# 4.20 WATER RESOURCES: WATER QUALITY AND FLOODPLAINS

## Summary

A strong correlation exists between the ecological health of the United States Highway 36 (US 36) corridor environment and water resources. US 36 crosses four major watercourses and five floodplains. These watercourses provide the most productive wildlife habitat in the project area and serve as important riparian corridors connecting protected open spaces. In addition, these riparian corridors serve as the backbone for trail systems that provide public recreation. The importance of these corridors is becoming more critical as the project area urbanizes and the availability of valuable habitat diminishes.

*The watercourses that traverse and cross US 36 provide important wildlife habitat and connection between open spaces.*

Water quality has progressively been reduced with increased urbanization as impervious surfaces (i.e., asphalt and concrete) have been added to the landscape and non-point sources of contamination have been introduced to the surface drainage system through increased storm runoff. Historically, water quality protection from storm runoff was not typically provided in new development projects, including highway and street projects. During rain events, pollutants and sediments that accumulated on impervious surfaces were flushed into the receiving stream, causing a detrimental effect on stream water quality. As a result, current federal and state regulations require stormwater detention and treatment for most transportation improvements, including the new pavements proposed for the US 36 packages. This is critical to future water quality and flood control, as the amount of impervious surfaces in the project area is predicted to increase from 21 percent currently to 24 percent in 2035 (see Section 4.23, Cumulative Impacts). The water quality analysis indicates that none of the build packages would degrade water quality due to the incorporation of protective measures. In fact, the build packages, due to the inclusion of water quality controls, would result in improved water quality over the existing condition where no controls are currently provided. Likewise, the floodplain and hydraulics analyses indicate that the build packages would not create a significant impact, greater than 1 foot for the Federal Emergency Management Agency (FEMA) Zone A or greater than a 0.00 foot rise in FEMA Zone AE, to flood elevations in any of the affected watercourses. This is because new bridges would be designed to accommodate a 100-year flood or would at least match the existing bridge or culvert span across the floodplain.

*None of the build packages would degrade water quality due to the incorporation of protective measures.*

Assumptions for modeling and related information are included in the report, *Conceptual Drainage Analysis* (URS 2004).

## Affected Environment

The US 36 corridor is located in the South Platte River Basin. This large basin encompasses more than 4,000 square miles. Drainage out of this basin flows in an east or northeast direction into the South Platte River. The terrain throughout the project corridor is gently rolling with a predominant trend to slope to the north and east. Four perennial streams are located in the US 36 corridor. The water-related subjects evaluated in this section include all major perennial streams, groundwater, and floodplains, as well as water quality.

### ***Streams***

There are four major streams in the US 36 corridor: Big Dry Creek, Rock Creek, Coal Creek, and South Boulder Creek. Ditches and other water features such as lakes and reservoirs are described in Section 4.21, Wetlands and Other Waters.

## Groundwater

The US 36 corridor is situated above the Denver groundwater basin. The Denver Basin underlies a 6,700-square-mile area in Colorado, extending from the Front Range of the Rocky Mountains east to near Limon, and from Greeley south to near Colorado Springs. This basin includes four main bedrock aquifers that occur as layers in an elongated bowl-shaped basin, three of which are located in the project area. The three Denver Basin aquifers located in the project area are the Denver Aquifer, the Arapahoe Aquifer, and the Laramie-Fox Hills Aquifer. The aquifers are generally confined, except in areas in the upper parts of aquifers where surface water may interact with groundwater.

The low transmissivity of the Denver Basin aquifers historically has limited large-volume, low-profit water uses, such as irrigation of most commercial crops, and has enabled water use that is less constrained by cost. Records that date from 1985 to present show that water withdrawn from the approximately 12,000 wells completed in the Denver Basin aquifer was primarily used for public supply, with the remainder used for agriculture.

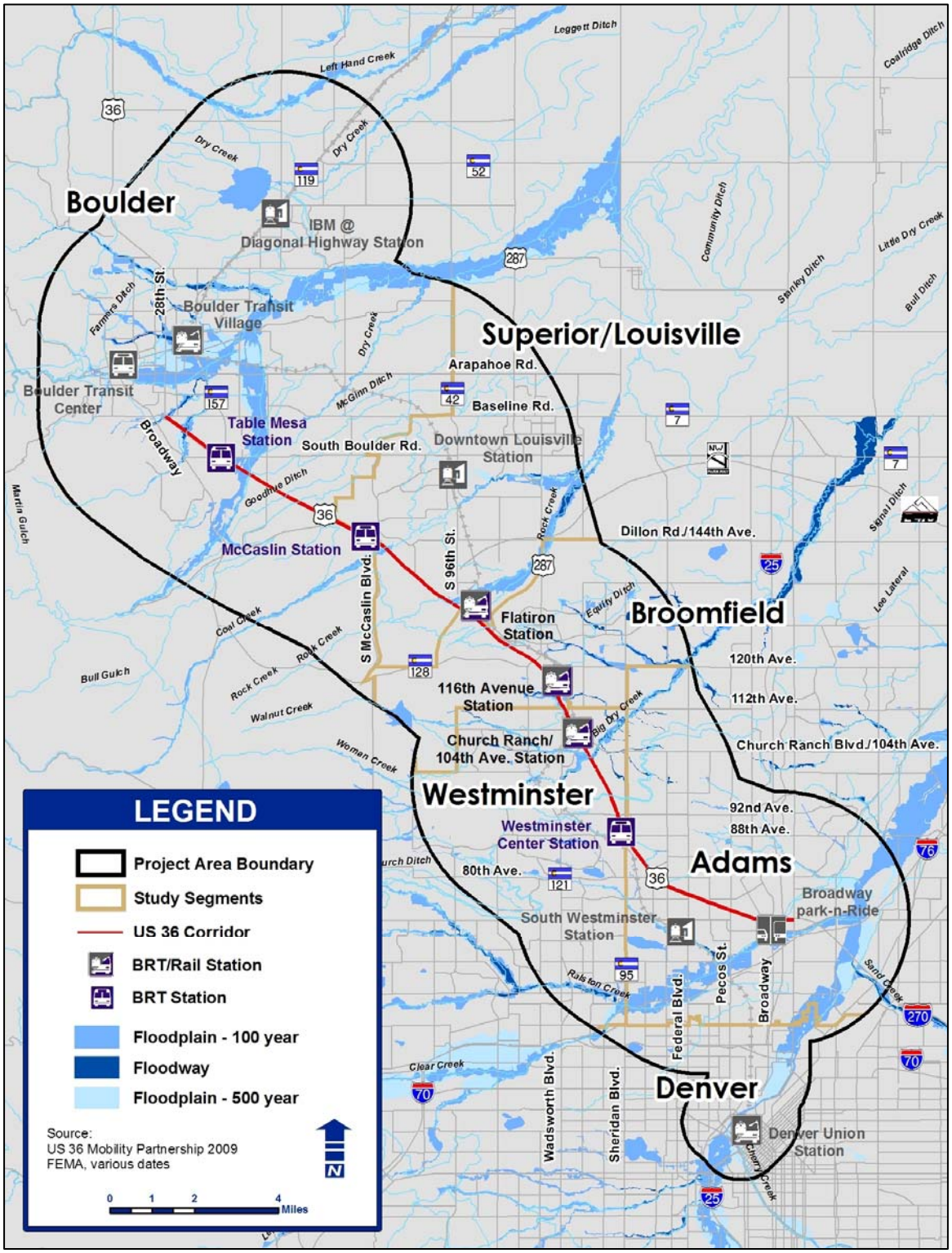
Based on the information provided by the Colorado State Engineer's Office, up to nine water supply wells are located within 300 feet of US 36. Exact locations of water supply wells are typically not provided for security reasons; therefore, these wells are not shown on any of the figures. Well records do not indicate whether or not these wells are still in use. This determination would need to be made as the project enters the design process, as active wells may need to be relocated.

## Floodplains

There are five floodplains crossed by the US 36 corridor: Big Dry Creek, Airport Creek, Rock Creek, Coal Creek, and South Boulder Creek. Floodplains are the areas on either side of a stream that are inundated during a flood when the capacity of the stream channel is exceeded. Floodplains are associated with most of the major streams in the project area. Changes in the floodplain, such as adding fill material, constructing buildings or bridges, or in any way limiting the natural conveyance of floodwaters, can cause a rise in the water surface elevation, and can subsequently impact properties not previously affected by flooding of the same magnitude. Within specific identified stream channels, a portion of the floodplain, called the floodway, must be reserved to discharge the base flood without cumulatively increasing the water surface more than a designated height. The floodway limits are typically calculated through hydraulic modeling and are site-specific to each stream channel.

Areas of specific interest are the floodplains defined by FEMA as special flood hazard areas that are inundated by the 100-year design storm or storm event that has a 1 percent chance of occurring in any given year. FEMA floodplains are labeled by flood zones in FEMA Flood Insurance Rate Maps. Each flood zone represents a type of flooding and level of detail used to create the floodplain boundary. Figure 4.20-1, Floodplain Information for Streams and Ditches in the Project Area, depicts the FEMA floodplain information for the US 36 project area.

**Figure 4.20-1: Floodplain Information for Streams and Ditches in the Project Area**




Note: The 116th Avenue Rail Station is not a part of the 2004 FasTracks Program. Additional stations were added in the early planning stages of the US 36 Environmental Impact Statement. Exact rail station locations and additional stations may be reconsidered in the U.S. Army Corps of Engineers/Regional Transportation District Northwest Rail Environmental Assessment/Environmental Evaluation.

### *Floodplain Regulations Affecting the Project*

The following regulatory requirements apply to the floodplains located within the US 36 project area:

- *EO 11988, Floodplain Management* (1977), was authorized to direct federal agencies to "provide leadership and take action to reduce the risk of flood loss, to minimize the impacts of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values served by floodplains." This Executive Order (EO) was authorized to assist in furthering National Environmental Policy Act of 1969 (NEPA), the National Flood Insurance Act of 1968 (amended), and the Flood Disaster Protection Act of 1973.
- *23 Code of Federal Regulations [CFR] Part 650 – Highways, Chapter I – Federal Highway Administration, United States (U.S.) Department of Transportation, Part 650 – Bridges, Structures, and Hydraulics*, prescribes the policies and procedures that the FHWA is directed to implement in the "location and hydraulic design of highway encroachments on floodplains."
- *44 CFR Part 1 – Emergency Management and Assistance, Chapter I – FEMA*, contains the basic policies and procedures of FEMA to regulate floodplain management and to analyze, identify, and map floodplains for flood insurance purposes.

In addition to floodplains, a drainage and hydrology analysis was conducted to evaluate the effects of increased impervious surfaces along the US 36 corridor. Runoff would be directed to follow historic flow paths. It may be necessary to create detention facilities to meter the runoff flow rates to historic (pre-project) rates. The method used to evaluate the need for detention and detention facility sizing would be based on the drainage requirements of the Urban Drainage and Flood Control District (UDFCD), and local agency drainage policies.

The UDFCD serves the Denver metropolitan area, including the City of Boulder and surrounding areas, which includes the US 36 project limits. The UDFCD acts as a support/review agency for local government floodplain administrators and public works staff on project issues relating to stormwater collection and management. UDFCD has an agreement with FEMA to allow UDFCD to review changes to floodplains and act on the behalf of FEMA for all projects within the UDFCD boundaries.

Changes to floodplains are submitted to the UDFCD for review in the same format as most parts of the United States would submit changes to FEMA. If a project does not require a major change to a FEMA floodplain, then the UDFCD may only be involved to review a project at the request of a local government agency. The local governments associated with this project with floodplain administrators and floodplain development permit requirements are as follows:

- City and County of Boulder
- City of Louisville
- City and County of Broomfield
- City of Westminster
- Adams County
- City and County of Denver

The FEMA-designated flood zone for each drainage crossing is listed and defined in Table 4.20-1, Federal Emergency Management Agency Floodplain Zone Designation. Zone A and Zone AE areas have a 1 percent annual chance of flooding. Zone AH areas have a 1 percent annual chance of shallow flooding, usually in the form of a pond, with an average depth ranging from 1 to 3 feet.

**Table 4.20-1: Federal Emergency Management Agency Floodplain Zone Designation**

| Drainage Name | Crossing Zone[1] |
|---|---|
| Big Dry Creek | AE |
| Airport Creek | A (west), AE (east) |
| Rock Creek | AE |
| Coal Creek | AH (west), AE (east) |
| South Boulder Creek | AE |

Source: Federal Emergency Management Agency National Flood Insurance Rate Map and Current Letter of Map Revisions and Changes (LOMR or LOMC) as of February 2009.

Notes:

[1] Zone A: no base flood elevations determined
Zone AE: base flood elevations determined
Zone AH: flood depths of 1 foot to 3 feet (usually areas of ponding), base flood elevations determined

## ***Water Quality***

This section discusses the regulations governing water quality within the project area and the water resources and water quality conditions for determining the effects of transportation alternatives on US 36. Water quality conditions are identified by watershed basins, as runoff from the transportation improvements will collect by drainage basin. The study area for water quality effects is generally the immediate site of the stream crossings, where the runoff would tend to collect and be discharged back into the stream. To evaluate the water quality effects, the drainage basins for streams were researched to develop the data needed at the stream crossings.

### *Water Quality Regulations Affecting the Project*

The primary federal regulatory drivers for the current stormwater quality program are the Phase I and Phase II Stormwater Regulations under the Clean Water Act, 33 United States Code (USC) 1251, et seq., which, among other requirements, require regulated entities to acquire a National Pollutant Discharge Elimination System (NPDES) permit for their stormwater discharges. The U.S. Environmental Protection Agency (USEPA) stormwater NPDES regulations specify that entities are required to have municipal permits to control the discharge of pollutants to the maximum extent practicable. The Colorado Department of Public Health and Environment has jurisdiction over the NPDES permit program in Colorado.

### *Colorado Department of Transportation Regulatory Requirements*

The Colorado Department of Transportation (CDOT) obtained its Colorado Discharge Permit System (CDPS), Permit for Municipal Separate Storm Sewer Systems (MS4), Permit No. COS-000005, on February 1, 2007. The Department's permit covers "state and interstate highways and their right-of-ways (ROW) within the jurisdictional boundary of CDOT served by, or otherwise contributing to discharges to state waters from municipal separate storm sewers owned or operated by CDOT."

As part of the permit, CDOT was required to "develop and implement a program that ensures that new highway projects and significant highway modifications are reviewed for the need to include permanent BMPs." Based on the "sensitive" water criteria for the New Development and Redevelopment Program established by CDOT, the US 36 build packages would be considered a significant highway modification requiring permanent best management practices (BMPs).

*All of the build packages would be considered a significant highway modification requiring permanent BMPs.*

The general MS4 permit requires seven program elements to address the protection of water quality. These seven elements are:

1. Construction Site Stormwater Runoff Control
2. Post-construction Stormwater Management in New Development and Redevelopment
3. Illicit Discharge Detection and Elimination
4. Industrial Facilities Program
5. Public Involvement/Public Education
6. Pollution Prevention/Good Housekeeping for Municipal Operations
7. Wet Weather Monitoring Program

US 36 traverses several local jurisdictions, including Adams County, Jefferson County, City of Arvada, City of Westminster, City and County of Broomfield, City of Louisville, Town of Superior, and the City and County of Boulder. Many of these jurisdictions implement programs that address the CDPS MS4 Phase II permit requirements. The City and County of Denver and CDOT have individual permits. The other jurisdictions fall under a state general permit.

### *Other Jurisdictional Regulatory Requirements*

Some jurisdictions have additional water quality-related permitting requirements. The City of Boulder has a wetland permitting program that generally requires the protection and mitigation of impacts to existing wetlands.

Currently, the Regional Transportation District (RTD) has a limited number of site-specific stormwater discharge permits. These are related to specific facilities. RTD typically complies with the local jurisdiction stormwater quality criteria for stations, transfer, and parking areas. RTD is also in the process of developing programs that address the CDPS MS4 Phase II permit requirements.

### *Surface Water Classifications*

The Colorado Water Quality Control Commission (WQCC) has classified streams for various uses as described in Colorado Regulation 38, *Classifications and Numeric Standards for South Platte River Basin, Laramie River Basin, Republican River Basin, Smoky Hill River Basin,* effective February 9, 2009 (CDPHE 2009). The affected segments of these streams and the designated stream uses are presented in Table 4.20-2, Major Watercourse Crossings and Designated Beneficial Uses. The numeric water quality standards that are suitable for maintaining the water quality in order to preserve the beneficial uses or improve the water quality of the stream are listed in the subsequent watershed sections. According to the water quality regulations established by the WQCC, classifications are established for any state surface waters, except water in ditches and other man-made conveyance structures. Although ditches are considered waters of the state, they are not classified and numeric water quality standards do not apply.

Of particular note are streams that have designated uses of Domestic Water Supply, Recreation Class 1a or 1b, or Cold Water Aquatic Life Class 1. This includes each of the major streams in the project area.

**Table 4.20-2: Major Watercourse Crossings and Designated Beneficial Uses**

| Project Segment | Stream Crossings | River Basin | Total Area of Stream Watershed[1] (square miles) | Designated Uses |
|---|---|---|---|---|
| Denver | None | N/A | N/A | • N/A |
| Adams | None | N/A | N/A | • N/A |
| Westminster | Big Dry Creek (Segment 4B) | Big Dry Creek Basin | 21.0 | • Use Protected<br>• Class 2 – Warm Water Aquatic Life<br>• Class 2 – Recreation<br>• Water Supply<br>• Agriculture |
| Broomfield | None | N/A | N/A | • N/A |
| Superior/Louisville | Rock Creek (Segment 8) | Boulder Creek Basin | 9.3 | • Use Protected<br>• Class 2 – Warm Water Aquatic Life<br>• Class 1a – Recreation<br>• Agriculture |
| | Coal Creek (Segment 7B) | Boulder Creek Basin | 36.0 | • Use Protected<br>• Class 2 – Warm Water Aquatic Life<br>• Class 1a - Recreation<br>• Agriculture |
| Boulder | South Boulder Creek (Segment 4B) | South Boulder Creek Basin | 132.0 | • Class 1 – Cold Water Aquatic Life<br>• Class 1a – Recreation<br>• Water Supply<br>• Agriculture |

Source: CDPHE, Regulation 38, March 30, 2009.

Notes:

[1]Total surface area tributary to creek upstream of stream crossing with US 36.

**Use Protected:** These are waters that the Commission has determined do not warrant special protection provided by the outstanding waters designation or the anti-degradation review process.

**Class 1 – Cold Water Aquatic Life**: These are waters that (1) currently are capable of sustaining a wide variety of cold water biota, including sensitive species, or (2) could sustain such biota but for correctable water quality conditions. Waters shall be considered capable of sustaining such biota where physical habitat, water flows or levels, and water quality conditions result in no substantial impairment of the abundance and diversity of species.

**Class 2 – Cold and Warm Water Aquatic Life**: These are waters that are not capable of sustaining a wide variety of cold or warm water biota, including sensitive species, due to physical habitat, water flows or levels, or uncorrectable water quality conditions that result in substantial impairment of the abundance and diversity of species.

**Water Supply:** These surface waters are suitable or intended to become suitable as a drinking water supply.

**Agriculture**: These surface waters are suitable or intended to become suitable for irrigation of crops usually grown in Colorado, and which are not hazardous as drinking water for livestock.

**Class 1a – Recreation:** These are surface waters in which primary contact uses have been documented or are presumed to be present. These uses include recreational activities in or on the water when the ingestion of small quantities of water is likely to occur such as swimming, rafting, kayaking, tubing, windsurfing, and water-skiing.

**Class 2 – Recreation:** These surface waters are not suitable or intended to become suitable for primary contact recreation uses, but are suitable or intended to become suitable for recreational uses on or about the water which are not included in the primary contact subcategory, including but not limited to wading, fishing, and other streamside or lakeside recreation.

N/A = not applicable

The WQCC has developed a list of water quality-limited segments and parameters in the 2008 303(d) List of Impaired State Waters. The 303(d) List of Impaired State Waters identifies waterbodies and parameters for which the WQCC has determined that one or more assigned uses or standards are not currently attained. According to the 303(d) List adopted April 30, 2008, the stream segments in the project area are impaired that are shown in Table 4.20-3, Affected Water Quality Segments.

**Table 4.20-3: Affected Water Quality Segments**

| Stream | Segment | Segment Description | Portion | Parameters |
|---|---|---|---|---|
| Coal Creek | 7b, Boulder Creek Basin | Mainstem of Coal Creek from US 36 to the confluence with Boulder Creek. | All | *E. coli* |
| Boulder Creek | 2, Boulder Creek Basin | Mainstem of Boulder Creek, including all tributaries, lakes, reservoirs, and wetlands, from the boundary of the Indian Peaks Wilderness Area to a point immediately above the confluence with South Boulder Creek, except for the specific listings in Segments 3 and 12. | Below 13th Street in Boulder | *E. coli* |
| Big Dry Creek | 1, Big Dry Creek Basin | Mainstem of Big Dry Creek, including all tributaries, lakes, reservoirs, and wetlands from the source to the confluence with the South Platte River. | All | *E. coli*, Se |

Source: CDPHE, WQCC, Regulation #93, Section 303(d), April 30, 2008.
Notes:
*E. coli* = *Escherichia coli*
Se = selenium
US 36 = United States Highway 36

### *Existing Surface Water Quality*

Water quality data and standards do not exist for all the streams that cross US 36. Existing water quality data and/or standards are available for the streams listed below. For those streams that do not have water quality data, estimates were extrapolated based on similar land use.

#### Denver Segment

US 36 does not cross any streams in this segment.

#### Adams Segment

US 36 does not cross any streams in this segment.

#### Westminster Segment

**Big Dry Creek** — Big Dry Creek is part of the Big Dry Creek Basin. The Big Dry Creek Basin water quality standards in the project area apply for various physical, biological, inorganic, and metal parameters (CDPHE 2009). Water quality data collected throughout 2001 by the Big Dry Creek Watershed Association (BDCWA) for various constituents indicated that streams within the watershed attained numeric water quality standards.

However, the stream standards for several water quality constituents have been exceeded, including fecal coliform, *E. coli*, un-ionized ammonia, nitrite, total iron, and total mercury (BDCWA 2002). In addition, significant erosion has occurred along Big Dry Creek in both urban and agricultural areas (BDCWA 2002).

Historical water quality data were obtained from the BDCWA. Data were obtained for two monitoring stations, BDC 0.5 and BDC 1.0, in the vicinity of the US 36 stream crossing. To evaluate ambient water quality conditions, a statistical summary was developed for each monitoring station for the water quality pollutants of concern. The summary covers 5 years of available data and can be found in the report, *Conceptual Drainage Analysis* (URS 2004). When the ambient water quality data were compared to the water quality standards for Stream Segment 1 of the Big Dry Creek Basin, the following parameters exceeded the water quality numeric standards: dissolved chloride, *E. coli*, fecal coliform, nitrite, total iron, and dissolved selenium. The BDCWA attributes elevated iron concentrations to natural sources based on soil erosion from storm events.

### Broomfield Segment

US 36 does not cross any streams in this segment.

### Superior/Louisville Segment

**Rock Creek and Coal Creek** — Rock Creek and Coal Creek are both tributaries to the Boulder Creek Basin. The Boulder Creek Basin is discussed in detail in the next section.

### Boulder Segment

**South Boulder Creek** — This creek is a tributary to the Boulder Creek Basin. The Boulder Creek Basin water quality standards for Stream Segments 2, 4b, 5, 7a, 7b, and 11 apply for various physical, biological, inorganic, and metal parameters (CDPHE 2009). Water quality data were collected throughout the year 2000 for alkalinity, ammonia, dissolved oxygen, fecal coliform, hardness, nitrate, nitrite, organic nitrogen, orthophosphate, pH, specific conductance, temperature, total dissolved solids, total phosphorus, total suspended solids, and turbidity. Data indicate that concentrations for dissolved constituents were typically higher during low-flow conditions when less water was available for dilution (USGS 2000). Anthropogenic sources, such as lawn and road runoff and instream recreational activities, increase as Boulder Creek flows northeast through Boulder.

## Water Quality Impact Evaluation

### *Methodology*

This water quality impact assessment used guidance developed by FHWA to determine the impacts of highway improvement projects in accordance with NEPA guidelines. The parameters listed in Table 4.20-4, Typical Water Quality Pollutants of Concern, establish the baseline water quality for beneficial uses in the stream segments located in the project area. Water quality impacts resulting from each of the build packages were determined from the preliminary design layouts. There is a general correlation between the amount of new pavement and reductions in water quality due to increased runoff.

**Table 4.20-4: Typical Water Quality Pollutants of Concern**

| Constituent | Source | Basis for Inclusion |
|---|---|---|
| Suspended solids | Pavement wear, vehicles, atmosphere, maintenance, snow/ice abrasives, and sediment disturbance. | Excessive sediment can be detrimental to aquatic life (primary producers, benthic invertebrates, and fish) by interfering with photosynthesis, respiration, growth, and reproduction. |
| Zinc | Tire wear, motor oil, and grease. | Toxic to aquatic organisms, can bioaccumulate, and can contaminate drinking water supplies. |
| Cadmium | Tire wear and insecticide application. | Toxic to aquatic organisms, can bioaccumulate, and can contaminate drinking water supplies. |
| Arsenic | Lead slag waste when smelter slag is used as the abrasive blast material for removal of surface coatings. Slag is likely to contain arsenic and mercury in hazardous quantities. | Toxic to aquatic organisms, can bioaccumulate, and can contaminate drinking water supplies. |
| Nickel | Diesel fuel and gasoline, lubricating oil, metal plating, brake lining wear, and asphalt paving. | Toxic to aquatic organisms, can bioaccumulate, and can contaminate drinking water supplies. |
| Copper | Metal plating, bearing wear, engine parts, brake lining wear, fungicides, and insecticides. | Toxic to aquatic organisms, can bioaccumulate, and can contaminate drinking water supplies. |
| Iron | Auto body rust, steel highway structures, and engine parts. | Toxic to aquatic organisms, can bioaccumulate, and can contaminate drinking water supplies. |
| Lead | Leaded gasoline, tire wear, lubricating oil and grease, bearing wear, and atmospheric fallout. | Toxic to aquatic organisms, can bioaccumulate, and can contaminate drinking water supplies. |
| Manganese | Engine parts. | Toxic to aquatic organisms, can bioaccumulate, and can contaminate drinking water supplies. |

**Table 4.20-4: Typical Water Quality Pollutants of Concern**

| Constituent | Source | Basis for Inclusion |
|---|---|---|
| Chromium | Metal plating, engine parts, and brake lining wear. | Toxic to aquatic organisms, can bioaccumulate, and can contaminate drinking water supplies. |
| Nitrite and nitrate nitrogen | Atmosphere, roadside fertilizer use, and sediments. | Can result in accelerated growth of vegetation or algae, resulting in impaired use of water; un-ionized ammonia can be toxic to freshwater fish. |
| Total phosphorus | Atmosphere, roadside fertilizer use, and sediments. | Can result in accelerated growth of vegetation or algae, resulting in impaired use of water. |
| Total coliforms/fecal coliforms | Soil litter, bird droppings, trucks hauling, and livestock/stockyard waste. | Common bacteria found in stormwater that can lead to the closure of adjacent swimming areas, and may increase the cost of treating drinking water at water supply reservoirs. |
| PAH | Fuels. | Toxic to aquatic organisms. Toxicity of PAHs is additive where, even though no single PAH concentration exceeds a water quality standard, the sum of the PAHs can, under certain circumstances, be toxic. |
| Magnesium | Engine parts. | Toxic to aquatic organisms, can bioaccumulate, and can contaminate drinking water supplies. |
| Sodium/Chloride | De-icing salts. | Can be detrimental to plants and animals. Can increase salinity that could impact groundwater, streams, and lakes. |
| Sulfates | Roadway beds, fuel, and de-icing salts. | Lowers pH (increases acidity) in streams, which stresses aquatic life and leaches toxic metals out of sediment and rocks. High acidity and concentrations of heavy metals can be fatal to aquatic organisms, and may eliminate entire aquatic communities. |
| Chemical oxygen demand | Oxygen-demanding substances, including plant debris, street litter, animal waste, and organic matter commonly found in stormwater. | Estimates the level of oxygen demand in polluted waters and is indicative of the sustainable level of aquatic life. |
| Biological oxygen demand | Oxygen-demanding substances, including plant debris, street litter, animal waste, and organic matter commonly found in stormwater. | Often used to determine the amount of organic pollution in surface waters. |
| Oil and grease | Spills, leaks, motor lubricants, antifreeze, hydraulic fluids, and asphalt surface leachate. | Contain a wide array of hydrocarbon compounds, some of which are toxic to aquatic organisms at low concentrations. |

Source: FHWA, 2006.

Note:

PAH = polyaromatic hydrocarbon

Annual pollutant mass loadings from highway runoff were evaluated for existing and 2035 proposed build conditions, which are assumed as the worst-case scenarios, using the Driscoll Method. The FHWA probabilistic dilution model developed with Driscoll was used to determine the impacts of highway runoff on the receiving waters. The complete analyses for Packages 2 and 4 are presented in the report, *Conceptual Drainage Analysis* (URS 2004). Highway impervious surface areas that were considered for the Driscoll Method analysis and FHWA probabilistic dilution model were 0.57, 0.96, 0.91, and 0.71 square miles for Packages 1, 2, 4, and the Combined Alternative Package (Preferred Alternative), respectively. Additionally, the analysis considered the total drainage area of highway segments in each package including paved surfaces in the highway ROW, and related the total highway surface area to receiving stream flow conditions. The drop-ramps add impervious surface to Package 2, while the climbing lanes add to the impervious totals in Package 4. Consideration of the impervious area against all of the analysis factors, and the relatively small difference in impervious area between Packages 2, 4, and the Combined Alternative Package (Preferred Alternative), made the impervious area less distinguished in the analysis. Therefore, the increase in impervious area is not a discriminating factor in evaluating the water quality impacts between Packages 2 and 4, and only a minor discriminating factor between these two packages and the Combined Alternative Package (Preferred Alternative).

Table 4.20-5, Driscoll Pollutant Mass Loading, summarizes the calculated pollutant mass loadings for lead, copper, and zinc for Big Dry Creek, which was the one major stream with enough available data for numerical analysis. The proposed loadings for Packages 2 and 4 are reported together because these packages would have similar impervious areas and therefore similar mass loadings. The impervious

surface required for the Combined Alternative Package (Preferred Alternative) would be less than Packages 2 and 4, and it is reported separately in Table 4.20-5. The mass loadings are the expected pollutant loads prior to any mitigation efforts.

**Table 4.20-5: Driscoll Pollutant Mass Loading**

| Waterway | Existing (pounds per year) | | | Packages 2 and 4 (pounds per year) | | | Combined Alternative Package (Preferred Alternative) (pounds per year) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Lead | Copper | Zinc | Lead | Copper | Zinc | Lead | Copper | Zinc |
| Big Dry Creek | 16.9 | 2.8 | 14.0 | 33.3 | 10.5 | 54.1 | 26.0 | 8.2 | 42.2 |

Source: US 36 Mobility Partnership, 2009.

## ***Package 1: No Action***

### *Direct Impacts*

#### All Segments

Because Package 1 would not involve new bridge construction over the streams crossing US 36, water quality impacts due to temporary erosion, sedimentation, and destruction of riparian vegetation would be avoided.

Regarding operations, implementation of Package 1 would result in degraded water quality from highway runoff in all the streams traversed by US 36, except for Big Dry Creek. Seasonal flows in Big Dry Creek are sufficiently high that spikes of concentrated contaminant runoff have a low potential to exceed the regulatory water quality standards, based on the Driscoll Method analysis. Flows in the remaining streams are sufficiently low that spikes of concentrated contaminated runoff have a high potential of exceeding the regulated water quality standard, contributing negative effects on water quality. Increases in highway congestion resulting from implementation of Package 1 would cause an increase in contaminant concentrations in the highway runoff. Water quality would degrade with time in Rock Creek, Coal Creek, and South Boulder Creek, as well as in the surrounding wetlands, because runoff controls are not provided with Package 1. Package 1 does not include the implementation of permanent BMPs for treating stormwater runoff.

*Implementation of Package 1 would result in degraded water quality from highway runoff in all streams traversed by US 36, except for Big Dry Creek.*

Sanding and salt (magnesium chloride) applications are often used to improve winter driving conditions. Sanding increases traction and salt delays ice formation. Salt application has become the primary method used to maintain winter roads because salt is such an effective de-icer. The corresponding reduction in the use of sand reduces sediment loads, as well as source material for airborne pollution. State roadway maintenance crews currently follow application procedures and guidelines to control the amount of chlorides used for de-icing. For example, magnesium chloride applications take into account the forecasted low temperature, the concentration of the magnesium chloride solution, and the solution's corresponding freezing point. This procedure reduces the amount of magnesium chloride applied to roads so that excessive salts are not used. These procedures would be used in all packages. Effects of road salts, such as magnesium chloride, are potentially harmful to the environment, especially to nearby receiving streams. Chloride-based de-icers mixed with corrosion inhibitors can cause high biological oxygen demand levels and deplete available oxygen in streams. Furthermore, the presence of high levels of phosphorus, ammonia, and nitrates in corrosion inhibitors can result in eutrophication of surface water. Sand can have negative effects on water quality by increasing the turbidity levels impacting fish, bottom-dwelling organisms, and aquatic plants. Studies are currently being conducted by CDOT to investigate the environmental impacts of de-icers used on highways in Colorado.

### *Indirect Impacts*

#### All Segments

In Package 1, the planned population increase in the project area would result in additional demand for water resources for domestic and industrial uses. The volume of water would be directly proportionate to new population, as land can be expected to develop comparable to past trends. Additionally, new urbanization would increase impervious surfaces and urban runoff, resulting in some stream channel erosion and higher levels of contaminants being delivered to the receiving streams. Existing regulations protecting floodplains and requiring stormwater detention would serve to reduce these impacts, but some level of water quality degradation is probable.

## ***Package 2: Managed Lanes/Bus Rapid Transit***

### *Direct Impacts*

#### Operations Impacts

The widened roadway in Package 2 would result in an increase in impervious area over the existing impervious area. Vehicle traffic generates the majority of water pollutants; particulate matter settling out of the air also generates pollutants. If unmitigated, the larger impervious area generates more runoff, flushing contaminants into receiving waters. During winter months, application of de-icers to the larger paved surfaces may increase chloride levels in snowmelt from the roadway.

The model predicts water quality impacts only from lead, copper, and zinc due to runoff from pavements on US 36. It is likely that these impacts would be reduced to acceptable levels as a result of the municipal separate storm sewer system BMPs required with implementation of either of the build packages. However, to achieve these results, the effectiveness of the BMPs should be 60 to 80 percent, which should be feasible given the proposed designs.

In comparison to Package 1, water quality would improve with time if Package 2 was implemented rather than Package 1. Package 2 would provide the necessary BMPs to reduce water quality impacts to acceptable levels, whereas Package 1 would not include the implementation of permanent BMPs for reducing water quality impacts from existing highway congestion.

Areas of park-n-Ride alterations for bus rapid transit (BRT) stations are planned outside of the highway ROW and would fall under the water quality criteria of the local jurisdiction where the stations are located. The impact to water quality from these types of improvements would be directly related to the increase in impervious area over existing conditions. Similar to highway widening, the increase in imperviousness related to land development results in larger surfaces where pollutants collect between rainfall events. Rain events then flush these pollutants into the stream systems. Additionally, the larger impervious areas prevent rain from infiltrating into the ground, resulting in more runoff. The increased runoff could cause erosion and higher sediment loads in the receiving streams. Unmitigated, these two mechanisms combine to negatively affect the quality of water in the receiving stream.

Along the US 36 corridor, most of the local jurisdictions have adopted the water quality criteria published in the UDFCD's *Urban Storm Drainage Criteria Manual* (UDFCD 2004). These regulations require that site runoff must be maintained to the pre-development levels, thus mitigating impacts to water quality.

#### Construction Impacts

Implementation of Package 2 would present construction-related erosion and sediment control issues related to earthwork and loss of vegetation. The resulting bare surfaces would be highly susceptible to erosion from rain and wind. The erosion and sediment effects on water quality would be relatively short-lived, as numerous BMPs could be implemented to mitigate adverse impacts.

The implementation of Package 2 would require widening and/or replacement of structures over Big Dry Creek, Rock Creek, Coal Creek, and South Boulder Creek. Typical structure construction is anticipated to include construction of temporary access roads, traffic detours, demolition of the existing structures, placement of new abutments, placement of intermediate piers or bents, placement of the new structure, dewatering for foundations, and temporary stream diversions. Construction from the existing structures or from the stream banks is preferred to minimize activities within the stream channels. However, some activities, such as driving piers, must take place in the channel. Even in these cases, all attempts shall be made to keep equipment out of the channel and limit the time that the activity occurs in the channel. Temporary stream diversions can be both an impact and a mitigation. The construction of the diversion would likely have short-lived, immediate turbidity effects, but would isolate the stream from instream construction disturbance. Application of BMPs would reduce the amount of erosion and sedimentation.

The bikeway alignment on South Boulder Road/Cherryvale Road would add approximately 1.98 acres of impervious surface along South Boulder Road and Cherryvale Road. This compares to 2.155 acres of impervious surface for the US 36 bikeway. The difference between the two alignments would be minimal and would not be expected to impact water quality substantially.

The construction of Package 2 may require the relocation or replacement of up to four domestic wells, which would be confirmed during final design.

#### *Indirect Impacts*

The domestic water supply requirements to serve the population increases described in Package 1 would be the same with either of the build packages.

### ***Package 4: General-Purpose Lanes, High-Occupancy Vehicle, and Bus Rapid Transit***

The improvements associated with Package 4 would result in impacts comparable to Package 2. Package 4 consists of one additional general-purpose lane and one additional BRT/high-occupancy vehicle (HOV) lane in each direction. These additional lanes increase the impervious area over the existing conditions and are similar to Package 2. However, the increase in impervious area is not a discriminating factor in evaluating the water quality impacts between Packages 2 and 4, based on the Driscoll Method analysis and FHWA probabilistic dilution model analysis. Similar to Package 2, water quality would improve with time if Package 4 was implemented rather than Package 1. Package 4 would provide the necessary BMPs to reduce water quality impacts to acceptable levels, whereas Package 1 would not include the implementation of permanent BMPs for reducing water quality impacts from existing highway congestion.

### ***Combined Alternative Package (Preferred Alternative): Managed Lanes, Auxiliary Lanes, and Bus Rapid Transit***

The improvements associated with the Combined Alternative Package (Preferred Alternative) would result in impacts comparable to but less than either Package 2 or Package 4, as the proposed impervious surface area for the Combined Alternative Package (Preferred Alternative) would be less than the proposed impervious surface area of Package 2 and Package 4. As with Package 2 and Package 4, the increase in impervious area is not a discriminating factor in evaluating the water quality impacts between Package 2, Package 4, and the Combined Alternative Package (Preferred Alternative), based on the Driscoll Method analysis and FHWA probabilistic dilution model analysis. Similar to Package 2 and Package 4, water quality would improve with time if the Combined Alternative Package (Preferred Alternative) was implemented rather than Package 1. The Combined Alternative Package (Preferred Alternative) would provide the necessary BMPs to reduce water quality impacts to acceptable levels, whereas Package 1 would not include the implementation of permanent BMPs for reducing water quality impacts from existing highway runoff.

## Mitigation

Every effort would be made to minimize both temporary and permanent impacts to water quality to ensure the proposed action would not affect the wildlife, fish, and vegetation dependent upon the water. Table 4.20-6, Mitigation Measures — Water Quality, presents the proposed mitigation measures for protecting water quality.

**Table 4.20-6: Mitigation Measures — Water Quality**

| Impact | Impact Type | Mitigation Measures |
|---|---|---|
| Destruction of riparian vegetation | Construction | Temporary BMPs for construction, including re-establishment of native vegetation, will be installed and implemented. |
| Untreated stormwater runoff entering surface waterway during construction | Construction | • NPDES guidelines for stormwater quality, including obtaining a CDPS stormwater construction permit, will be followed.<br>• All work performed on the project within CDOT ROW will conform to Section 107.25 (Water Quality), and Section 208 (Erosion Control) of the CDOT *Standard Specifications for Road and Bridge Construction* (CDOT 2005).<br>• A Stormwater Management Plan will be developed that will detail the BMPs to be used for construction. Practices from the *Erosion Control and Stormwater Quality Guide (ECSQG)* (CDOT 2002 or most current volume) will be followed.<br>• park-n-Ride areas for transit stations will follow local water quality ordinances of the local jurisdiction where the transit stations are located. Local requirements will require the permanent BMPs to treat runoff from developed areas.<br>• Adequate storm drainage systems for the existing and proposed improvements near the interchanges will be developed to prevent high levels of sediment and pollutants from being carried into the wetlands, natural drainageways, and irrigation ditches. Non-structural BMPs, such as pesticide and fertilizer application guidelines and anti-icing and de-icing guidelines, will be employed to improve water quality in conjunction with BMP implementation. Other non-structural BMPs, such as water quality signage adjacent to the receiving streams and irrigation ditches, are examples of other tools that will be considered for implementation.<br>• A construction dewatering discharge permit may be required for groundwater dewatering activities.<br>• A Section 404 Permit will be obtained for instream work performed to retrofit any bridge and channel improvements, and 401 certification will be required to ensure that water quality standards will not be violated. |
| Control of storm runoff from new and existing impervious surfaces within CDOT ROW | Construction/ Operations | • Permanent BMPs will be constructed in compliance with the *Urban Drainage Criteria Manual* (UDFCD 2004) and the CDOT New Development and Redevelopment Program, where practical, for use during the construction phase to improve the water quality control at the site.<br>• In the tributary to Big Dry Creek, operational BMPs such as alternative de-icing measures that minimize the use of salts or operational guidelines that more closely manage the application of salts, will be considered.<br>• Permanent BMPs will be designed and constructed in compliance with the CDOT New Development and Redevelopment Program for all highway improvements.<br>All highway runoff will be collected and treated to the level required by the CDOT New Development and Redevelopment Program. The US 36 corridor improvements fall into Tier 1 BMP requirements under this program. BMPs within the project corridor will need to provide 100% of the required water quality capture volume, or the project needs to provide BMPs designed to remove at least 80% of the average annual total suspended solids loading from the average storm event. |
| Control of industrial wastes | Operations | • All proposed new connections to CDOT's storm sewer system will be inspected and verified during the construction phase to ensure the connections are constructed as designed and improper connections are avoided. |

**Table 4.20-6: Mitigation Measures — Water Quality**

| Impact | Impact Type | Mitigation Measures |
|---|---|---|
| Replacement and relocation of domestic wells | Groundwater | • Up to four domestic wells will be replaced. |

Source: US 36 Mobility Partnership, 2006.
Notes:
% = percent
BMP = best management practice
CDOT = Colorado Department of Transportation
CDPS = Colorado Discharge Permit System
*ECSQG* = *Erosion Control and Stormwater Quality Guide*
NPDES = National Pollutant Discharge Elimination System
ROW = right-of-way
UDFCD = Urban Drainage and Flood Control District

## Floodplain Impact Evaluation

A hydraulic analysis was performed for each package to compare the existing condition to the build package condition. Where available and in a form useable for this project, the FEMA Flood Insurance Study (FIS) hydraulic model that was originally prepared and used to determine the 100-year base flood elevation and the special flood hazard areas, shown in Figure 4.20-1, Floodplain Information for Streams and Ditches in the Project Area, was used for this analysis. In areas where the FEMA hydraulic model was not in a useable form (i.e., only paper copies of HEC-2 input was available), the hydraulic analysis was performed with Hydrologic Engineering Centers River Analysis System (HEC-RAS) hydraulic models created from the project survey. The FEMA FIS 100-year flow rate was used to evaluate each package and to determine floodplain and water surface elevation impacts.

### ***Methodology***

Baseline conditions of the streams, within the project area, were analyzed using either project-created HEC-RAS models or FEMA's FIS HEC-2 models. The HEC-2 models were converted to the newer HEC-RAS software to facilitate structure sizing. Drainage basin size and flow rates used are listed in Table 4.20-7, Drainage Basin Information for Streams within the Project Area.

**Table 4.20-7: Drainage Basin Information for Streams within the Project Area**

| Drainage Name | Basin Area[1] (square miles) | FEMA $Q_{100}$[2] (cfs) | FHAD $Q_{100}$[2] (cfs) |
|---|---|---|---|
| Big Dry Creek | 21 | 5,669 | 7,570[3] |
| Airport Creek | 1.2 | 118 | - |
| Rock Creek | 9 | 4,812 | - |
| Coal Creek | 36 | 3,820 | - |
| South Boulder Creek | 132 | 7,250[4] | 6,160 |

Source: FEMA FIS HEC-2 models and UDFCD Flood Hazard Area Delineation, and South Boulder Creek Floodplain Study.
Notes:
[1] Total basin area tributary to stream at crossing with US 36. Total basin area only includes the drainage area upstream of US 36.
[2] Total stream flows at crossing with US 36.
[3] Release through the US 36 embankments limited to existing structure sizes per City of Westminster agreement with Urban Drainage and Flood Control District.
[4] Flow is based on new hydrologic data currently being reviewed by FEMA.
- = not available
cfs = cubic feet per second
FEMA = Federal Emergency Management Agency
FHAD = Flood Hazard Area Delineation
Q = 100-year flood flow rate which has a 1 percent annual chance of flood flows being equaled or exceeded in cubic feet per second

Floodplain impacts are measured by the change in the water surface elevation or base flood elevation. A hydraulic analysis was performed for each package using either the project-created HEC-RAS hydraulic models or the regulatory FEMA hydraulic model and the U.S. Army Corps of Engineers (USACE) computer program HEC-2. HEC-2 models were imported into the USACE computer program HEC-RAS Version 3.1.1 and the datum was adjusted to match the project base-map datum. Additional cross-sections were added to both the existing and build package hydraulic models for comparison purposes. FEMA-published water surface elevations were used for the downstream cross-section as the starting condition for the analysis of each floodplain in either model format. A common point in the river located upstream from the project area was used to compare the impacts of the packages. This common point is a hydraulic feature and is the same for all packages, including the build packages. There are no impacts upstream from this point.

Channel bank stabilization features were not included in the models. These features would need to be designed to not affect the hydraulic performance of the channel or drainage structures and would not impact the floodplain. Stabilization techniques would focus on stabilizing the banks, reducing the amount of sediment leaving the banks, restoring vegetative growth, improving habitat for wildlife, reducing long-term maintenance, and protecting the roadway infrastructure. Stabilization measures may include, but are not limited to, buried riprap covered with soil and revegetated with native grasses, bio-engineered embankment toe stabilization, willow stakes, placement, grade control structures, and rebuilding and shaping the banks.

Table 4.20-8, Floodplain Impact Analysis, summarizes the impacts based on the floodplain hydraulic analysis performed in accordance with 23 CFR Part 650, and 44 CFR Part 1. The build package drainage structures have been sized to comply with FEMA regulations of either providing a “No-Rise” condition in detailed floodplain areas, or limiting the rise in water surface to be no more than 1 foot in non-detailed floodplain areas. Any floodplain requiring a rise greater than allowable will have a conditional letter of map revision (CLOMR) prepared and submitted to FEMA for review followed by a Letter of Map Revision (LOMR) prepared by the project sponsor upon completion of the project construction. Local agency floodplain ordinances would be incorporated and the most stringent criteria would be used for analysis, drainage structure sizing, and design. Decreases in water surface elevations, as shown in Table 4.20-8, are considered a favorable condition in the property upstream from the US 36 crossing, which would be less affected by the floodplain. The results of the hydraulic analysis show that none of the crossings have a significant impact to the floodplain. The floodplain encroachments shown in Table 4.20-8 were calculated based on the amount of fill and disturbance that each build package footprint would have at each floodplain. These types of encroachments reduce floodplain area, but do not always directly impact the ability of water to flow or cause a change in water surface elevation. Floodplains are delineations of the water surface elevations determined during the hydraulic analysis. However, the hydraulic analysis only models and evaluates flowing water (so only a portion of a floodplain is actually conveying the storm event, and the remaining portion of the floodplain is where water backs up to the elevation of the flowing water or pools). Floodplain encroachment can appear large in size and have little or no impact on the water surface elevations, especially if the encroachment is located in a pooled area.

**Table 4.20-8: Floodplain Impact Analysis**

| FEMA Floodplain | Package 1 | | Package 2 | | Package 4 | | Combined Alternative Package (Preferred Alternative) | | Impacts | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Water Surface Change (feet) | Floodplain Encroach-ment (acres) | Water Surface Change (feet) | Floodplain Encroach-ment (acres) | Water Surface Change (feet) | Floodplain Encroach-ment (acres) | Water Surface Change (feet) | Floodplain Encroach-ment (acres) | Impact | Lateral Impact (Y/N) | Significant Impact (Y/N) |
| Big Dry Creek | 0.00 | 0.00 | 0.04 | 6.9 | 0.04 | 7.0 | 0.04 | 12.0 | Minor | Y | N |
| Airport Creek | 0.00 | 0.00 | 0.00 | 2.3 | 0.00 | 2.3 | 0.00 | 2.0 | None | N | N |
| Rock Creek | 0.00 | 0.00 | -5.85 | 11.7 | -5.85 | 9.2 | -6.52 | 12.4 | None | Y | N |
| Coal Creek | 0.00 | 0.00 | - 1.78 | 3.5 | - 1.78 | 3.7 | -2.37 | 4.4 | None | Y | N |
| South Boulder Creek | 0.00 | 0.00 | -0.23 | 15.9 | -0.23 | 15.1 | -0.23 | 18.9 | None | Y | N |

Source: US 36 Mobility Partnership, 2004; URS, 2004; and URS, 2009.

Notes:

- = minus

Y = yes

N = no

Floodplain encroachment: FEMA floodplain area located within build package footprint, that includes fills and general disturbance

Minor impacts: less than 1-foot rise in water surface elevation

Major impacts: greater than 1-foot rise in water surface elevation

Lateral impact: floodplain encroachment from widening US 36

Significant impacts: meeting requirements as defined in 23 CFR Part 650 and 44 CFR

The Airport Creek floodplain is delineated upstream from US 36 in a pond, and downstream from the pond outlet works. There is no floodplain delineated in the US 36 corridor.

## ***Package No 1: No Action***

Package 1 presumes that the other funded transportation projects presented in Chapter 2, Alternatives Considered, would proceed. Impacts resulting from these projects are being or have been evaluated as part of other environmental documents; they are not addressed as part of this Final Environmental Impact Statement (FEIS).

## ***All Build Packages***

There would be no effect on future flood elevations in the US 36 corridor or flooding because the bridges and structures for all of the build packages have been configured to meet the requirements of EO 11988 and CFRs previously listed. At four of the five locations, more acres of fill would be placed in the floodplain with the Combined Alternative Package (Preferred Alternative) than with the other two build packages.

**Big Dry Creek:** According to the City of Westminster, the US 36 drainage structure and the upstream BNSF Railway drainage structure act as flow rate limiting structures. The City of Westminster has asked to maintain the existing structure capacity and to not provide a structure with a larger capacity. The City has an assurance agreement with the UDFCD stating that the City will not allow these two drainage structures to pass flow rates greater than existing conditions. The analysis for all build packages has provided for lengthening the existing culvert to accommodate a wider US 36 roadway surface. Through this assurance agreement, the existing floodplain boundaries and all natural and beneficial floodplain values have not changed. The FEMA floodplain zone designation upstream from the crossing has changed since the *Conceptual Drainage Analysis* was completed in August 2004 (URS 2004). The floodplain changed from a FEMA Zone A to a FEMA Zone AE. A LOMR was prepared and the new floodplain became effective November 30, 2005. A Zone AE floodplain requires a "No-Rise" condition in the upstream water surface elevation, or the preparation of a CLOMR to request a change in the floodplain from FEMA and to document the change. As listed in Table 4.20-8, Floodplain Impact Analysis, the extended drainage structure would cause a 0.04 foot rise in the upstream 100-year water

surface elevation and may require a CLOMR to be prepared during the design phase of the project. Due to the small change in water surface elevation and limitations on changing the structure size with the assurance agreement, the City of Westminster's floodplain manager will be contacted during the design phase to determine if a CLOMR/LOMR is required.

**Airport Creek:** This creek originates near Jefferson County Airport. The channel is not well defined and flows through open fields and storm sewer systems to a recently constructed regional detention pond. The floodplain at Airport Creek has been modified since the *Conceptual Drainage Analysis* was completed in August 2004 (URS 2004). A LOMR was prepared and the new floodplain became effective September 11, 2006. The new floodplain shows water being collected in the regional detention pond and the pond outletting downstream from US 36. The pond has also reduced the 100-year flow rate passing under US 36. The Airport Creek floodplain is delineated to show the upstream pond and downstream pond outlet works. The pond outlet structure passes under US 36. The build package, as listed in Table 4.20-8, Floodplain Impact Analysis, will not impact the Airport Creek floodplain, the regional detention pond, or the performance of the pond outlet works.

**Rock Creek:** The Rock Creek floodplain upstream from US 36 is a narrow, incised channel that is deep and well defined. The creek flows towards US 36 from the southwest, and is then redirected by the roadway and flows adjacent to the roadway to the southeast until it reaches the existing drainage structure. The channel is relatively steep in this area and the existing floodplain overtops the US 36 roadway. The build condition would replace the existing drainage structure with a new drainage structure that would pass the 100-year flows under US 36. This new structure would reduce the upstream 100-year water surface elevation, as shown in Table 4.20-8, Floodplain Impact Analysis. Since the upstream floodplain is narrow and confined, the decrease in water surface elevation does not change the floodplain boundaries by a significant amount. The build packages would encroach on the floodplain limits by between 9.2 acres and 12.4 acres, but would lower the water surface elevation by more than 5 feet. The safety to the public will be improved by preventing roadway overtopping for the 100-year event. The upstream floodplain values are low since Rock Creek is currently flowing around the perimeter of the FlatIron Crossing parking lot, and the Rock Creek drainage basin is being developed near US 36. It should be expected that more of the basin will be developed in the future. The downstream channel between US 36 and 96$^{th}$ Street is not well defined, and the floodplain spreads out between the two drainage structures. Ramp D in the Combined Alternative Package (Preferred Alternative) would encroach on the existing channel. The build packages would provide for a new channel to be constructed between US 36 and 96$^{th}$ Street from the US 36 drainage structure to a point downstream from the Ramp D encroachment area and would then tie into the existing channel. Downstream from 96$^{th}$ Street, the channel is better defined and passes under the BNSF Railway embankment. These drainage structures have been sized to pass the 100-year flow rates, and the changes at US 36 will not affect the hydraulic performance of these downstream structures. The floodplain encroachment and disturbance areas at Rock Creek appear large in size; however, the actual impact to Rock Creek is minimal. The build package footprint would not cross Rock Creek where Rock Creek parallels US 36 upstream from the US 36 drainage structure. The existing floodplain values, natural floodplain beyond the FEMA floodplain, have little or no impact due to the project.

**Coal Creek:** The Coal Creek drainage basin is mostly undeveloped with a majority of the basin upstream from US 36 in agricultural and range land with no regional detention pond. Under existing conditions, US 36 is overtopped due to a combination of the height of the roadway above the channel and the existing drainage structure being undersized. All build packages would provide a larger drainage structure to pass the 100-year flows under US 36 with a roadway grade rise. The build packages, as listed in Table 4.20-8, Floodplain Impact Analysis, would encroach on the floodplain by between 3.5 acres and 4.4 acres, but would lower the floodplain water surface by between 1.78 feet and 2.37 feet depending on the selected build package.

**South Boulder Creek:** The City of Boulder has recently completed and adopted an initial study of the South Boulder Creek floodplain with revised flow rates and water surface elevations. The City has submitted a LOMR to FEMA to officially change the FEMA floodplain data for South Boulder Creek. In order for the 100-year flows to pass US 36, part of the flow would pass under the US 36 bridge located over the South Boulder Creek channel and the remainder would pass over the top of US 36. The 100-year water surface elevation is approximately 17 feet above the lowest point on US 36, near the Table Mesa Drive crossing, and covers a nearly 5,000-foot-long stretch of roadway. A majority of this is pooled water that has filled in the low areas, and is not the moving water flowing over US 36. The depth of flowing water averages approximately 4 to 5 feet deep.

Removing US 36 from the 100-year floodplain map or the latest City of Boulder study map would require the mainline profile of US 36 to be elevated by at least 4 feet for a distance of nearly 5,000 feet; a 1,000-foot long, 20-foot high levee to be built in Boulder open space; and construction of a large upstream reservoir.

Due to these requirements, the complexity surrounding this issue, and the current difference in definition for the 100-year floodplain limits between the City of Boulder and FEMA flood control maps, US 36 at this location would remain in the 100-year floodplain.

The 10-year and 50-year storm events were reviewed using FEMA information to obtain the respective water surface elevations. The 50-year water surface is approximately 1 foot lower than the 100-year water surface elevation and overtops US 36. The 10-year water surface elevation is approximately 3 feet lower than the 100-year water surface elevation.

Emergency vehicles would not have access to US 36 between South Boulder Creek and the US 36/ Foothills Parkway interchange during storm events from approximately the 10-year storm event and greater.

The build alternatives are predicted to reduce the 100-year water surface elevation on South Boulder Creek at US 36 by 0.23 feet because the stream channel would be improved within the highway ROW to accommodate a wider bridge section. The build packages would encroach on the floodplain from between 15.9 acres to 18.9 acres. The bridge would remain at the current length of about 114 feet. Channel improvements on the upstream side of the bridge would include wing dikes that would better direct water flows under the highway. The US 36 roadway profile that is overtopped during the 100-year storm would remain the same as the existing roadway profile between South Boulder Creek and Foothills Parkway. As listed in Table 4.20-8, Floodplain Impact Analysis, the build package would not substantially impact the floodplain.

A portion of the bikeway alignment on South Boulder Road/Cherryvale Road would be located in the 100-year floodplain, which crosses South Boulder Road. There is currently a bikepath along South Boulder Road in this location, thus there would not be new fill added to the floodplain.

## Mitigation

Big Dry Creek may require a CLOMR due to the small increase in upstream water surface elevation. CDOT will work with the City of Westminster and the UDFCD to determine if this is required, and if so, will work with the City of Westminster floodplain manager to submit the CLOMR to FEMA. If a CLOMR is required, a LOMR will be prepared by the project sponsors at the completion of project construction.

No mitigation is proposed for the remaining floodplains since all packages either decrease the water surface elevation from the existing condition or have no impact. As stipulated in 23 CFR 650.115(5), encroachment within any of the floodplains along US 36 would be subject to the requirements of local jurisdictions. CDOT will work closely with these agencies to define appropriate designs in accordance with CDOT Procedural Directive 501.2, Cooperative Storm Drainage System. If required by the UDFCD or by the local agency floodplain administrator for any of these floodplains, a CLOMR will be prepared to request a modification of the floodplain and floodplain maps to mitigate increases in water surface elevations. A LOMR will be prepared by the project sponsors upon completion of project construction. This process follows the requirements of 23 CFR Part 650, and 44 CFR Part 1.