Chapter 15: Floodplains

15.1 Introduction

Floodplains are normally dry areas that are occasionally inundated by stormwater runoff or high lake water. Development in floodplains, including roads, can reduce their flood-carrying capacity and extend the flooding hazard beyond the developed area.

This chapter discusses the floodplains in the floodplain impact analysis area and the effects on these floodplains from each alternative under consideration for the West Davis Corridor (WDC) Project.

What is the floodplain impact analysis area?

The floodplain impact analysis area includes I-15 on the east, the Great Salt Lake floodplains on the west, 3000 South in Hooper and West Haven on the north, and Parrish Lane on the south.

Floodplain Impact Analysis Area. The floodplain impact analysis area was selected to include all floodplains near or adjacent to the WDC alternatives that could be affected by the project. This area includes Interstate 15 (I-15) on the east, the Great Salt Lake floodplains on the west, 3000 South in Hooper and West Haven on the north, and Parrish Lane on the south (see Section 1.2, Description of the Needs Assessment Study Area).

15.2 Regulatory Setting

Two terms that are used in floodplain regulatory guidance are *100-year flood* and *floodplain*. Floods are usually described in terms of their statistical frequency. A *100-year flood* or *100-year floodplain* describes an event or an area subject to a 1% probability of a certain size flood occurring in any given year. This concept does not mean that such a flood will occur only once in 100 years. Whether or not it occurs in a given year has no bearing on the fact that there is still a 1% chance of a similar occurrence in the following year.

What is a 100-year flood?

A 100-year flood (also referred to as a base flood) is an event subject to a 1% probability of a certain size flood occurring in any given year. A 100-year floodplain is the area around a water body that would be inundated by a 100-year flood.

Since floodplains can be mapped, the boundary of the 100-year flood is commonly used in floodplain mitigation programs to identify areas where the risk of flooding is significant. Any other statistical frequency of a flood event can be chosen depending on the degree of risk that is selected for evaluation, such as a 5-year, 20-year, 50-year, or 500-year floodplain.

15.2.1 Federal Emergency Management

In response to escalating taxpayer costs for flood disaster relief, Congress established the National Flood Insurance Program. This program is a voluntary mitigation program administered by the Federal Emergency Management Agency (FEMA). Under this program, the federal government makes flood insurance available in those communities that practice sound floodplain management. This incentive encourages state and local governments to develop and implement floodplain-management programs. FEMA requirements for land management and use, and for identification and mapping of special hazard areas, are described in 44 Code of Federal Regulations [CFR] 60 and 65, respectively.

In the 1970s and 1980s, FEMA performed location hydrologic and hydraulic studies to identify and map the most significant special flood hazard areas within developed or developing areas of the communities participating in the National Flood Insurance Program. A result of the FEMA studies is the development of flood insurance rate maps that show the floodplain for each river, lake, or other surface water resource that was studied.

A *special flood hazard area* is the area that would be inundated by a 100-year flood, also referred to by FEMA as a *base flood*. Special flood hazard areas are given a zone designation based on the level of detail of the FEMA study and the anticipated type of flooding. There are several types of zones in the floodplain impact analysis area, but the following special flood hazard area zones are pertinent to this project:

- **Zone A** – Areas subject to inundation by a base flood. 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.
- **Zone AO** – Areas subject to riverine, stream, or other flood hazards with a 1% or greater chance of shallow flooding each year, usually in the form of sheet flow, with average depths ranging from 1 to 3 feet.
- **Zone VE** – Areas with a 1% annual chance of coastal flooding with an additional hazard associated with storm waves (FEMA 2010).

What is a stream?

In this chapter, *stream* is used as a general term to describe waterways such as rivers, creeks, canals, and washes.

The 100-year floodplain for rivers and streams is the area in and around the river or stream that would be inundated by a 100-year flood. In AE zones, this floodplain consists of both the floodway and the floodway fringe as shown in Figure 15-1, FEMA Floodplain Schematic, in Volume IV (FEMA 2012). The *floodway* is the defined stream channel and the adjacent areas that must be kept free of encroachment to pass the 100-year flood without increasing the water surface elevation more than a designated height. The *floodway fringe* is the area between the floodway and the boundary of the floodplain.

Similarly, the 100-year floodplain for lakes and reservoirs is the area in and around the lake or reservoir that would be inundated by a 100-year flood.

15.2.2 Executive Order 11988, Floodplain Management

Executive Order 11988, Floodplain Management (May 24, 1977), as amended by Executive Order 13690 (January 30, 2015), Establishing a Federal Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input, established federal policy "to avoid to the extent possible the long- and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct or indirect support of floodplain development wherever there is a practicable alternative."

Based on Executive Order 11988, the Federal Highway Administration (FHWA) adopted regulations governing the development of projects that could have impacts to floodplains (23 CFR 650, Subpart A). These regulations require that a location hydraulic report be prepared to demonstrate how the requirements of 44 CFR 60 and 65 have been met by the project. These regulations state that FHWA will not approve a project that involves a "significant encroachment" on a floodplain unless FHWA finds that the proposed significant

encroachment is the "only practicable alternative" (23 CFR 650.113). This regulation also clearly states that the project must conform to 44 CFR 60 and 65 as well as the floodplain management ordinance of the affected community. If the impacts exceed the standards defined in the regulations, the project could be subject to conditional approval from FEMA in accordance with 44 CFR 65.12. What constitutes a "significant encroachment" is determined on a case-by-case basis by considering adjacent development. FEMA has set a 1-foot increase in the 100-year flood elevation as the upper limit of the allowable encroachment caused by the cumulative development (in this case, the encroachment from the WDC Project in conjunction with previous and future project encroachments).

Under FHWA's regulations, a significant encroachment can arise from any of the following situations:

- Significant potential for interfering with a transportation facility that is needed for emergency vehicles or that provides a community's only evacuation route
- A significant risk of upstream flooding
- A significant adverse impact to natural and beneficial floodplain values (natural and beneficial floodplain values include flood conveyance, storage, and control; groundwater recharge; water quality function; and wildlife habitat and diversity)

The project design effort will include the supporting floodplain and hydraulic analyses to address FHWA regulations. The Utah Department of Transportation's (UDOT) design process includes the preparation of technical memoranda that, together with roadway and drainage plans and profiles, demonstrate compliance with various regulations, permitting requirements, and design criteria. Using this floodplain impact analysis as a basis, design roadway elevations will be compared to floodplain elevations to assess the potential for interference with the transportation facility. FEMA has issued guidance regarding the applicability of Executive Order 13690 and the Federal Flood Risk Management Standard indicating that the 1% annual chance floodplain will continue to be used for developing Flood Insurance Rate Maps (FEMA 2015a). Accordingly, the 1% annual chance floodplain event was used in this floodplain impact analysis and will be used through UDOT's design process. At each cross drainage facility, a detailed hydraulic analysis will be performed to confirm that bridges and culverts identified during preliminary design will provide adequate conveyance of flood waters. Overall impacts to the floodplains and floodplain values will be measured against the impacts and requirements documented in this Environmental Impact Statement (EIS).

If the preferred alternative includes a floodplain encroachment that would cause significant impacts, the Final EIS must include a finding that it is the only practicable alternative as required by 23 CFR 650, Subpart A. The finding should refer to Executive Order 11988 and 23 CFR 650, Subpart A. It should be included in a separate subsection titled "Only Practicable Alternative Finding" and must be supported by the following information:

- The reasons why the proposed action must be located in the floodplain,
- The alternatives considered and why they were not practicable, and
- A statement indicating whether the action conforms to applicable state or local floodplain protection standards.

Furthermore, it is FHWA's policy "to avoid longitudinal encroachments, where practicable" [23 CFR 650.103(b)]. Longitudinal encroachments are parallel or nearly parallel to a stream or the edge of a lake.

For this project and based on the analysis performed, the WDC action alternatives would not cause a significant impact to the floodplain; therefore, a finding of practicable alternative as required by 23 CFR 650, Subpart A, is not required.

15.3 Affected Environment

The rivers and creeks that traverse the floodplain impact analysis area originate primarily in the Wasatch Mountains east of the impact analysis area in Davis and Weber Counties and flow west to the Great Salt Lake. Several streams in the impact analysis area convey stormwater runoff, but not all of these creeks and rivers have a regulatory (defined) floodplain boundary.

What is a regulatory floodplain?

A water body has a regulatory floodplain if the floodplain is identified and mapped by FEMA.

For the purpose of identifying streams and floodplains, the floodplain impact analysis area is described from north to south and is divided into the two counties crossed by the impact analysis area. Information was gathered from a variety of sources including FEMA's Community Status Book, flood insurance studies, hard-copy and digital flood insurance rate maps, U.S. Geological Survey topographic maps, and the Utah Geographic Information Systems (GIS) Portal. Potential indirect impacts to floodplains are also described in Chapter 23, Indirect Effects.

15.3.1 Methodology

To evaluate the affected environment, the WDC team developed an inventory of the streams and water bodies in the floodplain impact analysis area. Because FEMA's flood insurance program and flood hazard data are organized by local (city and county) jurisdictions, the first step in creating the stream inventory was to identify the communities in the impact analysis area.

What is the WDC team?

The WDC team consists of the lead agencies for the WDC Project (FHWA and UDOT).

Next, the WDC team identified streams and water bodies within the affected communities. These waterways can be perennial (containing water year-round) or intermittent (wet only part of the year). The primary sources of data used to develop the stream inventory were FEMA digital flood insurance rate map data, U.S. Geological Survey topographic maps, and stream data available from the Utah GIS Portal.

15.3.2 Communities Participating in FEMA's National Flood Insurance Program

The floodplain impact analysis area includes parts of communities in Davis and Weber Counties as well as unincorporated areas of each county. With the exception of Hooper, all of these communities participate in FEMA's National Flood Insurance Program. The National Flood Insurance Program requires participating communities to enact ordinances that protect the natural floodplain environment, prevent damage to property, and protect public safety. The identification numbers for the participating communities are listed in Table 15-1.

Table 15-1. National Flood Insurance Program Community Identification Numbers

Community	FEMA Community Identification Number
Davis County[a]	490038
Centerville	490040
Clearfield	490041
Clinton	490042
Farmington	490044
Kaysville	490046
Layton	490047
Sunset	490050
Syracuse	490051
West Point	490053
Weber County[a]	490187
Hooper[b]	490256
Ogden	490189
Riverdale	490190
Roy	490223
West Haven	490249

Source: FEMA 2017

[a] Effective floodplain data (digital flood insurance rate maps) are organized by county.

[b] Hooper is not a participant in the National Flood Insurance Program.

15.3.3 Floodplains in the Impact Analysis Area

Streams and water bodies in the floodplain impact analysis area are described below and include named, natural waterways or water bodies for which regulatory floodplains are defined. Current effective floodplain maps for Davis and Weber Counties were last revised in 2007 and 2015, respectively (FEMA 2007, 2015b). Stream names are based on the FEMA data and are generally consistent with the names found on U.S. Geological Survey topographic quadrangles (USGS 1990, 1991, 1998a, 1998b, 1999). Other streams exist within the impact analysis area, as do numerous irrigation canals. Although some canals receive stormwater runoff, none of the canals identified in the impact analysis area have regulatory floodplains.

In the descriptions, references to Davis County or Weber County indicate that the stream runs through one or more unincorporated parts of the county. Left and right banks are designated as if one were looking downstream. These streams are also shown in Figures 15-2 and 15-3, Floodplains, in Volume IV.

South Fork of the Weber River. The South Fork of the Weber River crosses the northwestern part of the impact analysis area, flowing generally to the southwest toward the Great Salt Lake. In this area, the wide floodplain is associated with both the North and South Forks of the Weber River as well as the Great Salt Lake.

Kays Creek. Within the impact analysis area, Kays Creek flows in a southwesterly direction through south Layton, north Kaysville, and Davis County. The regulatory floodplain is generally confined to the channel except near the confluence with the Great Salt Lake floodplain.

North Fork Holmes Creek. North Fork Holmes Creek is located in Kaysville and is a right-bank tributary to Holmes Creek. A regulatory floodplain is defined along North Fork Holmes Creek from the I-15 and FrontRunner (commuter rail) corridors to the confluence with Holmes Creek, with the exception of an approximately 0.25-mile reach just upstream of the confluence.

Holmes Creek. Holmes Creek flows southwesterly through Kaysville. Near the confluence of North Fork Holmes Creek, floodplain mapping indicates that high water in the creek overtops the left (south) bank, and the flood waters flow to a separate, nearby unnamed drainage.

Baer Creek. Baer Creek also follows the predominant drainage pattern, flowing southwesterly through Kaysville to the Great Salt Lake. The regulatory floodplain becomes significantly wider southwest of Shepard Lane.

Haight Creek. Haight Creek enters the impact analysis area north of Shepard Lane in Kaysville and flows to the southwest. Its regulatory floodplain terminates before it reaches the Great Salt Lake.

Farmington Creek. Farmington Creek enters the impact analysis area in the vicinity of the interchanges of I-15, U.S. Highway 89, and Legacy Parkway. The stream floodplain meets the Great Salt Lake floodplain west of the Denver and Rio Grande Western Railroad corridor.

Great Salt Lake. The Great Salt Lake, one of the largest terminal lakes in the world, receives water from the Bear River, the Weber River, the Jordan River, and numerous streams. Additionally, water is received through direct precipitation and groundwater. The Weber River watershed includes the Ogden River, and the Jordan River receives water from the Provo River and Spanish Fork River watersheds via Utah Lake. The Great Salt Lake's drainage area is more than 21,000 square miles (UGS 2010).

The lake levels of the Great Salt Lake fluctuate due to seasonal differences in precipitation and runoff. Flooding along the shoreline is also influenced by wind and wave action on the lake. Wind and waves on the lake will increase flooding levels in areas along the lake shore. In addition to estimating the 1% annual chance lake level for a large terminal lake, FEMA has estimated the expected base flood elevation for the Great Salt Lake with the maximum 1%

annual chance wave crest elevation, which is the maximum wave height that can be expected to occur, on average, every 100 years. The zone that is anticipated to be affected by a wave surge is mapped as Zone VE. Beyond the wave surge zone is the area that would have flooding associated with wave-driven flood waters.

Table 15-2 shows FEMA's expected maximum wave crest elevations for locations surrounding the lake in Davis County, as well as the lake's base flood stillwater elevations, which are the maximum lake elevations expected in the absence of wind or waves (FEMA 2007). Areas within Zone VE are anticipated to have both a flooding hazard and an erosion hazard associated with wave action. Zone AE stillwater zones are not anticipated to have significant wave action.

Flooding associated with the Great Salt Lake also differs from riverine flooding in duration. Riverine flooding will typically last for hours at peak stage, but flooding associated with the Great Salt Lake will take months to recede since lake levels will decline only in response to evaporation from the lake surface.

Table 15-2. Flood Elevations for the Great Salt Lake

in feet NAVD 88[a]

Location[b]	1% Annual Chance Stillwater Elevation	Maximum 1% Annual Chance Wave Crest Elevation
West Point	4,215	4,218.6
Syracuse	4,215	4,218.7
Kaysville	4,215	4,219.1
Farmington	4,215	4,219.3

Source: FEMA 2007

[a] The North American Vertical Datum of 1988 (NAVD 88) is the vertical control datum established by the National Geodetic Survey for measuring elevation.

[b] See FEMA 2007 for transect locations and additional information regarding the hydraulic analysis. The locations presented in this table are limited to those in the impact analysis area.

The corresponding study for Weber County (FEMA 2015b) does not include Great Salt Lake flood elevations. Within Weber County, the Great Salt Lake floodplain is designated as Zone A; no base flood elevations are established. The U.S. Army Corps of Engineers requires notification of all federal activities that will affect a water of the U.S. below the elevation of 4,200 feet adjacent to the Great Salt Lake (USACE 2015).

15.4 Environmental Consequences

The WDC action alternatives were evaluated equally in this chapter. However, to reduce repetitive discussions, if impacts from one alternative would be the same as impacts from a previously discussed alternative, the text is not repeated but instead references the previous analysis.

15.4.1 Methodology

The WDC team determined the impacts from the WDC action alternatives by comparing FEMA flood insurance rate maps to the right-of-way of the WDC alternatives to identify regulatory floodplain crossings in the floodplain impact analysis area. The floodplain analysis is based on FEMA regulatory requirements. When reviewing the floodplain impacts described in this chapter, readers should take the following factors into consideration:

- A regulatory floodplain can be defined for all of, part of, or no portion of a stream. The analysis performed for and documented in this chapter is an analysis of the impacts on regulatory floodplains, not an analysis of the impacts on streams (with or without defined regulatory floodplains).
- A stream located in the floodplain impact analysis area might not intersect an alternative.
- Some alternatives pass through confluence areas where the floodplain associated with a stream meets the floodplain associated with the Great Salt Lake. In these cases, there might be more than one flood zone designation in the area (for example, an alternative might cross both a Zone A and a Zone AE floodplain in a confluence area).
- New bridges and culverts would be designed for a 50-year or 100-year stormwater event, which would reduce floodplain impacts. These structures would be designed to meet the more stringent of UDOT and FEMA requirements. According to the WDC Project requirements, culverts and bridges would be designed to accommodate a 50-year or greater magnitude flood (one with a 2% chance of occurring in a given year) where no regulatory floodplain is defined. There is a regulatory floodplain at the locations of some proposed structures. To satisfy FEMA requirements, these culverts and bridges would be designed to accommodate a 100-year flood (one with a 1% chance of occurring in a given year). The drainage design described in this EIS is based on a preliminary roadway design at a sufficient level of detail to conduct the floodplain analysis. During the final design process after the preferred WDC alternative is selected, more-detailed drainage studies would be conducted. All floodplain designs will meet FEMA's and FHWA's regulatory requirements for roadway design in a floodplain.

The WDC team determined the floodplain impacts of the WDC alternatives using a GIS approach. The team compared FEMA National Flood Hazard Layer (NFHL) data to the right-of-way of the alternatives to identify the locations of regulatory floodplain crossings, to determine whether the crossings are transverse or longitudinal, and to quantify the floodplain impact area (reported in acres).

The effective NFHL data were obtained for Davis County (FEMA 2016a) and Weber County (FEMA 2016b). Floodplain impact areas are reported by crossing type and FEMA-designated special flood hazard area zones.

What are transverse and longitudinal crossings?

Transverse crossings are crossings that are perpendicular or nearly perpendicular to the direction of stream flow. Longitudinal crossings are crossings that are parallel or nearly parallel to a stream or the edge of a lake.

As noted in the list above, some impacts occur in confluence areas. Both lake floodplain impacts and stream–lake confluence floodplain impacts are considered longitudinal impacts based on the lengths of roadway through these areas.

15.4.2 No-Action Alternative

With the No-Action Alternative, the WDC would not be constructed, so no floodplains would be affected by the WDC. However, floodplain impacts could occur as a result of other infrastructure and development projects in the floodplain impact analysis area. These projects would occur with both the No-Action and WDC action alternatives. Regulatory floodplains would continue to be managed by local floodplain administrators based on local ordinances and National Flood Insurance Program requirements.

15.4.3 Alternatives A1–A2

As described Chapter 2, Alternatives, Alternative A is the more westerly alternative and consists of two separate alternatives: Alternatives A1 and A2. These alternatives are defined in Table 15-3.

Table 15-3. Components of Alternatives A1–A2

Alternative	I-15 Connection	Four-Lane Highway	Two-Lane Highway	West Point/ Hooper Cities Segment	North Terminus
A1	Glovers Lane	I-15 to 2000 West	2000 West to 1800 North	4100 West	1800 West (West Point)
A2	Glovers Lane	I-15 to 2000 West	2000 West to 5500 South	5400 West	5500 South (Hooper)

Table 15-4 below summarizes the floodplain crossings associated with Alternatives A1 and A2. Crossings are designated as transverse or longitudinal. The floodplain impact areas by FEMA flood zone are shown in Table 15-5 below. Regulatory floodplains in the impact analysis area are shown in Figures 15-2 and 15-3, Floodplains, in Volume IV.

Table 15-4. Floodplain Crossings for Alternatives A1–A2

Stream/Water Body	FEMA Zone(s)[a]	Crossings by Alternative[b]	
		A1	A2
Streams			
Kays Creek	A	T	T
Holmes Creek	A	T	T
Farmington Creek	AE	T	T
Great Salt Lake and Confluence Areas			
Holmes Creek Overflow	A/AE	L	L
Baer Creek	A/AE	L	L
Haight Creek	A/AE	L	L
Farmington Bay between Baer Creek and Farmington Creek	A/AE	L	L
Farmington Bay near I-15	A/AE/AH	L	L

[a] FEMA zones: A = No base flood elevations determined. AE = Base flood elevations determined. AH = Shallow flooding with average depths of 1 to 3 feet; base flood elevations determined.

[b] L = longitudinal, T = transverse.

Table 15-5. Floodplain Impact Areas for Alternatives A1–A2

in acres

FEMA Zone[a]		Floodplain Impact Areas[b]	
		A1	A2
Transverse Crossings			
A		6.5	6.5
AE		0.2	0.2
AE floodway		0.0	0.0
	Subtotal	6.7	6.7
Longitudinal Crossings			
A		84.8	84.8
AE		94.8	94.8
AE floodway		0.0	0.0
AH		1.4	1.4
	Subtotal	181	181
Total		**187.7**	**187.7**

[a] FEMA zones: A = No base flood elevations determined. AE = Base flood elevations determined. (Note: The area within a Zone AE floodplain that is not within a floodway is referred to as the floodway fringe. See Figure 15-1, FEMA Floodplain Schematic, in Volume IV.) AE floodway = Base flood elevations and floodway determined. AH = Shallow flooding with average depths of 1 to 3 feet; base flood elevations determined.

[b] Includes the area within the right-of-way, since the roadway footprint uses this entire area.

15.4.3.1 Alternative A1 – Glovers Lane and 4100 West/1800 North

As shown in Table 15-4 above, Alternative A1 would result in transverse crossings of the Farmington Creek, Kays Creek, and Holmes Creek floodplains and multiple longitudinal crossings of floodplains associated with the Great Salt Lake and its stream confluence areas in Davis County. As shown in Table 15-5 above, Alternative A1 would result in a total floodplain impact area of 187.7 acres, affecting Zone A, AE, and AH floodplains. The impacts are predominantly longitudinal; longitudinal floodplain crossings account for 181 acres of the total impact area. Without measures to reduce or mitigate floodplain impacts, an alternative could reduce the natural and beneficial floodplain values including flood conveyance, storage, and control; groundwater recharge; water quality function; and wildlife habitat and diversity.

Adherence to appropriate design standards and criteria would reduce water surface impacts to adjoining properties and risks to the highway infrastructure and the traveling public. Roadway elevations would be above adjacent floodplain elevations, where those elevations are defined, so that flooding would not interfere with the functional use of a transportation facility needed for emergency vehicles or evacuation. Culverts and bridges in regulatory floodplains would be designed to accommodate a 100-year flood in accordance with FEMA and local floodplain ordinance criteria. Culverts and bridges in other areas would be designed to accommodate a 50-year flood per UDOT's requirements for the facility. These design standards together with the proper placement of structures would reduce the risk that the WDC would exacerbate flooding of adjoining properties.

Culverts and bridges would provide floodplain connectivity and would reduce impacts to natural and beneficial floodplain values, specifically flood conveyance (for flood waters moving toward the lake) and flood storage (for flood waters extending to the northeast in Farmington Bay as the Great Salt Lake level rises). The hydraulic connections would also reduce impacts to groundwater recharge, since surface water from the northeast would be able to flow to the southwest to existing recharge areas.

Floodplain values, water quality, and ecosystems are interrelated; the reader is referred to the following chapters for additional discussion: Chapter 13, Water Quality; Chapter 14, Ecosystem Resources; and Chapter 24, Cumulative Impacts. With the mitigation measures presented in Section 15.4.6, Mitigation Measures, Alternative A1 would not result in a significant adverse impact to natural and beneficial floodplain values.

In the southern part of the impact analysis area in Farmington and parts of Kaysville, the Great Salt Lake floodplain extends eastward toward I-15 and crosses all of the WDC action alternatives. Therefore, completely avoiding longitudinal encroachments from the WDC alternatives, including Alternative A1, is not practicable. The alignment avoids the Zone VE floodplain, which is the portion of the floodplain with the most dynamic conditions for wave action, wave deflection, and erosion potential. The portion of the Great Salt Lake floodplain that would be affected by Alternative A1 is the portion of the floodplain that is outside the influence of significant wave action. Impacts to this flood zone would be displacement of volume of storage in the Great Salt Lake. The potential displacement would be insignificant in relation to the large volume of water associated with the Great Salt Lake.

In summary, Alternative A1 would result in neither a significant potential for interfering with a transportation facility needed for emergency vehicles or evacuation nor a significant risk of upstream flooding. Furthermore, the impacts to natural and beneficial floodplain values would not be significant because floodplain connectivity would be maintained to reduce these impacts. Maintaining floodplain connectivity would allow both passage of flood waters conveyed by tributary streams to the Great Salt Lake and conveyance from the lake to the adjacent floodplain during periods of high water. This connectivity would allow floodplain inundation, establishment of vegetation and habitat, and groundwater recharge to occur similar to current conditions around the roadway facility, thereby maintaining the natural and beneficial floodplain values.

In total, the Glovers Lane Option would affect about 0.007% of the Great Salt Lake's 2.3-million-acre floodplain and would not likely unlikely that the floodplain storage capacity or elevation of the Great Salt Lake. Because of the slow rise and fall of Great Salt Lake levels and the equalization culverts included in the project design, equivalent flooding conditions would occur on both sides of the roadway. Finally, avoidance of longitudinal encroachments is not practicable. Overall, no significant encroachment to the floodplain is expected to occur.

15.4.3.2 Alternative A2 – Glovers Lane and 5400 West/5500 South

As shown above in Table 15-4, Floodplain Crossings for Alternatives A1–A2, Alternative A2 would result in transverse crossings of the Farmington Creek, Kays Creek, and Holmes Creek floodplains and multiple longitudinal crossings of floodplains associated with the Great Salt Lake and its stream confluence areas in Davis County. Alternative A2 would not cross regulatory floodplains in Weber County. The floodplain impacts from Alternative A2 would be the same as those from Alternative A1.

15.4.4 Alternatives B1–B2

As described Chapter 2, Alternatives, Alternative B is the more easterly alternative and consists of two separate alternatives: Alternatives B1 and B2. These alternatives are defined in Table 15-6.

Table 15-6. Components of Alternatives B1–B2

Alternative	I-15 Connection	Four-Lane Highway	Two-Lane Highway	West Point City Segment	North Terminus
B1	Glovers Lane	I-15 to Antelope Drive[a]	Antelope Drive to 1800 North	4100 West	1800 North (West Point)
B2	Glovers Lane	I-15 to Antelope Drive[a]	Antelope Drive to 1800 North	4800 West	1800 North (West Point)

[a] The transition from a four-lane highway to a two-lane highway would occur between Antelope Drive and 700 South.

Table 15-7 below summarizes the floodplain crossings associated with Alternatives B1 and B2. Crossings are designated as transverse or longitudinal. The floodplain impact areas by FEMA flood zone are shown in Table 15-8 below. Regulatory floodplains in the impact analysis area are shown in Figures 15-2 and 15-3, Floodplains, in Volume IV.

Table 15-7. Floodplain Crossings for Alternatives B1–B2

Stream/Water Body	FEMA Zone(s)[a]	Crossings by Alternative[b]	
		B1	B2
Streams			
Kays Creek	A	T	T
Holmes Creek	A	T	T
Farmington Creek	AE	T	T
Great Salt Lake and Confluence Areas			
Holmes Creek Overflow	A/AE	L	L
Baer Creek	A/AE	L	L
Haight Creek	A/AE	L	L
Farmington Bay between Baer Creek and Farmington Creek	A/AE	L	L
Farmington Creek	A/AE	L	L
Farmington Bay near I-15	A/AE/AH	L	L

[a] FEMA zones: A = No base flood elevations determined. AE = Base flood elevations determined. AH = Shallow flooding with average depths of 1 to 3 feet; base flood elevations determined.

[b] L = longitudinal, T = transverse.

Table 15-8. Floodplain Impact Areas for Alternatives B1–B2

in acres

FEMA Zone[a]		Floodplain Impact Areas[b]	
		B1	B2
Transverse Crossings			
A		6.5	6.5
AE		0.2	0.2
AE floodway		0.0	0.0
	Subtotal	6.7	6.7
Longitudinal Crossings			
A		84.8	84.8
AE		94.8	94.8
AE floodway		0.0	0.0
AH		1.4	1.4
	Subtotal	181	181
Total		**187.7**	**187.7**

[a] FEMA zones: A = No base flood elevations determined. AE = Base flood elevations determined. (Note: The area within a Zone AE floodplain that is not within a floodway is referred to as the floodway fringe. See Figure 15-1, FEMA Floodplain Schematic, in Volume IV.) AE floodway = Base flood elevations and floodway determined. AH = Shallow flooding with average depths of 1 to 3 feet; base flood elevations determined.

[b] Includes the area within the right-of-way, since the roadway footprint uses this entire area.

15.4.4.1 Alternative B1 – Glovers Lane and 4100 West/1800 North

As shown above in Table 15-7, Alternative B1 would result in transverse crossings of the Farmington Creek, Kays Creek, and Holmes Creek floodplains and multiple longitudinal crossings of floodplains associated with the Great Salt Lake and its stream confluence areas in Davis County.

As shown above in Table 15-8, Alternative B1 would result in a total floodplain impact area of 187.7 acres, affecting Zone A, AE, and AH floodplains. The floodplain impacts from Alternative B1 would be the same as those from Alternative A1.

15.4.4.2 Alternative B2 – Glovers Lane and 4800 West/1800 North

As shown above in Table 15-7, Alternative B2 would result in transverse crossings of the Farmington Creek, Kays Creek, and Holmes Creek floodplains and multiple longitudinal crossings of floodplains associated with the Great Salt Lake and its stream confluence areas in Davis County. The floodplain impacts from Alternative B2 would be the same as those from Alternative A1.

15.4.5 Wetland Avoidance Options

Two wetland avoidance options are being evaluated in this Final EIS, as shown in Table 15-9. The purpose of these options is to avoid wetland impacts per guidance from the U.S. Army Corps of Engineers on wetland avoidance. Either wetland avoidance option could be implemented with any of the A or B Alternatives.

In this section, the impact information for the wetland avoidance options provides only the differences in impacts for the A and B Alternatives as a result of using the wetland avoidance options. The differences in impacts would apply to any of the A and B Alternatives if they were to use the wetland avoidance options.

Table 15-9. Components of the Wetland Avoidance Options

Option	Location	City	Description
Farmington	Prairie View Drive and West Ranches Road	Farmington	Shift the A and B Alternatives in Farmington about 150 feet east to the southwest side of the intersection of Prairie View Drive and West Ranches Road.
Layton	2200 West and 1000 South	Layton	Shift the A and B Alternatives in Layton about 500 feet east to the northeast side of the intersection of 2200 West and 1000 South.

The wetland avoidance options would reduce the Zone AE floodplain impact by about 4 acres for Alternatives A1, A2, B1, and B2, resulting in a total floodplain impact of 183.7 acres. Overall, the impacts to floodplains from the wetland avoidance options would be the same as from Alternatives A1, A2, B1, and B2.

15.4.6 Mitigation Measures

Measures will be taken to reduce floodplain impacts and to ensure that constructing the WDC complies with all applicable regulations. These mitigation measures include the following:

- The proposed alternatives would require a number of stream and floodplain crossings. When bridges and culverts are designed, the design will follow the UDOT Manual of Instruction – Roadway Drainage and WDC Project and FEMA requirements, where applicable. Where no regulatory floodplain is defined, culverts and bridges will be designed to accommodate a 50-year (2% annual chance) or greater magnitude flood event. Where regulatory floodplains are defined, hydraulic structures will be designed to accommodate a 100-year (1% annual chance) flood.
- Stream alteration permits will be obtained for stream crossings as required by the Utah Division of Water Rights. Note that the stream alteration permitting process is a separate process from the floodplain permitting process. The stream alteration process is required to satisfy state regulations and may also be used to meet Clean Water Act Section 404 permitting requirements.
- Floodplain development permits will be obtained for all locations where the proposed roadway would encroach on a regulatory floodplain, and structures will be designed to meet the more stringent of FEMA requirements and local floodplain ordinances. FEMA requires that construction within a floodway must not increase the base (100-year) flood elevation. FEMA Conditional Letter of Map Revision (CLOMR) and Letter of Map Revision processes will be executed in compliance with 44 CFR 60.3 and 65.12 as necessary based on hydrologic and hydraulic analyses and the nature of anticipated changes in base flood elevation and/or floodplain limits. The following cases apply:
    - For areas of Zone A floodplain impacts, the approach will be to analyze existing and proposed conditions and design project features such that compliance is achieved (that is, such that a CLOMR is not required) as much as possible. In these areas, FEMA performed floodplain mapping based on approximate methods. The absence of a detailed study or floodway delineation places the burden on the project proponent (in this case, UDOT) to perform hydrologic and hydraulic analyses consistent with FEMA standards. These analyses will confirm or refine the FEMA floodplain mapping and could increase or decrease the estimate of affected areas. Near the Great Salt Lake, FEMA's floodplain mapping in confluence areas reflects divergent and/or uncertain flow paths. In these confluence areas, streams entering the Great Salt Lake will require evaluation based on an independent extreme event on that water course with average lake levels in the Great Salt Lake rather than concurrent flooding events. In accordance with FEMA standards, both the lake floodplain and the independent stream floodplain will be evaluated.
    - For areas of Zone AE floodplain impacts, the approach will be to analyze proposed conditions relative to effective floodplain mapping (with base flood elevations defined) and design project features such that compliance is achieved (that is, such that a CLOMR is not required) as much as possible.

- Roadway elevations will be a minimum of 2 feet above adjacent floodplain elevations, where those elevations are defined, so that flooding will not interfere with a transportation facility needed for emergency vehicles or evacuation.
- In areas of longitudinal crossings near the Great Salt Lake, surface water conveyance structures will be installed to allow flood waters to flow freely between the northeast and southwest sides of the WDC. Maintenance of wetland hydrology will also be considered in the design of conveyance structures. Furthermore, erosion-control measures will be implemented at these structure locations. These actions will reduce impacts to natural and beneficial floodplain values.
- In areas of longitudinal crossings near the Great Salt Lake, potential wave action against the roadway embankment will be evaluated and, as necessary, mitigated with countermeasures such as rock riprap to reduce erosion potential and impacts to natural and beneficial floodplain values.

15.4.7 Cumulative Impacts

As part of the WDC EIS process, scoping meetings were held with the public and resource agencies to help identify issues to be analyzed in this EIS. The comments received during the public and agency scoping period were reviewed to determine whether any significant issues were identified. The agencies identified the impact to floodplains as a concern. Chapter 24, Cumulative Impacts, provides a detailed analysis of the potential cumulative impacts to floodplains. This section provides a summary of that analysis.

What are cumulative impacts?

Cumulative impacts are the resulting impacts from the proposed action combined with impacts from other past, present, and reasonably foreseeable future actions.

The WDC alternatives would traverse the eastern edge of the Great Salt Lake floodplain. Alternatives A1, A2, B1, and B2 would affect up to 187.7 acres of floodplain. Adherence to appropriate design standards and criteria would reduce floodplain impacts. For those segments of the WDC in the Great Salt Lake floodplain, the highway would be designed to allow floodwaters to pass through to minimize the impacts to the floodplain and not cause a rise in floodplain elevations. To satisfy FEMA and local floodplain requirements, culverts and bridges in regulatory floodplains would be designed to accommodate a 100-year flood.

What is scoping?

Scoping is an early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action.

In addition, floodplain-development permits will be obtained for all locations where the proposed roadway would encroach on a regulatory floodplain, and structures will be designed to meet the more stringent of FEMA requirements and local floodplain ordinances. FEMA requires that construction within a floodway must not increase the base (100-year) flood elevation.

Bridges and culverts would provide floodplain connectivity and would reduce impacts to natural and beneficial floodplain values, specifically flood conveyance (for flood waters moving toward the lake) and flood storage (for flood waters extending to the northeast in Farmington Bay as the Great Salt Lake level rises). The hydraulic connections provided by bridges and culverts would also reduce impacts to groundwater recharge, since surface water from the northeast would be able to flow to the southwest to existing recharge areas. With current ordinances and regulations in place, no future urban developments are expected to occur within the floodplain.

The up to 187.7 acres of floodplain impacts within the context of the large Great Salt Lake floodplain would result in negligible cumulative impacts. In addition, with the mitigation measures specified in Section 15.4.6, Mitigation Measures, the WDC alternatives would not result in a significant adverse impact to natural and beneficial floodplain values and therefore would not contribute to a cumulative floodplain impact.

15.4.8 Summary of Impacts

Table 15-10 summarizes the floodplain impact areas from each WDC action alternative. The floodplain impacts would occur in the southern part of the WDC alternatives, mostly in Farmington and Kaysville.

Although each alternative would have floodplain impacts, various mitigation measures would reduce these impacts. With the mitigation measures presented in 15.4.6, Mitigation Measures, the alternatives would not result in a significant adverse impact to natural and beneficial values. In addition, no significant encroachment to the floodplain is expected to occur.

In the southern part of the impact analysis area in Farmington and parts of Kaysville, the Great Salt Lake floodplain extends eastward toward I-15 and crosses all of the WDC action alternatives. Therefore, completely avoiding longitudinal encroachments from the WDC alternatives west of I-15 is not practicable.

Table 15-10. Summary of Floodplain Impact Areas

in acres

	Floodplain Impact Areas[b]	
FEMA Zone[a]	**Alternatives A1, A2, B1 and B2**	**Alternatives A1, A2, B1, and B2 with Wetland Avoidance Options**
Transverse Crossings		
A	6.5	6.5
AE	0.2	0.2
AE floodway	0.0	0.0
Subtotal	6.7	6.7
Longitudinal Crossings		
A	84.8	84.8
AE	94.8	90.8
AE floodway	0	0
AH	1.4	1.4
Subtotal	181	177
Total	**187.7**	**183.7**

[a] FEMA zones: A = No base flood elevations determined. AE = Base flood elevations determined. (Note: The area within a Zone AE floodplain that is not within a floodway is referred to as the floodway fringe. See Figure 15-1, FEMA Floodplain Schematic, in Volume IV.) AE floodway = Base flood elevations and floodway determined.

[b] Includes the area within the right-of-way, since the roadway footprint uses this entire area.

15.5 References

Executive Order 11988, Floodplain Management (May 24, 1977), 23 CFR 650.113.

Executive Order 13690, Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input (January 30, 2015), 80 CFR 6425.

[FEMA] Federal Emergency Management Agency

2007 Flood Insurance Study, Davis County, Utah, and Incorporated Areas. June 18.

2010 Definitions of FEMA Flood Zone Designations. www.msc.fema.gov/webapp/wcs/stores/servlet/info?storeId=10001&catalogId=10001&langId=-1&content=floodZones&title=FEMA%20Flood%20Zone%20Designations. Accessed October 22, 2010.

2012 Flood Insurance Study, Flood County, USA and Incorporated Areas. (Sample Flood Insurance Study) www.fema.gov/library/viewRecord.do?id=2361. Accessed April 27, 2012.

2015a The Applicability of Executive Order 11988/13690 to FEMA Programs. https://www.fema.gov/media-library-data/1433261696599-041232427db8c587d74fd1b5ac65c7fe/FFRMS_FEMA_Public_6-2-2015.pdf. June.

2015b Flood Insurance Study, Weber County, Utah, and Incorporated Areas. June 2.

2016a National Flood Hazard Layer for Davis County (All Jurisdictions). Obtained via FEMA Map Service Center. https://msc.fema.gov/portal. August 5.

2016b National Flood Hazard Layer for Weber County (All Jurisdictions). Obtained via FEMA Map Service Center. https://msc.fema.gov/portal. December 27.

2017 Community Status Book. www.fema.gov/cis/UT.pdf. Accessed May 1, 2017. [FEMA's Community Status Book is updated daily.]

[UGS] Utah Geological Survey

2010 Public Information Series #39: Commonly Asked Questions about Utah's Great Salt Lake and Ancient Lake Bonneville. geology.utah.gov/utahgeo/gsl/index.htm#gsl. Accessed October 30, 2010.

[USACE] U.S. Army Corps of Engineers

2015 Regulatory Division Memorandum 2015-02. Methodology for Identifying the Ordinary High Water Mark for the Great Salt Lake. September 28.

[USGS] U.S. Geological Survey

1990 Roy, Utah, 7.5-minute topographic quadrangle, scale 1:24,000.

1991 Ogden Bay, Utah, 7.5-minute topographic quadrangle, scale 1:24,000.

1998a Farmington, Utah, 7.5-minute topographic quadrangle, scale 1:24,000.

1998b Kaysville, Utah, 7.5-minute topographic quadrangle, scale 1:24,000.

1999 Clearfield, Utah, 7.5-minute topographic quadrangle, scale 1:24,000.