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E.1. USFWS Biological Assessment (Including IPaC)

Biological Assessment

American Fork River Supplemental Watershed Plan #15
Utah County, Utah

Prepared For:

U.S. Department of Agriculture
Natural Resources Conservation Service
Water Resources Coordinator
125 South State Street Room 4010
Salt Lake City, Utah 84138
(801) 524-4560

Prepared By:

Jones & DeMille Engineering
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February 2024

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1. Introduction

This Biological Assessment (BA) analyzes the potential effects to federally listed species and designated critical habitat from the implementation of the American Fork River Watershed Plan Supplement #15 Project in Utah County, Utah. American Fork City, the project sponsor, and Lehi City and Saratoga Springs City, the project cosponsors, propose to address flooding along the American Fork River, Dry Creek, and the Waste Ditch.

The Natural Resources Conservation Service (NRCS) is providing technical and financial assistance to the Sponsor for the project, and is the lead federal agency. The project occurs on private lands in American Fork, Lehi, and Saratoga Springs cities. Project activities will likely require Section 404 permits from the U.S. Army Corps of Engineers (USACE). This BA has been prepared for the NRCS to identify the project's potential impacts on federally listed species, including critical habitat for such, and make an effects determination in accordance with the Endangered Species Act (ESA) of 1973 (7 U.S.C. 136, 16 U.S.C. 1531 et seq.), as amended.

1.1. Consultation to Date

- September 1, 2023 – An official species list was acquired from the U.S. Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPaC) system.

2. Project Description

2.1. Project Location

The proposed project is located in northern Utah County. More specifically, the project occurs within the following sections within the Salt Lake Base and Meridian (see Map 1 in Appendix A).

T5S, R1W, Sections 12 and 13

T5S, R1E, Sections 8, 13, 14, 17, 18, 19, 23, 30

2.2. Project Details

The project consists of channel improvements at the following locations:

Location 1: Channel Improvements at 300 North in American Fork City

The proposed measures at this location include improving the channel by raising the riverbanks by 1.5 feet for approximately 350 feet upstream of 300 North and constructing new upstream and downstream wingwalls. A new concrete apron would be placed on the downstream side at the outlet to protect against erosion. The embankments would be armored with gabions or riprap to protect against erosion. Other channel improvements could include modifications to the channel slope and channel width for up to 680 feet. Trees and vegetation would be removed within the flow area. The total area of disturbance would be up to 0.9 acres.

Location 2: Channel Improvements at 100 North and 200 East in American Fork City

The proposed measures at this location include improving the channel by raising the riverbanks by 2.5 feet for approximately 350 feet upstream of 100 North and creating a new transition into the existing box culvert. The embankments would be armored with gabions or riprap to protect against erosion.

Other channel improvements could include modifications to the channel slope and channel width for up to 700 feet. Trees and vegetation would be removed within the flow area. The total area of disturbance would be up to 1.2 acres.

Location 3: Channel Improvements at 200 South in American Fork City

At this location, project measures would consist of removing energy dissipation baffle blocks that catch debris and cause backups in the channel. Riprap would be placed as erosion protection on the downstream banks instead of the baffle blocks. The existing culvert is anticipated to be replaced in the future under a separate action. Other channel improvements could include modifications to the channel slope and channel width for up to 150 feet. Trees and vegetation would be removed within the flow area. The total area of disturbance would be up to 0.3 acres.

Location 4: Channel Improvements at 400 South in American Fork City

The proposed measures at this location consist of widening the upstream channel and raising the riverbanks from 5 feet to 8 feet for approximately 300 feet using gabion baskets. Other channel improvements could include modifications to the channel slope and channel width for up to 900 feet. Trees and vegetation would be removed within the flow area. The total area of disturbance would be up to 0.9 acres.

Location 5: Upper Dry Creek in Lehi City

As Dry Creek passes Lehi Elementary School, the existing 510-foot-long 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.

The channel downstream of the box culvert 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 for approximately 381 feet. Channel slopes would match the existing channel slope, with a minimum of 0.3 percent. Trees and vegetation would be removed within the flow area. The total area of disturbance would be up to 2.6 acres.

Location 6: Upper Waste Ditch in Lehi City

As the Waste Ditch passes the school, it enters a 42-inch-diameter corrugated metal pipe, is conveyed under a portion of lawn for approximately 348 feet, and discharges back into the open channel. The existing pipe 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 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 for approximately 550 feet. Channel slopes would match the existing channel slope, with a minimum of minimum of 0.3 percent. Trees and vegetation would be removed within the flow area. The total area of disturbance would be up to 3.2 acres.

Location 7: Waste Ditch at Willow Park in Lehi City

Approximately 1,279 feet of unimproved sections of the Waste Ditch channel would be excavated and expanded to match the upstream capacity and an undersized box culvert at 300 North in Willow Park would be replaced. 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.

Floodplain diversions would also be constructed along the lower portion of the channel. Fill material would be imported and compacted into berms to contain flows adjacent to the channel. The total area of disturbance would be up to 8.1 acres.

Location 8: Lower Dry Creek in Lehi City and Saratoga Springs City

Approximately 4,150 feet of the Dry Creek channel between 1100 West and Utah Lake would be improved with a combination of channel clearing (dredging channel and restoring natural channel capacity) and gabion-lined channel sections. The minimum slope of this channel would be 0.3 percent. Several large trees would be removed from the channel to restore hydraulic capacity. Channel dredging would extend up to 2 feet below the existing channel flow line. Culverts would upsized at 1700 West (12-foot-wide by 5-foot-tall) and 1900 South (14-foot-wide by 5-foot-tall). The total area of disturbance would be up to 19.4 acres.

2.3. Operation and Maintenance

Operation and maintenance actions may include repairing damage or replacing the measure as needed to prevent failure. Normal deterioration, droughts, flooding, or vandalism that cause damage to completed measures are considered maintenance, which can include both routine and as-needed work.

2.4. Conservation Measures

The following conservation measures are proposed:

1. Work in the American Fork River and Dry Creek will occur during seasonal no-flow conditions, outside of the known June sucker (*Chasmistes liorus*) spawning period (May 15 through July 31).
2. Sediment curtains will be installed at the outflows of Dry Creek and the American Fork River into Utah Lake during in-stream work for the respective channel to reduce erosion into the lake and to reduce the potential for June suckers to enter the worksites.
3. All project personnel will be educated about the sensitive nature of the habitats, instructed to stay within the authorized project limits, and instructed on the specific avoidance and minimization measures implemented.
4. Only water (no chemicals, reclaimed production water, or oil field brine) will be used for dust abatement measures.
5. Fueling of machinery will occur in confined, designated upland areas to prevent spillage into waterways and wetlands. All fueling areas will have spill cleanup kits available.
6. Equipment will be cleaned to remove noxious weeds/seeds and petroleum products prior to accessing project sites.
7. Fill materials will be free of waste, pollutants, and noxious weeds and seeds.
8. Disturbed areas will be monitored for noxious and undesirable plant species during construction, and will be controlled using approved methods and materials to prevent spread.
9. Where practicable, disturbed areas will be seeded with a mix appropriate for the respective land use and soil conditions.
10. Where practicable, vegetation will be removed during the fall and winter to avoid impacts during the breeding bird season (March 1 – August 31). If vegetation removal activities occur between March 1 and August 31, clearance surveys for migratory birds within 10 days prior

by a qualified biologist will be required. Appropriate spatial and temporal buffers will be applied if nesting birds are located. Timing and spatial stipulations for nesting raptors will be implemented per the Utah Field Office Guidelines for Raptor Protection from Human and Land Use Disturbances (Romin and Muck 2002).

2.5. General Setting

The project is located in the northern portion of Utah County, within the Wasatch Front Valleys section of the Basin and Range physiographic province. Elevations of the project area range from approximately 4,660 feet to 4,500 feet asl. The area is largely urbanized and most ground is heavily disturbed. Many of the channels where project measures are proposed are lined with concrete or riprap, or have banks too steep to support wetland vegetation. Vegetative communities in the area are dominated by ornamental and agricultural species. Along the channels, native species such as narrowleaf cottonwood (*Populus angustifolia*) and coyote willow (*Salix exigua*) are interspersed with weedy species such as cheat grass (*Bromus tectorum*), Russian olive (*Elaeagnus angustifolia*), and Mexican fire-weed (*Bassia scoparia*). The American Fork River, Dry Creek, and the Waste Ditch are frequently dry throughout the year.

3. Species Considered

3.1. Species that May Be Present

An official species list was obtained from the Information for Planning and Consultation (IPaC) system on September 1, 2023 (see Appendix B). The species listed as threatened or endangered that "may be present in the area of the proposed action" are listed in Table 3-1 below. There is no designated critical habitat within or adjacent to the Action Area.

Table 3-1. Listed species that may be present in the area of the proposed action, and rationale for further consideration in this Biological Assessment

Species	Status	Species Likely Occurrence in the Project Area and Consideration in this BA
Canada lynx (*Lynx canadensis*)	Threatened	Not considered. Suitable high-elevation, remote forest habitat (Interagency Lynx Biology Team 2013) occurs within the watershed, but not within 4 miles of the proposed project activities. There would be no effect to Canada lynx.
Yellow-billed cuckoo (*Coccyzus americanus*)	Threatened	Not considered. The nearest critical habitat for this species is located approximately 95 miles away. Suitable riparian nesting habitat of appropriate patch size and configuration below 8,500 feet in elevation (USFWS 2017) does not occur within one-half (0.5) mile of the proposed project activities. There would be no effect to yellow-billed cuckoo.
June sucker (*Chasmistes liorus*)	Threatened	**Considered**. June sucker are known to spawn in the American Fork River when sufficient flows are present. June sucker could also occur in the lower portions of Dry Creek when sufficient flows are present.

Species	Status	Species Likely Occurrence in the Project Area and Consideration in this BA
Monarch butterfly (*Danaus plexippus*)	Candidate	Not considered. Monarchs require milkweed (*Asclepias* spp.), nectar sources, overwintering habitat, and migration habitat (USFWS 2020). Botanical surveys conducted in 2021 and 2022 did not identify milkweed in the study area. Overwintering occurs along the Pacific Coast. There would be no effect to monarch butterfly.
Ute ladies'-tresses (ULT; *Spiranthes diluvialis*)	Threatened	Not considered. Horrocks Engineers conducted protocol surveys for ULT on August 12, 2021, and habitat validations for areas that had not been surveyed on May 3, 2022 (see habitat suitability assessment in Appendix C). Suitable habitat was not identified within 300 feet of the proposed project.

The NRCS has determined that there would be no effect to the following species as a result of the proposed action: Canada lynx, yellow-billed cuckoo, monarch butterfly, and Ute ladies'-tresses.

3.2. Species Carried Forward

The June sucker were identified as potentially occurring in the vicinity of proposed project activities; therefore, this species is being carried forward in this BA for further analysis.

3.3. Current Conditions – June Sucker

The June sucker is a long-lived plankton feeder that is endemic to Utah Lake and its tributaries, and spawns in the tributaries in May and June. Spawning habitat is characterized by "moderately deep runs and riffles in slow to moderate current with a substrate composed of 4-8 in (100-200 mm) coarse gravel or small cobble that is free of silt and algae" (USFWS 2021).

Passive integrated transponder (PIT) tags have been implanted in individual suckers and hundreds of tagged individuals have been recorded spawning in the American Fork River when sufficient flows are present; however, flows have been insufficient since tagging began to identify how far upstream the suckers may spawn. There are no known barriers downstream of Location 3 (200 South), but immediately upstream of Location 3, the river is concrete lined for about one-half (0.5) mile with scarce vegetative cover or shade; this length of channel is likely a barrier to further fish passage. The barrier at Location 3 is approximately 12,000 feet upstream from Utah Lake. During a sufficient water year, June sucker can likely reach Locations 3 and 4 (see Map 2 in Appendix A).

The segment of Dry Creek (Location 8) from 1900 South to Utah Lake is approximately 0.3 miles long and may provide suitable habitat for June sucker (see Map 3 in Appendix A). The 0.6-mile-long segment of the creek between 1900 South and 1700 West lacks vegetative cover and shade and portions are concrete lined. It is unknown if the existing culverts at 1900 South or 1700 West are barriers, but the channel between them is likely a barrier to fish passage.

Suitable habitat does not occur in the Waste Ditch.

4. Project Action Area

The Action Area for the project consists of the disturbance limits for all project features, and extends 300 feet beyond the disturbance limits to address potential indirect impacts of dust and vibration. The project Action Area encompasses approximately 304 acres, and includes narrow riparian areas through dense residential and municipal development, roadways, limited irrigated fields and pastures, and portions of the Jordan River and Utah Lake.

Ongoing activities within the Action Area include residential development, agricultural development, and public infrastructure construction and maintenance.

5. Effects Analysis

5.1. Direct and Indirect Effects – June Sucker

Habitat

Since June suckers within the American Fork River are unlikely to be able to pass upstream of Location 3 (200 South), project measures at Locations 1 or 2 (upstream of Location 3) would not directly affect June sucker habitat or use of the river. The proposed improvements at Location 3 would not remove the passage barrier nor improve habitat conditions. Although June suckers could reach Location 3, approximately 730 feet of the channel downstream of 200 South does not have mature trees that would provide effective cover or shade. Removal of the vegetation along the channel at Location 3 would not affect habitat for June sucker.

Location 4 (400 South) is downstream of the barrier at Location 3 on the American Fork River. At Location 4, the channel would be widened and the riverbanks would be raised to contain the flows. Tree removal for up to 900 feet along the channel could reduce habitat suitability by removing cover and shade along the river. This segment of river is the most upstream segment that provides accessible and suitable habitat for June sucker. Approximately 10,000 feet of channel that could provide suitable habitat occurs downstream of Location 4 (between I-15 and Utah Lake) and would not be affected by the proposed action. Since June suckers are unlikely to use the river upstream of Location 4 and this segment represents less than 10 percent of the total passable river length, the loss of vegetation along the most-upstream 900 feet of suitable habitat would not have an adverse impact on June sucker use of the American Fork River.

Since suckers in Dry Creek at Location 8 are unlikely to be able to pass upstream of 1900 South, project measures upstream of that crossing would not directly affect June sucker habitat or use of the creek. Below 1900 South, approximately 0.3 miles (1,670 feet) of channel would be cleared to increase conveyance capacity; approximately 28 large trees would be removed along this length as part of the clearing. Approximately 300 feet of channel immediately downstream of 1900 South would be lined with gabion baskets, and the culvert at 1900 South would be replaced with a new box culvert. Channel modifications could reduce habitat suitability for the June sucker in Dry Creek; however, some mature trees would remain adjacent to the channel and natural stream channel substrate would remain for the majority of the segment.

Operation of the project measures would not affect June sucker habitat. Maintenance activities would be limited to the project disturbance limits and would not result in additional impacts to suitable habitat.

Species

No June sucker would be killed or injured as a result of construction activities, and conservation measures would be applied to minimize or avoid adverse impacts to June sucker during construction. In-channel work in the American Fork River and Dry Creek would occur outside of spawning season, during no- or low-flow periods when fish would not be present. Operation of the project measures would not affect June suckers. Maintenance activities would be limited to the project disturbance limits and would occur during no- or low-flow periods when fish would not be present.

Determination

Due to the localized and temporary nature of construction disturbance at each project site and the application of conservation measures, implementation of the Proposed Action may affect but would not likely adversely affect the June sucker.

5.2. Interrelated and Interdependent Effects

The project is not part of a larger action, nor would any other actions be dependent upon this project; therefore, there are no interrelated or interdependent effects of the proposed action.

5.3. Cumulative effects

Non-federal activities that are likely to occur in the foreseeable future and that have potential to cause cumulative effects include municipal and residential development throughout Utah Valley, and changes in water management that may affect flows into Utah Lake.

Most residential and municipal development would occur in uplands, and would not directly affect June sucker habitat. Changes in water management could reduce the amount and duration of flows in the river, which could further limit availability of spawning habitat. Because the Proposed Action is unlikely to adversely affect June sucker in the short or long term, cumulative impacts are not anticipated.

6. Conclusion and Determination of Effect

Considering all the potential effects disclosed above, we determine that the proposed action:

- **May affect but is not likely to adversely affect June sucker.**
- Would have no effect on all other species on the official list.
- Would have no effect on designated critical habitat.

7. Literature Cited

Interagency Lynx Biology Team. 2013. Canada lynx conservation assessment and strategy. 3rd edition. USDA Forest Service, USDI Fish and Wildlife Service, USDI Bureau of Land Management, and USDI National Park Service. Forest Service Publication R1-13-19, Missoula, MT. 128 pp.

Romin, L. A., and J. A. Muck. 2002. Utah Field Office Guidelines for Raptor Protection from Human and Land Use Disturbances. U.S. Fish and Wildlife Service, Utah Field Office, Salt Lake City, Utah.

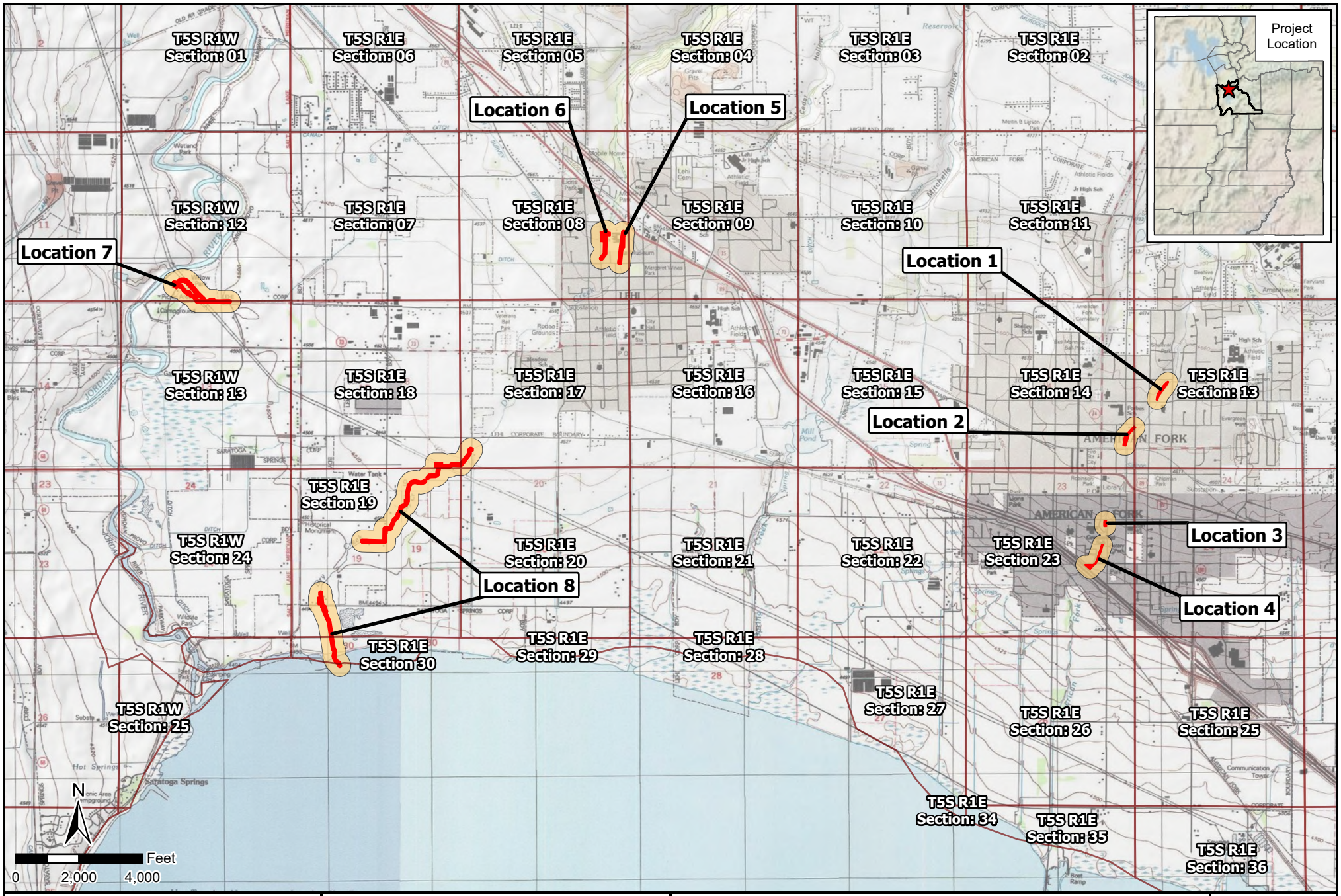
USFWS. 2017. Guidelines for the identification and evaluation of suitable habitat for western yellow-billed cuckoo in Utah. https://www.fws.gov/utahfieldoffice/Documents/August%202017%20Guidelines%20for%20the

%20identification%20and%20evaluation%20of%20suitable%20habitat%20for%20western%20yellow%20billed%20cuckoo%20in%20Utah.pdf. (Accessed 10-30-2020)

_____. 2020. Monarch (*Danaus plexippus*) Species Status Assessment Report. V2.1 96 pp + appendices.

_____. 2021. Endangered and Threatened Wildlife and Plants; Reclassification of the Endangered June Sucker to Threatened with a Section 4(d) Rule. Federal Register 86:192-212. January 4, 2021.

Appendix A. Maps



Disturbed Area

Action Area

Township and Range Sections

Jones & DeMille Engineering

- Shaping the Quality of Life -

800.748.5275 www.jonesanddemille.com

American Fork River Supplemental Watershed Plan #15

Biological Assessment – Project Overview

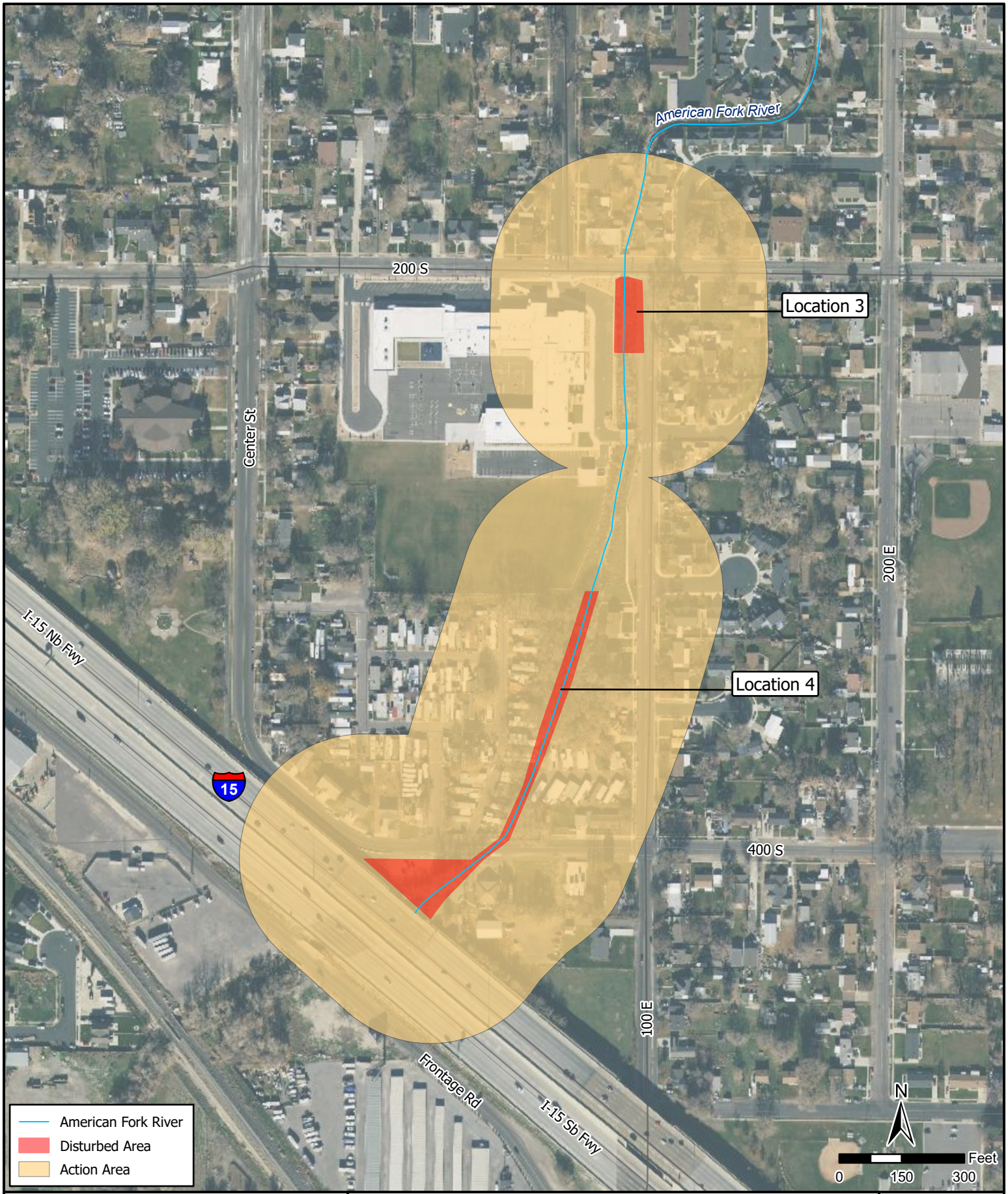
Map Name: H:\JD\Proj\2004-028\Design\GIS\Projects\Environmental\2004-028_Env.aprx - Exh 01 Biological Assessment Project Overview

Project Number: 2004-028 | Drawn by: TAS 07-22 | Last Edit: 04/28/2023

Utah County, Utah

Scale: 1" = 4,000'

1



Jones & DeMille Engineering

- Shaping the Quality of Life -

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American Fork River Supplemental Watershed Plan #15

Utah County, Utah

Biological Assessment – Locations 3 and 4

Scale: 1" = 300'

Map Name: H:\JD\Proj\2004-028\Design\GIS\Projects\Environmental\2004-028_Env.aprx - Exh 02 Biological Assessment – Locations 3 and 4

Project Number: 2004-028 | Drawn by: TAS 07-22 | Last Edit: 04/27/2023

2



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American Fork River Supplemental Watershed Plan #15

Utah County, Utah

Biological Assessment – Location 8

Scale: 1" = 300'

Map Name: H:\JD\Proj\2004-028\Design\GIS\Projects\Environmental\2004-028_Env.aprx - Exh 03 Biological Assessment – Location 8

Project Number: 2004-028 | Drawn by: TAS 07-22 | Last Edit: 05/04/2023

3

Appendix B. USFWS IPaC Species Report

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Utah Ecological Services Field Office
2369 West Orton Circle, Suite 50
West Valley City, UT 84119-7603
Phone: (801) 975-3330 Fax: (801) 975-3331

In Reply Refer To: September 01, 2023
Project Code: 2022-0009580
Project Name: American Fork Supplemental Watershed Plan

Subject: List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed, and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the IPaC system by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, the Service suggests that a biological

evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

https://www.fws.gov/sites/default/files/documents/endangered-species-consultation-handbook.pdf

Migratory Birds: In addition to responsibilities to protect threatened and endangered species under the Endangered Species Act (ESA), there are additional responsibilities under the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA) to protect native birds from project-related impacts. Any activity, intentional or unintentional, resulting in take of migratory birds, including eagles, is prohibited unless otherwise permitted by the U.S. Fish and Wildlife Service (50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)). For more information regarding these Acts, see https://www.fws.gov/program/migratory-bird-permit/what-we-do.

The MBTA has no provision for allowing take of migratory birds that may be unintentionally killed or injured by otherwise lawful activities. It is the responsibility of the project proponent to comply with these Acts by identifying potential impacts to migratory birds and eagles within applicable NEPA documents (when there is a federal nexus) or a Bird/Eagle Conservation Plan (when there is no federal nexus). Proponents should implement conservation measures to avoid or minimize the production of project-related stressors or minimize the exposure of birds and their resources to the project-related stressors. For more information on avian stressors and recommended conservation measures, see https://www.fws.gov/library/collections/threats-birds.

In addition to MBTA and BGEPA, Executive Order 13186: *Responsibilities of Federal Agencies to Protect Migratory Birds*, obligates all Federal agencies that engage in or authorize activities that might affect migratory birds, to minimize those effects and encourage conservation measures that will improve bird populations. Executive Order 13186 provides for the protection of both migratory birds and migratory bird habitat. For information regarding the implementation of Executive Order 13186, please visit https://www.fws.gov/partner/council-conservation-migratory-birds.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Code in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List

OFFICIAL SPECIES LIST

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Utah Ecological Services Field Office
2369 West Orton Circle, Suite 50
West Valley City, UT 84119-7603
(801) 975-3330

PROJECT SUMMARY

Project Code: 2022-0009580
Project Name: American Fork Supplemental Watershed Plan
Project Type: Flooding
Project Description: Watershed planning measures within the American Fork Watershed
Project Location:

The approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@40.4556242,-111.7632203772763,14z



Counties: Salt Lake, Utah, and Wasatch counties, Utah

ENDANGERED SPECIES ACT SPECIES

There is a total of 5 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

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1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

MAMMALS

NAME	STATUS
Canada Lynx *Lynx canadensis* Population: Wherever Found in Contiguous U.S. There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/3652	Threatened

BIRDS

NAME	STATUS
Yellow-billed Cuckoo *Coccyzus americanus* Population: Western U.S. DPS There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/3911	Threatened

FISHES

NAME	STATUS
June Sucker *Chasmistes liorus* There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/4133	Threatened

INSECTS

NAME	STATUS
Monarch Butterfly *Danaus plexippus*	Candidate

No critical habitat has been designated for this species.
Species profile: https://ecos.fws.gov/ecp/species/9743

FLOWERING PLANTS

NAME	STATUS
Ute Ladies'-tresses *Spiranthes diluvialis*	Threatened

No critical habitat has been designated for this species.
Species profile: https://ecos.fws.gov/ecp/species/2159

CRITICAL HABITATS

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

YOU ARE STILL REQUIRED TO DETERMINE IF YOUR PROJECT(S) MAY HAVE EFFECTS ON ALL ABOVE LISTED SPECIES.

IPAC USER CONTACT INFORMATION

Agency: Natural Resources Conservation Service
Name: Jenna Jorgensen
Address: 1535 S. 100 W.
City: Richfield
State: UT
Zip: 84701
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Phone: 4358935203

Appendix C. Ute Ladies'-tresses Habitat Suitability Assessment

HORROCKS ENGINEERS

MEMORANDUM

TO: Project File

FROM: Marley Madsen, Biologist

DATE: May 12, 2022

SUBJECT: **Ute ladies'-tresses Habitat Suitability Assessment**
American Fork River Supplemental Watershed Plan

INTRODUCTION

The United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS), with assistance from American Fork City as the project sponsor, and Lehi City as project co-sponsor, is considering proposed improvements within the American Fork River Watershed. The main objective of the project is to implement flood reduction and prevention solutions in specific locations within sponsor cities that will protect public safety on public roadways, private property, and agricultural areas. The proposed improvements include the design and construction of concrete box culverts and the reconstruction of channels to increase capacity and improve channel operations.

As part of this project, the USDA-NRCS must evaluate potential impacts to threatened and endangered species listed under the Endangered Species Act (ESA). The purpose of this memorandum is to assess habitat suitability in the study area for the ESA listed plant species, Ute ladies'-tresses (*Spiranthes diluvalis*). This memorandum also provides recommendations for whether clearances surveys following approved U.S. Fish and Wildlife Service (USFWS) should be performed for Ute ladies'-tresses (ULT) prior to project implementation.

EVALUATION METHODS

The proposed project includes nine separate study areas located within the cities of American Fork and Lehi (see attached Project Location Map). Nathan Clarke of Horrocks Engineers performed field visits to each of the study areas to assess habitat suitability for ULT. Field work took place on two separate dates, August 12, 2021, and May 3, 2022. Habitat suitability was determined using habitat descriptions found in *Rangewide Status Review of Ute Ladies'-Tresses* (Fertig 2005) and *Revised Interim Survey Requirements for Ute Ladies'-tresses Orchid* (USFWS 2017). Habitat suitability requirements are summarized below:

> ULT is a perennial forb and member of the orchid family. It has laterally symmetrical white or ivory flowers that gradually spiral up the stem. ULT is primarily associated with moist meadows, perennial stream terraces, floodplains, oxbows, seasonally flooded river terraces, and subirrigated or spring-fed abandoned stream channels, valleys, and lakeshores. It can also be found in human-altered wetlands such as irrigation canals, berms, levees, irrigated meadows, gravel pits, roadside barrows, and reservoirs. In Utah, the elevational range of the species is from approximately 4,300 to 7,000 feet above sea level (Fertig 2005).

Habitats that cannot support ULT include highly disturbed or modified sites, uplands, sites entirely inundated by standing water, sites composed of heavy clay soils, very saline sites, and sites composed entirely of dense strands of reed canary grass (*Phalaris arundinacea*), tamarisk (*Tamarix ramosissima*), greasewood (*Sarcobatus vermiculatus*), teasel (*Dipsacus sylvestris*), or common reed (*Phragmites australis*) (USFWS 2017). Additionally, ULT do not persist in shay wetland areas dominated by riparian shrubs and trees (e.g., willows or cottonwoods) (Fertig 2005).

HABITAT SUITABILITY ASSESSMENT RESULTS

No suitable habitat for ULT was identified in the study area during the habitat suitability assessment. The habitat in the study area is too disturbed or modified and/or composed of upland plant species or unsuitable riparian shrubs or trees.

The study area is extremely urbanized and nearby developments include schools, businesses, and residential areas. Undeveloped portions of the study area are still heavily disturbed. Much of the American Fork River and other watershed features within the study area are lined with concrete, riprap, or have banks too steep to support wetland vegetation (see Figures 1 – 6). Vegetative communities in the study area are dominated by weedy and noxious species such as cheat grass (*Bromus tectorum*), Russian olive (*Elaeangnus angustifolia*), and Mexican fire-weed (*Bassia scoparia*). Native vegetation found in the study area includes narrowleaf cottonwood (*Populus angustifolia*) and coyote willow (*Salix exigua*).



Figure 1 – General habitat conditions in the study area. Photo shows Dry Creek as a concrete lined channel, surrounded by uplands and residential and commercial developments.



Figure 2 - General habitat conditions in the study area. Photo shows a dry segment of the American Fork River with steep banks and weeds.



Figure 3 - General habitat conditions in the study area. Photo shows Waste Ditch with unvegetated, heavily shaded, steep banks.



Figure 4 - General habitat conditions in the study area. Photo shows Waste Ditch with concrete lined and steep, gravelly banks.



Figure 5 - General habitat conditions in the study area. Photo shows a dry segment of the American Fork River shaded by large cottonwoods.



Figure 6 - General habitat conditions in the study area. Photo shows a dry, concrete lined segment of the American Fork River.

Aerial imagery shows three locations within the study area that appear to contain potentially suitable habitat for ULT: a wetland at Willow Park; a field adjacent to Dry Creek and south of Pioneer Crossing; and a field adjacent to Dry Creek and south of 145 North (see attached map). Field visits to each of these areas were conducted on May 3, 2022, and it was determined that the habitat was not suitable for the following reasons:

- **Willow Park**: What appears to be a wetland area at Willow Park in the aerial imagery (see Figure 7), is actually a small pond. Usually, the pond is completely inundated with water making it unsuitable for ULT. Additionally, when the pond is empty it is dominated by incompatible species such as teasel (*Dipsacus follonum*) (see Figure 8).
- **Field south of Pioneer Crossing**: The field adjacent to Dry Creek and south of Pioneer Crossing looks like it could be a pasture containing wet meadow vegetation in the aerial imagery (see Figure 9). However, the field is actually an agricultural field that is tilled and planted annually making it unsuitable for ULT (see Figure 10).
- **Field south of 145 North**: The field adjacent to Dry Creek and south of 145 North looks like it could be a pasture containing wet meadow vegetation in the aerial imagery (see Figure 11). However, the field is extremely dry and dominated by upland plant species such as intermediate wheatgrass (*Thinopyrum intermedium*) and Johnson grass (*Sorghum halepense*), making it unsuitable for ULT (see Figure 12).



Figure 7 – Aerial image of the pond at Willow Park (indicated by the white arrow). Aerial image is from Google Earth and was taken in May 2021.



Figure 8 - General habitat conditions in the pond at Willow Park. A "No Swimming Allowed Sign", and a cement water outfall structure (outside the photo frame) indicate that the area is usually inundated with water.



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Figure 10 - General habitat conditions of the field adjacent to Dry Creek and south of Pioneer Crossing. The field is dry, has been recently tilled, and contains planted rows of crops.



Figure 11 – Aerial image of the field adjacent to Dry Creek and south of 145 North. Aerial image is from Google Earth and was taken May 2022.



Figure 12 - General habitat conditions of the field adjacent to dry creek and south of 145 North. The photo looks like it could have been taken in suitable wet meadow habitat. However, the field is extremely dry and is dominated by non-native upland grasses. There is no evidence of a high-water table or other hydrology necessary to support ULT.

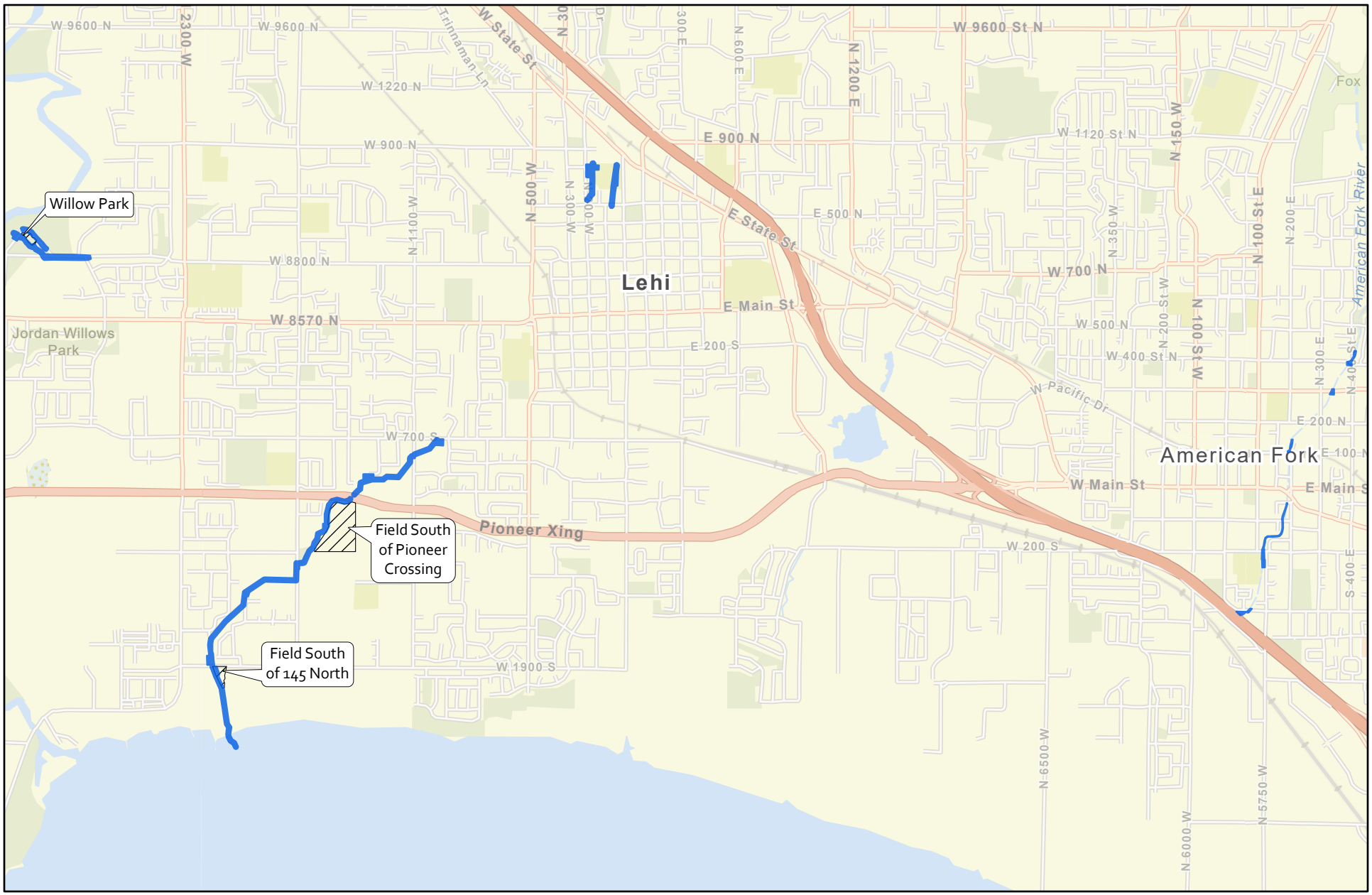
CONCLUSION

There is no suitable habitat in the study area for ULT. Presence/absence surveys for ULT are not recommended and no mitigation is required.

REFERENCES

Fertig, W. et al. 2005. *Rangewide Status Review of Ute Ladies'-Tresses (Spiranthes diluvialis)*. https://efotg.sc.egov.usda.gov/references/public/WY/UtesRangewideStatusReview2005byFertig.pdf

U.S. Fish and Wildlife Service (USFWS). 2017. *Revised Interim Survey Requirements for Ute Ladies'-tresses Orchid (Spiranthes diluvialis).* https://www.fws.gov/sites/default/files/documents/SPDI_interimSurveyRequirements_1992_revised%202017.pdf



ULT Habitat Assessment

NRCS AF River Watershed Improvement

Appendix C. Ute Ladies'-tresses Habitat Suitability Assessment

HORROCKS ENGINEERS

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TO: Project File

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DATE: May 12, 2022

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The proposed project includes nine separate study areas located within the cities of American Fork and Lehi (see attached Project Location Map). Nathan Clarke of Horrocks Engineers performed field visits to each of the study areas to assess habitat suitability for ULT. Field work took place on two separate dates, August 12, 2021, and May 3, 2022. Habitat suitability was determined using habitat descriptions found in *Rangewide Status Review of Ute Ladies'-Tresses* (Fertig 2005) and *Revised Interim Survey Requirements for Ute Ladies'-tresses Orchid* (USFWS 2017). Habitat suitability requirements are summarized below:

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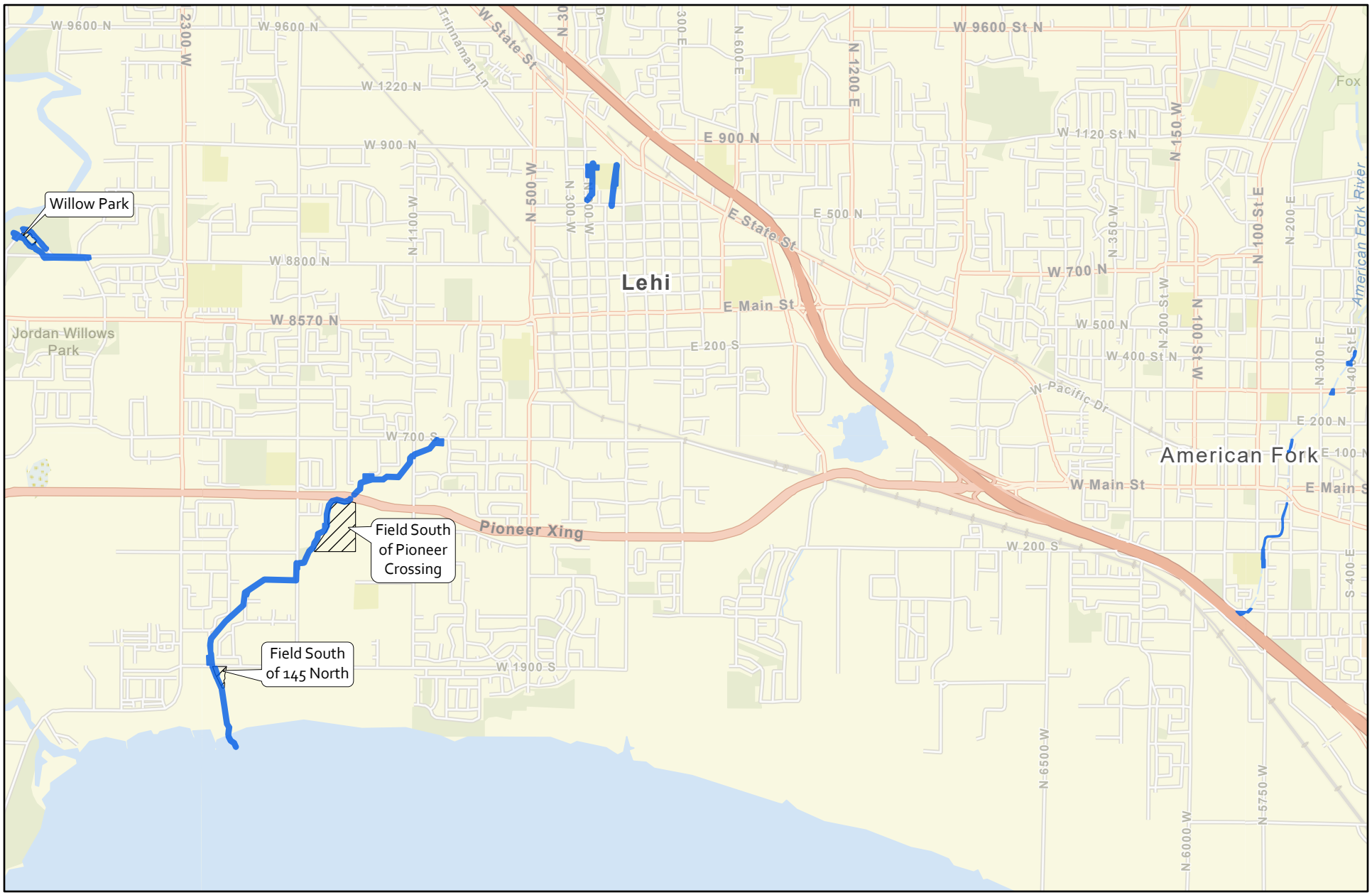
CONCLUSION

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REFERENCES

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ULT Habitat Assessment

NRCS AF River Watershed Improvement

E.2. Fish and Wildlife Species of Concern

Fish and Wildlife Species of Concern

Fish and wildlife species and habitats are managed on multiple levels. Species of concern that may occur in the watershed area are listed in Table 1, and were identified from the following data sets: Utah species of concern (see Utah Natural Heritage Program Online Species Search Report from October 5, 2021, in Biological Assessment in **Error! Reference source not found.**), UDWR big game habitat coverages[1], and additional migratory birds (see USFWS IPaC report in Biological Assessment in **Error! Reference source not found.**).

Table 1. Fish and wildlife species of concern that may occur in the watershed area

Species	Classification	Status relative to watershed area	Potential to be impacted by project
American bittern (*Botaurus lentiginosus*)	Utah species of greatest conservation need	American bittern have been observed within or near the watershed, and are associated with wetland habitats (Parrish et al. 2002).	None. Suitable habitats do not occur within the project area.
American white pelican (*Pelecanus erythrorhynchos*)	Utah species of greatest conservation need	Pelicans have been observed within or near the watershed and are associated with wetland and water habitats (Parrish et al. 2002).	None. Suitable habitats do not occur within the project area.
American pika (*Ochotona princeps*)	Utah species of greatest conservation need	Pika may occur within the watershed where habitat includes “high-elevation talus slopes, boulder fields, and adjacent meadows” (UDWR 2015).	None. Suitable habitats do not occur within the project area.
Bald eagle (*Haliaeetus leucocephalus*)	Utah species of greatest conservation need; Migratory bird	Bald eagles have been observed within the watershed, and may hunt or scavenge throughout the area.	Likely to forage/scavenge in project area.
Band-tailed pigeon (*Patagioenas fasciata*)	Utah species of greatest conservation need	Band-tailed pigeon habitat includes “mountainous forest and woodland habitats” (UDWR 2015:246). UDWR-mapped crucial spring-fall habitat occurs within the watershed.	None. Suitable habitats do not occur within the project area.
Bendire’s thrasher (*Toxostoma bendirei*)	Utah species of greatest conservation need	Bendire’s thrasher occur in association with low desert scrub habitats (Parrish et al. 2002), which are limited due to urban development in the lower elevations of the watershed.	None. Suitable habitats do not occur within the project area.
Black rosy-finch *(Leucosticte atrata)*	Utah species of greatest conservation need; Migratory bird	The black rosy-finch nests in cliffs and talus slopes in alpine habitats (UDWR 2015), which occur at the high elevations within the watershed.	None. Suitable habitats do not occur within the project area.

[1] Available at: https://dwrcdc.nr.utah.gov/ucdc/downloadgis/disclaim.htm (accessed 5-31-21)

Species	Classification	Status relative to watershed area	Potential to be impacted by project
Black swift (*Cypseloides niger*)	Utah species of greatest conservation need; Migratory bird	Black swift nest in association with waterfalls but may forage in lowland riparian habitats (Parrish et al. 2002), including riparian areas within the watershed.	May forage in project area.
Bobolink (*Dolichonyx oryzivorus*)	Migratory bird	Bobolink are associated with wet meadow and agricultural habitats (Parrish et al. 2002), which occur in the lower elevations of the watershed.	None. Suitable habitats do not occur within the project area.
Bonneville cutthroat trout (*Oncorhynchus clarki utah*)	Utah species of greatest conservation need	Bonneville cutthroat trout are known to occur in tributaries above the mouth of American Fork Canyon (Mike Slater, UDWR; personal communication, October 6, 2021).	None. Suitable habitats do not occur within the project area.
Boreal (western) toad (*Anaxyrus boreas*)	Utah species of greatest conservation need	Boreal toad could occur in association with waters and wetlands at the higher elevations of the watershed, generally above 7,500 feet (Keinath and McGee 2005).	None. Suitable habitats do not occur within the project area.
Brown-capped rosy-finch (*Leucosticte australis*)	Migratory bird	The brown-capped rosy-finch nests in cliffs and talus slopes in alpine habitats (Sibley 2003), which occur at the high elevations within the watershed.	None. Suitable habitats do not occur within the project area.
Burrowing owl (*Athene cunicularia*)	Utah species of greatest conservation need	Burrowing owl occurs in association with high desert scrub and grasslands (Parrish et al. 2002), which are limited due to urban development in the lower elevations of the watershed.	None. Suitable habitats do not occur within the project area.
Cassin's finch (*Carpodacus cassinii*)	Migratory bird	Cassin's finch are associated with aspen and subalpine conifer habitats in Utah (Parrish et al. 2002), which occur at the high elevations within the watershed.	None. Suitable habitats do not occur within the project area.
Clark's grebe (*Aechmophorus clarkii*)	Migratory bird	Clark's grebe are associated with wetland habitats in Utah (Parrish et al. 2002).	None. Suitable habitats do not occur within the project area.
Evening grosbeak (*Coccothraustes vespertinus*)	Migratory bird	Evening grosbeak are associated with conifer habitats in Utah (Parrish et al. 2002), which occur at the high elevations within the watershed.	None. Suitable habitats do not occur within the project area.
Ferruginous hawk (*Buteo regalis*)	Utah species of greatest conservation need	Ferruginous hawks could occur in association with pinyon-juniper and shrubsteppe habitats within the watershed area (Parrish et al. 2002).	None. Suitable habitats do not occur within the project area.

Species	Classification	Status relative to watershed area	Potential to be impacted by project
Flammulated owl (*Psiloscops flammeolus*)	Utah species of greatest conservation need	Flammulated owl occur in association with coniferous forest habitats (Parrish et al. 2002), which occur at the high elevations within the watershed.	None. Suitable habitats do not occur within the project area.
Franklin's gull (*Leucophaeus pipixcan*)	Migratory bird	Franklin's gull are associated with wetland habitats (Parrish et al. 2002).	None. Suitable habitats do not occur within the project area.
Greater sage-grouse (*Centrocercus urophasianus*)	Utah species of greatest conservation need	Although historic records of sage-grouse occur within the watershed area, suitable habitat is not mapped in the area.	None. Suitable habitats do not occur within the project area.
Green River pebblesnail (*Fluminicola coloradoensis*)	Utah species of greatest conservation need	The species is known to occur in the Jordan River, but specific habitat needs are unknown (UDWR 2022).	None. Suitable perennial water sources do not occur within the project area.
Kit fox (*Vulpes macrotis*)	Utah species of greatest conservation need	Kit fox in Utah occur in open desert-shrub habitats (BLM 2007), which are limited due to urban development in the lower elevations of the watershed.	None. Suitable habitats do not occur within the project area.
Least chub (*Iotichthys phlegethontis*)	Utah species of greatest conservation need	Although a historic record of the least chub occurs within the watershed area, the species is only known to occur outside of the area (USFWS 2014).	None. Suitable habitats do not occur within the project area.
Lesser yellowlegs (*Tringa flavipes*)	Migratory bird	Lesser yellowlegs may occur in mud flat areas in Utah during migration (Sibley 2003), which may occur in association with Utah Lake and the Jordan River.	None. Suitable habitats do not occur within the project area.
Lewis's woodpecker (*Melanerpes lewis*)	Utah species of greatest conservation need, Migratory bird	In Utah, Lewis's woodpecker primarily nest in ponderosa pine, but will also breed in lowland riparian habitats (Parrish et al. 2002).	May nest in project area.
Little brown myotis (*Myotis lucifugus*)	Utah species of greatest conservation need	Little brown myotis are associated with forest habitats (including parks) throughout Utah (Oliver 2000).	Likely to roost and forage in project area.
Long-eared owl (*Asio otus*)	Migratory bird	Long-eared owl occur in association with lowland and mountain riparian habitats (Parrish et al. 2002).	May nest in project area.
Marbled godwit (*Limosa fedoa*)	Migratory bird	Marbled godwit may occur in mud flat areas in Utah during migration (Sibley 2003).	None. Suitable habitats do not occur within the project area.
Mule deer (*Odocoileus hemionus*)	UDWR-mapped habitat	Mule deer and UDWR-mapped habitats are known to occur within the watershed.	Unlikely. Although deer may range through the area, the highly modified project area does not provide suitable habitat characteristics.

Species	Classification	Status relative to watershed area	Potential to be impacted by project
Northern leopard frog (*Lithobates pipiens*)	Utah species of greatest conservation need	Northern leopard frog could occur in association with waters and wetlands within the watershed (Smith and Keinath 2007).	None. Suitable habitats do not occur within the project area.
Olive-sided flycatcher (*Contopus cooperi*)	Utah species of greatest conservation need, Migratory bird	Olive-sided flycatcher are associated with subalpine conifer habitats in Utah (Parrish et al. 2002), which occur at the high elevations within the watershed.	None. Suitable habitats do not occur within the project area.
Peregrine falcon (*Falco peregrinus anatum*)	Utah species of greatest conservation need; Migratory bird	Suitable cliff nesting and proximal foraging habitat (USFWS 1984) occur within the watershed.	May forage within the project area.
Pinyon jay (*Gymnorhinus cyanocephalus*)	Migratory bird	Pinyon jay are associated with pinyon-juniper type habitat in Utah (Parrish et al. 2002), which may occur along the foothills in the watershed.	None. Suitable habitats do not occur within the project area.
Rocky Mountain bighorn sheep (*Ovis canadensis*)	UDWR-mapped habitat	Rocky mountain bighorn sheep and UDWR-mapped habitats are known to occur within the watershed.	None. Suitable habitats do not occur within the project area.
Rocky Mountain elk (*Cervus elaphus nelsoni*)	UDWR-mapped habitat	Rocky mountain elk and UDWR-mapped habitats are known to occur within the watershed.	None. Suitable habitats do not occur within the project area.
Rufous hummingbird (*Selasphorus rufus*)	Migratory bird	Rufous hummingbird may occur in Utah during migration (Sibley 2003).	May roost in riparian habitat in the project area.
Sage thrasher (*Oreoscoptes montanus*)	Migratory bird	Sage thrasher are associated with shrub-steppe and high desert scrub habitats in Utah (Parrish et al. 2002).	None. Suitable habitats do not occur within the project area.
Townsend's big-eared bat (*Corynorhinus townsendii)*	Utah species of greatest conservation need	Townsend's big-eared bats roost sites range from the lowest elevations in Utah up to 10,460 feet (Gruver and Keinath 2006), and may occur within the watershed.	May roost and forage in the project area.
Turkey	UDWR-mapped habitat	Mapped habitat occurs along the foothills within the watershed area.	None. Suitable habitats do not occur within the project area.
Virginia's warbler (*Vermivora virginiae*)	Migratory bird	Virginia's warbler are associated with oak and pinyon-juniper habitats in Utah (Parrish et al. 2002), which occur along the foothills of the watershed.	None. Suitable habitats do not occur within the project area.
Willet (*Tringa semipalmata*)	Migratory bird	Willet are associated with wetland and wet meadow habitats in Utah (Parrish et al. 2002).	None. Suitable habitats do not occur within the project area.
Wolverine (*Gulo gulo luscus*)	Utah species of greatest conservation need	Wolverine may range in the forested areas of the watershed (USFWS 2018).	None. Suitable habitats do not occur within the project area.

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E.3 NRCS Soil Resource Report

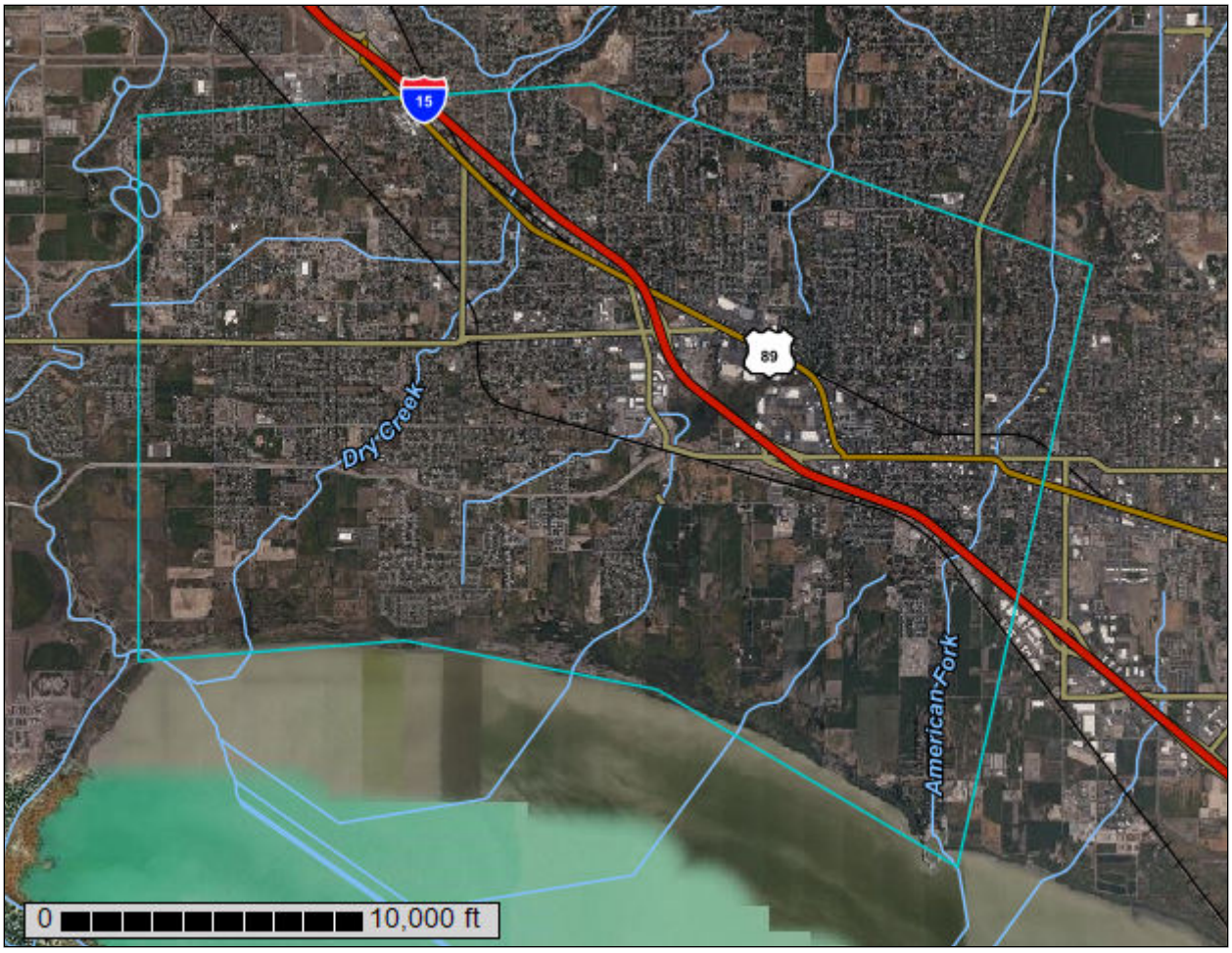
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Utah County, Utah - Central Part



February 10, 2022

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

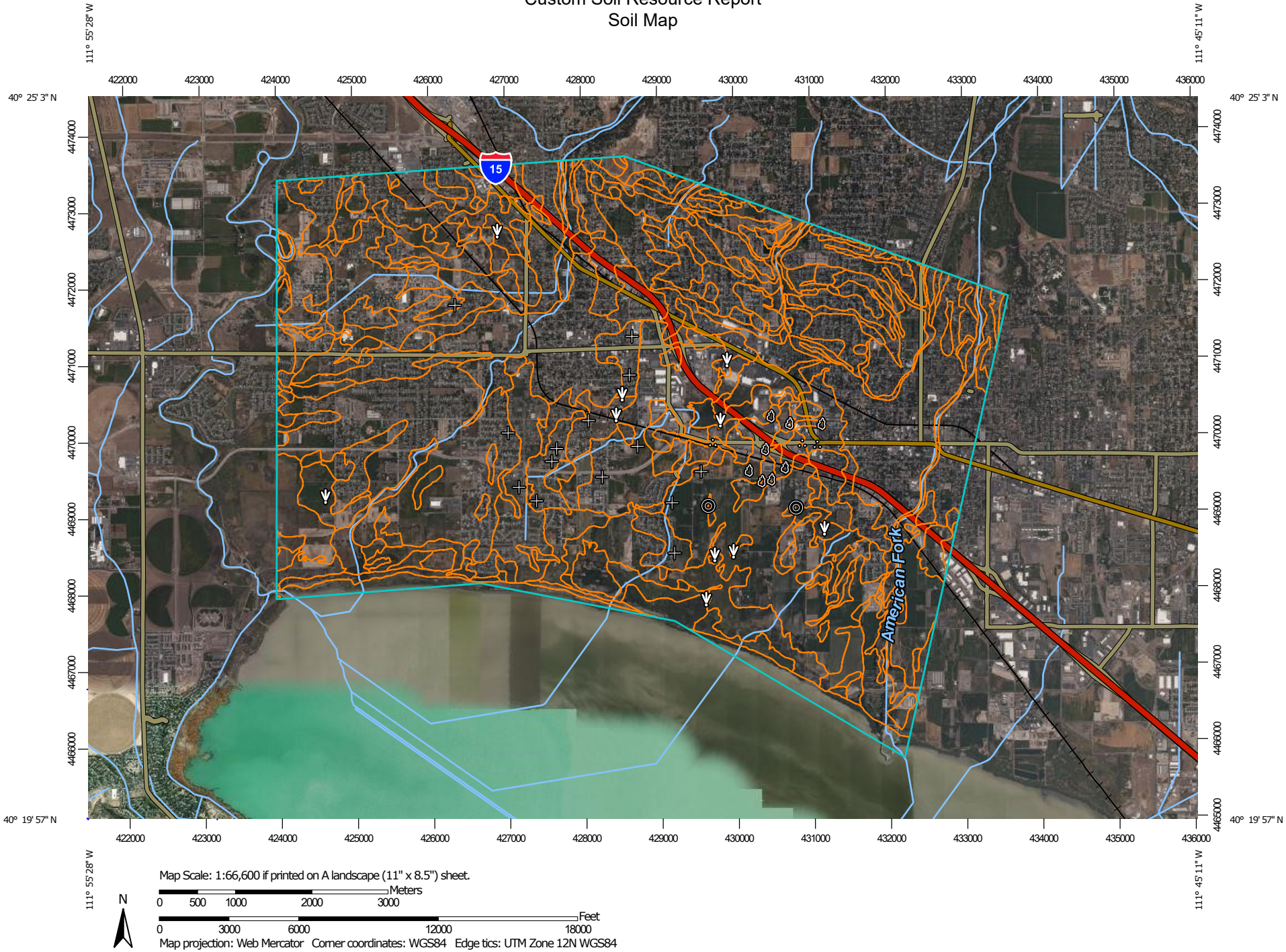
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Utah County, Utah - Central Part
Survey Area Data: Version 14, Sep 7, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 14, 2010—Aug 29, 2018

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
1000	Parleys loam, 0 to 4 percent slopes	12.6	0.1%
BC	Beaches	79.3	0.6%
BhB	Bingham loam, 1 to 3 percent slopes	51.8	0.4%
Br	Bramwell silty clay loam	1,157.9	8.9%
Bs	Bramwell silty clay loam, drained	328.4	2.5%
Ch	Chipman loam	17.0	0.1%
Ck	Chipman silty clay loam	1,076.9	8.3%
Cm	Chipman silty clay loam, moderately deep water table	551.7	4.2%
Cn	Chipman silty clay loam, moderately saline	50.0	0.4%
Cp	Chipman-McBeth complex	263.1	2.0%
CU	Cobbly alluvial land	34.3	0.3%
HOF	Hillfield-Sterling complex, 20 to 35 percent slopes	133.9	1.0%
Hr	Holdaway silt loam	139.5	1.1%
Ir	Ironton loam	16.6	0.1%
Is	Ironton loam, moderately saline-alkali	61.3	0.5%
Ks	Kirkham silty clay loam	335.4	2.6%
Kt	Kirkham silty clay loam, moderately saline-alkali	195.2	1.5%
LaC	Lakewin gravelly fine sandy loam, 1 to 6 percent slopes	612.4	4.7%
LaD	Lakewin gravelly fine sandy loam, 6 to 15 percent slopes	9.1	0.1%
LfC	Layton fine sandy loam, 1 to 6 percent slopes	137.2	1.1%
Lo	Logan silty clay loam	294.6	2.3%
Ls	Logan silty clay loam, heavy variant	142.4	1.1%
Mf	Martini fine sandy loam	122.0	0.9%
Mh	McBeth silt loam	463.7	3.6%
Mn	McBeth silt loam, moderately saline	147.2	1.1%
MU	Mixed alluvial land	107.6	0.8%
Pf	Peteetneet peat	150.1	1.2%
PK	Pits and dumps	39.3	0.3%

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
Pw	Provo gravelly fine sandy loam	86.1	0.7%
RdA	Redola loam, 0 to 3 percent slopes	101.4	0.8%
ReC	Redola gravelly loam, 3 to 6 percent slopes	8.1	0.1%
RV	Riverwash	31.0	0.2%
Sd	Steed sandy loam	254.8	2.0%
Se	Steed gravelly sandy loam	968.1	7.5%
SgB	Sterling gravelly fine sandy loam, 1 to 3 percent slopes	77.6	0.6%
SgC	Sterling gravelly fine sandy loam, 3 to 6 percent slopes	187.4	1.4%
SgD	Sterling gravelly fine sandy loam, 6 to 10 percent slopes	231.8	1.8%
Sr	Sunset loam	1,178.2	9.1%
Ss	Sunset loam, gravelly substratum	876.4	6.7%
TaA	Taylorsville silty clay loam, 0 to 1 percent slopes	251.5	1.9%
TaB	Taylorsville silty clay loam, 1 to 3 percent slopes	230.2	1.8%
TmB	Timpanogos loam, 0 to 3 percent slopes	4.5	0.0%
VnA	Vineyard fine sandy loam, 0 to 2 percent slopes	399.0	3.1%
VsA	Vineyard fine sandy loam, moderately saline, 0 to 2 percent slopes	261.5	2.0%
W	Water	340.8	2.6%
WbA	Welby silt loam, 0 to 1 percent slopes	239.2	1.8%
WbB	Welby silt loam, 1 to 3 percent slopes	454.1	3.5%
WbC	Welby silt loam, 3 to 6 percent slopes	62.5	0.5%
WeB	Welby silt loam, extended season, 1 to 3 percent slopes	17.6	0.1%
Totals for Area of Interest		**12,993.0**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps.

The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Utah County, Utah - Central Part

1000—Parleys loam, 0 to 4 percent slopes

Map Unit Setting

National map unit symbol: 2tjtg
Elevation: 4,210 to 5,400 feet
Mean annual precipitation: 12 to 18 inches
Mean annual air temperature: 49 to 51 degrees F
Frost-free period: 130 to 180 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Parleys and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Parleys

Setting

Landform: Lake terraces, stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits and/or alluvium derived from igneous and sedimentary rock

Typical profile

Ap - 0 to 6 inches: loam
A - 6 to 15 inches: loam
Bt - 15 to 26 inches: clay loam
Bk - 26 to 33 inches: silty clay loam
CBk - 33 to 48 inches: silt loam
C - 48 to 60 inches: stratified fine sand to silty clay loam

Properties and qualities

Slope: 0 to 4 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 35 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 5.0
Available water supply, 0 to 60 inches: High (about 10.8 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Ecological site: R028AY310UT - Upland Loam (Bonneville Big Sagebrush) North

Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)
Hydric soil rating: No

Minor Components

Unnamed soils
Percent of map unit: 15 percent
Hydric soil rating: No

BC—Beaches

Map Unit Setting
National map unit symbol: j6wc
Elevation: 4,490 to 4,510 feet
Farmland classification: Not prime farmland

Map Unit Composition
Beaches: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Beaches

Setting
Landform: Beach plains
Landform position (three-dimensional): Rise, talf
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile
H1 - 0 to 60 inches: fine sand

Properties and qualities
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: About 12 to 24 inches
Calcium carbonate, maximum content: 5 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 10.0
Available water supply, 0 to 60 inches: Low (about 3.6 inches)

BhB—Bingham loam, 1 to 3 percent slopes

Map Unit Setting
National map unit symbol: j6wj

Elevation: 4,700 to 5,200 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 45 to 52 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition
Bingham and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bingham

Setting
Landform: Terraces, alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear, concave
Across-slope shape: Linear, convex
Parent material: Alluvium and/or lacustrine deposits derived from mixed sources

Typical profile
Ap - 0 to 6 inches: gravelly loam
B21t - 6 to 12 inches: gravelly sandy clay loam
B22t - 12 to 18 inches: gravelly fine sandy loam
IIIB3ca - 18 to 27 inches: very gravelly sandy loam
IICca - 27 to 60 inches: very gravelly sand

Properties and qualities
Slope: 1 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 30 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.2 inches)

Interpretive groups
Land capability classification (irrigated): 3s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: B
Ecological site: R028AY306UT - Upland Gravelly Loam (Bonneville Big Sagebrush)
Hydric soil rating: No

Br—Bramwell silty clay loam

Map Unit Setting
National map unit symbol: j6wn
Elevation: 4,320 to 4,600 feet

Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 45 to 52 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Bramwell and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bramwell

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

Ap - 0 to 6 inches: silty clay loam
A1 - 6 to 11 inches: silty clay loam
C1 - 11 to 20 inches: silty clay loam
C2ca - 20 to 31 inches: silty clay loam
C3ca - 31 to 60 inches: silty clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 24 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 30 percent
Maximum salinity: Moderately saline to strongly saline (8.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum: 30.0
Available water supply, 0 to 60 inches: Moderate (about 7.8 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: D
Ecological site: R028AY001UT - Alkali Bottom (Alkali Sacaton)
Hydric soil rating: No

Minor Components

Chipman

Percent of map unit: 5 percent

Taylorsville

Percent of map unit: 3 percent

Strongly saline soils

Percent of map unit: 3 percent

Hardpan soils
Percent of map unit: 2 percent

Depressional soils
Percent of map unit: 2 percent
Landform: Depressions on lake terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Linear, concave
Across-slope shape: Linear, concave
Ecological site: R028AY001UT - Alkali Bottom (Alkali Sacaton)
Hydric soil rating: Yes

Bs—Bramwell silty clay loam, drained

Map Unit Setting
National map unit symbol: j6wp
Elevation: 4,320 to 4,600 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 45 to 52 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Bramwell and similar soils: 92 percent
Minor components: 8 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bramwell

Setting
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile
Ap - 0 to 6 inches: silty clay loam
A1 - 6 to 11 inches: silty clay loam
C1 - 11 to 20 inches: silty clay loam
C2ca - 20 to 31 inches: silty clay loam
C3ca - 31 to 60 inches: silty clay loam

Properties and qualities
Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 36 to 48 inches

Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Maximum salinity: Slightly saline to strongly saline (4.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum: 30.0
Available water supply, 0 to 60 inches: Moderate (about 8.8 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: D
Ecological site: R028AY001UT - Alkali Bottom (Alkali Sacaton)
Hydric soil rating: No

Minor Components

Taylorsville

Percent of map unit: 5 percent

Depressional soils

Percent of map unit: 3 percent
Landform: Depressions on lake terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Ecological site: R028AY001UT - Alkali Bottom (Alkali Sacaton)
Hydric soil rating: Yes

Ch—Chipman loam

Map Unit Setting

National map unit symbol: j6wr
Elevation: 4,500 to 4,800 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Chipman and similar soils: 97 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chipman

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

Apca - 0 to 8 inches: loam
Alg - 8 to 16 inches: silty clay loam
C1cag - 16 to 20 inches: silty clay loam
C2ca - 20 to 27 inches: silty clay loam
C3ca - 27 to 44 inches: loam
C4cag - 44 to 60 inches: clay loam

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 30 to 60 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum content: 60 percent
Maximum salinity: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum: 13.0
Available water supply, 0 to 60 inches: High (about 9.9 inches)

Interpretive groups

Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C
Ecological site: R028AY012UT - Semiwet Fresh Meadow
Hydric soil rating: No

Minor Components

Depressional soils

Percent of map unit: 3 percent
Landform: Depressions on lake terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Ecological site: R028AY001UT - Alkali Bottom (Alkali Sacaton)
Hydric soil rating: Yes

Ck—Chipman silty clay loam

Map Unit Setting

National map unit symbol: j6ws
Elevation: 4,500 to 4,800 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Chipman and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chipman

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

Apca - 0 to 8 inches: silty clay loam
Alg - 8 to 16 inches: silty clay loam
C1cag - 16 to 20 inches: silty clay loam
C2ca - 20 to 27 inches: silty clay loam
C3ca - 27 to 44 inches: loam
C4cag - 44 to 60 inches: clay loam

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 30 to 60 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum content: 60 percent
Maximum salinity: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum: 13.0
Available water supply, 0 to 60 inches: High (about 10.0 inches)

Interpretive groups

Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C
Ecological site: R028AY012UT - Semiwet Fresh Meadow
Hydric soil rating: No

Minor Components

Ironton

Percent of map unit: 5 percent
Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R028AY012UT - Semiwet Fresh Meadow
Hydric soil rating: Yes

Bramwell

Percent of map unit: 5 percent

Mcbeth

Percent of map unit: 5 percent
Landform: Lake terraces, alluvial fans, flood plains
Landform position (three-dimensional): Tread, dip, talf
Down-slope shape: Linear, concave
Across-slope shape: Linear, convex, concave
Ecological site: R028AY012UT - Semiwet Fresh Meadow
Hydric soil rating: Yes

Cm—Chipman silty clay loam, moderately deep water table

Map Unit Setting

National map unit symbol: j6wt
Elevation: 4,500 to 4,800 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Chipman and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chipman

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

Apca - 0 to 8 inches: silty clay loam
Alg - 8 to 16 inches: silty clay loam
C1cag - 16 to 20 inches: silty clay loam
C2ca - 20 to 27 inches: silty clay loam
C3ca - 27 to 44 inches: loam
C4cag - 44 to 60 inches: clay loam

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: NoneOccasional
Frequency of ponding: None

Calcium carbonate, maximum content: 60 percent
Maximum salinity: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum: 13.0
Available water supply, 0 to 60 inches: High (about 10.0 inches)

Interpretive groups

Land capability classification (irrigated): 4w
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: D
Ecological site: R028AY012UT - Semiwet Fresh Meadow
Hydric soil rating: No

Minor Components

Depressional soils

Percent of map unit: 5 percent
Landform: Depressions on lake terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Ecological site: R028AY001UT - Alkali Bottom (Alkali Sacaton)
Hydric soil rating: Yes

Cn—Chipman silty clay loam, moderately saline

Map Unit Setting

National map unit symbol: j6wv
Elevation: 4,500 to 4,800 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Chipman and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chipman

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

Apca - 0 to 8 inches: silty clay loam
Alg - 8 to 16 inches: silty clay loam
C1cag - 16 to 20 inches: silty clay loam

C2ca - 20 to 27 inches: silty clay loam
C3ca - 27 to 44 inches: loam
C4cag - 44 to 60 inches: clay loam

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: NoneOccasional
Frequency of ponding: None
Calcium carbonate, maximum content: 60 percent
Maximum salinity: Moderately saline to strongly saline (8.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum: 30.0
Available water supply, 0 to 60 inches: Moderate (about 7.6 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 6w
Hydrologic Soil Group: D
Ecological site: R028AY001UT - Alkali Bottom (Alkali Sacaton)
Hydric soil rating: No

Minor Components

Depressional soils

Percent of map unit: 3 percent
Landform: Depressions on lake terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Ecological site: R028AY001UT - Alkali Bottom (Alkali Sacaton)
Hydric soil rating: Yes

Strongly saline-alkali soils

Percent of map unit: 2 percent

Cp—Chipman-McBeth complex

Map Unit Setting

National map unit symbol: j6wx
Elevation: 4,500 to 4,800 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Chipman and similar soils: 60 percent

Mcbeth and similar soils: 40 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chipman

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

Apca - 0 to 8 inches: silty clay loam
Alg - 8 to 16 inches: silty clay loam
C1cag - 16 to 20 inches: silty clay loam
C2ca - 20 to 27 inches: silty clay loam
C3ca - 27 to 44 inches: loam
C4cag - 44 to 60 inches: clay loam

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: NoneOccasional
Frequency of ponding: None
Calcium carbonate, maximum content: 60 percent
Maximum salinity: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum: 13.0
Available water supply, 0 to 60 inches: High (about 10.0 inches)

Interpretive groups

Land capability classification (irrigated): 4w
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: D
Ecological site: R028AY012UT - Semiwet Fresh Meadow
Hydric soil rating: No

Description of Mcbeth

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from mixed sources

Typical profile

Ap - 0 to 8 inches: silt loam
A1 - 8 to 12 inches: silt loam
C1g - 12 to 18 inches: silt loam
C2g - 18 to 24 inches: very fine sandy loam
C3g - 24 to 53 inches: silt loam
C4g - 53 to 68 inches: silt loam

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: About 12 to 24 inches
Frequency of flooding: NoneOccasional
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Maximum salinity: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum: 13.0
Available water supply, 0 to 60 inches: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: C/D
Ecological site: R028AY012UT - Semiwet Fresh Meadow
Hydric soil rating: Yes

CU—Cobbly alluvial land

Map Unit Setting

National map unit symbol: j6wq
Elevation: 4,200 to 4,600 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 46 to 54 degrees F
Frost-free period: 120 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Aquic xerofluvents and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Aquic Xerofluvents

Setting

Landform: Flood plains
Landform position (three-dimensional): Dip, talf
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

H1 - 0 to 60 inches: extremely cobbly coarse sandy loam

Properties and qualities

Slope: 1 to 3 percent

Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: NoneFrequent
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: B
Ecological site: R028AY014UT - Semiwet Fresh Streambank
Hydric soil rating: Yes

Minor Components

Depressional soils

Percent of map unit: 5 percent
Landform: Depressions on lake terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Ecological site: R028AY001UT - Alkali Bottom (Alkali Sacaton)
Hydric soil rating: Yes

HOF—Hillfield-Sterling complex, 20 to 35 percent slopes

Map Unit Setting

National map unit symbol: j6xf
Elevation: 4,600 to 5,200 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Not prime farmland

Map Unit Composition

Hillfield and similar soils: 55 percent
Sterling and similar soils: 45 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hillfield

Setting

Landform: Escarpments, lake terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear

Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

Ap - 0 to 4 inches: silt loam
AC - 4 to 12 inches: silt loam
C1ca - 12 to 26 inches: silt loam
C2ca - 26 to 35 inches: loam
C3ca - 35 to 40 inches: loam
IIC4 - 40 to 60 inches: sandy loam

Properties and qualities

Slope: 20 to 30 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 50 percent
Maximum salinity: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum: 20.0
Available water supply, 0 to 60 inches: Moderate (about 8.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Ecological site: R028AY310UT - Upland Loam (Bonneville Big Sagebrush) North
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)
Hydric soil rating: No

Description of Sterling

Setting

Landform: Escarpments, lake terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

Ap - 0 to 5 inches: gravelly fine sandy loam
A1 - 5 to 11 inches: gravelly sandy loam
C1ca - 11 to 16 inches: gravelly sandy loam
C2ca - 16 to 21 inches: very gravelly sandy loam
C3ca - 21 to 60 inches: extremely gravelly sand

Properties and qualities

Slope: 20 to 35 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches

Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 10.0
Available water supply, 0 to 60 inches: Very low (about 2.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: B
Ecological site: R028AY334UT - Upland Stony Loam (Wyoming Big Sagebrush)
Other vegetative classification: Upland Stony Loam (Mountain Big Sagebrush) (028AY334UT)
Hydric soil rating: No

Hr—Holdaway silt loam

Map Unit Setting

National map unit symbol: j6xk
Elevation: 4,400 to 4,500 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Holdaway and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Holdaway

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

Ap - 0 to 7 inches: silt loam
A1 - 7 to 13 inches: silt loam
C1cag - 13 to 20 inches: silt loam
C2camg - 20 to 28 inches: indurated
C3cag - 28 to 32 inches: silt loam
C4cam-C6camg - 32 to 67 inches: cemented material

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 20 to 40 inches to petrocalcic
Drainage class: Poorly drained

Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.07 in/hr)
Depth to water table: About 12 to 24 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum content: 75 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 15.0
Available water supply, 0 to 60 inches: Low (about 3.4 inches)

Interpretive groups
Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: D
Ecological site: R028AY020UT - Wet Fresh Meadow
Hydric soil rating: Yes

Ir—Ironton loam

Map Unit Setting
National map unit symbol: j6xm
Elevation: 4,500 to 4,550 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition
Ironton and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ironton

Setting
Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile
Ap - 0 to 8 inches: loam
C1,2,3,cag - 8 to 32 inches: loam
IIC4g - 32 to 60 inches: very fine sandy loam

Properties and qualities
Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: About 12 to 24 inches

Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Maximum salinity: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum: 13.0
Available water supply, 0 to 60 inches: High (about 9.3 inches)

Interpretive groups

Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C/D
Ecological site: R028AY012UT - Semiwet Fresh Meadow
Hydric soil rating: Yes

ls—Ironton loam, moderately saline-alkali

Map Unit Setting

National map unit symbol: j6xn
Elevation: 4,500 to 4,550 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Ironton and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ironton

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

Ap - 0 to 8 inches: loam
C1,2,3cag - 8 to 32 inches: loam
IIC4g - 32 to 60 inches: very fine sandy loam

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 12 to 24 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent

Maximum salinity: Moderately saline to strongly saline (8.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum: 30.0
Available water supply, 0 to 60 inches: Moderate (about 6.9 inches)

Interpretive groups
Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: C/D
Ecological site: R028AY001UT - Alkali Bottom (Alkali Sacaton)
Hydric soil rating: Yes

Ks—Kirkham silty clay loam

Map Unit Setting
National map unit symbol: j6y0
Elevation: 4,500 to 4,600 feet
Mean annual precipitation: 13 to 17 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition
Kirkham and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kirkham

Setting
Landform: Flood plains, alluvial fans
Landform position (three-dimensional): Dip, talf
Down-slope shape: Linear, concave
Across-slope shape: Concave, convex
Parent material: Alluvium derived from sandstone, quartzite and granite

Typical profile
Ap - 0 to 11 inches: silty clay loam
C1,C2 - 11 to 28 inches: silty clay loam
C3 - 28 to 42 inches: silty clay
C4,C5 - 42 to 65 inches: silt loam

Properties and qualities
Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 24 to 48 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Maximum salinity: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)

Sodium adsorption ratio, maximum: 13.0
Available water supply, 0 to 60 inches: High (about 10.2 inches)

Interpretive groups
Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: D
Ecological site: R028AY012UT - Semiwet Fresh Meadow
Hydric soil rating: No

Minor Components

Benjamin
Percent of map unit: 5 percent

Pleasant vale
Percent of map unit: 5 percent

Kt—Kirkham silty clay loam, moderately saline-alkali

Map Unit Setting
National map unit symbol: j6y1
Elevation: 4,500 to 4,600 feet
Mean annual precipitation: 13 to 17 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Kirkham and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kirkham

Setting
Landform: Flood plains, alluvial fans
Landform position (three-dimensional): Dip, talf
Down-slope shape: Linear, concave
Across-slope shape: Concave, convex
Parent material: Alluvium derived from sandstone, quartzite and granite

Typical profile
Ap - 0 to 11 inches: silty clay loam
C1,C2 - 11 to 28 inches: silty clay loam
C3 - 28 to 42 inches: silty clay
C4,C5 - 42 to 65 inches: silt loam

Properties and qualities
Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained

Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: NoneOccasional
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Maximum salinity: Moderately saline to strongly saline (8.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum: 30.0
Available water supply, 0 to 60 inches: Moderate (about 7.6 inches)

Interpretive groups
Land capability classification (irrigated): 4w
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: D
Ecological site: R028AY001UT - Alkali Bottom (Alkali Sacaton)
Hydric soil rating: No

Minor Components

Strongly saine soils
Percent of map unit: 5 percent

LaC—Lakewin gravelly fine sandy loam, 1 to 6 percent slopes

Map Unit Setting
National map unit symbol: j6y3
Elevation: 4,600 to 5,100 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 50 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition
Lakewin and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Lakewin

Setting
Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile
A11,A12 - 0 to 10 inches: gravelly fine sandy loam
B21 - 10 to 17 inches: gravelly fine sandy loam
B22 - 17 to 27 inches: very gravelly sandy loam
IIC1&IIC2ca - 27 to 60 inches: extremely gravelly sand

Properties and qualities

Slope: 1 to 6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 20 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 10.0
Available water supply, 0 to 60 inches: Low (about 3.2 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: A
Ecological site: R028AY306UT - Upland Gravelly Loam (Bonneville Big Sagebrush)
Hydric soil rating: No

Minor Components

Sterling

Percent of map unit: 5 percent

Bingham

Percent of map unit: 5 percent

LaD—Lakewin gravelly fine sandy loam, 6 to 15 percent slopes

Map Unit Setting

National map unit symbol: j6y4
Elevation: 4,600 to 5,100 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 50 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Farmland of unique importance

Map Unit Composition

Lakewin and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Lakewin

Setting

Landform: Escarpments, lake terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear

Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

A11,A12 - 0 to 8 inches: gravelly fine sandy loam
B21 - 8 to 17 inches: gravelly fine sandy loam
B22 - 17 to 27 inches: very gravelly sandy loam
IIC1&C2ca - 27 to 60 inches: extremely gravelly sand

Properties and qualities

Slope: 6 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 20 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 10.0
Available water supply, 0 to 60 inches: Low (about 3.2 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: A
Ecological site: R028AY306UT - Upland Gravelly Loam (Bonneville Big Sagebrush)
Hydric soil rating: No

LfC—Layton fine sandy loam, 1 to 6 percent slopes

Map Unit Setting

National map unit symbol: j6y7
Elevation: 4,500 to 5,200 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 46 to 50 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Layton and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Layton

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear

Across-slope shape: Linear
Parent material: Eolian deposits derived from sandstone and quartzite

Typical profile
A11,A12,AC - 0 to 7 inches: fine sandy loam
C1 - 7 to 26 inches: loamy fine sand
C2CA - 26 to 39 inches: loamy fine sand
C3CA - 39 to 60 inches: fine sand

Properties and qualities
Slope: 1 to 6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Available water supply, 0 to 60 inches: Low (about 4.9 inches)

Interpretive groups
Land capability classification (irrigated): 3s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: A
Ecological site: R028AY330UT - Upland Sand (Black Greasewood, Indian Ricegrass)
Hydric soil rating: No

Minor Components

Preston
Percent of map unit: 5 percent

Kidman
Percent of map unit: 5 percent

Lo—Logan silty clay loam

Map Unit Setting
National map unit symbol: j6yb
Elevation: 4,450 to 4,550 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition
Logan and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Logan

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

Oe - 0 to 8 inches: peat
A11g,12g&O - 8 to 21 inches: silty clay loam
C123cag - 21 to 44 inches: silty clay loam
C4cag - 44 to 64 inches: silt loam
C5g - 64 to 85 inches: silty clay

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: NoneFrequent
Frequency of ponding: None
Calcium carbonate, maximum content: 50 percent
Maximum salinity: Nonsaline to moderately saline (0.0 to 8.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 10.6 inches)

Interpretive groups

Land capability classification (irrigated): 4w
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: C/D
Ecological site: R028AY020UT - Wet Fresh Meadow
Hydric soil rating: Yes

Minor Components

Chipman

Percent of map unit: 5 percent

Ironton

Percent of map unit: 5 percent
Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R028AY012UT - Semiwet Fresh Meadow
Hydric soil rating: Yes

Ls—Logan silty clay loam, heavy variant

Map Unit Setting

National map unit symbol: j6yc
Elevation: 4,500 to 4,600 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 44 to 46 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Logan variant and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Logan Variant

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

Ap - 0 to 7 inches: silty clay loam
A12 - 7 to 16 inches: silty clay loam
ACca, C1ca - 16 to 39 inches: silty clay
A1b - 39 to 46 inches: silty clay loam
C2 - 46 to 60 inches: silty clay loam

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 12 to 24 inches
Frequency of flooding: NoneOccasional
Frequency of ponding: None
Calcium carbonate, maximum content: 60 percent
Maximum salinity: Slightly saline to moderately saline (4.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum: 13.0
Available water supply, 0 to 60 inches: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): 4w
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: C/D
Ecological site: R028AY024UT - Wet Saline Meadow (Saltgrass)
Hydric soil rating: Yes

Mf—Martini fine sandy loam

Map Unit Setting

National map unit symbol: j6yh
Elevation: 4,500 to 4,600 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Martini and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Martini

Setting

Landform: Alluvial fans, flood plains
Landform position (three-dimensional): Dip, talf
Down-slope shape: Concave, linear
Across-slope shape: Convex, concave
Parent material: Alluvium derived from mixed sources

Typical profile

Ap - 0 to 9 inches: fine sandy loam
A1 - 9 to 12 inches: fine sandy loam
C1 - 12 to 17 inches: fine sandy loam
C2 - 17 to 50 inches: sandy loam
C3 - 50 to 60 inches: loamy fine sand

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: About 42 to 60 inches
Frequency of flooding: NoneOccasional
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 6.1 inches)

Interpretive groups

Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: A
Ecological site: R028AY012UT - Semiwet Fresh Meadow
Hydric soil rating: No

Minor Components

Depressional soils
Percent of map unit: 4 percent
Landform: Flood plains
Landform position (three-dimensional): Dip, talf
Down-slope shape: Linear
Across-slope shape: Concave
Ecological site: R028AY001UT - Alkali Bottom (Alkali Sacaton)
Hydric soil rating: Yes

Strongly saline-alkali soils
Percent of map unit: 3 percent

Sunset
Percent of map unit: 3 percent

Mh—McBeth silt loam

Map Unit Setting
National map unit symbol: j6yj
Elevation: 4,500 to 4,600 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition
Mcbeth and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Mcbeth

Setting
Landform: Lake terraces, alluvial fans, flood plains
Landform position (three-dimensional): Tread, dip, talf
Down-slope shape: Linear, concave
Across-slope shape: Linear, convex, concave
Parent material: Alluvium derived from mixed sources

Typical profile
Ap - 0 to 8 inches: silt loam
A1 - 8 to 12 inches: silt loam
C1g - 12 to 18 inches: silt loam
C2g - 18 to 24 inches: very fine sandy loam
C3g,C4g - 24 to 68 inches: silt loam

Properties and qualities
Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches

Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: About 12 to 24 inches
Frequency of flooding: NoneOccasional
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Maximum salinity: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum: 13.0
Available water supply, 0 to 60 inches: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: C/D
Ecological site: R028AY012UT - Semiwet Fresh Meadow
Hydric soil rating: Yes

Minor Components

Chipman

Percent of map unit: 5 percent
Hydric soil rating: No

Mn—McBeth silt loam, moderately saline

Map Unit Setting

National map unit symbol: j6yk
Elevation: 4,500 to 4,600 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Mcbeth and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Mcbeth

Setting

Landform: Lake terraces, alluvial fans, flood plains
Landform position (three-dimensional): Tread, dip, talf
Down-slope shape: Linear, concave
Across-slope shape: Linear, convex, concave
Parent material: Alluvium derived from mixed sources

Typical profile

Ap - 0 to 8 inches: silt loam
A1 - 8 to 12 inches: silt loam
C1g - 12 to 18 inches: silt loam

C2g - 18 to 24 inches: very fine sandy loam
C3g,C4g - 24 to 68 inches: silt loam

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: About 12 to 24 inches
Frequency of flooding: NoneOccasional
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Maximum salinity: Moderately saline to strongly saline (8.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum: 13.0
Available water supply, 0 to 60 inches: Moderate (about 7.7 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 6w
Hydrologic Soil Group: C/D
Ecological site: R028AY001UT - Alkali Bottom (Alkali Sacaton)
Hydric soil rating: Yes

MU—Mixed alluvial land

Map Unit Setting

National map unit symbol: j6yf
Elevation: 4,450 to 4,550 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 45 to 52 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Mixed alluvial land and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Mixed Alluvial Land

Setting

Landform: Channels, streams
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Alluvium derived from mixed sources

Typical profile

H1 - 0 to 6 inches: loam
H2 - 6 to 60 inches: gravelly clay loam

Properties and qualities

Slope: 0 to 10 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 12 to 36 inches
Frequency of flooding: NoneFrequent
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Maximum salinity: Moderately saline to strongly saline (8.0 to 32.0 mmhos/cm)
Sodium adsorption ratio, maximum: 20.0
Available water supply, 0 to 60 inches: Low (about 5.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6w
Hydrologic Soil Group: D
Ecological site: R028AY022UT - Wet Fresh Streambank
Hydric soil rating: Yes

Minor Components

Depressional soils

Percent of map unit: 5 percent
Landform: Depressions
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Ecological site: R028AY001UT - Alkali Bottom (Alkali Sacaton)
Hydric soil rating: Yes

Pf—Peteetneet peat

Map Unit Setting

National map unit symbol: j6z1
Elevation: 4,450 to 4,500 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Peteetneet and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Peteetneet

Setting

Landform: Depressions
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Organic material

Typical profile

Oa1 - 0 to 15 inches: peat
Oa2 - 15 to 60 inches: muck

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (1.42 to 7.09 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: NoneFrequent
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Very high (about 13.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: A/D
Ecological site: R028AY020UT - Wet Fresh Meadow
Hydric soil rating: Yes

Minor Components

Ironton

Percent of map unit: 5 percent
Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R028AY012UT - Semiwet Fresh Meadow
Hydric soil rating: Yes

Logan

Percent of map unit: 5 percent
Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R028AY020UT - Wet Fresh Meadow
Hydric soil rating: Yes

PK—Pits and dumps

Map Unit Setting

National map unit symbol: j6ys
Elevation: 4,490 to 4,900 feet
Farmland classification: Not prime farmland

Map Unit Composition

Pits: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Pw—Provo gravelly fine sandy loam

Map Unit Setting

National map unit symbol: j6zh
Elevation: 4,500 to 4,800 feet
Mean annual precipitation: 11 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Provo and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Provo

Setting

Landform: Flood plains
Landform position (three-dimensional): Dip, talf
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Alluvium derived from limestone, sandstone, quartzite, and shale

Typical profile

Ap - 0 to 7 inches: gravelly fine sandy loam
A1g - 7 to 15 inches: gravelly fine sandy loam
C1g - 15 to 25 inches: extremely gravelly sand
IIC2 - 25 to 40 inches: extremely gravelly loamy sand
IIC3 - 40 to 60 inches: extremely gravelly sand

Properties and qualities

Slope: 1 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained

Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: About 18 to 48 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 13.0
Available water supply, 0 to 60 inches: Very low (about 2.8 inches)

Interpretive groups

Land capability classification (irrigated): 4w
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: B
Ecological site: R028AY014UT - Semiwet Fresh Streambank
Hydric soil rating: No

Minor Components

Sunset

Percent of map unit: 5 percent

RdA—Redola loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: j6zp
Elevation: 4,600 to 5,000 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Redola and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Redola

Setting

Landform: Flood plains, alluvial fans
Landform position (three-dimensional): Dip, talf
Down-slope shape: Linear, concave
Across-slope shape: Concave, convex
Parent material: Alluvium derived from limestone and sandstone

Typical profile

Ap - 0 to 8 inches: loam
C1,C2 - 8 to 30 inches: loam
C3 - 30 to 50 inches: stratified gravelly coarse sand to very fine sandy loam
IIC4 - 50 to 60 inches: gravelly coarse sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 30 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 8.1 inches)

Interpretive groups

Land capability classification (irrigated): 2c
Land capability classification (nonirrigated): 3c
Hydrologic Soil Group: B
Ecological site: R028AY006UT - Loamy Bottom (Great Basin Wildrye)
Other vegetative classification: Loamy Bottom (Great Basin Wildrye) (028AY006UT)
Hydric soil rating: No

Minor Components

Martin

Percent of map unit: 5 percent

ReC—Redola gravelly loam, 3 to 6 percent slopes

Map Unit Setting

National map unit symbol: j6zq
Elevation: 4,600 to 5,000 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Redola and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Redola

Setting

Landform: Flood plains, alluvial fans
Landform position (three-dimensional): Dip, talf
Down-slope shape: Linear, concave
Across-slope shape: Concave, convex
Parent material: Alluvium derived from limestone and sandstone

Typical profile

Ap - 0 to 8 inches: gravelly loam
C1,C2 - 8 to 30 inches: loam
C3 - 30 to 50 inches: stratified gravelly coarse sand to very fine sandy loam
IIC4 - 50 to 60 inches: gravelly coarse sand

Properties and qualities

Slope: 3 to 6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 30 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 7.9 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: R028AY006UT - Loamy Bottom (Great Basin Wildrye)
Other vegetative classification: Loamy Bottom (Great Basin Wildrye) (028AY006UT)
Hydric soil rating: No

RV—Riverwash

Map Unit Setting

National map unit symbol: j6zm
Elevation: 4,500 to 4,800 feet
Farmland classification: Not prime farmland

Map Unit Composition

Riverwash: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Riverwash

Setting

Landform: Flood plains
Landform position (three-dimensional): Dip, talf
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Alluvium derived from sandstone and quartzite

Typical profile

H1 - 0 to 60 inches: extremely cobbly coarse sandy loam

Properties and qualities

Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: About 13 to 24 inches
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.6 inches)

Sd—Steed sandy loam

Map Unit Setting

National map unit symbol: j6zs
Elevation: 4,550 to 5,200 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Steed and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Steed

Setting

Landform: Alluvial fans
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Alluvium derived from limestone, sandstone, quartzite, and shale

Typical profile

A1 - 0 to 7 inches: sandy loam
C1 - 7 to 31 inches: extremely gravelly loamy sand
C2,C3 - 31 to 60 inches: extremely gravelly sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: About 48 to 72 inches
Frequency of flooding: NoneOccasional
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 5.0
Available water supply, 0 to 60 inches: Low (about 3.5 inches)

Interpretive groups

Land capability classification (irrigated): 4s

Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Ecological site: R028AY014UT - Semiwet Fresh Streambank
Hydric soil rating: No

Se—Steed gravelly sandy loam

Map Unit Setting

National map unit symbol: j6zt
Elevation: 4,550 to 5,200 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Steed and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Steed

Setting

Landform: Flood plains
Landform position (three-dimensional): Dip, talf
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Alluvium derived from limestone, sandstone, quartzite, and shale

Typical profile

A1 - 0 to 7 inches: gravelly sandy loam
C1 - 7 to 31 inches: extremely gravelly loamy sand
C2,C3 - 31 to 60 inches: extremely gravelly sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: About 48 to 72 inches
Frequency of flooding: NoneOccasional
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 5.0
Available water supply, 0 to 60 inches: Low (about 3.5 inches)

Interpretive groups

Land capability classification (irrigated): 4s
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A

Ecological site: R028AY014UT - Semiwet Fresh Streambank
Hydric soil rating: No

Minor Components

Provo
Percent of map unit: 5 percent

SgB—Sterling gravelly fine sandy loam, 1 to 3 percent slopes

Map Unit Setting
National map unit symbol: j6zv
Elevation: 4,600 to 5,000 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition
Sterling and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sterling

Setting
Landform: Benches, lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile
Ap - 0 to 5 inches: gravelly fine sandy loam
A1 - 5 to 11 inches: gravelly sandy loam
C1ca - 11 to 16 inches: gravelly sandy loam
C2ca - 16 to 21 inches: very gravelly sandy loam
C3ca - 21 to 60 inches: extremely gravelly sand

Properties and qualities
Slope: 1 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 10.0
Available water supply, 0 to 60 inches: Very low (about 2.8 inches)

Interpretive groups

Land capability classification (irrigated): 4s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: B
Ecological site: R028AY334UT - Upland Stony Loam (Wyoming Big Sagebrush)
Other vegetative classification: Upland Stony Loam (Mountain Big Sagebrush) (028AY334UT)
Hydric soil rating: No

SgC—Sterling gravelly fine sandy loam, 3 to 6 percent slopes

Map Unit Setting

National map unit symbol: j6zw
Elevation: 4,600 to 5,000 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Sterling and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sterling

Setting

Landform: Escarpments
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

Ap - 0 to 5 inches: gravelly fine sandy loam
A1 - 5 to 11 inches: gravelly sandy loam
C1ca - 11 to 16 inches: gravelly sandy loam
C2ca - 16 to 21 inches: very gravelly sandy loam
C3ca - 21 to 60 inches: extremely gravelly sand

Properties and qualities

Slope: 3 to 6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 10.0
Available water supply, 0 to 60 inches: Very low (about 2.8 inches)

Interpretive groups

Land capability classification (irrigated): 4s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: B
Ecological site: R028AY334UT - Upland Stony Loam (Wyoming Big Sagebrush)
Other vegetative classification: Upland Stony Loam (Mountain Big Sagebrush) (028AY334UT)
Hydric soil rating: No

SgD—Sterling gravelly fine sandy loam, 6 to 10 percent slopes

Map Unit Setting

National map unit symbol: j6zx
Elevation: 4,600 to 5,000 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Sterling and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sterling

Setting

Landform: Escarpments, lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from mixed sources

Typical profile

Ap - 0 to 5 inches: gravelly fine sandy loam
A1 - 5 to 11 inches: gravelly sandy loam
C1ca - 11 to 16 inches: gravelly sandy loam
C2ca - 16 to 21 inches: very gravelly sandy loam
C3ca - 21 to 60 inches: extremely gravelly sand

Properties and qualities

Slope: 6 to 10 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 10.0

Available water supply, 0 to 60 inches: Very low (about 2.8 inches)

Interpretive groups

Land capability classification (irrigated): 4s
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: B
Ecological site: R028AY334UT - Upland Stony Loam (Wyoming Big Sagebrush)
Other vegetative classification: Upland Stony Loam (Mountain Big Sagebrush) (028AY334UT)
Hydric soil rating: No

Sr—Sunset loam

Map Unit Setting

National map unit symbol: j6zz
Elevation: 4,500 to 4,900 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Sunset and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sunset

Setting

Landform: Flood plains
Landform position (three-dimensional): Dip, talf
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Alluvium derived from limestone, granite and shale

Typical profile

Ap - 0 to 7 inches: loam
A1 - 7 to 14 inches: loam
C1,C2,C3 - 14 to 41 inches: stratified very fine sandy loam to loam
C4,C5 - 41 to 60 inches: stratified loam to silty clay loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: About 30 to 48 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Moderately saline to strongly saline (8.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum: 13.0

Available water supply, 0 to 60 inches: Moderate (about 7.5 inches)

Interpretive groups

Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 6w
Hydrologic Soil Group: C
Ecological site: R028AY012UT - Semiwet Fresh Meadow
Hydric soil rating: No

Ss—Sunset loam, gravelly substratum

Map Unit Setting

National map unit symbol: j700
Elevation: 4,500 to 4,900 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Sunset and similar soils: 75 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sunset

Setting

Landform: Flood plains
Landform position (three-dimensional): Dip, talf
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Alluvium derived from limestone, granite and shale

Typical profile

Ap - 0 to 7 inches: loam
A1 - 7 to 14 inches: loam
C1,C2,C3 - 14 to 20 inches: very fine sandy loam
C4,C5 - 20 to 60 inches: stratified gravelly loamy sand to gravelly sandy loam

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: About 42 to 60 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum: 13.0
Available water supply, 0 to 60 inches: Low (about 5.5 inches)

Interpretive groups

Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 6w
Hydrologic Soil Group: C
Ecological site: R028AY012UT - Semiwet Fresh Meadow
Hydric soil rating: No

Minor Components

Sunset

Percent of map unit: 25 percent
Ecological site: R028AY012UT - Semiwet Fresh Meadow

TaA—Taylorsville silty clay loam, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: j703
Elevation: 4,500 to 4,800 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Taylorsville and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Taylorsville

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from limestone and shale

Typical profile

Ap - 0 to 7 inches: silty clay loam
AC - 7 to 13 inches: silty clay loam
C1,C2 - 13 to 36 inches: silty clay loam
C3ca - 36 to 56 inches: silty clay loam
C4 - 56 to 62 inches: silty clay loam

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)

Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Maximum salinity: Slightly saline to moderately saline (4.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum: 25.0
Available water supply, 0 to 60 inches: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: C
Ecological site: R028AY310UT - Upland Loam (Bonneville Big Sagebrush) North
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)
Hydric soil rating: No

Minor Components

Bramwell

Percent of map unit: 5 percent

TaB—Taylorsville silty clay loam, 1 to 3 percent slopes

Map Unit Setting

National map unit symbol: j704
Elevation: 4,500 to 4,800 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Taylorsville and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Taylorsville

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from limestone and shale

Typical profile

Ap - 0 to 7 inches: silty clay loam
AC - 7 to 13 inches: silty clay loam
C1,C2 - 13 to 36 inches: silty clay loam
C3ca - 36 to 56 inches: silty clay loam

C4 - 56 to 62 inches: silty clay loam

Properties and qualities

Slope: 1 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Maximum salinity: Slightly saline to moderately saline (4.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum: 25.0
Available water supply, 0 to 60 inches: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Ecological site: R028AY310UT - Upland Loam (Bonneville Big Sagebrush) North
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)
Hydric soil rating: No

Minor Components

Bramwell

Percent of map unit: 5 percent

TmB—Timpanogos loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: j708
Elevation: 4,700 to 4,900 feet
Mean annual precipitation: 15 to 18 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Timpanogos and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Timpanogos

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear

Across-slope shape: Linear
Parent material: Lacustrine deposits derived from limestone, quartzite and granite

Typical profile

Ap - 0 to 9 inches: loam
B2t - 9 to 14 inches: loam
B3ca - 14 to 18 inches: loam
C1ca,C2ca - 18 to 48 inches: silt loam
IIC3 - 48 to 60 inches: gravelly loamy coarse sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 30 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 13.0
Available water supply, 0 to 60 inches: Moderate (about 8.7 inches)

Interpretive groups

Land capability classification (irrigated): 1
Land capability classification (nonirrigated): 3c
Hydrologic Soil Group: C
Ecological site: R028AY310UT - Upland Loam (Bonneville Big Sagebrush) North
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)
Hydric soil rating: No

Minor Components

Parleys

Percent of map unit: 5 percent

Kidman

Percent of map unit: 5 percent

VnA—Vineyard fine sandy loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: j70c
Elevation: 4,500 to 4,900 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Vineyard and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Vineyard

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from limestone, sandstone, and shale

Typical profile

Ap - 0 to 7 inches: fine sandy loam
AC - 7 to 13 inches: fine sandy loam
C1ca,C2ca - 13 to 35 inches: fine sandy loam
C3ca - 35 to 42 inches: very fine sandy loam
C4 - 42 to 60 inches: very fine sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: About 30 to 60 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Maximum salinity: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum: 10.0
Available water supply, 0 to 60 inches: Moderate (about 7.6 inches)

Interpretive groups

Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: A
Ecological site: R028AY012UT - Semiwet Fresh Meadow
Hydric soil rating: No

Minor Components

Timpanogos

Percent of map unit: 5 percent

Welby

Percent of map unit: 5 percent

VsA—Vineyard fine sandy loam, moderately saline, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: j70d
Elevation: 4,500 to 4,900 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Vineyard and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Vineyard

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from limestone, sandstone, and shale

Typical profile

Ap - 0 to 7 inches: fine sandy loam
B2t - 7 to 13 inches: fine sandy loam
B3ca - 13 to 35 inches: fine sandy loam
C1ca,C2ca - 35 to 42 inches: very fine sandy loam
IIC3 - 42 to 60 inches: very fine sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: About 30 to 60 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Maximum salinity: Moderately saline to strongly saline (8.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum: 10.0
Available water supply, 0 to 60 inches: Low (about 5.5 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: A
Ecological site: R028AY001UT - Alkali Bottom (Alkali Sacaton)
Hydric soil rating: No

W—Water

Map Unit Setting
National map unit symbol: j70s
Elevation: 4,470 to 4,720 feet
Farmland classification: Not prime farmland

Map Unit Composition
Water: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

WbA—Welby silt loam, 0 to 1 percent slopes

Map Unit Setting
National map unit symbol: j70f
Elevation: 4,500 to 5,200 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition
Welby and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Welby

Setting
Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from limestone, sandstone, and shale

Typical profile
Ap - 0 to 7 inches: silt loam
A1 - 7 to 12 inches: loam
Ac - 12 to 22 inches: silt loam
C1ca,C2ca,C3 - 22 to 65 inches: silt loam

Properties and qualities
Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches

Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 13.0
Available water supply, 0 to 60 inches: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): 2c
Land capability classification (nonirrigated): 3c
Hydrologic Soil Group: C
Ecological site: R028AY310UT - Upland Loam (Bonneville Big Sagebrush) North
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)
Hydric soil rating: No

Minor Components

Vineyard

Percent of map unit: 5 percent

Taylorsville

Percent of map unit: 5 percent

WbB—Welby silt loam, 1 to 3 percent slopes

Map Unit Setting

National map unit symbol: j70g
Elevation: 4,500 to 5,200 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Welby and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Welby

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from limestone, sandstone, and shale

Typical profile

Ap - 0 to 7 inches: silt loam
A1 - 7 to 12 inches: loam
AC - 12 to 22 inches: silt loam

C1ca,C2ca,C3 - 22 to 65 inches: silt loam

Properties and qualities

Slope: 1 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 13.0
Available water supply, 0 to 60 inches: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: R028AY310UT - Upland Loam (Bonneville Big Sagebrush) North
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)
Hydric soil rating: No

WbC—Welby silt loam, 3 to 6 percent slopes

Map Unit Setting

National map unit symbol: j70h
Elevation: 4,500 to 5,200 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Welby and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Welby

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from limestone, sandstone, and shale

Typical profile

Ap - 0 to 7 inches: silt loam
A1 - 7 to 12 inches: loam

AC - 12 to 22 inches: silt loam
C1ca,C2ca,C3 - 22 to 65 inches: silt loam

Properties and qualities

Slope: 3 to 6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 13.0
Available water supply, 0 to 60 inches: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: R028AY310UT - Upland Loam (Bonneville Big Sagebrush) North
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)
Hydric soil rating: No

Minor Components

Taylorsville

Percent of map unit: 5 percent

WeB—Welby silt loam, extended season, 1 to 3 percent slopes

Map Unit Setting

National map unit symbol: j70k
Elevation: 4,500 to 5,200 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Welby, c3, and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Welby, C3

Setting

Landform: Lake terraces
Landform position (three-dimensional): Tread

Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from limestone, sandstone, and shale

Typical profile

Ap - 0 to 7 inches: silt loam
A1 - 7 to 12 inches: loam
AC - 12 to 22 inches: silt loam
C1ca,C2ca,C3 - 22 to 65 inches: silt loam

Properties and qualities

Slope: 1 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 13.0
Available water supply, 0 to 60 inches: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: R028AY310UT - Upland Loam (Bonneville Big Sagebrush) North
Other vegetative classification: Upland Loam (Mountain Big Sagebrush) (028AY310UT)
Hydric soil rating: No

Minor Components

Timpanogos

Percent of map unit: 5 percent

Soil Information for All Uses

Suitabilities and Limitations for Use

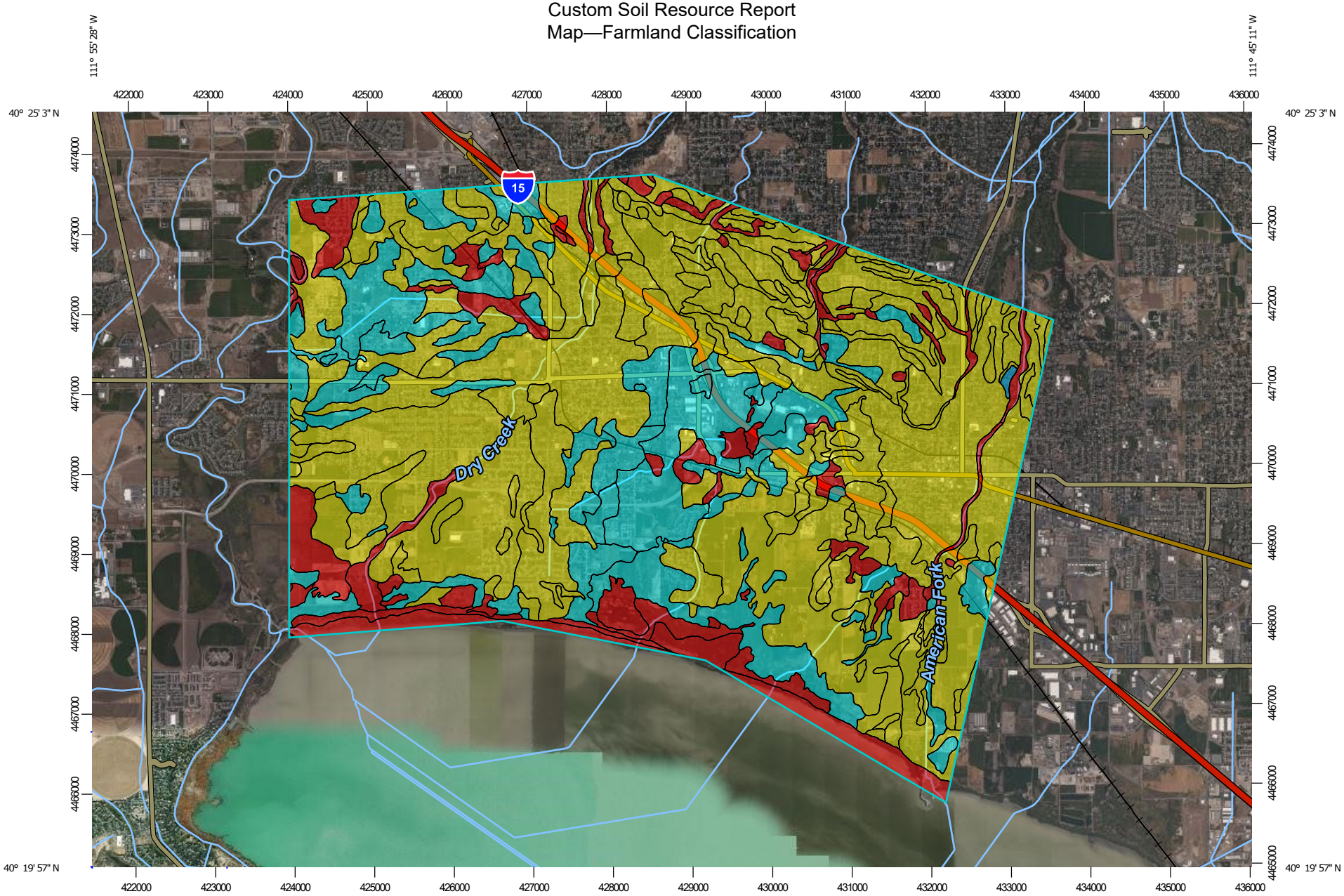
The Suitabilities and Limitations for Use section includes various soil interpretations displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each interpretation.

Land Classifications

Land Classifications are specified land use and management groupings that are assigned to soil areas because combinations of soil have similar behavior for specified practices. Most are based on soil properties and other factors that directly influence the specific use of the soil. Example classifications include ecological site classification, farmland classification, irrigated and nonirrigated land capability classification, and hydric rating.

Farmland Classification

Farmland classification identifies map units as prime farmland, farmland of statewide importance, farmland of local importance, or unique farmland. It identifies the location and extent of the soils that are best suited to food, feed, fiber, forage, and oilseed crops. NRCS policy and procedures on prime and unique farmlands are published in the "Federal Register," Vol. 43, No. 21, January 31, 1978.



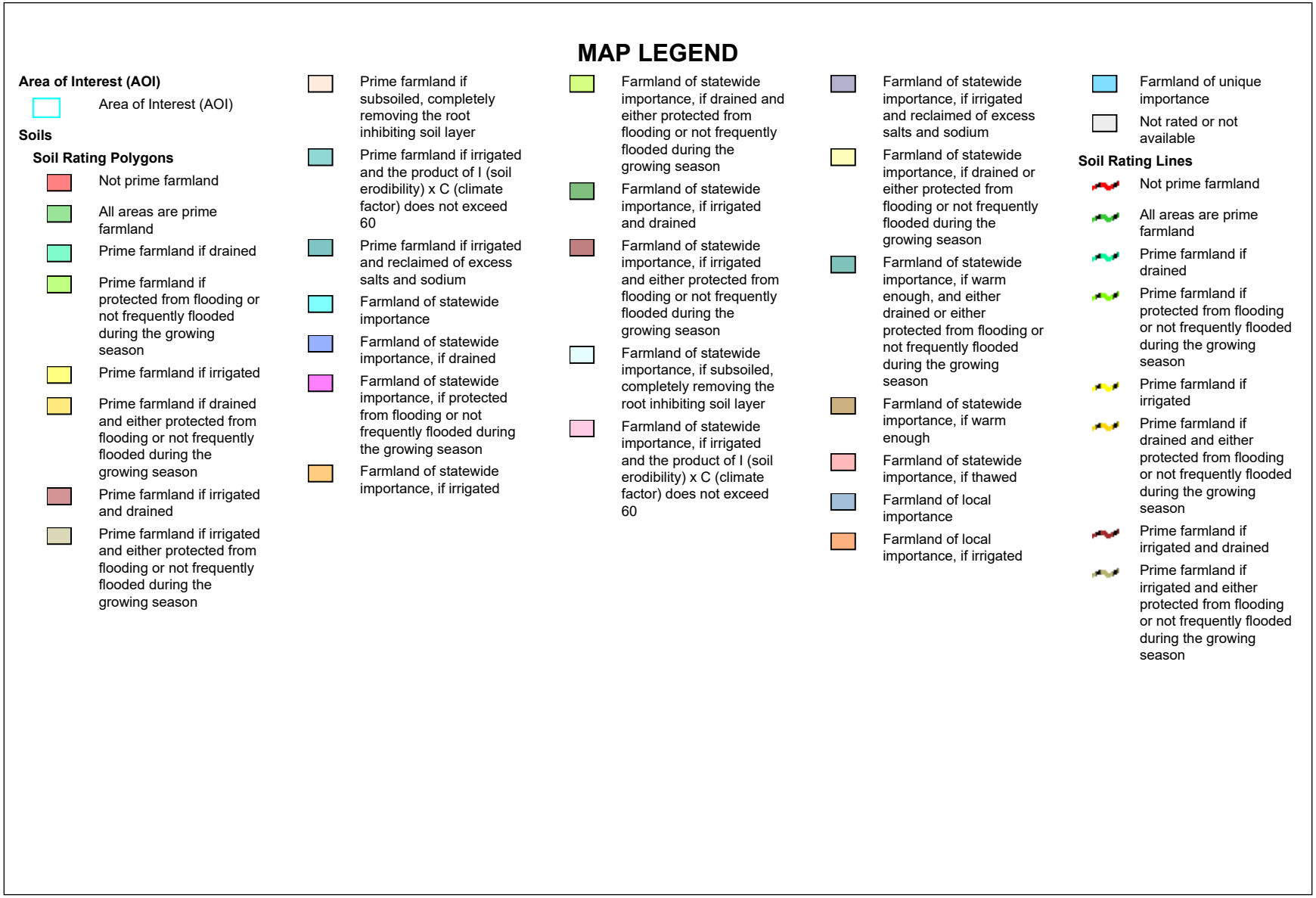
Map Scale: 1:66,600 if printed on A landscape (11" x 8.5") sheet.

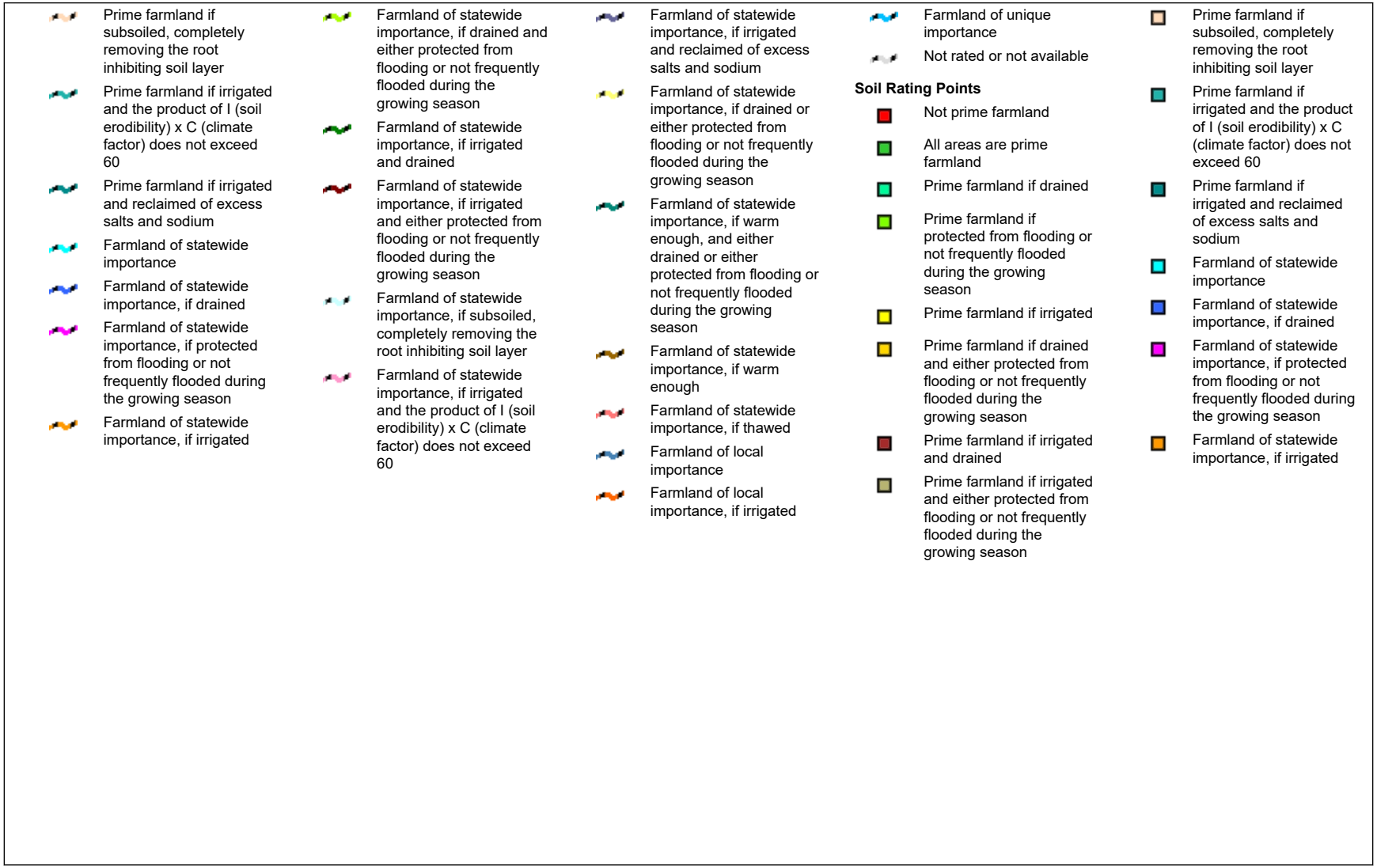
N

Meters
0 500 1000 2000 3000

Feet
0 3000 6000 12000 18000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 12N WGS84


MAP LEGEND
Area of Interest (AOI)
Area of Interest (AOI)
Soils
Soil Rating Polygons
Not prime farmland
All areas are prime farmland
Prime farmland if drained
Prime farmland if protected from flooding or not frequently flooded during the growing season
Prime farmland if irrigated
Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season
Prime farmland if irrigated and drained
Prime farmland if irrigated and either protected from flooding or not frequently flooded during the growing season
Prime farmland if subsoiled, completely removing the root inhibiting soil layer
Prime farmland if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60
Prime farmland if irrigated and reclaimed of excess salts and sodium
Farmland of statewide importance
Farmland of statewide importance, if drained
Farmland of statewide importance, if protected from flooding or not frequently flooded during the growing season
Farmland of statewide importance, if irrigated
Farmland of statewide importance, if drained and either protected from flooding or not frequently flooded during the growing season
Farmland of statewide importance, if irrigated and drained
Farmland of statewide importance, if irrigated and either protected from flooding or not frequently flooded during the growing season
Farmland of statewide importance, if subsoiled, completely removing the root inhibiting soil layer
Farmland of statewide importance, if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60
Farmland of statewide importance, if irrigated and reclaimed of excess salts and sodium
Farmland of statewide importance, if drained or either protected from flooding or not frequently flooded during the growing season
Farmland of statewide importance, if warm enough, and either drained or either protected from flooding or not frequently flooded during the growing season
Farmland of statewide importance, if warm enough
Farmland of statewide importance, if thawed
Farmland of local importance
Farmland of local importance, if irrigated
Farmland of unique importance
Not rated or not available
Soil Rating Lines
Not prime farmland
All areas are prime farmland
Prime farmland if drained
Prime farmland if protected from flooding or not frequently flooded during the growing season
Prime farmland if irrigated
Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season
Prime farmland if irrigated and drained
Prime farmland if irrigated and either protected from flooding or not frequently flooded during the growing season


Prime farmland if subsoiled, completely removing the root inhibiting soil layer
Prime farmland if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60
Prime farmland if irrigated and reclaimed of excess salts and sodium
Farmland of statewide importance
Farmland of statewide importance, if drained
Farmland of statewide importance, if protected from flooding or not frequently flooded during the growing season
Farmland of statewide importance, if irrigated
Farmland of statewide importance, if drained and either protected from flooding or not frequently flooded during the growing season
Farmland of statewide importance, if irrigated and drained
Farmland of statewide importance, if irrigated and either protected from flooding or not frequently flooded during the growing season
Farmland of statewide importance, if subsoiled, completely removing the root inhibiting soil layer
Farmland of statewide importance, if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60
Farmland of statewide importance, if irrigated and reclaimed of excess salts and sodium
Farmland of statewide importance, if drained or either protected from flooding or not frequently flooded during the growing season
Farmland of statewide importance, if warm enough, and either drained or either protected from flooding or not frequently flooded during the growing season
Farmland of statewide importance, if warm enough
Farmland of statewide importance, if thawed
Farmland of local importance
Farmland of local importance, if irrigated
Farmland of unique importance
Not rated or not available
Soil Rating Points
Not prime farmland
All areas are prime farmland
Prime farmland if drained
Prime farmland if protected from flooding or not frequently flooded during the growing season
Prime farmland if irrigated
Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season
Prime farmland if irrigated and drained
Prime farmland if irrigated and either protected from flooding or not frequently flooded during the growing season
Prime farmland if subsoiled, completely removing the root inhibiting soil layer
Prime farmland if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60
Prime farmland if irrigated and reclaimed of excess salts and sodium
Farmland of statewide importance
Farmland of statewide importance, if drained
Farmland of statewide importance, if protected from flooding or not frequently flooded during the growing season
Farmland of statewide importance, if irrigated

- Farmland of statewide importance, if drained and either protected from flooding or not frequently flooded during the growing season
- Farmland of statewide importance, if irrigated and drained
- Farmland of statewide importance, if irrigated and either protected from flooding or not frequently flooded during the growing season
- Farmland of statewide importance, if subsoiled, completely removing the root inhibiting soil layer
- Farmland of statewide importance, if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60
- Farmland of statewide importance, if irrigated and reclaimed of excess salts and sodium
- Farmland of statewide importance, if drained or either protected from flooding or not frequently flooded during the growing season
- Farmland of statewide importance, if warm enough, and either drained or either protected from flooding or not frequently flooded during the growing season
- Farmland of statewide importance, if warm enough
- Farmland of statewide importance, if thawed
- Farmland of local importance
- Farmland of local importance, if irrigated
- Farmland of unique importance
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Utah County, Utah - Central Part
Survey Area Data: Version 14, Sep 7, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 14, 2010—Aug 29, 2018

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Farmland Classification

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1000	Parleys loam, 0 to 4 percent slopes	Prime farmland if irrigated	12.6	0.1%
BC	Beaches	Not prime farmland	79.3	0.6%
BhB	Bingham loam, 1 to 3 percent slopes	Prime farmland if irrigated	51.8	0.4%
Br	Bramwell silty clay loam	Farmland of statewide importance	1,157.9	8.9%
Bs	Bramwell silty clay loam, drained	Farmland of statewide importance	328.4	2.5%
Ch	Chipman loam	Prime farmland if irrigated	17.0	0.1%
Ck	Chipman silty clay loam	Prime farmland if irrigated	1,076.9	8.3%
Cm	Chipman silty clay loam, moderately deep water table	Farmland of statewide importance	551.7	4.2%
Cn	Chipman silty clay loam, moderately saline	Farmland of statewide importance	50.0	0.4%
Cp	Chipman-McBeth complex	Farmland of statewide importance	263.1	2.0%
CU	Cobbly alluvial land	Not prime farmland	34.3	0.3%
HOF	Hillfield-Sterling complex, 20 to 35 percent slopes	Not prime farmland	133.9	1.0%
Hr	Holdaway silt loam	Farmland of statewide importance	139.5	1.1%
Ir	Ironton loam	Prime farmland if irrigated	16.6	0.1%
Is	Ironton loam, moderately saline-alkali	Farmland of statewide importance	61.3	0.5%
Ks	Kirkham silty clay loam	Prime farmland if irrigated	335.4	2.6%
Kt	Kirkham silty clay loam, moderately saline-alkali	Farmland of statewide importance	195.2	1.5%
LaC	Lakewin gravelly fine sandy loam, 1 to 6 percent slopes	Prime farmland if irrigated	612.4	4.7%
LaD	Lakewin gravelly fine sandy loam, 6 to 15 percent slopes	Farmland of unique importance	9.1	0.1%
LfC	Layton fine sandy loam, 1 to 6 percent slopes	Prime farmland if irrigated	137.2	1.1%
Lo	Logan silty clay loam	Not prime farmland	294.6	2.3%
Ls	Logan silty clay loam, heavy variant	Not prime farmland	142.4	1.1%

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
Mf	Martini fine sandy loam	Prime farmland if irrigated	122.0	0.9%
Mh	McBeth silt loam	Prime farmland if irrigated	463.7	3.6%
Mn	McBeth silt loam, moderately saline	Prime farmland if irrigated	147.2	1.1%
MU	Mixed alluvial land	Not prime farmland	107.6	0.8%
Pf	Peteetneet peat	Not prime farmland	150.1	1.2%
PK	Pits and dumps	Not prime farmland	39.3	0.3%
Pw	Provo gravelly fine sandy loam	Not prime farmland	86.1	0.7%
RdA	Redola loam, 0 to 3 percent slopes	Prime farmland if irrigated	101.4	0.8%
ReC	Redola gravelly loam, 3 to 6 percent slopes	Prime farmland if irrigated	8.1	0.1%
RV	Riverwash	Not prime farmland	31.0	0.2%
Sd	Steed sandy loam	Prime farmland if irrigated	254.8	2.0%
Se	Steed gravelly sandy loam	Prime farmland if irrigated	968.1	7.5%
SgB	Sterling gravelly fine sandy loam, 1 to 3 percent slopes	Prime farmland if irrigated	77.6	0.6%
SgC	Sterling gravelly fine sandy loam, 3 to 6 percent slopes	Prime farmland if irrigated	187.4	1.4%
SgD	Sterling gravelly fine sandy loam, 6 to 10 percent slopes	Prime farmland if irrigated	231.8	1.8%
Sr	Sunset loam	Prime farmland if irrigated	1,178.2	9.1%
Ss	Sunset loam, gravelly substratum	Prime farmland if irrigated	876.4	6.7%
TaA	Taylorsville silty clay loam, 0 to 1 percent slopes	Prime farmland if irrigated	251.5	1.9%
TaB	Taylorsville silty clay loam, 1 to 3 percent slopes	Prime farmland if irrigated	230.2	1.8%
TmB	Timpanogos loam, 0 to 3 percent slopes	Prime farmland if irrigated	4.5	0.0%
VnA	Vineyard fine sandy loam, 0 to 2 percent slopes	Prime farmland if irrigated	399.0	3.1%
VsA	Vineyard fine sandy loam, moderately saline, 0 to 2 percent slopes	Not prime farmland	261.5	2.0%
W	Water	Not prime farmland	340.8	2.6%

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
WbA	Welby silt loam, 0 to 1 percent slopes	Prime farmland if irrigated	239.2	1.8%
WbB	Welby silt loam, 1 to 3 percent slopes	Prime farmland if irrigated	454.1	3.5%
WbC	Welby silt loam, 3 to 6 percent slopes	Farmland of statewide importance	62.5	0.5%
WeB	Welby silt loam, extended season, 1 to 3 percent slopes	Prime farmland if irrigated	17.6	0.1%
Totals for Area of Interest			**12,993.0**	**100.0%**

Rating Options—Farmland Classification

Aggregation Method: No Aggregation Necessary

Tie-break Rule: Lower

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

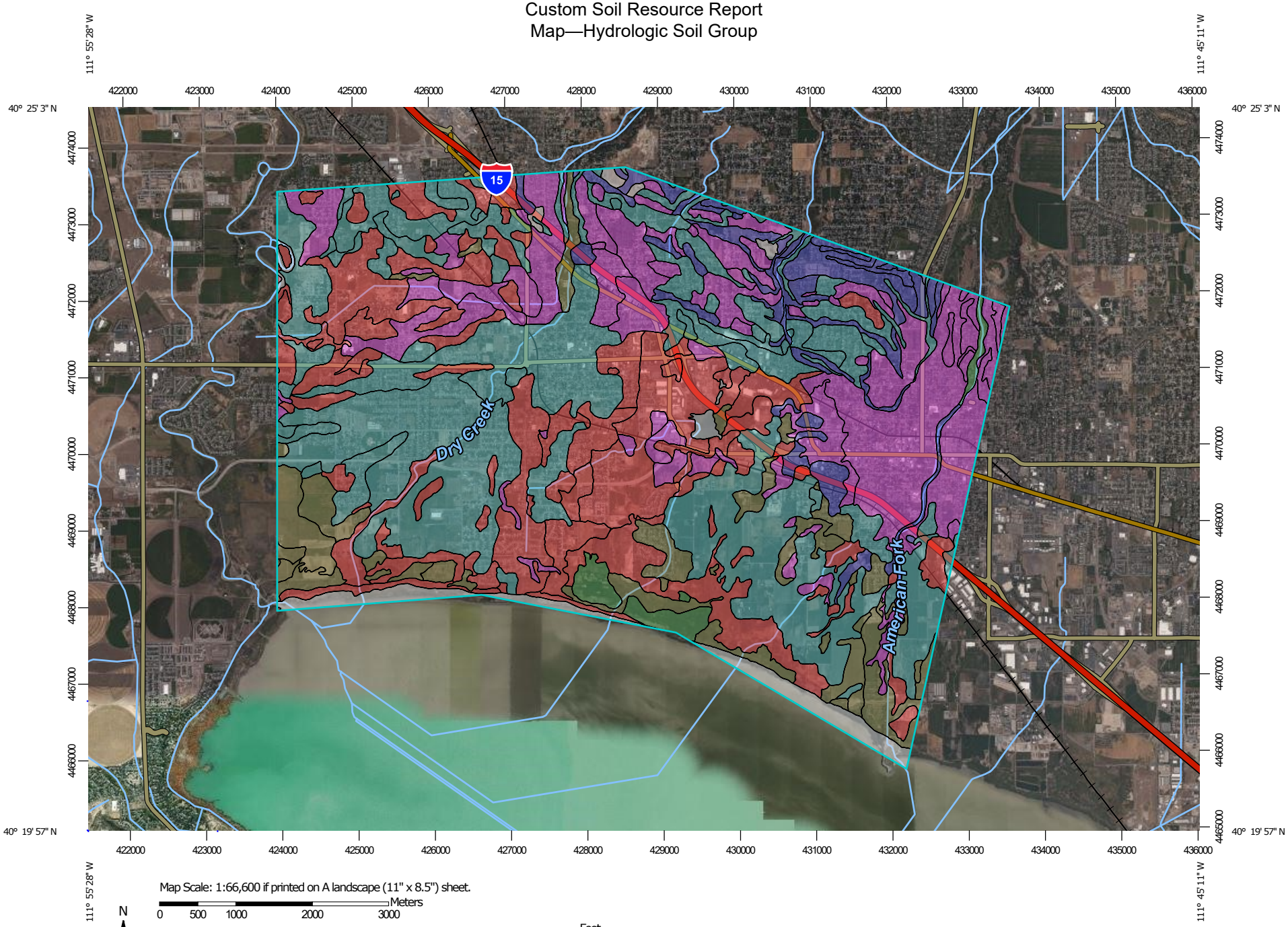
Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at

or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.


111° 55' 28" W
111° 45' 11" W
40° 25' 3" N
40° 19' 57" N
422000
423000
424000
425000
426000
427000
428000
429000
430000
431000
432000
433000
434000
435000
436000
4474000
4473000
4472000
4471000
4470000
4469000
4468000
4467000
4466000
4465000
15
Dry Creek
American Fork
Map Scale: 1:66,600 if printed on A landscape (11" x 8.5") sheet.
N
Meters
0 500 1000 2000 3000
Feet
0 3000 6000 12000 18000
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 12N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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Soil Survey Area: Utah County, Utah - Central Part
Survey Area Data: Version 14, Sep 7, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 14, 2010—Aug 29, 2018

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1000	Parleys loam, 0 to 4 percent slopes	C	12.6	0.1%
BC	Beaches	D	79.3	0.6%
BhB	Bingham loam, 1 to 3 percent slopes	B	51.8	0.4%
Br	Bramwell silty clay loam	D	1,157.9	8.9%
Bs	Bramwell silty clay loam, drained	D	328.4	2.5%
Ch	Chipman loam	C	17.0	0.1%
Ck	Chipman silty clay loam	C	1,076.9	8.3%
Cm	Chipman silty clay loam, moderately deep water table	D	551.7	4.2%
Cn	Chipman silty clay loam, moderately saline	D	50.0	0.4%
Cp	Chipman-McBeth complex	D	263.1	2.0%
CU	Cobbly alluvial land	B	34.3	0.3%
HOF	Hillfield-Sterling complex, 20 to 35 percent slopes	C	133.9	1.0%
Hr	Holdaway silt loam	D	139.5	1.1%
Ir	Ironton loam	C/D	16.6	0.1%
Is	Ironton loam, moderately saline-alkali	C/D	61.3	0.5%
Ks	Kirkham silty clay loam	D	335.4	2.6%
Kt	Kirkham silty clay loam, moderately saline-alkali	D	195.2	1.5%
LaC	Lakewin gravelly fine sandy loam, 1 to 6 percent slopes	A	612.4	4.7%
LaD	Lakewin gravelly fine sandy loam, 6 to 15 percent slopes	A	9.1	0.1%
LfC	Layton fine sandy loam, 1 to 6 percent slopes	A	137.2	1.1%
Lo	Logan silty clay loam	C/D	294.6	2.3%
Ls	Logan silty clay loam, heavy variant	C/D	142.4	1.1%
Mf	Martini fine sandy loam	A	122.0	0.9%
Mh	McBeth silt loam	C/D	463.7	3.6%
Mn	McBeth silt loam, moderately saline	C/D	147.2	1.1%

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
MU	Mixed alluvial land	D	107.6	0.8%
Pf	Peteetneet peat	A/D	150.1	1.2%
PK	Pits and dumps		39.3	0.3%
Pw	Provo gravelly fine sandy loam	B	86.1	0.7%
RdA	Redola loam, 0 to 3 percent slopes	B	101.4	0.8%
ReC	Redola gravelly loam, 3 to 6 percent slopes	B	8.1	0.1%
RV	Riverwash	A/D	31.0	0.2%
Sd	Steed sandy loam	A	254.8	2.0%
Se	Steed gravelly sandy loam	A	968.1	7.5%
SgB	Sterling gravelly fine sandy loam, 1 to 3 percent slopes	B	77.6	0.6%
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WeB	Welby silt loam, extended season, 1 to 3 percent slopes	C	17.6	0.1%

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
Totals for Area of Interest			**12,993.0**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Water Features

Water Features include ponding frequency, flooding frequency, and depth to water table.

Flooding Frequency Class

Flooding is the temporary inundation of an area caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, and water standing in swamps and marshes is considered ponding rather than flooding.

Frequency is expressed as none, very rare, rare, occasional, frequent, and very frequent.

"None" means that flooding is not probable. The chance of flooding is nearly 0 percent in any year. Flooding occurs less than once in 500 years.

"Very rare" means that flooding is very unlikely but possible under extremely unusual weather conditions. The chance of flooding is less than 1 percent in any year.

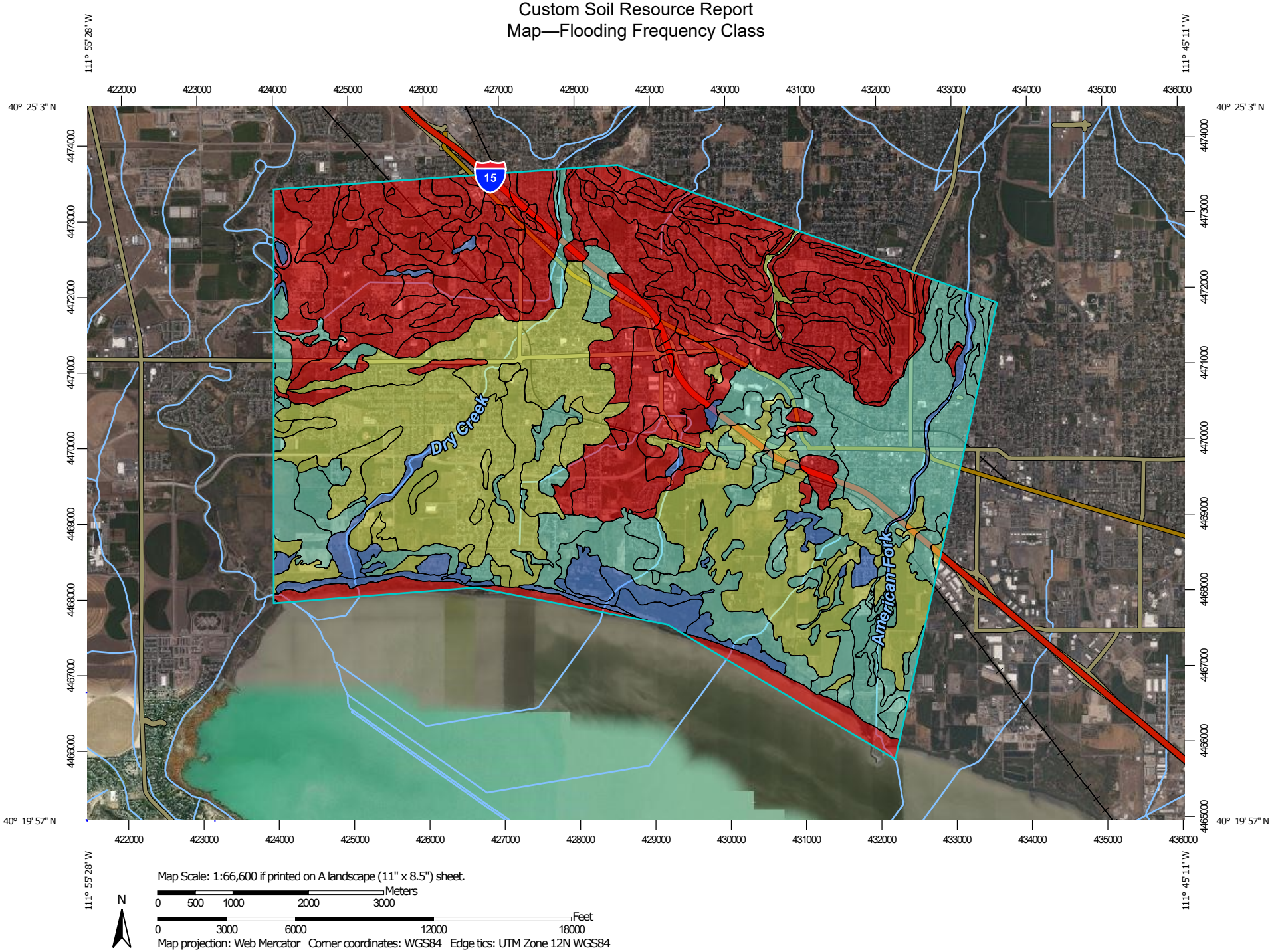
"Rare" means that flooding is unlikely but possible under unusual weather conditions. The chance of flooding is 1 to 5 percent in any year.

"Occasional" means that flooding occurs infrequently under normal weather conditions. The chance of flooding is 5 to 50 percent in any year.

"Frequent" means that flooding is likely to occur often under normal weather conditions. The chance of flooding is more than 50 percent in any year but is less than 50 percent in all months in any year.

"Very frequent" means that flooding is likely to occur very often under normal weather conditions. The chance of flooding is more than 50 percent in all months of any year.

Map—Flooding Frequency Class



Map Scale: 1:66,600 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 500 1000 2000 3000

Feet
0 3000 6000 12000 18000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 12N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- None
- Very Rare
- Rare
- Occasional
- Frequent
- Very Frequent
- Not rated or not available

Soil Rating Lines
- None
- Very Rare
- Rare
- Occasional
- Frequent
- Very Frequent
- Not rated or not available

Soil Rating Points
- None
- Very Rare
- Rare
- Occasional
- Frequent
- Very Frequent
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Utah County, Utah - Central Part
Survey Area Data: Version 14, Sep 7, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 14, 2010—Aug 29, 2018

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Flooding Frequency Class

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1000	Parleys loam, 0 to 4 percent slopes	None	12.6	0.1%
BC	Beaches	Frequent	79.3	0.6%
BhB	Bingham loam, 1 to 3 percent slopes	None	51.8	0.4%
Br	Bramwell silty clay loam	None	1,157.9	8.9%
Bs	Bramwell silty clay loam, drained	None	328.4	2.5%
Ch	Chipman loam	Rare	17.0	0.1%
Ck	Chipman silty clay loam	Rare	1,076.9	8.3%
Cm	Chipman silty clay loam, moderately deep water table	Occasional	551.7	4.2%
Cn	Chipman silty clay loam, moderately saline	Occasional	50.0	0.4%
Cp	Chipman-McBeth complex	Occasional	263.1	2.0%
CU	Cobbly alluvial land	Frequent	34.3	0.3%
HOF	Hillfield-Sterling complex, 20 to 35 percent slopes	None	133.9	1.0%
Hr	Holdaway silt loam	Rare	139.5	1.1%
Ir	Ironton loam	Rare	16.6	0.1%
Is	Ironton loam, moderately saline-alkali	Rare	61.3	0.5%
Ks	Kirkham silty clay loam	Rare	335.4	2.6%
Kt	Kirkham silty clay loam, moderately saline-alkali	Occasional	195.2	1.5%
LaC	Lakewin gravelly fine sandy loam, 1 to 6 percent slopes	None	612.4	4.7%
LaD	Lakewin gravelly fine sandy loam, 6 to 15 percent slopes	None	9.1	0.1%
LfC	Layton fine sandy loam, 1 to 6 percent slopes	None	137.2	1.1%
Lo	Logan silty clay loam	Frequent	294.6	2.3%
Ls	Logan silty clay loam, heavy variant	Occasional	142.4	1.1%
Mf	Martini fine sandy loam	Occasional	122.0	0.9%
Mh	McBeth silt loam	Occasional	463.7	3.6%
Mn	McBeth silt loam, moderately saline	Occasional	147.2	1.1%

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
MU	Mixed alluvial land	Frequent	107.6	0.8%
Pf	Peteetneet peat	Frequent	150.1	1.2%
PK	Pits and dumps	None	39.3	0.3%
Pw	Provo gravelly fine sandy loam	Rare	86.1	0.7%
RdA	Redola loam, 0 to 3 percent slopes	None	101.4	0.8%
ReC	Redola gravelly loam, 3 to 6 percent slopes	None	8.1	0.1%
RV	Riverwash	Frequent	31.0	0.2%
Sd	Steed sandy loam	Occasional	254.8	2.0%
Se	Steed gravelly sandy loam	Occasional	968.1	7.5%
SgB	Sterling gravelly fine sandy loam, 1 to 3 percent slopes	None	77.6	0.6%
SgC	Sterling gravelly fine sandy loam, 3 to 6 percent slopes	None	187.4	1.4%
SgD	Sterling gravelly fine sandy loam, 6 to 10 percent slopes	None	231.8	1.8%
Sr	Sunset loam	Rare	1,178.2	9.1%
Ss	Sunset loam, gravelly substratum	Rare	876.4	6.7%
TaA	Taylorsville silty clay loam, 0 to 1 percent slopes	None	251.5	1.9%
TaB	Taylorsville silty clay loam, 1 to 3 percent slopes	None	230.2	1.8%
TmB	Timpanogos loam, 0 to 3 percent slopes	None	4.5	0.0%
VnA	Vineyard fine sandy loam, 0 to 2 percent slopes	None	399.0	3.1%
VsA	Vineyard fine sandy loam, moderately saline, 0 to 2 percent slopes	None	261.5	2.0%
W	Water	None	340.8	2.6%
WbA	Welby silt loam, 0 to 1 percent slopes	None	239.2	1.8%
WbB	Welby silt loam, 1 to 3 percent slopes	None	454.1	3.5%
WbC	Welby silt loam, 3 to 6 percent slopes	None	62.5	0.5%
WeB	Welby silt loam, extended season, 1 to 3 percent slopes	None	17.6	0.1%

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
Totals for Area of Interest			**12,993.0**	**100.0%**

Rating Options—Flooding Frequency Class

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: More Frequent

Beginning Month: January

Ending Month: December

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E.4 Aquatic Resources Delineation Report

HORROCKS
ENGINEERS

AQUATIC RESOURCES DELINEATION

THE AMERICAN FORK RIVER SUPPLEMENTAL WATERSHED PLAN

PREPARED FOR:
Natural Resources Conservation Service
Cities of Lehi and American Fork, Utah

PREPARED BY:
Nathan Clarke
Horrocks Engineers
2162 West Grove Parkway, Suite 400
Pleasant Grove, Utah 84062

May 2022

EXECUTIVE SUMMARY

The United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS), with assistance from American Fork City as the project sponsor, and Lehi City as project co-sponsor, is considering proposed improvements within the American Fork River Watershed. The main objective of the project is to implement flood reduction and prevention solutions in specific locations within sponsor cities that will protect public safety on public roadways, private property, and agricultural areas. The proposed improvements include the design and construction of concrete box culverts and the reconstruction of channels to increase capacity and improve channel operations.

The aquatic resources delineation was completed in accordance with the U.S. Army Corps of Engineers' (USACE) *1987 Wetland Delineation Manual* (USACE 1987) and the *Regional Supplement: Arid West Region Version 2.0* (USACE 2008), and stream channels were delineated by using the USACE delineation manual, *A Field Guide to the Identification of the Ordinary High Water Mark (OHWM) in the Arid West Region of the Western United States* (Lichvar and McColley 2008).

Four Waters of the U.S. (WOTUS), totaling 4.14 acres, were identified within the 35.7-acre delineation study area. The identified WOTUS are associated with Utah Lake, Dry Creek, the Waste Ditch, and the American Fork River.

ACRONYMS AND ABBREVIATIONS

L2ABF	Lacustrine, Littoral, Aquatic Bed, Semipermanently Flooded
MP	Milepost
NRCS	Natural Resources Conservation Service
NWI	National Wetland Inventory
OHWM	Ordinary High Water Mark
R4SBc	Riverine, Intermittent, Streambed, Seasonally Flooded
R4SBCx	Riverine, Intermittent, Streambed, Seasonally Flooded, Excavated
R5UBFx	Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanetly Flooded, Excavated
USACE	U.S. Army Corps of Engineers
WOTUS	Waters of the United States

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1.1 INTRODUCTION

The purpose of this report is to identify and describe aquatic resources, and to identify known possible sensitive plant, fish, wildlife species, and cultural/historic properties in the survey area. The report facilitates efforts to:
1. Avoid or minimize impacts to aquatic resources during the design process.
2. Document aquatic resource boundary determinations for review by regulatory authorities.
3. Provide early indications of known sensitive species and historic/cultural properties within the survey area.
4. Provide background information.

Impacts to identified features from the proposed improvements, as well as strategies for avoidance and minimization, will need to be considered. See Appendix B for a project location map. Section 404 of the Clean Water Act regulates the discharge of dredged or fill material into navigable waters, which has been defined to include tributaries and adjacent wetlands. The Corps will make final determinations of wetland boundaries and jurisdictions as waters of the U.S.

1.1.1 Contact Information for the Applicant and Owner

The applicant and owner for this project are the same:

Natural Resources Conservation Service
Derek Hamilton
Ph. 801-524-4560
derek.hamilton@usda.gov

1.1.2 Contact Information for Aquatic Resources Delineation Consultant

Horrocks Engineers
Nathan Clarke
2162 West Grove Parkway, Suite 400
Pleasant Grove, UT 84062
Ph. (801) 763-5100
nathanc@horrocks.com

1.1.3 Site Description

The study area lies within the Arid West Region in Lehi and American Fork, Utah. Elevations in the study area range from approximately 4,660 feet asl to 4,4455 feet asl. The project area is located in highly urbanized areas in Lehi and American Fork, as well as undeveloped areas within Willow Park and near Utah Lake.

1.2 PROJECT LOCATION

The study areas are located in Utah County, Utah, in Sections 8, 17, 19, 24 and 30 of Township 5 South, Range 1 East, Section 12 of Township 5 South, Range 1 West, of the Lehi-Part Timpanogos Caves and Jordan Narrow Quadrangles. The central coordinates for each of the study areas are Lat. 40.369627, Long. -111.881272; Lat. 40.3735630297, Lng. -111.79467343; Lat. 40.3962375197, Lng. -111.852060946; Lat. 40.3960174127, Lng. -111.850243331; and Lat. 40.3913718251, Lng. -111.896467079, Lat. 40.368870, Lng. -111.7965808, Lng. -111.896467079, Lat. 40.36871, Lng. -111.7972584, Lat. 40.3795167, Long. -111.79310813, Lat. 40.3829587, Long. -111.78962648, respectively.

To arrive at the study area from Salt Lake City, UT, travel south on I-15 for approximately 23.9 miles. Take exit 283 onto Thanksgiving Way and turn right on 2300 W/ Triumph Blvd for 1.5 miles. Turn right (west) onto 300 N and follow for 0.4 miles to arrive at the westernmost study area. The delineation results may be field-verified by Corps' personnel.

1.3 AQUATIC RESOURCES DELINEATION METHODOLOGY

1.3.1 Delineation Methodology for Wetlands

The aquatic resources delineation was completed in accordance with the U.S. Army Corps of Engineers' (USACE) *1987 Wetland Delineation Manual* (USACE 1987) and *the Regional Supplement: Arid West Region Version 2.0* (USACE 2008). All potential wetland areas were verified for wetland indicators as established in the above delineation manuals. The following procedures were implemented at each sample point to determine presence of wetland indicators, and the collected information was recorded on Arid West Supplement V2 Data Forms. Photographs were also taken to document the sample point (See Appendix C for photos).

Hydrophytic Vegetation

All plant species within a five-foot radius area of the sample point were recorded. The percent of relative cover for each species was determined by estimating aerial cover. The indicator status of each species was determined by using the *2018 National Wetland Plant List - Arid West* (USACE 2018). Vegetation species comprising of at least twenty (20) percent of the total aerial cover in its stratum were considered dominant, following the guidelines of the USACE 50/20 rule. If the vegetation passed the prevalence index, or if more than fifty (50) percent of the dominant plant species had an indicator status of obligate wetland species (OBL), facultative wetland species (FACW), or facultative species (FAC), the sample point met the hydrophytic vegetation parameter.

Hydric Soils

At the sample point, a soil pit was excavated to a minimum depth of 18 inches to assess soil characteristics and water conditions. A profile of the soil pit was used to determine soil color, texture and moisture at different depths within the soil profile. Colors of the soil profile and any redox features were identified by comparing a moistened soil sample to the Munsell® Soil Color Charts (Munsell® 2000). Soil texture and moisture were determined by tactile assessment. If the soil characteristics met one of the primary hydric soil indicators or indicators of problematic soil, identified in the *Arid West Regional Supplement* (USACE 2008) and the *Field Indicators of Hydric Soils in the U.S. Version 8.2* (USDA 2010), the sample point met the hydric soils parameter.

Wetland Hydrology

The soil pits were also examined for the presence or absence of hydrologic indicators. These hydrologic indicators are described in the Arid West Regional Supplement. If it was determined that at least one primary hydrologic indicator or two or more secondary hydrologic indicators were present, the sample point met the hydrologic parameter.

Wetland Boundary Determination Procedure

Sample points that met all three parameters, hydrophytic vegetation, hydric soils, and wetland hydrology, were classified as occurring in a wetland. A second sample point, located in the adjacent upland, was then documented for the presence of the three indicators. If the point did not meet

all three parameters, the point was classified as occurring in upland. The next step was to define the wetland boundary occurring between the wetland sample point and the upland sample point. Boundaries were based on information gathered from the two sample points and observable changes in elevation and plant communities. Using a hand-held Trimble GeoExplorer XT global positioning system receiver, the wetland boundary and sample points were surveyed and data was downloaded into ArcMAP. The data was then used to produce a map that shows delineated wetland boundaries and sample point locations. Acreages for each wetland polygon were included on the map, and the Cowardin Classification System (Cowardin et al. 1979) was used to designate the wetland type.

1.3.2 Delineation Methodology for Stream Channels

Stream channels were delineated according to guidance outlined in the USACE delineation manual, *A Field Guide to the Identification of the Ordinary High Water Mark (OHWM) in the Arid West Region of the Western United States* (Lichvar and McColley 2008). These stream channels within the project area were identified, and the OHWM for these waters was surveyed using a hand-held Trimble GeoExplorer XT global positioning system receiver. The survey data was downloaded into ArcMAP to produce a map that depicts the delineated WOTUS. The acreage for each WOTUS within the project area was included on the map and the Cowardin Classification System was used to designate the WOTUS type.

1.4 EXISTING CONDITIONS

1.4.1 Landscape Setting

The eleven (11) study areas, totaling 35.7-acres, are located in Utah County, UT, in Lehi along 300 N, near Lehi Elementary School, in Willow Park, and along Dry Creek from 700 S to Utah Lake, and in American Fork at the corner of 400 N and 400 E, along 300 N, near 100 N and 200 E, near 200 E and 100 S, at the corner of 200 S and 100 E, and along 400 S near 65 E. The land surrounding the study area is mostly developed with schools, residential housing, and commercial buildings. Some areas are also undeveloped open land or agricultural fields.

More detailed information regarding the site's existing vegetation, soils, and hydrology is included in the sections below.

1.4.2 Field Conditions

The delineation field work was conducted by Nathan Clarke of Horrocks Engineers on August 12, 2021, March 21, 2022, and May 3, 2022. The nearby weather station in Lehi, UT indicates that the area on average receives 11.95 inches of annual precipitation. The area has been in an extreme drought, and weather data shows the month of June 2021 received only a trace amount of precipitation and July received 0.82 inches of precipitation. The area received 0.34 inches of precipitation in the weeks leading up to the visit in August. Temperatures during the field visit ranged from 58° Fahrenheit (F) in the mornings to 98° F in the afternoons and evenings, which is higher than the average temperature for this area. Conditions in May of 2022 were still dry, and the previous month of April had 0.89 inches of precipitation. Temperatures for the May visit ranged from 34° Fahrenheit (F) in the mornings to 50° F in the afternoons and evenings, which is lower than the average temperature for this area.

1.4.3 Known Sensitive Species and Historic/Cultural Properties Within the Survey Area

A cultural resources inventory was completed by Horrocks Engineers in the summer of 2021 and in 2022. A total of seven sites and two architectural resources were noted during this survey, three of which are located outside of the aquatic resources delineation study areas.

1.5 AQUATIC RESOURCES

1.5.1 Overview

Four WOTUS, totaling 4.14 acres were identified within the 35.7-acre delineation study area. Table 1.1 summarizes the delineated features (see Appendix A for maps, and Appendix B for data forms and photos). All aquatic resources within the study area were identified, documented, and mapped, and all would likely be considered jurisdictional because they are a relatively permanent flowing and standing water with a specific surface water connection to a navigable WOTUS. Greater information about delineated features is provided in the paragraphs below the table.

Table 1.1 Summary of Delineated Features

FEATURE NAME	COWARDIN CLASSIFICATION	LOCATION (LAT/LONG)	ACRES	LINEAR FT
Waters of the U.S.				
Dry Creek	R4SBC	40.39553722, -111.8503270	2.46	13,811
Waste Ditch	R5UBFx	40.39130974, -111.8963496	0.72	2869
American Fork River	R4SBCx	40.37365886, -111.7945907	0.73	2716
Utah Lake	L2ABF	40.35987977, -111.8818949	0.24	134
Other WOTUS Total				19,530
TOTAL			**4.14**	**19,530**

*R4SBC *(Riverine, Intermittent, Streambed, Seasonaly Flooded)*, R4SBCx *(Riverine, Intermittent, Streambed, Seasonaly Flooded, Excavated),* R5UBFx *(Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded, Excavated),* L2ABF (Lacustrine, Littoral, Aquatic Bed, Semipermanently Flooded)

Wetland Features

During the delineation fieldwork, sample points were established in wetland and upland vegetation communities for sampling of vegetation, soils, and hydrology characteristics. Two sample points were taken to determine the boundaries between wetlands and uplands (See Appendix E for data sheets). Neither of the sample points met the three parameters indicative of wetlands. Table1.2 summarizes the sample point data.

Table 1.2 Wetland Indicators for each Sample Point

SAMPLE POINT	HYDROPHYTIC VEGETATION PRESENT	HYDRIC SOIL INDICATORS PRESENT	HYDROLOGY INDICATORS PRESENT	IS THE SAMPLE POINT IN A WETLAND?	MAP # (APPENDIX A)
1	N	N	N	N	14
2	Y	N	N	N	16

1.5.2 Other Waters of the U.S.

American Fork River

The American Fork River is an intermittent stream that flows through the study area in American Fork into Utah Lake. The OHWM of the stream was surveyed and the portions of the creek within the study area are approximately 0.73 acre and 2716 linear feet in size. The width of the stream varies from 10-18 feet, and no water was flowing at the time of the field visit. The stream receives its flow from the Wasatch Mountains in American Fork Canyon located northeast of American Fork. The majority of the stream flows through urbanized areas and has been concrete-lined. The American Fork River would be classified as R4SBCx (Riverine, Intermittent, Streambed, Seasonaly Flooded, Excavated) and would likely be considered jurisdictional.

Dry Creek

Dry Creek is an intermittent stream that flows through the study area in Lehi into Utah Lake. The OHWM of the stream was surveyed and the portions of the creek within the study area are approximately 2.46 acre and 13,811 linear feet in size. The width of the stream varies from 6-20 feet, and no water was flowing at the time of the field visit, but there was some standing water in a couple of areas. Some portions of the stream have been realigned or lined with riprap. The stream receives its flow from the Wasatch Mountains located northeast of Lehi. The majority of the stream flows through urbanized areas and has been concrete-lined. As the stream gets closer to Utah Lake the channel becomes less defined, and the lower reaches did not have a discernible OHWM. Dry Creek would be classified as R4SBC (Riverine, Intermittent, Streambed, Seasonaly Flooded), and would likely be considered jurisdictional.

Waste Ditch

The Waste Ditch is a man-made diversion channel that splits off from Dry Creek near Lehi Elementary School. The feature flows through the study area in Lehi into the Jordan River. The OHWM of the stream was surveyed and the portions of the creek within the study area are approximately 0.72-acre and 2896 linear feet in size. The width of the stream varies from 6-20 feet, and water was flowing at the time of the field visit at a depth of 6-12 inches. The stream receives its flow from Dry Creek and other stormwater management systems in the area. The Waste Ditch would be classified as R5UBFx (Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded, Excavated), and would likely be considered jurisdictional.

1.5.3 Hydrology

The study area lies directly north of Utah Lake. Two intermittent streams, Utah Lake, and the Waste Ditch account for all the hydrology present within the study area. Developed areas in Lehi City have been flooded or are at risk for flooding along Dry Creek and the waste ditch, which is the secondary canal that diverts excess water from Dry Creek westward to the Jordan River. In recent years, Lehi City, in partnership with private landowners and state agencies, has invested millions of dollars improving the Dry Creek channel and waste ditch in various locations throughout the city. High flows have posed an increasing threat to residential structures and Lehi Elementary School in the sections of the channel that have not been improved due to lack of sufficient financial resources. The study area is located in the Utah Lake watershed (HUC 16020201).

1.5.4 Soils

The soil survey information compiled by NRCS identifies 12 soil mapping units within the delineation study area. Three of these are included on the Utah Hydric Soil list (USDA 2010). See Table 1.4 for general soils information obtained from the NRCS Web Soil Survey. For attached soils map and legend, see Appendix B.

Table 1.4 Soils in Delineation Study Area

SOIL SERIES NAME	ACRES IN STUDY AREA	PERCENT COVERAGE OF STUDY AREA	HYDRIC SOIL?
Beaches	0.8	1.8	No
Chipman-McBeth complex	5..2	12.4	Yes
Cobbly alluvial land	1.4	3.2	Yes
Lakewin gravelly fine sandy loam, 1 to 6 percent slopes	1.2	2.9	No
McBeth silt loam	4.4	10.5	Yes
Mixed alluvial land	19.7	47.1	
Riverwash	0.6	1.3	No
Steed gravelly sandy loam	0.4	0.9	No
Sunset Loam	5.5	13.1	No
Sunset loam, gravelly substratum	0.1	1.7	No
Water	0.8	1.9	No
Welby silt loam, 0 to 1 percent slopes	0.4	4.7	No

1.5.5 Vegetation

The vegetation within the study area consisted mainly ornamental landscapes and mature cottonwood and box elder trees. See Table 1.4 in Appendix D for common plants in the delineation study area.

1.5.6 Interstate and Foreign Commerce

No examples of interstate or foreign commerce were observed or documented in the WOTUS or wetlands mapped as part of this Aquatic Resources Delineation.

1.6 REFERENCES

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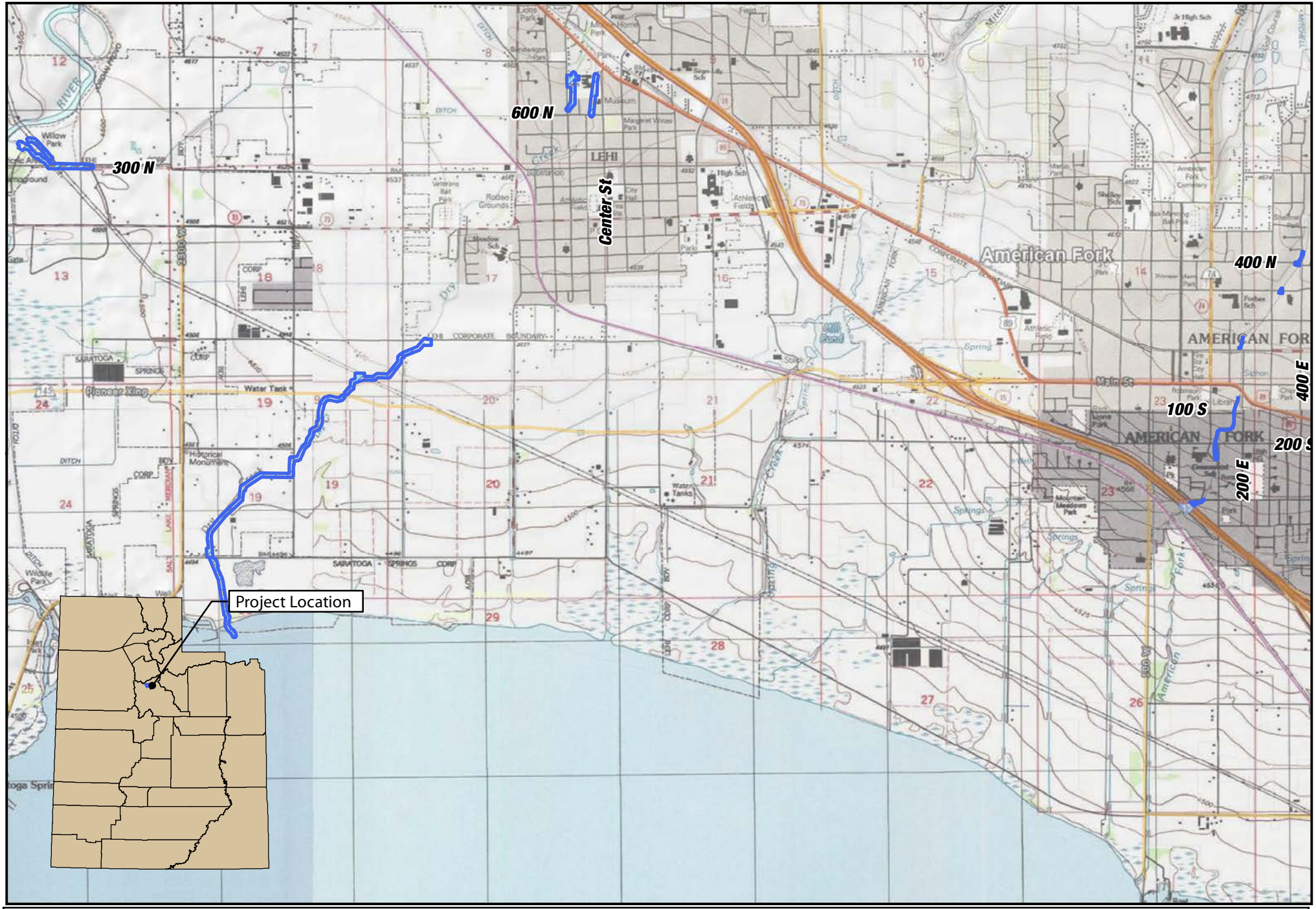
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APPENDIX A: AQUATIC RESOURCES DELINEATION MAPS



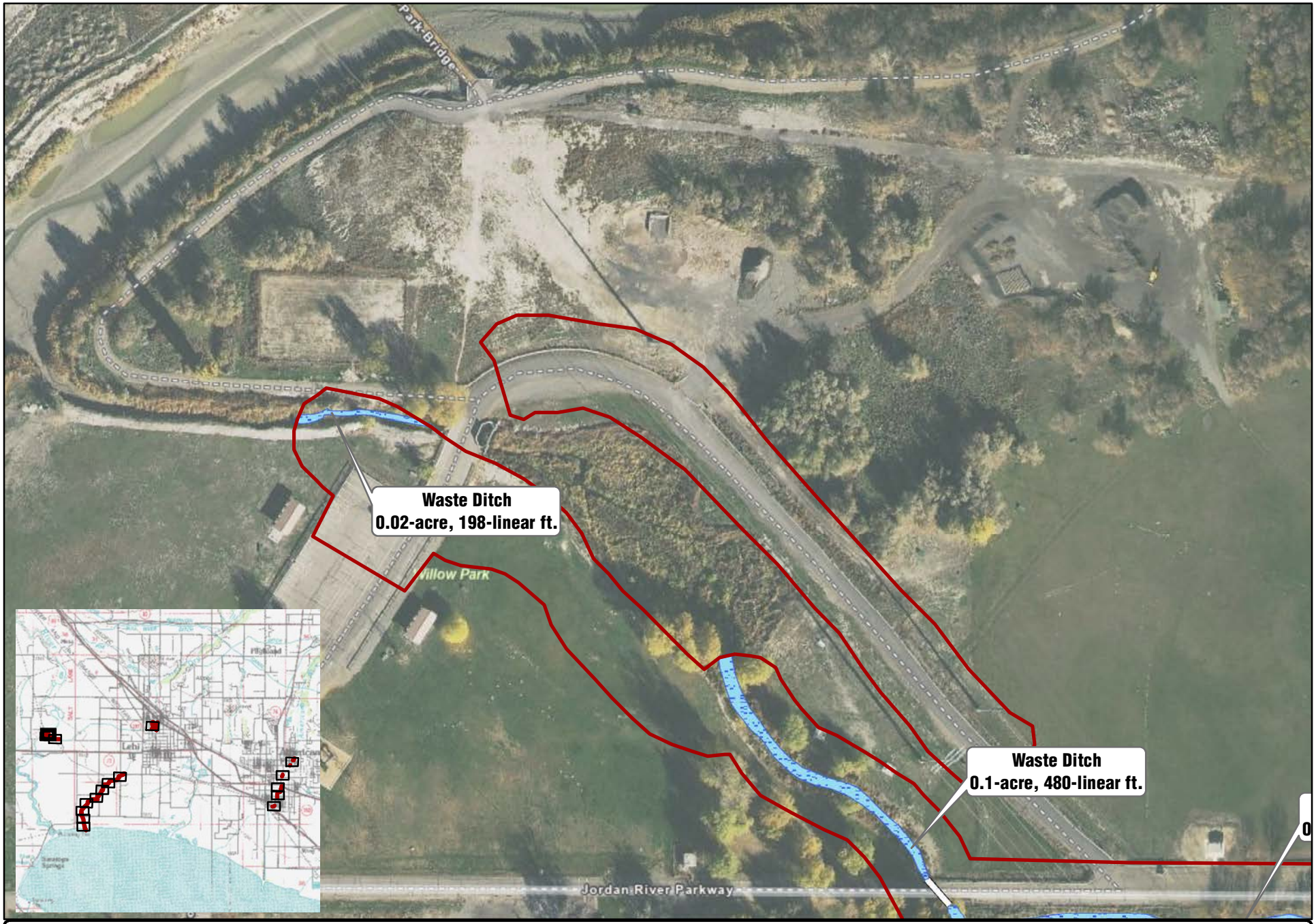
Study Areas

0 3,950 7,900 Feet

1 inch = 4,000 feet

AMERICAN FORK RIVER
SUPPLEMENTAL WATERSHED PLAN

Project Location Map



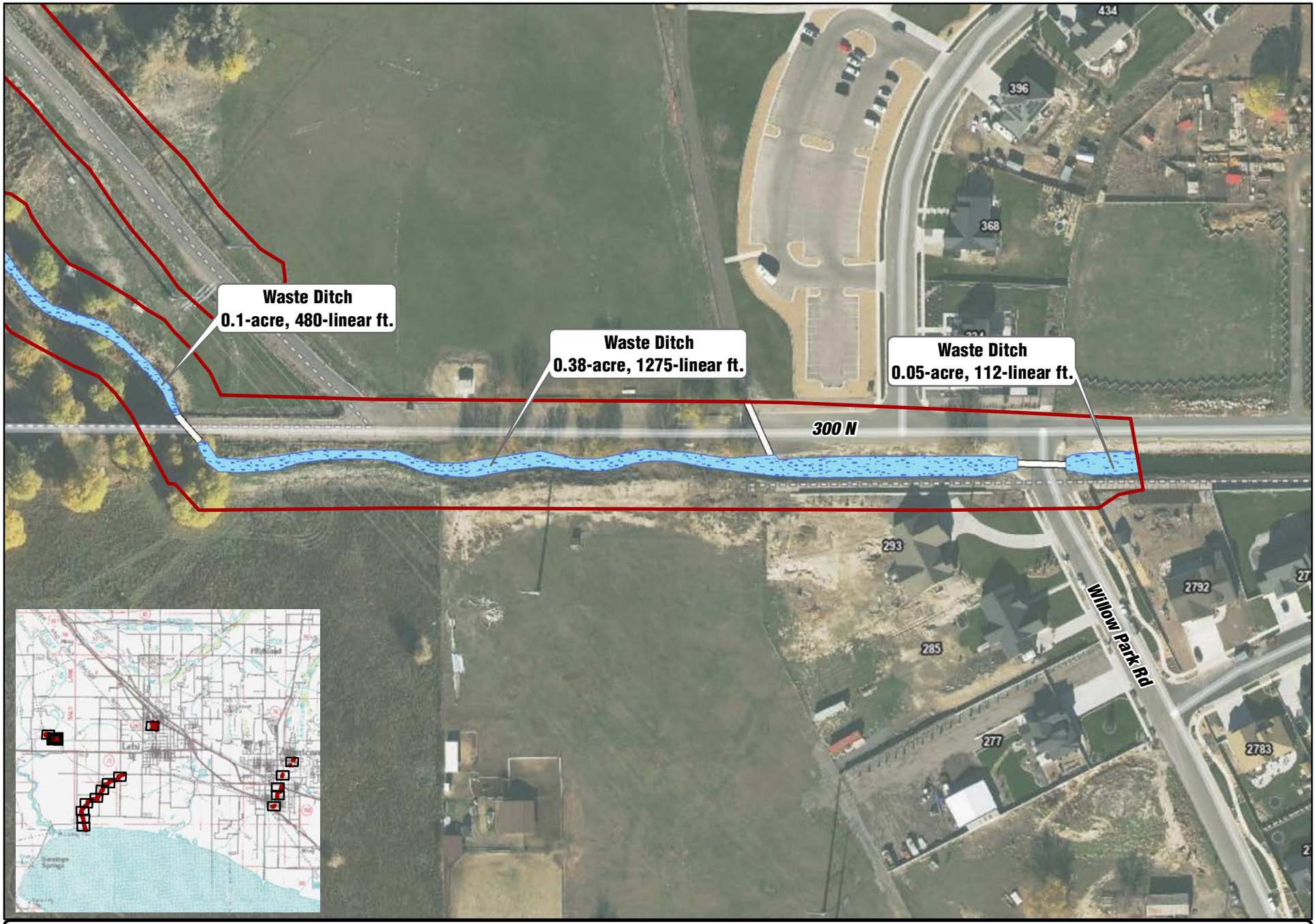
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Projection: Mercator Auxiliary Sphere
Datum: WGS 1984
Area delineated by Horrocks Engineers in August, 2021 and March and May of 2022

Upland Sample Point
Culverts
Study Area
Delineated Features

AMERICAN FORK RIVER SUPPLEMENTAL WATERSHED PLAN
Aquatic Resources Delineation Mapbook

1 inch = 200 feet

0 100 200 Feet



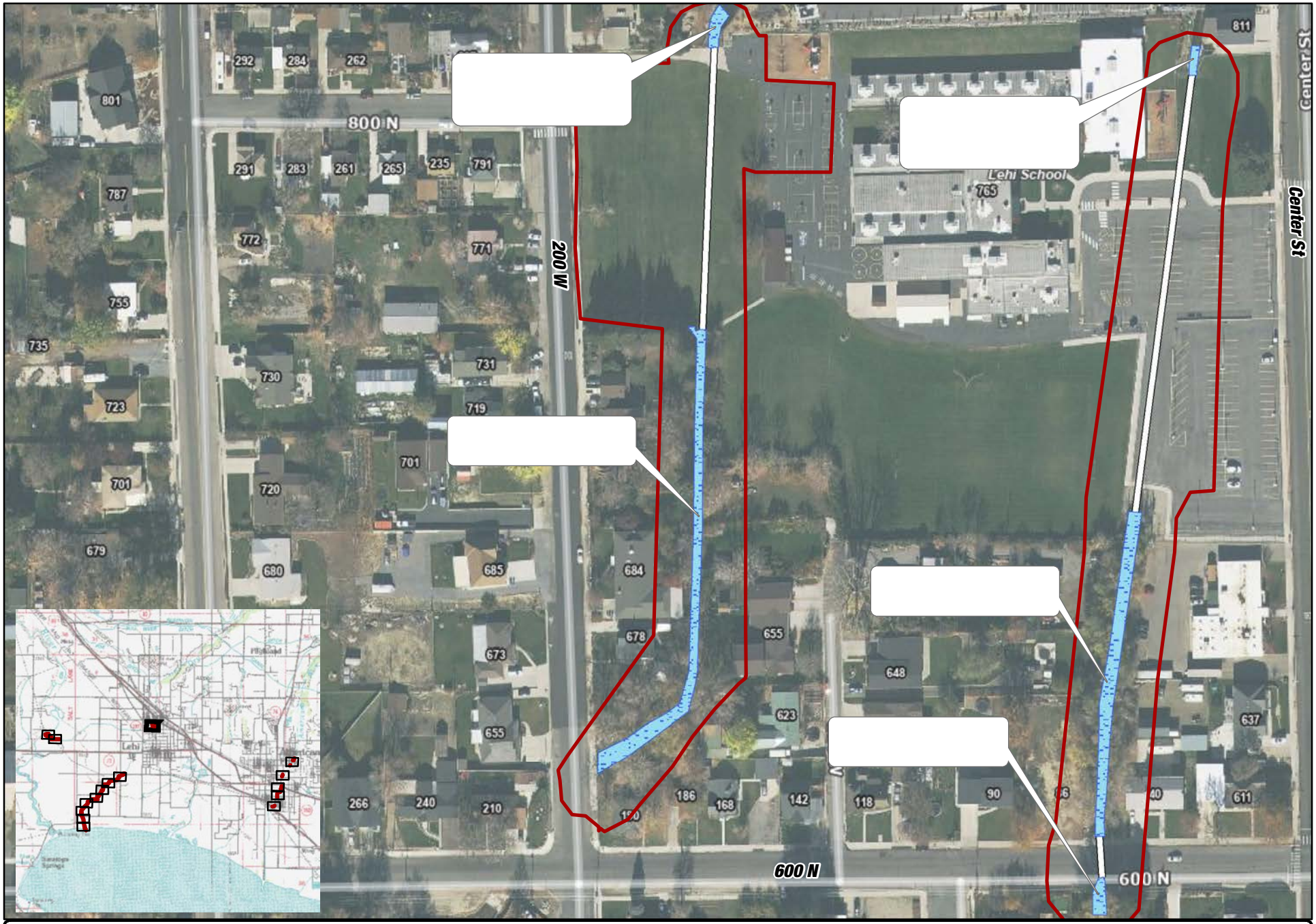
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Area delineated by Horrocks Engineers in August, 2021 and March and May of 2022

Upland Sample Point
Culverts
Study Area
Delineated Features

AMERICAN FORK RIVER SUPPLEMENTAL WATERSHED PLAN
Aquatic Resources Delineation Mapbook

1 inch = 200 feet

0 100 200 Feet



Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere
Projection: Mercator Auxiliary Sphere
Datum: WGS 1984
Area delineated by Horrocks Engineers in August, 2021 and March and May of 2022

Upland Sample Point
Culverts
Study Area
Delineated Features

AMERICAN FORK RIVER SUPPLEMENTAL WATERSHED PLAN
Aquatic Resources Delineation Mapbook

1 inch = 200 feet

0 100 200 Feet


400 N
400 E
American Fork Pkwy
300 N
414
457
273
283
295
406
315
325
345
353
363
387
393
411
443
453
403
460
395
390
320
346
360
384
390
278
416
436
446
456
376
369
370
375
367
356
363
352
348
351
341
335
331
332
334
455
321
407
385
361
375
406
420
430
440
460
480



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Projection: Mercator Auxiliary Sphere
Datum: WGS 1984
Area delineated by Horrocks Engineers in August, 2021 and March and May of 2022

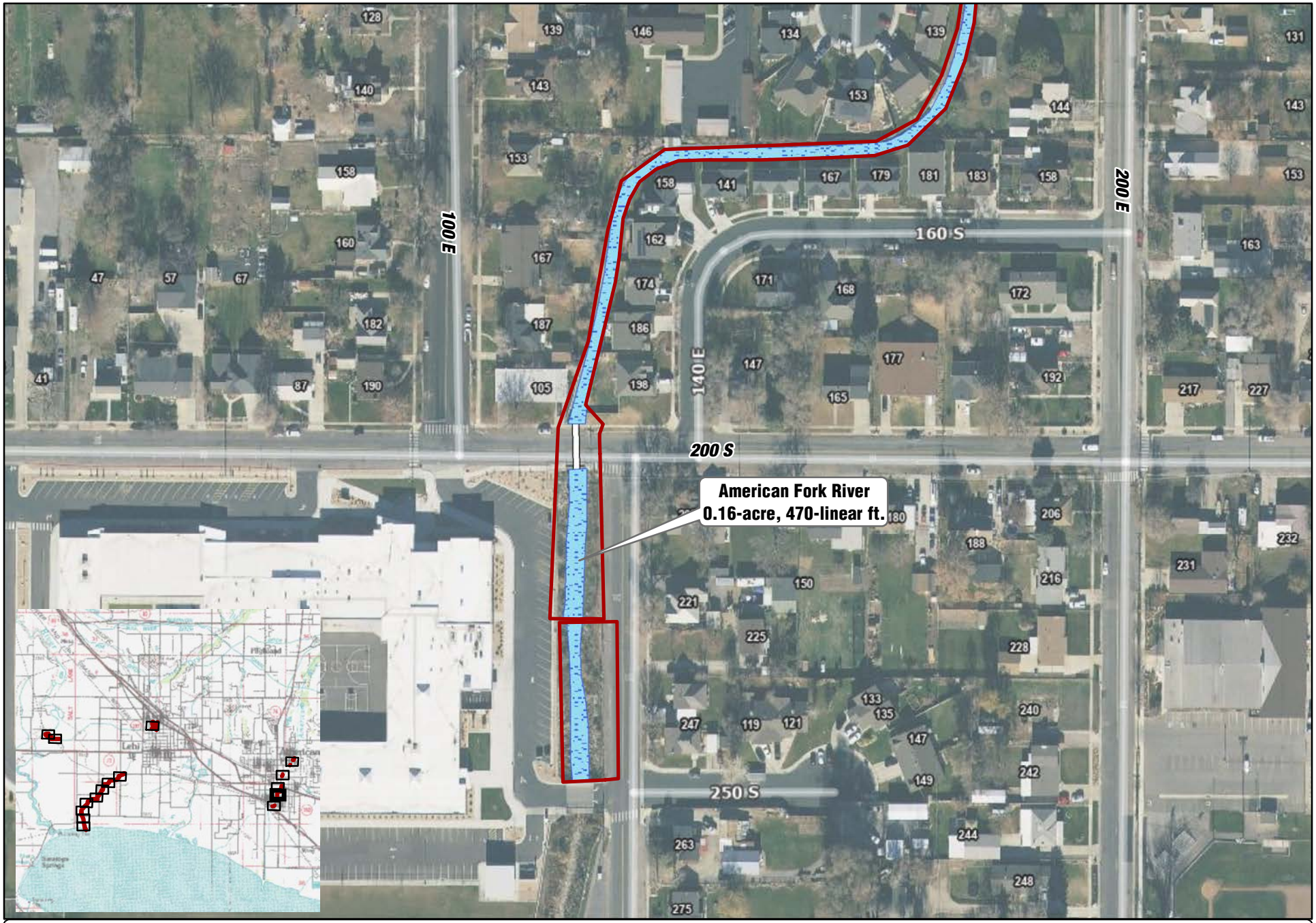
Upland Sample Point
Culverts
Study Area
Delineated Features

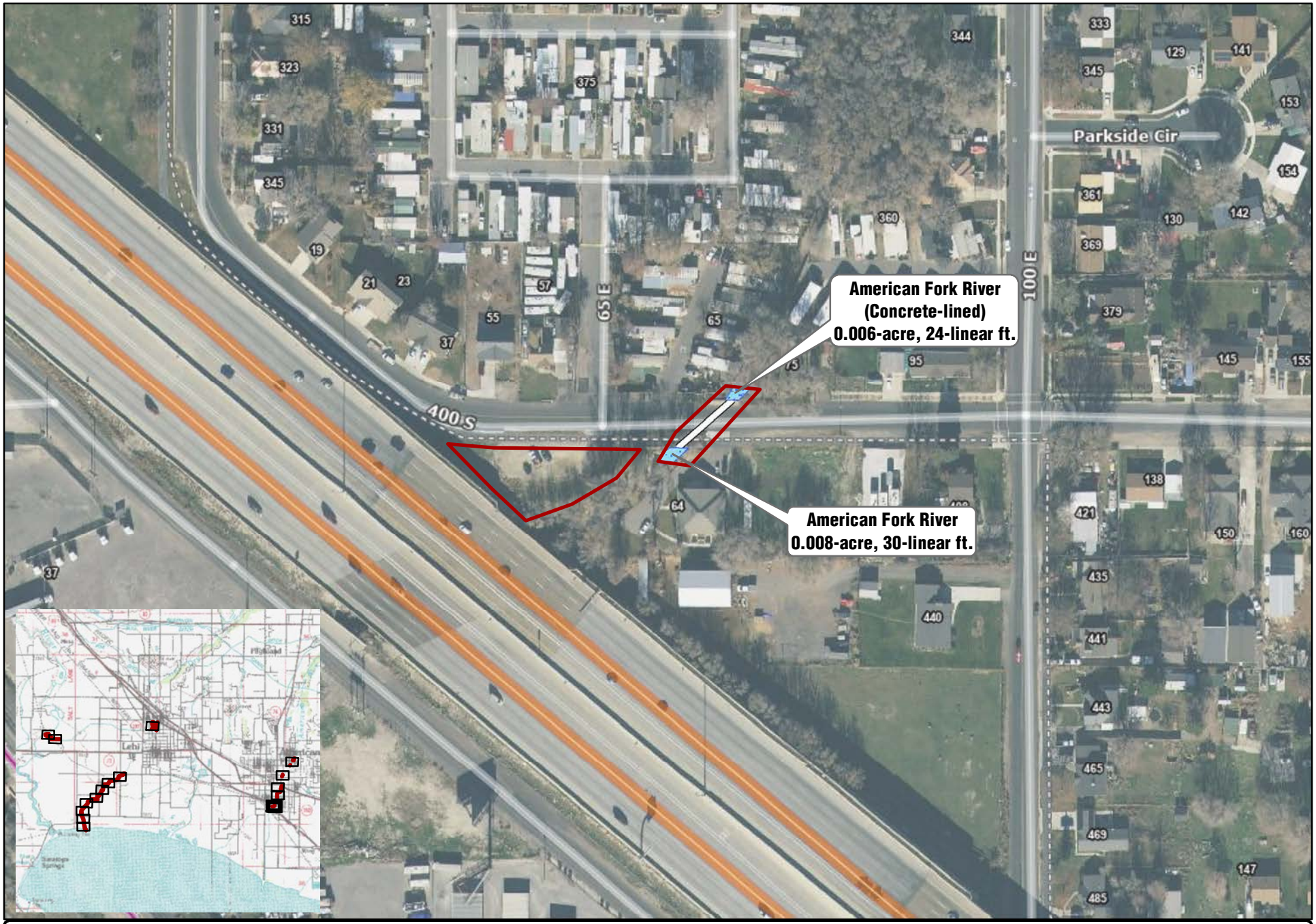
AMERICAN FORK RIVER SUPPLEMENTAL WATERSHED PLAN
Aquatic Resources Delineation Mapbook

1 inch = 200 feet

0 100 200 Feet


Main St
State Rd
Main St
Robinson Park
American Fork River
(Concrete-lined)
0.12-acre, 512-linear ft.
30 S
Grant Ave
200 E
100 E
100 S
160 E
American Fork River
(Concrete-lined)
0.3-acre, 1283-linear ft.


American Fork River
0.16-acre, 470-linear ft.
100 E
140 E
200 E
160 S
200 S
250 S



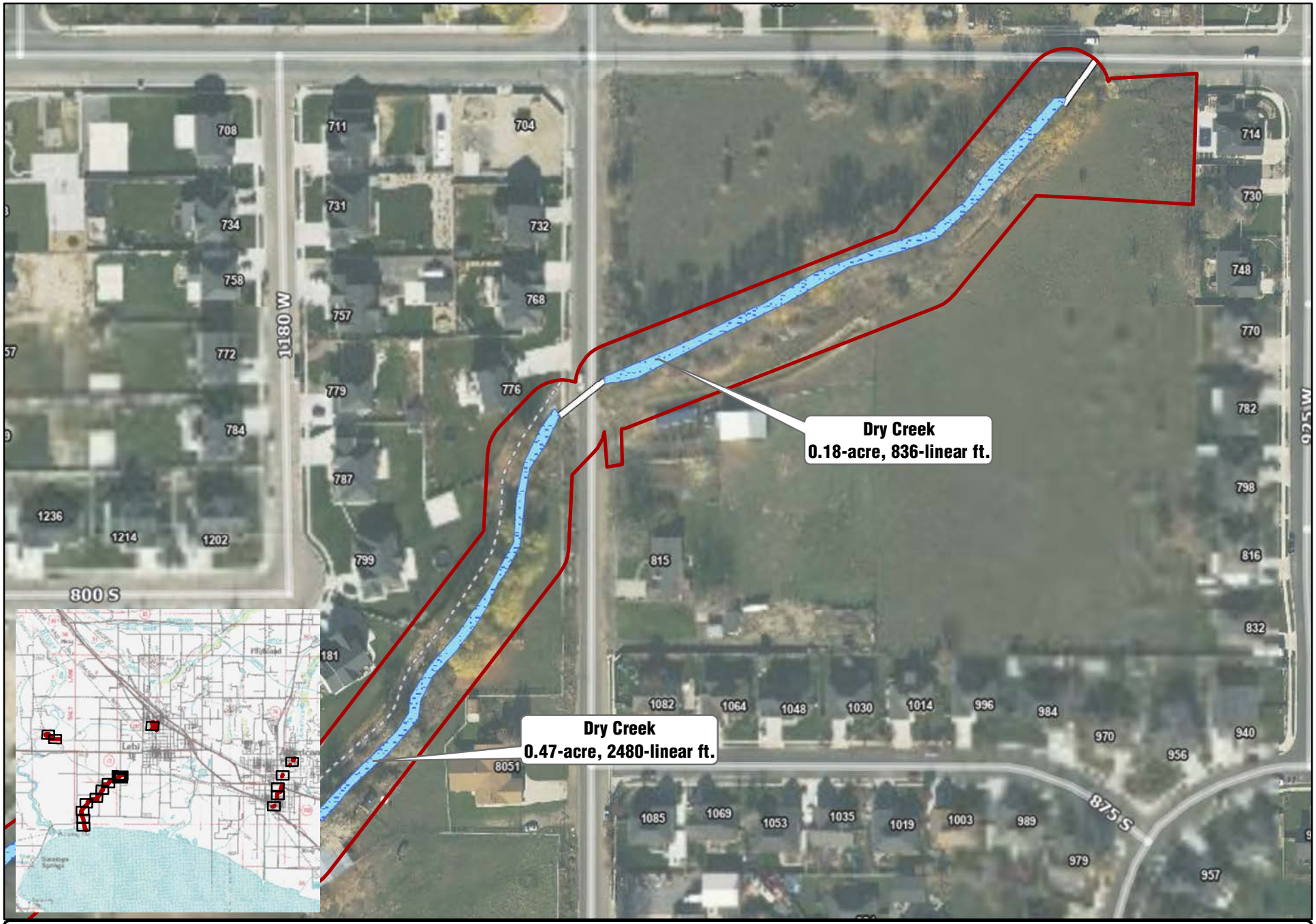
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Projection: Mercator Auxiliary Sphere
Datum: WGS 1984
Area delineated by Horrocks Engineers in August, 2021 and March and May of 2022

Upland Sample Point
Culverts
Study Area
Delineated Features

1 inch = 200 feet

AMERICAN FORK RIVER SUPPLEMENTAL WATERSHED PLAN
Aquatic Resources Delineation Mapbook

0 100 200 Feet



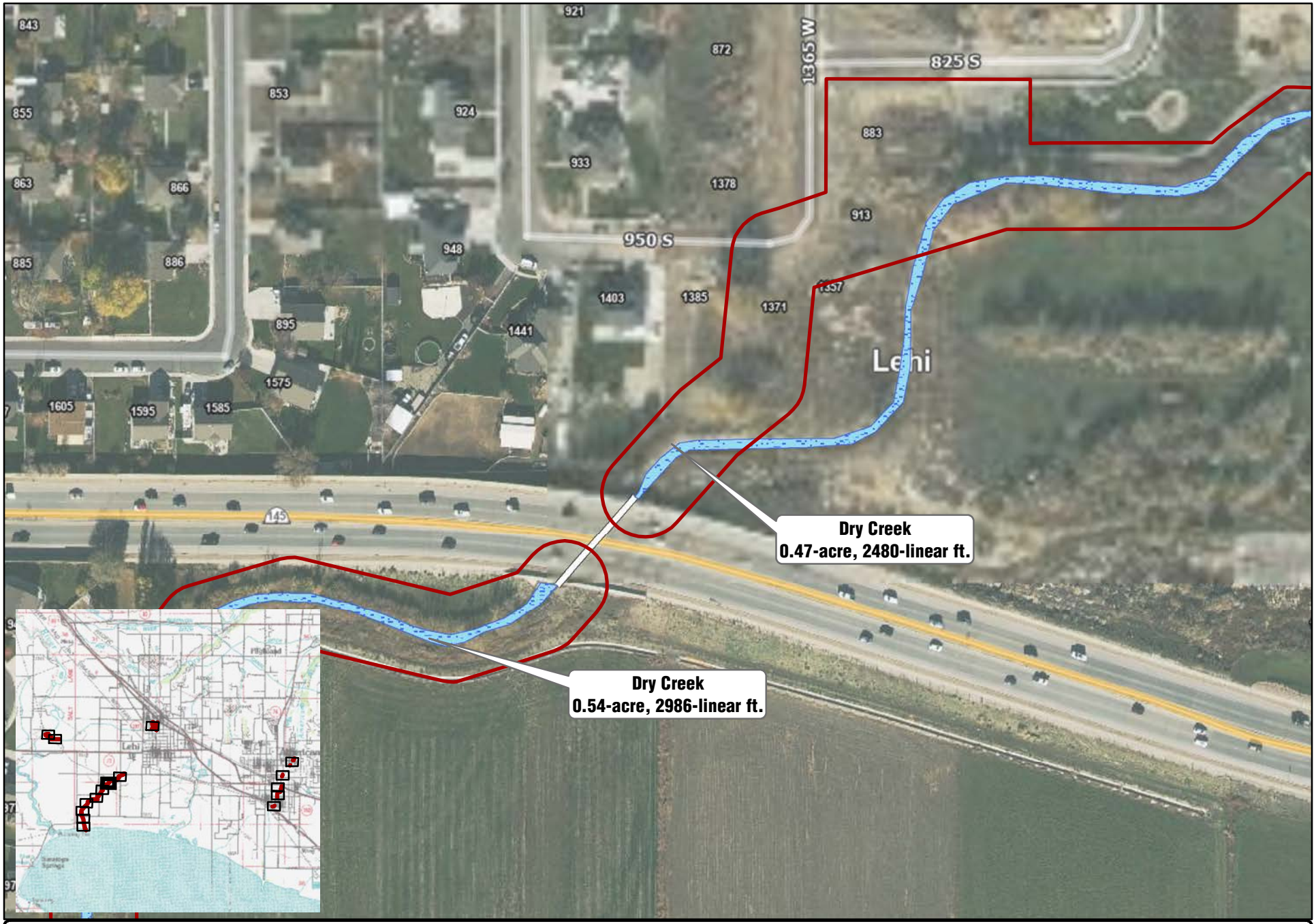
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Datum: WGS 1984
Area delineated by Horrocks Engineers in August, 2021 and March and May of 2022

Upland Sample Point
Culverts
Study Area
Delineated Features

AMERICAN FORK RIVER SUPPLEMENTAL WATERSHED PLAN
Aquatic Resources Delineation Mapbook

1 inch = 200 feet

0 100 200 Feet



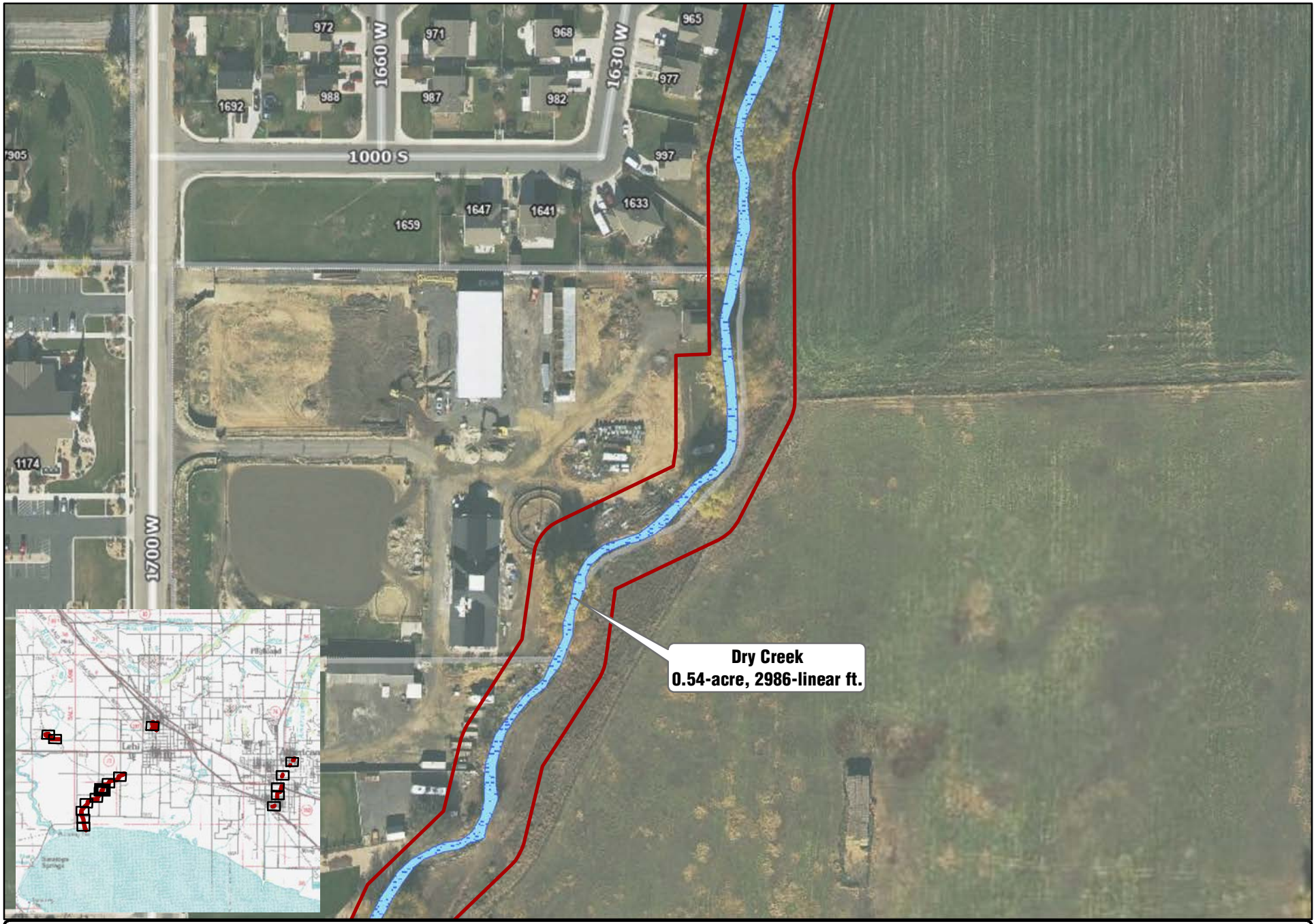
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Projection: Mercator Auxiliary Sphere
Datum: WGS 1984
Area delineated by Horrocks Engineers in August, 2021 and March and May of 2022

Upland Sample Point
Culverts
Study Area
Delineated Features

AMERICAN FORK RIVER SUPPLEMENTAL WATERSHED PLAN
Aquatic Resources Delineation Mapbook

1 inch = 200 feet

0 100 200 Feet



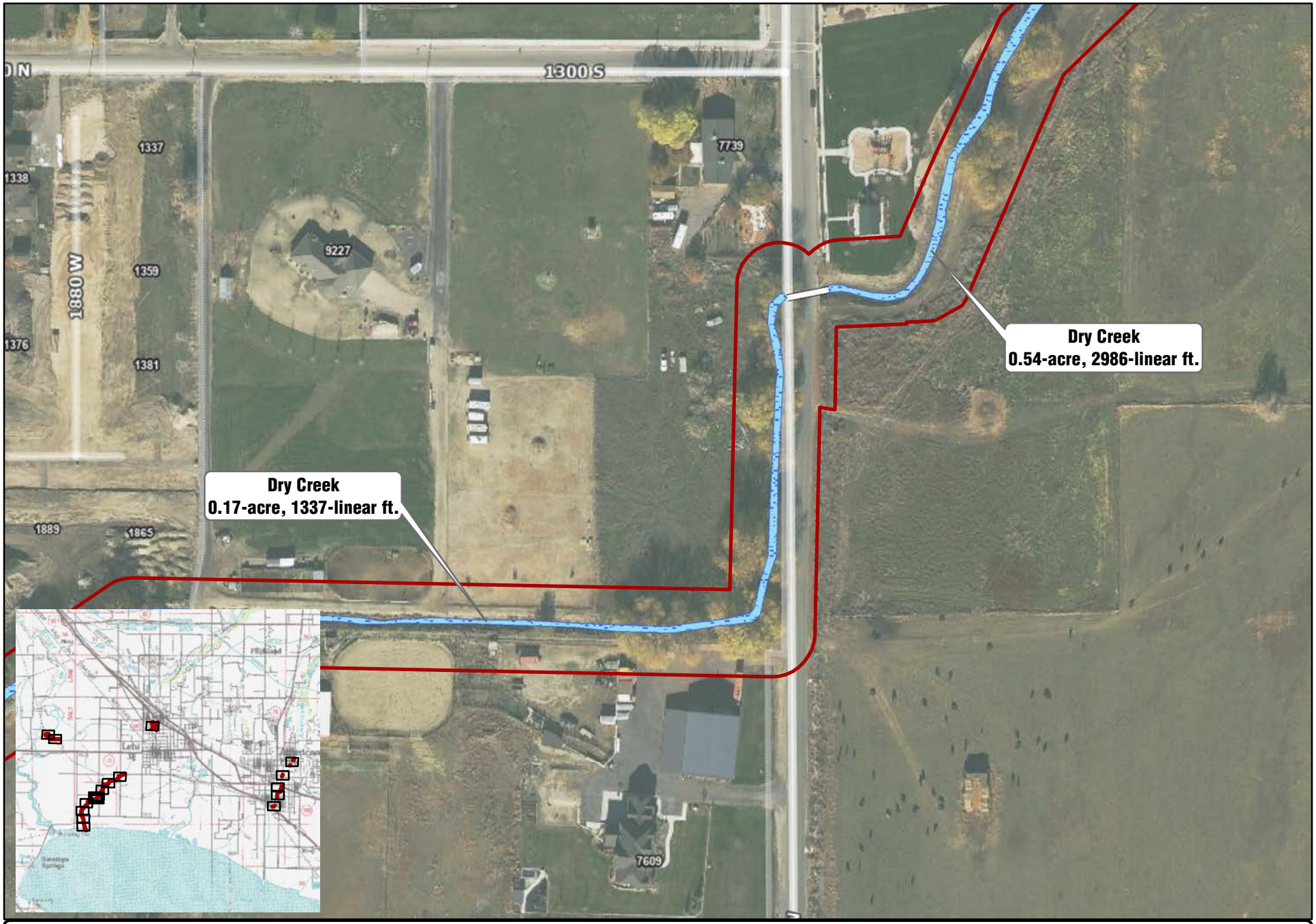
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Projection: Mercator Auxiliary Sphere
Datum: WGS 1984
Area delineated by Horrocks Engineers in August, 2021 and March and May of 2022

Upland Sample Point
Culverts
Study Area
Delineated Features

AMERICAN FORK RIVER SUPPLEMENTAL WATERSHED PLAN
Aquatic Resources Delineation Mapbook

1 inch = 200 feet

0 100 200 Feet



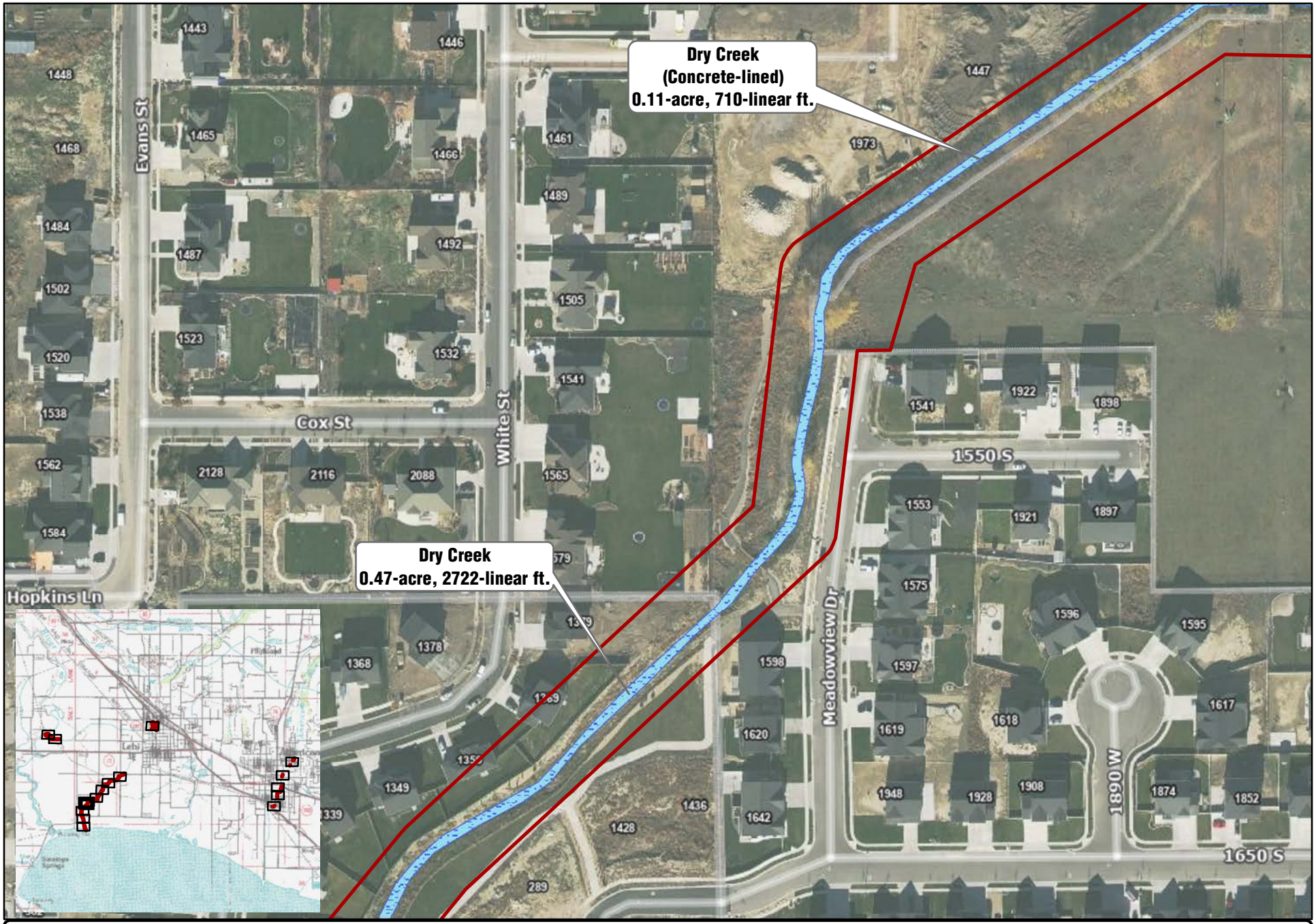
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Projection: Mercator Auxiliary Sphere
Datum: WGS 1984
Area delineated by Horrocks Engineers in August, 2021 and March and May of 2022

Upland Sample Point
Culverts
Study Area
Delineated Features

AMERICAN FORK RIVER SUPPLEMENTAL WATERSHED PLAN
Aquatic Resources Delineation Mapbook

1 inch = 200 feet

0 100 200 Feet



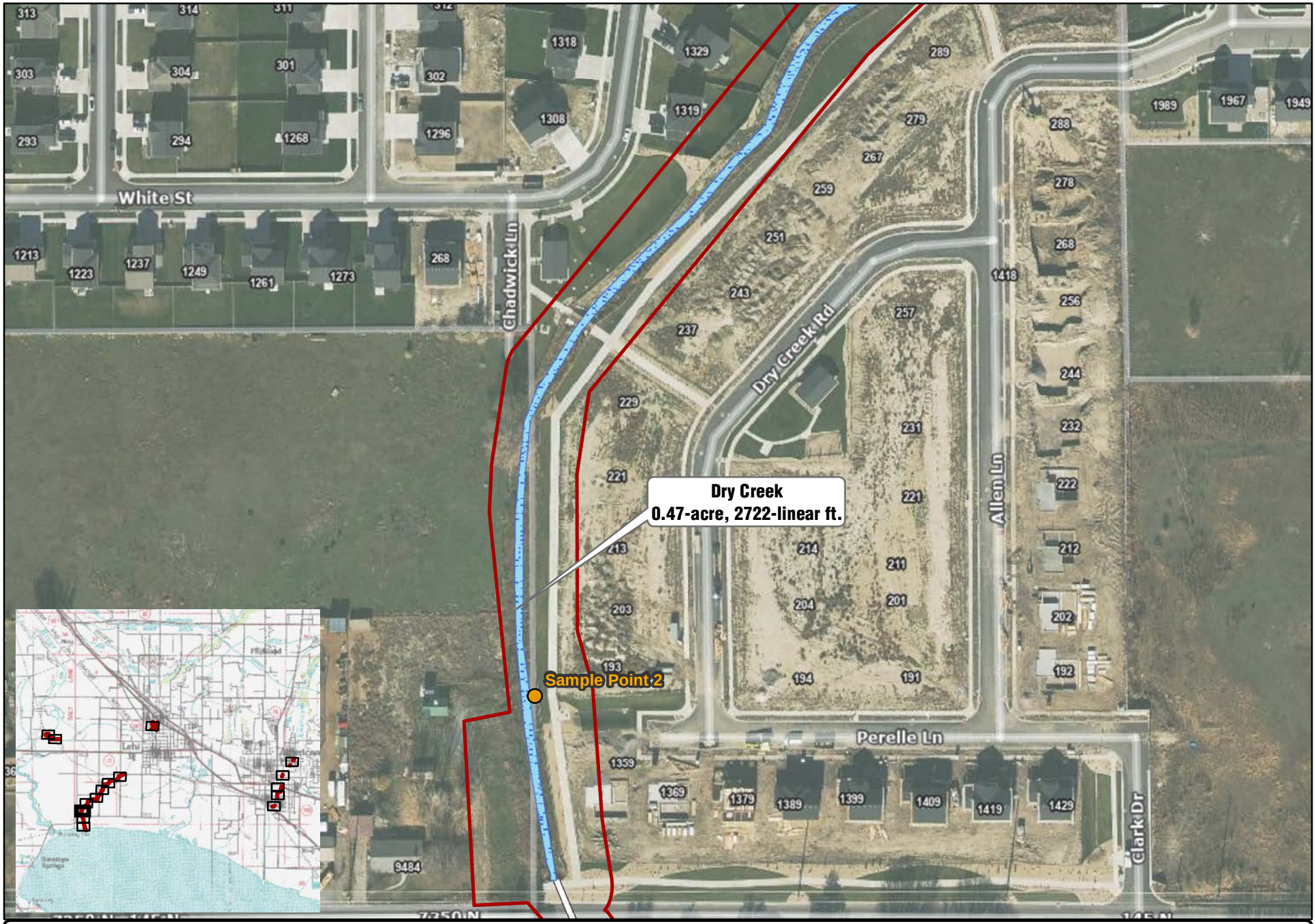
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Area delineated by Horrocks Engineers in August, 2021 and March and May of 2022

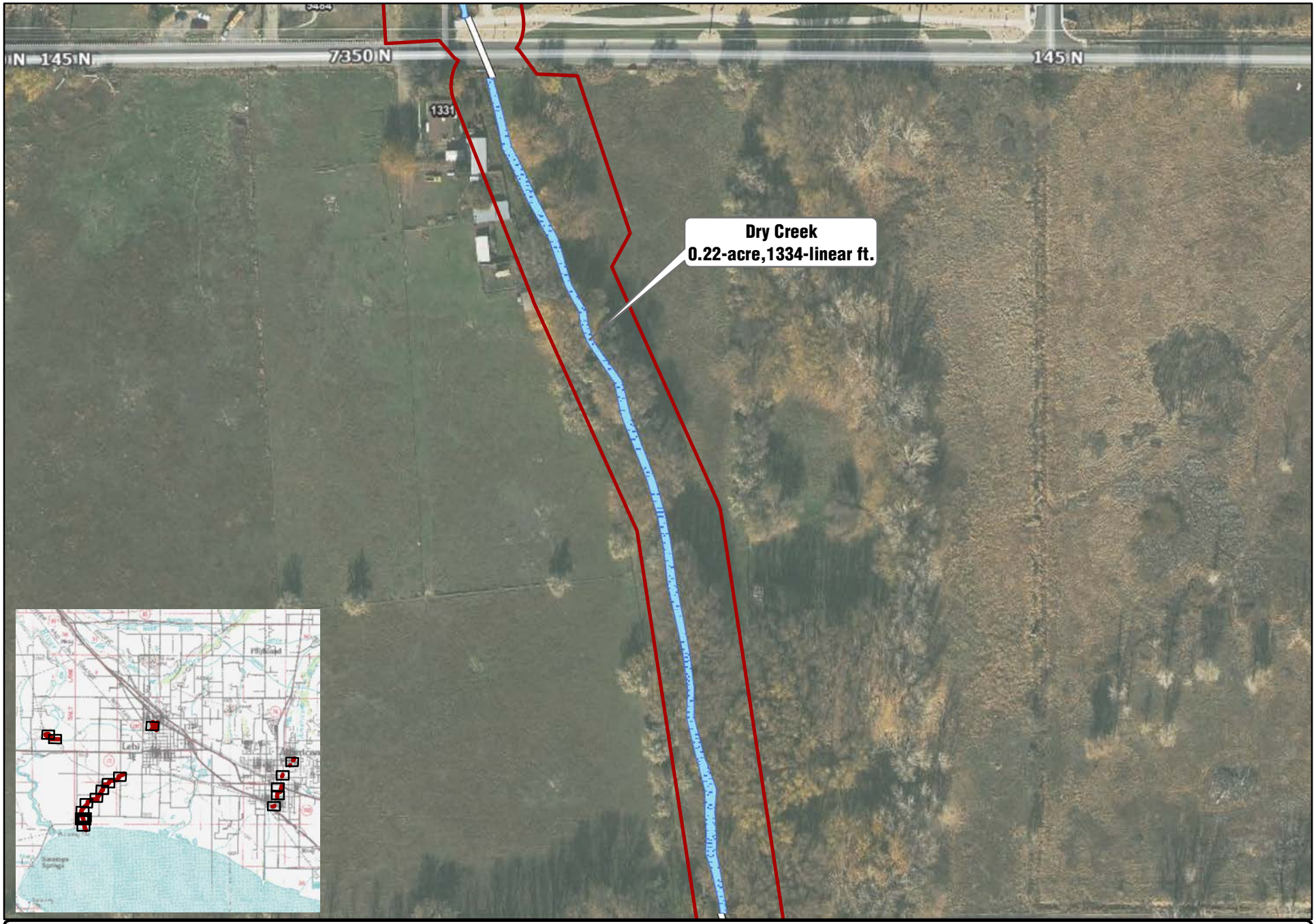
Upland Sample Point
Culverts
Study Area
Delineated Features

AMERICAN FORK RIVER SUPPLEMENTAL WATERSHED PLAN
Aquatic Resources Delineation Mapbook

1 inch = 200 feet

0 100 200 Feet


Dry Creek
0.47-acre, 2722-linear ft.
Sample Point 2
White St
Chadwick Ln
Dry Creek Rd
Allen Ln
Perelle Ln
Clark Dr
313
314
311
303
304
301
302
293
294
1268
1296
1308
1318
1319
1329
1213
1223
1237
1249
1261
1273
268
289
279
267
259
251
243
237
229
221
213
203
193
214
204
194
211
201
191
288
278
268
256
244
232
222
212
202
192
1418
257
231
1359
1369
1379
1389
1399
1409
1419
1429
1989
1967
1949
9484
Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere
Projection: Mercator Auxiliary Sphere
Datum: WGS 1984
Area delineated by Horrocks Engineers in August, 2021 and March and May of 2022
Upland Sample Point
Culverts
Study Area
Delineated Features
1 inch = 200 feet
0
100
200
Feet
AMERICAN FORK RIVER SUPPLEMENTAL WATERSHED PLAN
Aquatic Resources Delineation Mapbook
Map 14 of 16



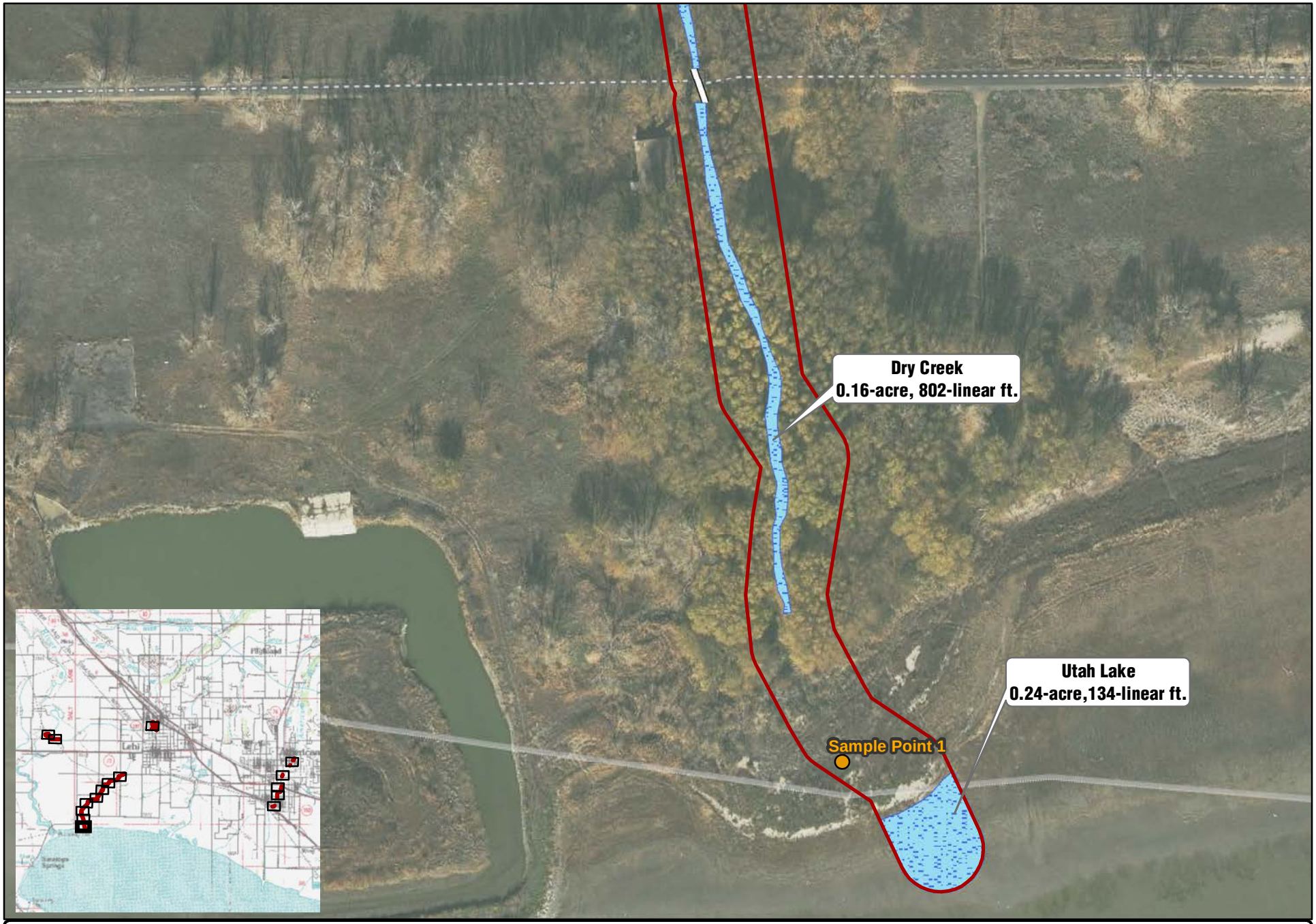
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Projection: Mercator Auxiliary Sphere
Datum: WGS 1984
Area delineated by Horrocks Engineers in August, 2021 and March and May of 2022

Upland Sample Point
Culverts
Study Area
Delineated Features

AMERICAN FORK RIVER SUPPLEMENTAL WATERSHED PLAN
Aquatic Resources Delineation Mapbook

1 inch = 200 feet

0 100 200 Feet



Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere
Projection: Mercator Auxiliary Sphere
Datum: WGS 1984
Area delineated by Horrocks Engineers in August, 2021 and March and May of 2022

Upland Sample Point
Culverts
Study Area
Delineated Features

AMERICAN FORK RIVER SUPPLEMENTAL WATERSHED PLAN
Aquatic Resources Delineation Mapbook

N

0 100 200 Feet

1 inch = 200 feet

APPENDIX B: SUPPORTING MAPS

United States Department of Agriculture

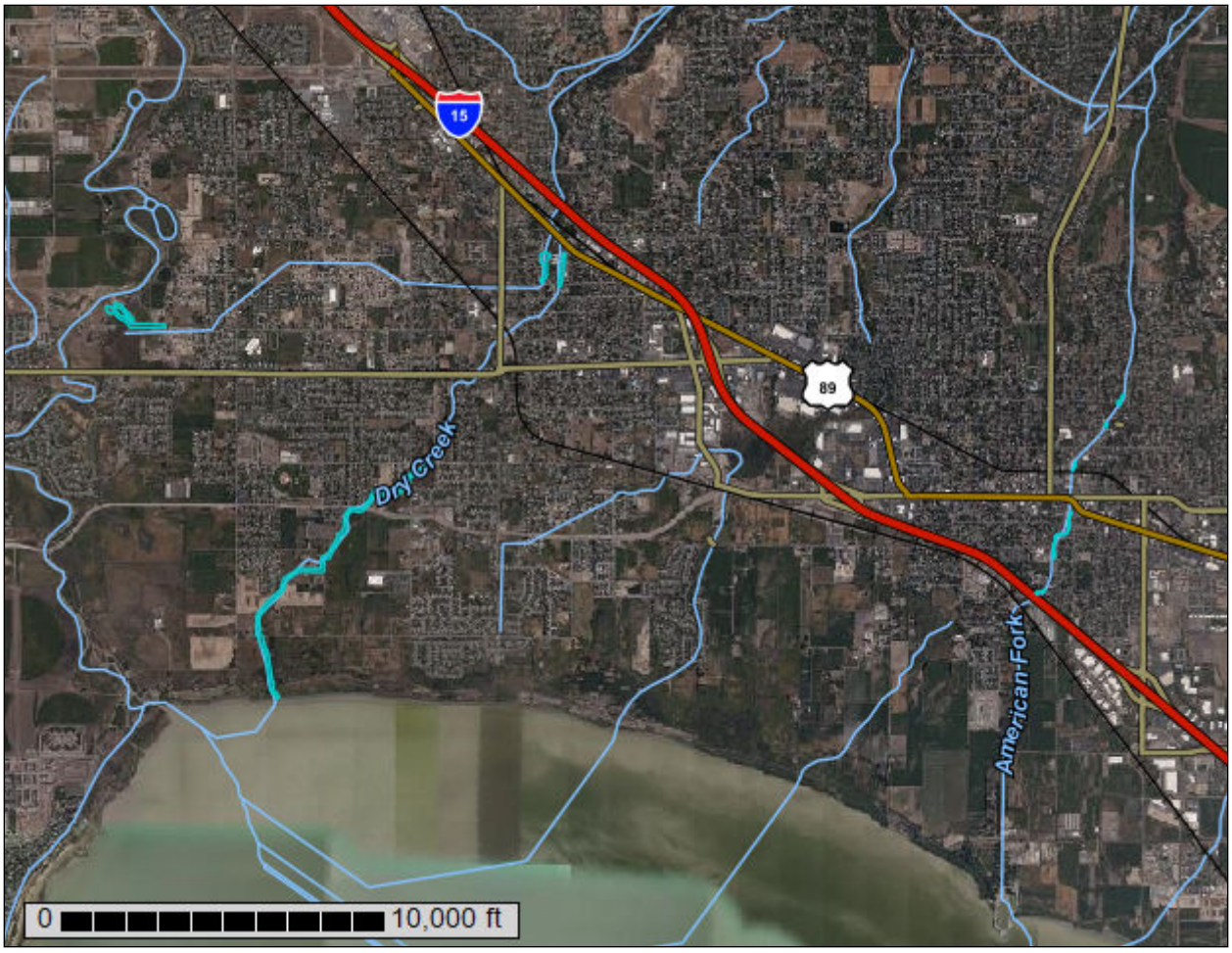
NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Utah County, Utah - Central Part

American Fork Watershed

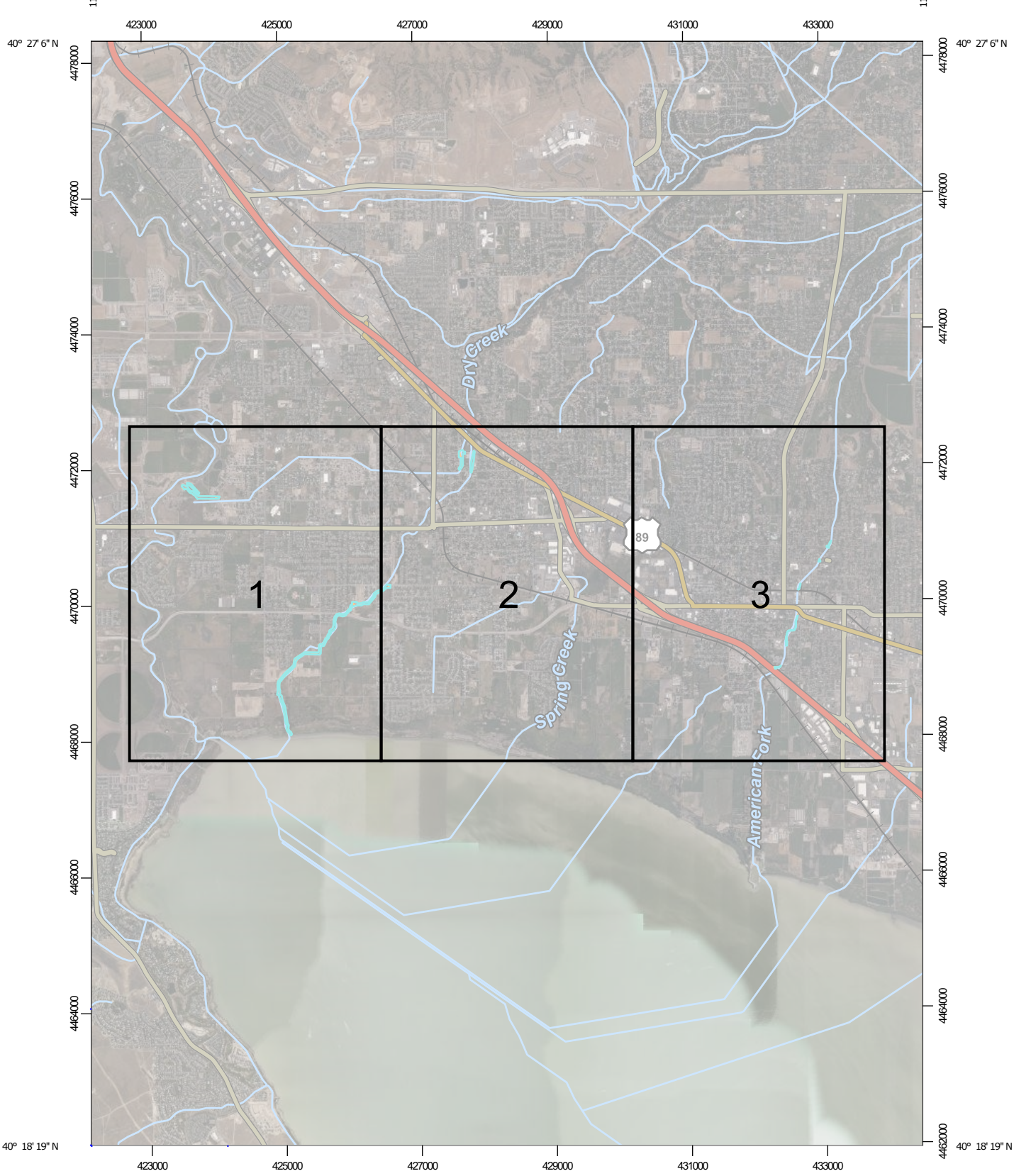


June 1, 2022

Contents

Preface..... 2
Soil Map..... 5
Soil Map.....6
Legend.....10
Map Unit Legend..... 11
Map Unit Descriptions.....11
Utah County, Utah - Central Part..... 13
BC—Beaches.....13
Cp—Chipman-McBeth complex.....13
CU—Cobbly alluvial land.....15
LaC—Lakewin gravelly fine sandy loam, 1 to 6 percent slopes.....16
Mh—McBeth silt loam..... 17
MU—Mixed alluvial land.....18
RV—Riverwash.....20
Se—Steed gravelly sandy loam.....20
Sr—Sunset loam.....21
Ss—Sunset loam, gravelly substratum..... 22
W—Water.....24
WbA—Welby silt loam, 0 to 1 percent slopes..... 24

Custom Soil Resource Report
Soil Map
Index Sheet



Map Scale: 1:79,200 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 1000 2000 4000 6000

Feet
0 3500 7000 14000 21000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 12N WGS84

Custom Soil Resource Report
Soil Map
Map sheet 1 of 3



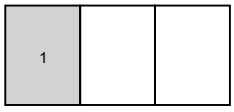
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Feet: 0 1000 2000 4000 6000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 12N WGS84



Map Sheet Location

Custom Soil Resource Report
Soil Map
Map sheet 2 of 3



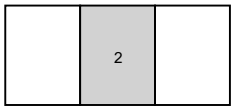
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N

Meters
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Feet
0 1000 2000 4000 6000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 12N WGS84



Map Sheet Location

Custom Soil Resource Report
Soil Map
Map sheet 3 of 3



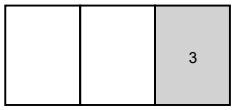
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N

Meters
0 350 700 1400 2100

Feet
0 1000 2000 4000 6000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 12N WGS84



Map Sheet Location

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Utah County, Utah - Central Part
Survey Area Data: Version 14, Sep 7, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 30, 2018—Jun 21, 2021

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
BC	Beaches	0.8	1.8%
Cp	Chipman-McBeth complex	5.2	12.4%
CU	Cobbly alluvial land	1.4	3.2%
LaC	Lakewin gravelly fine sandy loam, 1 to 6 percent slopes	1.2	2.9%
Mh	McBeth silt loam	4.4	10.5%
MU	Mixed alluvial land	19.7	47.1%
RV	Riverwash	0.6	1.3%
Se	Steed gravelly sandy loam	0.4	0.9%
Sr	Sunset loam	5.5	13.1%
Ss	Sunset loam, gravelly substratum	1.6	3.9%
W	Water	0.8	1.9%
WbA	Welby silt loam, 0 to 1 percent slopes	0.4	1.0%
Totals for Area of Interest		**41.9**	**100.0%**

U.S. Fish and Wildlife Service
National Wetlands Inventory

NWI 1



August 30, 2021

Wetlands

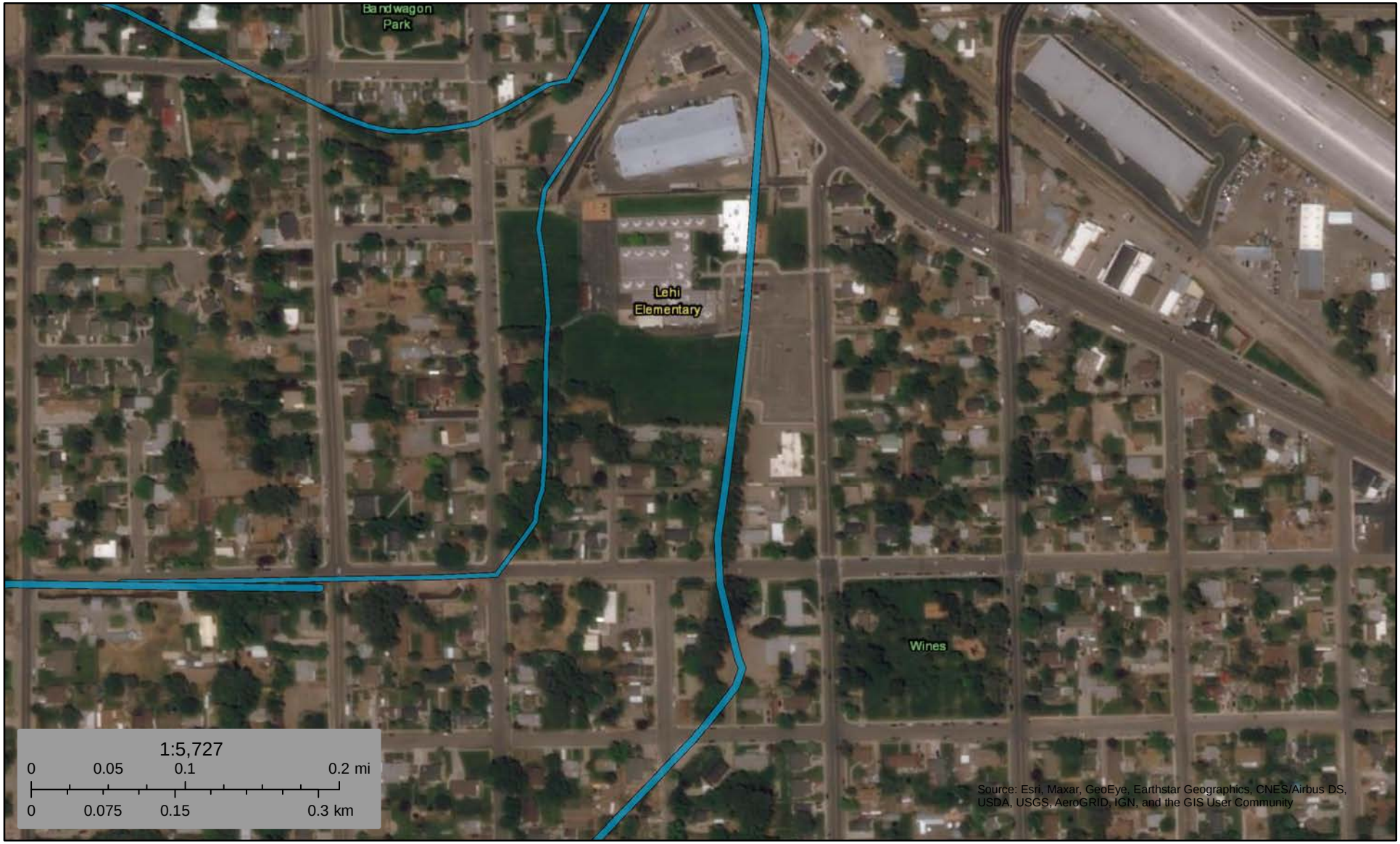
- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

U.S. Fish and Wildlife Service

National Wetlands Inventory

NWI 2



August 30, 2021

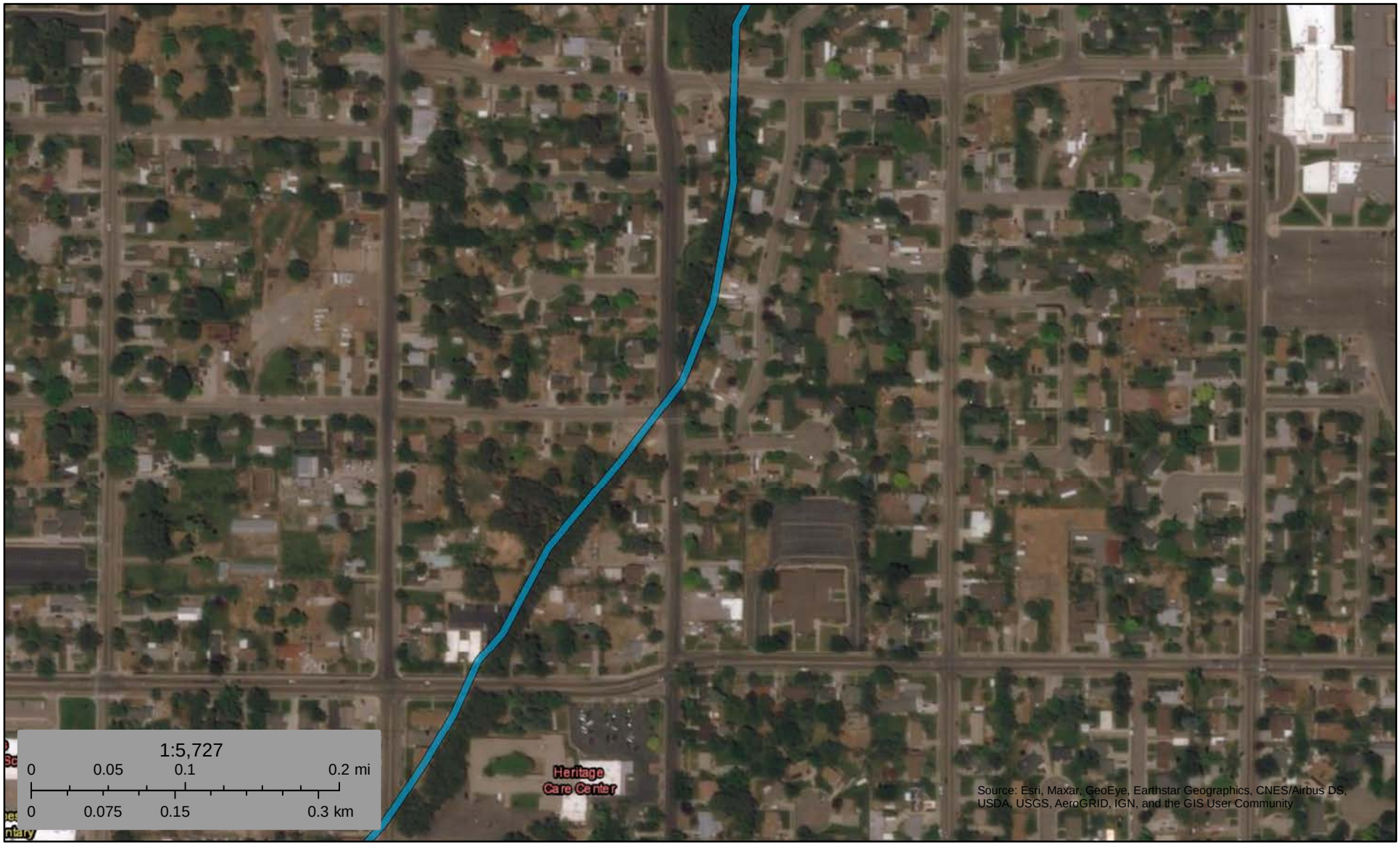
Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

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U.S. Fish and Wildlife Service
National Wetlands Inventory

NWI 3



August 30, 2021

Wetlands

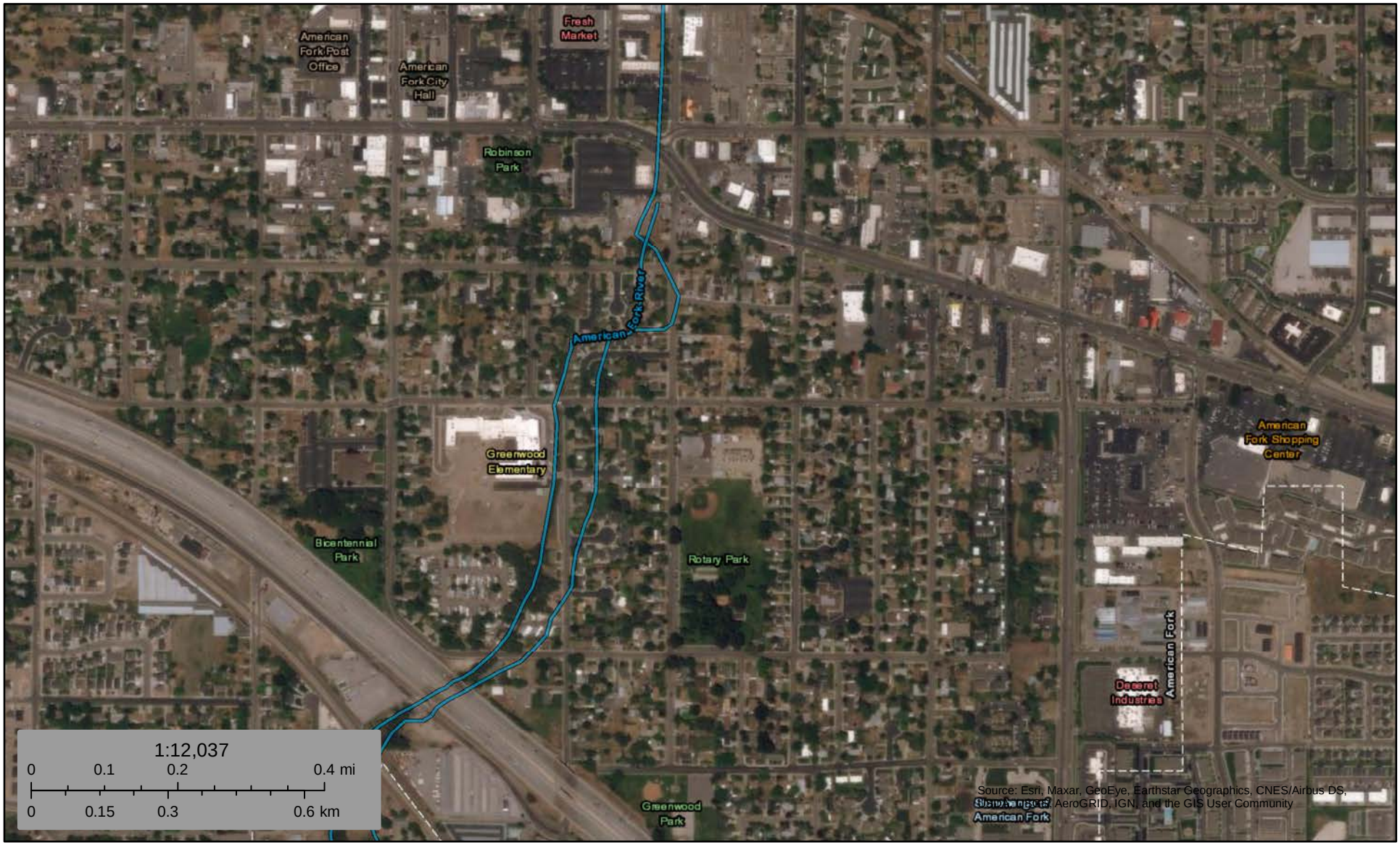
- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

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U.S. Fish and Wildlife Service

National Wetlands Inventory

NWI 4



March 22, 2022

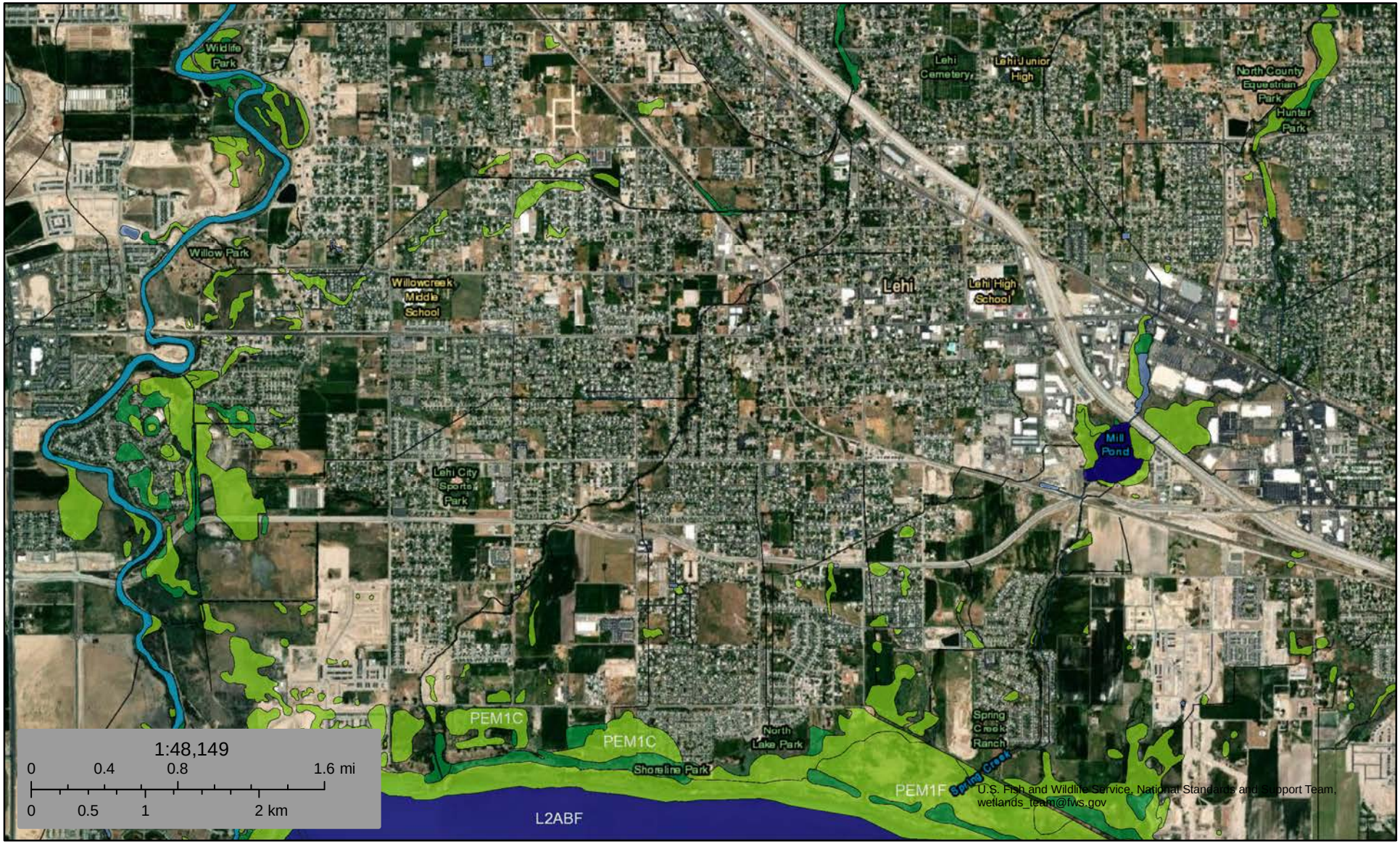
Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

U.S. Fish and Wildlife Service
National Wetlands Inventory

NWI 5



June 1, 2022

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

APPENDIX C: PHOTOGRAPHS & DATA SHEETS

WETLAND DETERMINATION DATA FORM - Arid West Region

Project/Site: American Fork River Watershed Plan | City/County: Lehi, Utah | Sampling Date: 05/03/2022

Applicant/Owner: USDA Natural Resources Conservation Service | State: UT | Sampling Point: 1

Investigator(s): Terry Johnson, Nathan Clarke | Section, Township, Range: S30 T5S R1E

Landform (hillslope, terrace, etc.): beach | Local relief (concave, convex, none): Concave | Slope (%): 4%

Subregion (LRR): D - Interior Deserts | Lat: 40.3601255898 | Long: -111.882292413 | Datum: WGS 1984

Soil Map Unit Name: Beaches | NWI classification: PEM

Are climatic / hydrologic conditions on the site typical for this time of year? Yes (●) No ( ) (If no, explain in Remarks.)

Are Vegetation [ ] Soil [ ] or Hydrology [ ] significantly disturbed? Are "Normal Circumstances" present? Yes (●) No ( )

Are Vegetation [ ] Soil [ ] or Hydrology [ ] naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ( )	No (●)	
Hydric Soil Present?	Yes ( )	No (●)	**Is the Sampled Area within a Wetland?** Yes ( ) No (●)
Wetland Hydrology Present?	Yes ( )	No (●)	

Remarks: Located above what we believe is the OHWM of Utah Lake, but below the elevation of the High Water level

VEGETATION

Tree Stratum (Use scientific names.)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
Total Cover:	%		
Sapling/Shrub Stratum			
1.			
2.			
3.			
4.			
5.			
Total Cover:	%		
Herb Stratum			
1. *Xanthium strumarium*	30	Yes	FAC
2. *Phleum pratense*	40	Yes	FACU
3. *Onopordum acanthium*	5		UPL
4.			
5.			
6.			
7.			
8.			
Total Cover:	75 %		
Woody Vine Stratum			
1.			
2.			
Total Cover:	%		

% Bare Ground in Herb Stratum 25 % | % Cover of Biotic Crust %

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 50.0 % (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	0
FACW species		x 2 =	0
FAC species	30	x 3 =	90
FACU species	40	x 4 =	160
UPL species	5	x 5 =	25
Column Totals:	75 (A)		275 (B)

Prevalence Index = B/A = 3.67

Hydrophytic Vegetation Indicators:

- (●) Dominance Test is >50%
- (●) Prevalence Index is ≤3.0[1]
- [ ] Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- [ ] Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present.

Hydrophytic Vegetation Present? Yes ( ) No (●)

Remarks: Area north of this location that is identified on NWI maps as PFO is dominated by asperugo procumbens, which is an UPL plants.

SOIL

Sampling Point: 1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture[3]	Remarks
0-6	10 YR 2/2	98	10 YR 4/4	2	C	M	Silty clay	
6-12	10 YR 4/2	98	10 YR 4/6	2	C	M	Sand	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix. [2]Location: PL=Pore Lining, RC=Root Channel, M=Matrix.

[3]Soil Textures: Clay, Silty Clay, Sandy Clay, Loam, Sandy Clay Loam, Sandy Loam, Clay Loam, Silty Clay Loam, Silt Loam, Silt, Loamy Sand, Sand.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5) (**LRR C**)
- ☐ 1 cm Muck (A9) (**LRR D**)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)
- ☐ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[4]:

- ☐ 1 cm Muck (A9) (**LRR C**)
- ☐ 2 cm Muck (A10) (**LRR B**)
- ☐ Reduced Vertic (F18)
- ☐ Red Parent Material (TF2)
- ☐ Other (Explain in Remarks)

[4]Indicators of hydrophytic vegetation and wetland hydrology must be present.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ○ No ◉

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1) (**Nonriverine**)
- ☐ Sediment Deposits (B2) (**Nonriverine**)
- ☐ Drift Deposits (B3) (**Nonriverine**)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water-Stained Leaves (B9)
- ☐ Salt Crust (B11)
- ☐ Biotic Crust (B12)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Plowed Soils (C6)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water Marks (B1) (**Riverine**)
- ☐ Sediment Deposits (B2) (**Riverine**)
- ☐ Drift Deposits (B3) (**Riverine**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Thin Muck Surface (C7)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ○ No ◉ Depth (inches): _____

Water Table Present? Yes ○ No ◉ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes ○ No ◉ Depth (inches): _____

Wetland Hydrology Present? Yes ○ No ◉

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: some drift deposits at High Water line, but no indications that water reaches this level on annual basis.

Sample Point 1



Photo 1.1 Soil profile



Photo 1.2 Area around Sample Point 1

WETLAND DETERMINATION DATA FORM - Arid West Region

Project/Site: American Fork River Watershed Plan | City/County: Lehi, Utah | Sampling Date: 05/03/2022

Applicant/Owner: USDA Natural Resources Conservation Service | State: UT | Sampling Point: 2

Investigator(s): Terry Johnson, Nathan Clarke | Section, Township, Range: S30 T5S R1E

Landform (hillslope, terrace, etc.): bank of stream | Local relief (concave, convex, none): Concave | Slope (%): 4%

Subregion (LRR): D - Interior Deserts | Lat: 40.3657803476 | Long: -111.884064177 | Datum: WGS 1984

Soil Map Unit Name: Mixed alluvial land | NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes (●) No ( ) (If no, explain in Remarks.)

Are Vegetation [ ] Soil [ ] or Hydrology [ ] significantly disturbed? Are "Normal Circumstances" present? Yes (●) No ( )

Are Vegetation [ ] Soil [ ] or Hydrology [ ] naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes (●)	No ( )	
Hydric Soil Present?	Yes ( )	No (●)	**Is the Sampled Area within a Wetland?** Yes ( ) No (●)
Wetland Hydrology Present?	Yes ( )	No (●)	

Remarks: Located above the bank of Dry Creek

VEGETATION

Tree Stratum (Use scientific names.)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
Total Cover:	%		
Sapling/Shrub Stratum			
1. *Salix exigua*	80	Yes	FACW
2.			
3.			
4.			
5.			
Total Cover:	80 %		
Herb Stratum			
1. *Melilotus officinalis*	40	Yes	FACU
2. *Equisetum arvense*	15	Yes	FAC
3. *Bromus techtorum*	10	No	UPL
4. *Hippuris vulgaris*	10	No	OBL
5.			
6.			
7.			
8.			
Total Cover:	75 %		
Woody Vine Stratum			
1.			
2.			
Total Cover:	%		

% Bare Ground in Herb Stratum 25 % | % Cover of Biotic Crust %

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 66.7 % (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	10	x 1 =	10
FACW species	80	x 2 =	160
FAC species	15	x 3 =	45
FACU species	40	x 4 =	160
UPL species	10	x 5 =	50
Column Totals:	155 (A)		425 (B)

Prevalence Index = B/A = 2.74

Hydrophytic Vegetation Indicators:

- [x] Dominance Test is >50%
- [x] Prevalence Index is ≤3.0[1]
- [ ] Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- [ ] Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present.

Hydrophytic Vegetation Present? Yes (●) No ( )

Remarks:

SOIL

Sampling Point: 2

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture[3]	Remarks
0-18	10 YR 3/2	100					sand	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix. [2]Location: PL=Pore Lining, RC=Root Channel, M=Matrix.

[3]Soil Textures: Clay, Silty Clay, Sandy Clay, Loam, Sandy Clay Loam, Sandy Loam, Clay Loam, Silty Clay Loam, Silt Loam, Silt, Loamy Sand, Sand.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5) (**LRR C**)
- ☐ 1 cm Muck (A9) (**LRR D**)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)
- ☐ Vernal Pools (F9)

Indicators for Problematic Hydric Soils:[4]

- ☐ 1 cm Muck (A9) (**LRR C**)
- ☐ 2 cm Muck (A10) (**LRR B**)
- ☐ Reduced Vertic (F18)
- ☐ Red Parent Material (TF2)
- ☐ Other (Explain in Remarks)

[4]Indicators of hydrophytic vegetation and wetland hydrology must be present.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ○ No ◉

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1) (**Nonriverine**)
- ☐ Sediment Deposits (B2) (**Nonriverine**)
- ☐ Drift Deposits (B3) (**Nonriverine**)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water-Stained Leaves (B9)
- ☐ Salt Crust (B11)
- ☐ Biotic Crust (B12)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Plowed Soils (C6)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water Marks (B1) (**Riverine**)
- ☐ Sediment Deposits (B2) (**Riverine**)
- ☐ Drift Deposits (B3) (**Riverine**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Thin Muck Surface (C7)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ○ No ◉ Depth (inches): _____

Water Table Present? Yes ○ No ◉ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes ○ No ◉ Depth (inches): _____

Wetland Hydrology Present? Yes ○ No ◉

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Sample Point 2



Photo 1.3 Soil profile



Photo 1.4 Area around Sample Point 2

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: AMERICAN FORK RIVER SUPPLEMENTAL WATERSHED PLAN
Date: 08/12/2021
Time: 12:30 pm
Project Number:
Town: American Fork
State: Utah
Stream: American Fork River
Photo begin file#:
Photo end file#:
Investigator(s): Nathan Clarke

Y ☑ / N ☐ Do normal circumstances exist on the site?

Y ☑ / N ☐ Is the site significantly disturbed?

Location Details: Located in city of American Fork

Projection: Lambert Conformal Conic **Datum:** NAD 83
Coordinates: 40.373658866,-111.794590742

Potential anthropogenic influences on the channel system:

Stream flows through several culverts, and the majority of the channel within the study area has been channelized and is concrete-lined

Brief site description:

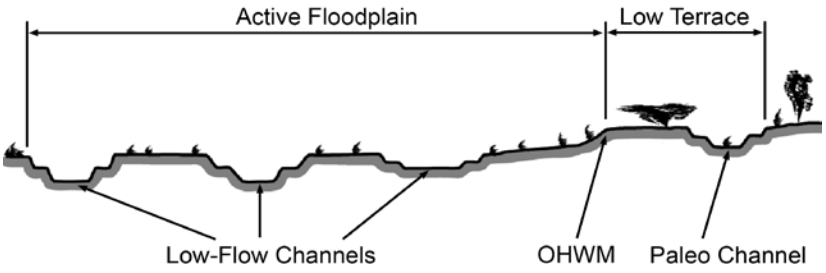
Stream has been highly channelized in urban environment. No water was flowing at the time of the delineation field work.

Checklist of resources (if available):

- ☑ Aerial photography
  Dates:
- ☑ Topographic maps
- ☐ Geologic maps
- ☐ Vegetation maps
- ☑ Soils maps
- ☐ Rainfall/precipitation maps
- ☐ Existing delineation(s) for site
- ☑ Global positioning system (GPS)
- ☐ Other studies

- ☐ Stream gage data
  Gage number:
  Period of record:
- ☐ History of recent effective discharges
- ☐ Results of flood frequency analysis
- ☐ Most recent shift-adjusted rating
- ☐ Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units

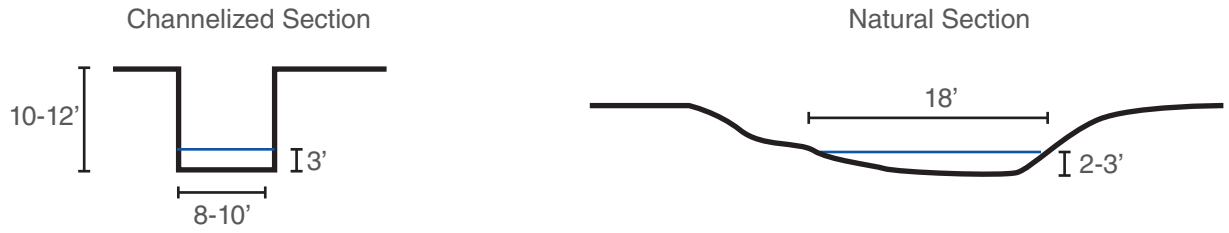


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - ☐ Mapping on aerial photograph
   - ☑ GPS
   - ☐ Digitized on computer
   - ☐ Other:

Project ID: **Cross section ID:** **Date:** 08/12/2021 **Time:** 12:30 pm

Cross section drawing:



OHWM

GPS point: 40.3854409007, -111.787753546 and 40.3848003298,-111.788211212

Indicators:

- ☑ Change in average sediment texture
- ☐ Change in vegetation species
- ☑ Change in vegetation cover
- ☐ Break in bank slope
- ☑ Other: Marks on concrete
- ☐ Other: _____

Comments:

The northernmost section of the river is in a more natural state. All the rest of the channel is concrete-lined

Floodplain unit: ☑ Low-Flow Channel ☑ Active Floodplain ☑ Low Terrace

GPS point: _____

Characteristics of the floodplain unit:

Average sediment texture: _____

Total veg cover: _____ % Tree: _____% Shrub: _____% Herb: _____%

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ☐ Benches
- ☐ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

No low-flow channel, low terrace, or active floodplain

American Fork River



Photo 1.5 American Fork River looking south from 400 N



Photo 1.6 American Fork River looking south in channel north of 400 N

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: AMERICAN FORK RIVER SUPPLEMENTAL WATERSHED PLAN
Date: 08/12/2021
Time: 12:30 pm
Project Number:
Town: American Fork
State: Utah
Stream: Dry Creek
Photo begin file#:
Photo end file#:
Investigator(s): Nathan Clarke

Y ☑ / N ☐ Do normal circumstances exist on the site?

Y ☑ / N ☐ Is the site significantly disturbed?

Location Details: Located in Lehi

Projection: Lambert Conformal Conic **Datum:** NAD 83
Coordinates: 40.3955372289, -111.850327018

Potential anthropogenic influences on the channel system:

Stream flows through several culverts, and the majority of the channel within the study area has been channelized. Some is concrete-lined and some banks have been lined with gabion baskets

Brief site description:

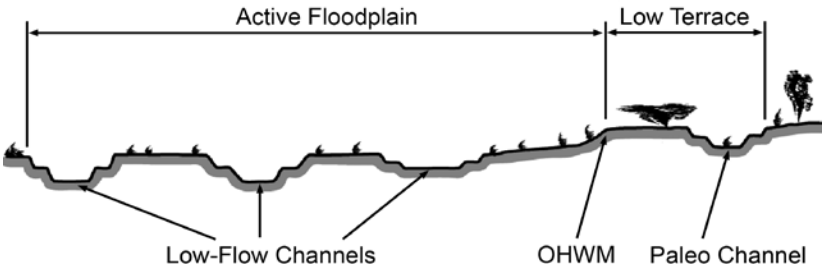
Stream has been highly channelized in urban environment. No water was flowing at the time of the delineation field work, but some standing water was present to a depth of 1-3".

Checklist of resources (if available):

- ☑ Aerial photography
  Dates:
- ☑ Topographic maps
- ☐ Geologic maps
- ☐ Vegetation maps
- ☑ Soils maps
- ☐ Rainfall/precipitation maps
- ☐ Existing delineation(s) for site
- ☑ Global positioning system (GPS)
- ☐ Other studies

- ☐ Stream gage data
  Gage number:
  Period of record:
- ☐ History of recent effective discharges
- ☐ Results of flood frequency analysis
- ☐ Most recent shift-adjusted rating
- ☐ Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units

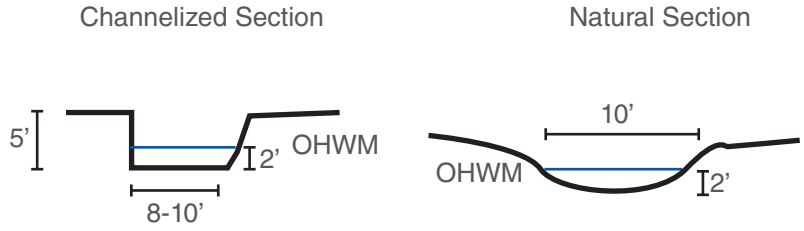


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - ☐ Mapping on aerial photograph
   - ☑ GPS
   - ☐ Digitized on computer
   - ☐ Other:

Project ID: **Cross section ID:** **Date:** 08/12/2021 **Time:** 12:30 pm

Cross section drawing:



OHWM

GPS point: 40.3974654223, -111.849994176, and 40.3955372289, -111.850327018

Indicators:

- ☑ Change in average sediment texture
- ☐ Change in vegetation species
- ☑ Change in vegetation cover
- ☐ Break in bank slope
- ☑ Other: Marks on concrete
- ☐ Other: _____

Comments:

The northernmost section of the channel is concrete-lined.

Floodplain unit: ☑ Low-Flow Channel ☑ Active Floodplain ☑ Low Terrace

GPS point: _____

Characteristics of the floodplain unit:

Average sediment texture: _____

Total veg cover: _____ % Tree: _____% Shrub: _____% Herb: _____%

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ☐ Benches
- ☐ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

No low-flow channel, low terrace, or active floodplain

Dry Creek



Photo 1.7 Dry Creek looking north from Lehi Elementary



Photo 1.8 Dry Creek looking south toward Lehi Elementary

Dry Creek



Photo 1.9 Dry Creek looking downstream (south) north of Utah Lake



Photo 1.10 Dry Creek looking upstream (east) west of 1700 West

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: AMERICAN FORK RIVER SUPPLEMENTAL WATERSHED PLAN
Date: 08/12/2021
Time: 1:30 pm
Project Number:
Town: American Fork
State: Utah
Stream: Waste Ditch
Photo begin file#:
Photo end file#:
Investigator(s): Nathan Clarke

Y ☑ / N ☐ Do normal circumstances exist on the site?

Y ☑ / N ☐ Is the site significantly disturbed?

Location Details: Located in Lehi

Projection: Lambert Conformal Conic **Datum:** NAD 83
Coordinates: 40.3913097486, -111.896349617

Potential anthropogenic influences on the channel system:

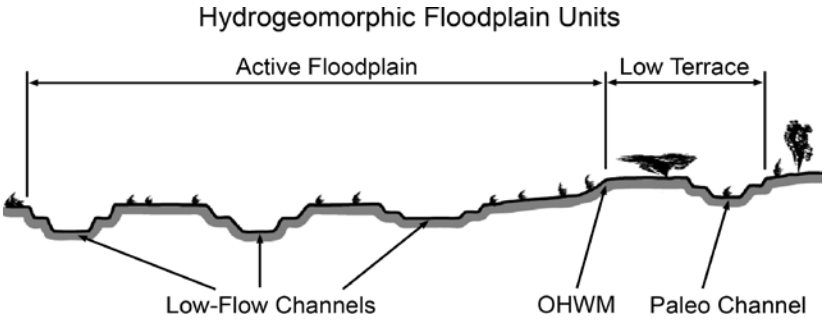
Stream flows through several culverts, and the majority of the channel within the study area has been channelized. Some portions are concrete-lined

Brief site description:

Stream has been highly channelized in urban environment. Water was flowing at a depth of 6-12" (below OHWM) at the time of the delineation field work.

Checklist of resources (if available):

- ☑ Aerial photography
  Dates:
- ☑ Topographic maps
- ☐ Geologic maps
- ☐ Vegetation maps
- ☑ Soils maps
- ☐ Rainfall/precipitation maps
- ☐ Existing delineation(s) for site
- ☑ Global positioning system (GPS)
- ☐ Other studies
- ☐ Stream gage data
  Gage number:
  Period of record:
- ☐ History of recent effective discharges
- ☐ Results of flood frequency analysis
- ☐ Most recent shift-adjusted rating
- ☐ Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

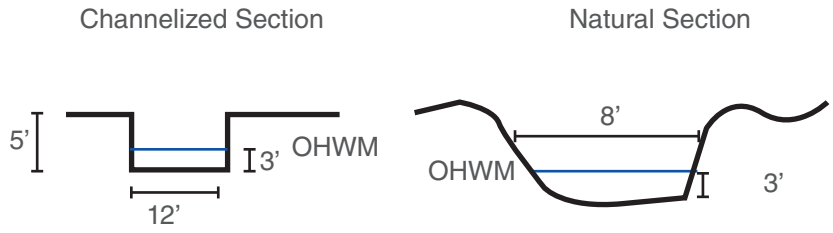


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - ☐ Mapping on aerial photograph
   - ☑ GPS
   - ☐ Digitized on computer
   - ☐ Other:

Project ID: **Cross section ID:** **Date:** 08/12/2021 **Time:** 1:30 pm

Cross section drawing:



OHWM

GPS point: 40.3975720034, -111.851992382 and 40.3957834693, -111.85215262

Indicators:

- ☑ Change in average sediment texture
- ☐ Change in vegetation species
- ☑ Change in vegetation cover
- ☐ Break in bank slope
- ☑ Other: Marks on concrete
- ☐ Other: _____

Comments:

The northernmost section of the channel is concrete-lined. Water flows to the Jordan River.

Floodplain unit: ☑ Low-Flow Channel ☑ Active Floodplain ☑ Low Terrace

GPS point: _____

Characteristics of the floodplain unit:

Average sediment texture: _____

Total veg cover: _____ % Tree: _____% Shrub: _____% Herb: _____%

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ☐ Benches
- ☐ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

No low-flow channel, low terrace, or active floodplain

Waste Ditch



Photo 1.11 Waste Ditch looking southwest toward 200 W



Photo 1.12 Waste Ditch looking west toward Willow Park

APPENDIX D: PLANT LIST

Table 1.5 Common Plants in Delineation Study Area

COMMON NAME	SCIENTIFIC NAME	WETLAND INDICATOR STATUS
HYDROPHYTIC PLANTS		
Common Mare's-Tail	Hippuris vulgaris	OBL
Coyote willow	Salix exigua	FACW
Mexican Fire-weed	Bassia scoparia	FAC
Russian olive	Elaeagnus angustifolia	FAC
Field Horsetail	Equisetum arvense	FAC
Narrowleaf cottonwood	Populus angustifolia	FAC
Rough cocklebur	Xanthium strumarium	FAC
UPLAND PLANTS		
Common Timothy	Phluem pratense	FACU
Yellow Sweet-Clover	Melilotus officinalis	FACU
Madwort	Asperugo procumbens	UPL
Cheatgrass	Bromus tectorum	UPL
Scotch Thistle	Onopordum acanthium	UPL

*USACE 2018, National Wetland Plant List – Arid West

OBL: Obligate Wetland – Almost always occur in wetlands
FACW: Facultative Wetland – Usually occur in wetlands, but may occur in non-wetlands
FAC: Facultative – Occur in wetlands and non-wetlands
FACU: Facultative Upland – Usually occur in non-wetland, but may occur in wetlands
UPL: Obligate Upland – Almost never occur in wetlands

APPENDIX E: AQUATIC RESOURCE SHEET

Table 1.6 Aquatic Resources

WATER NAME	STATE	COWARDIN CODE	HGM CODE	MEASURMENT TYPE	AMOUNT	UNITS	WATER TYPES	LATITUDE	LONGITUDE	LOCAL WATERWAY
Dry Creek	UTAH	R4SBC	RIVERINE	Polygon	2.46	Acre	RPW	40.39553722	-111.8503270	Utah Lake
Waste Ditch	UTAH	R5UBFx	RIVERINE	Polygon	0.72	Acre	RPW	40.39130974	-111.8963496	Utah Lake
American Fork River	UTAH	R4SBCx	RIVERINE	Polygon	0.73	Acre	RPW	40.37365886	-111.7945907	Jordan River
Utah Lake	UTAH	L2ABF	LACUSTRINF	Polygon	0.24	Acre		40.35987977	-111.8818949	Utah Lake

E.5 Economics Investigations and Analysis Report

Economic Investigation and Analysis Report

American Fork—Dry Creek Supplemental Watershed Plan-Environmental Assessment

Proposed Floodwater Retarding Structures

Utah County, Utah

Prepared for:

NRCS

January 2025

Prepared by:

Hal Gordon, Economist

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1.0 SUMMARY OF REQUIREMENTS AND GUIDELINES

The NRCS National Watershed Program Manual (NWPM) was used as a reference for the economic analysis along with three other documents: the National Resource Economics Handbook, Part 611 Water Resources Handbook for Economics, USDA/Natural Resources Conservation Service, July 1998; Principles and Guidelines for Water and Land Related Resources Implementation Studies (P&G), December 1983; and Guidance for Conducting Analyses Under the Principles, Requirements, and Guidelines for Water and Land Related Resources Implementation Studies and Federal Water Resource Investments (PR&G), DM 9500-013. The latter includes requirements set forth in the Council on Environmental Quality (CEQ) Principles and Requirements for Federal Investments in Water Resources (P&R) and Interagency Guidelines (IAG). DM 9500-013 provides guidance on completing a PR&G analysis, including steps in the planning and evaluation process, differences between project- and programmatic-level evaluations, direction on incorporating an ecosystem services framework, and techniques for economic analysis. NRCS's Nine Steps of Conservation Planning were broadly followed while developing the watershed plan, as described in the National Planning Procedures Handbook (180-VI-NPPH, Amend. 4, March 2003).

According to the P&G, the alternative that maximizes net economic benefits is referred to as the National Efficiency Evaluation (NEE) alternative and will be the preferred alternative. In addition to P&G requirements, PR&G requires that public benefits (monetary and non-monetary) be maximized relative to cost. Furthermore, there is no hierarchal relationship among the economic, social, or environmental goals, regardless of whether they can be monetized. Agency policy allows for the use of social effect goals to make the case for flood control activities, even if the associated benefit-cost (B/C) ratio is less than 1:1. This is due to the difficulty in monetizing the value of life and quality of life, which is laden with subjective value judgments. Therefore, threats to human life and quality factors can be used to outweigh purely economic considerations when appropriate. PR&G allows a wide range of alternatives to illustrate the range of potential tradeoffs among environmental, economic, and social goals.

The Federal Objective, as set forth in the Water Resources Development Act of 2007, specifies that Federal water resources investments shall reflect national priorities, encourage economic development, and protect the environment by: (1) seeking to maximize sustainable economic development; (2) seeking to avoid the unwise use of floodplains and flood-prone areas and minimizing adverse impacts and vulnerabilities in any case in which a floodplain or flood-prone area must be used; and (3) protecting and restoring the functions of natural systems and mitigating any unavoidable damage to natural systems.

The guiding principles in P&G and PR&G constitute the concepts that should be considered when analyzing Federal investments in water resources, and the P&G and PR&G General Requirements are topics that agencies must consider when analyzing Federal investments in water resources. The following Principles constitute the overarching concepts the Federal government seeks to promote through Federal investments in water resources now and into the foreseeable future.

A. Healthy and Resilient Ecosystems. Federal investments in water resources should protect and restore the functions of ecosystems and mitigate any unavoidable damage to these natural systems.

B. Sustainable Economic Development. Federal investments in water resources should encourage sustainable economic development.

C. Floodplains. Federal investments in water resources should avoid the unwise use of floodplains and flood-prone areas and minimize adverse impacts and vulnerabilities in any case in which a floodplain or flood-prone area must be used.

D. Public Safety. Threats to people, including loss of life and injury from natural events, should be assessed in determining existing and future conditions and, ultimately, in the decision-making process.

E. Environmental Justice. Environmental justice is the fair treatment and meaningful involvement of all people, regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Agencies should ensure that Federal actions identify any disproportionately high and adverse public safety, human health, or environmental burdens of projects on minority, Tribal, and low-income populations.

F. Watershed Approach. A watershed approach to analysis and decision-making facilitates evaluating a more complete range of potential solutions. It is more likely to identify the best means to achieve multiple goals over the entire watershed.

The project sponsors include American Fork City, Lehi City, and Saratoga Springs City. The Project incorporates waterway improvements along the American Fork River in American Fork City, Upper Dry Creek and Waste Ditch in Lehi City, and Lower Dry Creek in Lehi and Saratoga Springs Cities for flood protection. The proposed improvements for the 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. The proposed improvements for the area would reconstruct approximately 12,000 feet of the existing channel to improve the channel capacity and hydraulics through Lehi Elementary School's property, public transportation corridors, private property, and parks. The Project is anticipated to cost approximately $16,207,0000, which includes construction ($11,542,000), engineering ($1,721,000), and real property ($2,944,000).

The installation costs of the Preferred Alternative equate to an average annual cost of $656,800. PL-566 funds would cover $13,263,000. The sponsors and/or other nonfederal funds would contribute $2,944,000 of the total project cost. While flood prevention measures are covered at 100%, improvements to existing culverts are considered "real property" and not covered by PL-566.

2.0 ALTERNATIVES EVALUATED

According to the P&G and the NWPM, "Flood Prevention" was the purpose analyzed for the American Fork Watershed Plan-EA. Table 7, Comparison of NED Benefits and Costs, contains a summary of the average annual project costs and benefits. The Excel Workbook "DryCreekBenefitsCosts.xml," with associated sheets within the workbook, provides the details for the complete economic analysis.

In accordance with the NRCS and PR&G step processes, the formulation of alternatives seeks to achieve the sponsor's objectives, solve identified concerns, take advantage of opportunities to improve or protect resource conditions (NRCS Nine-Step Conservation Planning Process), identify tradeoffs between environmental, economic, and social goals and objectives (DM 9500-013, page 16). To facilitate these processes, the following considerations have been developed to help emphasize specific goals to illustrate the potential tradeoffs as part of the ecosystem services framework.

- No Action Alternative (FWOFI): This is the baseline against which all other alternatives are compared and evaluated. NEPA requires this and it should always be included as part of PR&G.
- Nonstructural Alternative (FWFI): These are alternatives that alter the use of existing infrastructure or human activities to avoid or minimize adverse changes to existing hydrologic, geomorphic, and ecological processes. They usually include modifications to public policy,

regulatory policy, pricing policy, management practices, land cover practices, or the use of green infrastructure.

- Additional Alternatives (FWFI): These are alternatives that are needed to address additional Federal, State, or local concerns not addressed by the alternatives above.

During the process of alternative formulation, it is very common for alternatives to meet more than one of the definitions described above. As stated in the PR&G guidance, "the alternatives listed above, and any other alternatives included in the PR&G analysis may overlap in whole or in part. (USDA-NRCS, DM9500-013, pg.17, 2017)." As an example, when the PR&G process is fully implemented, it is very common for the Environmentally Preferrable Alternative (LEDPA) and the Locally Preferred Alternative to be the same. Additionally, this is often the alternative with the highest National benefit/cost ratio due to the desire of the local sponsors to minimize their own capital investment while maximizing their own returns.

For this Plan-EA, the alternatives evaluated during formulation included the following:

- Alternative 1 -- No Action Alternative (FWOFI): The No Action Alternative (FWOFI) is the most likely future condition without any developed Federal alternative or changes in law or public policy. It is what could be expected if NRCS takes no action.

- Alternative 2 – Proposed Action – Flood Reduction Alternative (FWFI): The Flood Reduction Alternative is the Action Alternative that structurally addresses the flooding issues along the waterways while providing channel improvements at specific locations. It includes four locations in American Fork, three locations in Lehi City, and one location along lower Dry Creek that stretches between Lehi City and Saratoga Springs City. See Map B-2 in Appendix B. The design improvements for American Fork City are based on the 100-year storm, and for Lehi City/Saratoga Springs City are based on the 50-year storm, as per each city's design standards.

- Alternative 3 – Proposed Action – Property Buyouts Alternative (Nonstructural) (FWFI): The Nonstructural Alternative includes acquiring easements for property located within the 50-year recurrence interval floodplain that would otherwise be protected by channel improvements. Alternative 4 – Proposed Action – 500-year Storm Event Alternative (FWFI): This alternative included measures to address the flooding issues associated with the 500-year storm event along the waterways.

The project area contained three sub-basins: American Fork, Lehi Upstream, and Lehi Downstream. These areas have been flooded or are at risk of flooding. This analysis identified that the enlargement of some of the structures and channel improvements are needed to reduce the risk of flooding. Incremental analysis was conducted considering each sub-basin. There were no increments within each sub-basin. There are eight project areas: Four in American Fork and four total in Lehi/Saratoga Springs Cities, comprised of the Upstream and Downstream Lehi sub-basins. The project areas work in conjunction with each other in the sub-basin and the omission of any project area within any sub-basin would render the remaining project areas ineffective. As such, the project areas for American Fork, Lehi Upstream, and Lehi Downstream sub-basins are inclusive as a single alternative increment for each sub-basin. The first increment was American Fork, the second increment was Lehi Upstream, and the third increment was Lehi Downstream:

The American Fork Alternative includes five project locations:

Location 1 Channel Improvements at 300 North
Location 2 Channel Improvements at 100 North and 200 East
Location 3 Channel Improvements at 200 South
Location 4 Channel Improvements at 400 South

The Lehi Upstream Alternative includes three project locations:

Location 5 Upper Dry Creek
Location 6: Upper Waste Ditch
Location 7 Waste Ditch at Willow Park

The Lehi/Saratoga Springs Downstream Alternative includes one project location:

Location 8: Lower Dry Creek

As described in the Plan-EA, the main purpose of the watershed plan is to reduce the average annual flood damage within the watershed. While only flood-damage related benefits were quantified, other types of benefits serving the project purposes were still considered qualitatively when evaluating the costs and benefits of project alternatives.

According to PR&G, after preliminary consideration, agencies may remove from detailed study those alternatives that do not achieve the Federal Objective and Guiding Principles. In addition, alternatives that may at first appear reasonable but clearly become unreasonable because of cost, logistics, existing technology, and social or environmental reasons may also be eliminated from further analysis. These

alternatives should be briefly discussed to indicate that they were considered, and the analysis should document the reason(s) why they were eliminated (e.g., they do not achieve the Federal Objective and Guiding Principles).

In general, the NEE alternative was developed in accordance with PR&G by evaluating the economic, social, and environmental impacts of flood damage reduction in the rural community. Given the emphasis placed on the construction of flood protection structures by the local steering committee to provide flood mitigation, the geographic extents of evaluated alternatives are limited to the area where one or more of the proposed structural alternatives would have an estimated impact to the 500-year flood depth. The annual benefits of the project alternatives are based on the estimated reduction in average annual floodwater damages with proposed flood control measures in place compared to future conditions without mitigative action (No Action Alternative).

Alternatives considered included the No-Action Alternative, nonstructural alternatives, the locally preferred alternative, and the NEE Alternative. Alternatives were compared against the No-Action Alternative, which involved projecting existing resources and conditions into the future to establish a benchmark against which alternatives were evaluated. Tradeoffs between alternatives with respect to environmental, economic, and social goals were identified.

This planning study evaluated both structural and nonstructural alternatives. However, the planning team eliminated nonstructural alternatives from the detailed study due to their exorbitant costs compared to the potential benefits. One structural alternative was eliminated because the monetary benefits were well below the costs. The following are summaries of eliminated alternatives, which propose to mitigate damages from the 100-year flood.

- **Alternative 3.** Property Buyouts Alternative- The alternative to relocate the residences, improvements, structures, and other land value uses to a location outside of the floodplain has been analyzed. There are 994 residences, 91 commercial businesses, and 4 public properties in the 100-year floodplain. Costs for such relocation include the purchase of new property for the relocated items, the logistical, labor, and material costs associated with relocating and constructing new facilities, and the demolition and cleanup of the existing improvements and structures. Costs to complete this have been estimated at two times the current assessed value of the properties. Relocating the affected properties in all three sub-basins would require costs of almost $394,346,259. Further, the demolition and cleanup of the existing properties and the development

of properties elsewhere create a larger impact on the environment and communities. This alternative is economically and culturally unreasonable and does not provide any additional flood protection benefit. The table below summarizes the average annual costs and benefits of the Property Buyouts Alternative:

Costs and Benefits of Alternative 3 – Proposed Action – Property Buyouts Alternative (Nonstructural)

Costs/Benefits	Value
Total Project Investment	$394,346,259
Annual Project Investment	$14,606,948
Annual OM&R Costs	$0
Flood Damage Reduction Benefit (Monetized Regulating Service)	$7,396,733
Total Annual Project Costs	**$14,606,948**
Total Annual Project Benefits	**$7,396,733**
Benefit-Cost Ratio	**0.51**
Annual Monetized Net Benefit	**-$7,210,215**

Alternative 5. Floodproofing - To protect areas that would be affected by flooding, individual properties could be floodproofed, or floodwalls could be constructed within the floodplain boundary. The area protected includes portions of the communities of American Fork and Lehi. Floodproofed structures would include 994 residences, 91 commercial businesses, and 4 public properties in the 100-year floodplain. Floodwalls would be required along roadways and developed areas throughout the floodplain. This alternative is unreasonable because the community and environmental impacts are significantly greater than in other alternatives. Additionally, floodproofing structures is not feasible given the sheer amount of structures that would have to be floodproofed. It is not acceptable to the NRCS or the sponsor.

Alternative 2. Flood Protection. Along with the No Action Alternative, one alternative proposing the construction of several flood protection improvements for three sub-basin project areas was identified and evaluated in detail. The project consists of eight project areas across waterways within the three sub-basins. The three sub-basins are: 1. American Fork City (along the American Fork River), 2. Lehi City (along

Dry Creek and Waste Ditch) and 3. Lehi City and Saratoga Springs City (along lower Dry Creek). The project improvements were designed to convey flood waters offsite safely.

In all three sub-basins, each flood protection structure works in conjunction with each other, and omitting any item within the alternative would render the remaining options ineffective. As such, the project locations include all items as a single alternative for each sub-basin.

The project measures address flooding issues along the waterways. Project measures for channel improvements include two methods, an earthen channel or gabion baskets, to address flooding concerns and improve public safety along the waterways. It is less expensive to construct earthen channel improvements. However, each location was evaluated to select the most feasible solution that meets all the functionality and needs based on location and the space available for the necessary improvements to meet each city's design standards.

The design standards for each city were used to determine which storm event to design for and to assess the extent of project measures required. Project measures proposed for each of the three sub-basins are described below.

Location 1: Channel Improvements at 300 North in American Fork City

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 measures at this location include improving the channel by raising the riverbanks by 1.5 feet for approximately 350 feet upstream of 300 North and constructing new upstream and downstream wingwalls. A new concrete apron would be placed on the downstream side at the outlet to protect against erosion. The embankments would be armored with gabions or riprap to protect against erosion. Other channel improvements could include modifications to the channel slope and channel width for up to 680 feet. Trees and vegetation would be removed within the flow area. The total area of disturbance would be up to 0.9 acres. These channel improvements would allow the 100-year flood to pass without any flooding upstream.

Location 2: Channel Improvements at 100 North and 200 East in American Fork City

The proposed measures at this location include improving the channel by raising the riverbanks by 2.5 feet for approximately 350 feet upstream of 100 North and creating a new transition into the existing box culvert. The embankments would be armored with gabions or riprap to protect against erosion. Other channel improvements could include modifications to the channel slope and channel width for up to 700

feet. Trees and vegetation would be removed within the flow area. The total area of disturbance would be up to 1.2 acres. These channel improvements would allow the 100-year flood to pass without any flooding upstream.

Location 3: Channel Improvements at 200 South in American Fork City

At this location, project measures would consist of removing energy dissipation baffle blocks that catch debris and cause backups in the channel. Riprap would be placed as erosion protection on the downstream banks instead of the baffle blocks. The existing culvert is anticipated to be replaced in the future under a separate action. Other channel improvements could include modifications to the channel slope and channel width for up to 150 feet. Trees and vegetation would be removed within the flow area. The total area of disturbance would be up to 0.3 acres. These improvements would allow the 100-year flood to pass without any flooding.

Location 4: Channel Improvements at 400 South in American Fork City

The proposed measures at this location include widening the upstream channel and raising the riverbanks from 5 feet to 8 feet for approximately 300 feet using gabion baskets. Other channel improvements could include modifications to the channel slope and channel width for up to 900 feet. Trees and vegetation would be removed within the flow area. The total area of disturbance would be up to 0.9 acres. These improvements would allow the passage of the 100-year flood and would prevent flooding the houses near the river.

Location 5: Channel Improvements along Upper Dry Creek in Lehi City

As Dry Creek passes Lehi Elementary School, the existing 510-foot-long culvert would be replaced with a 12-foot-wide by 5-foot-tall concrete box culvert. The box culvert would have a trash rack and intake structure to prevent plugging.

The channel downstream of the box culvert would be improved to handle the design flow and 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 for approximately 381 feet. Channel slopes would match the existing channel slope with a minimum of 0.3 percent. Trees and vegetation would be removed within the flow area. The total area of disturbance would be up to 2.6 acres. Proposed improvements provide near 100% flood

reduction of the 50-year flood and would prevent flooding of houses, roadways, and other critical infrastructure.

Location 6: Channel Improvements along Upper Waste Ditch in Lehi City

As the Waste Ditch passes the school, it enters a 42-inch-diameter corrugated metal pipe, is conveyed under a portion of lawn for approximately 348 feet, and discharges back into the open channel. To provide more capacity, the existing pipe would be replaced with a 20-foot-wide by 4-foot-tall concrete box culvert. The box culvert would also have a trash rack and intake structure to prevent plugging.

The downstream channel 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 for approximately 550 feet. Channel slopes would match the existing channel slope, with a minimum of minimum of 0.3 percent. Trees and vegetation would be removed within the flow area. The total area of disturbance would be up to 3.2 acres. Proposed improvements provide near 100% flood reduction of the 50-year flood and would prevent flooding of houses, roadways, and other critical infrastructure.

Location 7: Channel Improvements along Waste Ditch at Willow Park in Lehi City

Approximately 1,279 feet of unimproved sections of the Waste Ditch channel would be excavated and expanded to match the upstream capacity. An undersized box culvert at 300 North in Willow Park would be replaced. The new box culvert would be a 20-foot-wide by 4-foot-tall concrete box culvert. The channel improvements would be the same as those 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.

Floodplain diversions would also be constructed along the lower portion of the channel. Fill material would be imported and compacted into berms to contain flows adjacent to the channel. The total area of disturbance would be up to 8.1 acres. Proposed improvements provide near 100% flood reduction of the 50-year flood and would prevent flooding of houses, roadways, and other critical infrastructure.

Location 8: Channel Improvements along Lower Dry Creek in Lehi City and Saratoga Springs City

Approximately 4,150 feet of the Dry Creek channel between 1100 West and Utah Lake would be improved with a combination of channel clearing (dredging channel and restoring natural channel capacity) and gabion-lined channel sections. The minimum slope of this channel would be 0.3 percent. Several large

trees would be removed from the channel to restore hydraulic capacity. Channel dredging would extend up to 2 feet below the existing channel flow line. Culverts would be upsized at 1700 West (12-foot-wide by 5-foot-tall) and 1900 South (14-foot-wide by 5-foot-tall). The total area of disturbance would be up to 19.4 acres. Proposed improvements provide near 100% flood reduction of the 50-year flood and would prevent flooding of houses, roadways, and other critical infrastructure.

The preferred alternative will allow the Sponsors to protect property and infrastructure while maximizing public benefits. This alternative's average annual monetary benefits are estimated to be $2,670,190, while its estimated average annual cost is $656,800, resulting in an annual net benefit of $2,013,390.

3.0 ENVIRONMENTAL AND SOCIAL BENEFITS

Environmental and social benefits were not monetized, but they are explained in detail for each alternative studied in the Environmental Consequences Section of the Plan/EA.

Environmentally adverse impacts will be minimized during construction. In the long term, there would only be negligible adverse impacts anticipated from any of the evaluated alternatives. The region is developed urban land with intermittently dry waterways.

Socially, the threat of loss of life or property will be minimized with reduced flood depths at buildings and roads. The annual average daily traffic on county major collector and rural roads near the project area near American Fork was about 2,500 to 8,000 vehicles per day, and near Lehi, 1,000 to 200,000 vehicles per day (Utah Department of Transportation, 2023). However, road and bridge damages were deemed insignificant in the project area and were not evaluated. Incidental recreation and wildlife use after construction will continue and will not be affected by the project improvements. No waterbodies will be developed from the project improvements.

This project was initiated in 2019, prior to the 2020 census. While the project area may be considered urban, the sponsor cities met the rural definition by having populations under 50,000 people in the 2010 census, which was used for the applications. Since then, Lehi City's population has grown to over 50,000 people in the 2020 census. NRCS-Utah has moved the project forward due to meeting the 20% agricultural benefits/population less than 50,000 for the whole project, as defined in Section 2 (16 U.S.C. Section 1002, "Definitions". (See Appendix B for email correspondence from Sonya Keith, National Watershed and Flood Prevention Operations Program Coordinator, NRCS – Lexington, KY.)

4.0 PERIOD OF ANALYSIS

The Period of Analysis used was 52 years (including 2 years for design and construction). Floods from the 2, 5, 10, 25, 50, 100, 200, and 500-year storm events were analyzed to estimate average annual flood-related damages.

A net present value analysis was conducted to compare the costs of project alternatives. Average annual values were also estimated. All costs of installation, operation and maintenance were based on 2024 prices. The costs associated with designing and implementing all structural measures were assumed to be implemented over a one-year period immediately preceding operation. The alternative with a 51-year period of analysis yielded the highest net benefits using the mandated 2.75% discount rate for all federal water resource projects for FY24 to discount and amortize the anticipated streams of costs and benefits.

5.0 ECONOMIC ANALYSIS AND DOCUMENTATION

A customized Excel worksheet using Federal Emergency Management Agency (FEMA) depth-damage curves and locally obtained data was used to evaluate the benefits and costs of alternatives. Each project alternative, storm event, and flood damage category was included in the worksheet to estimate average annual damages. Alternative cost estimates provided by the project engineers were also included in the worksheet. Economic data and results were linked in the worksheet to create the required P&G tables for the final project report.

6.0 RURAL COMMUNITY AND AGRICULTURAL DAMAGES

The stream of monetary benefits was described in average annual equivalent terms. The average annual expected benefits were the difference between the No Action Alternative and each project Alternative. The expected average annual damages for each alternative, storm event (8-events), and damage category below were estimated with the following equation:

$$\sum_{i=1}^{8} \underline{(PFED_{i-1} + FED_i)/2} * (PPFE_{i-1} - PFE_i)$$

$PFED_{i-1}$ - Previous Flood Event Damages
FED_i - Flood Event Damages
$PPFE_{i-1}$ - Probability of Previous Flood Event
PFE_i - Probability of Flood Event

6.1 STRUCTURE, CONTENT & VEHICLE DAMAGES

Structure, building content, and vehicle damages for each storm event and project alternative were estimated based on structures identified from aerial imagery and property data provided by the Utah County, Utah tax assessor. Local tax appraisal district records were utilized in order to obtain the structural values of residences, commercial and public properties, and outbuildings that would be affected by project activities. The structure damages were estimated using the methodology described in the Structural Damages Calculations Template (Tim Goody, NWMC). The value of the structures was calculated by subtracting the depreciated replacement value (DRV) from the Tax Accessor's structure value. The structures in the project area that are affected by flooding are located in a small rural town. The year structures were built varied significantly, as did the DRV:

Structure Built	Approx. Age	DRV
2000 – 2024	25 Years	.20
1980 -1997	40 Years	.18
1960 – 1979	65 Years	.28
1936 – 1958	82 Years	.10
1911 – 1935	100 Years	.25
1895 – 1910	120 Years	.30

Based on the Life Cycle Chart (Swiftestimator.com, building cost reports online 2/2007) the Depreciated Multiplier ranged from 18% to 30%. The structure value used in the flood damage analysis was estimated as: The County Tax Accessed Value * (1- Depreciated Replacement Value Factor) (see: DelaneyFloodDamagesBenefitsData.xls for calculations). For vehicles, local project managers estimated the typical vehicle replacement dollar value.

This estimated Depreciated Replacement Value is also consistent with the USACE National Structure Inventory documentation: "Structure Valuation - These replacement values for structures are then depreciated in order to obtain depreciated replacement value; each structure is depreciated by 1% per year for the first 20 years, after which it is assumed that routine maintenance would keep structure values at 80% of their replacement values".

(https://www.hec.usace.army.mil/confluence/nsi/technicalreferences/latest/technical-documentation).

Areas flooded and flood depths with and without project were estimated for the 2-, 5-, 10-, 25-, 50-, 100-, 200-, and 500-year storm events. The water depths for the 10- through 500-year storm events were obtained from the hydraulic simulation performed by Jones & DeMille Engineering, Inc., Richfield, Utah. The 2- and 5-year storm events were included in the economic analysis but were not modeled. Instead, a conservative assumption was made that the flood depths were zero during the 2- and 5-year storm events. Building types, contents, and the typical number of vehicles and vehicle values associated with impacted buildings were estimated using interpolation of flood depth-damage curves developed by FEMA. The percent damage factor was multiplied by each building structure and vehicle dollar value to estimate flood damages. The total value of structures on impacted properties is shown below. This value does not include land values, only structure values.

Watershed Planning Area 500 yr Flooded Structures (W/O Project)

	Total Structures	Residences & Apartments	Commercial Properties	Public Properties
Number	1,336	1,209	125	2
Value	$241,673,943	$179,568,556	$61,917,707	$187,680

Structure and content values were estimated as a percentage (about 75% structure and 60% content damages at 10-feet flood depth in a 1-story, no basement home) of assessed property values. Estimated floodwater depths (where damage occurs) for various storms (including the 500-year storm) for each structure were based on the results of the hydrology and hydraulics (H&H) simulation modeling. Floodwater data was then used with water depth to damage functions to estimate structural and content damages based on the ground elevation of each structure. A similar analysis was conducted for vehicles located at the property within the floodplain area. Damages to vehicles were estimated to begin at 0.5 feet of flood depth. Each affected property was estimated to have a minimum of two vehicles. The vehicle value was estimated to be $7,500/vehicle.

6.2 ROAD DAMAGES

Road damages caused by storms up to and including the 500-year storm event would be insignificant, so they were not evaluated.

6.3 BRIDGE & CULVERT DAMAGES

For the economic analysis, no identified culverts and bridges (stream crossings) were affected by storms up to and including the 500-year event.

6.4 OTHER DAMAGES

Local county officials provided or estimated no additional "Other Damages" (emergency aid, clean-up, sewer, debris removal, etc.).

6.5 AGRICULTURAL OR CROP DAMAGES

No pasture, range, livestock, or confined animal feeding operation damages were identified within the project area affected by storms up to and including the 500-year event.

6.6 RECREATION

Based on evidence found at the site and information from local residents, the waterways are not used for recreational purposes. The flood protection measures are not intended to store water for recreation. Incidental recreational activities such as walking are expected to be minimal. Since there is no official or unofficial usage count, estimated annual visitor days are unavailable. Therefore, incidental recreation impacts were not evaluated.

6.7 SCOUR & SEDIMENT DAMAGES

Erosion and sedimentation were not identified as a project resource concern. Flood erosion, scour, and sediment deposition damages are assumed to be minimal and not evaluated with and without the project.

The table below shows that the current average annual floodwater damages without project (present condition) are $7,396,773. Floodwater damages with project (Alternative 1) were estimated at $4,726,583.

Table 6-1: Summary of Annual Expected Damages

Plan Annual Expected Damages		
Category	**Present Condition**	**Alt 1**
Structure, Contents & Vehicles		

American Fork	$781,766	$246,810
Lehi Upstream	$5,419,884	$4,445,151
Lehi Downstream	$1,195,123	$34,622
Total:	$7,396,773	$4,726,583

1 Price base: 2024. Calculated using FY 20242 Water Resources Discount Rate (2.75%), annualized over 50 years, and 52-year period of analysis.

The number of structures that could be flooded and their total structural value are displayed below for each of the three sub-basins:

American Fork 500 yr Flooded Structures (W/O Project)

	Total Structures	Residences & Apartments	Commercial Properties	Public Properties
Number	328	254	72	2
Value	$73,574,967	$22,064,487	$51,322,800	$187,680

American Fork 500 yr Flooded Structures (Alt 1)

	Total Structures	Residences & Apartments	Commercial Properties	Public Properties
Number	210	163	45	2
Value	$30,957,510	$13,059,120	$17,710,710	$187,680

Lehi Upstream 500 yr Flooded Structures (W/O Project)

	Total Structures	Residences & Apartments	Commercial Properties	Public Properties
Number	858	809	49	0
Value	$141,607,320	$131,471,373	$10,135,947	$0

Lehi Upstream 500 yr Flooded Structures (Alt 1)

	Total Structures	Residences & Apartments	Commercial Properties	Public Properties
Number	793	750	43	0
Value	$136,686,467	$126,658,187	$10,028,280	$0

Lehi Downstream 500 yr Flooded Structures (W/O Project))

	Total Structures	Residences & Apartments	Commercial Properties	Public Properties

Number	150	146	4	0
Value	$26,491,656	$26,032,696	$458,960	$0

Lehi Downstream 500 yr Flooded Structures (Alt 1)

	Total Structures	Residences & Apartments	Commercial Properties	Public Properties
Number	80	76	4	0
Value	$15,987,075	$15,528,115	$458,960	$0

Structures Flooded in the Dry Fork Watershed Project Area Without Project

	Home			Commercial			Public		
Event	< 1 ft	1 to 3 ft	> 3 ft	< 1 ft	1 to 3 ft	> 3 ft	< 1 ft	1 to 3 ft	> 3 ft
2-yr	0	0	2	0	0	2	0	0	2
5-yr	0	0	2	0	0	2	0	0	2
10-yr	258	57	4	11	3	2	2	0	2
25-yr	556	159	12	44	9	2	1	1	2
50-yr	649	208	18	54	16	6	1	1	4
100-yr	732	246	16	56	27	8	1	1	2
200-yr	809	275	18	68	33	10	1	1	2
500-yr	884	305	21	79	35	13	1	1	2

7.0 WATERSHED PROJECT COSTS

Project costs for flood control measures and channel work were estimated by Franson Civil Engineers, Jones & DeMille Engineering, and Horrocks Engineers. Installation and operation & maintenance costs for each activity are described in detail in the cost tabs in the economic analysis Excel worksheet.

All costs were allocated to the flood prevention purpose according to the procedure in the National Resource Economics Handbook, Part 611 Water Resources Handbook for Economics, Chapter 6 Costs and Cost Allocation (NRCS 2014b). Work Plan-EA tables were constructed based on the calculated cost allocated to flood prevention. Within this purpose, the costs were shared between NRCS and the local and state entities as specified in the NWPM; in this case, the cost share for flood prevention is 100 percent federal and 0 percent local. Within these guidelines, engineering is 100 percent federal, and operation,

maintenance, and replacement are 100 percent local. See Work Plan Table 2 in the Plan-EA for the cost allocation/cost-sharing process results.

All costs were amortized at the Fiscal Year 2024 Federal Water Resource Discount of 2.75 percent for 52 years. Average Annual Costs are computed as the sum of the amortized construction and annual operation and maintenance costs. Engineers estimate that each structure would last 50 years, the project's life.

Project engineers estimated all project costs and converted them to Present Values by discounting each cost at the beginning of the period of analysis using the applicable project discount rate. Installation expenditures before the project was installed were brought forward to the end of the installation period by charging compound interest at the project discount rate from the date the costs were incurred. Finally, the project discount rate converted the present values to average annual equivalent terms. All estimated values and damages were assessed within a customized Excel template.

Watershed Project Annual Cost Summary

	Amortization of Installation Cost	Operation, Maintenance, and Replacement Cost2	Total
American Fork	$104,000	$8,600	$112,600
Lehi Upstream	$251,400	$14,200	$265,600
Lehi Downstream	$263,900	$14,700	$278,600
Total	$619,300	$37,500	$656,800

1/ Discount rate 2.75% with a 52 year period of analysis. Price base 2024

8.0 WATERSHED PROJECT BENEFITS AND COSTS

The table below shows that the current average annual benefits are $2,670,190, and the average annual costs are $656,800. The net annual benefits between with and without project that the project would provide to downstream properties are $2,013,390.

As reflected below, all three project areas had a B/C ratio greater than 1.0. Under Alternative 1, all three geographic areas produce a B/C ratio of 4.07.

Watershed Project Benefit-Cost Summary

Alternative 1	Average Annual Benefits 2/	Average Annual Costs 3/	Benefit Cost Ratio	Net Benefits
American Fork	$534,956	$112,600	4.75	$422,356

Lehi Upstream	$974,733	$265,600	3.67	$709,133
Lehi Downstream	$1,160,501	$278,600	4.17	$881,901
Grand Total	$2,670,190	$656,800	4.07	$2,013,390

1/ Discount rate 2.75% with a 52 year period of analysis. Price base 2024

9.0 FINAL TABLES

Below are all tables for all project increments and alternatives.

Table 6-1
Estimated Installation Cost American Fork-Dry Creek Watershed, Utah [2024 Dollars][1]

Works of Improvement	Unit	Number			Estimated Cost (2024 Dollars)[1]						
					Public Law 83-566 Funds			Other Funds			Total
		Federal Land	Non-Federal Land	Total	Federal Land	Non-Federal Land	Total	Federal Land	Non-Federal Land	Total	
Structural Measures											
Flood Protection											
American Fork	Acres	0	1,305	1,305	$0	$2,728,000	$2,728,000	$0	$0	$0	$2,728,000
Lehi Upstream	Acres	0	2,323	2,323	$0	$5,718,000	$5,718,000	$0	$865,000	$865,000	$6,583,000
Lehi Downstream	Acres	0	284	284	$0	$4,817,000	$4,817,000	$0	$2,079,000	$2,079,000	$6,896,000
Total Project					$0	$13,263,000	$13,263,000	$0	$2,944,000	$2,944,000	$16,207,000

[1] Price base: 2024

Table 6-2
Estimated Cost Distribution—Water Resource Project Measures American Fork—Dry Creek Watershed, Utah [2024 Dollars][1]

Works of Improvement	Installation Cost—Public Law 83-566						Installation Cost—Other Funds							Total
	Construction[3]	Engineering[6]	Real Property Rights[4,5]	Relocation Payments	Project Admin.	Total Public Law 566	Construction[3]	Engineering[6]	Real Property Rights[4,5]	Water Rights	Relocation Payments	Project Admin.[2]	Total Other	Installation Costs
American Fork	$2,387,000	$341,000	$0	$0	$0	$2,728,000	$0	$0	$0	$0	$0	$0	$0	$2,728,000
Lehi Upstream	$4,968,000	$750,000	$0	$0	$0	$5,718,000	$0	$0	$865,000	$0	$0	$0	$865,000	$6,583,000
Lehi Downstream	$4,187,000	$630,000	$0	$0	$0	$4,817,000	$0	$0	$2,079,000	$0	$0	$0	$2,079,000	$6,896,000
Total	$11,542,000	$1,721,000	$0	$0	$0	$13,263,000	$0	$0	$2,944,000	$0	$0	$0	$2,944,000	$16,207,000

1 Price base: 2024

2 Includes $0 for relocation assistance advisory service.

3 Includes $___ of Public Law 83-566 funds and $___ of other funds for cultural resource protection and mitigation measures.

4 Includes $0 of real property cost for mitigation.

5 Includes $___ or surveys, legal fees, other costs.

6 Engineering services contract cost to be borne: $3,066,477 by Public Law 83-566 funds and $0 by other funds.

Table 6-3

Cost Allocation and Cost Sharing Summary for Multi-Purpose Watershed Project Plans American Fork—Dry Creek Watershed, Utah [2024 Dollars][1]

	PL-566 Funds		Other Funds		Total Funds	
	Flood Protection	Total	Flood Protection	Total	Flood Protection	Total
Structural Measures						
Construction	$11,542,000	$11,542,000	$0	$0	$11,542,000	$11,542,000
Engineering	$1,721,000	$1,721,000	$0	$0	$1,721,000	$1,721,000
Real property rights	$0	$0	$2,944,000	$2,944,000	$2,944,000	$2,944,000
Relocation Payments	$0	$0	$0	$0	$0	$0
Project admin.	$0	$0	$0	$0	$0	$0
Total		$13,263,000		$2,944,000		$16,207,000

[1] Price base: 2024

[2] Method of cost allocation:

Table 5c: Estimated Average Annual Flood Damage Reduction Benefits
Alternative 1 – Flood Reduction Alternative

Table 6-4

Estimated Average Preferred Alternative Annual Costs, American Fork—Dry Creek Watershed, Utah (2024 Dollars)[1]

Works of Improvement	Amortization of Installation Cost	Operation, Maintenance and Replacement Cost[2]	Other Direct Costs	Total
American Fork	**$104,000**	**$8,600**	**$0**	**$112,600**
Lehi Upstream	**$251,400**	**$14,200**	**$0**	**$265,600**
Lehi Downstream	**$263,900**	**$14,700**	**$0**	**$278,600**
Total	**$619,300**	**$37,500**	**$0**	**$656,800**

1 Price base: 2024, amortized over 52-years at a discount rate of 2.75 percent.

2 Includes $0 for operation, maintenance, and replacement for recreational development.

3 Costs for technical assistance to install measures in this evaluation unit are included.

Table 6-5
Estimated Average Annual Flood Damage Reduction Benefits American Fork—Dry Creek Watershed, Utah [2024 Dollars]

Item	Estimated Average Annual Damage				Damage Reduction Benefit[3,4]	
	Without Project		With Project			
	Agriculture-related[2]	Non-agriculture-related	Agriculture-related[2]	Non-agriculture-related	Agriculture-related[2]	Non-agriculture-related
Flood Protection Improvements						
Structure, Contents & Vehicles						
American Fork	$781,766		$246,810		$534,956	
Lehi Upstream	$5,419,884		$4,445,151		$974,733	
Lehi Downstream	$1,195,123		$34,622		$1,160,501	
Grand Total	$7,396,773		$4,726,583		$2,670,190	

[1] Price base: 2024

[2] Agriculture-related damage includes damage to rural communities.

[3] Includes effects of land-treatment measures.

[4] Costs and benefits for on-farmland treatment have been netted out.

Table 6-6

Estimated Average Annual Watershed Protection Damage Reduction Benefits American Fork—Dry Creek Watershed, Utah [2024 Dollars][1]

Item	Damage Reduction Benefit, Average Annual	
	Agriculture-related	Non-agriculture-related
Onsite		
Structure, Contents & Vehicles	$2,670,190	
Total	$2,670,190	$0

[1] Price base: 2024

Table 6-7
Comparison of Preferred Alternative Benefits and Costs American Fork—Dry Creek Watershed, Utah [2024 Dollars][1]

Works of Improvement	Agricultural Damage Reduction Flood Reduction	Non-Agricultural Other	Average Annual Benefits	Average Annual Costs[2]	Benefit Cost Ratio
Land Treatment—acres					
American Fork	$534,956	$0	$534,956	$112,600	4.75
Lehi Upstream	$974,733	$0	$974,733	$265,600	3.67
Lehi Downstream	$1,160,501	$0	$1,160,501	$278,600	4.17
Total	$2,670,190	$0	$2,670,190	$656,800	4.07

[1] Price base: 2024

[2] From Table 2

E.6 PR&G Ecosystem Services Scoping and Evaluation Worksheet

PR&G Ecosystem Services Scoping and Evaluation Worksheet

Franson Civil Engineers

PROJECT NAME	American Fork-Dry Creek Supp.Watershed Plan-EA
PROJECT NUMBER	20053
PROJECT MANAGER	Eric Franson, P.E.

Overview of Framework

The PR&G Ecosystem Services Framework is an analysis approach that traces the pathways of natural ecosystem processes to the benefits which they grant to society in monetary and non-monetary terms. NRCS requires that an ecosystem services framework be worked within throughout the preliminary investigation and planning process. Ecosystem services are broken into four service categories which include:

(1) Provisioning Services: tangible goods for human use such as food, clean air, fresh water, energy, fuel, forage, fiber, and minerals.
(2) Regulating Services: maintain natural processes which provide buffers against environmental catastrophe such as long-term storage of carbon; climate regulation; water filtration, purification, and storage; soil stabilization; flood prevention/control; and disease regulation.
(3) Supporting Services: underlying processes maintaining conditions for life such as pollination, seed dispersal, soil formation, and nutrient cycling.
(4) Cultural Services: services related to the cultural or spiritual needs of people such as educational, aesthetic, spiritual and cultural heritage values, recreational experiences, and tourism opportunities.

Evaluation Approach

Ecosystem services are first evaluated from a qualitative perspective during scoping to identify the types of services present in the watershed, and then specifically to identify those that could interact with (impact or be impacted by) the authorized project purpose(s)/problems.

Regulatory Requirement (Level II PR&G Analysis)

The National Watershed Program Manual (NWPM) requires a level II PR&G analysis for any WSOP or REHAB program that will have a Federal construction cost-share of more than $10 million. This level of PR&G analysis requires the robust development of an ecosystem service framework and resulting ecosystem services flows.

Use of this Worksheet

This worksheet was created as a way to document our incorporation and use of the ecosystem services framework and to provide written evidence of the evaluation approach described above. Fill in all the applicable fields on this worksheet for the project you are working on. If it is not a text form or dropdown list, it should not be changed. Depending on the project, not every form or field will be applicable.

AFFECTED ENVIRONMENT: IDENTIFICATION/SCOPING FOR ECOSYSTEM SERVICES

In the tables below, identify ecosystem services that currently exist in the project area and place them under the appropriate service categories as described in the "Overview of Framework" section of this worksheet. Remember, the initial evaluation of ecosystem services should be conducted from a qualitative perspective. The services identified should be directly related to the PL-566 authorized purpose(s)/Problem(s) for the project. Incidental service benefits will be identified in a later section.

Table 1 Scoped Provisioning Services in the Project Area

PROVISIONING SERVICES
Instream Fish Species/Food Source
Food Production/Agriculture
NA
NA

Provisioning Services: tangible goods for human use such as food, clean air, fresh water, energy, fuel, forage, fiber, and minerals.

Table 2 Scoped Regulating Services in the Project Area

REGULATING SERVICES
Flood Prevention/Damages
Surface Water Quality/Erosion
Wetlands/WOTUS Environmental Buffer
NA

Regulating Services: maintain natural processes which provide buffers against environmental catastrophe such as long-term storage of carbon; climate regulation; water filtration, purification, and storage; soil stabilization; flood prevention/control; and disease regulation.

Table 3 Scoped Supporting Services in the Project Area

SUPPORTING SERVICES
Evaluated as an intermediate ecosystem service, therefore it is not carried forward in this ecosystem services analysis.
NA
NA
NA

Supporting Services: underlying processes maintaining conditions for life such as pollination, seed dispersal, soil formation, and nutrient cycling.

Table 4 Scoped Cultural Services in the Project Area

CULTURAL SERVICES
Visual/Scenic/Aesthetics
Public Safety Conditions
Ecosystem Viability
NA

Cultural Services: services related to the cultural or spiritual needs of people such as educational, aesthetic, spiritual and cultural heritage values, recreational experiences, and tourism opportunities.

FORECASTED FUTURE CONDITIONS (NO ACTION/FWOFI/ANALYTIC BASELINE)

In the section below, evaluate the reasonably projected changes in the ecosystem service benefits you identified in the previous section. The main focus of this projections should be on how the change in the provision of the service will alter the benefits they provide to society/human welfare. Again, this section should be qualitative and does not necessarily need to provide any specific quantities of services. This write-up (or some slight variation of it) will be included in the Plan-EA/EIS.

The projected changes in the provision of ecosystem services in the project area if no Federal Investment were made would result in overall reductions in the ecosystem service benefits that the natural systems in the project area provide to society. The following changes in ecosystem service benefits would be expected if existing conditions are to continue:

1. Instream Fish Species Provisioning Service:
- Poor water quality during flooding/storm events caused by increased sedimentation may not facilitate proliferation of the instream fish species.
- Damages incurred by flooding may destroy existing aquatic habitat that instream species use.

2. Agriculture/Food Production Provisioning Service:
- In the short-term, there would be no impacts to the delivery or quantity of agricultural water to cropland in the project area.
- In the long-term, in light of reasonably foreseeable long-term climate trends, drought frequency will likely increase, potentially limiting the quantity of water available for irrigation which would decrease crop yields in the watershed.

3. Flood Prevention Regulating Service:
- Flood events would continue to occur in the watershed/project area. Continued damages as a result of these flood events would continue to impair the ability of the ecosystem to buffer against environmental catastrophe (i.e., flooding in this case).
- Damages to the floodplain could occur as well as to the quality of surface water, which would reduce the buffering capability of the local ecosystem.

4. Surface Water Quality/Erosion Regulating Service:
- As flooding in the project area continues, streambank erosion and sedimentation would continue to occur, loading the local waterways with sediments and continuing to degrade the water quality to a similar degree as they currently do. Although conditions would not worsen, the ability of the project area to buffer against erosion damages would remain impaired.

5. Wetlands/WOTUS Buffer Regulating Service:
- Wetlands play a critical role in acting as a buffer against environmental catastrophe by cycling critical nutrients like Nitrogen and Sulfur, providing habitat for species, natural flood protection, and carbon sequestration.
- This regulating service would continue to exist in its current condition should No Action be taken.

6. Visual/Aesthetic Cultural Service:
- The scenic value of the watershed would continue to be damaged and impaired by flood events, which taken cumulatively over time, would dramatically re-shape and impact the aesthetic quality of the area.

7. Public Safety Cultural Service:
- Public Safety conditions would not be improved if No Action were taken. Flood events would continue to occur, poising a threat to life and property, and risks associated with drowning in open waterways would also continue. The damages incurred to structures/roads/crops etc. during flood events would continue to occur.

8. Ecosystem Viability Cultural Service:
- If existing conditions were to continue, the ecological viability of the watershed/project area would continue to degrade. Flood events and other associated damages to regulating and provisioning services would make the ecosystem less functional overall, reducing its long-term viability and resilience, especially in light of long-term predicted climate trends.

MONETIZING, QUANTIFYING, AND QUALIFYING ECOSYSTEM SERVICES

The decision tree below was provided by the National Watershed Management Center (NWMC) and should be a helpful reference in completing this section of the worksheet.

NWMC Decision Tree for Ecosystem Services

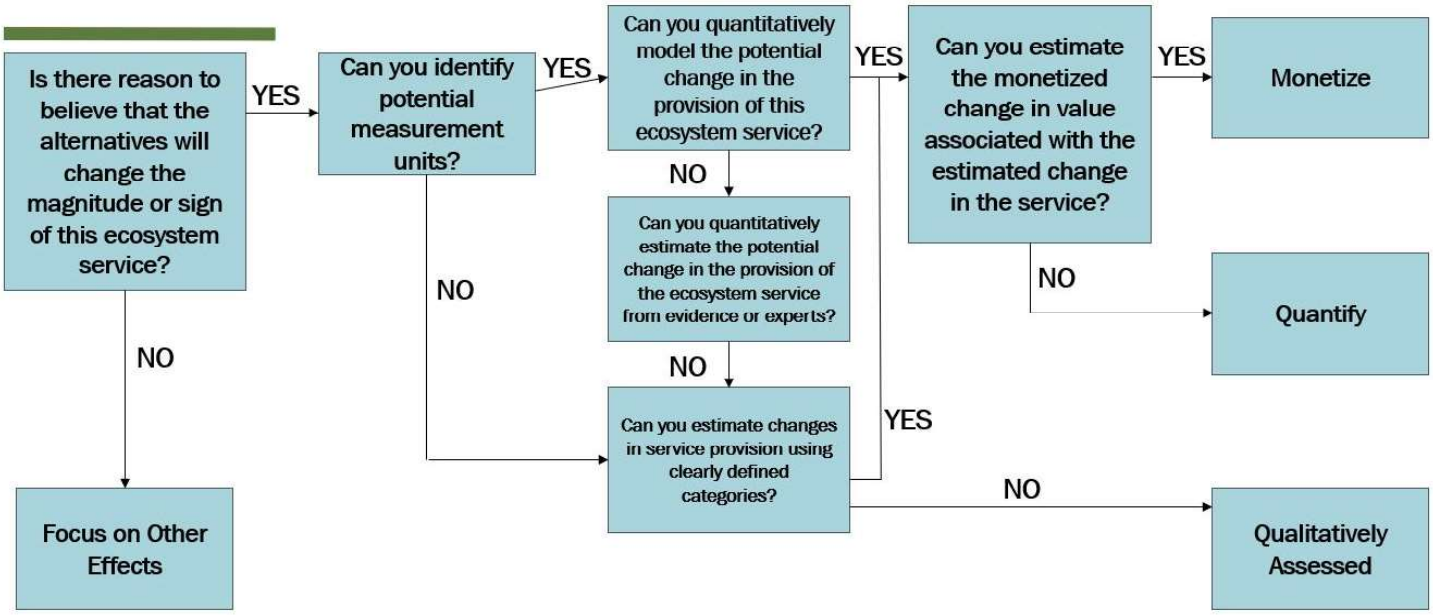


Table 5 Summary of Ecosystem Services & Their Representative Metrics

PROVISIONING SERVICES		
SERVICE	**MONETIZED/QUANTIFIED/QUALIFIED?**	**REPRESENTATIVE METRIC**
Instream Fish Species	Qualified/Non-Monetized	Observed fish species in waterways
Agriculture/Food Production	Qualified/Non-Monetized	Availability of Water for Agriculture
	Not Applicable	
	Not Applicable	
REGULATING SERVICES		
SERVICE	**MONETIZED/QUANTIFIED/QUALIFIED?**	**REPRESENTATIVE METRIC**
Flood Prevention	Monetized	Flood Damage Reduction Benefit ($)
Surface Water Quality/Erosion	Qualified/Non-Monetized	Observed Level of Erosion/Sedimentati
Wetlands/Buffer	Quantified	Acres of Wetlands Disturbed/Impacted
	Not Applicable	
SUPPORTING SERVICES		
SERVICE	**MONETIZED/QUANTIFIED/QUALIFIED?**	**REPRESENTATIVE METRIC**
Evaluated as Intermediate	Not Applicable	
	Not Applicable	
	Not Applicable	
	Not Applicable	
CULTURAL SERVICES		
SERVICE	**MONETIZED/QUANTIFIED/QUALIFIED?**	**REPRESENTATIVE METRIC**
Visual/Aesthetic	Qualified/Non-Monetized	Subjective Changes to Viewshed
Public Safety	Quantified	No. of Structures Damaged by Flooding
Ecological Viability	Qualified/Non-Monetized	Cumulative Functionality of Ecosystem
	Not Applicable	

Examples of Monetized Representative Metrics: flood damage benefits (dollars), expected tourism (dollars)

Examples of Quantified Representative Metrics: protected/restored acres of farmland, crop yields, acre-feet of saved water, WQ Index, habitat units, wildlife/fish/plant species population changes

Examples of Qualified Representative Metrics: aesthetic improvements, vegetation restoration, new recreational opportunities, improved access to the outdoors

MONETIZED ECOSYSTEM SERVICES BENEFITS SUMMARY FOR ALTERNATIVES

Fill in the table below to summarize the estimated monetized benefits of the ecosystem services you identified (if applicable). This table should be provided to the project economist to be included in the economic analysis. It should also be noted that, if necessary, the non-monetized ecosystem service benefits should be provided to the economist to serve as a tradeoff if the B/C ratio does not meet at least 1. These benefits may be used to raise the B/C ratio given subjective values.

Also note, if there were no monetized benefits identified or if any of the ecosystem service categories were eliminated during scoping, note that in the table by including a line that says, "not monetized for this plan".

Table 6 Monetized Benefits Summary for Ecosystem Services

	No Action	Action Alternative 1	Action Alternative 2
PROVISIONING SERVICES			
Instream Fish Species	Not Monetized for this Plan	Not Monetized for this Plan	Not Monetized for this Plan
Agriculture/Food Production	Not Monetized for this Plan	Not Monetized for this Plan	Not Monetized for this Plan
REGULATING SERVICES			
Flood Prevention/Damages	$0	$2,670,190	$7,396,733
Surface Water Quality/Erosion	Not Monetized for this Plan	Not Monetized for this Plan	Not Monetized for this Plan
Wetlands Ecological Buffer	Not Monetized for this Plan	Not Monetized for this Plan	Not Monetized for this Plan
SUPPORTING SERVICES			
Evaluated as an Intermediate Service	NA	NA	NA
CULTURAL SERVICES			
Visual/Scenic/Aesthetic Quality	Not Monetized for this Plan	Not Monetized for this Plan	Not Monetized for this Plan
Public Safety	Not Monetized for this Plan	Not Monetized for this Plan	Not Monetized for this Plan
Ecological Viability/Functionality	Not Monetized for this Plan	Not Monetized for this Plan	Not Monetized for this Plan
Total Annual Monetized Benefits	$0	$2,670,190	$7,396,733
Total Annual Monetized Costs	$0	$656,800	$14,606,948
Benefit-Cost Ratio	0.0	4.07	0.51
Annual Monetized Net Benefit	$0	$2,013,390	-$7,210,215

ENVIRONMENTAL CONSEQUENCES: IMPACTS OF ALTERNATIVES ON ECOSYSTEM SERVICES

In the environmental consequences chapter of the Plan-EA/EIS, the impacts of each alternative in the final array on ecosystem services must be evaluated. If the service is monetized or quantified, the dollars or values associated with that service under each alternative should be listed in the descriptions. In the sections below, generate write-ups for the Plan-EA/EIS that evaluate the environmental consequences/impacts to the ecosystem services in the project area.

Ecosystem Services Impact Write-Ups:

No Action/FWOFI: Provisioning Services would not be improved but would diminish over time under this Alternative Plan. See the "Forecasted Future Conditions" section of this worksheet/documentation.

Action Alternative 1: Provisioning Services would likely improved under this alternative, although water quantity would not change. Water quality would improve as a result of reduced erosion and sedimentation, providing better aquatic habitat for native fish species. Area would become more resilient to long-term climate trends, safeguarding agricultural production in the area and allowing agricultural production to continue as it currently does.

Action Alternative 2: Under this alternative, habitat for instream fish species would continue to be degraded during flood events. Long-term climate trends, such as increased drought frequency, would continue to be a threat to agricultural production in the watershed and agricultural viability would not be increased or maintained by this alternative plan.

No Action/FWOFI: Regulating Services would not be improved but would diminish over time under this Alternative Plan. See the "Forecasted Future Conditions" section of this worksheet/documentation.

Action Alternative 1: There would be significant flood damage reduction improvements to 504 structures. This would increase the ability of the area to serve as a buffer against environmental catastrophe. Riverbanks would be stabilized with gabions or rock lining to reduce erosion and sediment deposition, improving the surface water quality. There would be no acres of Wetlands impacted during implementation, meaning the ability of wetlands to serve as natural buffers would not be interrupted.

Action Alternative 2: Conducting relocations in the floodplain would eliminate the risk of flood damage to structures and the risk to public safety posed by the flooding. However, riverbanks would continue to be vulnerable to bank erosion and sediment deposition into the water, and surface water quality conditions would not improve. Wetlands would continue to exist in their current state but would be susceptible to flood damages.

SUPPORTING SERVICES EVALUATED AS INTERMEDIATE SERVICE IN THIS PLAN, NO ADDITIONAL INFORMATION NECESSARY.

No Action/FWOFI: Cultural Services would not be improved but would be diminished over time under this Alternative Plan. See the "Forecasted Future Conditions" section of this worksheet/documentation.

Action Alternative 1: As part of riverbank stabilization and channel improvements, the aesthetics may change with the removal of trees and vegetation. Temporarily reduced visual appeal may occur to residents in the floodplain during construction. Reduction of flooding provides better public safety conditions and greater peace of mind to residents during flood events. The ecosystem functionality and viability would also improve as there would be reduced erosion and sediment depositions and significantly reduced damages from flooding.

Action Alternative 2: Buyout and removal of structures in the floodplain would modify the aesthetics. The safety of the public residents who were relocated would be improved. The ecosystem viability would not be improved under this alternative.

E.7 PR&G Alternative Formulation and Screening Process

PR&G ALTERNATIVE FORMULATION AND SCREENING PROCESS FOR THE AMERICAN FORK - DRY CREEK SUPPLEMENTAL WATERSHED PLAN-ENVIRONMENTAL ASSESSMENT LOCATED IN UTAH COUNTY, UTAH

LEAD AGENCY: USDA NATURAL RESOURCES CONSERVATION SERVICE (NRCS)

SPONSORING LOCAL ORGANIZATION: AMERICAN FORK CITY

CO-SPONSORING LOCAL ORGANIZATIONS: LEHI CITY & SARATOGA SPRINGS CITY

CONSULTANTS: FRANSON CIVIL ENGINEERS, JONES & DEMILLE ENGINEERS, & HORROCKS ENGINEERS



PHASE I: PROBLEMS & OPPORTUNITIES, DEFICIENCIES, OBJECTIVES, & PLANNING CONSTRAINTS

TABLE 1: PROBLEMS AND OPPORTUNITIES

Problem Statement(s): **Flood Prevention**	Within the American Fork River-Dry Creek Watershed, flood control of the river and waterways are critical for protection of infrastructure, homes, commercial properties, etc. Problems in the watershed are associated with flooding and include areas that have historically flooded or are at risk for flooding that would impact structures in American Fork, Lehi, and Saratoga Springs cities.
Opportunity 1 - Resilience to Flooding	Enhance safety & community resilience to flood risks through the implementation of project measures.
Opportunity 2 - Protect Structures	Provide improved flood protection for structures through the implementation of project measures.
Opportunity 3 - Reduce Erosion	Reduce streambank erosion in the project area through the implementation of project measures.

IDENTIFIED DEFICIENCIES
Deficiency 1. Flooding & Erosion at Locations in American Fork City
Deficiency 2. Flooding & Erosion at Locations in Lehi City & Saratoga Springs City

Federal Objective (Required by PR&G)

The Federal Objective specifies that Federal water resource investments shall reflect national priorities, encourage economic development, and protect the environment by:
1. Seeking to maximize sustainable economic development;
2. Seeking to avoid the unwise use of floodplains and flood-prone areas and minimize adverse impacts and vulnerabilities in any case in which a floodplain or flood-prone area may be used; and
3. Protecting and restoring the functions of natural systems and mitigating any unavoidable damage to natural systems.

TABLE 2: PROJECT OBJECTIVES

Objective 1 - Flood Control Problems	Address flood control problems at identified locations in American Fork, Lehi, and Saratoga Springs cities to effectively manage high flows and prevent damage to homes, businesses, and agricultural fields through the year 2080.
Objective 2 - Erosion Reduction	Adress streambank erosion in the project area to prevent deterioration of surface water quality in the waterbodies associated with the study area through the year 2080.
Objective 3 - Protect Public Safety	Address current threats to public safety resulting from flood events, which pose a threat to life and property, at the identified locations within American Fork, Lehi, and Saratoga Springs cities through the year 2080.

TABLE 3: CONSTRAINTS AND CONSIDERATIONS

Constraint 1 - Disruptions to Property	Minimize disruptions to existing residential and commercial properties during the construction of the project in American Fork, Lehi, and Saratoga Springs cities.
Constraint 2 - Cultural/Historic Impacts	Minimize adverse impacts to cultural and historic resources in the watershed to the maximum extent possible during construction of the project.
Constraint 3 - Sedimentation Impacts	Minimize water pollution and sedimentation of waterways during construction activities to protect aquatic ecosystems in the waterbodies within the study area.
Constraint 4 - Protect June Sucker	Avoid all impacts that would directly or indirectly adversely impact or degrade potential habitat for the June Sucker, a Federally listed fish species.

DEFICIENCY #1: FLOODING & EROSION AT LOCATIONS IN AMERICAN FORK CITY

TABLE 4: INITIAL APPROACHES AND MANAGEMENT MEASURES

Initial Approaches & Management Measures	Initial Qualitative Evaluation	Carried Forward?
CHANNEL IMPROVEMENTS AT 300 NORTH IN AMERICAN FORK CITY		
Improvements to embankments, new wingwalls, new concrete apron on DS side of the outlet to protect against erosion, armoring of embankments with gabions/rip rap.	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, constructing new upstream and downstream wingwalls and a new concrete apron on the downstream side at the outlet to protect against erosion. The embankments would be armored with gabions or riprap to protect against erosion. These channel improvements would allow the 100-year flood to pass without any flooding upstream. See maps in Appendix B.	Y
CHANNEL IMPROVEMENTS AT 100 NORTH & 200 EAST IN AMERICAN FORK CITY		
reconstruction of embankments, new transition into box culvert, embankment armoring with gabions/rip rap.	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 and creating a new transition into the existing box culvert. The embankments will be armored with gabions or riprap to protect against erosion. These channel improvements would allow the 100-year flood to pass without any flooding upstream. See maps in Appendix B.	Y
CHANNEL IMPROVEMENTS AT 200 SOUTH IN AMERICAN FORK CITY		
	At this location, project measures would consist of removing energy dissipation baffle blocks that catch debris and cause backups in the channel. Riprap would be placed as erosion protection on the downstream banks instead of the baffle blocks. The existing culvert is anticipated to be replaced in the future under a separate action. Other channel improvements wcould include modifications to the channel slope and channel width. These channel improvements would allow the 100-year flood to pass without any flooding upstream. See maps in Appendix B.	Y
CULVERT REPLACEMENT AT 200 SOUTH IN AMERICAN FORK CITY (Not Eligible for PL 83-566 Funding)		
Replace existing culvert at this location	The existing culvert at 200 South in American Fork needs to be replaced and a management measure was initially considered to remove the current culvert and replace it with another. However, it was learned that culvert replacement cannot be conducted using cost-share/funding from the PL 83-566 program and the measure was not carried forward. Additionally, during alternative development, the SLO identifed other means to replace this culvert as part of a separate action/project.	N
CHANNEL IMPROVEMENTS AT 400 SOUTH IN AMERICAN FORK CITY		
	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 includes widening the upstream channel and raising the riverbanks using gabions. These improvements would allow the passage of the 100-year flood and would prevent flooding the houses near the river. See maps in Appendix B.	Y

NONSTRUCTURAL PROPERTY BUYOUTS IN AMERICAN FORK		
Conduct buyouts of properties in floodplain as a nonstructural solution.	This measure involves acquisition of downstream properties within the 50-year inundation area and demolishing structures to prevent recurring flood damages as a nonstructural solution to the problem. The impacted areas downstream of American Fork River were evaluated to determine the number of lands and damaged structures, including mobile homes, permanent homes, commercial buildings, and "other" (churches, schools, libraries, and government offices). In American Fork City, this would include 139 structures at an estimate cost of 7.4 million dollars. By acquiring properties, the problem of flood prevention would be addressed, and the Purpose and Need of the project would be fulfilled.	**Y**
CHANNEL IMPROVEMENTS IN AMERICAN FORK CITY DESIGNED FOR THE 500-YEAR FLOOD EVENT		
All channel improvements at locations disclosed in 100-year event measures but designed for larger flood event.	These measures would be the same as the measures considered for the 100-year storm event alternative above but would be designed for th 500-year event instead of the 100-year event, which is the minimum requirement for American Fork City. The 500-year storm event would create a flow in the American Fork River of approximately 1,199 cfs, which is more than the 100-year storm flow of approximately 934 cfs. In order to contain the additional flow, it was estimated that the channel banks would have to be increased one foot higher than to contain the 100-year storm event. The channel improvements would also have to be extended upstream approximately 50 feet further than for the 100-year storm event for each improvement area.	**Y**

DEFICIENCY #2: FLOODING & EROSION AT LOCATIONS IN LEHI CITY AND SARATOGA SPRING CITY

TABLE 4: INITIAL APPROACHES AND MANAGEMENT MEASURES

Initial Approaches & Management Measures	Initial Qualitative Evaluation	Carried Forward?
CHANNEL IMPROVEMENTS AT UPPER DRY CREEK IN LEHI CITY		
36-inch and 48-inch CMPs replaced, gabion baskets.	Additional capacity is needed at this project location by Lehi Elementary School to handle the 50-year flood flows. Existing culvert structures [36-inch corrugated metal pipe (CMP) in parking lot of Lehi Elementary School (Dry Creek) and a 48-inch CMP (Waste Ditch that runs through the playground/field area behind the school] would be replaced to provide more capacity and the downstream channel would be improved. Other channel improvements include gabion baskets. Proposed improvements provide near 100% flood reduction in this area and would prevent flooding of houses, roadways, and other critical infrastructure. See maps in Appendix B.	Y
CHANNEL IMPROVEMENTS AT UPPER WASTE DITCH IN LEHI CITY		
Replacement of existing structures, downstream improvements	Additional capacity is needed at this project location to handle the 50-year flood flows. Existing structures would be replaced to provide more capacity, and the downstream channel would be improved. Proposed improvements provide near 100% flood reduction in this area and would prevent flooding of houses, roadways, and other critical infrastructure. See maps in Appendix B.	Y
CHANNEL IMPROVEMENTS AT WASTE DITCH AT WILLOW PARK IN LEHI CITY (Partially Funded by PL 83-566)		
Excavation and expansion of sections of waste ditch, replacement of box culvert at 300 North.	Unimproved sections of Waste Ditch would be excavated and expanded to match the upstream capacity and an undersized box culvert at 300 North in Willow Park would be replaced. The downstream channel would be improved to provide more capacity. Proposed improvements provide near 100% flood reduction in this area and would prevent flooding of roadways and other critical infrastructure. See maps in Appendix B.	Y
Channel clearing, gabion lining.	Dry Creek through this area would be improved with a combination of channel clearing (dredging channel and restoring natural channel capacity) and gabion-lined channel sections. Proposed improvements provide near 100% flood reduction in this area and would prevent flooding of houses, roadways, and other critical infrastructure. See maps in Appendix B.	Y
NONSTRUCTURAL PROPERTY BUYOUTS IN LEHI AND SARATOGA SPRINGS CITIES		
Conduct buyouts of properties in floodplain as a nonstructural solution.	This measure involves acquisition of downstream properties within the 50-year inundation area and demolishing structures to prevent recurring flood damages as a nonstructural solution to the problem. The impacted areas downstream of Dry Creek and Waste Ditch were evaluated to determine the number of lands and damaged structures, including mobile homes, permanent homes, commercial buildings, and "other" (churches, schools, libraries, and government offices).In Lehi City, this would include 860 structures at an estimated cost of 107 million dollars. By acquiring properties, the problem of flood prevention would be addressed, and the Purpose and Need of the project would be fulfilled.	Y
CHANNEL IMPROVEMENTS IN LEHI/SARATOGA SPRINGS CITIES DESIGNED FOR THE 500-YEAR FLOOD EVENT		
	the 500-year storm event creates flows in Dry Creek of approximately 503 cfs and 754 cfs in Waste Ditch. The selected 500-year storm event creates flows in Dry Creek of approximately 369 cfs and 553 cfs in Waste Ditch. To contain the additional flow of the	

All channel improvements at locations disclosed in 100-year event measures but designed for larger flood event.	100-year storm event, it was estimated the banks of the channel would need to be raised an additional 0.5 ft than what is required to contain the 500-year storm event. To contain the additional flow of the 500-year storm event, it was estimated the banks of the channel would need to be raised an additional 1.5 ft than what is required to contain the 50-year storm event. Additionally, the 500-year storm event approximately doubles each improvement area along the channel. These additional improvements decrease the potentially flooded areas but increase the overall cost of the project.	**Y**
CHANNEL IMPROVEMENTS ALONG ADDITIONAL SECTIONS OF WASTE DITCH IN LEHI CITY		
Flow containment and channel improvements in sections of waste ditch in recent developed areas.	Waste Ditch has seen significant improvements by developers in recent years as new subdivisions are built in the area. Dry Creek, however, runs through areas of the city that were developed several decades ago, and the channel has deficiencies. Due to high cost and impractical design requirements for flood flow containment, these segments of Dry Creek were not considered in the Project. Modeling shows flooding would still occur in these areas, but the flooding was not induced by any included project measures nor was the flooding as extensive as the areas included in the Project.	**N**

TABLE 5: MEASURES CONSIDERED AND SELECTED FOR INCORPORATION INTO ALTERNATIVES

C = Compatible/Combinable, M = Mutually Exclusive or Unecessarily Redundant

PHASE III & IV: PAIRWISE COMPATIBILITY FOR EACH MANAGEMENT MEASURE AND COMBINATION INTO ALTERNATIVE PLANS

M = Mutually Exclusive or Incompatible

C = Compatible in an alternative

	Pairwise Compatibility	DEFICIENCY 1. FLOODING & EROSION AT LOCATIONS IN AMERICAN FORK CITY						DEFICIENCY 2. FLOODING & EROSION AT LOCATIONS IN LEHI CITY AND SARATOGA SPRINGS CITY						RESULTS OF PARIWISE ANALYSIS	COMBINED TO ALTERNATIVES?
		Channel Improvemets at 300 North in AF City	Channel Improvements at 100 North & 200 East in AF City	Channel Improvements at 200 South in AF City	Channel Improvements at 400 South in AF City	Nonstructural Property Buyouts in AF City	Channel Improvements in AF City Designed for the 500 Year Event	Channel Improvements at Upper Dry Creek in Lehi City	Channel Improvements at Upper Waste Ditch in Lehi City	Channel Improvements at Waste Ditch at Willow Park in Lehi City	Channel Improvements at Lower Dry Creek in Lehi & Saratoga Springs Cities	Nonstructural Property Buyouts in Lehi & Saratoga Springs Cities	Channel Improvements in Lehi/Saratoga Springs Cities Designed for the 500 Year Event	Preliminary Evaluation of Combinations	Carried Forward?
DEFICIENCY 1. FLOODING & EROSION AT LOCATIONS IN AMERICAN FORK CITY	Channel Improvemets at 300 North in AF City	NA	C	C	C	M	M	C	C	C	C	C	C	This measure is compatible with all proposed structural measures in American Fork, Lehi, & Saratoga Springs cities designed to the 100-year flood event. Incompatible with nonstructural measures in AF City & AF City 500-yr event measure. Carried forward.	Y
	Channel Improvements at 100 North & 200 East in AF City	C	NA	C	C	M	M	C	C	C	C	C	C	This measure is compatible with all proposed structural measures in American Fork, Lehi, & Saratoga Springs cities designed to the 100-year flood event. Incompatible with nonstructural measures in AF City & AF City 500-yr event measure. Carried forward.	Y
	Channel Improvements at 200 South in AF City	C	C	NA	C	M	M	C	C	C	C	C	C	This measure is compatible with all proposed structural measures in American Fork, Lehi, & Saratoga Springs cities designed to the 100-year flood event. Incompatible with nonstructural measures in AF City & AF City 500-yr event measure. Carried forward.	Y
	Channel Improvements at 400 South in AF City	C	C	C	NA	M	M	C	C	C	C	C	C	This measure is compatible with all proposed structural measures in American Fork, Lehi, & Saratoga Springs cities designed to the 100-year flood event. Incompatible with nonstructural measures in AF City & AF City 500-yr event measure. Carried forward.	Y
	Nonstructural Property Buyouts in AF City	M	M	M	M	NA	M	C	C	C	C	C	C	Nonstructural measure is incompatible with structural flood prevention measures in AF City. Compatible with structural measures in Lehi City. Carried Forward.	Y
	Channel Improvements in AF City Designed for the 500 Year Event	M	M	M	M	M	NA	C	C	C	C	C	C	Incompatible with all 100-year storm event designed measures in AF-City. Compatible with all proposed structural and nonstructural measures in Lehi/Saratoga Springs. Carried Forward.	Y
DEFICIENCY 2. FLOODING & EROSION AT LOCATIONS IN LEHI CITY AND SARATOGA SPRINGS CITY	Channel Improvements at Upper Dry Creek in Lehi City	C	C	C	C	C	C	NA	C	C	C	M	M	This measure is compatible with all proposed structural measures in American Fork, Lehi, & Saratoga Springs cities designed to the 100-year flood event. Incompatible with nonstructural measures in LehiCity & Lehi City 500-yr event measure. Carried forward.	Y
	Channel Improvements at Upper Waste Ditch in Lehi City	C	C	C	C	C	C	C	NA	C	C	M	M	This measure is compatible with all proposed structural measures in American Fork, Lehi, & Saratoga Springs cities designed to the 100-year flood event. Incompatible with nonstructural measures in LehiCity & Lehi City 500-yr event measure. Carried forward.	Y
	Channel Improvements at Waste Ditch at Willow Park in Lehi City	C	C	C	C	C	C	C	C	NA	C	M	M	This measure is compatible with all proposed structural measures in American Fork, Lehi, & Saratoga Springs cities designed to the 100-year flood event. Incompatible with nonstructural measures in LehiCity & Lehi City 500-yr event measure. Carried forward.	Y
	Channel Improvements at Lower Dry Creek in Lehi & Saratoga Springs Cities	C	C	C	C	C	C	C	C	C	NA	M	M	This measure is compatible with all proposed structural measures in American Fork, Lehi, & Saratoga Springs cities designed to the 100-year flood event. Incompatible with nonstructural measures in LehiCity & Lehi City 500-yr event measure. Carried forward.	Y
	Nonstructural Property Buyouts in Lehi & Saratoga Springs Cities	C	C	C	C	C	C	M	M	M	M	NA	M	Nonstructural measure is incompatible with structural flood prevention measures in Lehi/Saratoga Springs Cities. Compatible with structural measures in AF City. Carried Forward.	Y
	Channel Improvements in Lehi/Saratoga Springs Cities Designed for the 500 Year Event	C	C	C	C	C	C	M	M	M	M	M	NA	Incompatible with all 100-year storm event designed measures inLehi/Saratoga Springs Cities. Compatible with all proposed structural and nonstructural measures in AF City. Carried Forward.	Y

PHASE V: FIRST SCREENING OF THE INITIAL ARRAY AGAINST THE FEDERAL/PROJECT OBJECTIVES & PLANNING CONSTRAINTS

TABLE 6: SUMMARY OF INITIAL ALTERNATIVES AND 1ST SCREENING BASED ON OBJECTIVES AND CONSTRAINTS

N = not met, Y = met, NA = not applicable

ID	ALTERNATIVE DESCRIPTION	Federal Objective	Flood Control Objective	Erosion Reduction Objective	Public Safety Objective	Property Disruptions Constraint	Cultural/Historic Impacts Constraint	Sedimentation Impacts	June Sucker Constraint	CARRIED FORWARD Y/N?
Alternative 1 -- No Action -- FWOFI Alternative	**No Action Alternative (FWOFI)** Existing conditions would continue, the problems and opportunities would not be met and conditions would generally worsen. Required to be carried forward under NEPA and PR&G to serve as the analytic baseline.	N	N	N	N	N	Y	N	Y	Y
Alternative 2 -- Proposed Action -- Flood Reduction Alternative	Flood Reduction Alternative • Channel Improvements at 300 North in American Fork City • Channel Improvements at 100 North/200 East in American Fork City • Channel Improvements at 200 South in American Fork City • Channel Improvements at 400 South in American Fork City • Channel Improvements at Upper Dry Creek in Lehi City • Channel Improvements at Upper Waste Ditch in Lehi City • Channel Improvements at Waste Ditch at Willow Park in Lehi City • Channel Improvements at Lower Dry Creek in Lehi & Saratoga Springs	Y	Y	Y	Y	Y	Y	Y	Y	Y
Alternative 3 -- Proposed Action -- Property Buyouts Alternative (Nonstructural)	Property Buyouts Alternative • Nonstructural Property Buyouts in American Fork City • Nonstructural Property Buyouts in Lehi City The PR&G requires at least one nonstructural alternative to be carried into the final array of alternative plans.	Y	Y	N	Y	N	Y	N	Y	Y
Alternative 4 -- Proposed Action -- 500-Year Storm Event Alternative	500-Year Storm Event Alternative • Channel Improvements in American Fork City Designed for the 500-Year Storm Event • Channel Improvements in Lehi City and Saratoga Springs City for the 500-Year Storm Event The 500-year storm event alternative would not meet all the project objectives and would open up the possibility of flooding in new locations.	N	N	Y	N	N	Y	Y	Y	N

TABLE 7: SUMMARY OF 2ND SCREENING OF INITIAL ARRAY OF ALTERNATIVES BY ECOSYSTEM SERVICES AND ECONOMICS

N = not met/Decreased or Did Not Increase Service Provision, Y = met/Increased Service Provision, NA = not applicable

ID	ALTERNATIVE NAME	PROVISIONING	REGULATING	CULTURAL	SUPPORTING	BCR	NET ANNUAL BENEFITS	CARRIED FORWARD?
	Alternative 1 -- No Action -- FWOFI Alternative. Although this alternative does not improve the provision of any ecosystem service categories or meet the minimum BCR, it is carried forward into the final array because it is required under NEPA and the PR&G as the analytic baseline alternative.	N	N	N		0	$0	Y
	Alternative 2 -- Proposed Action -- Flood Reduction Alternative. The Flood Reduction Alternative would improve the provision of provisioning, regulating, and cultural ecosystem services in the watershed and would meet the BCR requirement, with a BCR of **6.2** and net benefits of **$3,325,600**.	Y	Y	Y		4.07	$2,013,390	Y
	Alternative 3 -- Proposed Action -- Property Buyouts Alternative (Nonstructural). The Property Buyouts Alternative would improve the provision of regulating, and cultural ecosystem services in the watershed but would not improve provisioning services and would just barely meet the BCR requirement, with a BCR of **1.12** and net benefits of **$292,149**. However, due to this alternative being a nonstructural alternative, which is required for flood prevention projects, it was carried forward to the final array despite its inability to meet all the screening criteria.	N	Y	Y		0.51	($7,210,215)	Y

PHASE VII: IDENTIFICATION OF THE FINAL ARRAY OF ALTERNATIVES (TO BE SCREENED USING C,E,E,& A)

TABLE 8: FINAL ARRAY OF ALTERNATIVES

Alternative 1 No Action FWOFI Alternative	The No Action Alternative describes the most likely future condition with no federal technical and/or financial assistance through the Watershed and Flood Prevention Operations (WFPO) Program. It consists of no improvements along the waterways, including neither concrete-lined nor unlined portions. No construction or permits would be required, nor would there be a need for on-going maintenance of constructed facilities. Existing conditions and trends would continue into the future. The cities would continue to experience flood damage and address issues on a case-by-case basis. Flood flows would pass through the same historic channels, waterways, and culverts with continuation of potential flooding and the associated risk to public health and safety, Routine operational and maintenance (O&M) activities by each respective city would continue.
Alternative 2 Proposed Action Flood Reduction Alternative	The Flood Reduction Alternative is the Action Alternative which structurally addresses the flooding issues along the waterways in accordance with each city's design standards. The Alternative includes four locations in American Fork, three locations in Lehi City, and one location along lower Dry Creek that stretches between Lehi City and Saratoga Springs City. These project measures address flooding issues along the waterways. The Action Alternative's installation cost is estimated at $16,207,0000. See PR&G and Economics Analysis in Appendix E for cost estimate details and assumptions. Hydrologic and hydraulic analyses were completed in accordance with NRCS requirements and standards to evaluate and verify that this alternative meets the purpose and need of the Project. Ensuring that improvements do not cause induced flooding downstream was a major consideration in the evaluation. The analyses were reviewed by the study team to identify the locations that needed replacement or rehabilitation due to the flooding events. Project measures for channel improvements include two methods, an earthen channel or gabion baskets, to address flooding concerns and improve public safety along the waterways. It is less expensive to construct earthen channel improvements. However, each location was evaluated to select the most feasible solution that meets all the functionality and needs based on location and the space available for the necessary improvements to meet each city's design standards.
Alternative 3 Proposed Action Property Buyouts Alternative (Nonstructural)	The Nonstructural Alternative involves acquisition of downstream properties within the 50-year inundation area and demolishing structures to prevent recurring flood damages. The impacted areas downstream of American Fork River, Dry Creek, and Waste Ditch were evaluated to determine the number of lands and damaged structures, including mobile homes, permanent homes, commercial buildings, and "other" (churches, schools, libraries, and government offices). This alternative would have an estimated cost of $394,346,259. By acquiring properties, the problem of flood prevention would be addressed, and the Purpose and Need of the project would be fulfilled. The PR&G requires full consideration and reporting of at least one Nonstructural Alternative in the final array of alternative plans.
Environmentally Preferred Alternative (from NEPA)	The NEPA process mandates that an environmentally preferred alternative be identified as a part of the planning process. Additionally, if a CWA Section 404 permit (any potential impacts to WOTUS) is required, the principles of the U.S. Army Corps of Engineers (USACE) Least Environmentally Damaging Practicable Alternative (LEDPA) should be followed and complied with during the development of alternative plans. LEDPA principles are best adhered to using the framework of first, avoidance, then, minimization, then, and only then, mitigation. Alternative 2 – Proposed Action – Flood Reduction Alternative is the environmentally preferable/LEDPA alternative for this Supplemental Plan-EA.
Locally Preferred Alternative	Under the PR&G, it is required to identify an alternative plan that is locally preferred. This alternative was developed with sponsors and local interests that have oversight or implementation authorities and responsibilities. In the case of this project, the locally preferred alternatives in Alternative 2 – Proposed Action – Flood Reduction Alternative.

TABLE 9: SUMMARY AND COMPARISON OF ALTERNATIVES -- PLANNING PROCESS

Green = Met, Red = Not Met

ITEM OR CONCERN	ALTERNATIVE 1 NO ACTION/FWOFI	ALTERNATIVE 2 FLOOD REDUCTION	ALTERNATIVE 3 PROPERTY BUYOUTS
NEPA PURPOSE AND NEED			
NEPA PURPOSE AND NEED	This alternative would not meet the purpose and need. Flooding problems would persist.	Flood Prevention project purpose would be met. Needs would be addressed. Is the environmentally preferred and locally preferred alternative.	Flood Prevention project purpose would be met using nonstructural measures for flood control. However, would relocate many residents and be very costly.
PROJECT OBJECTIVES			
OBJECTIVE #1. Flood Control Objective	Would not address flood control infrastructure problems. Flood damages would not be prevented and would continue to occur. Objective would not be met.	Flood risks would be significantly reduced at all identified locations in the project area as a result of implementation of project measures. Objective would be met.	Conducting property relocations in the study area would eliminate the risks of damages associated with flood events in the project area. Objective would be met.
OBJECTIVE #2. Erosion Reduction Objective	Would not address issues related to streambank erosion and/or sedimentation of waterways. Sedimentation would continue to occur. Objective would not be met.	Streambank erosion and sedimentation problems would be reduced in the project area as a result of implementation of project measures. Objective would be met.	Conducting property relocations would do nothing to prevent the issues related to streambank erosion and sedimentation. Existing conditions would continue. Objective would not be met.
OBJECTIVE #3. Public Safety Objective	Would not protect or improve public safety conditoins. Risks to life and structures associated with intense flood events would continue to occur. Objective would not be met.	Public safety would be significantly improved in the project area as a result of the flood prevention measures implemented at the identified locations. Objective would be met.	By relocating all residents, they would no longer experience risks and threats to public safety associated with flooding. Objective would be met.
CONSTRAINTS			
CONSTRAINT #1. Disruptions to Property	No construction would occur under this alternative, and so, disruptions to property would continue to occur as a result of flooding. Constraint would not be met.	This alternative would not disrupt any properties during implementation outside of unavoidable noise disruptions, which would be minimized with BMPs. Constraint would be met.	This alternative would require the purchasing and relocation of all properties/structures within the floodplain as a nonstructural solution to the problems. Constraint would not be met.
CONSTRAINT #2. Cultural Site Impacts	By not installing any flood control infrastructure, no cultural or historic sites/properties would be damaged as a result of implementation. Constraint would be met.	This plan would not have any adverse impacts on any historic/cultural properties/sites as a result of construction. BMPs would be followed should a discovery be made. Constraint would be met.	This plan would not have any adverse impacts on any historic/cultural properties/sites as a result of implementation. Constraint would be met.
CONSTRAINT #3. Sedimentation Impacts	No construction would occur under this alternative, and so, no improvement would be made to the sedimentation and erosion of banks. Constraint would not be met.	This alternative would reduce the amount of streambank erosion and sedimentation in the waterways in the project area. Constraint would be met.	This plan would not reduce the amount of streambank erosion and/or sedimentation in the waterways in the project area. Constraint would not be met.
CONSTRAINT #4. June Sucker Impacts	No construction would occur under this alternative, and so, no impacts to the June Sucker would occur. Constraint would be met.	There would be no impacts to the June Sucker during implementation and BMPs would be used to adhere to the conservation measures in the BA. Constraint would be met.	There would be no impacts to the June Sucker during implementation and BMPs would be used to adhere to the conservation measures in the BA. Constraint would be met.
PR&G EVALUATION CRITERIA			
COMPLETENESS	This alternative would not constitute a complete alternative as no problems would be addressed.	This alternative would account for all necessary investments to achieve the planned effects. Constitutes a complete solution.	This alternative would account for all necessary investments to achieve the planned effects. Constitutes a complete solution.
EFFECTIVENESS	This alternative would not constitute an effective solution as no problems would be solved and no objective would be met.	This alternative would address all the identified problems and meet all of the project objectives to constitute an effective solution.	This alternative, while addressing the problem, would not meet all the project objectives, thus it does not constitute an effective solution.
EFFICIENCY	This alternative would not cost anything to implement and so, would constitute a cost-efficient solution.	This alternative is the NEE alternative and has net positive benefits and a BCR of 6.2. This alternative constitutes an efficient solution.	This alternative does not have net positive benefits and a BCR of 0.51 due to the exorbitant cost of $394,346,259 to conduct property buyouts in the floodplain. Is not an efficient solution.
ACCEPTABILITY	This alternative would not be acceptable or consistent with existing Federal laws as it would not protect the environment and would not address any of the problems in the watershed.	This alternative would comply with all Federal and State regulatory frameworks and is the environmentally preferred alternative to NEPA and the locally preferred alternative. The problems in the watershed would be addressed. This alternative constitutes an acceptable solution.	This alternative would not be acceptable as it is highly unlikely that property buyouts could be conducted on an entirely voluntary basis, requiring the use of eminent domain to accomplish it. This alternative does not constitute an acceptable solution.

E.8 List of Historic Properties

Historic Properties in American Fork City and Lehi City.

	House Number	Street Direction	Street Name	Construction Year	Building Type	Style	Construction Material
American Fork City							
1	485	S	100 EAST	1940	SINGLE DWELLING	MINIMAL TRADITIONAL	CLAPBOARD SIDING
2	345	S	CENTER STREET	1910	SINGLE DWELLING	GREEK REVIVAL	STUCCO/PLASTER
3	345	S	CENTER	1900	SINGLE DWELLING	GREEK REVIVAL	STUCCO/PLASTER
4	63	S	CENTER	1901	RESIDENTIAL (GEN.)	CLASSICAL: OTHER	STUCCO/PLASTER
5	98	S	CENTER	1890	RESIDENTIAL (GEN.)	VICTORIAN ECLECTIC	REGULAR BRICK
6	71	S	CENTER	1919	RESIDENTIAL (GEN.)	BUNGALOW	REGULAR BRICK
7	148	S	CENTER	1910	RESIDENTIAL (GEN.)	GREEK REVIVAL	REGULAR BRICK
8	120	S	CENTER	1924	RESIDENTIAL (GEN.)	BUNGALOW	REGULAR BRICK
9	29	S	CENTER	1922	RESIDENTIAL (GEN.)	BUNGALOW	REGULAR BRICK
10	95	N	200 EAST	1910	WAREHOUSE	20TH C. COMMERCIAL	REGULAR BRICK
11	80	N	200 EAST	1955	COMMERCIAL (GEN.)	POST-WWII: OTHER	REGULAR BRICK
12	58	N	100 EAST	1896	SINGLE DWELLING	VICTORIAN ECLECTIC	REGULAR BRICK
13	171	E	100 NORTH	1910	SINGLE DWELLING	BUNGALOW	DROP/NOVELTY SIDING
14	97	N	200 EAST	1920	COMMERCIAL (GEN.)		REGULAR BRICK
15	55	N	GRANT	1920	AGRICULTURAL (GEN.)		PLANK SIDING
16	407	N	400 EAST	1920	SINGLE DWELLING	ENGLISH COTTAGE	STONE:OTHER/UNDEF.
17	389	E	400 NORTH	1925	AGRIC. OUTBUILDING		LUMBER/SLAB SIDING
18	205	N	300 EAST	1920	SINGLE DWELLING	POST-WWII: OTHER	CAST CONCRETE
Lehi City							
1	7364	N	9550 WEST	1937	SINGLE DWELLING	MINIMAL TRADITIONAL	ALUMINUM SIDING
2	7364	N	9550 WEST	1940	SINGLE DWELLING	MINIMAL TRADITIONAL	ALUMINUM SIDING
3	7410	N	8350 WEST	1915	SINGLE DWELLING	BUNGALOW	ALUMINUM SIDING
4	7414	N	8350 WEST	1915	SINGLE DWELLING	BUNGALOW	DROP/NOVELTY SIDING
5	7416	N	8350 WEST	1900	SINGLE DWELLING	VICTORIAN ECLECTIC	ADOBE BRICK
6	7932	N	8350 WEST	1901	SINGLE DWELLING	VICTORIAN ECLECTIC	DROP/NOVELTY SIDING
7	7900	N	8350 WEST	1890	SINGLE DWELLING	GOTHIC REVIVAL	ALUMINUM SIDING
8	7710	N	8350 WEST	1885	SINGLE DWELLING	GOTHIC REVIVAL	ALUMINUM SIDING
9	7840	N	8350 WEST	1890	SINGLE DWELLING	VICTORIAN ECLECTIC	STUCCO/PLASTER
10	7870	N	8350 WEST	1900	SINGLE DWELLING	VICTORIAN ECLECTIC	STUCCO/PLASTER
11	99	N	500 WEST	1890	SINGLE DWELLING	VICTORIAN ECLECTIC	DROP/NOVELTY SIDING
12	445	W	100 SOUTH	1875	AGRICULTURAL (GEN.)	VICTORIAN ECLECTIC	ADOBE BRICK
13	447	W	100 SOUTH	1875	AGRIC. PROCESSING		STONE:OTHER/UNDEF.
14	119	N	500 WEST	1930	SINGLE DWELLING	ENGLISH COTTAGE	SHIP-LAP SIDING
15	564	W	WEST MAIN	1890	SINGLE DWELLING	VICTORIAN ECLECTIC	STUCCO/PLASTER
16	320	S	300 WEST	1905	SINGLE DWELLING	VICTORIAN ECLECTIC	STUCCO/PLASTER
17	385	N	300 WEST	1895	RESIDENTIAL (GEN.)	VICTORIAN ECLECTIC	REGULAR BRICK
18	344	W	100 NORTH	1895	RESIDENTIAL (GEN.)		DROP/NOVELTY SIDING
19	394	W	MAIN	1887	HOTEL/MOTEL	CLASSICAL: OTHER	ADOBE BRICK
20	87	N	300 WEST	1925	RESIDENTIAL (GEN.)	ARTS & CRAFTS	STUCCO/PLASTER

	House Number	Street Direction	Street Name	Construction Year	Building Type	Style	Construction Material
21	30	S	300 WEST	1900	RESIDENTIAL (GEN.)	BUNGALOW	REGULAR BRICK
22	292	W	300 NORTH	1895	RESIDENTIAL (GEN.)	VICTORIAN ECLECTIC	DROP/NOVELTY SIDING
23	112	S	300 WEST	1920	RESIDENTIAL (GEN.)	BUNGALOW	REGULAR BRICK
24	391	W	MAIN	1875	RESIDENTIAL (GEN.)	VICTORIAN ECLECTIC	ADOBE BRICK
25	320	W	100 NORTH	1915	RESIDENTIAL (GEN.)	BUNGALOW	REGULAR BRICK
26	85	N	400 WEST	1890	RESIDENTIAL (GEN.)	VICTORIAN ECLECTIC	REGULAR BRICK
27	206	S	300 WEST	1890	RESIDENTIAL (GEN.)	VICTORIAN ECLECTIC	REGULAR BRICK
28	295	N	300 WEST	1930	RESIDENTIAL (GEN.)	BUNGALOW	REGULAR BRICK
29	391	N	300 WEST	1890	RESIDENTIAL (GEN.)	ITALIANATE	STUCCO/PLASTER
30	351	W	100 SOUTH	1935	RESIDENTIAL (GEN.)		DROP/NOVELTY SIDING
31	450	W	300 NORTH	1927	PUBLIC WORKS		REGULAR BRICK
32	270	S	300 WEST	1875	RESIDENTIAL (GEN.)	GOTHIC REVIVAL	STUCCO/PLASTER
33	88	S	300 WEST	1920	RESIDENTIAL (GEN.)	PRAIRIE SCHOOL	REGULAR BRICK
34	394	W	MAIN	1880	RESIDENTIAL (GEN.)	ITALIANATE	ADOBE BRICK
35	308	W	MAIN	1895	RESIDENTIAL (GEN.)	VICTORIAN ECLECTIC	REGULAR BRICK
36	382	N	200 WEST	1925	RESIDENTIAL (GEN.)		STUCCO/PLASTER
37	420	W	300 NORTH	191			REGULAR BRICK
38	310	W	300 NORTH	1895	RESIDENTIAL (GEN.)	VICTORIAN ECLECTIC	REGULAR BRICK
39	376	S	200 WEST	1930	SINGLE DWELLING	PERIOD REVIVAL: OTHER	DROP/NOVELTY SIDING
40	363	N	300 WEST	1895	RESIDENTIAL (GEN.)	VICTORIAN ECLECTIC	REGULAR BRICK
41	357	W	300 NORTH	1930	RESIDENTIAL (GEN.)	BUNGALOW	ROCK-FACED CONC. BLK
42	410	N	500 WEST	1895	RESIDENTIAL (GEN.)	VICTORIAN ECLECTIC	REGULAR BRICK
43	420	N	500 WEST	1870	RESIDENTIAL (GEN.)		ADOBE BRICK
44	567	N	200 WEST	1925	SINGLE DWELLING		SHIP-LAP SIDING
45	559	N	200 WEST	1905	SINGLE DWELLING	VICTORIAN ECLECTIC	REGULAR BRICK
46	511	N	200 WEST	1940	SINGLE DWELLING	MINIMAL TRADITIONAL	ROCK-FACED CONC. BLK
47	467	N	200 WEST	1900	RESIDENTIAL (GEN.)	VICTORIAN ECLECTIC	REGULAR BRICK
48	416	N	200 WEST	1925	RESIDENTIAL (GEN.)	BUNGALOW	DROP/NOVELTY SIDING
49	442	N	200 WEST	1895	RESIDENTIAL (GEN.)	VICTORIAN ECLECTIC	REGULAR BRICK
50	160	W	500 NORTH	1930	RESIDENTIAL (GEN.)		CLAPBOARD SIDING
51	484	N	200 WEST	1895	RESIDENTIAL (GEN.)	VICTORIAN ECLECTIC	REGULAR BRICK
52	61	W	STATE	1890	SINGLE DWELLING	VICTORIAN ECLECTIC	REGULAR BRICK
53	9243	W	8570 NORTH	1920	SINGLE DWELLING	ARTS & CRAFTS	STUCCO/PLASTER
54	9156	W	8570 NORTH	1900	SINGLE DWELLING	VICTORIAN: OTHER	DROP/NOVELTY SIDING
55	8501	N	9550 WEST	1950	SINGLE DWELLING	RANCH/RAMBLER (GEN.)	ALUMINUM SIDING
56	76	S	2300 WEST	1950	SINGLE DWELLING	EARLY RANCH (GEN.)	STRIATED BRICK
57	8560	N	9150 WEST	1920	SINGLE DWELLING	BUNGALOW	REGULAR BRICK
58	8565	N	9150 WEST	1930	SINGLE DWELLING	ENGLISH TUDOR	STRIATED BRICK

E.9 Cultural Resources Inventory

HORROCKS
ENGINEERS

A CULTURAL RESOURCES INVENTORY OF THE AMERICAN FORK RIVER SUPPLEMENTAL WATERSHED PLAN (Redacted)

UTAH ANTIQUITIES PROJECT NUMBER U21HX0470

PREPARED FOR:
Natural Resources Conservation Service
Cites of Lehi, American Fork, and Pleasant Grove, Utah

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06/15/2022

ABSTRACT

Report Title
American Fork River Supplemental Watershed Plan-EA Project

State Project Number
U21HX0470

Project Description
The United States Department of Agriculture's Natural Resources Conservation Service (USDA-NRCS), with assistance from American Fork City as the project sponsor, and Lehi City and Pleasant Grove City as project co-sponsors, is considering proposed improvements within the American Fork River Watershed. The main objective of the project is to implement flood reduction and prevention solutions in specific locations within the three sponsor cities that will protect public safety on public roadways, private property, and agricultural areas.

Survey Area
The survey area for cultural resources was defined as linear corridors. Four project areas were evaluated for this survey. These areas included Waste Ditch and Dry Creek in Lehi; the American Fork River channel in American Fork, and irrigation ditches in Pleasant Grove that have since been removed from the project but were originally evaluated for cultural resources as part of the overall study. A total of nine cultural resources were revisited, newly recorded, or updated (Table 1).

Table 1. Results of survey

SITE NUMBER	DESCRIPTION	RECOMMENDED ELIGIBILITY	SURVEY TYPE
42UT1029	Utah Southern/Union Pacific Railroad	**Eligible**	Updated
42UT1908	Lehi Pioneer Cemetery	**Eligible**	Revisited
42UT1909	Waste Ditch	Not Eligible	Updated
42UT1101	Denver & Rio Grande Western Railroad	**Eligible**	Updated
42UT592	Lithic Scatter	**Eligible**	Revisited
42UT1725	Spring Ditch	Not Eligible	Updated
42UT2309	Unnamed Ditch	Not Eligible	Revisited
049001D	Box Culvert Bridge, [redacted]	Not Eligible	Revisited
N/A*	Box Culvert Bridge, [redacted]	Not Eligible	Newly Recorded

** No historic bridge number has been assigned to this feature*

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I. INTRODUCTION

The United States Department of Agriculture's Natural Resources Conservation Service (NRCS), with assistance from American Fork City as the project sponsor, and Lehi City and Pleasant Grove City as project co-sponsors, is considering proposed improvements within the American Fork River Watershed. The main objective of the project is to implement flood reduction and incorporate flood prevention solutions in specific locations within the three sponsor cities that will protect public safety on public roadways, private property, and agricultural areas. The survey area for cultural resources includes the proposed footprint of the current study area. The archaeological survey examined all areas of potential ground disturbance. Areas of marshes, wetlands, or roadway development were excluded from the survey. The survey area covered areas not previously surveyed for other projects. No right-of-way would acquired and no historic properties would affected. Construction would consist of the designing and building of box culverts, as well as the reconstruction of channels to increase capacity and improve channel operations.

Developed areas in Lehi City have been flooded, or are at risk for flooding, particularly along Dry Creek and the Waste Ditch, which is the secondary canal that diverts excess water from Dry Creek and conveys it westward to the Jordan River. In recent years, Lehi, in partnership with private landowners and state agencies, has invested in improving the Dry Creek channel and Waste Ditch in various locations throughout the city. High flows have posed an increasing threat to residential structures and Lehi Elementary School in the sections of the channel that have not yet been improved.

The American Fork 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 converted to a channel with either a closed-top box culvert at road crossings or an open-top rectangular concrete channel. American Fork City has had increasing concerns about the structural integrity of six flood control structures along the American Fork River, including several culverts and sections of concrete rectangular channel. In the event these structures fail during high flows, there is a significant risk of flood damage to the surrounding area of about 128 acres, which includes approximately 240 residential homes, 20 commercial buildings, one elementary school, and one church. The current conditions of some structures pose a threat of eroding and cutting through the soil around the banks and beneath the structure. The project proposes to rehabilitate or replace these six structures in order to maintain public safety around these structures and to protect surrounding areas from possible flood damage.

Storm water in and around Pleasant Grove City has historically flowed southwest to Utah Lake through various drainage channels. These channels have been modified and rerouted to accommodate agricultural practices and residential and commercial uses. Channel capacities have been restricted due to limited foresight or the acceptance of occasional flooding. A culvert crossing under I-15 has been identified as a consistent flooding location due to insufficient capacities. This flooding during 1-year and larger recurrence interval storm events impacts nearby agricultural lands and limits the potential for future development of the area.

Upon further consultation with the designers and affiliated cities, the Pleasant Grove City portion of this project will not advance. Therefore, there will be no impacts to the cultural resources located in the Pleasant Grove City area. Results of the survey are still presented within this report as the area was evaluated for cultural resources as part of the overall study prior to the Pleasant Grove City portion of the study area being removed from the project.

In 2022, six addtional study areas fo project staging and a 100-foot buffer around the shores of Dry Creek were added to the project. Those were evaluated and added to this report.

Table 2. Legal Location of the Project.

TOWNSHIP AND RANGE	SECTIONS
22 South 5 West	1, 2, 6, 10, 11, 15, 16, 20, 21, 29, 31, 32
23 South 6 West	1, 8, 11, 12, 14, 15, 21, 22, 29, 32
24 South 6 West	5, 6, 7
24 South 7 West	7, 12, 13
5 South 1 East	13, 14, 23
5 South 2 East	31
6 South 2 East	6

II. PROJECT AREA SETTING

The geographic setting for the project area is in the Wasatch Front Valleys subdivision of the Basin and Range region (Table 2) (Stokes, 1986). Four project areas were evaluated for this survey. These areas included Waste Ditch in Lehi, Utah; Dry Creek in Lehi Utah; two irrigation ditches in Pleasant Grove, Utah; and the American Fork River channel in American Fork, Utah. Elevations in the project area range from 4,494 feet above sea level (1,369 meters) at I-15 where the diversion of Waste Ditch and Dry Creek begins, to 4,603 feet (1,402 meters) at the southern end of the project area where Waste Ditch ends at the Jordan River. Elevations along the Dry Creek portion of the project area span from 4,485 feet (1,367 meters) just above the same diversion and I-15, to 4,636 feet (1,413 meters) where Dry Creek meets Utah Lake. The Pleasant Grove ditch elevations range from 4,492 feet (1,369 meters) beginning near the eastern corner of the DoTERRA parking lot and I-15 to 4,507 feet (1,373 meters) where the ditch reaches Utah Lake crossing under the Union Pacific Railroad. The American Fork River channel's elevations start at 4,717 (1,437 meters) in the Art Dye Disc Golf parking lot to 5,474 feet (1,668 meters) where the river crosses under I-15 near 500 South. Dominant vegetation in the project area includes sagebrush, bunch grasses, residential and recreational landscaping (primarily turf grass), and riparian vegetation such as cottonwoods, willows, and dogbane.

III. HISTORICAL CONTEXT

Prehistoric Period

The first group known to occupy the area now called Utah County was a hunter-gatherer culture known as Desert Archaic (8,000–2,000 BP) (Janetski 1990:12–16). Only a few sites with Archaic components (such as American Fork Cave and Spotten Cave) have been excavated, and are not well-reported. Around 2,000 BP (0 AD), a farming culture known as the Fremont, appears in the archaeological record. They are distinguished by the use of agriculture, pottery, and, in Utah County, the presence of mound sites around the Provo River Delta and near Goshen (Dahle 2011:1–7; Janetski 1990:16–23; Mooney 2014:1–9).

Around 1300 AD, Numic cultures based on a hunter-gatherer lifestyle appeared (Janetsk 1990:24–29). These groups, including modern day Utes, occupied the area around the Utah Lake and used resources in the mountains as well. These life-ways persisted up to and beyond the exploration and settlement of the Salt Lake and Utah counties by Euroamericans. These early explorers and settlers found groups of Utes residing in Utah Valley (Holzapfel 1999:35). Late prehistoric sites, such as those occupied by the Utes, have not been well investigated in Utah Valley.

European-American Influence AD 1776-Present

In 1849, Latter-day Saints from Salt Lake City and surrounding areas colonized Utah Valley. They established scattered farms on which crops and livestock were raised. The initial arrival by colonists into Utah Valley was met with some resistance by the Timponogots branch of Utes. The Utes were persuaded to allow Latter-Day Saint settlers in the area, but armed conflict between natives and Latter-Day Saint colonists escalated into a series of battles and other smaller conflicts that ended in 1872 when federal troops intervened and began forcing Utes onto the Uintah Reservation (Holzapfel 1999).

The city of Pleasant Grove, originally called Battle Creek, was settled in 1850. Pleasant Grove was primarily a farming community that became famous for its fruit production, particularly strawberries. Although initial settlement focused on the area of the current downtown, where a fort was constructed, many farmers traveled daily to fields north of the city. This area was originally called North Fields, but was later changed to the neighborhood of Manila.

During a period of rapid expansion, several new settlements were also added to the Utah Valley in 1850 including Lehi, American Fork, Payson, Alpine, and Springville. These settlements participated in the growing Utah Valley Latter-Day Saint village system which encouraged the community to be involved in public works such as irrigation canals, roads, fences, and public buildings. The economy was based heavily upon agriculture and utilized the abundant supply of mountain runoff, such as from Dry Creek, to become the region's breadbasket (Holzapfel 1999:56–58).

Shortly after settlement of the towns, the new inhabitants began to construct irrigation ditches to carry water from streams to agricultural areas. Construction of ditches from the American Fork River began in 1852 and included the Eighty-Rod Ditch on the boundary of American Fork and Pleasant Grove, the Pleasant Grove Main Ditch, and the Sterrett Ditch. Water rights were occasionally a source of contention as settlements developed in the highlands above Lehi and American Fork causing the residents to be cut off from Dry Creek's water supply. In 1892 the highland's water rights were delineated, smoothing the development path for future settlements and resulting in population increases (Holzapfel 1999:59–60).

The establishment of the railroad facilitated the expansion of the population and a shift in settlement patterns in the Utah Territory. The 1860s saw a population transfer from central Utah County to the north when the Union Pacific and Central Pacific railroads opted to establish a more northerly route through Ogden (Holzapfel 1999:58–59). The Utah Southern Railroad would not reach Lehi until 1872, as the railway spanned from Salt Lake City to Juab. The local section of railroad was an early "Mormon Road" made to connect main communities along the Wasatch Front. It was eventually incorporated into the Union Pacific Railroad (UPRR) and functioned as part of the UPRR until it was sold to the UTA in 2002 (Steele 2015).

IV. PREVIOUS RESEARCH

A literature search was conducted on June 10th, 2021 on the Utah Division of State History's (UDSH) online database, SEGO, to identify previously documented archaeological sites or areas of historic importance within the Area of Potential Effects (APE) and a 1/2 mile radius beyond the APE. The literature search noted seven previously recorded sites in the APE. Four sites appear repeatedly across the different project areas while the Dry Creek area contained one additional site. The Pleasant Grove project held a separate site and the Waste Ditch area included one site that Horrocks recommends be merged with one of the four repeated sites. One resource, 42UT592, was previously recorded as a large lithic scatter [redacted] Upon revisiting the site, no artifacts were observed [redacted] and the site appeared to have been heavily impacted by the water drainage and Utah Lake's shoreline.

A full list of literature search results can be found in Appendix A. Topographic maps, General Land Office (GLO) maps from the Bureau of Land Management, and historic aerial photographs were also examined for evidence of potential cultural resources. These resources show the American Fork River, Canyon Road, and the Pleasant Grove (Main) Ditch.

V. METHODS

Aaron Woods, Principal Investigator with Horrocks Engineers, and Brianne Murdock, field archaeologist, conducted an intensive-level pedestrian inventory of the APE on June 11, 2021. Additional areas were visited in July 2021, February 2022, and March 2022. The inventory was conducted according to NRCS guidelines, and the Secretary of the Interior's *Standards and Guidelines for Archaeology and Historic Preservation* (NPS 2010). The survey was performed by evaluating exposed portions of the canals and ditches in the APE. These exposures were examined for historic features. Railroads and other previously recorded archaeological resources in the area were revisited. Aerial photographs and a GPS unit were used to confirm transects. Sites were recorded according to the UDSH guidelines. Sites were defined as areas containing a minimum of 10 artifacts within 10 meters. The Utah Professional Archaeological Council's (UPAC) *2008 Linear Sites: Guidance for Identifying and Recording under Section 106 of the National Historic Preservation Act* was also considered.

VI. RESULTS

Four project areas were evaluated for this survey These areas included Waste Ditch and Dry Creek in Lehi Utah; two irrigation ditches in Pleasant Grove, Utah; and the American Fork River channel in American Fork, Utah. A total of seven sites and two architectural resources were noted during this survey. Four sites are recommended to maintain their eligible status within these project areas. The Lehi Pioneer Cemetery, 42UT1908, and the prehistoric Lithic Scatter, 42UT592, will not be impacted by this project and no updated site forms were created due to recent site form updates. Railroad sites 42UT1029 and 42UT1101 have been previously determined eligible for the National Register of Historic Places (NRHP). Updated site forms for the segments of these sites within the project areas were created. Site 42UT1736 is a drainage ditch that in Horrocks's opinion is a segment of Waste Ditch 42UT1909 and should be considered linked. Waste Ditch, site 42UT1909, and Spring Ditch, site 42UT1725, likewise were previously recommended as not eligible for the NRHP and Horrocks concurs with those recommendations. A previously unrecorded canal, site 42UT2309 was recorded. Horrocks has recommended this canal as not eligible for the NRHP. Two architectural features were noted, both of these box culvert bridges, and were recommended not eligible to the NRHP. A summary of the results can be found in Table 3.

Table 3. Survey Results

SITE NUMBER	DESCRIPTION	ELIGIBLE	PREVIOUSLY RECORDED	IMPACTED BY PROJECT	SURVEY TYPE
42UT1029	Utah Southern/Union Pacific Railroad	Yes	Yes	No	Updated
42UT1908	Lehi Pioneer Cemetery	Yes	Yes	No	Revisited
42UT1909	Waste Ditch	No	Yes	No	Updated
42UT1101	Denver & Rio Grande Western Railroad	Yes	Yes	No	Updated
42UT592	Lithic Scatter	Yes	Yes	No	Revisited
42UT1725	Spring Ditch	No	Yes	No	Updated
42UT2309	Unnamed Ditch	No	No	No	Revisited
049001D	Box Culvert Bridge. [redacted]	No	Yes	No	Revisited
N/A	Box Culvert Bridge. [redacted]	No	No	No	Newly Recorded

Sites Revisited by this Survey- Divided by City

Lehi, Utah

42UT1029

In 2015, Horrocks updated the recording of the UPRR that was originally recorded in 1996 by Sagebrush Archaeological Consultants. Utah Southern Railroad constructed the railway between 1871 and 1879. It reached Lehi in 1872 and was later consolidated with other railways initially under Utah Central Railway. [redacted] The line is no longer in use and sustains a modest amount of overgrowth on and above the tracks. The size and dimensions maintain the same standard gauge as other locations of 4.7 feet (1.4 meters) wide (Steele 2015).

A second segment of the UPRR in American Fork was also noted by Horrocks as part of the unnamed culvert bridge [redacted] The segment had been previously recorded in 2003 by Baseline Data, Inc. as part of a 29-mile update to the railroad. The line in this segment consists of a single track and is still in use. It functions as a bridge for vehicle traffic and the railroad, as well as a concrete culvert for the American Fork River. The bridge is made of board-formed concrete and rounded rebar reinforcements, with the date 1925 stamped on the south side.

The site has been recommended eligible to the NRHP in past recordings and Horrocks concurs that this site is eligible under Criteria A and B. The railroad was associated with prominent figures in the area such as Brigham Young and was critical to the development and growth of Utah County. The setting and feeling of the site remain relatively undisturbed and the location of the site is unmoved. The design and materials used by the railroad have not been altered by modern use or improvements.



Figure 1. 42UT1029 UPRR [redacted].

42UT1908

The Lehi Pioneer Cemetery was previously recorded by Certus Environmental Solutions, SLC in 2014. [redacted] The boundary of the cemetery is marked by a maintained grassy section, however this boundary may only cover a portion of the site. There are no demarcated headstones to locate burial locations but the Daughters of the Utah Pioneers plaque on site reads that "several pioneers of this community still lie buried here." The plaque states that the cemetery was established in early 1851, shortly after the first settlement was founded in Lehi. In 1872 some of the burials were moved to a new cemetery in Lehi and additional burials were uncovered during construction-related excavations in the 1950s and 1970s (Ellis 2014).

Horrocks returned to the site and noted that an additional plaque had been added to the back of the existing marker in 2020. The new sign is in memoriam of those buried in the Lehi Pioneer Cemetery from 1851–1871, listing about 80 names and birth/death dates. [redacted]
This site was previously recommended eligible for the NRHP under Criterion A by Ellis (2014).

Horrocks concurs with the previous recommendation of eligibility as the site is associated with the earliest settlement of Lehi and perhaps is the first European-American burial in Lehi. The site was created only a few months after the Lehi settlement was established and is representative of the earliest burial practices in the community (Ellis 2014). The cemetery's setting in relation to Dry Creek and Waste Ditch is relatively undisturbed. However, the location is somewhat compromised and the current boundaries of the site may no longer be exactly over the entirety of the original grounds. The feeling of the area is somewhat preserved against the modern roads and community due to the maintenance of the park, but the design of the original site is no longer intact.



Figure 2. 42UT1908 Lehi Cemetery, [redacted]

42UT1909

It is Horrocks's opinion that there are two site numbers associated with Waste Ditch, 42UT1909 and 42UT1736. Site 42UT1736 was previously recorded by EarthTouch, Inc. in 2010 as an unspecified drainage ditch segment carrying excess water from Dry Creek to the Jordan River. Horrocks's survey relocated the drainage site and has decided that it is part of Waste Ditch and should therefore be linked to site 42UT1909, [redacted] Additionally, the nature of the canal has changed since its 2010 recording, this section of the ditch is no longer earthen but has been paved. To the east, portions of the ditch are located on private land that appear to be earthen.

42UT1909 was previously recorded by Certus Environmental Solutions, LLC in 2014, [redacted] Horrocks was able to relocate the divergence and a culvert which is still in use. [redacted] The ditch itself is about 5,058 feet (1,541 meters) long and is the last of several ditches belonging to the Lehi Irrigation Company System that pull water from their source at Dry Creek. Local newspaper articles suggest that the ditch was constructed prior to, or during 1897 and was typical of other waste ditches that carried unused portions of water allocations from their source. The divergent section of Waste Ditch is 480 feet (146 meters) long and crosses under the Union Pacific Railroad (42UT1101) and the Pioneer Cemetery (42UT1908). The concrete at the divergence appears to be replaced by modern updates except for the stepped stone divider on the Dry Creek side (Ellis 2014).

Horrocks documented the exposed portions of Waste Creek using both aerial maps of the project area and in-person survey as private property and accessibility allowed. Evidence of old concrete was found along several exposures such as board formed culverts and yellow tinted concrete. The sides of the ditch were occasionally stabilized with old sections of broken concrete while many other visible sections had been updated with modern pavement. Portions of the ditch maintain an earthen construction with stones, gravel, and soil as the main sources of material.

In Horrocks's opinion, Site 42UT1909 should be linked with 42UT1736 as they are both different linear segments of the same ditch. Waste Ditch does not qualify for recommendation for the NRHP under any criterion. Although Waste Ditch dates to the pioneer period, due to the general lack of information regarding the ditch when many local histories are available would suggest that Waste Ditch was not strongly associated with any important historical events under Criterion A. Additionally, this site is not associated with any important individuals which may have contributed to the shared history of the area under Criterion B. The lack of engineering or structural distinction of this site disqualifies it for eligibility under Criterion C, and there is low potential to produce additional data regarding agricultural practices, water utilization, or irrigation under Criterion D. The site maintains integrity of location and general setting. The materials of the ditch are widely missing, if materials are present, they are mostly broken, scattered, or repurposed, leaving little of the original design. The site is not associated with any important historical figures or events and the feeling of the ditch is often disrupted by new neighborhood developments or modern road construction.



Figure 3. 42UT1909 Waste Ditch [redacted]

42UT1101- Segments 1 and 2 in Lehi, Segment 3 in Pleasant Grove

SWCA updated site 42UT1101 in 2011 along with other segments of the Denver and Rio Grande Western Railroad. [redacted]

This particular segment [redacted] has not been previously documented. The railroad is currently in use and is still consistent in form and size as other documented sections of the Denver and Rio Grande Western Railroad, measuring 4.7 feet (1.4 meters) wide on a raised gravel berm. The section is fenced off and inaccessible with modern concrete barriers and guardrails. The original rails and ties are still intact and functional. Segment 2 [redacted] Constructed over the top of a board formed culvert, the railway is still intact in this location with the original materials and is in use. Segment 3 [redacted] is still intact and maintains the same dimensions as the other sections.

The site has been previously determined eligible for inclusion in the NRHP under Criterion A due to the railroads strong contribution to historical economic growth, settlement patterns, population increase, and community development. Horrocks concurs with this decision as the site is firmly associated with important historical events and figures. The location and general setting of the site remain unaltered. The materials of the rails themselves maintain their integrity even while the contributing features to the railroad's functionality have been updated to modern standards. The feeling and design of the site has been dramatically altered with the recent modifications and safety precautions surrounding the tracks, leaving mostly its association with historical development to speak for the sites maintained integrity.



Figure 4. 42UT1101 Segment 3 Denver and Rio Grande Western Railroad [redacted]

Saratoga Springs, Utah

42UT592

A literature review noted that there was a possibility of site 42UT592 being within the project area. This site was previously updated in 2015 by Project Engineering Consultants Ltd. (PEC). The site boundary noted on the SEGO system, and in maps provided by PEC, suggested that Dry Creek was in close proximity to site 42UT592.

During our survey, Horrocks was not able to relocate the site within the project area, and after further exploration near our project area, we were unable to relocate any elements of this site. Since this site does not appear to be situated within our project area, Horrocks did not update the site form and will not make a recommendation of eligibility or determination of effect in this report.

The Late Prehistoric site of 42UT592 was initially recorded by Brigham Young University in 1987 and then an extensive update was preformed by PEC in 2015. PEC conducted excavations near the far eastern boundary of the site, preforming two 50-cm-wide by 50-cm-long by 50-cm-deep shovel test units and eight 10 cm diameter, 125 cm deep auger test units. The test pits yielded 16 artifacts including bone fragments and lithic debitage, a ratio much lower than BYU's average of 1,680 artifacts per square meter for a total of 134,000 surface artifacts recorded.

This dramatic reduction in finds resulted in the PEC's estimation that they had found the eastern fringe of the prehistoric site. The project area that Horrocks surveyed is on the western boundary of site 42UT592 [redacted] The area was heavily impacted by the drainage of the creek and varying water levels of the lake. Much of the ground was covered with wetland vegetation, loose sandy soil, and driftwood. The area was devoid of any archeological finds on the surface suggesting that the project area is located well away from the BYU 1987 heavy concentration of artifacts.

Pleasant Grove, Utah

42UT1725

This site is a segment of Spring Ditch in the Pleasant Grove area of this project. It was originally recorded by Earth Touch, Inc. in 2010 and was most recently updated by SWCA in 2011. The ditch is typically earthen in construction but is piped below modern buildings and roads. [redacted]

The site has been previously recommended as not eligible for inclusion in the NRHP under any criteria. Horrocks agrees with the previous recommendation due to the site's inability to relate to the areas major ditch network and general lack of integrity in setting, feeling, location, and association (Kissman 2011). The site is not associated with any significant historic event under Criterion A. It has not been linked to any prominent historic figures of the area under Criterion B. The ditch is not a representation of exceptional engineering design or the work of a master under Criterion C. Additionally, the site does not have the potential to offer more information to the area's history under Criterion D.

42UT2309

This unnamed ditch was first recorded for this project. Due to design modifactions and changes in schedule, however, this status of a first recording has been modified to a site revisit. A recent cultural survey for a transportation project by the Utah Department of Transportation (UDOT) was completed in the same area. This site is also situated within the UDOT APE. Therefore, the dicsussion of this site will be treated as a revisitation and no new site form will be generated for the report since the UDOT site form has now been sent to SHPO under Utah Department of State History project number U22HX0085. This modifcation of recording status was done under the advisement of UDOT and NRCS.

This site that appears in historic aerial photographs as early as 1947. In these photographs, the canal is well established, suggesting that it was constructed earlier than 1947. It runs north to south and is likely an agricultural irrigation ditch. The northern origin point of the unnamed ditch is not known. It is typically of an earthen construction and is occasionally piped under modern buildings, parking lots, and roads. [redacted]

It flows southeast for about 485 yards (445 meters) [redacted]



Figure 5. 42UT2309 Unnamed ditch, looking north.

[redacted]

Horrocks recommends that this site be considered not eligible for the NRHP as it is not associated with any significant historical events under Criterion A, is not affiliated with any historical persons of interest under Criterion B, does not represent any masterful engineering technique under Criterion C, and likely cannot add any important data to the area's history through Criterion D. The unnamed ditch fails to relate to the area's larger irrigation network and does not impact the historical record in any significant way. The site retains only a portion of its original integrity in that the location appears to be unmoved and the setting is still somewhat earthen.

Architectural Features Noted by this Survey- American Fork, Utah

Two box culvert bridges were noted during the survey in American Fork, Utah. A total of six box culvert locations were examined as part of the evaluation in the American Fork portion of this project. Two of the box culvert bridges were determined to be built in the 1920s. Horrocks decided to create Historic Site Forms for these two features as they do not necessarily qualify for formal archaeological sites (see Appendix D).

Bridge 049001D, [redacted]

A review of the Utah Historic Bridge Inventory demonstrated that this bridge had been previously documented and issued a number, 049001D. This bridge is a continuous slab measuring 23.94 feet long and spans 9.84 feet. There are two main spans. This bridge falls within the early period of standardization within this bridge type in Utah and was built in 1925. While it serves as a bridge, it also functions as a box culvert, allowing flood and irrigation waters from the American Fork River to flow. Alterations to this culvert/bridge occurred in 1980. The original Historic Bridge Inventory for this feature determined that is was not eligible due to major alterations and it's lack of integrity. Horrocks concurs with this previous assessment.

Unnamed Bridge, [redacted]

This is a box culvert bridge for vehicles that cross the American Fork River and the Union Pacific Railroad. It is 21 feet wide [redacted] with a width of 83 feet. This box culvert bridge was built in 1925 and allows

both vehicles and trains to cross the American Fork River. This feature is made of board-formed concrete with rebar reinforcements. The rebar is rounded with no ribbing.

The internal structure of the bridge can be seen on the north side due to extreme deterioration. Aluminum and steel pipes are present which once carried water to residences or businesses. Narrow-gauge rails can also be seen as part of the bridge matrix suggesting that they may have been re-purposed to stabilize the bridge. The south side of the box culvert is stamped with the year 1925. It appears this culvert was reinforced with steel beams at one point. Records from American Fork City note that some maintenance was done to this feature in 1985.

Horrocks recommends this bridge as not eligible for the NRHP as significant alterations occurred in 1985 as well as smaller, more recent efforts to shore it up. The box culvert below this bridge is deteriorating and American Fork City



Figure 6. Detail of box culvert for Bridge 049001D, looking east.



Figure 7. Overview of the previously unrecorded box culvert bridge and the UPRR, looking northeast.

has proposed rehabilitation, alteration, or total replacement of the culvert and the bridge to accommodate flood and irrigation waters.

Isolated Occurrences - Redacted

VII. CONCLUSIONS

A total of seven sites and two architectural resources were noted during this survey. Four sites were recommended to maintain their eligible status within these project areas. The Lehi Pioneer Cemetery, 42UT1908, and the prehistoric lithic scatter, 42UT592, will not be impacted by this project and no updated site forms were created for these sites due to recent site form updates. Railroad sites 42UT1029 and 42UT1101 have been previously determined eligible for the NRHP. Updated site forms for the segments of these sites within our project areas were created. These sites will also not be impacted by this project.

Waste Ditch, 42UT1909, and Spring Ditch, 42UT1725, likewise were previously recommended as not eligible for the NRHP and Horrocks concurs with those recommendations. A previously unrecorded canal, 42UT2309, was recorded. Horrocks has recommended this canal as not eligible for the NRHP. Two architectural features were noted, both box culvert bridges, and were recommended not eligible for the NRHP.

Management Recommendations

Horrocks recommends a determination of “no adverse effect to historic properties” for the project pursuant to 36 CFR 800.5(d)(2) of the National Historic Preservation Act (NHPA). Site 42UT1908, the Lehi Pioneer Cemetery, will not be affected by the project as no improvements to Waste Ditch or Dry Creek are occurring adjacent to this site. Site 42UT1909 will not be adversely impacted since the box culverts that will be replaced date to the modern era. The segments of sites 42UT1101 (the Denver and Rio Grande Western Railroad), and 42UT1029 (the Utah Southern/ Pacific Railroad), will not be affected by the project as no widening to the canals will occur. Site 42UT1725, Spring Ditch, will not be affected by the project as the areas to be improved are culverts dating to the modern era. Site 42UT592, the lithic scatter, was not relocated by this survey and will not be affected by this project. The two historic features, the bridge box culverts, were significantly altered in the 1980s and while they maintain integrity of location, they are deteriorating quickly and do not warrant preservation in place.

Upon futher consultation with the designers and affiliated cities, the Pleasant Grove City portion of this project will not advance. Therefore, there will be no impacts to the cultural resources located in the Pleasant Grove City area. These include sites 42UT2309, 42UT1725, and the thrid segment of 42UT1101. In the event that the project design

is again altered to incorporarte the Pleasant Grove City portion, mitigation of adverse effects in this situation would be determined through consultation between the UDSH, Pleasant Grove City, the Advisory Council on Historic Preservation, the NRCS, and other designated consulting parties.

VIII. WORKS CITED

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2011 "Macrobotanical Evidence of Diet and Plant Use at Wolf Village (42UT273), Utah Valley, Utah." MA thesis. Provo: Brigham Young University.

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2010 Guidelines for Identifying Recording, and Evaluating Archaeological and Paleontological Resources. Electronic Document, chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://westdavis.udot.utah.gov/wp-content/uploads/2019/10/WDC_FEIS_16_Cultural.pdf accessed 06/10/2022.

APPENDIX A—LITERATURE SEARCH RESULTS

Table A1. Previously Filed Cultural Resource Reports

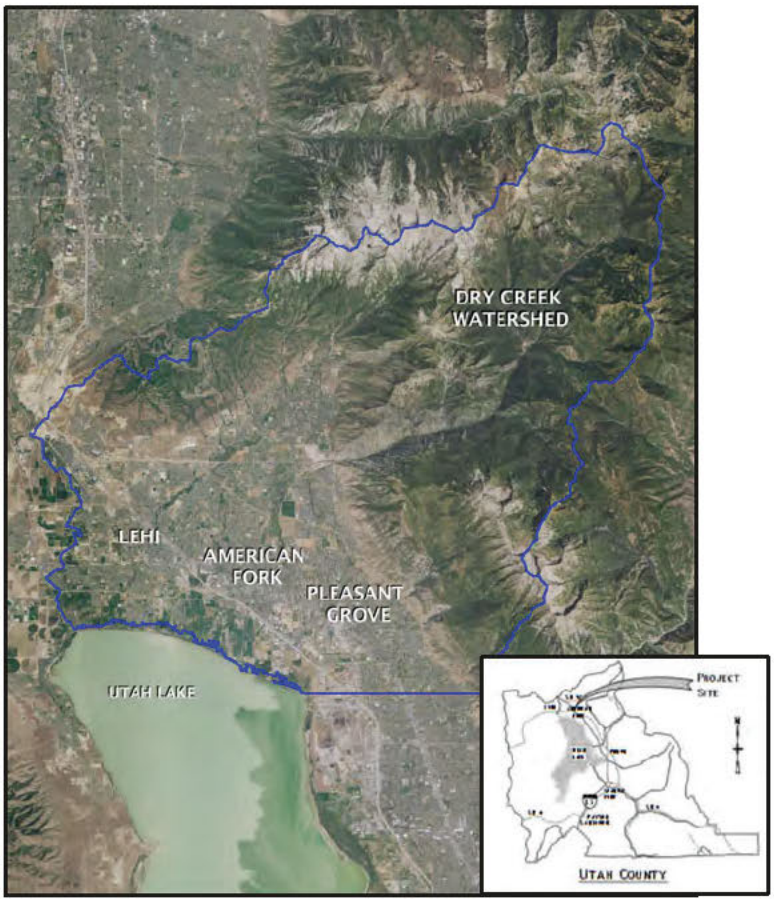
PROJECT NAME	PROJECT NUMBER	ORGANIZATION
Lehi Utah Southern Rail Trail Phase 2	U14HY1195	Certus Environmental Solutions, LLC
An intensive cultural resources inventory for the historic Southern rail trail project, Utah County, Utah	U07ST1294	SWCA
Cultural Resources Inventory Of The Proposed Spectrum Fiber-Optic Cable Corridor In Utah And Salt Lake Counties, Utah	U03BS0434	Baseline Data, Inc.
Provo To Salt Lake City Front Runner Project	U07JS0404	Jones and Stokes
A Cultural Resource Inventory of the Proposed Road Improvement Project Along 2300 West, Lehi, Utah County, Utah	U07EP0374	EarthTouch, Inc.
A Cultural Resource Investigation for Kern River Gas Transmission Company, Geneva Lateral, Utah County, Utah	U94EE0172	Harry Reid Center for Environmental Studies
A Cultural Resource Inventory Of The Creekside Farm Project, Utah County, Utah	U15SJ0849	Sagebrush Consultants
An Archaeological, Architectural, And Paleontological Assessment Of The Proposed East-West Connector Survey Area, Utah County, Utah	U07ST0680	SWCA
An Archaeological Resources Investigation Of The Saratoga Springs Utah Lakeshore Trail Project	U14ZP1310	Project Engineering Consultants Ltd.
Utah Lake Parkway	U07UI0248	URS

Table A2. Previously Recorded Sites within 1/2 Mile of the Project Area

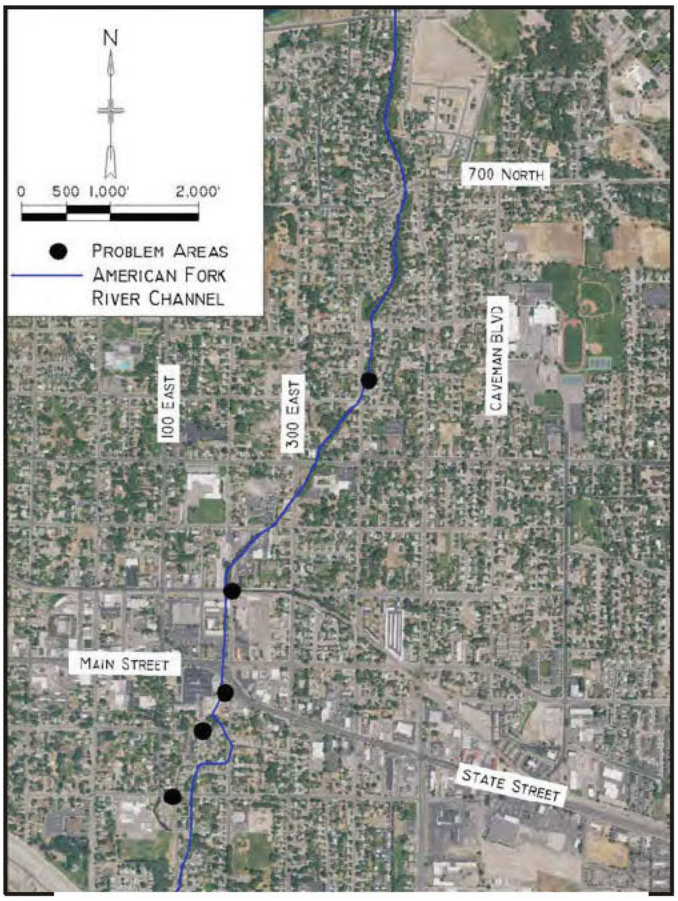
SITE NUMBER	SITE TYPE
42UT1908	Lehi Pioneer Cemetery
42UT1029	Utah Southern/Union Pacific Railroad
42UT1101	Denver & Rio Grande Western Railroad
42UT1909	Waste Ditch
42UT1725	Spring Ditch
42UT592	Late Prehistoric Lithic, Ceramic, Bone and Ground Stone Scatter

APPENDIX C—AREA OF POTENTIAL EFFECTS ON 7.5' USGS MAPS

USDA United States Department of Agriculture



Project Location Overview



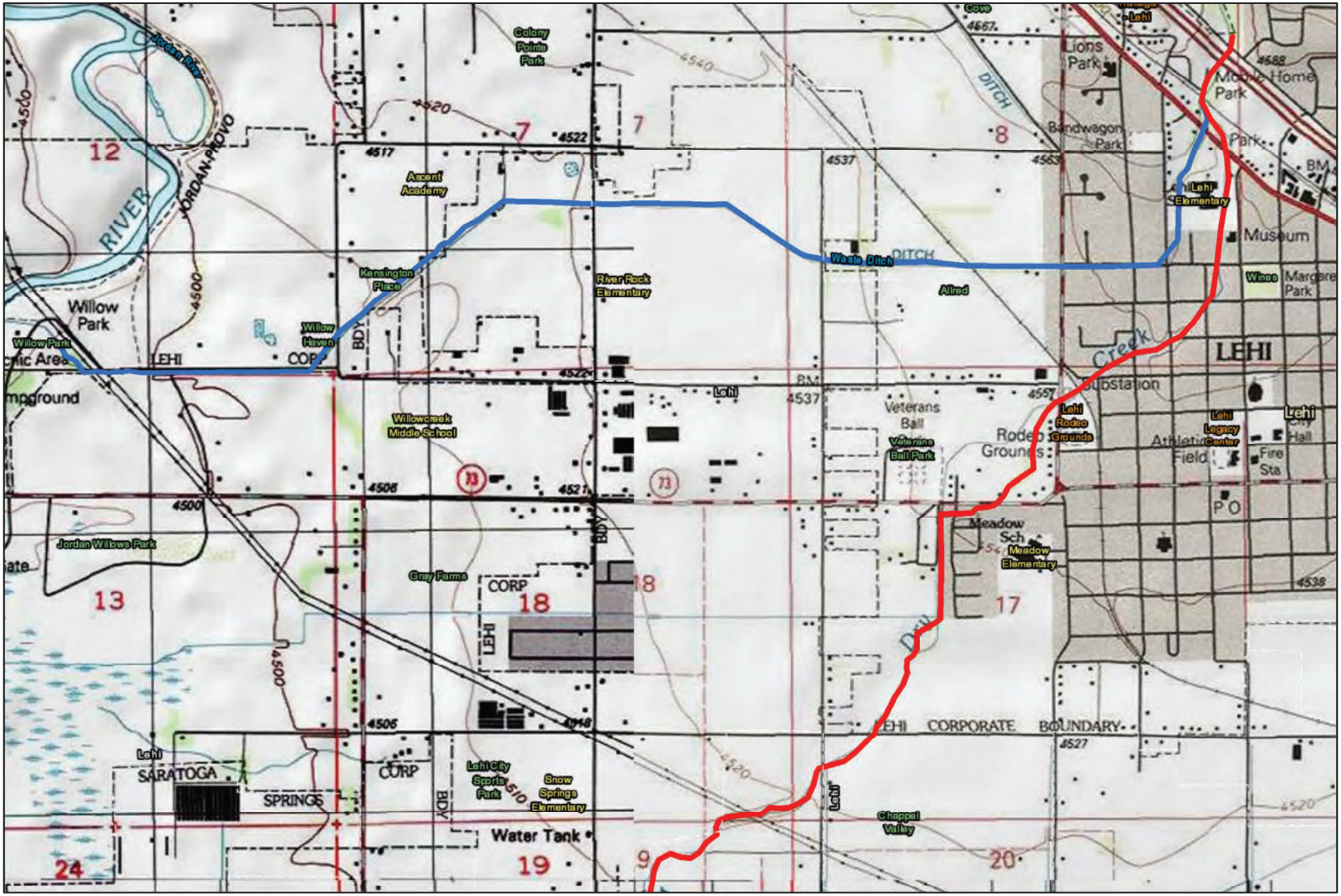
American Fork City Project



Lehi City Project



Pleasant Grove City Project



American Fork River Supplemental Watershed Plan
Archaeological Survey Results
Lehi City Project
Map 1 of 2

Saratoga Springs 1994, Jordan Narrows 1999, Lehi 1994, Pelican Point 1992, USGS 7.5' Quad 1:24,000

0 0.25 0.5
Miles

Study Area 1
Study Area 2

N



American Fork River Supplemental Watershed Plan
Archaeological Survey Results
Lehi City Project
Map 2 of 2

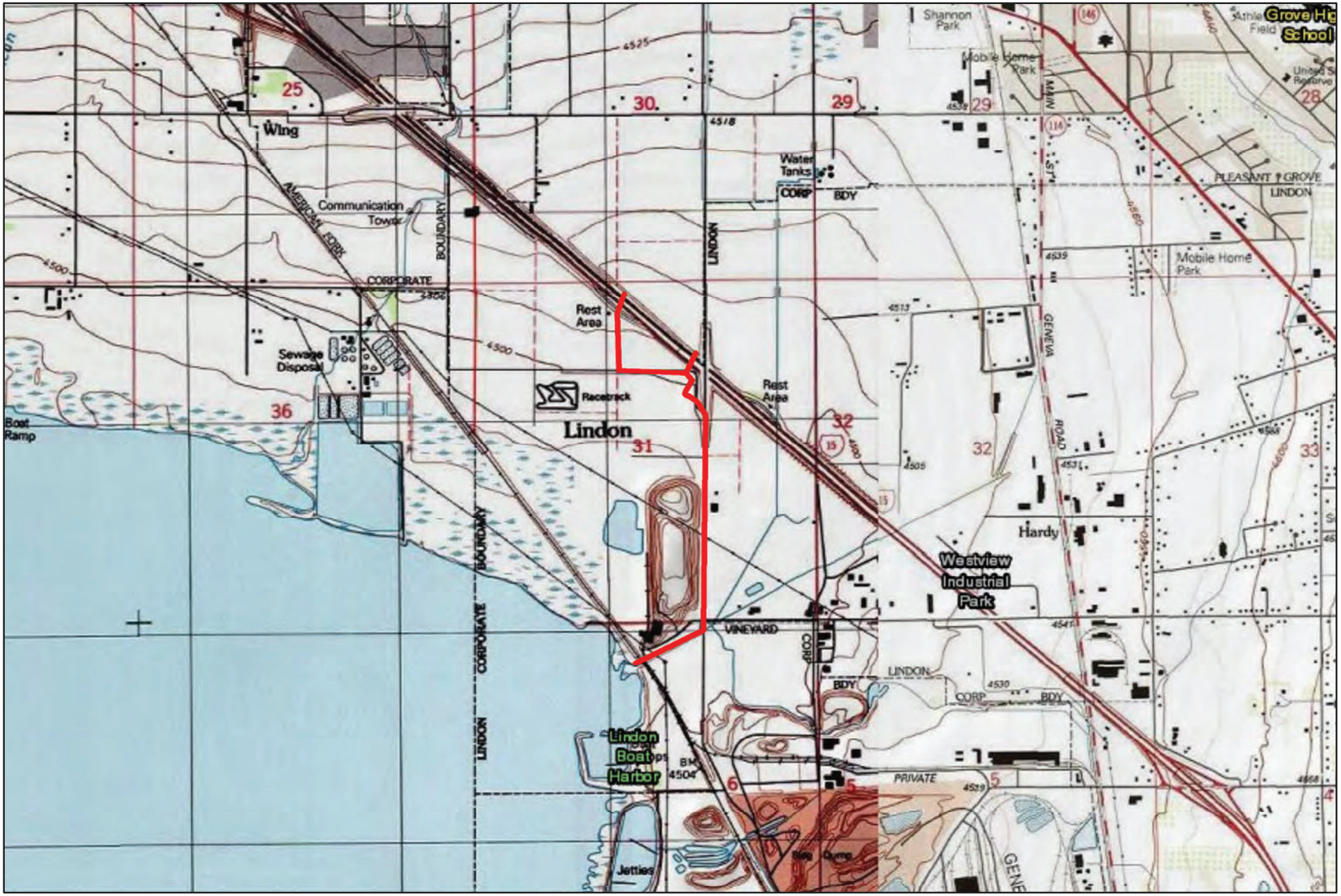
Saratoga Springs 1994, Jordan Narrows 1999, Lehi 1994, Pelican Point 1992, USGS 7.5' Quad 1:24,000

Study Area 1

N

0 0.25 0.5

Miles



American Fork River Supplemental Watershed Plan
Archaeological Survey Results
Pleasant Grove City Project

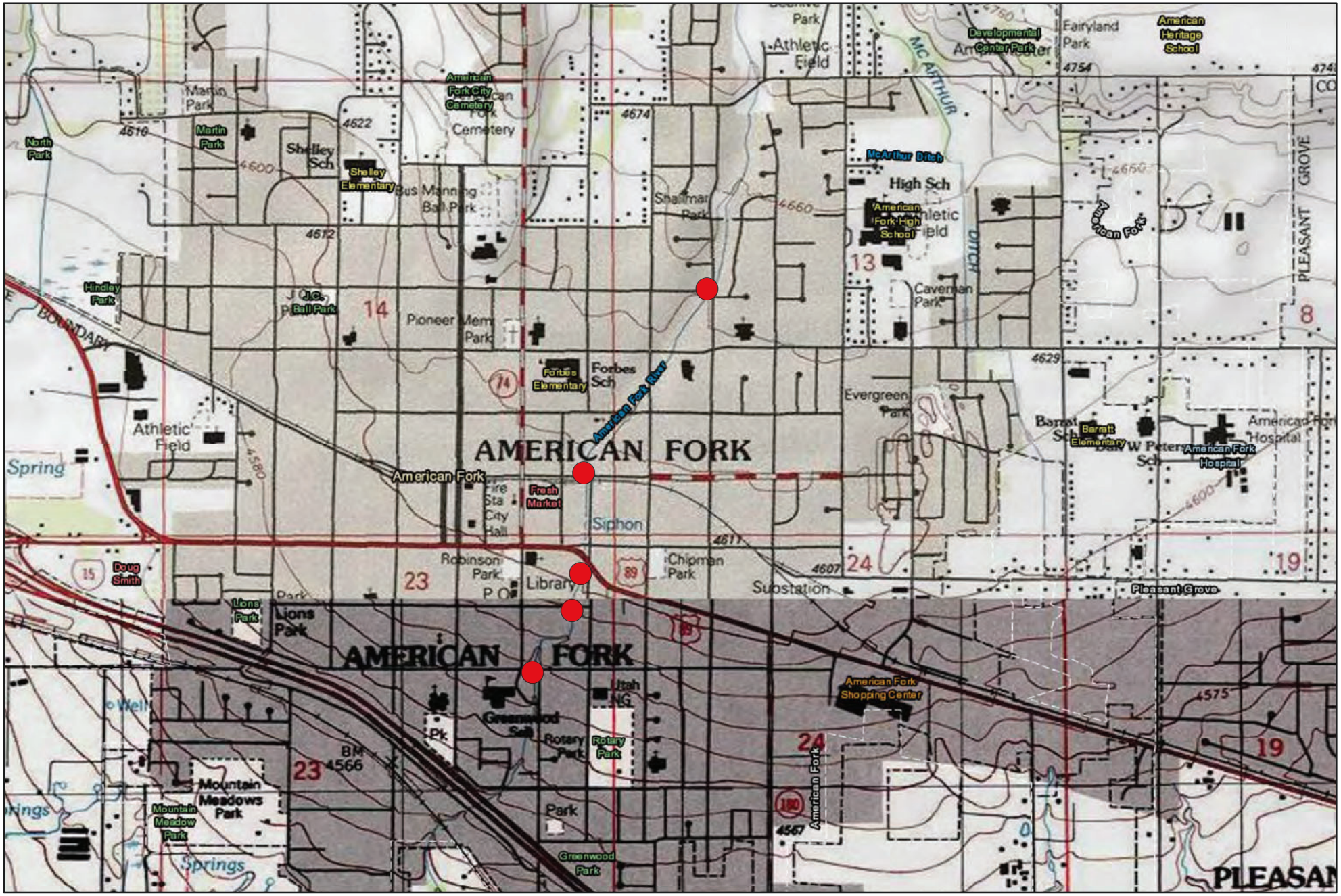
Study Area 3

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Miles

Pelican Point 1992, Orem 1994, USGS 7.5' Quad 1:24,000



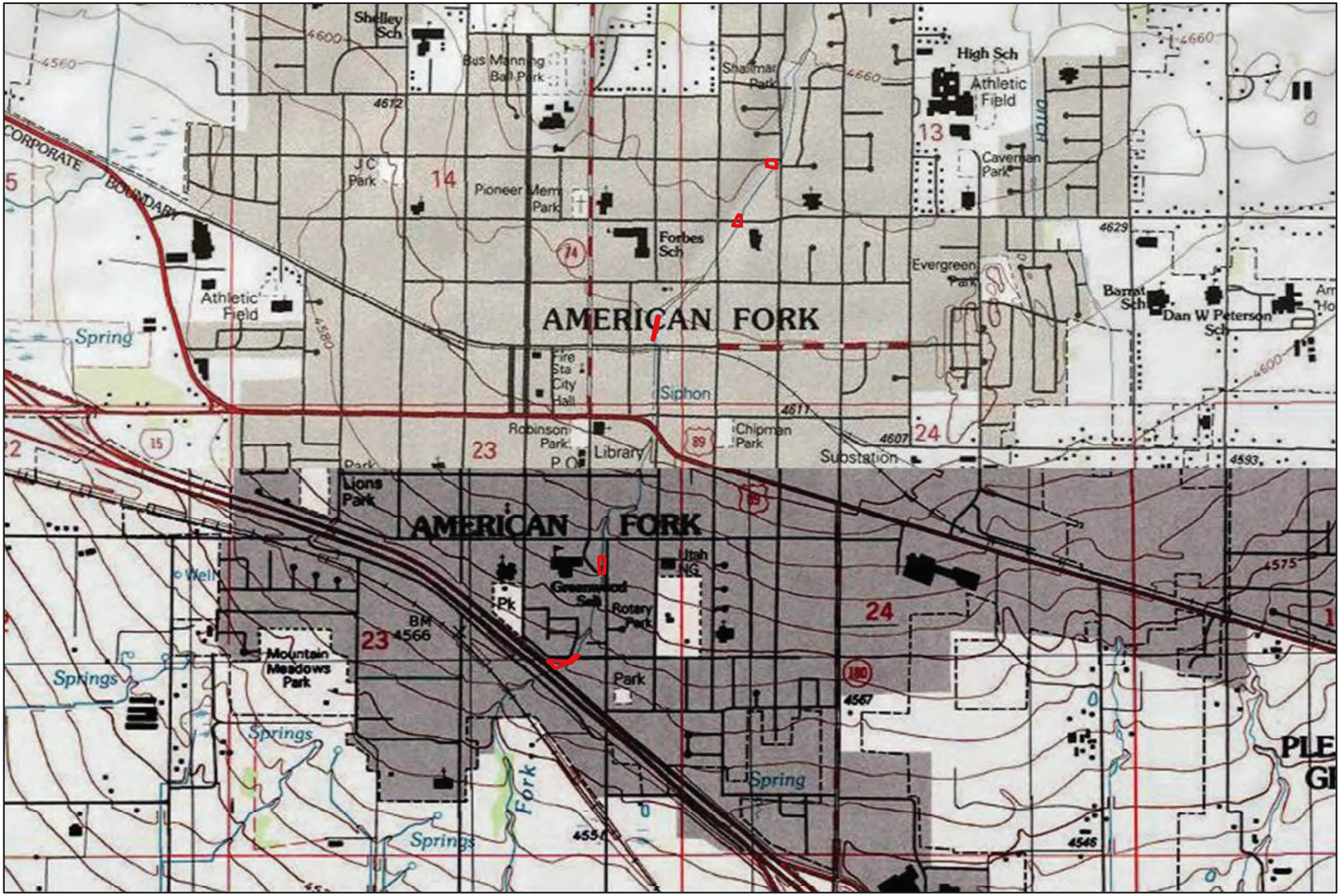
American Fork River Supplemental Watershed Plan
Archaeological Survey Results
American Fork City Project

Study Area 4

N

0 0.25 0.5
Miles

Pelican Point 1994, Lehi 1994, USGS 7.5' Quad 1:24.000



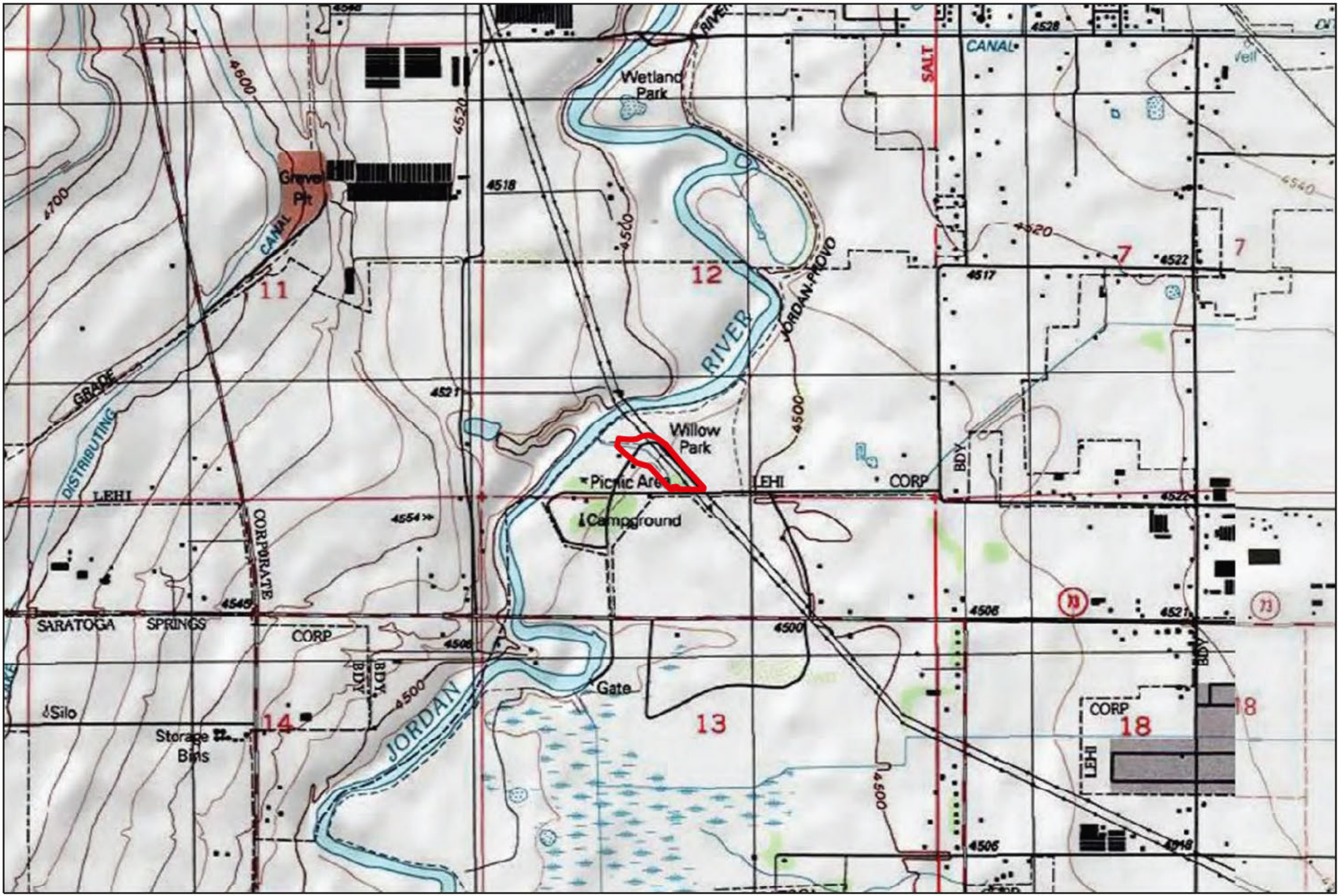
American Fork River Supplemental Watershed Plan
2022 Additional Study Areas
Staging Areas

2022 Additional Study Areas

N

0 0.25 0.5
Miles

Pelican Point 1994, Lehi 1994, USGS 7.5' Quad 1:24.000



American Fork River Supplemental Watershed Plan
2022 Additional Study Area

2022 Additional Study Areas

N

0 0.25 0.5
Miles

Jordan Narrows 1999, USGS 7.5' Quad 1:24,000

APPENDIX D—HISTORIC SITE FORM BUILDINGS FORM

HISTORIC SITE SHORT FORM

(3/12)

UTAH OFFICE OF HISTORIC PRESERVATION
For Section 106 Review Only
(Do not use this form to record archeological sites)

1 IDENTIFICATION

Name of Property: Unnamed Bridge (049001D) and Box Culvert
Address: 200 South 100 East
City, County: American Fork, Utah County

Geographical Data (optional):
Lat/Long (degr dec.): 40° 22'21.92" N; 111° 47' 43.46" W
Geographical Description: Section 23, T: 5S R: 1E

2 EVALUATION

Evaluation (select one)

☐ *The property is considered* **Eligible** *at this time because it is already listed in the National Register* **or**

- is at least 50 years old **and** retains its historic integrity (minimal alterations to key features), and has potential significance.

☑ *The property is considered* **Not Eligible** *at this time because it:*

- is less than 50 years old **or** is 50 years or older but there have been major alterations to key features, and is known to have no significance.

3 DOCUMENTATION

Required
☑ *Upload two photos*
☐ *site sketch map (optional)*
☐ *other:*

Research Sources (optional, check all sources consulted, whether useful or not)
☐ *abstract of title*
☐ *tax card & photo*
☐ *building permit*
☐ *Sanborn Maps*
☑ *other:* Utah Historic Bridge Inventory

4 ARCHITECTURAL DESCRIPTION AND HISTORY

Date of Construction: 1925
No. of Stories:
Use
Building Type: Other Type
Building Style: Bridge
Original Use: Transportation
Foundation Material: Concrete
Wall Material(s): Concrete
Current Use: Transportation
Additions: ☐ *none* ☑ *minor* ☐ *major (describe below)*
Alterations: ☐ *none* ☑ *minor* ☐ *major (describe below)*
No. of contributing outbuildings and/or structures: 0
No. of non-contributing outbuildings and/or structures: 0

Briefly describe the original building, any major additions or alterations and their dates, and associated outbuildings and structures. Also provide a brief history of the building's construction and use (if known). Use continuation sheets as necessary for additional photos and text.

This bridge is a concrete continuous slab measuring 23.94 feet long and spanning 9.84 feet. There are two main spans. A record of this bridge was found in the Utah Historic Bridge Inventory, structure number 049001D. This bridge falls within the early period of standardization within this bridge type in Utah and was built in 1925. While it serves as a bridge, it also functions as a box culvert allowing flood and irrigation waters from the American Fork River to flow. Alterations to this culvert/bridge occurred in 1980.

5 PROPOSED ACTION

Describe the impending action (e.g., road widening, rehabilitation, alteration, demolition). Use continuation sheets as necessary for additional photos and text.

The box culvert below this bridge is deteriorating and the City of American Fork has proposed rehabilitation or alteration of the culvert and the bridge to slow the deterioration of these features.

Form completed by: Aaron Woods

Date (mo/yr): 07/08/2021

6 PHOTO UPLOAD

Upload your images. Please upload a current and clear image.
If you have additional documents, such as a site sketch map or project area map, please submit those separately as a pdf.





HISTORIC SITE SHORT FORM

(3/12)

UTAH OFFICE OF HISTORIC PRESERVATION
For Section 106 Review Only
(Do not use this form to record archeological sites)

1 IDENTIFICATION

Name of Property: Unnamed rail and road bridge and box culvert
Address: 100 North 200 East
City, County: American Fork, Utah County

Geographical Data (optional):
Lat/Long (degr dec.): 40° 22' 44.47" N; 111° 47'35.94" W
Geographical Description: Section 14, T 5S R1E

2 EVALUATION

Evaluation (select one)

☐ *The property is considered* **Eligible** *at this time because it is already listed in the National Register* **or**

- is at least 50 years old **and** retains its historic integrity (minimal alterations to key features), and has potential significance.

☑ *The property is considered* **Not Eligible** *at this time because it:*

- is less than 50 years old **or** is 50 years or older but there have been major alterations to key features, and is known to have no significance.

3 DOCUMENTATION

Required
☑ *Upload two photos*
☐ *site sketch map (optional)*
☐ *other:*

Research Sources (optional, check all sources consulted, whether useful or not)
☐ *abstract of title*
☐ *tax card & photo*
☐ *building permit*
☐ *Sanborn Maps*
☑ *other:* Utah Historic Bridge Inventory

4 ARCHITECTURAL DESCRIPTION AND HISTORY

Date of Construction: 1925
No. of Stories:
Use
Building Type: Other Type
Building Style: Bridge
Original Use: Transportation
Foundation Material: Concrete
Wall Material(s): Concrete
Current Use: Transportation
Additions: ☐ *none* ☑ *minor* ☐ *major (describe below)*
Alterations: ☐ *none* ☑ *minor* ☐ *major (describe below)*
No. of contributing outbuildings and/or structures: 0
No. of non-contributing outbuildings and/or structures: 0

Briefly describe the original building, any major additions or alterations and their dates, and associated outbuildings and structures. Also provide a brief history of the building's construction and use (if known). Use continuation sheets as necessary for additional photos and text.

This is a box culvert bridge for trains and vehicles that cross American Fork Creek and the UPRR. It is 21 feet wide and spans 100 North with a width of 83 feet. This box culvert bridge was built in 1925 and allowed both vehicles and trains to cross American Fork Creek. This feature is made of board-formed concrete with rebar reinforcements. The rebar is rounded with no ribbing. The internal structure of the bridge can be seen on the north side due to extreme deterioration. Aluminum and steel pipes are present which once carried water to residences or businesses. Narrow-gauge rails can also be seen as part of the bridge matrix suggesting that they may have been re-purposed to stabilize the bridge. The south side of the box culvert is stamped with the year 1925. It appears this culvert was reinforced with steel beams at one point. Records from American Fork City note that some maintenance was done to this feature in 1985.

5 PROPOSED ACTION

Describe the impending action (e.g., road widening, rehabilitation, alteration, demolition). Use continuation sheets as necessary for additional photos and text.

The box culvert below this bridge is deteriorating and the City of American Fork has proposed rehabilitation, alteration, or total replacement of the culvert and the bridge to accommodate flood and irrigation waters.

Form completed by: Aaron Woods

Date (mo/yr): 07/08/2021

6 PHOTO UPLOAD

Upload your images. Please upload a current and clear image.
If you have additional documents, such as a site sketch map or project area map, please submit those separately as a pdf.



