Hills, and Dawson formations. Shallow alluvial groundwater in the main South Platte River valley generally flows in a north-northwest direction, parallel to the general direction of surface flow of the South Platte River. However, more localized studies have shown a possible relationship between the water table elevation and the bedrock surface elevation. Local groundwater conditions may be influenced by the position of underlying valleys within the bedrock surface.

The alluvial aquifer, which is historically recharged by precipitation and tributaries, is unconfined and hydraulically connected to the South Platte River. Groundwater recharge has been enhanced by reservoirs, irrigation ditch leakage, and infiltration of applied irrigation water.

The uppermost bedrock aquifer underlying the project area is the Denver Aquifer, which is formed by the water-yielding part of the Denver Formation. The primary water-bearing zones of the Denver Formation are moderately consolidated sandstone and siltstone layers ranging in thickness from a few inches to 50 feet. Although the Denver Formation is an aquifer in some parts of the Denver area, the upper portion of the formation generally yields little water in the corridor area due to its low permeability, as compared to the overlying coarse-grained alluvial materials. This low permeable material forms a confining layer below the overlying alluvial materials.

All groundwaters in the State of Colorado are classified and are expected to support basic designated uses such as domestic drinking water, agriculture surface water protection, potentially useable quality, and limited use quality. The water quality in alluvial aquifers within the project area is generally poor. Groundwater water quality standards for drinking water and agricultural uses are shown on **Table 4.9-4**.

Table 4.9-4 State of Colorado Groundwater Standards

Parameter	State Groundwater Standards Drinking Water (mg/L)	State Groundwater Standards Agricultural (mg/L)
Arsenic	0.05	100
Barium	2.0	-
Cadmium	0.005	10
Chromium	0.1	100
Copper	-	200
Iron	-	5,000
Lead	0.05	100
Manganese	-	200
Molybdenum	-	-
Selenium	0.05	20
Uranium	0.002	-
Zinc	-	2,000
Total Radium 226/228 [1]	5	-
Gross Alpha [1]	15	15
Gross Beta [1]	50	0.01

Source: CDPHE, 2001d
[1] Concentrations in picocuries per liter (pCi/L) for radionuclides.
mg/L – milligram per liter

Groundwater Studies

Data collected during the I-25/Broadway Viaduct Replacement project were summarized in the *Site Investigation Summary Report* (Balloffet - Entranco, 2001b). Groundwater was generally encountered near the bedrock interface in the area of the Broadway interchange at depths from 14 to 26 feet. Such data may indicate that lower permeability bedrock acts as an aquitard, slowing the downward movement of groundwater from the more permeable unconsolidated upper aquifer zone. Although shallow groundwater flow in the vicinity of the site was found to flow toward the north/northwest, which is generally consistent with the regional flow direction, groundwater in the area east of Broadway and north of the I-25 South on-ramp was found to flow to the northeast. This local flow pattern could be the result of the influence of variations in the bedrock surface or localized recharge.

Surface water is the primary water source for the City and County of Denver. Water pumped from the alluvial aquifer sees limited use for commercial and industrial purposes. The alluvial groundwater is particularly vulnerable to human activities due to the shallow groundwater table and high permeability of the soils. Groundwater samples collected during the Southeast Corridor Project EIS (Carter-Burgess, 1999) and during the I-25/Broadway Viaduct Replacement Project investigations (Balloffet - Entranco, 2001b) indicate a localized area of contamination apparently originating from commercial and industrial activities. Additional discussion on groundwater contamination is included in **Section 4.13** *Hazardous Waste*.

Important Groundwater Issues in the Project Area

Local groundwater quality has been impacted by historical industrial practices in the area. Groundwater contamination is an important consideration for the Valley Highway project. Risks associated with groundwater contamination include exposure from highway construction and maintenance activities. Material management plans, health and safety plans, CDOT 250 construction specifications, or other CDOT procedures will be required during construction to minimize risks from existing groundwater contamination in the vicinity of the project. Additional information regarding contaminated groundwater can be found in **Section 4.13** *Hazardous Waste*.

4.9.1.4 STORMWATER DRAINAGE

The drainage basin in the vicinity of the project area is almost entirely developed with industrial, commercial, and residential uses. Stormwater runoff throughout the project corridor and tributary drainage basins flows overland, in storm sewers, and by open channel to the South Platte River. Runoff east of I-25 flows from east to west and is intercepted by storm sewer systems and conveyed to the river. Runoff west of I-25 and the South Platte River flows from west to east towards the river. Stormwater runoff from land west of Federal Boulevard flows to Weir Gulch which flows to the South Platte River north of 8th Avenue.

The City and County of Denver's *Phase I Stormwater Drainage Master Plan* for the Denver Metro Area encompasses the project corridor and contains the framework for future city storm sewer projects in the project area. Several storm drainage improvements are proposed in or near the project area. Denver's master plan and subsequent drainage improvements should be considered with each phase of final design for the Valley Highway Project. Offsite drainage information and peak discharge calculations for the Valley Highway Project were based on the information provided in the *Phase I Stormwater Drainage Master Plan* and in the *Draft Floodplain and Drainage Assessment (*Muller Engineering, 2000).

There are four general areas (basins) with similar drainage patterns and outfall systems: the US 6 area, the I-25/US 6 interchange, Alameda Avenue, and the I-25/Broadway area. **Table 4.9-5** provides a summary of key data for the existing basins. Locations susceptible to localize flooding are provided in **Table 4.9-6**. More detailed information on drainage studies, drainage basins and drainage patterns can be found in the *Water Resources Report* (FHU and Muller Engineering, 2005g).

Table 4.9-5 Existing Basin Information

Basin Name	Area	Percent Impervious	100-Year (Flow Rate)
US 6 Area			
US 6 – West	26 acres	64%	81 cfs
US 6 – East	17 acres	50%	55 cfs
US 6 – South Platte River	7.8 acres	90%	47 cfs
CCD – 7th Avenue West	47 acres	75%	NOT CALCULATED
CCD – 5th Avenue West	39 acres	75%	NOT CALCULATED
I-25/US 6 Interchange Area			
I-25 – US 6 Interchange	37 acres	43%	100 cfs
I-25 – 3rd Avenue	17 acres	100%	59 cfs
CCD – 6th Avenue East	263 acres	80%	840 cfs
CCD – 3rd Avenue	187 acres	62%	570 cfs
Alameda Avenue Area			
I-25 – Alameda Avenue	25 acres	94%	126 cfs
I-25 – Low Point	2.6 acres	100%	18 cfs
Santa Fe Drive/Kalamath Street	13 acres	90%	51 cfs
CCD – Virginia Avenue	726 acres (plus 610 acres in 100-year)	48%	2560 cfs (includes extra acres)
CCD – Alameda Avenue	99 acres	80%	400 cfs
CCD – Bayaud Avenue	310 acres	55%	950 cfs
CCD – Ellsworth Avenue	9.3 acres	65%	70 cfs
I-25/Broadway Area			
I-25 – T-REX	6.3 acres	100%	22 cfs
I-25 – Broadway	20 acres	82%	56 cfs
CCD – 42” Outfall	49 acres	86%	200 cfs

Source: FHU and Muller Engineering, 2005g

Note : Values not calculated were deemed not relevant to the project area.

CCD – City and County of Denver

cfs – cubic feet per second

Table 4.9-6 Existing Major Flooding Areas

Location	Basin(s) Contributing To Flooding	Flooding Extent On I-25	Affected Structures / Land Use
I-25 near 3rd Avenue	CCD – 3rd Avenue	4.5 inches of ponding	City streets, railroad tracks, building foundations
I-25 near Ellsworth Avenue	CCD – Ellsworth Avenue	4 inches of sheet flow	City streets, railroad tracks
I-25 near Bayaud Avenue	CCD – Bayaud Avenue	9 inches of sheet flow	City streets, railroad tracks, building foundations
I-25 under Alameda Avenue	I-25 and CCD – Alameda Avenue	Up to 20 feet of ponding possible	City streets, railroad tracks, building foundations

Source: FHU and Muller Engineering, 2005g
CCD – City and County of Denver

US 6 Area

Figure 4.9-4 shows the US 6 area, which encompasses approximately 143 acres of roadway, grassy right-of-way, parks, residential, and light industrial uses. This drainage area is defined by the highpoint west of Federal Boulevard to the east edge of the South Platte River, the tributary areas, and nearby drainage. Runoff from west of Federal Boulevard flow from west to east and is intercepted by Weir Gulch, located west of Federal Boulevard. Runoff east of Federal Boulevard also flows to the east and is collected in storm sewer systems that convey it to the South Platte River. There are five basins in this drainage area.

I-25 / US 6 Interchange Area

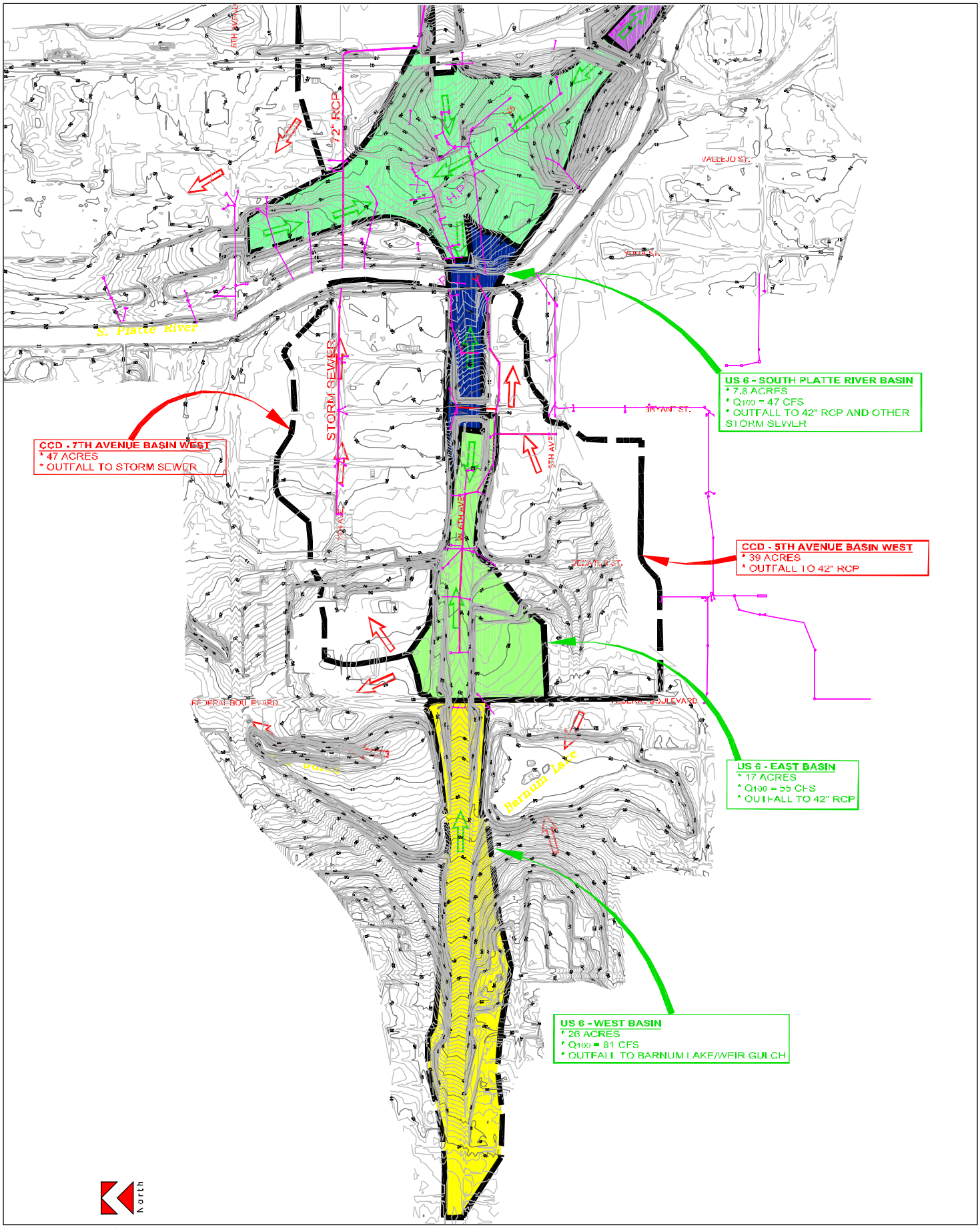
I-25 / US 6 interchange area consists of runoff from the I-25 and US 6 interchange, I-25 – 3rd Avenue Basin, and some City and County of Denver runoff east of I-25 (see **Figure 4.9-5**). This drainage area contains four drainage basins in the northern portion of the project area.

Alameda Avenue Area

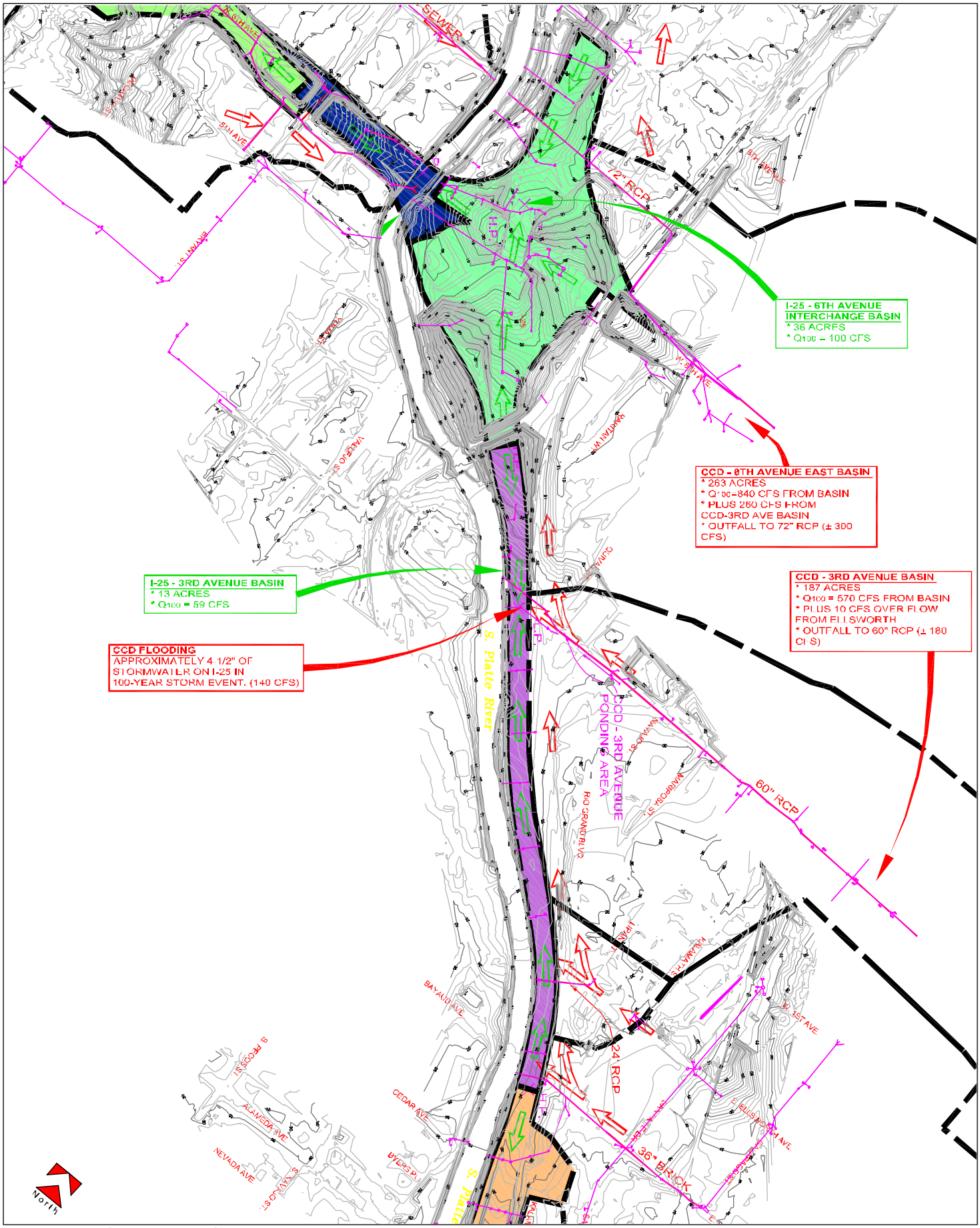
This drainage area consists of several basins, most of which are offsite and produce severe flooding on I-25. The onsite areas consist of some runoff from Santa Fe Drive/Kalamath Street and a basin on I-25. The Alameda Avenue area is shown on **Figure 4.9-6**. There are seven basins in the Alameda Avenue drainage area.

I-25 / Broadway Area

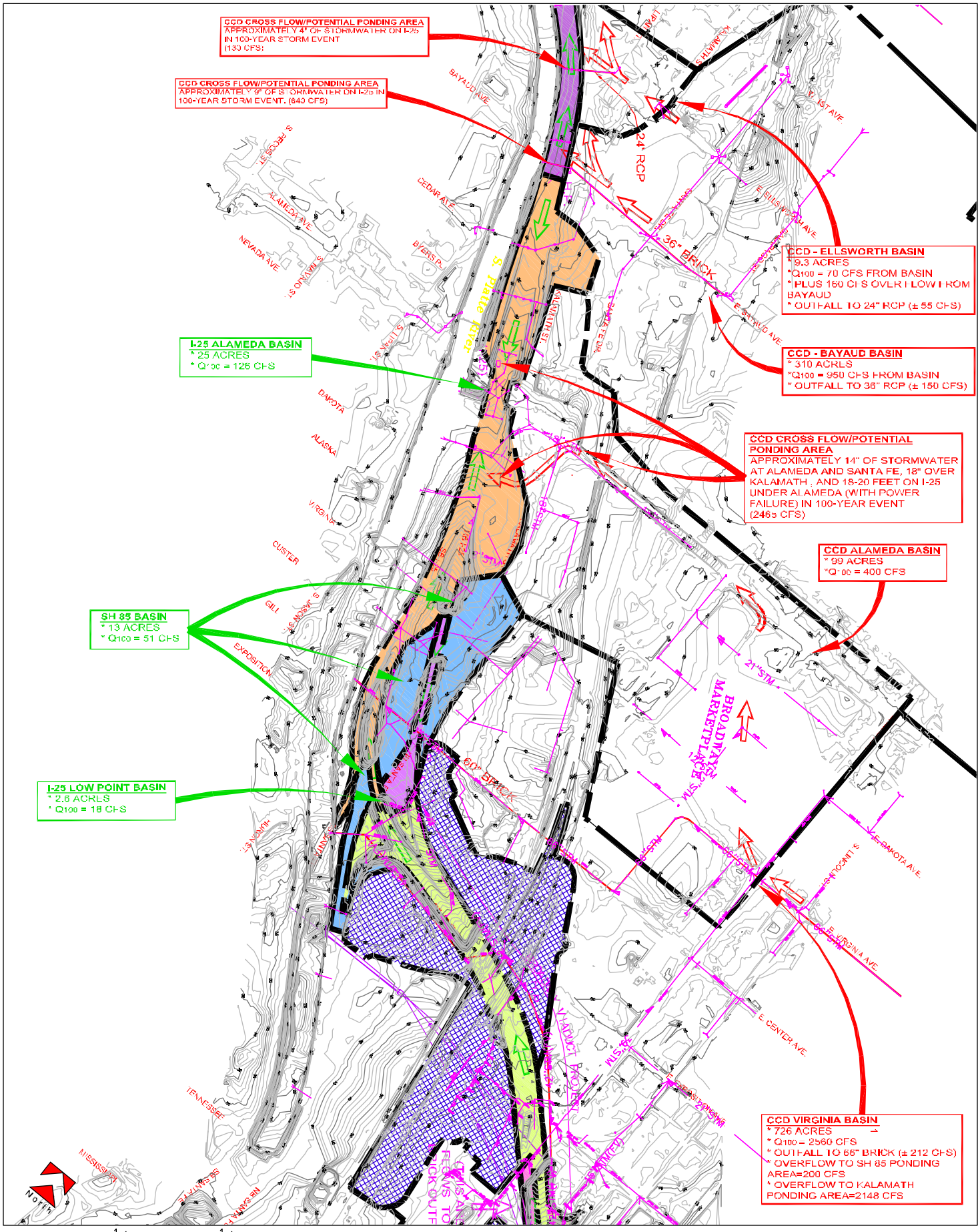
The I-25/Broadway area extends from the Santa Fe/Kalamath Basin southern boundary to the I-25 underpass of Logan Street (see **Figure 4.9-7**). Part of this area is the Broadway Viaduct Replacement Project area. The Broadway Viaduct Replacement Project consists of removing, replacing, and realigning the existing viaduct over Broadway, the railroad, and light rail tracks and includes re-construction of various on- and off-ramps. There are three drainage basins in this southern portion of the project area.



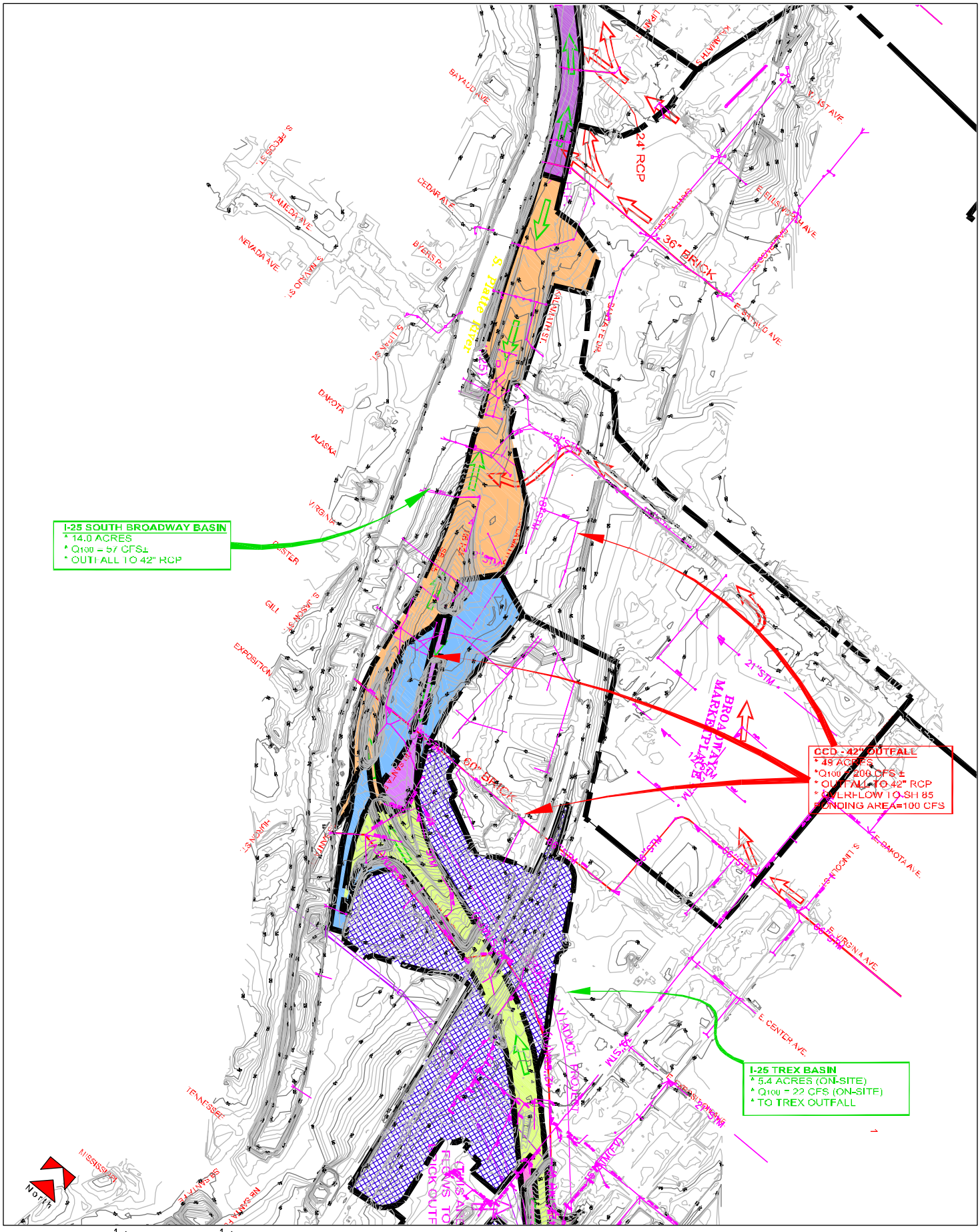
Existing Basins - US 6 Area



Existing Basins - 6th Avenue Interchange Area



Existing Basins - Alameda Area



Existing Basins - Broadway Area

4.9.2 Consequences of the Alternatives

Water resources impacts have been identified for the No Action Alternative and for the system alternatives.

4.9.2.1 No Action Alternative

Stormwater runoff from I-25 and the surrounding City and County of Denver Drainage Basin discharges directly into the South Platte River. There are no structural BMPs located near I-25 to collect and passively treat stormwater. The No Action Alternative would continue to allow direct discharges of stormwater directly into the South Platte River without collection and treatment. Pollutant pulses would continue to occur from storm and snowmelt events.

The City and County of Denver is continuing to improve their stormwater quality management and controls within their drainage basins, which would improve the water quality of runoff tributary to the South Platte River. The South Platte River drinking water designation and other designated uses would remain vulnerable to highway spills and discharges from accidents. The number of outfalls would not be reduced and the outfall structures would not be aesthetically improved. Drainage improvements would not be realized and the potential for significant standing water (ponding) on I-25 and local streets would continue to exist. The Alameda sump discharging collected groundwater and stormwater into the South Platte River would not be modified.

4.9.2.2 System Alternatives 1, 2, 3, and the Preferred Alternative

Overall, adverse impacts to water resources caused by the system alternatives, which include System Alternatives 1, 2, 3, and the Preferred Alternative, are considered to be minor. The system alternatives avoid direct impacts to the river by moving I-25 to the east, provide best management practices (BMPs) to capture previously uncollected and untreated stormwater, and improve drainage systems, thereby reducing the potential for flooding on local streets and I-25. Adverse impacts to the river are mostly temporary, such as sediment transport from bridge, pier, and storm sewer outfall structure construction.

An increase in the Valley Highway's impervious area with each system alternative has the potential of accumulating more copper and other heavy metals on the road surface and ultimately into the South Platte River via stormwater runoff. Heavy metals are water pollutants that are associated with highway operations. Metals, such as copper, lead, zinc, nickel, chromium, and cadmium, come from automobile brake systems, mechanical part movements, and tires. Copper is of concern in the South Platte River since it is on the State of Colorado's monitoring and evaluation list and may be adding to stream impairment. No stormwater data exist for copper and other heavy loading into the South Platte River from I-25 or from other Denver metropolitan road surfaces. Proposed stormwater BMPs would aid in reducing the amount of copper and total suspended solids entering the river from I-25.

Groundwater encountered from dewatering during construction activities, or longer term actions required due to grade separations or tunnel development could eventually impact the South Platte River. Groundwater that is encountered and/or removed over either the short- or long-term must be managed according to Clean Water Act and CDPS regulations. Contaminated groundwater will need to be contained, conveyed, and treated before any discharge to surface

or groundwater. A Section 402 permit (Clean Water Act/Colorado Discharge Permit System) will be required from the Water Quality Control Division in order to discharge treated groundwater. A permit is also required to discharge groundwater or stormwater from sumps. Treatment systems will require routine monitoring and reporting to the Water Quality Control Division along with routine operation and maintenance activities.

In accordance with the CDOT Phase I MS4 permit, BMPs would be designed, constructed, and maintained in the South Platte River corridor as a part of each of the system alternatives. BMPs are methods to improve and/or maintain existing water quality by treating stormwater to the maximum extent practical. Three main types of BMPs are structural, nonstructural, and construction. Structural BMPs remain in place and require routine maintenance to ensure their functionality. Grass buffers, water quality/sedimentation ponds, riprap outlet protection, and wetland channels are examples of structural BMPs. Nonstructural BMPs are intended to reduce or eliminate the pollutants that impact stormwater runoff (UDFCD, 2002). Examples of these are street sweeping and spill containment. Examples of construction BMPs are silt fences, straw bale barriers, and temporary check dams. Construction BMPs are used to reduce erosion of disturbed soil and often remain in place until vegetation is established. The project will employ a combination of all three BMP types.

Currently, there are very minimal BMPs being used within the project corridor for highway runoff. Two nonstructural BMPs, street sweeping and using a deicing agent instead of using sand or salt for snow and ice treatment, are being used on I-25 and US 6 as standard operating procedures. Product quality control checks exist for the use and application of deicing chemicals to reduce the risk of water quality impacts.

The New Development and Redevelopment Program states that 100 percent of water quality capture volume (WQCV) must be provided for the project area or 80 percent of total suspended solids should be removed (CDOT, 2004b). There are many different BMPs that are approved for use for CDOT projects that can meet these requirements. Those most suitable for use on this project include extended detention ponds with micropools, extended detention shallow wetlands, and dry swales. The appropriate BMPs will be determined during later design phases. BMPs would require maintenance on a regular basis and would need adequate maintenance access. CDOT maintenance will review all final designs for BMPs to ensure the access and maintainability of such designs. In addition, BMPs will be designed to be aesthetically pleasing for trail users, home and business owners, and vehicle occupants.

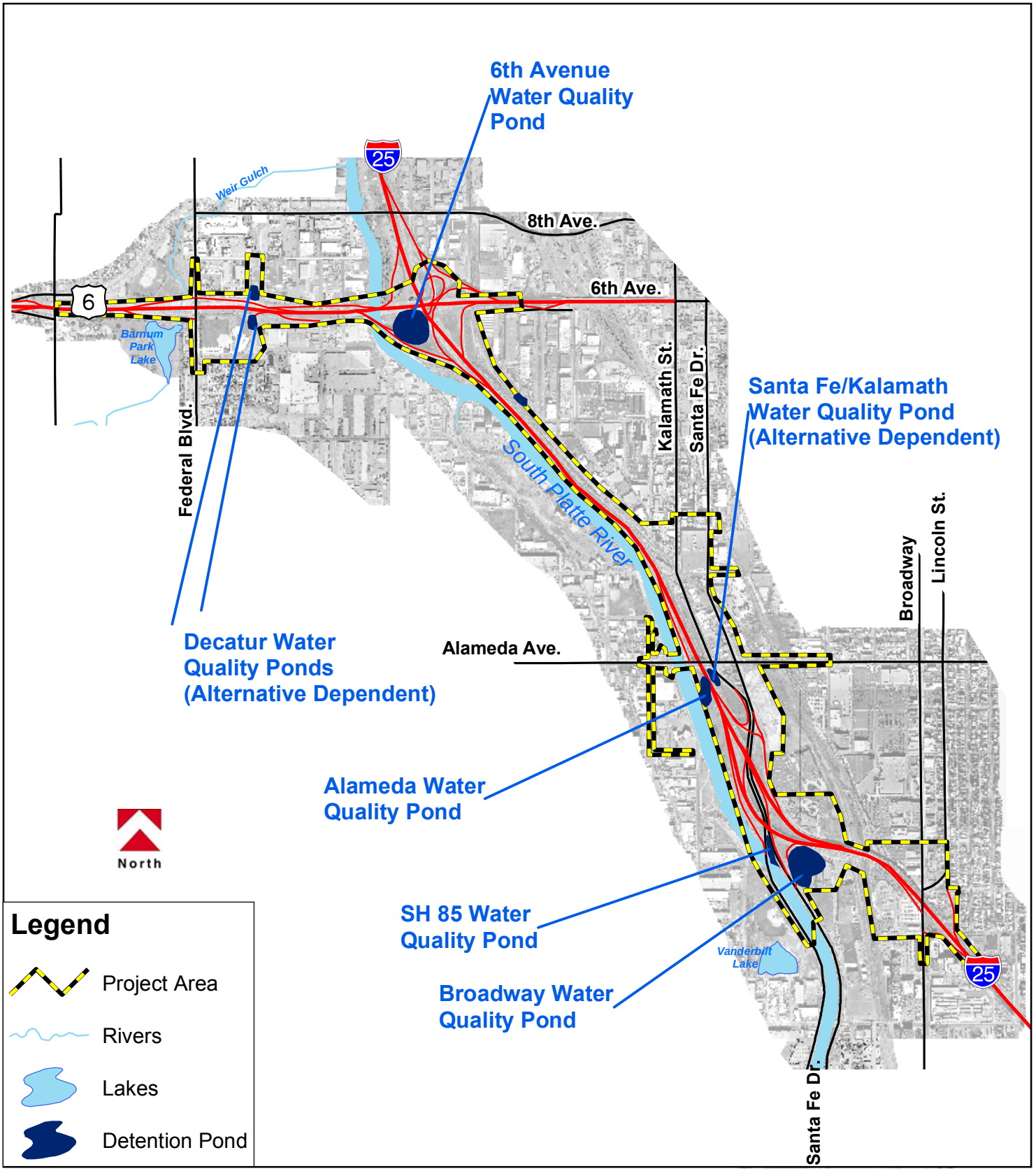
An extended detention pond with micropool BMP consists of two stages, an upper pre-sedimentation forebay and a lower micropool. The upper stage consists of a solid driving surface that serves to remove much of the larger sediment and debris in the stormwater runoff. The lower stage serves as the main collection place for smaller sediment by providing a pool for sediment to settle while allowing runoff to filter through an orifice plate before flowing to the river. In larger storms, an outlet structure will permit large volumes of runoff to flow to the river untreated, while the smaller storms will be held for approximately 40 hours to allow time for sediment settling. The pond also consists of a trickle channel to convey small flows from the upper to lower stages of the pond. Copies of fact sheets, which illustrate the conceptual design from the New Development and Redevelopment Program, are included in the *Water Resources Report* (FHU and Muller Engineering, 2005g).

The extended detention shallow wetland BMP is similar to the extended detention pond, in that they both have two stages and a similar outlet configuration. The difference is that instead of a trickle channel, runoff filters through a shallow constructed wetland between the upper and lower stages. Wetlands can provide added water quality enhancement through the biological uptake of pollutants. Dry swale BMPs are open-channels, lined with grass or vegetation, which filter pollutants as runoff moves through the swale. If constructed and designed properly, a dry swale can function as a stand-alone BMP but is also beneficial in combination with other BMPs.

A secondary benefit of using extended detention ponds and other detention pond-type BMPs is that they can aid in the collection of contaminations from spills on I-25 and US 6. While this aid is not automatic, CDOT could have maintenance crews block the pond outlets until they could remove the contaminated material, preventing spills from flowing to the river. In fact, gates could be installed onto the outlet structures to enable their blockage when spills occur. Even if contaminants filter into the ground in the ponds, it is easier to remove contaminated soil and treat contaminated water. Shortly after or during a storm event, the ponds would contain water, which would reduce the ability to collect spills and prevent flow to the river.

There are six major outfall locations in the project corridor where BMPs would be implemented. **Figure 4.9-8** shows the locations of these BMPs. For more detailed information, consult the *Water Resources Report* (FHU and Muller Engineering, 2005g).

1. **Decatur** – US 6 East Basin runoff would be collected by inlets and conveyed to an extended dry detention basin, located near Decatur Street, which would provide 100 percent of the required WQCV for this basin. From the Decatur water quality pond, runoff would be conveyed to the South Platte River.
2. **US 6 interchange** - The US 6 interchange water quality pond would be located in the southwest infield of the interchange. Dry swales would be used in combination with other BMPs near the US 6 interchange and as a stand-alone BMP north of the I-25/Alameda interchange. The pond would provide water quality enhancements for runoff coming from three basins - the I-25 – US 6 Interchange Basin with a WQCV requirement of 0.75 acre-feet, the I-25 – 3rd Avenue Basin, which requires 0.86 acre-feet, and the US 6 – South Platte River sub-basin that requires 0.18 acre-feet WQCV. Access to the pond in this area for maintenance would be important as specifics of the design are detailed. Roadway and drainage improvements in this location are consistent in each of the three system alternatives.
3. **SH 85** – The SH 85 water quality pond would be located in the open space between the South Platte River and Santa Fe/Kalamath. The specific location and geometry of the pond would vary depending on the alternative configuration in this area. In all alternatives, the pond would be located to minimize conflicts with existing utilities and future storm sewer systems planned by the City and County of Denver. This pond would serve the SH 85 basin and provide 100 percent of the WQCV.
4. **Alameda** - The Alameda water quality pond would be located between I-25 and the South Platte River. It would provide the required WQCV for the basin and would either be an extended detention shallow wetland or extended detention pond. Citizens expressed a desire for habitat expansion and pleasing aesthetics for the BMPs. A shallow wetland could meet both of these citizen preferences. A 240-foot swale would also be included as a BMP.



Source: FHU, 2005g

Valley Highway, 02-069,

0 0.25 0.5 1 Miles

Water Quality Ponds (BMPs)

Valley Highway - Logan to 6th Ave. Environmental Impact Statement (EIS)

Figure 4.9-8

5. **Broadway** – The Broadway water quality pond would be an extended detention pond. The I-25 – Broadway Basin is approximately 0.67 acre-feet. Adequate WQCV would be provided for the entire area. The pond could then be built with an invert elevation of approximately 5222.0 feet at the outlet. At this elevation, the pond would be approximately six feet higher than the existing groundwater table.
6. **Santa Fe / Kalamath** – The Santa Fe/Kalamath Grade Separation water quality ponds would be located between Kalamath Street and I-25 at Bayaud Street in System Alternatives 1 and 2. It would be located south of Alameda Avenue between Kalamath Street and I-25. This pond would serve the water captured in the Santa Fe Drive/Kalamath Street sump prior to discharge into the South Platte River.

Most of the post-construction acreage would be routed through BMPs. The post-construction onsite area consists of 172 acres. Of this, 162 acres, or 94 percent, would be routed through a BMP to enhance water quality. In addition, 30 offsite non-highway acres would be routed through the Santa Fe/Kalamath and Broadway water quality ponds and 5 to 24 acres would be routed through the Santa Fe / Kalamath water quality pond. These are basins managed by the City and County of Denver that traditionally drain directly to the South Platte River. These accommodations have been made in partnership with the City and County of Denver, in an attempt to improve overall corridor water quality enhancement independent of the projects requirements, where possible. BMP ponds would be sized to have a minimum of 100 percent of the project-required WQCV, but could be upsized to provide further water quality volume. CDOT and the City and County of Denver will continue conversations to explore opportunities for shared use, costs, and maintenance for these ponds.

Table 4.9-7 summarizes basin information, identifies the structural BMP requirements, and suggests an appropriate BMP. These ponds have been conceptually designed and details are available in the *Water Resource Report*.

Table 4.9-7 shows the percentage WQCV provided by the ponds. Two percentages are shown – “As Shown” and “At Pond Embankment.” The “As Shown” percentage represents the pond capacity to meet the project WQCV requirements. The “At Pond Embankment” percentage represents reserve capacity available should the pond be upsized. For example, the WQCV required for the US 6 interchange area is 1.67 acre-feet. The volume of the pond shown on figures in the *Water Resources Report* would be 1.67 acre-feet (100% WQCV), but if the design were modified, it could probably have a volume of 4.2 acre-feet. The increased volume of a pond could provide room for larger storms to be treated, instead of the normal two-year design storm or accommodate some of the off-site basin needs, as discussed above.

Table 4.9-7 BMP Summary

Contributing Basin and Area	Contributing Area (acres)	Required WQCV (acre-feet)	Structural BMP Type	Provided Size	% WQCV Provided	
					as shown	at pond embankment
US 6 - Decatur	43	1.08	EDB	1.08 acre-feet	100%	
US 6 - South Platte River (excluding sub-basin tributary to I-25 – 6th Avenue Interchange)	4.6	0.20	None	NA	0%	
I-25 - 6th Avenue Interchange, I-25 - 3rd Avenue, US 6 – South Platte River Sub-basin	57	1.67	EDB	1.67 as shown, up to 4.2 acre-feet at pond embankment	100%	251%
CCD – K-S, SF-S, SB-4, SB-14 (alternative dependent)	5-24 (off-site)	0.07-0.78 (CCD)	EDB	0.07-0.78 acre-feet	100%	
I-25 - Alameda SB 31	5.3	0.15	DS	230 LF of swale (if designed to UD criteria, it meets 100% WQCV)	Assume 100%	
I-25 - Alameda SB 22, SB 23	20	0.52	SW	0.98 as shown, up to 5.2 acre-feet at pond embankment*	188%	1000%
SH-85, I-25 Broadway SB 31	17	0.69	EDB	0.71 as shown, up to 2.3 acre-feet at pond embankment	103%	333%
I-25 - Broadway SB 32, SB 33, CCD - 42" Outfall	50 (including 30 off-site acres)	2.15 (including1.74 for CCD)	EDB	2.3 as shown, up to 5.1 acre-feet at pond embankment	107%	237%
I-25 - TREX	6.3	0.32	None	NA	0%	
Totals:	173 plus 35-54 off-site for CCD	5.08 plus 1.81-2.52 for CCD		6.96-7.67 as shown, up to 18.8 at pond embankments	101% (weighted percentages)	247-262%

* If this BMP were to provide volumes with depth greater than 2-3 feet, an EDB would be used instead of an SW.
BMP: Best Management Practice
DS: Dry Swale
EDB: Extended Detention Basin
SW: Shallow Wetland Basin
UD: Urban Drainage (and Flood Control District)
WQCV: Water Quality Capture Volume

Six percent of the onsite area is located in such a way that implementing a structural BMP would be extremely difficult or would require subsurface structures along the US 6 and I-25 drainage basins. Subsurface structures are difficult to maintain and their use is highly discouraged by maintenance personnel. With the at-grade structures, the ability to determine if BMPs are operating properly or need maintenance can be completed by simple surface observations. Subsurface structures are not as easy to visually inspect to confirm operation or maintenance needs. In many cases, confined-space entry procedures are required for personnel entry, which can increase maintenance costs and time. In addition, below-grade BMPs are easily overlooked because there are no negative visual impacts if improperly maintained. If subsurface BMPs are not maintained, the system may become septic or a high amount of sediment may be flushed into the receiving stream. Locations where implementation of structural BMPs are impracticable include:

- The US 6 – South Platte River Basin is located along US 6 and touches the banks of the South Platte River. The basin low point is located on the bridge over the river, and runoff that is collected is currently conveyed directly into the river. Approximately 3.2 acre of the basin would be routed to the 6th Avenue water quality pond. The steep banks of the river, the wetlands, and the floodplain location all limit access to the area and the ability to inspect and maintain a structural BMP. Additionally, any new BMP structures in this area would be a floodway encroachment and would likely impact wetlands as well. There is neither sufficient room for a water quality pond nor the right conditions for other at-grade BMPs in this area. Runoff from the US 6 bridge and part of the US 6 – South Platte River Basin would be collected and routed to the US 6 interchange water quality pond. However, the remainder of the basins runoff would directly drain to the South Platte River as it does today.
- Runoff from the I-25 T-REX Basin within the Valley Highway project flows to the T-REX concrete box culvert located underneath Mississippi Avenue. The runoff is but a small percentage of the total runoff and was accounted for during the design of the outfall underneath Mississippi Avenue. Furthermore, roadway and transit improvements in the corridor and the close proximity of residences on the north side of the highway limit opportunities to implement BMPs in this area. This project, therefore, would not incorporate additional water quality BMPs into this area.

Wherever possible, grassed medians or buffer zones will be established along the roadway to increase pervious area and will assist in water quality enhancement. Discharge from BMPs, such as extended detention ponds, have the potential of increasing streambank erosion and potentially disrupting wetlands, due to high velocity flows. To mitigate this impact, discharges from BMPs would use erosion control techniques to reduce sediment loading into South Platte River. BMP discharges outlets will have outfall protection, such as rip-rap conveyance channels or rock/rip-rap structures, to reduce stormwater velocities prior to stream discharge. It is possible that wetland impacts may be realized during the construction of temporary new discharge outlets and erosion control BMPs.

4.9.3 Mitigation Measures

Avoidance of adverse impacts to the South Platte River was identified very early in the alternatives screening process and was carried through identification of the Preferred Alternative. The widening of I-25 especially north of the Alameda Avenue interchange had the potential for stream movement/channelization, new bridge piers, or cantilevered structures over the South Platte River. A priority was placed on avoidance of the South Platte River and on widening the road towards the east.

As previously mentioned, BMPs will be used to collect stormwater from I-25 and portions of the City and County of Denver Basin. Water quality of stormwater runoff that is routed through BMPs will be improved prior to flowing to the South Platte River. BMPs will be important in preventing the majority of copper and other heavy metals from entering the South Platte River. Heavy metals have a high affinity to adsorb onto suspended solids in the water column in the BMPs identified in this EIS. BMPs will allow stormwater sediment to be collected and settle out before water is discharged into the South Platte River. Heavy metals will stay adsorbed on to the sediments and will be removed during routine maintenance. Water quality impacts to the South Platte River from highway operation are expected to be minimal as long as BMPs are functional and well maintained, and any impacts that will result will be within the CDOT MS4 requirements.

Appropriate application of the BMPs will be further defined during the final engineering phase of this project. Additional mitigation measures may be developed during final design, as appropriate. Additional discussion on sustainable construction and designs is provided in **Section 4.17** *Irreversible and Irretrievable Commitments of Resources***.**

The construction of storm sewer outfalls will temporarily impact wetland and riparian vegetation in the area and water quality in the South Platte River. Erosion and sediment control construction BMPs will be critical in this area, due to the close proximity of construction activities to the South Platte River. Any wetland or riparian vegetation that is temporarily and permanently lost, due to construction of the outfalls, would need to be mitigated as described in **Section 4.11** *Wetlands, Waters of the U.S. and Open Water.*

Implementation of any of the system alternatives will be done in accordance with the programs established under CDOT's MS4 permit. These include:

1. The Maintenance of Structural Controls Program outlines the routine maintenance activities of CDOT BMPs (structural controls) to reduce pollutants in discharges from the MS4.
2. The New Development and Redevelopment Planning Program is responsible for developing and implementing comprehensive planning procedures and controls designated to reduce the discharge of pollutants from areas of new highway development or significant redevelopment and associated drainages, once construction is complete.
3. The Public Street Maintenance Program is responsible for operating and maintaining public streets and roads in such a manner as to reduce the discharge of pollutants associated with maintenance activities (road repair, street sweeping, snow removal, and sanding operations).

4. The Herbicide, Pesticide, and Fertilizer Program is responsible for implementing activities to reduce discharge of herbicide-, pesticide-, and fertilizer-related pollutants in the vicinity of stream and wetland systems.
5. The Illicit Discharges Program is responsible for identifying and eliminating illegal and un-permitted discharges throughout the MS4 system.
6. The Industrial Facilities Program is responsible for tracking industries discharging stormwater in to the CDOT MS4 and addressing potential water quality issues associated with these types of discharges
7. The Construction Site Program is responsible for reducing the discharge of pollutants from CDOT construction sites.
8. The CDOT Facility Runoff and Control Program is responsible for reducing stormwater quality discharge impacts from CDOT-owned or-operated facilities, such as maintenance facilities. It also is responsible for developing plans to manage stormwater run-on and runoff to protect the area surface waters.

The New Development and Redevelopment Program requires that CDOT evaluate the need to develop special requirements for projects that have the potential to discharge stormwater into identified sensitive waters (impaired waters, domestic drinking water, High Quality Class I or a High Quality Class 2, or Aquatic Life Cold Water Class 1). This special requirement dictates that additional stormwater BMPs must be identified and implemented beyond the 100% water quality capture volume design criteria to improve or protect existing water quality conditions. This program was initiated by CDOT May, 2004. The additional BMPs that will be considered for this requirement on this project are as follows (CDOT, 2004b):

- Work with City and County of Denver to provide public signs requesting the public to pick up fecal material from their dogs. Dispensers for plastic bags and trash receptacles to collect this material could also be provided. The South Platte River currently is not meeting water quality standards for E. coli., and pets could be one of many sources.
- The use of deicing chemicals (magnesium chloride and other products) reduces the amount of traction sand that has been used historically. Deicing chemicals eliminate the need to add a sediment/salt mixture on to the road to improve safety conditions for the driving public. This maintenance activity reduces the amount of sediment that would enter the drainage system and ultimately enter the South Platte River. Standard operating guidance has been established for the efficient application and management of the deicing chemicals.
- Sweeping of I-25 would help reduce the amount of sediment and debris that would enter the South Platte River. This action is currently being performed in the area as part of Air Quality Regulation No. 16.
- Post-construction monitoring program to ensure that the BMPs are operating as designed and being maintained in a timely fashion. Indicator parameters can be used to determine the post-construction effectiveness of the BMP.
- CDOT and City and County of Denver could work together to improve the South Platte River in the project area and in Denver Metropolitan Area. Possible improvements could include pubic education, landscape enhancements, improved riparian vegetation, and water quality monitoring programs.

A key component in the success of the CDOT Stormwater Program is maintenance. Trained CDOT Maintenance personnel will be performing several important inspection functions concerning proper BMP operation, outfall discharges and erosion protection, detention pond sediment removal. In accordance with CDPHE Regulation No. 61, sufficient equipment, financial support and manpower must be provided to the CDOT Maintenance Department to properly manage stormwater in the project area (CDPHE, 2004).

A general stormwater construction permit will need to be acquired by CDOT from CDPHE before construction activities begin. A stormwater management plan (Section 208) must be developed, updated, and followed. CDOT program requirements and construction specifications must be followed by the contractor.

Discharge permits will be needed for dewatering and sump discharges during and after construction to protect water quality. This will involve initial water quality characterization, monitoring, and reporting to CDPHE.

There is also potential for several temporary impacts to the river due to the demolition and construction activities of the bridge. Actions identified below will be taken to avoid such impacts:

- If lead paint is present, this material must not be allowed to flake off and enter the South Platte River. (Section 402 Clean Water Act, CDPHE Regulation 61)
- If cranes and other equipment are used for bridge demolition within the river or streambank area, the equipment would be kept out of the river to the greatest extent possible, and all work shall minimize temporary impacts to the river. (State regulation Senate Bill 40). A crane pad would be built, if cranes or other equipment can not be kept out of the river.
- Sediment may enter the river from land disruption and subsequent erosion. Construction BMPs would be implemented and maintained as per the CDPHE General Construction Permit; the project must develop and adhere to a stormwater management plan. (Section 402 Clean Water Act, CDPHE Regulation 61)
- An energy dissipation device or material, such as riprap, would be used to control post-construction erosion near the bridge. If riprap is used above the ordinary high water level of the river, it must be covered with topsoil and vegetated. Vegetation or other erosion control techniques (as per CDOT erosion control practices) must be established to prevent sediment loading as per the general storm water construction permit.
- Caissons used to create bridge piers may require groundwater dewatering. A discharge permit and a possible treatment strategy will be needed before dewatering activities can occur.

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