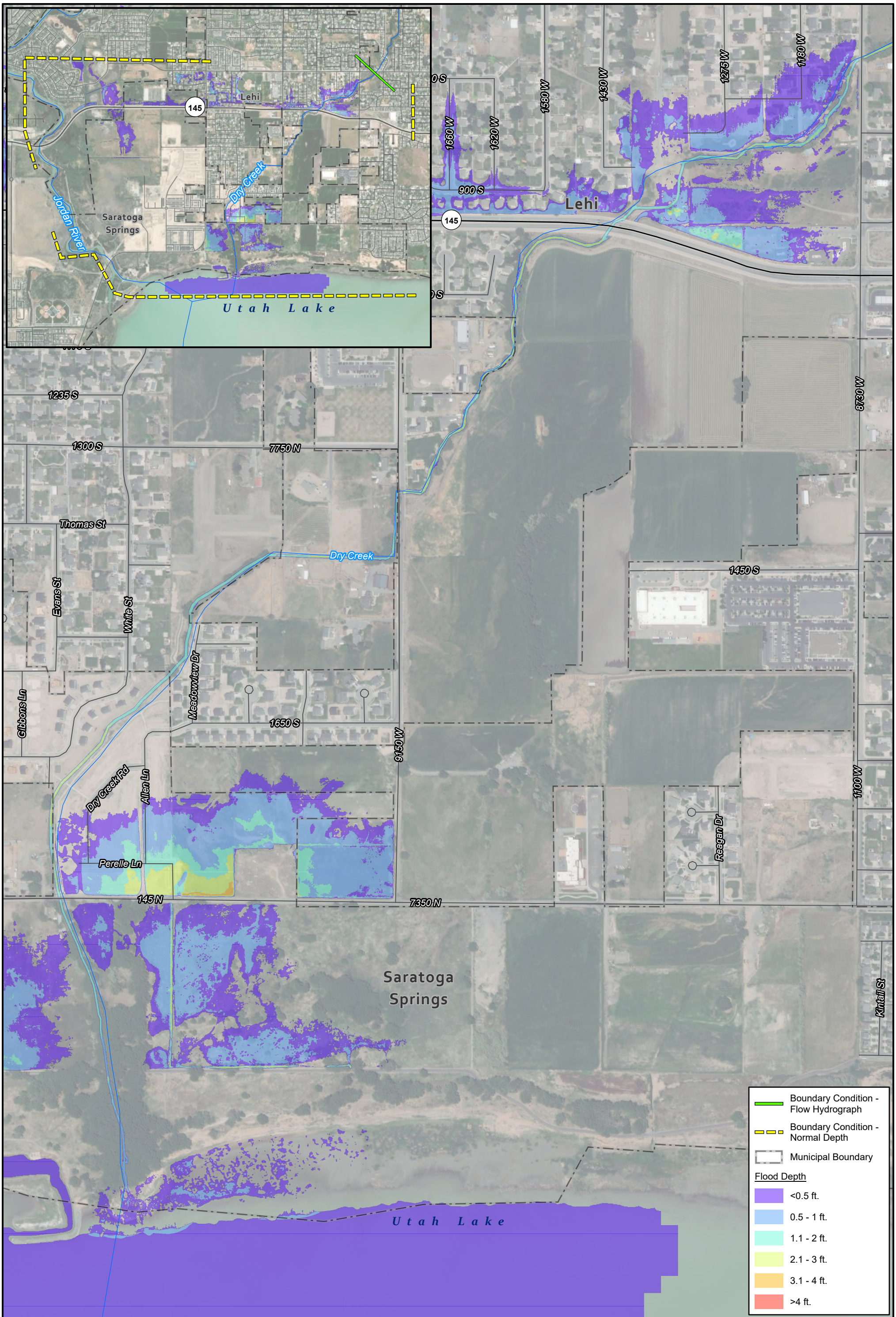
A.3. Lehi City Inundation Maps – Lower Dry Creek



N

Feet

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FRANSON CIVIL ENGINEERS

Jones & DeMille Engineering

Lehi City

Watershed Plan EA - Dry Creek Downstream
Existing Conditions - 10-year 24-hour Flood Event

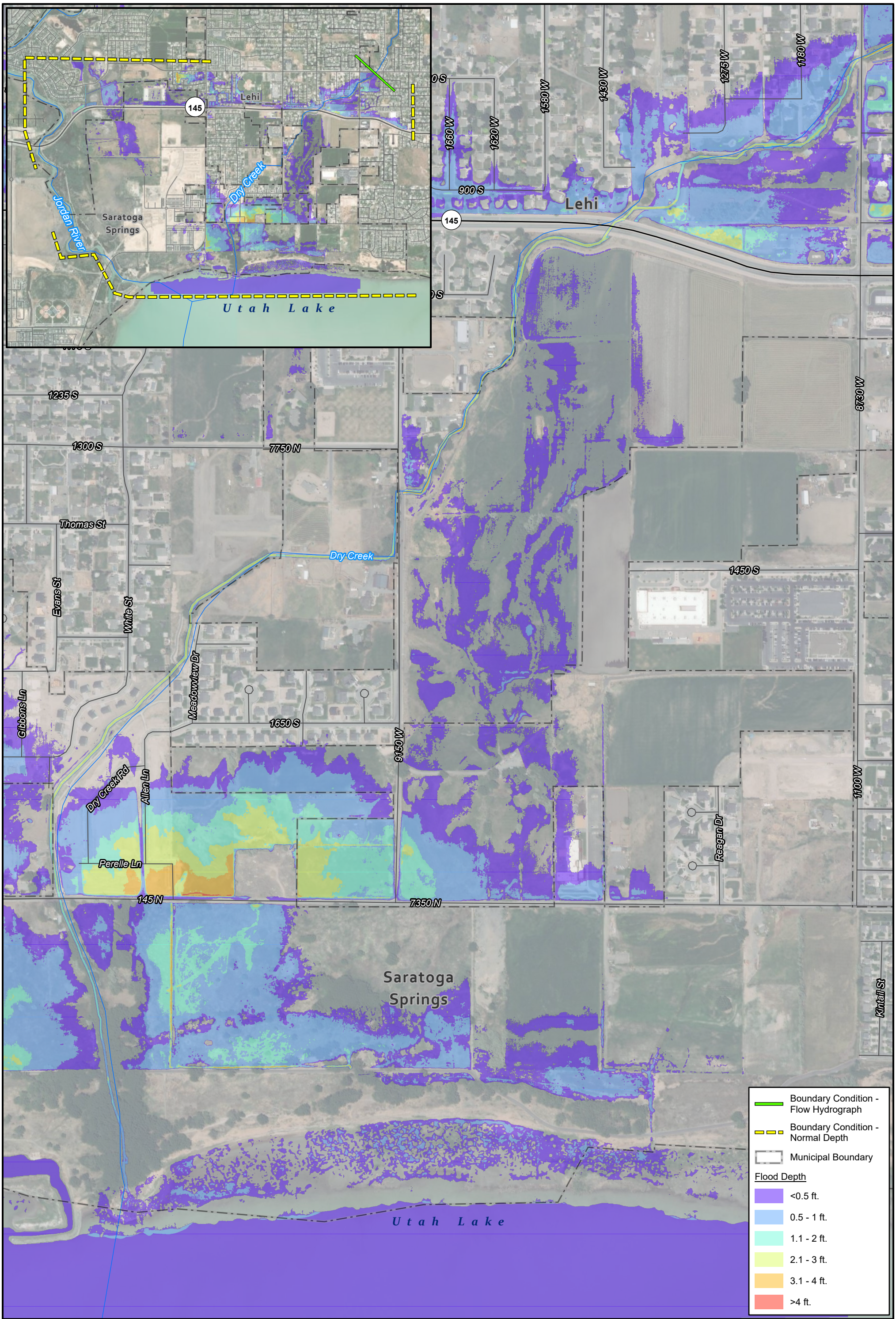
Map Name: H:\JD\Proj\2004-028\Design\GIS\Projects\Water\2004-028_Water.aprx - Exh Lehi Dry Creek Downstream Existing and Proposed Series

Project Number: 2004-028 | Drawn by: JWW 02-22 | Last Edit: 06/16/2022

Utah County

Scale: 1" = 500'

1



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FRANSON CIVIL ENGINEERS

Jones & DeMille Engineering

Lehi City

Watershed Plan EA - Dry Creek Downstream
Existing Conditions - 25-year 24-hour Flood Event

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Project Number: 2004-028 | Drawn by: JWW 02-22 | Last Edit: 06/16/2022

Utah County

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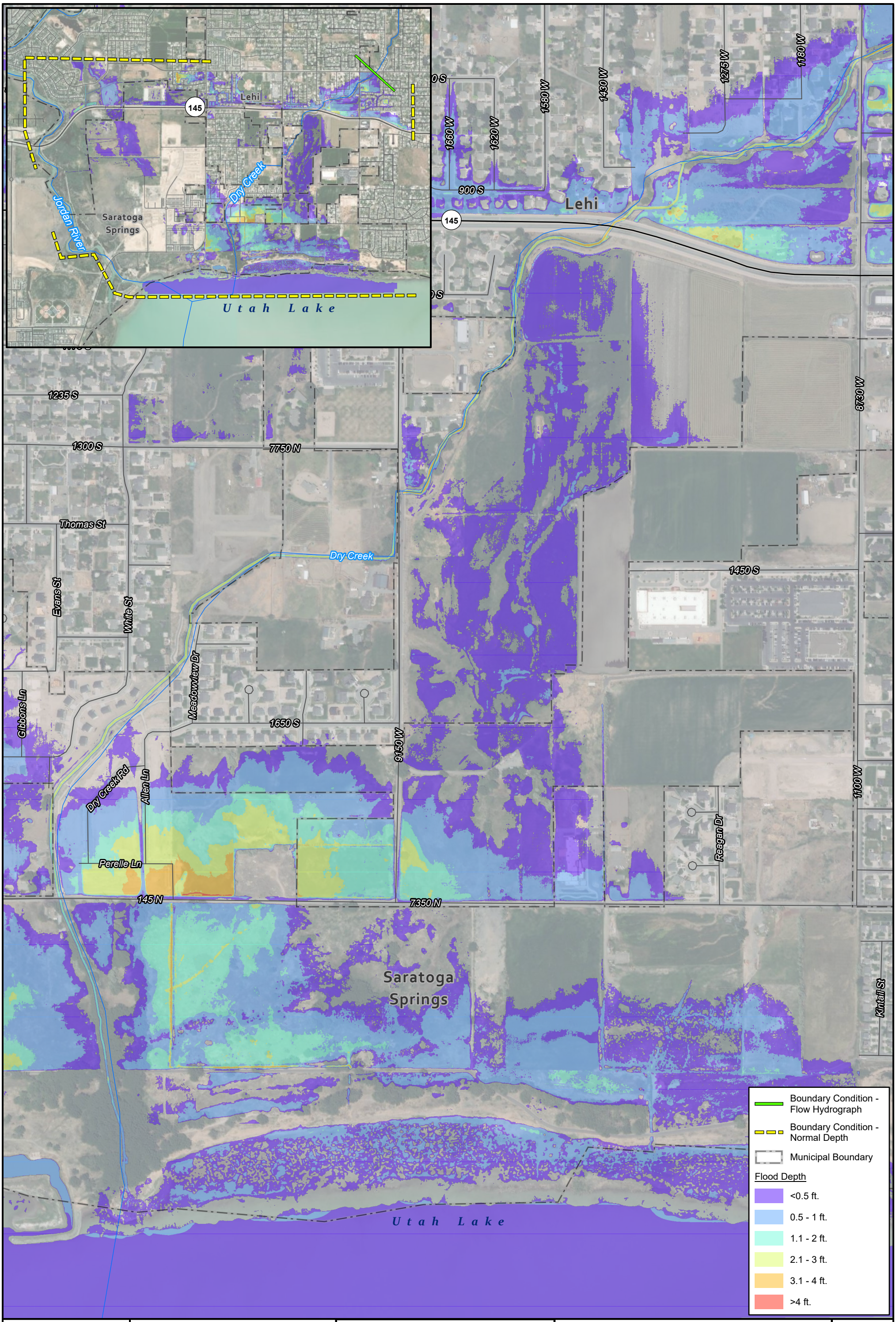
Lehi
145
Dry Creek
Jordan River
Saratoga Springs
Utah Lake
0 S
1660 W
1620 W
1550 W
1430 W
1275 W
1180 W
900 S
Lehi
145
1235 S
1300 S
7750 N
8730 W
Thomas St
Dry Creek
1450 S
Evans St
White St
Meadowview Dr
Gibbons Ln
1650 S
9150 W
11100 W
Dry Creek Rd
Allen Ln
Reagan Dr
Perelle Ln
145 N
7350 N
Saratoga Springs
Kintail St
Utah Lake
Boundary Condition - Flow Hydrograph
Boundary Condition - Normal Depth
Municipal Boundary
Flood Depth
<0.5 ft.
0.5 - 1 ft.
1.1 - 2 ft.
2.1 - 3 ft.
3.1 - 4 ft.
>4 ft.
N
Feet
0
250
500
FRANSON CIVIL ENGINEERS
Jones & DeMille Engineering
Lehi City
Utah County
Watershed Plan EA - Dry Creek Downstream
Existing Conditions - 50-year 24-hour Flood Event
Scale: 1" = 500'
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Project Number: 2004-028
Drawn by: JWW 02-22
Last Edit: 06/16/2022
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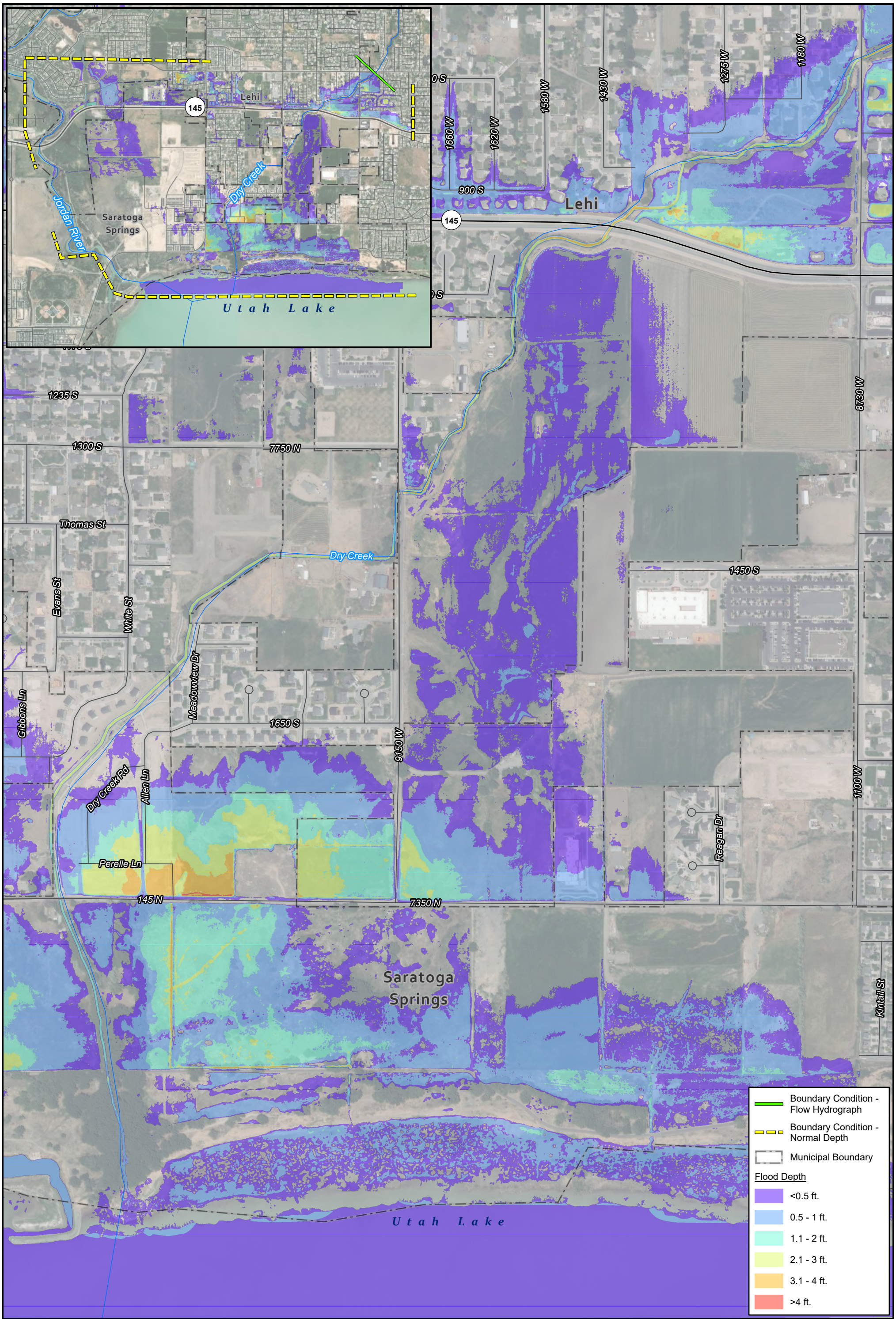

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Feet

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Lehi City

Utah County

Watershed Plan EA - Dry Creek Downstream
Existing Conditions - 100-year 24-hour Flood Event

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Project Number: 2004-028 | Drawn by: JWW 02-22 | Last Edit: 06/16/2022

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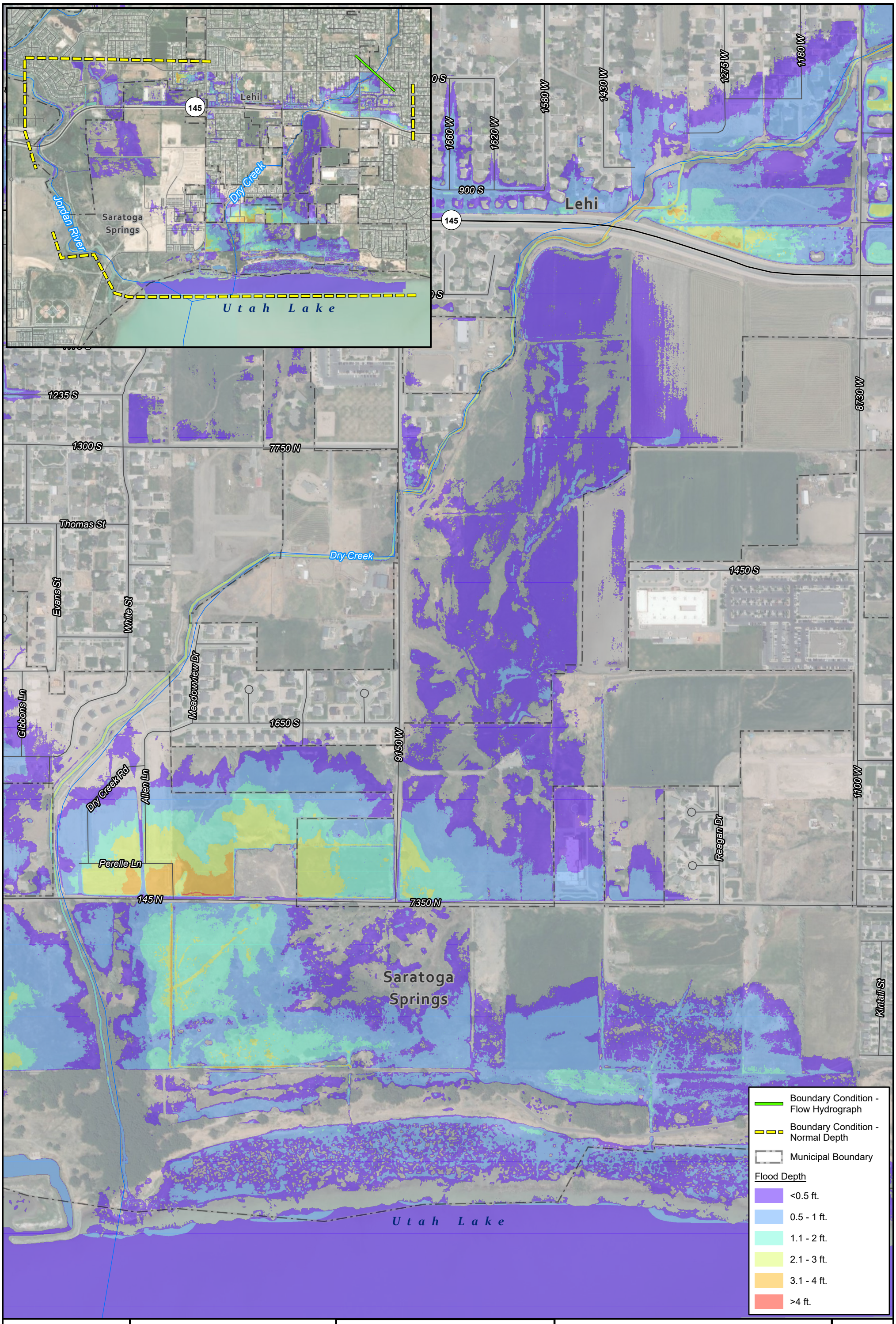
Lehi
145
Dry Creek
Jordan River
Saratoga Springs
Utah Lake
0 S
1660 W
1620 W
1550 W
1430 W
1275 W
1180 W
900 S
Lehi
145
1235 S
1300 S
7750 N
8730 W
Thomas St
Dry Creek
1450 S
Evans St
White St
Meadowview Dr
Gibbons Ln
1650 S
9150 W
Dry Creek Rd
Allen Ln
Perelle Ln
Reagan Dr
11100 W
145 N
7350 N
Saratoga Springs
Kinball St
Utah Lake
Boundary Condition - Flow Hydrograph
Boundary Condition - Normal Depth
Municipal Boundary
Flood Depth
<0.5 ft.
0.5 - 1 ft.
1.1 - 2 ft.
2.1 - 3 ft.
3.1 - 4 ft.
>4 ft.
N
Feet
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250
500
FRANSON CIVIL ENGINEERS
Jones & DeMille Engineering
Lehi City
Utah County
Watershed Plan EA - Dry Creek Downstream
Existing Conditions - 200-year 24-hour Flood Event
Scale: 1" = 500'
Map Name: H:\JD\Proj\2004-028\Design\GIS\Projects\Water\2004-028_Water.aprx - Exh Lehi Dry Creek Downstream Existing and Proposed Series
Project Number: 2004-028
Drawn by: JWW 02-22
Last Edit: 06/16/2022
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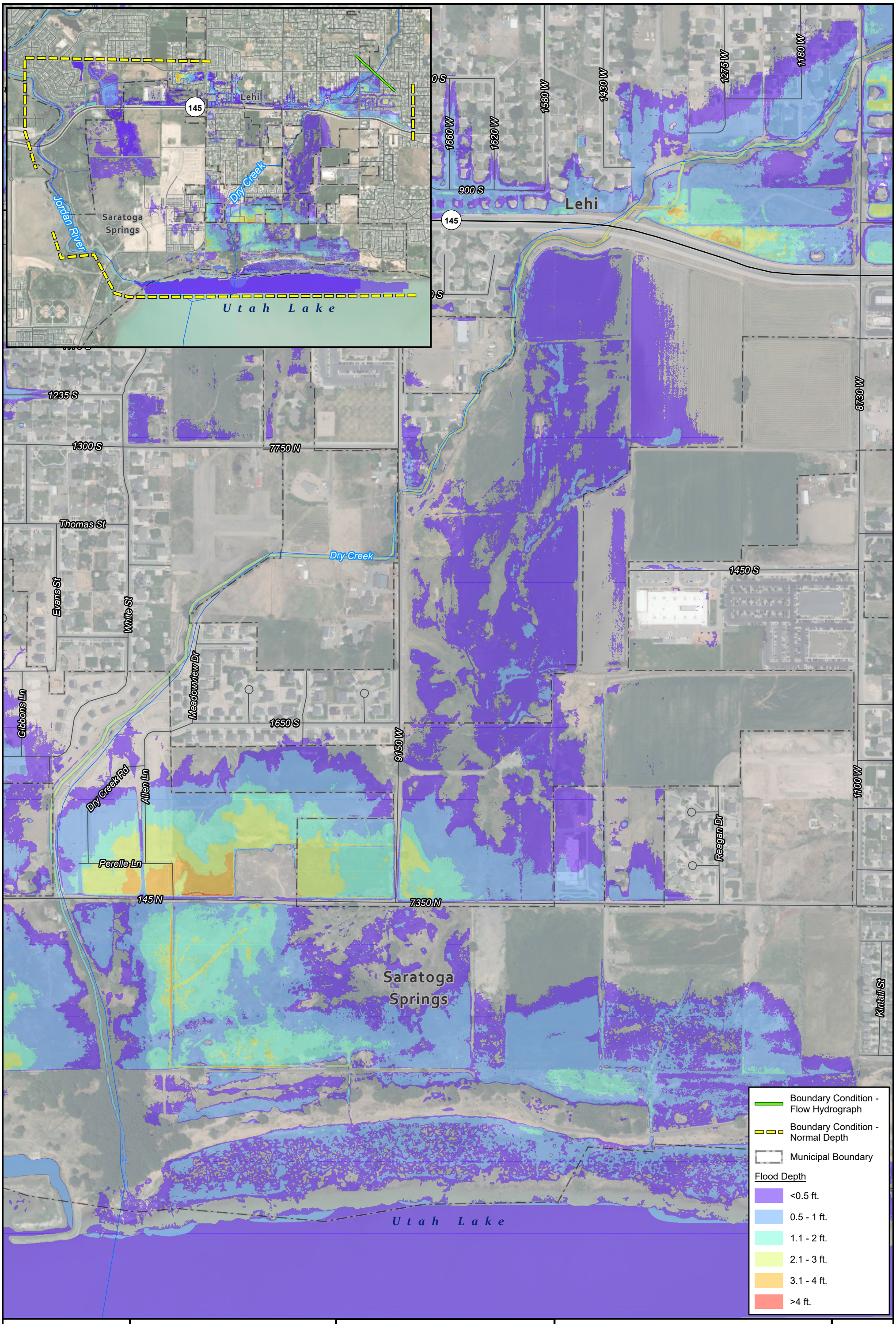

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FRANSON CIVIL ENGINEERS

Jones & DeMille Engineering

Lehi City

Utah County

Watershed Plan EA - Dry Creek Downstream
Existing Conditions - 500-year 24-hour Flood Event

Scale: 1" = 500'

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Project Number: 2004-028 | Drawn by: JWW 02-22 | Last Edit: 06/16/2022

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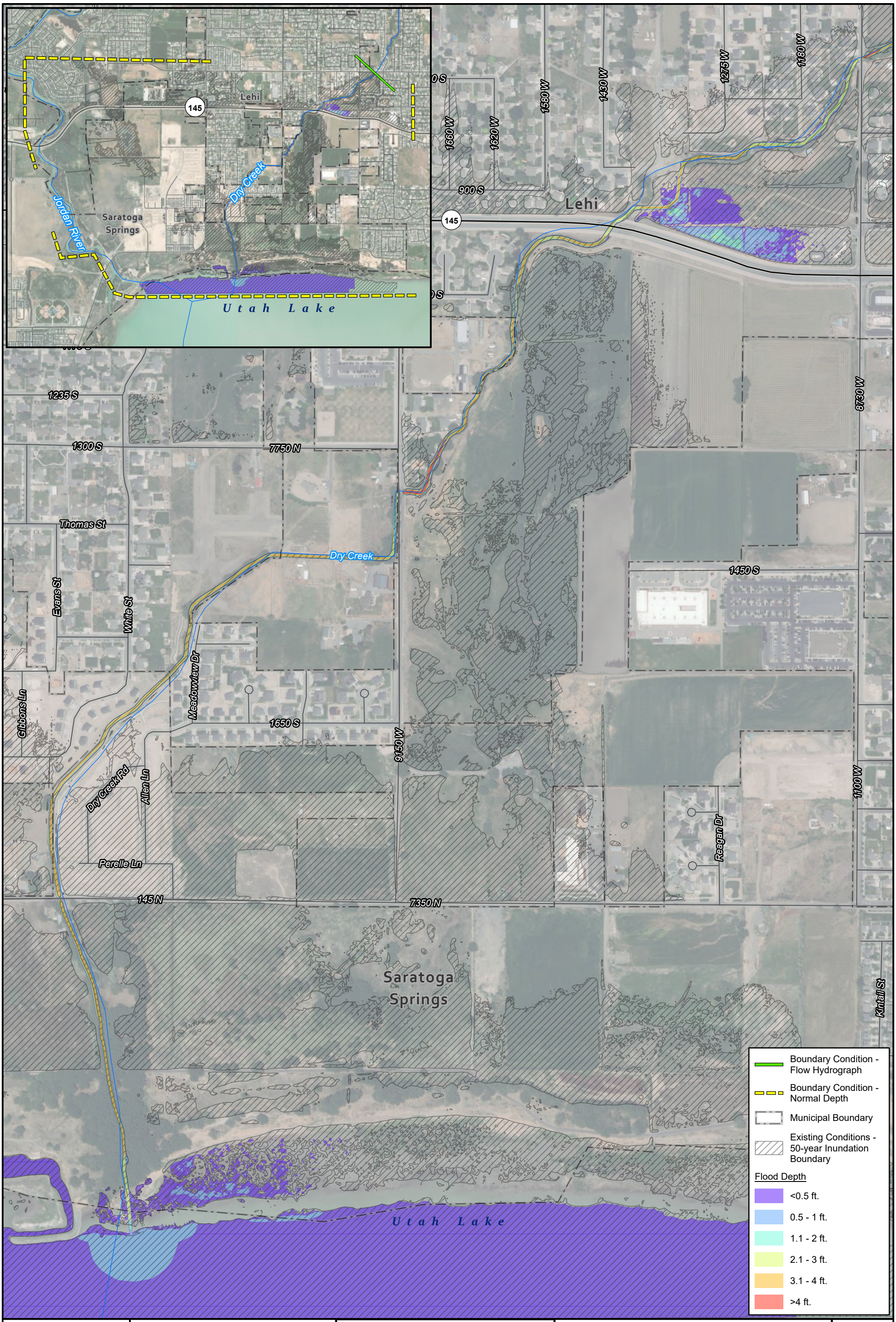

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Feet

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FRANSON CIVIL ENGINEERS

Jones & DeMille Engineering

Lehi City

Utah County

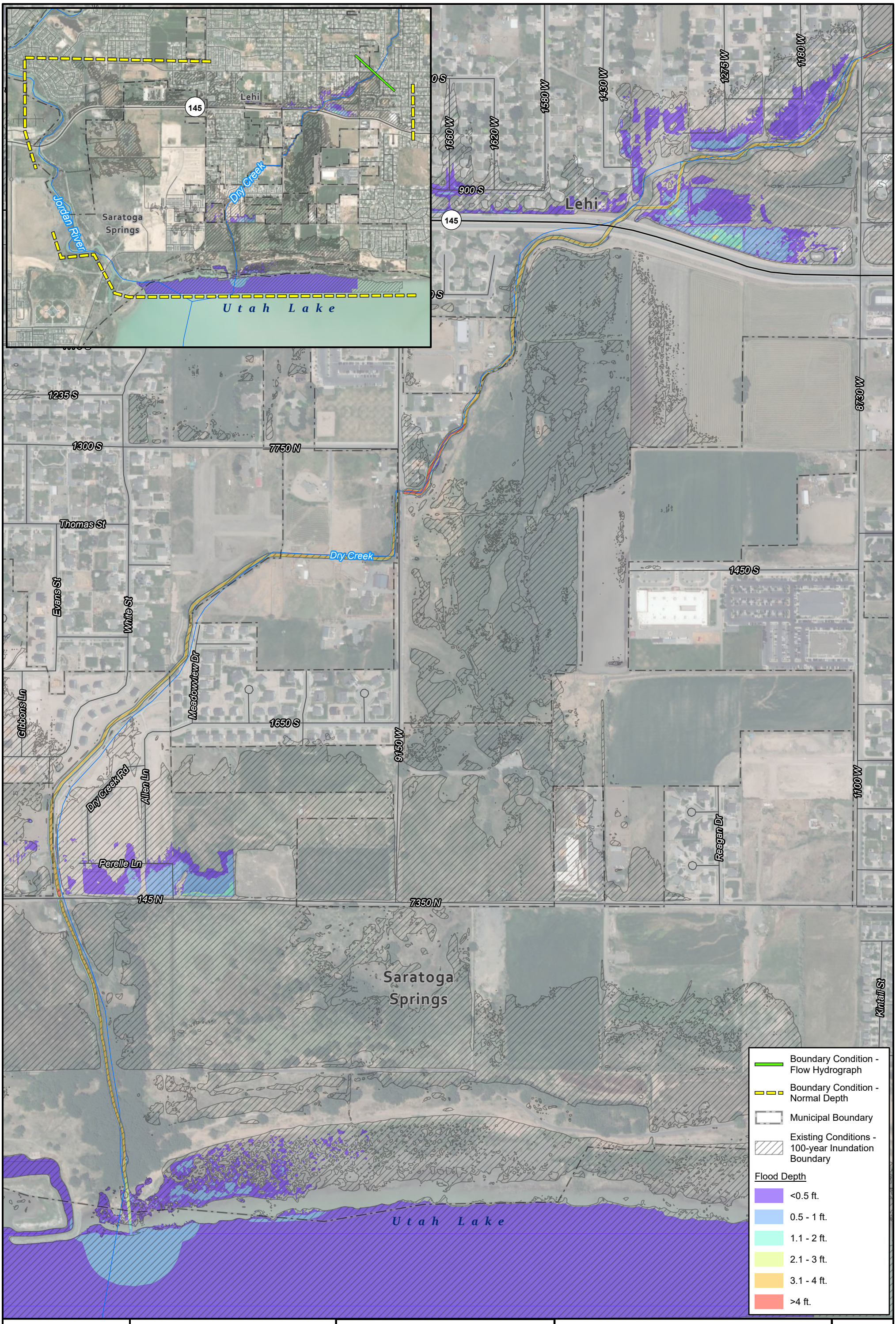
Watershed Plan EA - Dry Creek Downstream
Proposed Conditions - 50-year 24-hour Flood Event

Scale: 1" = 500'

Map Name: H:\JD\Proj\2004-028\Design\GIS\Projects\Water\2004-028_Water.aprx - Exh Lehi Dry Creek Downstream Existing and Proposed Series

Project Number: 2004-028 | Drawn by: JWW 02-22 | Last Edit: 06/16/2022

7



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Feet

0 250 500

FRANSON CIVIL ENGINEERS

Jones & DeMille Engineering

Lehi City

Utah County

Watershed Plan EA - Dry Creek Downstream
Proposed Conditions - 100-year 24-hour Flood Event

Scale: 1" = 500'

Map Name: H:\JD\Proj\2004-028\Design\GIS\Projects\Water\2004-028_Water.aprx - Exh Lehi Dry Creek Downstream Existing and Proposed Series

Project Number: 2004-028 | Drawn by: JWW 02-22 | Last Edit: 06/16/2022

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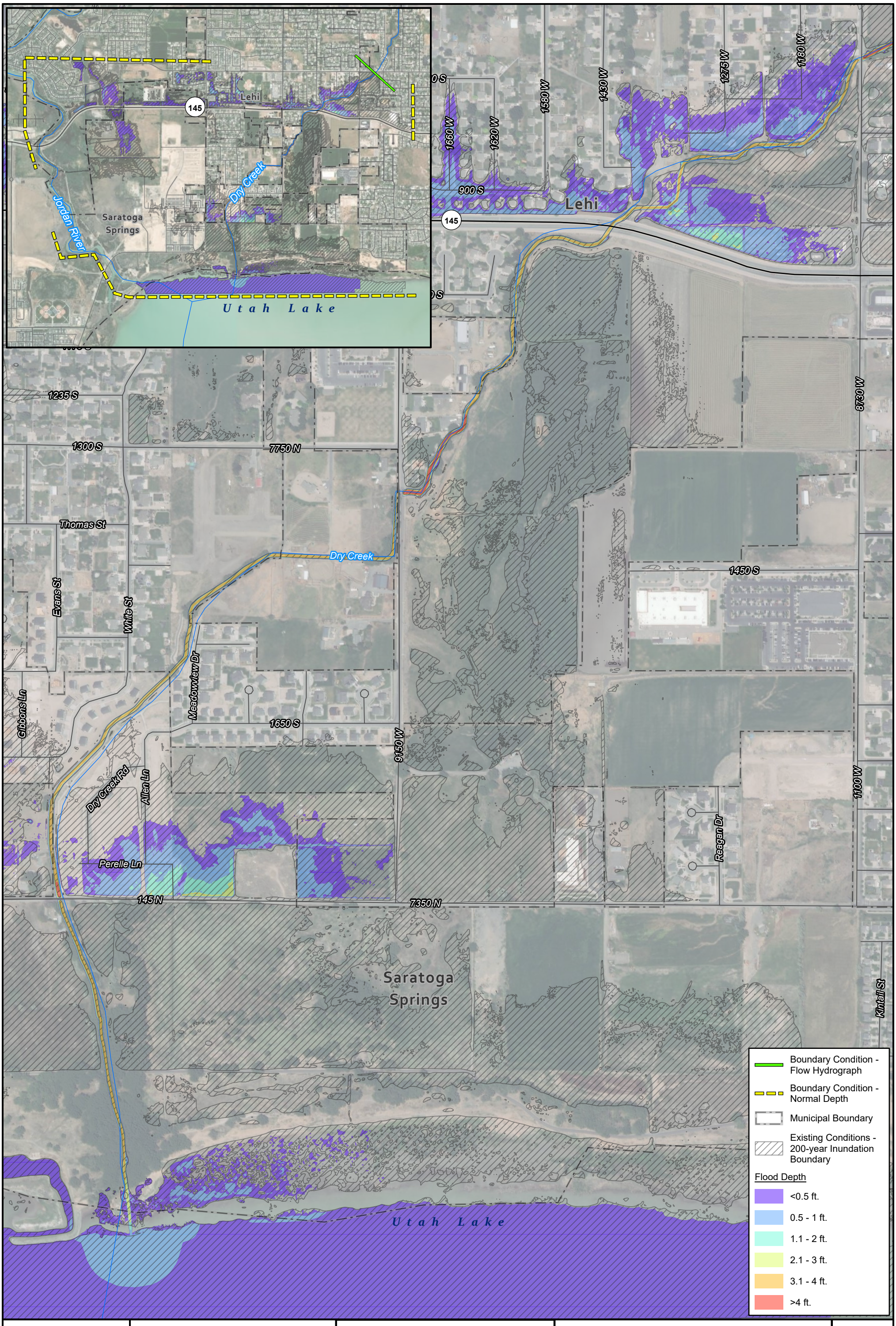


FRANSON CIVIL ENGINEERS

Jones & DeMille Engineering

Lehi City

Utah County

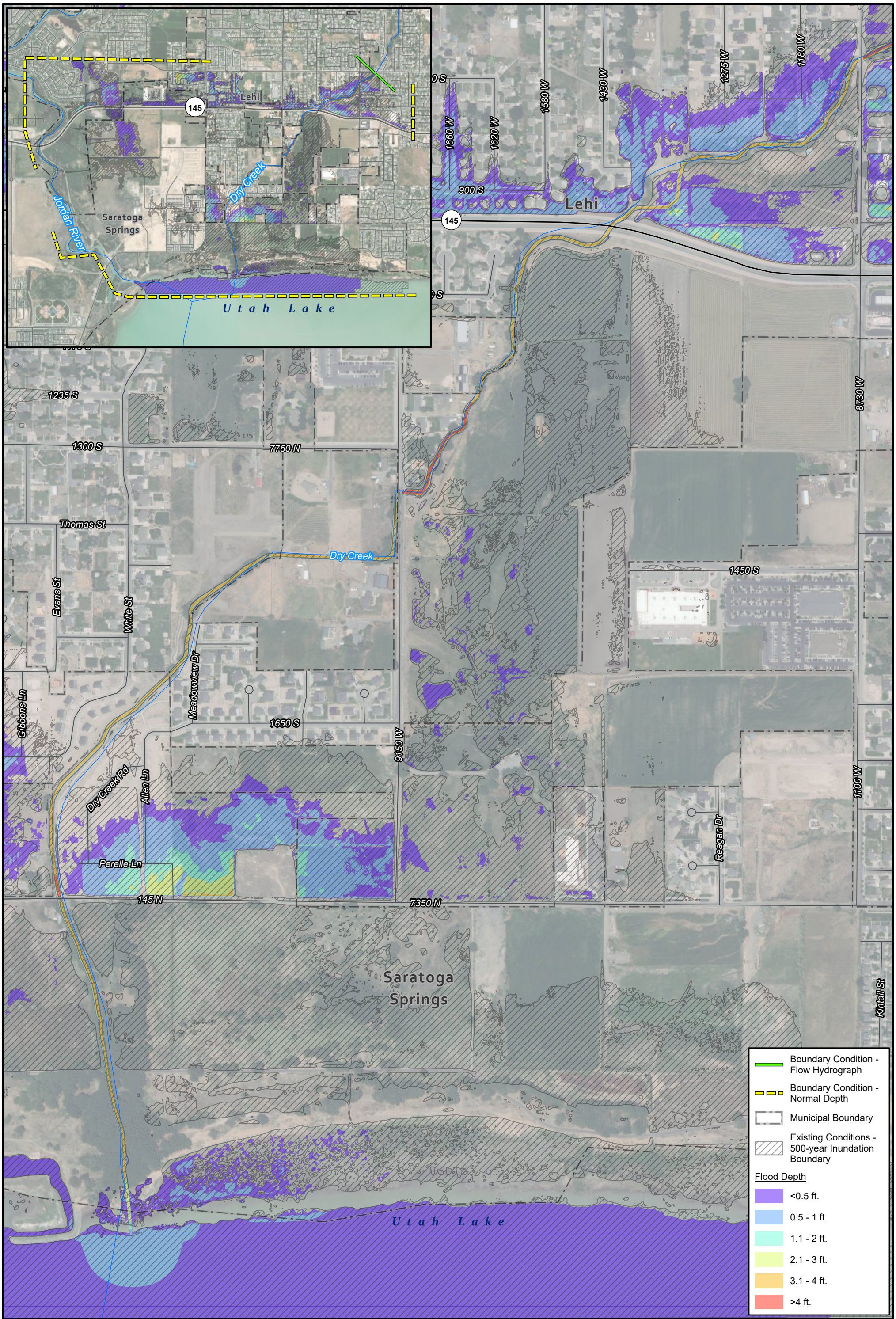
Watershed Plan EA - Dry Creek Downstream
Proposed Conditions - 200-year 24-hour Flood Event

Scale: 1" = 500'

Map Name: H:\JD\Proj\2004-028\Design\GIS\Projects\Water\2004-028_Water.aprx - Exh Lehi Dry Creek Downstream Existing and Proposed Series

Project Number: 2004-028 | Drawn by: JWW 02-22 | Last Edit: 06/16/2022

9



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0 250 500 Feet

FRANSON CIVIL ENGINEERS

Jones & DeMille Engineering

Lehi City

Watershed Plan EA - Dry Creek Downstream
Proposed Conditions - 500-year 24-hour Flood Event

Utah County

Scale: 1" = 500'

10

Map Name: H:\JD\Proj\2004-028\Design\GIS\Projects\Water\2004-028_Water.aprx - Exh Lehi Dry Creek Downstream Existing and Proposed Series

Project Number: 2004-028 | Drawn by: JWW 02-22 | Last Edit: 06/16/2022

Appendix B. Data for Economic Analysis

No Action Alternative (Existing Conditions) - American Fork City

Storm	Mobile Homes			Homes			Commercial			Schools			Churches			Other		
	<1 ft	1-3 ft	>3 ft	<1 ft	1-3 ft	>3 ft	<1 ft	1-3 ft	>3 ft	<1 ft	1-3 ft	>3 ft	<1 ft	1-3 ft	>3 ft	<1 ft	1-3 ft	>3 ft
10-YR	1	-	-	-	3	1	7	2	2	-	-	-	-	-	-	-	-	-
25-YR	24	7	-	15	5	3	15	4	2	-	-	-	-	-	-	2	-	-
50-YR	32	16	-	34	7	6	26	10	4	1	-	-	-	-	-	3	-	-
100-YR	34	20	-	78	18	6	28	21	8	1	-	-	-	-	-	8	1	-
200-YR	33	24	-	117	29	7	43	21	10	2	-	-	1	1	-	9	2	-
500-YR	31	27	-	161	34	11	51	24	11	1	1	-	2	1	-	11	3	-

Preferred Alternative (See TM004 - Frequency Flood Routing & TM005 - Hydraulic Analysis) - American Fork City

Storm	Mobile Homes			Homes			Commercial			Schools			Churches			Other		
	<1 ft	1-3 ft	>3 ft	<1 ft	1-3 ft	>3 ft	<1 ft	1-3 ft	>3 ft	<1 ft	1-3 ft	>3 ft	<1 ft	1-3 ft	>3 ft	<1 ft	1-3 ft	>3 ft
50-YR	-	-	-	1	2	2	9	2	3	-	-	-	-	-	-	-	-	-
100-YR	-	-	-	1	2	2	10	5	3	-	-	-	-	-	-	1	-	-
200-YR	8	9	-	43	5	6	23	7	5	-	-	-	-	-	-	6	1	-
500-YR	19	21	3	96	19	9	34	21	9	-	-	-	1	-	-	7	2	-

No Action Alternative (Existing Condtions) - Lehi City: Waste Ditch and Upper Dry Creek

Storm	Mobile Homes			Homes			Commercial			Schools			Other		
	<1 ft	1-3 ft	>3 ft	<1 ft	1-3 ft	>3 ft	<1 ft	1-3 ft	>3 ft	<1 ft	1-3 ft	>3 ft	<1 ft	1-3 ft	>3 ft
10-YR	4	1	-	256	49	1	11	2	1	2	-	-	15	2	-
25-YR	4	1	-	521	129	2	29	7	1	3	2	-	23	6	-
50-YR	4	1	-	591	169	2	34	13	1	5	2	-	24	10	1
100-YR	3	2	-	629	192	2	35	14	1	5	2	-	26	10	1
200-YR	3	2	-	666	210	2	33	17	1	5	2	-	27	10	1
500-YR	3	2	-	698	228	3	33	17	1	7	2	-	25	13	1

Preferred Alternative (See TM004 - Frequency Flood Routing & TM005 - Hydraulic Analysis) - Lehi City: Waste Ditch and Upper Dry Creek

Storm	Mobile Homes			Homes			Commercial			Schools			Other		
	<1 ft	1-3 ft	>3 ft	<1 ft	1-3 ft	>3 ft	<1 ft	1-3 ft	>3 ft	<1 ft	1-3 ft	>3 ft	<1 ft	1-3 ft	>3 ft
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25-YR	4	1	-	432	89	1	21	5	1	1	1	-	16	6	-
50-YR	4	1	-	503	115	2	27	8	1	2	1	-	20	6	1
100-YR	4	1	-	554	124	4	30	9	1	3	1	-	24	6	1
200-YR	4	1	-	607	153	6	32	10	1	5	1	-	24	7	2
500-YR	4	1	-	670	182	6	36	11	1	6	1	-	28	9	2

No Action Alternative (Existing Condtions) - Lehi City: Lower Dry Creek

Storm	Mobile Homes			Homes			Commercial			Schools			Churches			Other		
	<1 ft	1-3 ft	>3 ft	<1 ft	1-3 ft	>3 ft	<1 ft	1-3 ft	>3 ft	<1 ft	1-3 ft	>3 ft	<1 ft	1-3 ft	>3 ft	<1 ft	1-3 ft	>3 ft
10-YR	-	-	-	43	9	1	-	-	-	-	-	-	-	-	-	3	-	-
25-YR	-	-	-	84	33	6	-	-	-	-	-	-	-	-	-	4	-	-
50-YR	-	-	-	90	38	7	-	-	-	-	-	-	-	-	-	4	-	-
100-YR	-	-	-	97	43	7	-	-	-	-	-	-	-	-	-	4	-	-
200-YR	-	-	-	102	45	8	-	-	-	-	-	-	-	-	-	4	-	-
500-YR	-	-	-	108	50	8	-	-	-	1	-	-	-	-	-	4	-	-

Preferred Alternative (See TM004 - Frequency Flood Routing & TM005 - Hydraulic Analysis) - Lehi City: Lower Dry Creek

Storm	Mobile Homes			Homes			Commercial			Schools			Churches			Other		
	<1 ft	1-3 ft	>3 ft	<1 ft	1-3 ft	>3 ft	<1 ft	1-3 ft	>3 ft	<1 ft	1-3 ft	>3 ft	<1 ft	1-3 ft	>3 ft	<1 ft	1-3 ft	>3 ft
10-YR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25-YR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
50-YR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
100-YR	-	-	-	6	1	-	-	-	-	-	-	-	-	-	-	-	-	-
200-YR	-	-	-	36	5	1	-	-	-	-	-	-	-	-	-	3	-	-
500-YR	-	-	-	61	26	2	-	-	-	-	-	-	-	-	-	3	-	-

Attachment 5
Technical Memo 005 – Hydraulic Analysis

TM005 – Hydraulic Analysis

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1.0 Introduction

This memorandum is part of Appendix D which is the engineering report accompanying the American Fork River Watershed Supplemental Plan-EA being funded and completed through the NRCS PL566 program. The purpose of this memorandum is to document steps taken for hydraulic analysis for the project measures.

American Fork City and Lehi and Saratoga Springs Cities are collectively working with Franson Civil Engineers and Jones & DeMille Engineering (JDE), respectively, to complete a Natural Resources Conservation Service (NRCS) Supplemental Watershed Plan-Environmental Assessment (Plan-EA) of the American Fork River watershed in Utah County. The study includes evaluating how to reduce flooding in American Fork, Lehi, and Saratoga Springs Cities that are within the aforementioned watershed.

The purpose of this technical memo is to describe the methods, procedures, and results of the hydraulic modeling and analysis performed for the Supplemental Plan-EA.

1.1 Design Criteria

The Design Criteria for this Plan EA is documented in *TM002 – Design Criteria*. Hydrologic data and analysis have been documented in *TM003 –Hydrology.*

The modeling of the hydrographs is described in *TM004 – Frequency Flood Routing.* The peak flows presented in this report have been used to design the proposed improvements such as culvert sizes and widening of existing open channels.

All proposed design and construction procedures would meet the applicable NRCS standards and State Engineering criteria. The purpose is to maintain public safety around these structures and to protect surrounding areas from possible flood damage.

2.0 Proposed Improvements

American Fork City, north of Interstate 15, has sections of concrete lined channels and concrete culverts along the American Fork River, which provide flood protection to the surrounding areas. The hydrologic analysis identified that channel improvements are needed to reduce the risk of flooding. *TM001 – Existing Conditions* provides an overview of the existing conditions. The proposed improvements for American Fork City area include four sections of channel improvements, totaling approximately 1,000 feet, at locations of insufficiently sized under crossings to improve the channel capacity.

Developed areas in Lehi and Saratoga Springs, Utah, have been flooded or are at risk for flooding along Dry Creek and the Waste Ditch, which is a secondary canal used to convey excess water from Dry Creek to the Jordan River. Upgrades to the Dry Creek channel and Waste Ditch would reduce the risk of flooding throughout the cities. The proposed improvements for the area would reconstruct approximately 12,000 feet of existing channel to improve the channel capacity and hydraulics through Lehi Elementary School’s property, public transportation corridors, private property, and parks.

2.1 American Fork City Improvement Projects

The American Fork River (river) flows from American Fork Canyon southward through American Fork City until it discharges into Utah Lake. There are many areas of the river where the flow has been channelized with either a closed-top box culvert or an open-top rectangular concrete channel. AFC has had increasing concerns about the structural integrity of flood control structures along the river, including several culverts and sections of regular concrete channel. In the event these structures fail during high flows, there is significant risk of flood damage to the surrounding area.

2.1.1 No Action Alternative

The No Action Alternative does not provide improvements to any of the locations experiencing flood flows or deteriorating structures which are in need of replacement or rehabilitation. No improvements would be made to the open waterways including both concrete-lined and unlined portions. Flood flows would pass through the same historic channels, waterways, and culverts with the severity of the flooding events continuing, dependent upon the nature, timing, and severity of the event. No federally funded project measures would be implemented. Existing conditions and trends would continue into the future. Routine operational and maintenance (O&M) activities would continue, such as cleaning of the channels by removing debris and vegetation and upkeep on the culverts.

2.1.2 Proposed Action Alternative

The Proposed Action Alternative consists of the project measures identified below.

Location 1: Channel Improvements at 300 North

At this location, the upstream channel needs improvements to contain the flows and direct water to the existing box culvert under 300 North. The proposed improvements at this location include improving the embankments for approximately 350 feet upstream with 1.5-foot-high embankments and constructing new upstream and downstream wingwalls. A new concrete apron will be placed on the downstream side at the outlet to protect against erosion. The embankments will be armored with gabions or riprap to protect against erosion. Trees and vegetation would be removed within the flow area. Other channel improvements may also be needed which could include modifications to the channel slope and channel width. These channel improvements would allow the 100-year flood to pass without any flooding upstream of the structure.

Location 2: Channel Improvements at 100 North and 200 East

At this location, channel improvements are needed to contain the flows and direct water to the existing box culvert beneath the intersection of 100 North and 200 East. The proposed improvements include reconstructing the embankments for approximately 350 feet upstream with 2.5-foot-high embankments and creating a new transition into the existing box culvert. The embankments will be armored with gabions or riprap to protect against erosion. Trees and vegetation would be removed within the flow area. Other channel improvements may also be needed which could include modifications to the channel slope and channel width. These channel improvements would allow the 100-year flood to pass without any flooding upstream of the structure.

Location 3: Channel Improvements at 200 South

There is an existing box culvert under 200 South which causes backup and flooding upstream of the structure. This section of river includes channel improvements to the concrete S-Channel floor to remove vegetation and repair eroded concrete. The improvements would also include removing energy dissipation baffle blocks that catch debris and cause backups in the channel that increase the flooding upstream of the

structure. Riprap would be placed as erosion protection on the downstream banks instead of the baffle blocks. These improvements would allow the 100-year flood to pass without any flooding upstream of the structure and would prevent flooding the houses near the river. The existing culvert is anticipated to be replaced in the future under a separate action.

Location 4: Channel Improvements at 400 South

At this location, the upstream channel needs improvements to contain the flows and direct water to the existing box culvert under 400 South. The proposed improvement at this location includes widening the upstream channel and raising the riverbanks from 5 feet tall to 8 feet tall for approximately 300 feet using gabions. These improvements would allow the passage of the 100-year flood and would prevent flooding the houses near the river.

2.2 Lehi and Saratoga Springs Cities Improvement Projects

Dry Creek (a drainage channel in the American Fork watershed) passes through Lehi City. Waste Ditch is an overflow channel that handles flood water from Dry Creek. Portions of these channels have been improved through cooperation from several agencies and private development. The portions of Dry Creek in consideration for this project are located west of Interstate 15 and along Dry Creek in the area near Lehi Elementary School (LES) and the Waste Ditch from LES, intermittently to the point where it discharges into the Jordan River. The Waste Ditch originates from Dry Creek and the split occurs just upstream of LES. Flows are diverted at a splitter structure where historically approximately 2/3 of the flow goes to Waste Ditch and the remaining 1/3 to Dry Creek. Hydraulic modeling of the drainage system indicates that an adjustment to the split percentage may better control flood waters, reduce over-all flooding, and prevent Waste Ditch from being over-flowed. For modeling purposes this split ratio was altered by adjusting the splitter structure to allow 60% to flow down Waste Ditch and the remaining 40% to continue down Dry Creek. This adjustment was made due to the limiting capacity of several newly installed box culverts along Waste Ditch. The maximum channel capacity of Waste Ditch has been calculated to be approximately 550 cfs (used as design flow based on 60% of 50-year event).

The Dry Creek improvements have been designed to convey the 50-year Dry Creek flow, with approximately 40% of the flow continuing down Dry Creek below the splitter. The 50-year design flow for Dry Creek is approximately 364 cfs.

While the proposed improvements near LES are intended to reduce flooding in that area, other flood concerns exist downstream on Dry Creek. Several areas were identified for necessary improvements, however, the challenge of excessive project costs and causing of induced flooding has limited the downstream work to only include channel improvements from 700 South to Utah Lake (approximately 12,000 feet).

These proposed improvements are documented in this section.

2.2.1 Upper Dry Creek and Waste Ditch

Location 5 – Upper Dry Creek at Lehi Elementary School

No Action Alternative

The No Action Alternative consists of not improving Dry Creek channel at the LES. The school has flooded several times in recent years to the point that children and staff had to be evacuated out of the school on make-shift foot bridges to avoid walking through the flood waters. This risk would remain, and future flooding events are eminent, likely continuing to cause damage during large flood events.

Proposed Action Alternative

As Dry Creek passes Lehi Elementary School, the existing culvert would be replaced with a 12-foot-wide by 5-foot-tall concrete box culvert. The box culvert would be fitted with a trash rack and intake structure to prevent plugging from trash and debris.

The downstream channel from where the box culvert discharges would be improved to handle the design flow as well as the next box culvert downstream at 600 North (12-foot wide by 5-foot-tall concrete box culvert). Channel improvements are proposed to include a 15-foot-wide concrete-lined channel bottom with 5.5-foot-tall gabion basket channel banks. Channel slopes would match the existing channel slope, with a minimum of 0.3 percent. Proposed improvements provide near 100% flood reduction in this area and would prevent flooding of houses, roadways, and other critical infrastructure.

Location 6 - Waste Ditch at Lehi Elementary School

No Action Alternative

Similar to the Dry Creek channel, the No Action Alternative for Waste Ditch would also mean that high flows in the channel would continue to impact the LES and private property owners in the area. The flow capacity of each channel is being maximized and therefore, improvements to one channel but not the other would not yield an overall appreciable reduction of flood potential at the elementary school.

Proposed Action Alternative

As the Waste Ditch passes the school, it enters a 42-inch CMP and is conveyed under a portion of lawn approximately 350 feet and discharged back into the open channel. The existing culvert would be replaced with a 20-foot wide by 4-foot-tall concrete box culvert to provide more capacity. The box culvert would also be fitted with a trash rack and intake structure to prevent plugging.

The downstream channel from where the box culvert discharges would be improved to handle the design flow. Channel improvements would include a 15-foot-wide concrete-lined channel bottom with 5.5-foot-tall gabion basket channel banks. Channel slopes would match the existing channel slope, with a minimum of minimum of 0.3 percent. Proposed improvements provide near 100% flood reduction in this area and would prevent flooding of houses, roadways, and other critical infrastructure.

Location 7 - Waste Ditch at Willow Park

No Action Alternative

The No Action Alternative at Willow Park would mean that the undersized channel and box culverts would continue to flood as they have in the past and impact private property and residences. When considering “Do Nothing” at this area with improvements in Waste Ditch at LES, the hydraulic modeling shows that induced flooding would occur and that these improvements are necessary to mitigate any potential induced flooding from channel improvements upstream.

Proposed Action Alternative

Unimproved sections of the Waste Ditch channel would be excavated and expanded to match the upstream capacity and replace the undersized box culvert at 300 North in Willow Park. The channel improvements would be the same as the channel improvements at the elementary school, including a 15-foot-wide concrete-lined channel bottom with 5.5-foot-tall gabion basket channel banks. Channel slopes would match the existing channel slope, with a minimum of 0.3 percent. The new box culvert would be a 20-foot-wide by 4-foot-tall concrete box culvert. Proposed improvements provide near 100% flood reduction in this area and would prevent flooding of houses, roadways, and other critical infrastructure.

2.2.2 Lower Dry Creek

As Dry Creek passes under the railroad tracks, the channel has several deficiencies beginning primarily at 700 South and extending all the way to Utah Lake. There are only four primary culvert crossings in this reach, the specific culverts that need improvements are identified below.

No Action Alternative

The No Action Alternative consists of leaving the area in its existing conditions. This option would allow flooding that would continue to damage residential structures, roads, and other infrastructure.

Proposed Action Alternative

As Dry Creek passes under the railroad tracks (near 200 North and 400 West), the channel has several deficiencies beginning primarily at 1100 West and extending all the way to Utah Lake. There are only three primary culvert crossings in this reach (two in Lehi City and one in Saratoga Springs), one of which has been improved in recent years with the expansion of Pioneer Crossing (SR 145). The specific culverts that need improvements are identified below.

In general, Dry Creek through this area can be improved with a combination of channel clearing (dredging channel and restoring natural channel capacity) and gabion lined channel sections. Areas where access is constrained by existing development, scour risk is high (sharp channel bends) and critical infrastructure needs protection (concrete irrigation ditches, bridges, fences, roads, etc). The minimum slope of this channel would be 0.3 percent. Several large trees would be removed in the channel corridor to restore channel hydraulic capacity and to allow for site access to dredge the channel and import and place gabions. Channel dredging would extend up to 2 feet below the existing channel flow line. Proposed improvements provide near 100% flood reduction in this area and would prevent flooding of houses, roadways, and other critical infrastructure. The final 3,000 feet of Dry Creek fall within the city boundary of Saratoga Springs.

Improvements to two other locations are integral to the proposed improvements on lower Dry Creek. These culvert improvements at 1700 West (12-foot-wide by 5-foot-tall), and 1900 South (14-foot-wide by 5-foot-tall). Saratoga Springs and Lehi City will be financially responsible for these improvements.

3.0 Cost Estimates

Cost estimates for the proposed projects identified in this technical memo are included in Tables 1 through Table 6.

Table 1: Preliminary Cost Estimate - American Fork City - Location 1
Channel Improvements at 300 North

Item	Item Description	Unit	Quantity	Unit Cost	Total Cost
1	Mobilization	LS	1	$ 37,450	$ 37,450
2	Water Diversion and Management	LS	1	$ 50,000	$ 50,000
3	Public Information and Relations	LS	1	$ 10,000	$ 10,000
4	Elevation Survey and Control	LS	1	$ 3,478	$ 3,478
5	Quality Control and Material Testing	LS	1	$ 10,000	$ 10,000
6	Excavation, Removal and Disposal of Existing Concrete Bridge	CY	1100	$ 60	$ 66,000
7	Prepare Subbase and Bedding for Box Culvert	SY	300	$ 45	$ 13,500
8	Install Gabions For Channel Protection	LF	700	$ 450	$ 315,000
9	Backfill Gabions	CY	300	$ 50	$ 15,000
10	Restore Landscape and Fencing	LS	1	$ 15,000	$ 15,000
				Construction Subtotal	**$ 535,500**
				Engineering (Design and Construction Engineering)	**$ 99,125**
				25% Contingency	**$ 158,700**
				Total	**$ 793,325**

Table 2: Preliminary Cost Estimate - American Fork City - Location 2
Channel Improvements at 100 North and 200 East

Item	Item Description	Unit	Quantity	Unit Cost	Total Cost
1	Mobilization	LS	1	$ 37,100	$ 37,100
2	Water Diversion and Management	LS	1	$ 50,000	$ 50,000
3	Public Information and Relations	LS	1	$ 10,000	$ 10,000
4	Elevation Survey and Control	LS	1	$ 3,445	$ 3,445
5	Quality Control and Material Testing	LS	1	$ 10,000	$ 10,000
6	Excavation of Channel to Restore Flowline	CY	1100	$ 60	$ 66,000
7	Prepare Subbase and Bedding for Gabions	SY	300	$ 45	$ 13,500
8	Install Gabions for Channel Protection	LF	700	$ 450	$ 315,000
9	Backfill Gabions	CY	300	$ 50	$ 15,000
10	Restore Landscaping	LF	1	$ 10,000	$ 10,000
				Construction Subtotal	**$ 530,100**
				Engineering (Design and Construction Engineering)	**$ 98,200**
				25% Contingency	**$ 157,100**
				Total	**$ 785,400**

Table 3: Preliminary Cost Estimate - American Fork City - Location 3
Channel Improvements at 200 South

Item	Item Description	Unit	Quantity	Unit Cost	Total Cost
1	Mobilization	LS	1	$ 21,140	$ 21 140
2	Water Diversion and Management	LS	1	$ 50,000	$ 50,000
3	Public Information and Relations	LS	1	$ 10,000	$ 10,000
4	Elevation Survey and Control	LS	1	$ 3,445	$ 3,445
5	Quality Control and Material Testing	LS	1	$ 10,000	$ 10,000
6	Demolish and Remove Concrete Blocks and Floor	CY	1100	$ 60	$ 66,000
7	Install Apron, Cutoffs, and Wingwalls	CY	300	$ 45	$ 13,500
8	Sandblast Existing Floor and Exposed Rebar	SF	700	$ 450	$ 315,000
9	Prepare Subbase for Concrete	SY	300	$ 50	$ 15,000
10	Drill and Epoxy Rebar Dowels	SF	1	$ 10,000	$ 10,000
11	Place Concrete	CY	1	$ 50,000	$ 50,000
12	Place Fiber Reinforced Concrete	CY	1	$ 10,000	$ 10,000
13	Install Riprap in Channel	Ton	1	$ 3,445	$ 3,445
14	Restore Landscape and Fencing	LS	1	$ 10,000	$ 10,000
Construction Subtotal					**$ 302,200**
Engineering (Design and Construction Engineering)					**$ 56,100**
25% Contingency					**$ 89,600**
Total					**$ 447,900**

Table 4: Preliminary Cost Estimate - American Fork City - Location 4
Channel Improvements at 400 South

Item	Item Description	Unit	Quantity	Unit Cost	Total Cost
1	Mobilization	LS	1	$ 33,110	$ 33,110
2	Water Diversion and Management	LS	1	$ 50,000	$ 50,000
3	Traffic Control	LS	1	$ 10,000	$ 10,000
4	Public Information and Relations	LS	1	$ 12,000	$ 12,000
5	Elevation Survey and Control	LS	1	$ 10,000	$ 10,000
6	Quality Control and Material Testing	LS	900	$ 60	$ 54,000
7	Excavation of Channel to Restore Flowline	LF	200	$ 45	$ 9,000
8	Prepare Subbase and Bedding for Gabions	SY	600	$ 450	$ 270,000
9	Install Gabions for Channel Protection	LF	200	$ 50	$ 10,000
10	Backfill Fabions	CY	1	$ 15,000	$ 15,000
11	Restore Landscape	LS	1	$ 50,000	$ 50,000
Construction Subtotal					**$ 473,110**
Engineering (Design and Construction Engineering)					**$ 87,600**
25% Contingency					**$ 140,200**
Total					**$ 700,910**
Grand Total (Combined American Fork Areas)					**$ 2,728,000**

Table 5: Preliminary Cost Estimate – Lehi City - Locations 5, 6, and 7
Upper Dry Creek and Waste Ditch

Item	Item Description	Unit	Quantity	Unit Cost	Total Cost
1	Mobilization	LS	1	$ 150,000	$ 150,000
2	Construction Survey	LS	1	$ 30,000	$ 30,000
3	Prepare and Implement SWPPP & Dust Control	LS	1	$ 10,000	$ 10,000
4	Clearing and Grubbing	LS	1	$ 10,000	$ 10,000
5	Site Demolition – Existing Culverts	LF	930	$ 50	$ 46,500
6	Type 1 Box Culvert	LF	348	$ 2,500	$ 870,000
7	Type 1 Box Culvert (Non-NRCS Funded)	LF	72	$ 2,500	$ 180,000
8	Type 2 Box Culvert	LF	510	$ 2,250	$ 1,147,500
9	Type 2 Box Culvert (Non-NRCS Funded)	LF	78	$ 2,250	$ 175,500
10	Box Culvert Intake Structure	LF	2	$ 25,000	$ 50,000
11	Type 1 Gabion Lined Channel	LF	1,829	$ 600	$ 1,097,400
12	Type 2 Gabion Lined Channel	LF	381	$ 550	$ 209,550
13	Flood Plain Diversion	EA	1,320	$ 200	$ 264,000
14	Road Reconstruct (Raise Road)	LF	50	$ 500	$ 25,000
15	Large Tree Removal	SY	23	$ 1,200	$ 27,600
16	Surplus Material Removal	CY	2,800	$ 25	$ 70,000
				Construction Subtotal	**$ 4,363,050**
				15% Engineering (Design and Construction Engineering)	**$ 820,000**
				25% Contingency	**$ 1,090,000**
				Real Property Rights	**$ 310,000**
				Total	**$ 6,583,050**

Table 6: Preliminary Cost Estimate – Lehi and Saratoga Springs Cities - Location 8 Lower Dry Creek

Item	Item Description	Unit	Quantity	Unit Cost	Total Cost
1	Mobilization	LS	1	$ 175,000	$ 175,000
2	Construction Survey	LS	1	$ 30,000	$ 30,000
3	Prepare and Implement SWPPP & Dust Control	LS	1	$ 10,000	$ 10,000
4	Clearing and Grubbing	LS	1	$ 10,000	$ 10,000
5	Site Demolition – Existing Culverts	LF	258	$ 100	$ 25,800
6	Type 2 Box Culvert	LF	150	$ 2,200	$ 330,000
7	Type 3 Box Culvert	LF	108	$ 2,500	$ 270,000
8	Type 1 Channel Clearing		3,675	$ 50	$ 183,700
9	Type 2 Gabion Lined Channel	LF	4,150	$ 550	$ 2,282,500
10	Type 3 Gabion Lined Channel	LF	594	$ 600	$ 356,400
11	Large Tree Removal	EA	80	$ 1,200	$ 96,000
12	Surplus Material Removal	CY	7,815	$ 25	$ 195,375
Construction Subtotal					**$ 3,964,775**
15% Engineering (Design and Construction Engineering)					**$ 750,000**
25% Contingency					**$ 991,000**
Real Property Rights					**$ 1,190,000**
Total					**$ 6,895,775**
Grand Total (Combined Lehi/Saratoga Springs Projects) *					**$ 13,479,000**

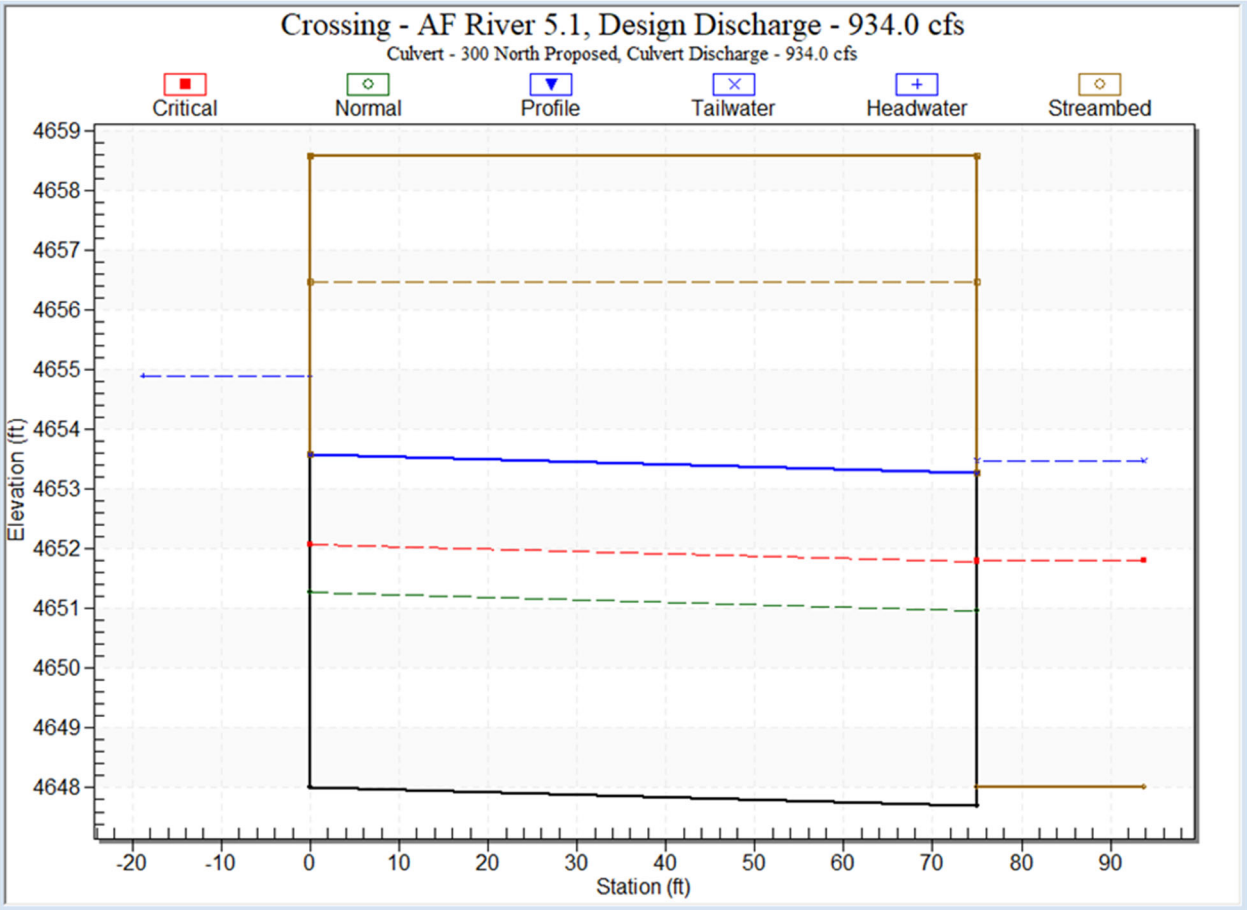
**rounded to nearest thousandth*

4.0 Conclusions

Design elements at each project location have been preliminarily sized using data provided in previous technical memos and were hydraulically modeled to verify the efficacy of flood reduction.

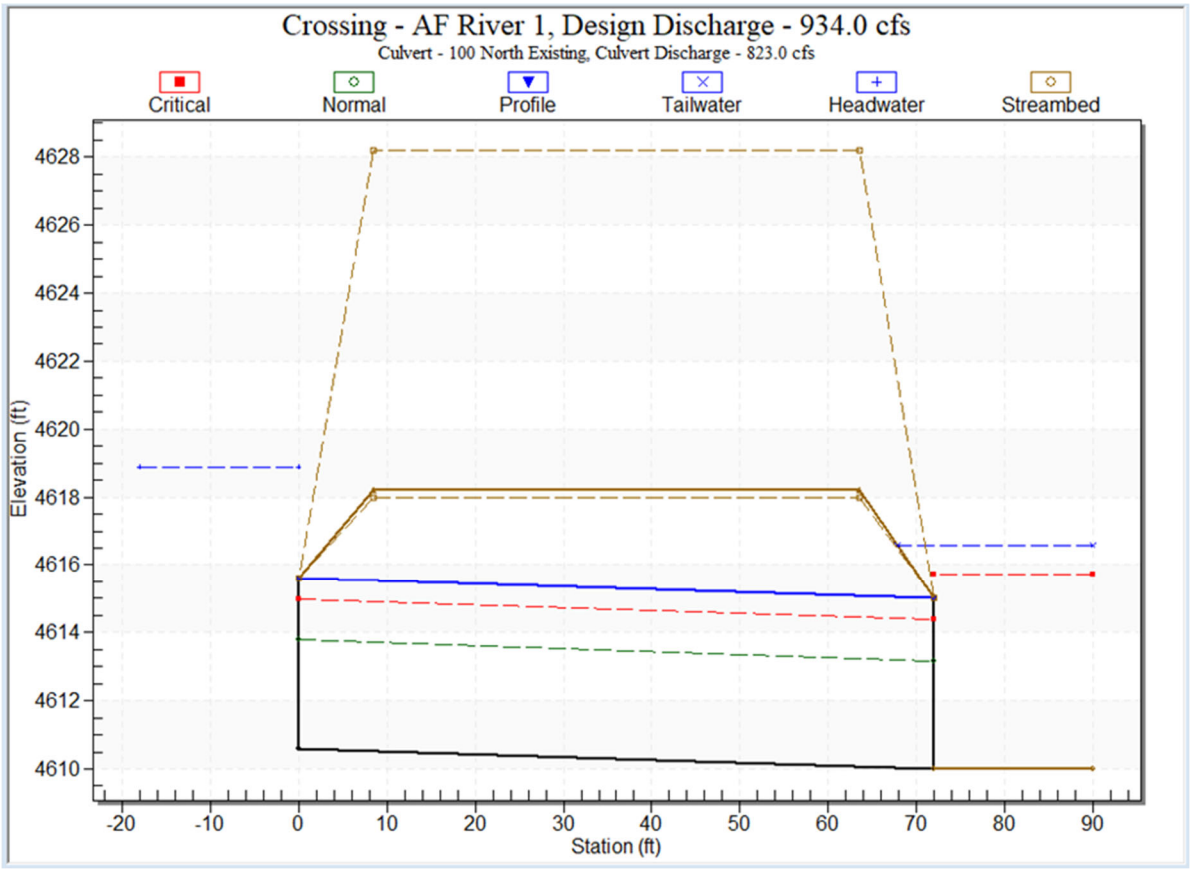
Appendix A. American Fork Area Design Documentation

A.1. American Fork Channel Improvement Design at 300 North



Headwater Elevation (ft)	Total Discharge (cfs)	300 North Proposed Discharge	Roadway Discharge (cfs)	Iterations
4648.37	10.00	10.00	0.00	1
4649.73	128.90	128.90	0.00	1
4650.61	247.80	247.80	0.00	1
4651.39	366.70	366.70	0.00	1
4652.13	485.60	485.60	0.00	1
4652.85	604.50	604.50	0.00	1
4653.58	723.40	723.40	0.00	1
4654.32	842.30	842.30	0.00	1
4654.90	934.00	934.00	0.00	1
4655.86	1080.10	1080.10	0.00	1
4656.65	1199.00	1192.91	6.31	4
4656.48	1171.33	1171.33	0.00	Overtopping

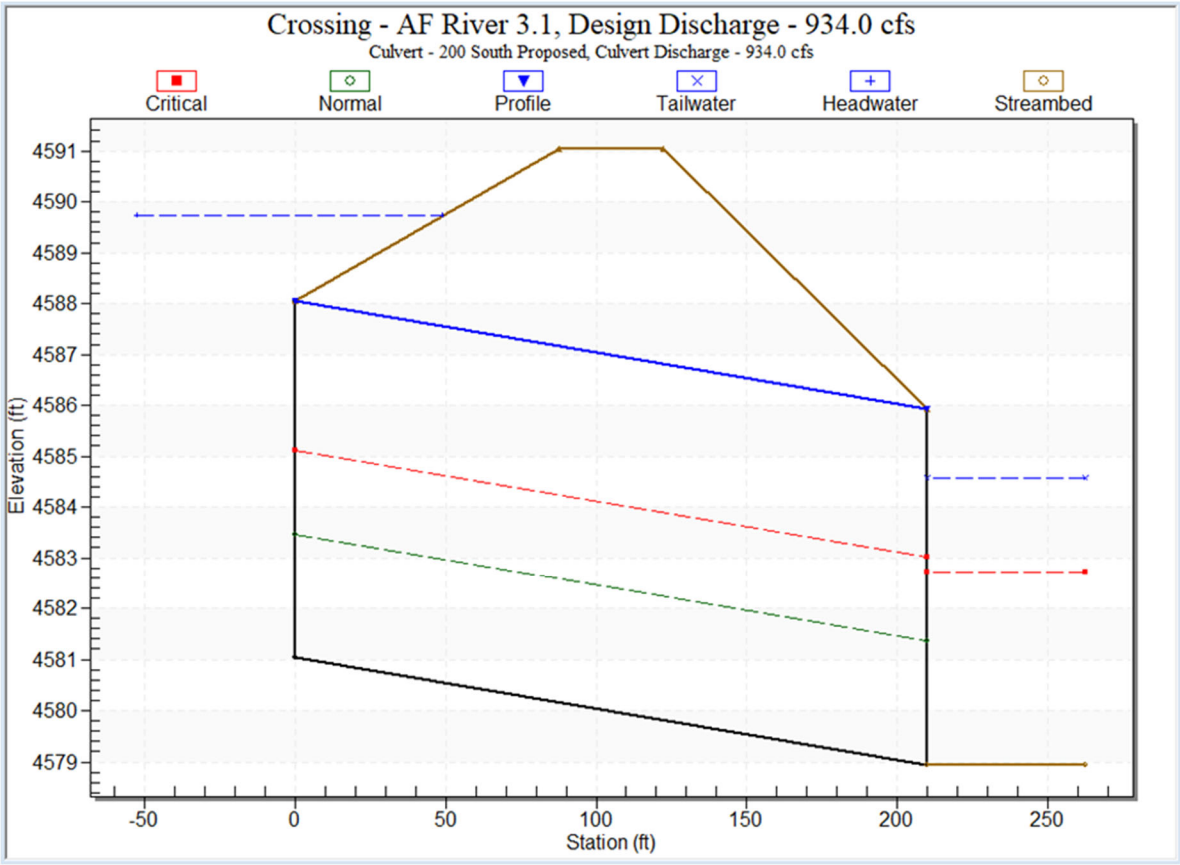
A.2. American Fork Channel Improvement Design at 100 North and 200 East



Summary of Flows at Crossing - AF River 1.1

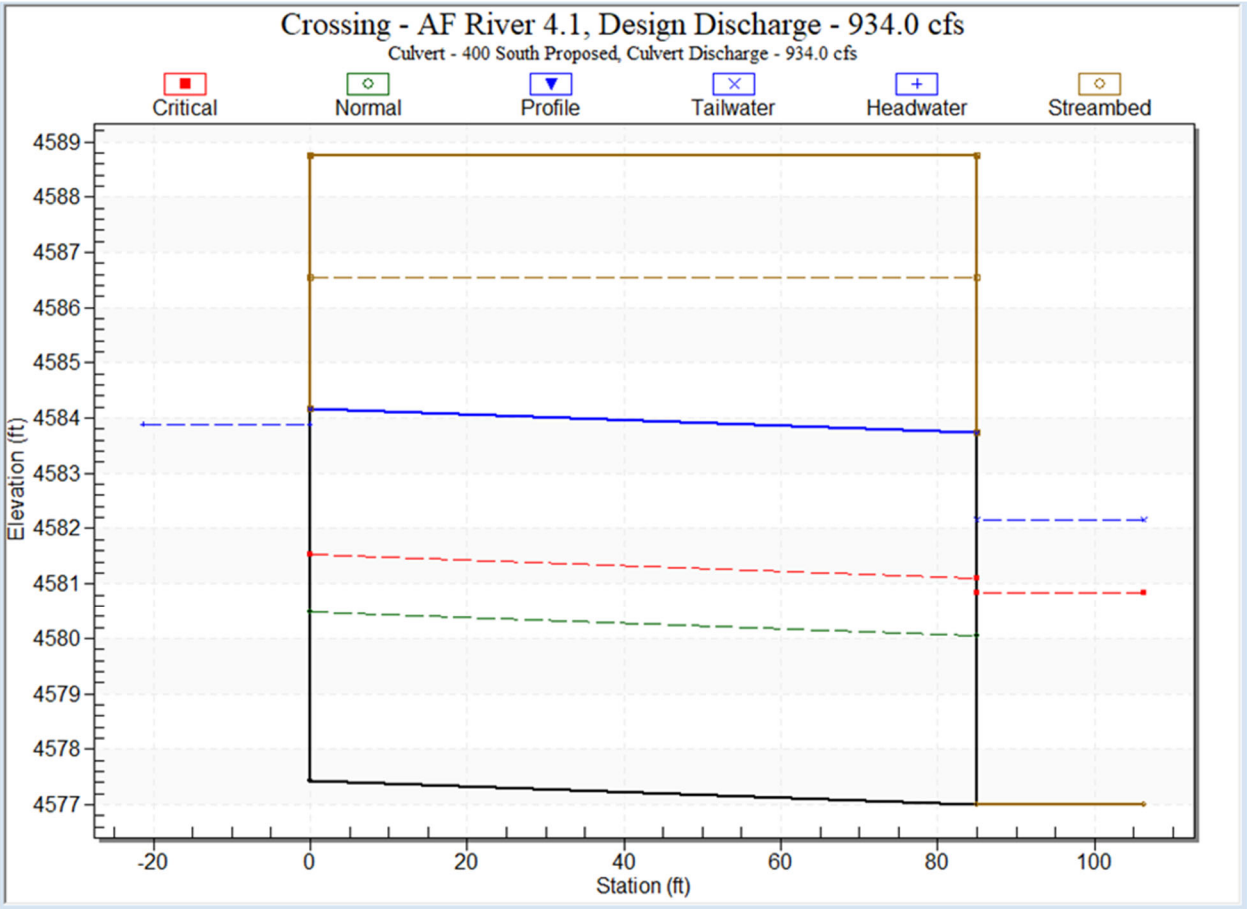
Headwater Elevation (ft)	Total Discharge (cfs)	100 North Proposed Discharge	Roadway Discharge (cfs)	Iterations
4610.90	10.00	10.00	0.00	1
4612.25	128.90	128.90	0.00	1
4613.15	247.80	247.80	0.00	1
4613.95	366.70	366.70	0.00	1
4614.69	485.60	485.60	0.00	1
4615.39	604.50	604.50	0.00	1
4616.09	723.40	723.40	0.00	1
4617.06	842.30	842.30	0.00	1
4617.84	934.00	934.00	0.00	1
4618.79	1080.10	997.12	82.97	4
4619.24	1199.00	971.28	227.30	4
4618.00	951.99	951.92	0.00	Overtopping

A.3. American Fork Channel Improvement at 200 South



Headwater Elevation (ft)	Total Discharge (cfs)	200 South Proposed Discharge (cfs)	Roadway Discharge (cfs)	Iterations
4583.55	10.00	10.00	0.00	1
4584.97	128.90	128.90	0.00	1
4585.91	247.80	247.80	0.00	1
4586.71	366.70	366.70	0.00	1
4587.43	485.60	485.60	0.00	1
4588.09	604.50	604.50	0.00	1
4588.70	723.40	723.40	0.00	1
4589.29	842.30	842.30	0.00	1
4589.72	934.00	934.00	0.00	1
4590.38	1080.10	1080.10	0.00	1
4590.89	1199.00	1199.00	0.00	1
4591.04	1233.50	1233.50	0.00	Overtopping

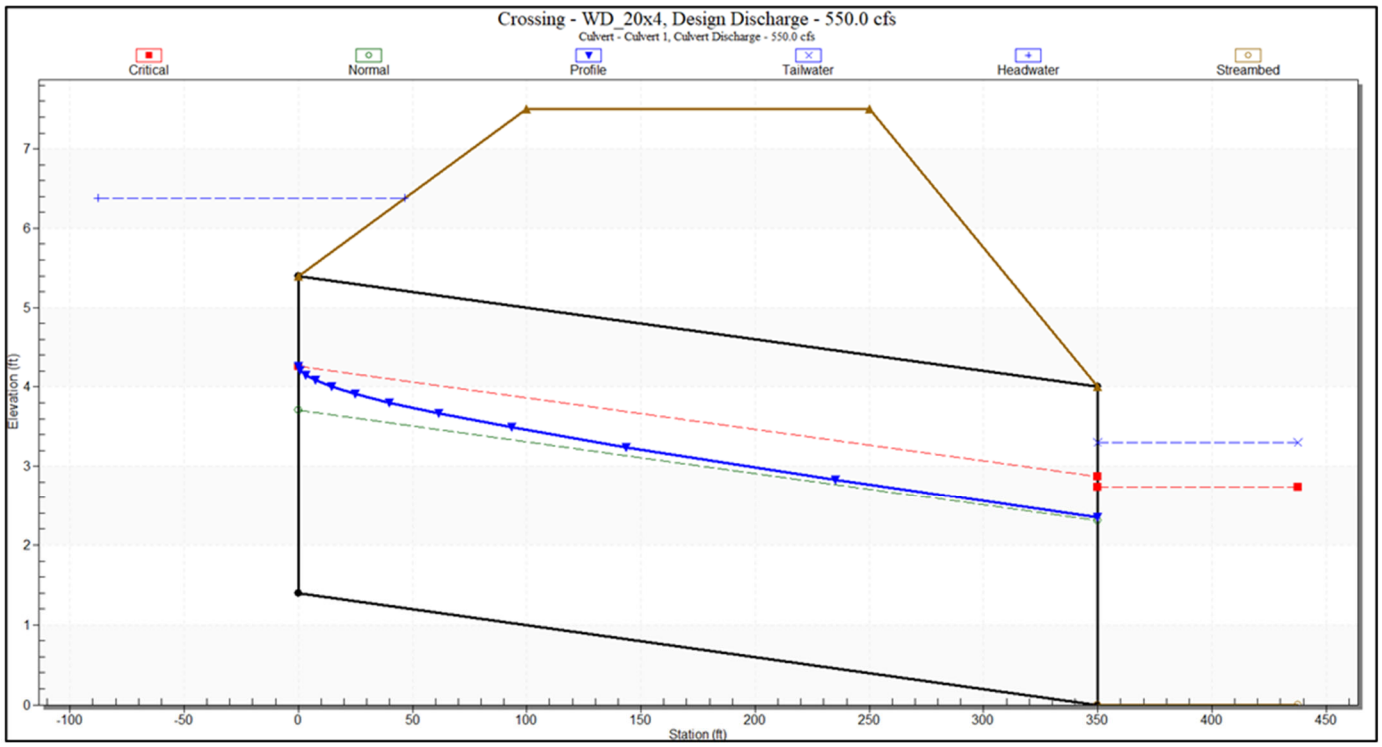
A.4. American Fork Channel Improvement Design at 400 South



Headwater Elevation (ft)	Total Discharge (cfs)	400 South Proposed Discharge	Roadway Discharge (cfs)	Iterations
4577.73	10.00	10.00	0.00	1
4579.09	128.90	128.90	0.00	1
4579.99	247.80	247.80	0.00	1
4580.76	366.70	366.70	0.00	1
4581.48	485.60	485.60	0.00	1
4582.15	604.50	604.50	0.00	1
4582.79	723.40	723.40	0.00	1
4583.40	842.30	842.30	0.00	1
4583.87	934.00	934.00	0.00	1
4584.62	1080.10	1080.10	0.00	1
4585.24	1199.00	1199.00	0.00	1
4586.55	1440.26	1440.26	0.00	Overtopping

Appendix B. Lehi City Area Design Documentation

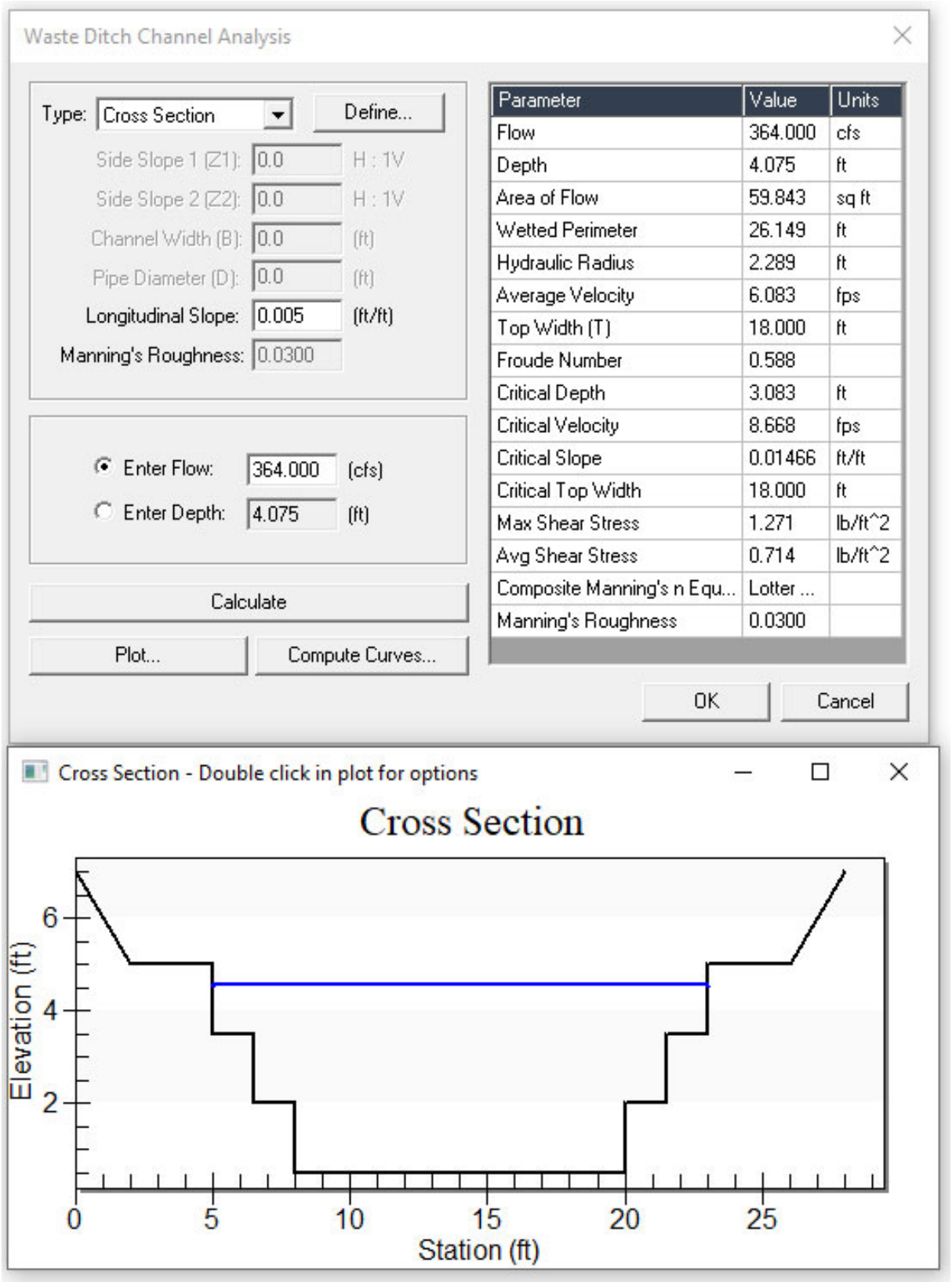
B.1. Waste Ditch Box Culvert Sizing



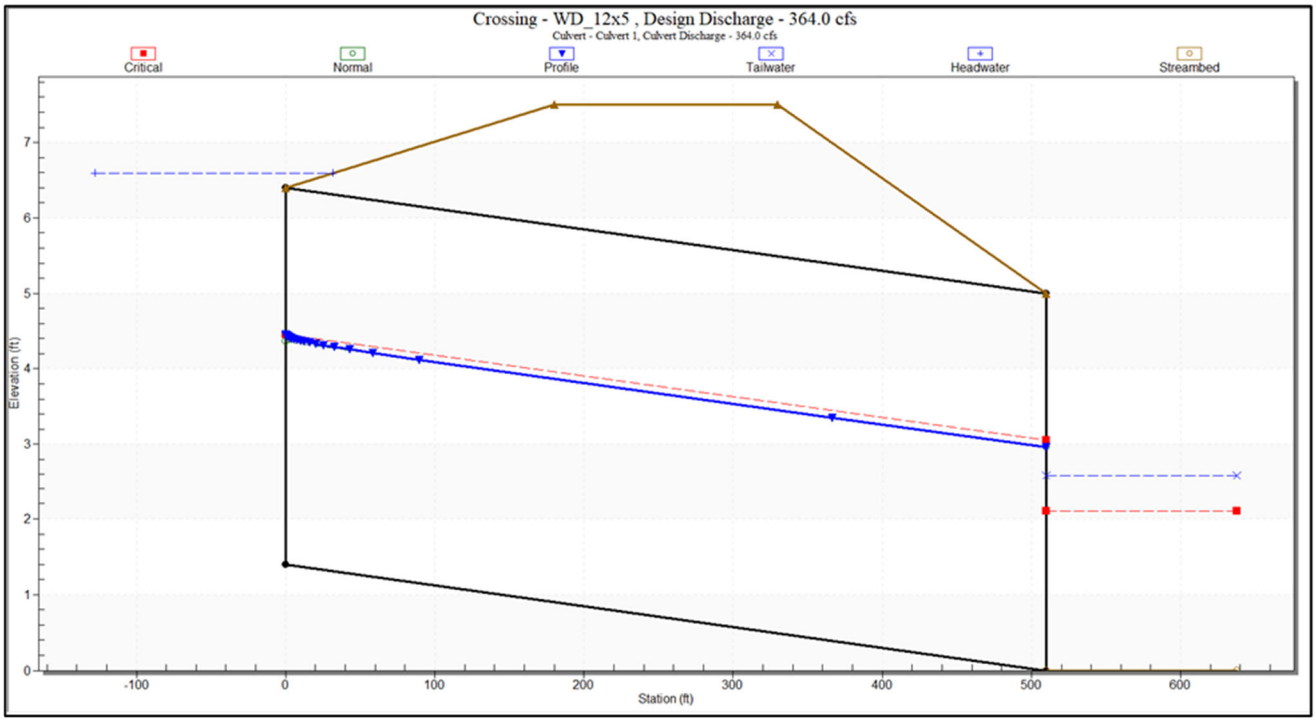
Summary of Flows at Crossing - WD_20x4

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert 1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
5.96	493.00	493.00	0.00	1
6.15	518.70	518.70	0.00	1
6.38	550.00	550.00	0.00	1
6.53	570.10	570.10	0.00	1
6.73	595.80	595.80	0.00	1
6.93	621.50	621.50	0.00	1
7.14	647.20	647.20	0.00	1
7.36	672.90	672.90	0.00	1
7.55	698.60	695.13	3.22	9
7.65	724.30	706.62	17.45	6
7.73	750.00	715.88	33.85	5
7.50	689.50	689.50	0.00	Overtopping

B.2. Waste Ditch Channel Design Cross Section



B.3. Dry Creek Box Culvert Sizing



Summary of Flows at Crossing - WD_12x5

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert 1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
5.94	300.00	300.00	0.00	1
6.04	310.00	310.00	0.00	1
6.15	320.00	320.00	0.00	1
6.25	330.00	330.00	0.00	1
6.35	340.00	340.00	0.00	1
6.45	350.00	350.00	0.00	1
6.59	364.00	364.00	0.00	1
6.66	370.00	370.00	0.00	1
6.76	380.00	380.00	0.00	1
6.86	390.00	390.00	0.00	1
6.97	400.00	400.00	0.00	1
7.50	449.71	449.71	0.00	Overtopping

B.4. Dry Creek Channel Design Cross Section