

FLOODPLAIN AND DRAINAGE TECHNICAL MEMORANDUM



April 2014



EB I-70 Peak Period Shoulder Lane CATEGORICAL EXCLUSION



FLOODPLAIN AND DRAINAGE TECHNICAL MEMORANDUM

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Acronyms and Abbreviations

BFE	Base Flood Elevation
CFR	Code of Federal Regulations
CDOT	Colorado Department of Transportation
CLOMR	Conditional Letter of Map Revision
CWCB	Colorado Water Conservation Board
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
LOMR	Letter of Map Revision
mph	miles per hour
PEIS	Programmatic Environmental Impact Statement
ROD	Record of Decision
SH	State Highway
WSE	Water surface elevation

Section 1. Purpose of the Memorandum

The Federal Highway Administration (FHWA), in cooperation with the Colorado Department of Transportation (CDOT), is preparing a Categorical Exclusion for proposed changes to the eastbound lanes of I-70 between approximately milepost (MP) 230 and MP 243, in Clear Creek County, Colorado. The proposed changes, known as the Peak Period Shoulder Lane (PPSL) project, will improve operations and travel time reliability in the eastbound direction of I-70 in the project area. Additionally, the improvements will be consistent with the *I-70 Mountain Corridor Programmatic Environmental Impact Statement (PEIS) Record of Decision (ROD)*, I-70 Mountain Corridor Context Sensitive Solutions process, and other commitments of the PEIS. The I-70 PEIS identified comprehensive improvements for the corridor (CDOT, 2011). The Proposed Action fits within the definition of “expanded use of existing transportation infrastructure in and adjacent to the corridor” as an element of the Preferred Alternative Minimum Program. The Proposed Action is described in more detail in Section 4.

The PPSL would operate up to, but not exceed, 20 percent of the annual days or 7.5 percent of the time. It would connect to the three-lane section of I-70 constructed by the Twin Tunnels project, east of Idaho Springs, thereby capitalizing on that investment.

This technical memorandum discusses the regulatory setting and describes the affected environment and the impacts of the Proposed Action on floodplains and drainage within the identified study area. This memorandum also documents mitigation measures, which would reduce impacts resulting from construction

Section 2. How Does the Analysis Relate to the Tier 1 PEIS?

The PPSL project falls within the Preferred Alternative Minimum Program of improvements described in the PEIS, with the primary difference of eastbound-only improvements rather than both lane directions. However, no floodplain or drainage analysis was included in the PEIS that can be applied to the PPSL project.

Section 3. What Process Was Followed to Analyze Floodplains and Drainage?

3.1 Methodology

The methodology used to assess potential impacts to floodplains and drainage associated with the Proposed Action is summarized as follows:

- Determine project extents and drainage design considerations
- Document existing floodplain and floodway limits
- Assess changes or encroachments that may occur during and after construction
- Evaluate potential mitigation strategies

3.2 Study Area

Within the 13-mile study area, the reach of roadway improvements and widening area would occur within the 10-mile segment of I-70 from the US 40/I-70 interchange (MP 232) to the Twin Tunnels (MP 242.2). This 10-mile segment is defined as the study area for the floodplain and drainage analysis.

Clear Creek is the primary water resource in the study area and generally flows immediately adjacent to I-70, receiving direct roadway runoff. Small, ephemeral drainages and larger perennial drainages generally flow under I-70 from north to south and into Clear Creek on the south side of I-70. The exception to this drainage pattern is between central Idaho Springs (MP 240) and west of the Twin Tunnels (MP 241.7), where Clear Creek is along the north side of I-70. Primary perennial drainages in the study area include Mill Creek, Spring Gulch, Fall River, Chicago Creek, and Soda Creek.

This highway segment is characterized by a steep canyon environment with slopes at the angle of repose and near-vertical rock outcrops in several areas. I-70 was constructed using cut-and-fill methods in most areas, with fill material placed on Clear Creek's bank. In many locations Clear Creek is constricted by the narrow canyon and further channelized by fill material from I-70.

There is minimal drainage infrastructure for the eastbound section of I-70 throughout the study area. I-70 was constructed prior to criteria requiring on-site management of stormwater. Westbound drainage is managed with inlets and culverts (see Figure 1). However, most eastbound drainage sheet flows off the highway and drains directly to Clear Creek (see Figure 1). In general, there are few inlets on the eastbound lanes in the study area, except in areas of left curves where the highway is super-elevated toward the median. An exception to this occurs between central Idaho Springs and just west of the Twin Tunnels, where Clear Creek flows along the north side of I-70, and inlets and culverts have been installed to manage highway drainage.

Figure 1. Study Area Drainage



Inlet capturing runoff from both traffic directions.



Eastbound I-70 runoff may drain directly to Clear Creek.

Most culverts extending beneath under I-70 within the study area are between 18-inches and 36-inches in diameter. Larger culverts are detailed in Table 1:

Table 1. Large Culverts in the Study Area

Mile Post	Drainage	Structure
232.3	Clear Creek	Twin 12-foot-wide by 10-foot-tall concrete box culverts
234.8	Mill Creek	10-foot by 10-foot concrete box culvert
236.2	Spring Gulch	14-foot-wide by 16-foot-tall concrete box culvert
237.5	Fall River	10-foot by 10-foot concrete box culvert
239.9	Clear Creek	Three-span bridge
240.1	Soda Creek	Large Pipe
240.65	Pedestrian Crossing	Box Culvert

3.3 Data Sources

The following data sources were used in this evaluation:

- CDOT I-70 topographic data (CDOT, 2013)
- FEMA Flood Insurance Study and Flood Insurance Rate Map data (FEMA, 2012)
- 2013 Clear Creek hydraulic model, ICON Engineering (ICON, 2013)

3.4 Regulations

This section identifies the relevant federal regulations that apply to work conducted within the 100-year floodplains. In general, the PPSL project is located outside of any regulatory floodplains. However, there are two areas of work upstream and downstream of State Highway 103 (SH 103) that would impact the regulatory floodplain of Clear Creek.

Federal Emergency Management Agency (FEMA) prepared Flood Insurance Study Number 08019CV000B, which delineates the floodplain in the study area (FEMA, 2012). This study indicates two flood hazard area zones in the study area:

- Zone A—Areas subject to inundation by a base flood (100-year recurrence). These areas are identified by approximate studies, and no base flood elevations are established.
- Zone AE—Areas subject to inundation by a base flood as determined by detailed methods. Base flood elevations are established.

The Zone A floodplains are delineated based upon approximate methods and sometimes encumber the I-70 roadway. However, this delineation is in error and being replaced with a more detailed Zone AE delineation, which is already complete but will not be made effective until 2015.

The flood hazard areas defined by Zone AE include base flood elevations (BFEs) indicating the water surface elevation corresponding to a 100-year event. The primary federal regulation pertaining to floodplains is 44 CFR 60.3 (d)(3), which states that a community shall “prohibit encroachments, including fill, new construction, substantial improvements, and other development within the adopted regulatory floodway unless it has been demonstrated through hydrologic and hydraulic analyses performed in accordance with standard engineering practice that the proposed encroachment would not result in any increase in flood levels within the community during the occurrence of the base flood discharge.” Any encroachment within the

floodway or action that would result in a rise in the base flood elevations of the regulatory floodway would trigger the need for a Conditional Letter of Map Revision (CLOMR) to be accepted by the community floodplain administrator and approved by FEMA prior to construction. A CLOMR application typically requires 6 to 9 months to complete and be approved by FEMA. However, if the impact of encroachment can be mitigated so there is no change in the base flood elevations, a CLOMR is not required. Regardless, at project completion (once the work within the floodplain is as-built), a Letter of Map Revision (LOMR) will be necessary to document the change to the floodplain.

The Colorado Water Conservation Board (CWCB) prohibits floodplain encroachment in areas where BFEs would be raised by more than 6 inches, or into the channel corridor where the main channel conveyance capacity may be compromised (2010).

3.5 Agency Coordination Conducted

Meetings and coordination with Clear Creek County's and Idaho Springs' Floodplain Administrators and CDOT's Region 1 Hydraulics Engineer have been ongoing to identify floodplain impacts and mitigation strategies. Meetings were held on October 2 and 9, and November 21, 2013, to describe the proposed work within the floodplain. It was noted that without any mitigation, a maximum rise of 0.2 foot would be anticipated on Clear Creek upstream of SH 103. With the proposed mitigation, the PPSL project would not cause any rise in the floodplain elevations and, therefore, a CLOMR will not be necessary. A LOMR will be processed at project completion.

Section 4. Description of the Proposed Action

The purpose of the I-70 PPSL project is to provide short-term eastbound operational improvements to relieve traffic congestion during periods when traffic volumes are highest. This segment is the most congested stretch of the entire I-70 Mountain Corridor. During both the summer and winter peak season, traffic volumes are highest on weekends when recreational travelers comprise more than 90 percent of traffic. In 2010 drivers experienced speeds of less than 20 miles per hour (mph) for 35 percent of the time on Sundays, which have the highest volume. Some motorists divert to the frontage road along I-70, which affects its ability to function as a local access county road.

The Proposed Action would add a PPSL between the US 40/I-70 interchange and east Idaho Springs. This managed lane would be used during peak periods, defined as Saturdays, Sundays, and holidays, improving travel times and operations. The project extends from MP 230 to MP 243, with improvements proposed as follows:

- MP 230 to MP 232: signage improvements only. Signage would notify motorists of the status of the managed lane, entrance and exit points, and cost.
- MP 232 to MP 242: roadway improvements, including up to 3.5 feet of widening in select areas to accommodate the managed lane, up to 14 feet of widening at the SH 103 on ramp and 4 feet to 8 feet of widening at all other on-ramps in the corridor; replacement of the existing SH 103 bridge; bridge replacement and interchange improvements at Exit 241; improvements to Water Wheel Park; signage; rock fall mitigation in two locations; and construction of 11 retaining walls.
- MP 242 to MP 243: signage improvements only.

The managed lane, which would be tolled, would operate up to, but not exceed, 20 percent of the annual days or 7.5 percent of the time, and connect to the three-lane section provided by the Twin Tunnels project, east of Idaho Springs, thereby capitalizing on that investment.

The improvements will be consistent with the *I-70 Mountain Corridor Programmatic Environmental Impact Statement (PEIS) Record of Decision (ROD)*, I-70 Mountain Corridor Context Sensitive Solutions process, and other commitments of the PEIS. The Proposed Action fits within the definition of “expanded use of existing transportation infrastructure in and adjacent to the corridor” as an element of the Preferred Alternative Minimum Program.

See Figure 2 for an overview of the proposed improvements.

Section 5. What Are the Current and Future Conditions of Floodplains in the Study Area?

5.1 Current Regulatory Floodplain

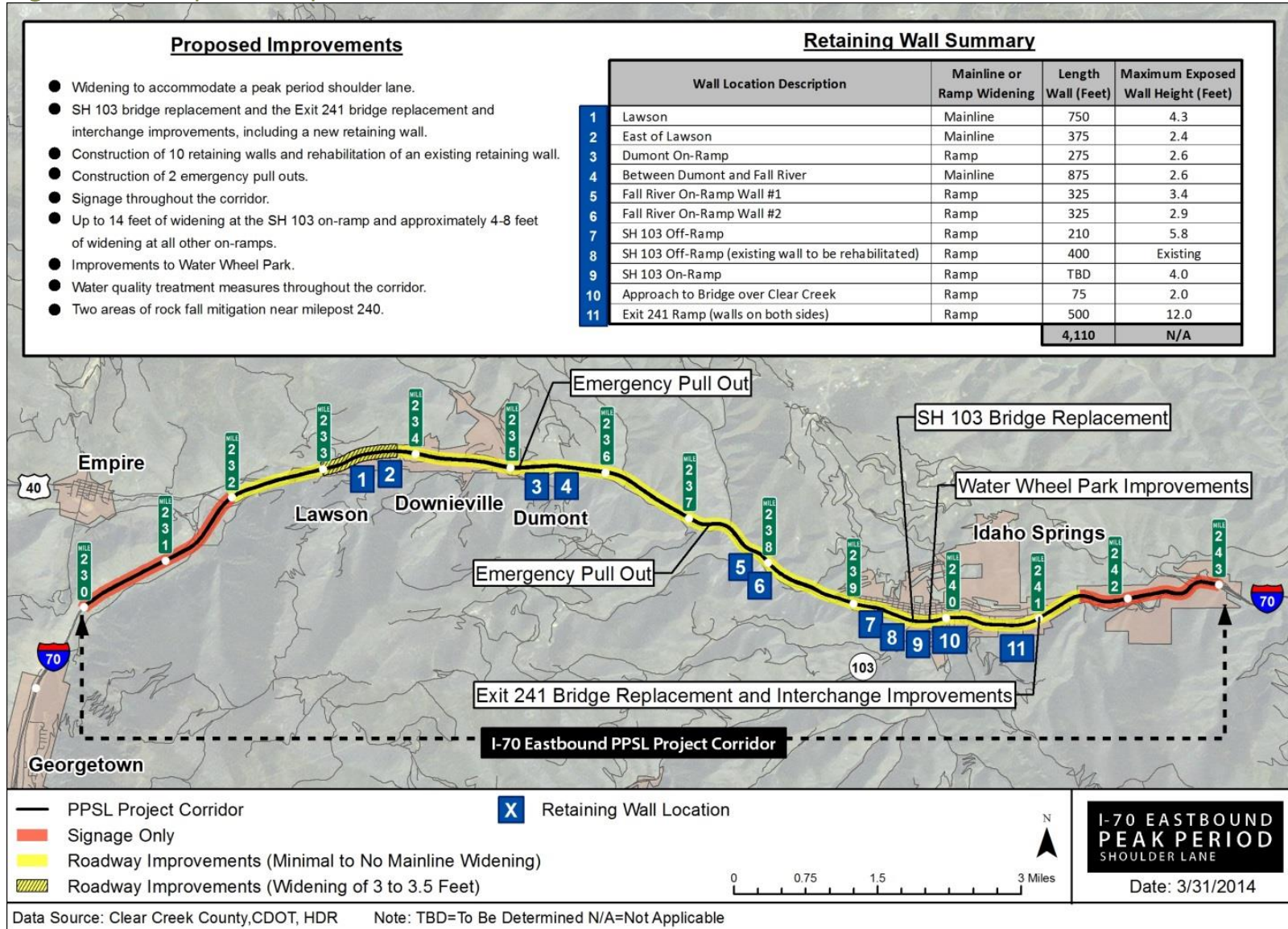
Currently, the majority of the FEMA floodplain in the study area is confined within Clear Creek’s banks and does not encroach onto the I-70 roadway. Areas designated Zone AE do not encroach on the roadway. The Zone AE delineations are determined by detailed methods for areas subject to inundation by a base flood. Base flood elevations are provided for Zone AE floodplain delineations.

There are several areas currently designated Zone A that encumber the roadway. This Zone A designation is approximate and these areas are not based upon detailed analyses and do not have established base flood elevations. Independent calculations were used to define the existing 100-year water surface at cross sections in each of these areas of potential encumbrance. Inputs for the model include the current hydrology and the topography of the area (CDOT, 2013). The models show that 100-year water surface elevation does not encumber the roadway. The hydraulic models produced by ICON Engineering confirm these findings (ICON, 2013). Therefore, the Zone A FEMA mapping is poorly defined, and none of the existing I-70 roadway within the project reach is actually within the 100-year floodplain of Clear Creek.

5.2 Future Regulatory Floodplain

An updated hydraulic model, completed by ICON Engineering for the Colorado Water Conservation Board, covering Clear Creek between Georgetown and the Twin Tunnels is expected to become the effective regulatory model for FEMA in 2015 (ICON, 2013). The model uses updated existing topography and hydrology to delineate the effective Zone AE floodplain within the entire study area. This updated model shows no encumbrance of the 100-year floodplain onto the existing I-70 roadway. Impacts of the Proposed Action on floodplains are discussed in Section 6.2 of this technical memorandum.

Figure 2. Proposed Improvements



Section 6. What Are the Environmental Consequences?

6.1 How Does the No Action Alternative Affect Floodplains?

The No Action Alternative would have no impact on regulatory floodplains.

6.2 How Does the Proposed Action Affect Floodplains?

The Proposed Action includes limited widening of asphalt pavement. The project expands the asphalt surface by 1.5 acre (3 percent increase to the existing eastbound roadway asphalt surface). The limited widening is expected to have negligible effects on the amount and peak flow rate of highway runoff and, therefore, is not expected to impact roadway drainage structure capacities. In the areas to be widened, a majority of the proposed work occurs outside of the 100-year floodplain. Figure A-1 and Figure A-2 in Appendix A of this technical memorandum illustrate (in plan view and in cross sectional view) the typical scenario where the work is outside of the floodplain. These figures illustrate an area with proposed roadway expansion towards Clear Creek with no floodplain impact.

Two activities associated with the proposed action would occur within the floodplain in the study area. The first area, illustrated on Figure A-3 and Figure A-4 in Appendix A of this technical memorandum, is approximately 440 feet upstream of the SH 103 bridge over Clear Creek. To accommodate pavement widening, improvements are proposed to be made to an existing retaining wall, west of the interchange and adjacent to Clear Creek (see Figure 3). This existing steel crib wall would be refaced and reinforced to accommodate minor highway widening and to address the scour and loss of backfill that currently occurs during high flow events. This wall is within the existing floodway, which means any changes could have an adverse impact to the floodplain. The maximum proposed expansion of the wall is 1.3 foot toward the channel. This wall expansion toward the creek is considered a fill within the floodway, which could adversely impact the floodplain.

Figure 3. Retaining Wall at SH 103



View along eastbound I-70 showing backfill loss at SH 103 retaining wall.



View of SH 103 retaining wall looking upstream from south bank of Clear Creek.

The retaining wall must be protected against scour during a flood event. Since a foundation footer cannot be constructed below scour depth, boulder revetment will be placed along the toe of the wall to protect it from general channel scour and degradation. These boulders will be 30-inch to 36-inch-diameter to armor the channel edge during a flood event. These boulders will be permanent and be set at the base of the wall along the channel bottom.

Without any mitigation, the corresponding maximum rise in the base flood elevations is modeled to be +0.20 foot. Although this rise is less than the +0.50 foot permitted by the CWCB, it is an expansion into the defined floodway, which is considered an adverse impact. Without any mitigation, the proposed construction at this location would require a CLOMR as discussed in Section 3.4 of this technical memorandum. Section 7 describes the proposed mitigation to avoid the need to submit a CLOMR application.

Construction associated with the rehabilitation of the retaining wall upstream of SH 103 would require temporary work in Clear Creek channel. Cofferdams and erosion control measures will be implemented during construction to isolate the work zone from the waterway. These effects would be temporary and are not expected to permanently impact the floodplain.

The second area where the Proposed Action would impact the 100-year floodplain is located at Water Wheel Park, approximately 940 feet downstream of the SH 103 interchange near MP 239.8. This area is illustrated on Figure A-5 and Figure A-6 in Appendix A of this technical memorandum. The current 100-year floodplain elevation at 7,536.5 feet is near the elevation of the existing trail. At this location the anticipated highway widening work would encroach into the floodplain. However, the improvements proposed for the Park would lower the existing Clear Creek Greenway trail, removing approximately 530 cubic yards of fill from the bank, of which 50 cubic yards would be removed from the 100-year floodplain. This park improvement will increase the riverine cross sectional area, thereby increasing flood conveyance. Work in this area will actually benefit the Clear Creek floodplain. No CLOMR is necessary for this area of work.

6.3 What Indirect Effects Are Anticipated?

There are no anticipated indirect effects on floodplains. The PPSL roadway is elevated above the 100-year floodplain and would not be inundated in a flood.

Section 7. What Mitigation Is Needed?

Table 2 describes the mitigation measures for floodplain impacts.

Table 2. Mitigation Measures

Activity	Location	Impact	Mitigation
Reconstruction of the retaining wall	West of SH 103	Placement of fill in the floodway.	A Section 404 Permit will be obtained prior to construction.
Reconstruction of the retaining wall	West of SH 103	Placement of fill in the floodway.	The low flow channel will be reshaped to offset the placement of fill.

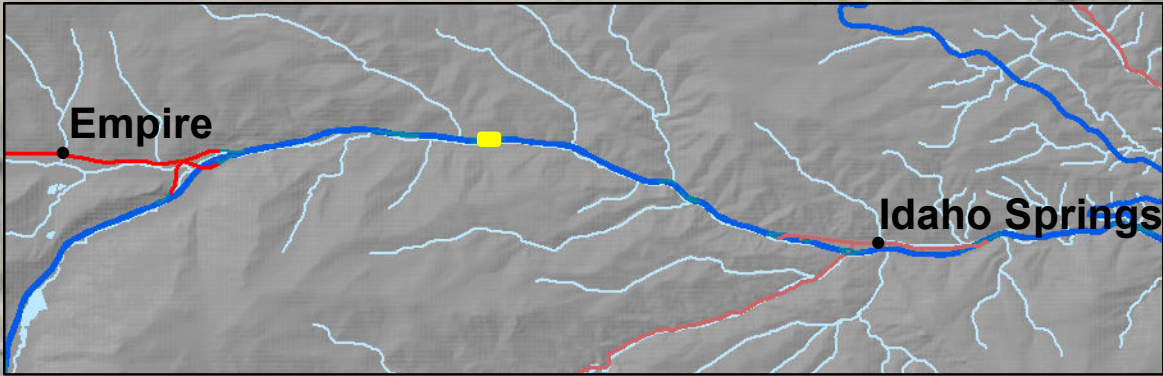
Section 8. References

- CDOT, 2011. *Final Programmatic Environmental Impact Statement. I-70 Mountain Corridor*. J.F.Sato & Associates for the Colorado Department of Transportation, Region 1. March.
- . 2013. *Peak Period Shoulder Lane Aerial LIDAR Contour Mapping and Topographic Data, Vertical Datum 1988 NAVD, Supplemented with Field Survey for Utilities and Structures (CDOT ProjectWise File Name: 18975SURV_Topo100Scale01.dgn)*.
- Colorado Water Conservation Board, 2010. *Rules and Regulations for Regulatory Floodplains in Colorado*. November.
- Federal Emergency Management Agency, 2012. *Flood Insurance Study, Clear Creek County, Colorado*. Federal Insurance Study Number 08019CV00B.
- Icon Engineering, Inc., 2013. *Clear Creek Hydraulic Model, Georgetown to Twin Tunnels*.

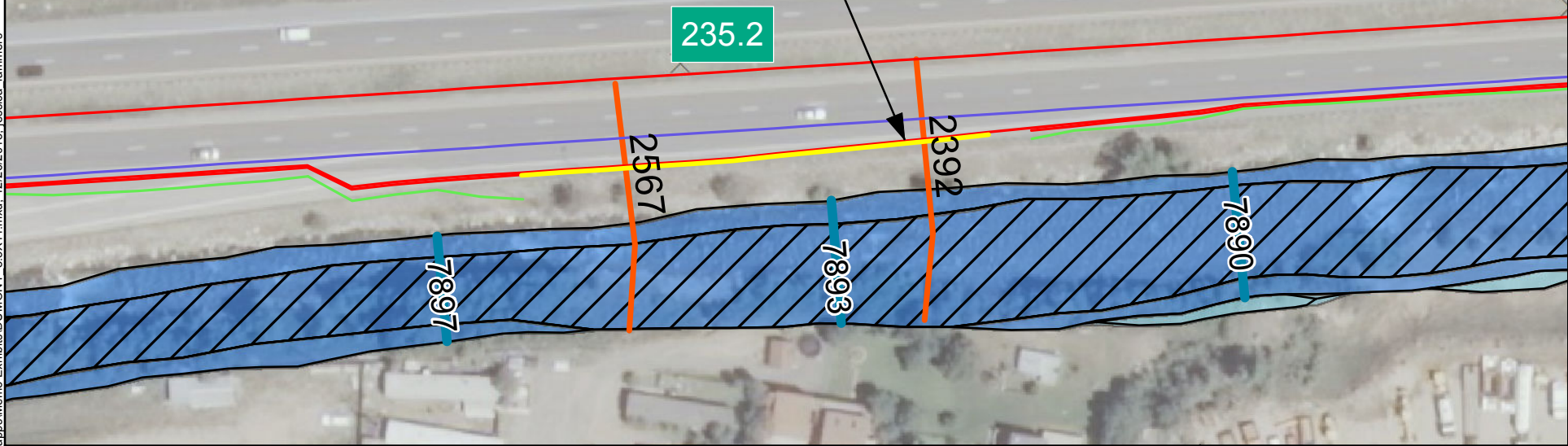


Appendix A. Plan View and Cross Section Figures

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- Figure A-1. Plan View for Roadway Expansion above the Floodplain
 - Figure A-2. Cross Sectional View for Roadway Expansion above the Floodplain
 - Figure A-3. Plan View for Retaining Wall Rehabilitation into the Floodplain
 - Figure A-4. Cross Sectional View for Retaining Wall Rehabilitation into the Floodplain
 - Figure A-5. Plan View for Water Wheel Park into the Floodplain
 - Figure A-6. Cross Sectional View for Water Wheel Park into the Floodplain
-



AREA OF NO FLOODPLAIN IMPACT:
RETAINING WALL WITH ROADWAY EXPANSION
NEAR DUMONT, CO



Legend

Floodplain

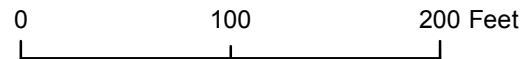
- 500-Year
- 100-Year, Zone A
- 100-Year, Zone AE

- Cross Sections
- Base Flood Elevation
- Mile Marker

CDOT PPSL Roadway Model

- Proposed Edge of Roadway
- Proposed Shoulder
- Proposed Toe of Fill

- Proposed Top of Cut
- Proposed Top of Wall



**I-70 EASTBOUND
PEAK PERIOD
SHOULDER LANE**

Figure A-1

Data Source: CDOT, ICON Engineering

Date: December 26, 2013

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CDOT I-70 PPSL: DUMONT RETAINING WALL CROSS SECTION 2567

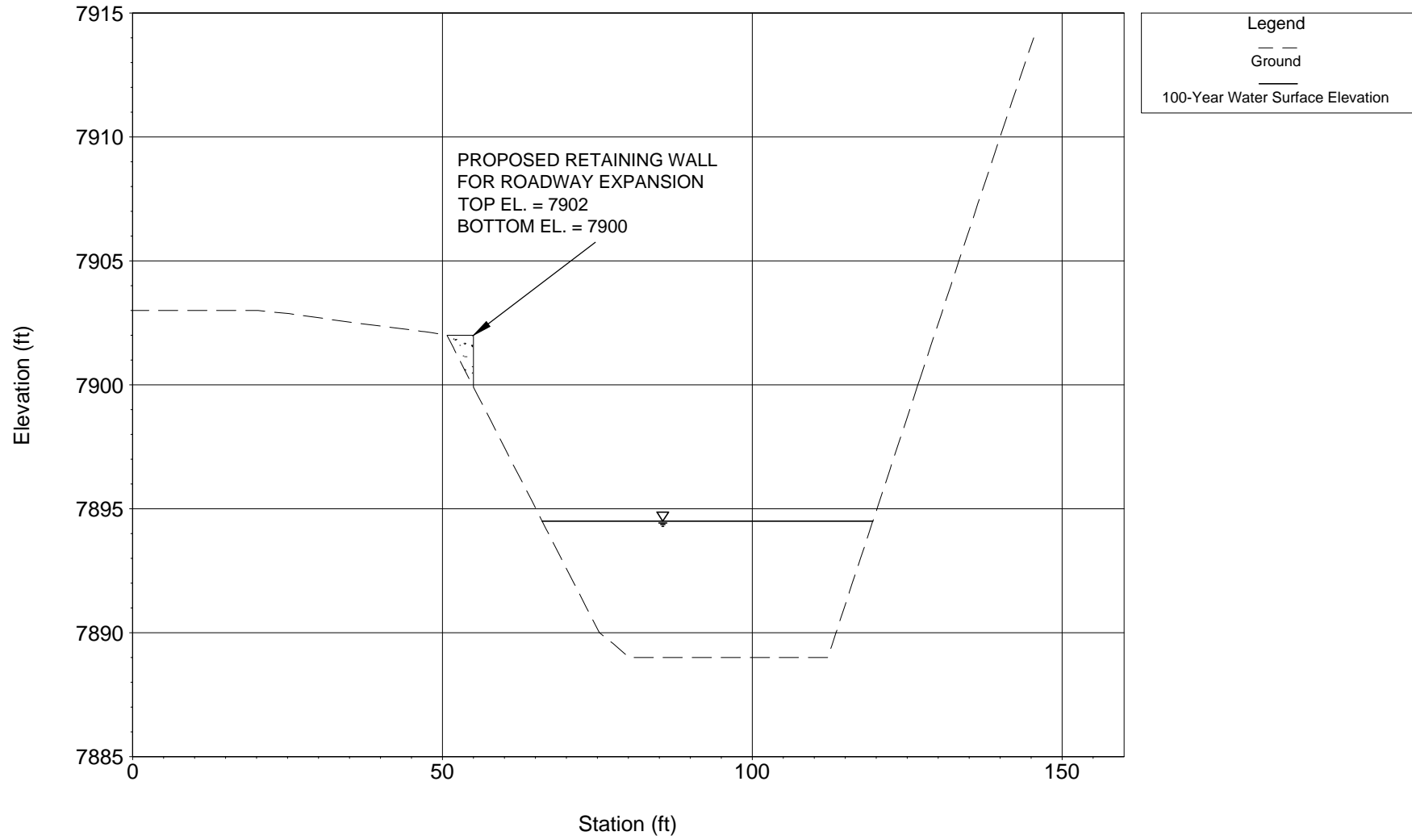
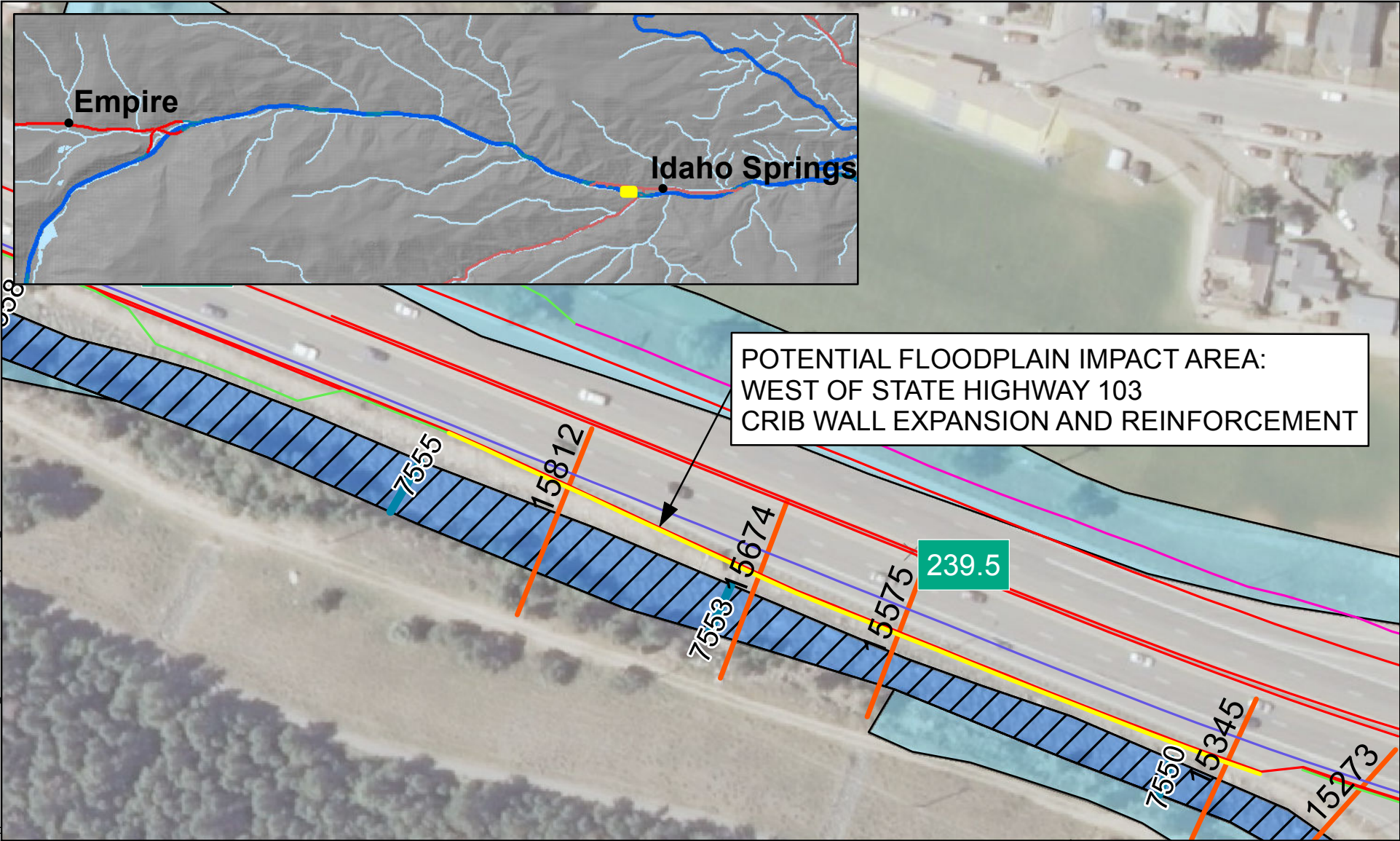


FIGURE A-2

DATA SOURCE: CDOT, ICON ENGINEERING

**I-70 EASTBOUND
PEAK PERIOD
SHOULDER LANE**

DATE: DECEMBER 26, 2013



POTENTIAL FLOODPLAIN IMPACT AREA:
WEST OF STATE HIGHWAY 103
CRIB WALL EXPANSION AND REINFORCEMENT

239.5

Legend

Floodplain

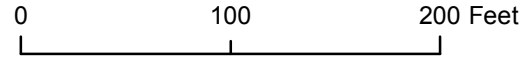
- 500-Year
- 100-Year, Zone A
- 100-Year, Zone AE

- Cross Sections
- Base Flood Elevation
- X Mile Marker

CDOT PPSL Roadway Model

- Proposed Edge of Roadway
- Proposed Shoulder
- Proposed Toe of Fill

- Proposed Top of Cut
- Proposed Top of Wall



**I-70 EASTBOUND
PEAK PERIOD
SHOULDER LANE**

Figure A-3

Data Source: CDOT, ICON Engineering

Date: December 26, 2013

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CDOT I-70 PPSL: IDAHO SPRINGS RETAINING WALL CROSS SECTION 15674

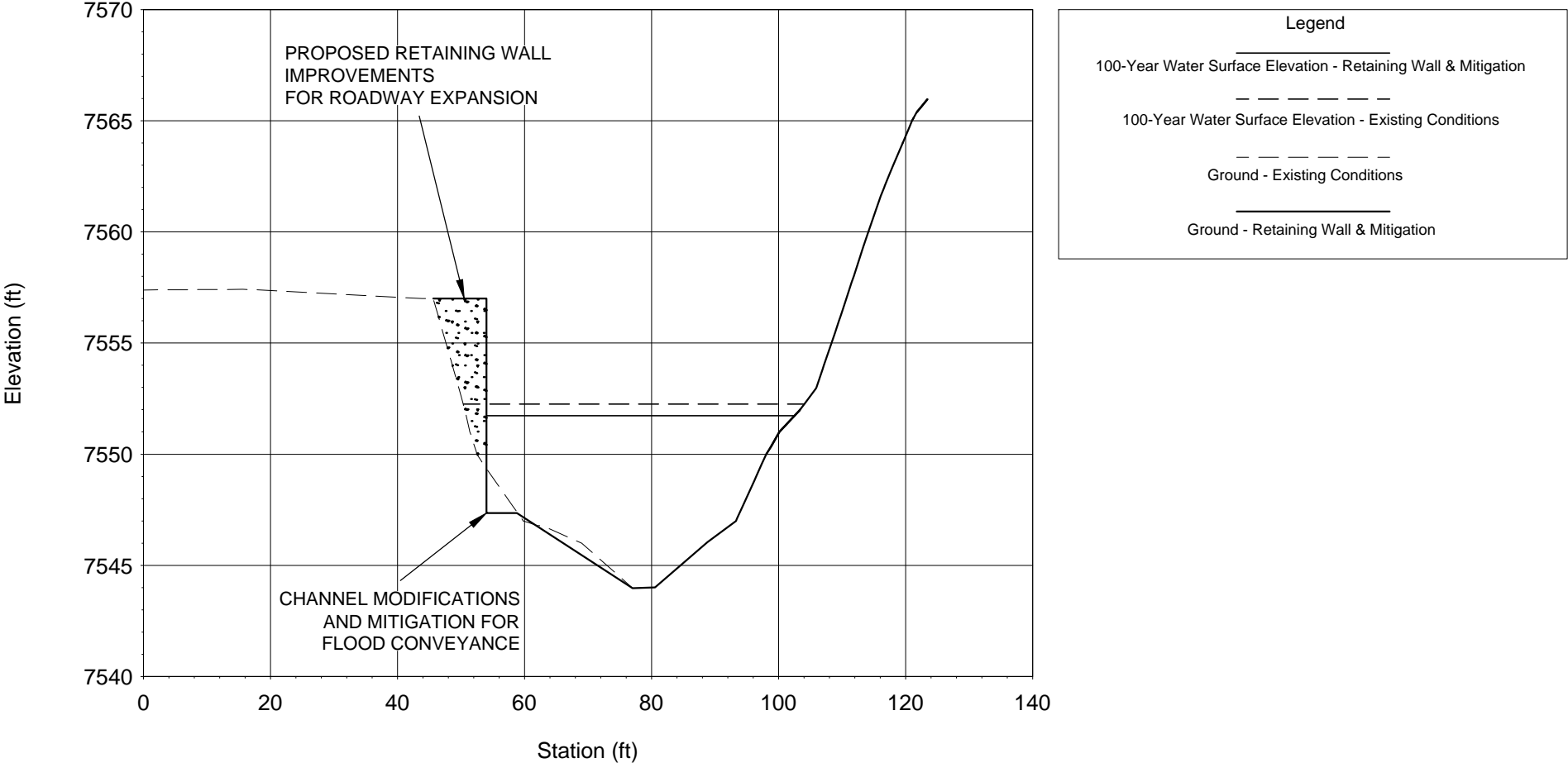


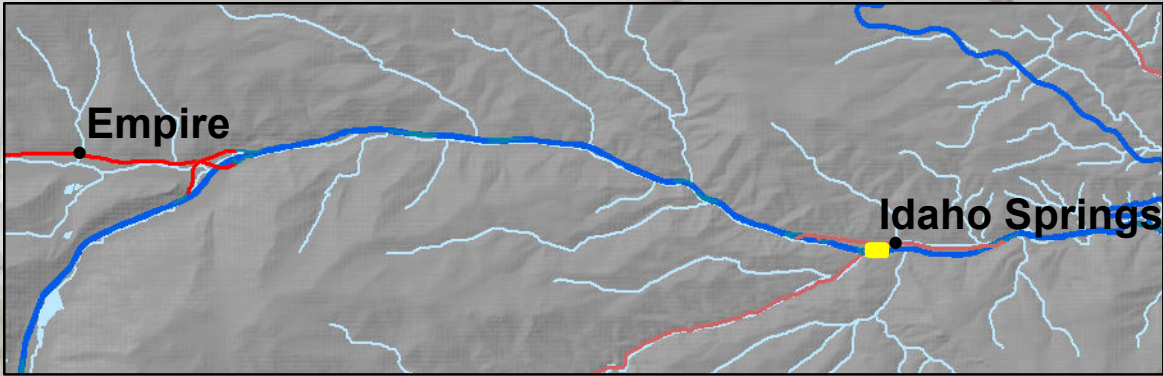
FIGURE A-4

DATA SOURCE: CDOT, ICON ENGINEERING

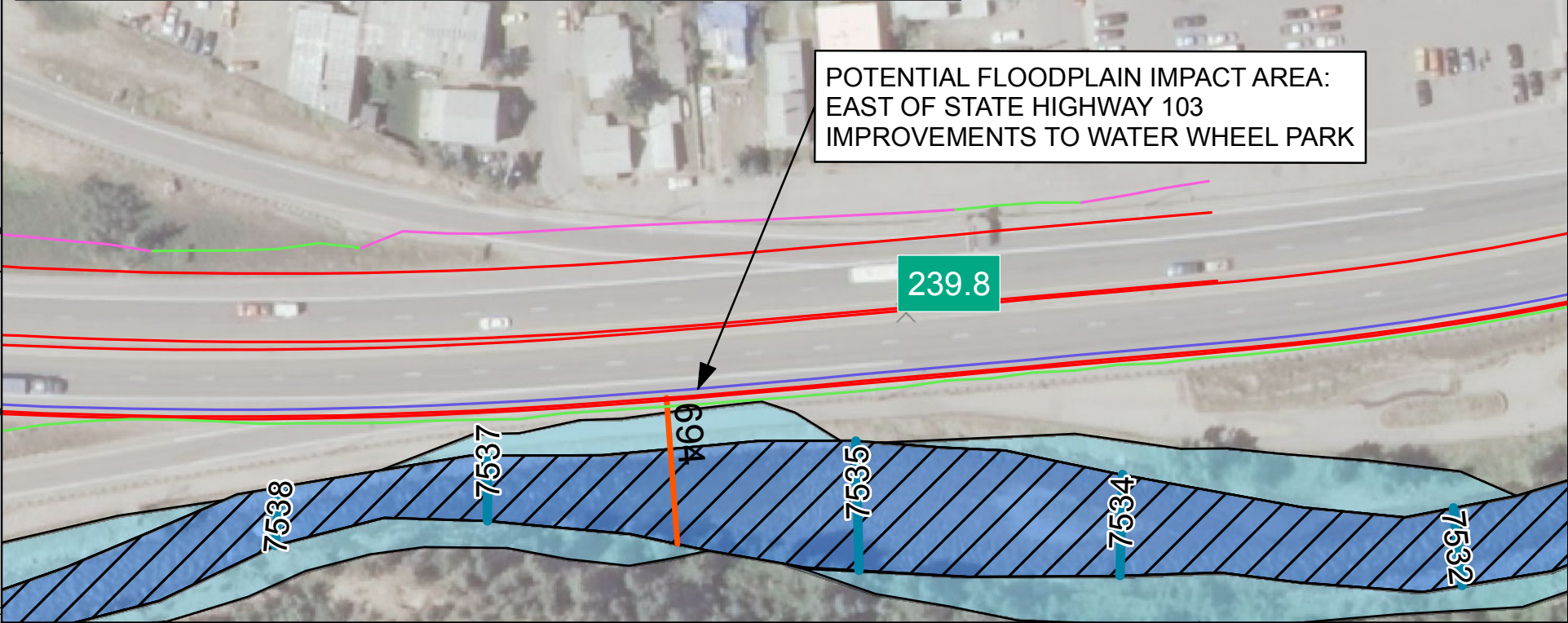
**I-70 EASTBOUND
PEAK PERIOD
SHOULDER LANE**

DATE: DECEMBER 26, 2013

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POTENTIAL FLOODPLAIN IMPACT AREA:
EAST OF STATE HIGHWAY 103
IMPROVEMENTS TO WATER WHEEL PARK



Legend

Floodplain

- 500-Year
- 100-Year, Zone A
- 100-Year, Zone AE

Cross Sections

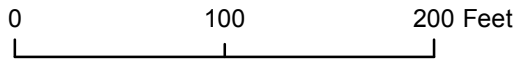
- Cross Sections
- Base Flood Elevation
- Mile Marker

CDOT PPSL Roadway Model

- Proposed Edge of Roadway
- Proposed Shoulder
- Proposed Toe of Fill

Proposed Top of Cut

- Proposed Top of Cut
- Proposed Top of Wall



**I-70 EASTBOUND
PEAK PERIOD
SHOULDER LANE**

Figure A-5

Data Source: CDOT, ICON Engineering

Date: December 26, 2013

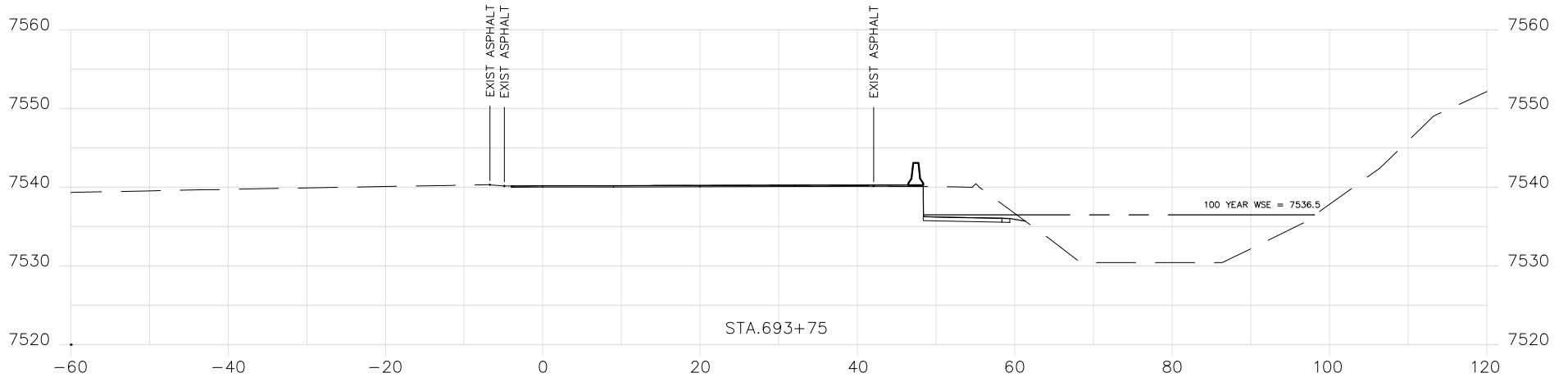
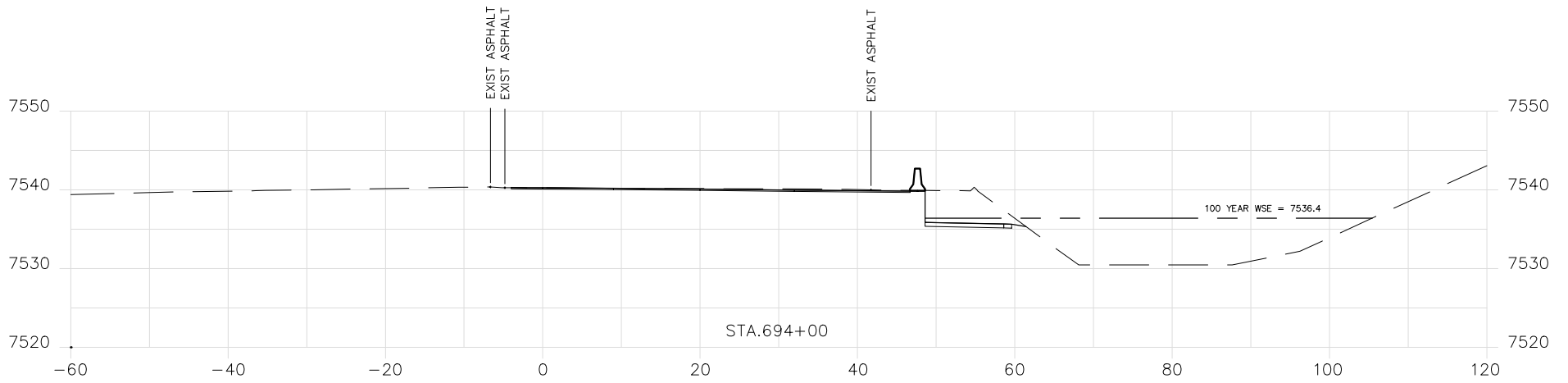


FIGURE A-6
 PROPOSED LOWERING OF TRAIL
 AT WATER WHEEL PARK
 INCREASED FLOOD CONVEYANCE

**I-70 EASTBOUND
 PEAK PERIOD
 SHOULDER LANE**
 DATE: DECEMBER 26, 2013

DATA SOURCE: CDOT, ICON ENGINEERING