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Biological Assessment

Biological Assessment for Woodruff Creek Watershed Agricultural Water Management Project

Rich County, Utah



Prepared for:

The USDA Natural Resources Conservation Service and

The Woodruff Irrigating Company

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Introduction

This Biological Assessment (BA) was developed to assess the potential impacts to biological resources from the proposed Woodruff Creek Watershed Agricultural Water Management Project (Proposed Project). This inventory and BE have been prepared on behalf of Rich County, Utah and the Woodruff Irrigating Company (WIC) for the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS). The WIC, along with co-sponsor Rich County, have received funding from the USDA-NRCS Watershed Protection and Flood Prevention Act (Public Law [PL] 83-566). The purpose of this BA is to provide technical information and to review the Proposed Project's footprint (Action Area) in sufficient detail to determine to what extent the Proposed Project may affect: federally threatened or endangered species or species proposed for listing; designated and proposed critical habitat; and State Sensitive Species under Conservation Agreements with the Federal government to reduce the potential need for listing under the Endangered Species Act (ESA). This BA serves as supporting documentation for the Watershed Plan and Environmental Assessment for the Proposed Project, and as supporting rationale for effect determinations for ESA consultation purposes. This BA is prepared in accordance with 50 CFR 402 and legal requirements found in Section 7 (a)(2) of the ESA (16 U.S.C. 1536(c)).

Proposed Project

The purpose of the Proposed Project is to provide flood damage prevention and reduction and to improve agricultural water management for Rich County residents and water users. The Proposed Project would establish flood protection, improve irrigation water delivery and efficiency, and conserve water. Project measures include improvements to the Woodruff Creek Reservoir gate; reconstructing the splitter structure on Woodruff Creek; reconstructing existing diversion structures on Woodruff Creek and Birch Creek; and installation of measurement flumes and supervisory control and data acquisition (SCADA) technologies throughout the existing irrigation system. Flood protection would be provided by the reconstruction of the primary splitter on Woodruff Creek and the diversion structures throughout the existing system, allowing for better flow control and gate actuation times during flood conditions.

The Proposed Project is needed to prevent runoff, erosion, and sediment damage in the areas downstream of the Woodruff Creek Reservoir, as well as to address water loss in WIC's irrigation canal system by conserving water lost to seepage, evaporation, and inefficient irrigation delivery systems. Currently, excessive erosion, runoff and sedimentation occur in areas downstream of Woodruff Creek Reservoir because of outdated irrigation system design. There is currently no watershed plan in place for the Woodruff Creek.

Action Area

The Action Area includes the footprint of the Proposed Project, a 50-foot construction buffer, and the potential area of impact buffers for two species. The U.S. Fish and Wildlife Service (USFWS) requires a 300-foot survey buffer for potential effects to the Ute ladies'-tresses (*Spiranthes diluvialis*) where suitable habitat may occur, and a 0.5-mile buffer for the yellow-billed cuckoo (*Coccyzus americanus*). The size of the Action Area, inclusive of all buffer areas around the footprint of the Proposed Project, is approximately 11,094 acres. The Action Area Vicinity is presented in Figure 1, and the Action Area is shown in Figure 2.

The Action Area is located in the Lower Woodruff Creek (HUC 160101010604) and the Birch Creek-Walton Canyon (HUC 160101010603) sub watersheds, in the Upper Bear River Basin area. The Action Area is bounded by the Town of Woodruff on the east, by Monte Cristo Road on the north and follows Woodruff Creek southwest to Woodruff Reservoir. A portion of the Action Area also follows Birch Creek where it meets Woodruff Creek northwest to the Birch Creek Reservoirs.

The Action Area would occur within the agricultural area just east of Woodruff, between Monte Cristo Road and Woodruff Creek, along portions of Birch Creek, and south of Woodruff (See Figure 1 and Figure 2). The Action Area is located in the following public land survey system areas:

- Township 9 North, Range 7 East, Sections 15, 16, 17, 18, and 22
- Township 9 North, Range 6 East, Sections 13, 19, 21, 22, 23, 24, 27, 28, 31, 32, and 33.

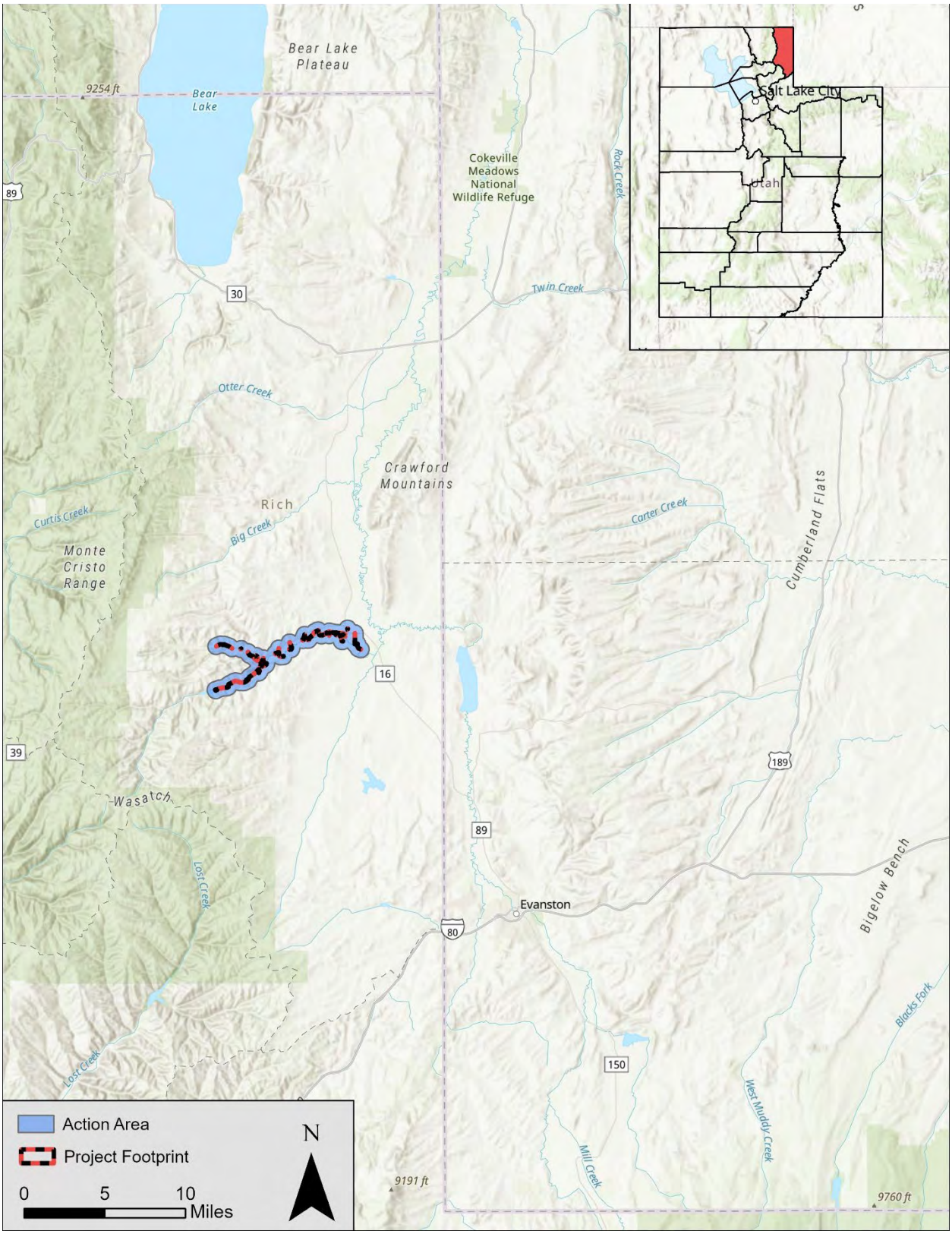


Figure 1 Action Area Vicinity Map

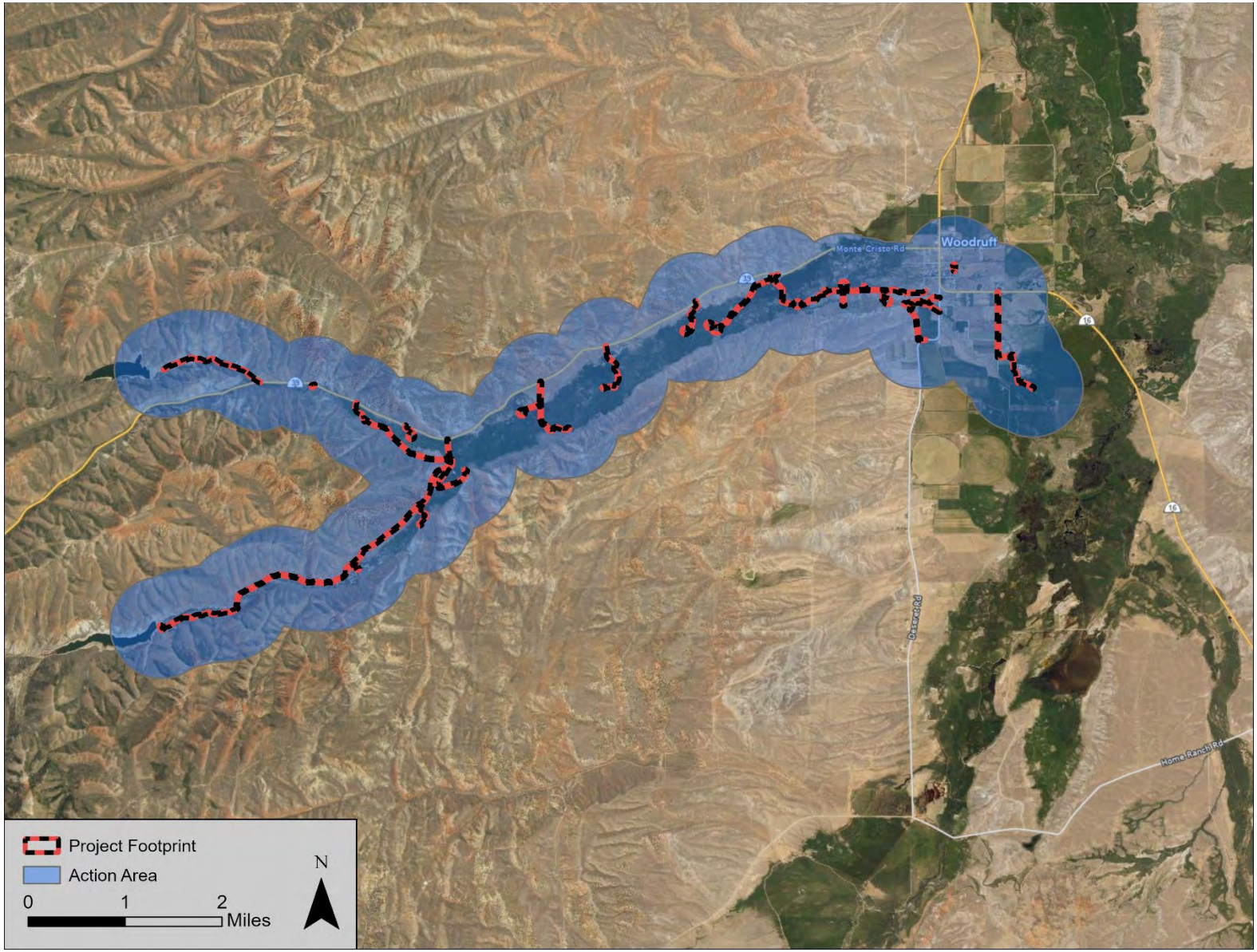


Figure 2 Action Area Map

Best Management Practices and Conservation Measures

Construction BMPs are standard requirements and a requisite for implementation of the Proposed Project. These BMPs would include, but are not limited to, soil and erosion control practices, noxious weed prevention and control, and construction timing to avoid breeding and nesting season for migratory birds.

1. Complete all work within the designated Action Area during established working hours.
2. Contain all work activities, including those within staging areas, to upland areas to minimize potential impacts to surface water quality, whenever feasible.
3. Ensure all applicable local or state water quality permits are in place, and where applicable, obtain an EPA Construction General Permit for the Proposed Project. Meet associated permit conditions during construction operations.
4. Ensure the contractor develops and follows an approved Stormwater Pollution Prevention Plan (SWPPP) and a Spill Prevention, Control and Countermeasure (SPCC) plan or other similar plan.
5. Comply with all measures in the associated SWPPP and SPCC plan when fueling, performing cleaning and maintenance, and storing or disposal of hazardous materials.
6. Comply with all measure in the associated SWPPP or similar document for implementing temporary erosion and sediment controls (TESCs), covering and storing materials, and other erosion prevention measures. Do not perform construction activities during extreme wet weather conditions, whenever practicable. If heavy precipitation is predicted to occur within 24 hours, take measures to cover up any stockpiles and check that TESCs are functioning.
7. Perform pre-construction surveys for migratory birds and raptors in all areas where vegetation removal will occur. These surveys should occur no more than 7 days before vegetation removal and disturbance. When construction activities or vegetation removal would occur during the breeding and nesting season of migratory birds (March-September) or eagles (December-August). Repeat surveys if construction and vegetation removal are paused and resumed. If an active nest is discovered within the Action Area, halt construction and/or vegetation removal and contact the appropriate regulatory agency for guidance.
8. Rehabilitate all areas of ground disturbance. Spread or grade stockpiled materials and use a native seed mix (99.9% noxious weed-free seed) approved by NRCS to reseed all areas where ground disturbance has occurred. Ensure the seed mix and plants are appropriate to the region and include milkweed species (*Asclepias sp.*) when appropriate to the site.
    a. If appropriate for the area, apply seed by hydroseeding, using a temporary erosion control mulch tackifier to provide stabilization, eliminate erosion concerns, and create vegetation recruitment opportunities.
9. Clean equipment of mud and other debris to avoid noxious weed or seed dispersal within or near the Action Area. Use pressure washing where appropriate to remove soil, plant parts, or other materials that may carry invasive and noxious weed seeds before arriving at the Action Area from a different location.

a. Ensure the contractor provides the site inspector with the opportunity to inspect the equipment before unloading at the construction site. If upon inspection, dirt, debris, and seeds are visible, ensure the contractor immediately removes the equipment from the Action Area and rewashes it. Ensure the equipment is clean by having the site inspector re-inspect the equipment.

10. Protect native site vegetation and plant communities, including wetland vegetation and milkweed, when practicable. Clearly mark, flag, or fence areas where vegetation is to be protected.

Specific conservation measures to avoid and minimize impacts to stopover and foraging habitat for the yellow-billed cuckoo and other migratory birds include the following:

11. Construction will be performed to avoid avian breeding and nesting seasons and will occur fall 2026-Spring 2028 and would occur outside the irrigation season.

12. If vegetation removal would occur during the breeding and nesting season for migratory birds, an incidental nest survey by a qualified biologist would be required prior to the removal of trees and shrubs to identify any active nests, if present, in the Action Area. Incidental nest surveys should be conducted no less than 7 days prior to vegetation removal.

Existing Conditions

Climate and Ecoregion

Elevation in the Action Area ranges from 6,329 to 6,837 feet above mean sea level (AMSL). The Woodruff climate station is the closest station near the Action Area. Natural Resources Conservation Service (NRCS) Climate Analysis for Wetland Tables (WETS) Agricultural Applied Climate Information System (AgACIS) was used for climate data for the local area. Woodruff has an average annual high temperature of 55.0° Fahrenheit (F) and an average annual low temperature of 23.0° F. The average annual precipitation is 9.43 inches of rain and 45.4 inches of snowfall. Information obtained from this WETS station indicates that 2021 had a higher-than-average amount of total precipitation at 11.58 inches (USDA-NRCS 2022).

The Action Area falls within the following ecoregions:

- Level 1 North American Deserts;
- Level 2 Cold Deserts; and,
- Level 3 the Wyoming Basin ecoregion.

Within the Wyoming Basin ecoregion, the Action Area lies in the Semiarid Bear Hills sub-ecoregion, which is characterized by rain shadow influenced precipitation patterns, unglaciated semiarid foothills, alluvial fans, hills, ridges and valleys. Rangeland is a primary land use in this region. The potential natural vegetation in this ecoregion is mapped bunchgrasses and big sagebrush (EPA 2023).

Within the Upper Bear River Watershed, half of the land is public and administered by the U.S. Forest Service (USFS) and the Bureau of Land Management (BLM). Approximately 75% of the land within the watershed is used for grazing, with other portions dedicated to small grain production and irrigated hay production. The Upper Bear River Watershed includes habitat that supports a variety of game and non-

game species, including elk, mule deer, cougars and grouse. In the headwaters of the Bear River Basin, forested areas constitute an important wildlife corridor, providing important connectivity between the Greater Yellowstone Ecosystem and the High Uintas Wilderness area.

The Woodruff Cooperative Wildlife Management Area, managed by the Utah Division of Wildlife Resources (UDWR) and the BLM, is located in the Action Area near the Birch Creek Reservoir and Woodruff Reservoir. This area is a high-desert site characterized by sage and grassland habitat. Species that occur here include sage grouse (*Centrocercus sp.*), golden eagle (*Aquila chrysaetos*), pronghorn antelope (*Antilocapra americana*), mule deer (*Odocoileus hemionus*) and elk (*Cervus canadensis*). Aquatic habitat is abundant in this watershed, however water quality degradation in tributaries of the Bear River and within the river itself have resulted in the loss of Bonneville Cutthroat Trout habitat (Bear River 2017).

Landscape Setting

Land uses in the surrounding area consist mainly of residential, agricultural, and open grazing. Within the Action Area, Birch Creek enters Woodruff Creek, which has floodplain connectivity with the Bear River and falls within the Upper Bear River Basin. Portions of Birch Creek and Woodruff Creek are characterized as lower and upper perennial stream types. Due to the muddy channel bottom of Birch and Woodruff Creeks, the soil substrate dries up when flows are diverted or controlled upstream. Short sections of canal extend from Woodruff Creek, in the downstream portion of the Action Area.

Vegetation

Vegetation present within the Action Area was typical for agricultural fields in the region, where heavy grazing occurs. Woodruff Creek and Birch Creek primarily pass through open cattle pastures. Most of the alignment, for both creeks, lacks functional midstory or overstory vegetation structure, except in some locations where willow (*Salix spp.*) is tall and particularly dense. Ruderal grasses, common non-native species and wetland species occurring in low lying pastural areas were observed during site surveys. Willow, Woods' rose (*Rosa woodsii*), and rubber rabbitbrush (*Ericameria nauseosa*) were common in the shrub layer. The canal varied in hydrology at different locations. Throughout the creek alignments, sections were dry, due to controlled flows, and sometimes lined with riprap, concrete, or other fill material. Human trash debris, such as cars, tires, and household trash, were commonly found within the Woodruff Creek and Birch Creek, usually associated with a diversion or headgate point. Bare ground is common along portions of the creeks where erosion from grazing cattle has disturbed the edges.

Surveys

Surveys of the Action Area were performed on September 15th and 16th, 2021, and October 4th, 2021. In total, 2.2 miles of lower perennial stream, 1.3 miles of upper perennial stream, 0.2 miles of intermittent stream and 2.5 miles of canal were surveyed. Dominant vegetation within the Action Area is described in Table 1. For representative photos of the Action Area, refer to the attached Photo Inventory in Appendix B.

Table 1. Dominant Vegetation Observed in the Action Area.

Common Name	**Scientific Name**
Alsike clover	*Trifolium hybridum*
Baltic rush	*Juncus balticus*

Common Name	Scientific Name
big sagebrush	*Artemisia tridentata*
bigtooth maple	*Acer grandidentatum*
bindweed	*Convolvulus arvensis*
blue wildrye	*Elymus glaucus*
Booth's willow	*Salix boothii*
boxelder maple	*Acer negundo*
bulrush	*Schoenoplectus acutus*
burdock	*Arctium minus*
Canada thistle	*Cirsium arvense*
cattail	*Typha latifolia*
common bentgrass	*Agrostis capillaris*
common spike-rush	*Eleocharis palustris*
coyote willow	*Salix exigua*
crested wheatgrass	*Agropyron cristatum*
dandelion	*Taraxacum officinale*
Fremont's cottonwood	*Populus fremontii*
fringed willowherb	*Epilobium ciliatum*
Great Basin wildrye	*Elymus cinereus*
golden currant	*Ribes aureum*
houndstongue	*Cynoglossum Officinale*
inland saltgrass	*Distichlis spicata*
longleaf aster	*Symphyotrichum ascendens*
meadow foxtail	*Alopecurus pratensis*
musk thistle	*Carduus nutans*
narrowleaf plantain	*Plantago lanceolata*
Nebraska sedge	*Carex nebrascensis*
red clover	*Trifolium pratense*
redtwig dogwood	*Cornus serecia*
reed canarygrass	*Phalaris arundinacea*
rubber rabbitbrush	*Ericameria nauseosa*
Russian olive	*Elaeagnus angustifolia*
smooth horsetail	*Equisetum laevigatum*
teasel	*Dipsacus sylvestris*
wild licorice	*Glycyrrhiza lepidota*
water sedge	*Carex aquatilis*
Wood's rose	*Rosa woodsii*
yellow sweet clover	*Melilotus officinalis*

Methodology & Agency Coordination

As part of the inventory completed for the Proposed Project, a species list from the U.S. Fish and Wildlife Service's (USFWS) Information for Planning and Consultation (IPaC) system was generated for the Proposed Project on September 13, 2021, and updated on May 5, 2025 (USFWS 2025; see USFWS IPaC Report in Appendix A). Four threatened Endangered Species Act (ESA) protected species, one ESA proposed threatened species, one ESA proposed endangered species, and fifteen Migratory Bird Treaty

Act (MBTA) protected species, including one Bald and Golden Eagle Protection Act (BGEPA) protected species, were identified by the IPaC Report.

The report did not identify any proposed or designated critical habitat or refuge lands within the Action Area. ESA-protected species that may occur in the Action Area are listed in Table 2. Desktop analyses were performed with aerial imagery and data provided by Utah Natural Heritage Program to determine the presence of state-protected species within the Action Area. Field surveys of the Action Area were conducted by a biologist from J-U-B ENGINEERS, Inc. on September 15th and 16th, 2021, and again on October 4th, 2021.

Table 2. ESA-Protected Species with the Potential to Occur in the Action Area

Common Name	Scientific Name	Critical Habitat present?	ESA Designation
Canada lynx	*Lynx canadensis*	No	Threatened
North American wolverine	*Gulo gulo luscus*	No	Threatened
yellow-billed cuckoo	*Coccyzus americanus*	No	Threatened
monarch butterfly	*Danaus plexippus*	No	Proposed Threatened
Suckley's cuckoo bumble bee	*Bombus suckleyi*	No	Proposed Endangered
Ute ladies'-tresses	*Spiranthes diluvialis*	No	Threatened

Species Descriptions and Determinations

Canada Lynx

The Canada lynx is a medium-sized cat that has long legs, large paws, tufted ears and a short, black-tipped tail. The Canada lynx was listed as threatened by USFWS on March 24, 2000. This cat species is widely distributed across the U.S. and Canada, and is strongly associated with moist, cool, boreal spruce-fir forests, where its primary prey, the snowshoe hare (*Lepus americanus*), is also found. The Canada lynx is a snowshoe hare obligate, meaning that snowshoe hare populations drive Canada lynx populations. Snowshoe hares commonly occupy higher-elevation, coniferous forests. Populations of the Canada lynx usually occur where annual continuous snow cover persists four months or longer (USFWS 2021a). In Utah, montane coniferous forest is the primary habitat for this species. Lack of evidence of breeding populations of Canada lynx in Utah suggest a decline in any present populations. The latest records of the Canada lynx occurring within the Uinta Mountains date back to 1982 (UDWR 2019). The primary concern for populations of Canada lynx is habitat loss and fragmentation, including snowshoe hare habitat loss and population decline.

Direct and Indirect Effects

Dense, coniferous montane forest habitat is not abundant within or near the Action Area. The elevation, shrub vegetation types, and the agricultural nature of the Action Area do not equate to suitable or high-quality habitat for the snowshoe hare or the Canada lynx. While much of northern and central Utah is considered potential Canada lynx habitat by USFWS, no documented occurrences of the Canada lynx in Rich County occur. Because no suitable snowshoe hare or Canada lynx habitat occurs in the Action Area,

and there are no known occurrences of these species within the Action Area, the Proposed Project will have **No Effect** on the Canada lynx or its habitat.

North American Wolverine

The North American wolverine was listed as threatened by the ESA on January 2, 2024. The North American wolverine is the largest terrestrial member of the weasel family. They are opportunistic feeders, primarily scavenging carrion, but also feed on small animals, birds, fruits, berries, and insects. Persistent spring snowpack levels are the strongest indicator of suitable habitat for the North American wolverine. They require a minimum snowpack depth of 60 inches lasting until April-May for successful denning (USFWS 2024a). In southern portions of the species' range in the U.S., where ambient temperatures are warmest, wolverine distribution is restricted to high elevations. The primary threat to the North American wolverine is from habitat and range loss due to development and climate change. Climate changes are predicted to reduce wolverine habitat and range by 23 percent over the next 30 years and 63 percent over the next 75 years (USFWS 2024a).

Direct and Indirect Effects

The average annual snowfall that occurs within the project area is approximately 45.4 inches and does not persist late into the year, which is less than what is required by the wolverine for suitable denning habitat. Additionally, human activity is common throughout the Action Area. Because there is no suitable denning habitat within the Action Area and there is high disturbance as a result of human activity, the Proposed Project will result in **No Efffect** to the North American wolverine.

Yellow-billed Cuckoo

The yellow-billed cuckoo (YBCU) was listed as threatened by the USFWS on November 3, 2014. Yellow-billed cuckoos are considered a riparian obligate and are usually found in large tracts of cottonwood/willow habitat with dense sub-canopies (below 33 feet). In Utah, the YBCU is dependent on large areas of woody, riparian vegetation that combine a dense shrubby understory for nesting and a cottonwood overstory for foraging. Suitable breeding and nesting habitat for the species must be at least 300-feet-wide and a minimum of 12 contiguous acres (USFWS 2021b).

In May of 2021, the USFWS updated the designation of 298,845 acres of critical habitat for the YBCU western distinct population segment (DPS) in Arizona, California, Colorado, Idaho, New Mexico, Texas, Utah, and Wyoming (86 CFR 20798). The USFWS IPaC Report did not identify any proposed or designated final critical habitat for the species in the Action Area. Primary threats to the YBCU include conversion of riparian habitat to agriculture and other uses, dam construction, stream channelization and stabilization and livestock grazing (USFWS 2017).

Direct and Indirect Effects

An incidental nesting and bird survey for raptors and migratory birds, including YBCU, was performed within the Action Area, however these were conducted outside of the typical YBCU breeding and nesting period. A habitat suitability assessment for YBCU within the Action Area was completed, which included a 0.5-mile buffer around the Action Area and utilized available aerial imagery and local regional data for a desktop analysis.

Across the Action Area, no location supported a riparian corridor with the appropriate vegetation cover, vegetation stratification, and acreage to constitute suitable habitat for the YBCU. Riparian fringe along

Birch and Woodruff Creeks ranged from 0 feet to 300 feet wide, often interrupted by pasture areas, on both sides of the creek corridors. Approximately 2,291 acres of riparian vegetation occurs within the Action Area, however this habitat is fragmented because agricultural areas dominate the landscape and infringe on riparian corridors. Additionally, no functional overstory is present in these riparian zones, and a functional midstory, comprised mostly of willow, is intermittent along Birch and Woodruff Creeks. Given the lack of suitable habitat for the species and the proposed timing of construction to be outside bird breeding and nesting season, the Proposed Project would result in **No Effect** to the YBCU.

Monarch Butterfly

The monarch butterfly was proposed for listing as a threatened species under the ESA on December 12, 2024. The monarch butterfly is a species of butterfly in the order Lepidoptera (family *Nymphalidae*) that occurs in North, Central, and South America; Australia; New Zealand; islands of the Pacific and Caribbean, and elsewhere (USFWS 2020). Monarchs lay their eggs on the leaves of an obligate host plant, milkweed (*Asclepias spp.*), and forage on milkweed and other nectar plants. This butterfly species migrates each year; individuals in eastern North America fly south or southwest to overwinter in central Mexico, while western North American monarchs fly south and west to overwinter on the California coast and in Baja California (USFWS 2020). Habitat loss, fragmentation and pesticide use are the biggest threats to the population success of the monarch butterfly.

Direct and Indirect Effects

No monarch butterfly or potential habitat (milkweed plants) were observed during surveys. BMPs and conservation measures would reduce impacts to native vegetation, including waterways, wetland and riparian habitats, where milkweed is often found. Disturbed areas within riparian zones and wetland areas will be revegetated with native plants. Given the absence of suitable breeding habitat, the Proposed Project would have **No Effect** to monarch butterfly.

Suckley's Cuckoo Bumble Bee

The Suckley's cuckoo bumble bee was proposed as an endangered species under the ESA on December 17th, 2024. Bumble bees require below-ground micro-sites for overwintering and nesting, including logs, stumps, and abandoned rodent and ground-nesting bird nests. This species is a parasitic bee that is confirmed to usurp nests of Western bumble bees (*Bombus occidentalis*) and Nevada bumble bees (*Bombus nevadensis*), and other potential hosts occur in subgenus *Bombus*. This species has been found in a variety of habitat types including prairies, grasslands, meadows, woodlands, and agricultural and urban areas. The Suckley's cuckoo bumble bee has been sampled in different habitats across various elevations, ranging from 6 feet to 10,500 feet AMSL. This species faces a population decline due to climate change, which affects their host species by changing temperatures that create unsuitable conditions for bees to complete their lifecycles (USFWS 2024b).

Direct and Indirect Effects

Potential habitat for Suckley's bumble bee occurs within the Action Area. BMPs such as site revegetation with native plants and pollinator species and protecting native vegetation to the maximum extent practicable would reduce impacts to vegetation, and therefore reduce potential impacts to the bumble bee, during construction. Therefore, the Proposed Project will have **No Effect** to the Suckley's cuckoo bumble bee.

Ute Ladies'-tresses

Ute ladies'-tresses (ULT) was listed as threatened by the USFWS on January 17, 1992. No critical habitat has been proposed or designated for the ULTs. The ULT is a perennial, terrestrial herb that is a member of *Orchidaceae*, the orchid plant family. This tall (8-20 inches) orchid species blooms between late July and late August between 720 ft and 7,000 feet AMSL. The current known distribution of ULT extends from the eastern slope of the Rocky Mountains in southeastern Wyoming to the eastern Great Basin area, and can be found in Colorado, Utah, Idaho, Montana and Washington and far eastern Nevada (USFWS 2021d).

ULT occurs in riparian areas, usually along edges of stabilized perennial streams and high flow channels, and gravel bars. It can also occur in wet meadows, stable wetlands and seepy areas, especially in historical or active floodplain landscapes, or near freshwater lakes or streams. ULT requires open habitat and is not tolerant of standing water, or of competition with aggressive plant species (NRCS 2009). The preferred soil type for ULT includes gravely, cobbly alluvial soils and substrates Threats to ULT include loss of riparian and wetland habitat resulting from urban development, flooding and de-watering of habitat from dam control and stream channel re-routing for agricultural development (USFWS 2021d).

Direct and Indirect Effects

Field surveys for ULT habitat suitability occurred during the growing period but outside of the blooming period for the ULT, in September 2021. Throughout the Action Area along Birch Creek, Woodruff Creek, and surrounding pastures, habitat suitability assessments were performed and zero vegetative or blooming ULTs were observed. See the attached ULT Memo in Appendix C.

Within pasture lands and along Birch Creek, Woodruff Creek and the canals, streamside areas exist. However, the streambanks and canal edges commonly exhibit steep, barren and eroded slopes, due to the presence of cattle. Elsewhere, the slopes are densely vegetated and there is competition from dense, tall-growing species along open water edges including reed canarygrass (*Phalaris arundinacea*), common teasel (*Dipsacus sylvestris*), cattail (*Typha sp*.) and timothy grass (*Phleum pratense*). No creek edge habitat was observed to be suitable for ULTs.

Soils across the Action Area, including on the banks of the creeks, are primarily loam and silty loam and are absent of gravel or cobble substrate. As a result, the soil type and vegetation composition are not suitable for ULT growth and persistence, even where hydrology may be suitable within or along the creeks or irrigation ditches.

Overwhelmingly, Birch Creek, Woodruff Creek and canals in the Action Area are highly disturbed and modified. Sections of the creeks were lined with riprap, scrap metal or household trash to create diversion or headgate structures, and some areas were dry at the time of field surveys, removing the possibility of suitable hydrological conditions to support ULTs. Signs of bank erosion caused by cattle grazing is widespread.

Hydric conditions suitable for ULT were not observed within pastures in the Action Area. In the pastures that were surveyed in September 2021, vegetation was dominated by tall aggressive species including bentgrass (*Agrostis spp.*), timothy grass, and reed canarygrass. Almost all of these locations are actively grazed, decreasing vegetative competition, but increasing the risk of trampling by livestock.

The competition from aggressive plant species, incompatible soil conditions, and disturbance from cattle herbivory and trampling create unsuitable habitat conditions for ULTs within the Action Area. There are no records of ULTs occurring within Rich County, nor within the Action Area. Based on this information and the habitat suitability assessments, which found unsuitable growing conditions and no vegetative ULTs, the Proposed Project will have **No Effect** on ULT individuals or suitable habitat.

Migratory Birds

The IPaC Report identified fifteen avian species protected under the Migratory Bird Treaty Act (MBTA) and/or the Bald and Golden Eagle Protection Act (BGEPA) as potentially occurring within the Action Area (Table 3). The bald eagle (*Haliaeetus leucocephalus*) and the golden eagle (*Aquila chrysaetos*) are included in the MBTA and BGEPA species list. Table 3 lists the fifteen MBTA-protected avian species that may occur within the Action Area and the presence or absence of habitat for each avian species within the Action Area.

Incidental survey for presence of nests and active nests for the fifteen migratory bird species listed in the USFWS IPaC report occurred on September 15 and 16, 2021 and was updated on May 5, 2025. No individuals from the USFWS IPaC MBTA bird species list were observed. No nests or breeding behavior in any avian species were observed during the survey. Table 3 details the type and absence or presence of habitat for each species within the Action Area.

Table 3. MBTA Protected Species Identified by USFWS. [1]

Common Name	Scientific Name	Breeding Season	Preferred Habitat[1]	Habitat Present within the Action Area
bald eagle*	*Haliaeetus leucocephalus*	Jan 1 – Aug 31	Forested areas; High nest sites near open bodies of water.	No
black tern	*Chlidonias niger*	May 15 – Aug 20	Large marsh areas (greater than 50 acres); will utilize wetland areas for stopover habitat.	No
bobolink	*Dolichonyx oryzivorus*	May 20 – Jul 31	Ground nesting species that prefer grassland habitats, such as large fields with grasses and broad-leafed plants, including meadows and agricultural fields like hayfields.	No
broad-tailed hummingbird	*Selasphorus platycercus*	May 25 – Aug 25	Open forest, including pine-oak and pinyon-juniper woods and near streams. Nests in a tree, typically sheltered by an overhanging branch from above.	No
California gull	*Larus californicus*	Mar 1 – Jul 31	Isolated islands surrounded by water, with open habitats that are not heavily vegetated; Will forage up to 40 miles from breeding colonies.	No
Cassin's finch	*Carpodacus cassinii*	May 15 – Jul 15	Mature pine forests and mixed evergreen forests; will sometimes breed in open sagebrush or juniper shrubland	No
Clark's grebe	*Aechmophorus clarkii*	Jun 1 – Aug 31	Ground nesting species that prefers semi-open woodlands, wet meadows, grasslands and prairies near freshwater lakes or marshes	No
evening grosbeak	*Coccothraustes vespertinus*	May 15 – Aug 10	A variety of coniferous forests composed of mature or second growth trees in northern North America and the Rocky Mountains.	No
Franklin’s gull	*Leucophaeus*	May 1 – Jul 31	Large freshwater marsh areas with abundant vegetation and patchy open water.	No
golden eagle*	*Aquila chrysaetos*	Jan 1 – Aug 31	Open and partly open habitats in mountain areas, including cliffs, bluffs, or steep slopes adjacent to grassland, shrubland and forested areas.	No
olive-sided flycatcher	*Contopus cooperi*	May 20 – Aug 31	Western coniferous forests and boreal forests in the Rocky Mountains; will utilize openings or	No

[1] *Sources for Table 3 are Cornell 2025a – Cornell 2025n.*

Common Name	Scientific Name	Breeding Season	Preferred Habitat[1]	Habitat Present within the Action Area
			edges in the forest, rather than closed forest environment.	
pinyon jay	*Gymnorhinus cyanocephalus*	Feb 15 – Jul 15	Open habitats including sagebrush, scrub-oak, chaparral, pinyon-juniper woodlands, and ponderosa pine forests.	No
Western grebe	*Aechmophorus occidentalis*	Jun 1 – Aug 31	Large freshwater lake and marsh areas, with reeds and rushes around the edges.	No
willet	*Tringa semipalmata*	Apr 20 – Aug 5	Ground nesting in semi-open woodlands, wet meadows, grasslands and prairies near freshwater lakes or marshes	No
Williamson's sapsucker	*Sphyrapicus thyroideus nataliae*	May 1 – Jul 31	Nests in coniferous and mixed conifer-deciduous forests including spruce, fir, and lodgepole pine.	No

*This species also protected under the BGEPA.

Temporal avoidance of nesting bird season is planned as part of the Proposed Project schedule, which will occur over winter months between 2026 and 2028 Given the absence of shrub and tree cover within the Action Area, the high level of existing disturbance in the Action Area, as well as the plans for construction to be performed outside of the breeding season for ground-nesting species (April-August), the Proposed Project is anticipated to have no impact on migratory birds, eagles, or raptors. If any part of the Proposed Project work cannot be scheduled outside of nesting season, an incidental nesting bird survey will be required to occur no less than 7 days prior to the commencement of construction activities, including ground disturbance and vegetation removal. If an active, occupied nest were identified within the Action Area, the NRCS Biologist and/or USFWS would be notified to discuss the appropriate course of action.

Conclusion

After considering the available scientific information regarding the biological requirements and the status of ESA-listed species considered in this BA, the environmental baseline for the Action Area, and the potential effects of the Proposed Project, the following effect determinations for the Canada lynx, North American wolverine, yellow-billed cuckoo, monarch butterfly, Suckley's cuckoo bumble bee and the Ute ladies'-tresses are shown in Table 4 below.

Table 4 Summary of Effect Determinations for ESA Species Evaluated in this BA.

Common Name	**Scientific Name**	**ESA Designation**	**Determination**
Canada lynx	*Lynx canadensis*	Threatened	No Effect
North American wolverine	*Gulo gulo luscus*	Threatened	No Effect
yellow-billed cuckoo	*Coccyzus americanus*	Threatened	No Effect
monarch butterfly	*Danaus plexippus*	Proposed Threatened	No Effect
Suckley's cuckoo bumble bee	*Bombus suckleyi*	Proposed Endangered	No Effect
Ute ladies'-tresses	*Spiranthes diluvialis*	Threatened	No Effect

If additional species are listed or proposed, or if critical habitat is designated prior to completion of construction, and the species or designated habitat occur within the Action Area, or may be affected by the Proposed Project, construction would be paused, and a species evaluation would be prepared. Species for which a no effect determination has been previously prepared would not be readdressed. It should be noted that the final authority with regard to effect determinations rests with the appropriate regulatory agency.

References

Bear River Watershed Information System (Bear River). 2017. Upper Bear. Accessed April 5, 2022. https://bearriverinfo.org/watershed-description/upper-bear/index.

The Cornell Lab (Cornell). 2025a. Black Tern: Life History. Accessed February 10, 2025. https://www.allaboutbirds.org/guide/Black_Tern/lifehistory.

Cornell. 2025b. Bobolink: Life History. Accessed February 10, 2025. https://www.allaboutbirds.org/guide/Bobolink/lifehistory.

Cornell. 2025c. Broad-tailed hummingbird: Life History. Accessed February 10, 2025. https://www.allaboutbirds.org/guide/Broad-tailed_Hummingbird/lifehistory.

Cornell. 2025d. California gull. Accessed February 10, 2025. https://www.allaboutbirds.org/guide/California_Gull/lifehistory.

Cornell. 2025e. Cassin's Finch: Life History. Accessed February 10, 2025. https://www.allaboutbirds.org/guide/Cassins_Finch/lifehistory.

Cornell. 2025f. Clark's Grebe: Life History. Accessed February 10, 2025. https://www.allaboutbirds.org/guide/Clarks_Grebe/lifehistory.

Cornell. 2025g. Evening grosbeak: Life History. Accessed February 10, 2025. https://www.allaboutbirds.org/guide/Evening_Grosbeak/lifehistory.

Cornell. 2025h. Franklin's gull: Life History. Accessed February 10, 2025. https://www.allaboutbirds.org/guide/Franklins_Gull/lifehistory.

Cornell. 2025i. Golden eagle: Life History. Accessed February 10, 2025. https://www.allaboutbirds.org/guide/Golden_Eagle/lifehistory.

Cornell. 2025j. Olive-sided Flycatcher: Life History. Accessed February 10, 2025. https://www.allaboutbirds.org/guide/Olive-sided_Flycatcher/lifehistory.

Cornell. 2025k. Pinyon Jay: Life History. Accessed February 10, 2025. https://www.allaboutbirds.org/guide/Pinyon_Jay/lifehistory.

Cornell. 2025l. Western Grebe: Life History. Accessed February 10, 2025. https://www.allaboutbirds.org/guide/Western_Grebe/lifehistory.

Cornell. 2025m. Willet: Life History. Accessed February 10, 2025. https://www.allaboutbirds.org/guide/Willet/lifehistory.

Cornell. 2025n. Williamson's sapsucker: Life History. Accessed February 10, 2025. https://www.allaboutbirds.org/guide/Williamsons_Sapsucker/lifehistory.

86 FR 20798 (Federal Register). 2021. Department of the Interior, Fish and Wildlife Service. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Western Distinct Population Segment of the Yellow-Billed Cuckoo.

U.S. Department of Agriculture-Natural Resources Conservation Service (USDA-NRCS). 2022. Woodruff, UT. AgAcis for Cache County. *WETS Table.* Accessed February 24, 2022. agacis.rcc-acis.org/?fips=49033.

Utah Division of Wildlife Resources (UDWR). 2019. Accessed March 10, 2022. https://fieldguide.wildlife.utah.gov/?species=lynx%20canadensis.

U.S. Environmental Protection Agency (EPA). 2023. Ecoregion Download Files by State – Region 8. Accessed May 2, 2023. https://www.epa.gov/eco-research/ecoregion-download-files-state-region-8.

U.S. Department of Agriculture Natural Resources Conservation Service (NRCS). 2009. Ute Ladies' Tresses (*Spiranthes diluvialis*). Accessed December 10, 2021. https://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/idpmcpg9318.pdf.

U.S. Environmental Protection Agency (EPA). 2021. Ecoregion Download Files by State - Region 8. Accessed December 10, 2021. https://www.epa.gov/eco-research/ecoregion-download-files-state-region-8.

U.S. Fish and Wildlife Service (USFWS). 2020. Monarch (Danaus plexippus) Species Status Assessment Report, version 2.1. Accessed September 14, 2021. https://www.fws.gov/savethemonarch/pdfs/Monarch-SSA-report.pdf.

USFWS. 2021a. Environmental Conservation Online System (ECOS). Species Profile: Canada lynx (*Lynx canadensis*). Accessed June 11, 2021. https://www.fws.gov/mountain-prairie/es/canadaLynx.php.

USFWS. 2021b. Wyoming Ecological Services Office: Yellow-billed Cuckoo (*Coccyzus americanus*). Accessed December 9, 2021. https://www.fws.gov/wyominges/Species/YellCuko.php.

USFWS. 2021c. Monarch Butterfly. Accessed November 4, 2021. https://www.fws.gov/savethemonarch/.

USFWS 2021d. Environmental Conservation Online System (ECOS). Species Profile: Ute ladies'-tresses (*Spiranthes diluvialis*). Accessed June 21, 2021. https://ecos.fws.gov/ecp0/profile/speciesProfile?sId=2159.

USFWS. 2021e. ECOS. Species Profile: Bald eagle. Accessed June 11, 2021. https://ecos.fws.gov/ecp0/profile/speciesProfile?spcode=B008#lifeHistory.

USFWS. 2022. ECOS. Golden eagle (*Aquila chrysaetos*). Accessed March 20, 2022. https://ecos.fws.gov/ecp/species/1680.

USFWS. 2024a. North American wolverine (Gulo gulo luscus). Accessed February 7, 2025. https://ecos.fws.gov/ecp/species/5123.

USFWS. 2024b. Special status assessment report for the Suckley's Cuckoo Bumble Bee (*Bombus suckleyi*), Version 1.0. August 2024. Alaska Region. 131 pp. Accessed February 7, 2025. https://iris.fws.gov/APPS/ServCat/DownloadFile/263505.

USFWS. 2025. Information for Planning and Consultation (IPaC) Species List. Generated May 5, 2025. https://ipac.ecosphere.fws.gov/.

U.S. Natural Resources Conservation Service (NRCS). 2022. *Web Soil Survey*. Custom Soil Resource Report for Rich County, Utah. *Woodruff Survey Area*. Generated February 24, 2022. Retrieved from Soils Report: https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx.

Utah Division of Wildlife Resources (Utah DNR) 2020. Western Yellow-billed Cuckoo (*Coccyzus americanus occidentalis*). Accessed December 10, 2021. https://wildlife.utah.gov/pdf/sensitive_species/birds_western_yellowbilled_cuckoo_2020.pdf.

World Wildlife Federation (WWF). 2021. Monarch Butterfly. Accessed November 5, 2021. https://www.worldwildlife.org/species/monarch-butterfly.

Appendix A

USFWS IPaC 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: 05/05/2025 20:31:08 UTC
Project Code: 2025-0048235
Project Name: Woodruff Creek 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: 2025-0048235
Project Name: Woodruff Creek Watershed Plan
Project Type: Irrigation
Project Description: The Woodruff Creek Watershed Plan would increase the efficiency of agricultural water use by reconstructing 25 existing diversion structures.
Project Location:

The approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@41.5157681,-111.19204229695183,14z



Counties: Rich County, Utah

ENDANGERED SPECIES ACT SPECIES

There is a total of 6 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. Note that 1 of these species should be considered only under certain conditions.

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
North American Wolverine *Gulo gulo luscus* No critical habitat has been designated for this species. This species only needs to be considered under the following conditions: ▪ Species may be present based on transient occurrence as it moves through or too suitable habitat. Effects should be considered to species and projects should consult with the Service, however, depending on the project, consultation may not be necessary. Species profile: https://ecos.fws.gov/ecp/species/5123	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

INSECTS

NAME	STATUS
Monarch Butterfly *Danaus plexippus* There is **proposed** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/9743	Proposed Threatened
Suckley's Cuckoo Bumble Bee *Bombus suckleyi* Population: No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/10885	Proposed Endangered

FLOWERING PLANTS

NAME	STATUS
Ute Ladies'-tresses *Spiranthes diluvialis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/2159	Threatened

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: J-U-B Engineers Inc.
Name: Sydney Allen
Address: 392 E Winchester St Suite 300
City: Salt Lake City
State: UT
Zip: 84107
Email seallen@jub.com
Phone: 8018669052

LEAD AGENCY CONTACT INFORMATION

Lead Agency: Natural Resources Conservation Service

IPaC **U.S. Fish & Wildlife Service**

IPaC resource list

This report is an automatically generated list of species and other resources such as critical habitat (collectively referred to as *trust resources*) under the U.S. Fish and Wildlife Service's (USFWS) jurisdiction that are known or expected to be on or near the project area referenced below. The list may also include trust resources that occur outside of the project area, but that could potentially be directly or indirectly affected by activities in the project area. However, determining the likelihood and extent of effects a project may have on trust resources typically requires gathering additional site-specific (e.g., vegetation/species surveys) and project-specific (e.g., magnitude and timing of proposed activities) information.

Below is a summary of the project information you provided and contact information for the USFWS office(s) with jurisdiction in the defined project area. Please read the introduction to each section that follows (Endangered Species, Migratory Birds, USFWS Facilities, and NWI Wetlands) for additional information applicable to the trust resources addressed in that section.

NOT FOR CONSULTATION

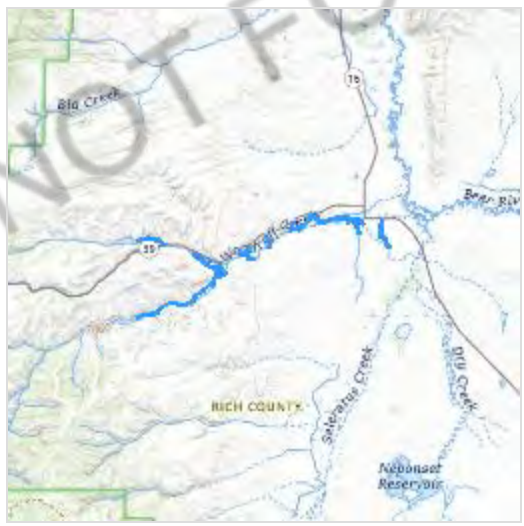
Project information

NAME

Woodruff Creek Watershed Plan

LOCATION

Rich County, Utah



DESCRIPTION

Some(The Woodruff Creek Watershed Plan would increase the efficiency of agricultural water use by reconstructing 25 existing diversion structures.)

Local office

Utah Ecological Services Field Office

(801) 975-3330
(801) 975-3331

2369 West Orton Circle, Suite 50
West Valley City, UT 84119-7603

NOT FOR CONSULTATION

Endangered species

This resource list is for informational purposes only and does not constitute an analysis of project level impacts.

The primary information used to generate this list is the known or expected range of each species. Additional areas of influence (AOI) for species are also considered. An AOI includes areas outside of the species range if the species could be indirectly affected by activities in that area (e.g., placing a dam upstream of a fish population even if that fish does not occur at the dam site, may indirectly impact the species by reducing or eliminating water flow downstream). Because species can move, and site conditions can change, the species on this list are not guaranteed to be found on or near the project area. To fully determine any potential effects to species, additional site-specific and project-specific information is often required.

Section 7 of the Endangered Species Act **requires** Federal agencies to "request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action" for any project that is conducted, permitted, funded, or licensed by any Federal agency. A letter from the local office and a species list which fulfills this requirement can **only** be obtained by requesting an official species list from either the Regulatory Review section in IPaC (see directions below) or from the local field office directly.

For project evaluations that require USFWS concurrence/review, please return to the IPaC website and request an official species list by doing the following:

1. Log in to IPaC.
2. Go to your My Projects list.
3. Click PROJECT HOME for this project.
4. Click REQUEST SPECIES LIST.

Listed species[1] and their critical habitats are managed by the Ecological Services Program of the U.S. Fish and Wildlife Service (USFWS) and the fisheries division of the National Oceanic and Atmospheric Administration (NOAA Fisheries[2]).

Species and critical habitats under the sole responsibility of NOAA Fisheries are **not** shown on this list. Please contact NOAA Fisheries for species under their jurisdiction.

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1. Species listed under the Endangered Species Act are threatened or endangered; IPaC also shows species that are candidates, or proposed, for listing. See the listing status page for more information. IPaC only shows species that are regulated by USFWS (see FAQ).
2. 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.

The following species are potentially affected by activities in this location:

NOT FOR CONSULTATION

Mammals

NAME	STATUS
Canada Lynx Lynx canadensis There is **final** critical habitat for this species. Your location does not overlap the critical habitat. https://ecos.fws.gov/ecp/species/3652	Threatened
North American Wolverine Gulo gulo luscus Wherever found This species only needs to be considered if the following condition applies: • Species may be present based on transient occurrence as it moves through or too suitable habitat. Effects should be considered to species and projects should consult with the Service, however, depending on the project, consultation may not be necessary. No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/5123	Threatened

Birds

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

Insects

NAME	STATUS
Monarch Butterfly Danaus plexippus Wherever found There is **proposed** critical habitat for this species. Your location does not overlap the critical habitat. https://ecos.fws.gov/ecp/species/9743	Proposed Threatened
Suckley's Cuckoo Bumble Bee Bombus suckleyi No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/10885	Proposed Endangered

Flowering Plants

NOT FOR CONSULTATION

NAME	STATUS
Ute Ladies'-tresses Spiranthes diluvialis Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/2159	Threatened

Critical habitats

Potential effects to critical habitat(s) in this location must be analyzed along with the endangered species themselves.

There are no critical habitats at this location.

You are still required to determine if your project(s) may have effects on all above listed species.

Bald & Golden Eagles

Bald and Golden Eagles are protected under the Bald and Golden Eagle Protection Act [2] and the Migratory Bird Treaty Act (MBTA) [1]. Any person or organization who plans or conducts activities that may result in impacts to Bald or Golden Eagles, or their habitats, should follow appropriate regulations and consider implementing appropriate avoidance and minimization measures, as described in the various links on this page.

Additional information can be found using the following links:

- Eagle Management https://www.fws.gov/program/eagle-management
- Measures for avoiding and minimizing impacts to birds https://www.fws.gov/library/collections/avoiding-and-minimizing-incidental-take-migratory-birds
- Nationwide avoidance and minimization measures for birds https://www.fws.gov/sites/default/files/documents/nationwide-standard-conservation-measures.pdf
- Supplemental Information for Migratory Birds and Eagles in IPaC https://www.fws.gov/media/supplemental-information-migratory-birds-and-bald-and-golden-eagles-may-occur-project-action

There are Bald Eagles and/or Golden Eagles in your project area.

Measures for Proactively Minimizing Eagle Impacts

NOT FOR CONSULTATION

For information on how to best avoid and minimize disturbance to nesting bald eagles, please review the National Bald Eagle Management Guidelines. You may employ the timing and activity-specific distance recommendations in this document when designing your project/activity to avoid and minimize eagle impacts. For bald eagle information specific to Alaska, please refer to Bald Eagle Nesting and Sensitivity to Human Activity.

The FWS does not currently have guidelines for avoiding and minimizing disturbance to nesting Golden Eagles. For site-specific recommendations regarding nesting Golden Eagles, please consult with the appropriate Regional Migratory Bird Office or Ecological Services Field Office.

If disturbance or take of eagles cannot be avoided, an incidental take permit may be available to authorize any take that results from, but is not the purpose of, an otherwise lawful activity. For assistance making this determination for Bald Eagles, visit the Do I Need A Permit Tool. For assistance making this determination for golden eagles, please consult with the appropriate Regional Migratory Bird Office or Ecological Services Field Office.

Ensure Your Eagle List is Accurate and Complete

If your project area is in a poorly surveyed area in IPaC, your list may not be complete and you may need to rely on other resources to determine what species may be present (e.g. your local FWS field office, state surveys, your own surveys). Please review the Supplemental Information on Migratory Birds and Eagles, to help you properly interpret the report for your specified location, including determining if there is sufficient data to ensure your list is accurate.

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to bald or golden eagles on your list, see the "Probability of Presence Summary" below to see when these bald or golden eagles are most likely to be present and breeding in your project area.

Review the FAQs

The FAQs below provide important additional information and resources.

NAME	BREEDING SEASON
Bald Eagle Haliaeetus leucocephalus This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1626	Breeds Jan 1 to Aug 31
Golden Eagle Aquila chrysaetos This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1680	Breeds Jan 1 to Aug 31

NOT FOR CONSULTATION

Probability of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read "Supplemental Information on Migratory Birds and Eagles", specifically the FAQ section titled "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (▪)

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.
2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.
3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

To see a bar's probability of presence score, simply hover your mouse cursor over the bar.

Breeding Season (▪)
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort (|)
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

To see a bar's survey effort range, simply hover your mouse cursor over the bar.

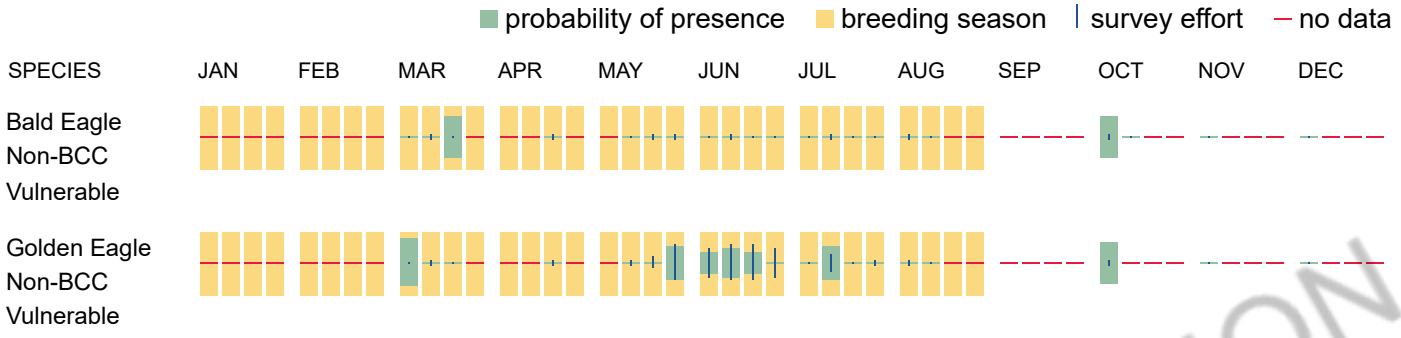
No Data (–)

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A week is marked as having no data if there were no survey events for that week.

Survey Timeframe

Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.



Bald & Golden Eagles FAQs

What does IPaC use to generate the potential presence of bald and golden eagles in my specified location?

The potential for eagle presence is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are an eagle (Bald and Golden Eagle Protection Act requirements may apply).

Proper interpretation and use of your eagle report

On the graphs provided, please look carefully at the survey effort (indicated by the black vertical line) and for the existence of the "no data" indicator (a red horizontal line). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort line or no data line (red horizontal) means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list and associated information help you know what to look for to confirm presence and helps guide you in knowing when to implement avoidance and minimization measures to eliminate or reduce potential impacts from your project activities or get the appropriate permits should presence be confirmed.

How do I know if eagles are breeding, wintering, or migrating in my area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating, or resident), you may query your location using the RAIL Tool and view the range maps provided for birds in your area at the bottom of the profiles provided for each bird in your results. If an eagle on your IPaC migratory bird species list has a breeding season associated with it (indicated by yellow vertical bars on the phenology graph in your “IPaC PROBABILITY OF PRESENCE SUMMARY” at the top of your results list), there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

Interpreting the Probability of Presence Graphs

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Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. A taller bar indicates a higher probability of species presence. The survey effort can be used to establish a level of confidence in the presence score.

How is the probability of presence score calculated? The calculation is done in three steps:
The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.

To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.

The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

Breeding Season ()
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort ()
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps.

No Data ()
A week is marked as having no data if there were no survey events for that week.

Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.

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Migratory birds

The Migratory Bird Treaty Act (MBTA) [1] prohibits the take (including killing, capturing, selling, trading, and transport) of protected migratory bird species without prior authorization by the Department of Interior U.S. Fish and Wildlife Service (Service). The incidental take of migratory birds is the injury or death of birds that results from, but is not the purpose, of an activity. The Service interprets the MBTA to prohibit incidental take.

1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.

Additional information can be found using the following links:

- Eagle Management https://www.fws.gov/program/eagle-management

- Measures for avoiding and minimizing impacts to birds https://www.fws.gov/library/collections/avoiding-and-minimizing-incidental-take-migratory-birds
- Nationwide avoidance and minimization measures for birds
- Supplemental Information for Migratory Birds and Eagles in IPaC https://www.fws.gov/media/supplemental-information-migratory-birds-and-bald-and-golden-eagles-may-occur-project-action

Measures for Proactively Minimizing Migratory Bird Impacts

Your IPaC Migratory Bird list showcases birds of concern, including Birds of Conservation Concern (BCC), in your project location. This is not a comprehensive list of all birds found in your project area. However, you can help proactively minimize significant impacts to all birds at your project location by implementing the measures in the Nationwide avoidance and minimization measures for birds document, and any other project-specific avoidance and minimization measures suggested at the link Measures for avoiding and minimizing impacts to birds for the birds of concern on your list below.

Ensure Your Migratory Bird List is Accurate and Complete

If your project area is in a poorly surveyed area, your list may not be complete and you may need to rely on other resources to determine what species may be present (e.g. your local FWS field office, state surveys, your own surveys). Please review the Supplemental Information on Migratory Birds and Eagles document, to help you properly interpret the report for your specified location, including determining if there is sufficient data to ensure your list is accurate.

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, see the "Probability of Presence Summary" below to see when these birds are most likely to be present and breeding in your project area.

Review the FAQs

The FAQs below provide important additional information and resources.

NAME	BREEDING SEASON
Bald Eagle Haliaeetus leucocephalus This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1626	Breeds Jan 1 to Aug 31
Black Tern Chlidonias niger surinamenisis This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/3093	Breeds May 15 to Aug 20

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Bobolink Dolichonyx oryzivorus — Breeds May 20 to Jul 31

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Broad-tailed Hummingbird Selasphorus platycercus — Breeds May 25 to Aug 21

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

California Gull Larus californicus — Breeds Mar 1 to Jul 31

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Cassin's Finch Haemorhous cassinii — Breeds May 15 to Jul 15

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9462

Clark's Grebe Aechmophorus clarkii — Breeds Jun 1 to Aug 31

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Evening Grosbeak Coccothraustes vespertinus — Breeds May 15 to Aug 10

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Franklin's Gull Leucophaeus pipixcan — Breeds May 1 to Jul 31

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Golden Eagle Aquila chrysaetos — Breeds Jan 1 to Aug 31

This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.
https://ecos.fws.gov/ecp/species/1680

Olive-sided Flycatcher Contopus cooperi — Breeds May 20 to Aug 31

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/3914

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Pinyon Jay Gymnorhinus cyanocephalus — Breeds Feb 15 to Jul 15
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9420

Western Grebe aechmophorus occidentalis — Breeds Jun 1 to Aug 31
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/6743

Willet Tringa semipalmata — Breeds Apr 20 to Aug 5
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Williamson's Sapsucker Sphyrapicus thyroideus nataliae — Breeds May 1 to Jul 31
This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA

Probability of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read "Supplemental Information on Migratory Birds and Eagles", specifically the FAQ section titled "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (■)

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.
2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the

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maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.

3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

To see a bar's probability of presence score, simply hover your mouse cursor over the bar.

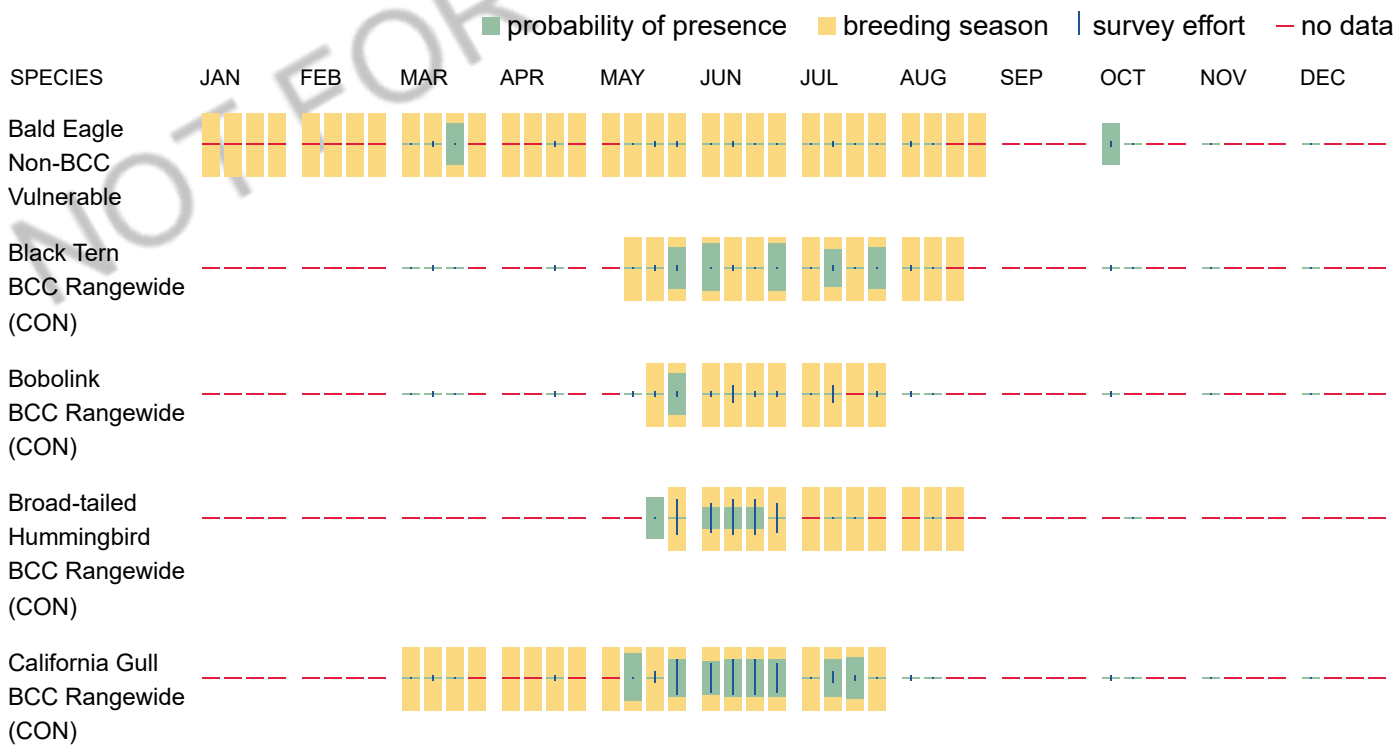
Breeding Season (■)
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort (|)
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

To see a bar's survey effort range, simply hover your mouse cursor over the bar.

No Data (–)
A week is marked as having no data if there were no survey events for that week.

Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.



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Migratory Bird FAQs

Tell me more about avoidance and minimization measures I can implement to avoid or minimize impacts to migratory birds.

Nationwide Avoidance & Minimization Measures for Birds describes measures that can help avoid and minimize impacts to all birds at any location year-round. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is one of the most effective ways to minimize impacts. To see when birds are most likely to occur and breed in your project area, view the Probability of Presence Summary. Additional measures or permits may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the list of migratory birds that potentially occur in my specified location?

The Migratory Bird Resource List is comprised of Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location, such as those listed under the Endangered Species Act or the Bald and Golden Eagle Protection Act and those species marked as “Vulnerable”. See the FAQ “What are the levels of concern for migratory birds?” for more information on the levels of concern covered in the IPaC migratory bird species list.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) with which your project intersects. These species have been identified as warranting special attention because they are BCC species in that area, an eagle (Bald and Golden Eagle Protection Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, and to verify survey effort when no results present, please visit the Rapid Avian Information Locator (RAIL) Tool.

Why are subspecies showing up on my list?

Subspecies profiles are included on the list of species present in your project area because observations in the AKN for **the species** are being detected. If the species are present, that means that the subspecies may also be present. If a subspecies shows up on your list, you may need to rely on other resources to determine if that subspecies may be present (e.g. your local FWS field office, state surveys, your own surveys).

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?

The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets.

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go to the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering, or migrating in my area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating, or resident), you may query your location using the RAIL Tool and view the range maps provided for birds in your area at the bottom of the profiles provided for each bird in your results. If a bird on your IPaC migratory bird species list has a breeding season associated with it (indicated by yellow vertical bars on the phenology graph in your “IPaC PROBABILITY OF PRESENCE SUMMARY” at the top of your results list), there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?

Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);

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2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the Bald and Golden Eagle Protection Act requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially BCC species. For more information on avoidance and minimization measures you can implement to help avoid and minimize migratory bird impacts, please see the FAQ “Tell me more about avoidance and minimization measures I can implement to avoid or minimize impacts to migratory birds”.

Details about birds that are potentially affected by offshore projects

For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Proper interpretation and use of your migratory bird report

The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated and see options for identifying what other birds may be in your project area, please see the FAQ "What does IPaC use to generate the migratory birds potentially occurring in my specified location". Please be aware this report provides the "probability of presence" of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please look carefully at the survey effort (indicated by the black vertical line) and for the existence of the "no data" indicator (a red horizontal line). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list does not represent all birds present in your project area. It is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list and associated information help you know what to look for to confirm presence and helps guide implementation of avoidance and minimization measures to eliminate or reduce potential impacts from your project activities, should presence be confirmed. To learn more about avoidance and minimization measures, visit the FAQ "Tell me about avoidance and minimization measures I can implement to avoid or minimize impacts to migratory birds".

Interpreting the Probability of Presence Graphs

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. A taller bar indicates a higher probability of species presence. The survey effort can be used to establish a level of confidence in the presence score.

How is the probability of presence score calculated? The calculation is done in three steps:

The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.

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To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.

The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

Breeding Season ()
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort ()
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps.

No Data ()
A week is marked as having no data if there were no survey events for that week.

Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.

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Facilities

National Wildlife Refuge lands

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

There are no refuge lands at this location.

Fish hatcheries

There are no fish hatcheries at this location.

Wetlands in the National Wetlands Inventory (NWI)

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

Please note that the NWI data being shown may be out of date. We are currently working to update our NWI data set. We recommend you verify these results with a site visit to determine the actual extent of wetlands on site.

This location overlaps the following wetlands:

FRESHWATER EMERGENT WETLAND
- PEM1Cf
- PEM1F
- PEM1C
- PEM1B

FRESHWATER FORESTED/SHRUB WETLAND
- PSS1C
- PSS1Cf

FRESHWATER POND
- PUSCh
- PABGh
- PUBF

LAKE
- L2USCh

RIVERINE
- R3UBH
- R4SBCx
- R4SBJ
- R2USC
- R2UBF
- R2UBFx
- R3UBF

A full description for each wetland code can be found at the National Wetlands Inventory website

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NOTE: This initial screening does **not** replace an on-site delineation to determine whether wetlands occur. Additional information on the NWI data is provided below.

Data limitations

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Data exclusions

Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

Data precautions

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate Federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

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Appendix B

Photo Inventory

Photo Inventory

Photos taken during site visits on September 15 and 16, and October 4, 2021.



Photo 1: Woodruff Creek at the Witheral Diversion, downstream of the Woodruff Reservoir.



Photo 2: Birch Creek at the Smith Ditch Diversion.



Photo 3: Birch Creek at the Cornia #1 Diversion. Dense grasses and willows grow on the banks.



Photo 4: Birch Creek downstream at the Putnam/Cornia Diversion. Riprap and concrete have been placed in the creek.



Photo 5: Eastman/Frazier Diversion on Woodruff Creek.



Photo 6: Bentgrass grows abundantly at the dry Saxton Diversion on Woodruff Creek



Photo 7: Frazier #1 Diversion on Woodruff Creek. Bailing twine debris is present around and in the diversion.



Photo 8: Frazier #2 Diversion on Woodruff Creek.



Photo 8: Eastman Diversion #2 on Woodruff Creek. Old vehicles and human made debris are within the diversion structure.



Photo 9: The Splitter Diversion on Woodruff Creek. A cement barrier is constructed as part of the diversion structure. Riprap and a metal walkway are present (not pictured).



Photo 10: The Tingey/Byson/Eastman Diversion on Woodruff Creek lies in a residential area in Woodruff. The canal adjacent to this diversion is dry. Human made debris is present in the canal.



Photo 11: The Shulthess Diversion on Woodruff Creek lies in a heavily grazed pasture. The canal adjacent to this diversion is dry.



Photo 12: The Buck Diversion on Woodruff Creek. The diversion was dry at the time of survey. Human-made debris is present in the creek bed and irrigation canal.



Photo 13: The Church/Brown Diversion on Woodruff Creek.



Photo 14: The Hagus Diversion on Woodruff Creek. Riprap and concrete has been used to construct the diversion.



Photo 15: Soil has been filled into the connected canal at the Hagus Diversion on Woodruff Creek.

Appendix C

ULT Memo

MEMORANDUM

DATE:	May 16, 2023
TO:	Rita Reisor, USFWS, Utah Ecological Services Field Office
CC:	Paul Willardson, Project Manager (J-U-B ENGINEERS, Inc.); Marti Hoge, Environmental Lead (J-U-B ENGINEERS, Inc.), Derek Hamilton, Water Resources Coordinator (NRCS)
FROM:	Autumn Foushee Davies, Senior Biologist (J-U-B ENGINEERS, Inc.); Becky Hendricks Miller, Biologist (J-U-B ENGINEERS, Inc.)
SUBJECT:	Rich County, UT, Woodruff Creek Watershed Plan Project: Ute ladies'-tresses Survey Findings

J-U-B ENGINEERS, Inc. Biologist Becky Hendricks Miller conducted the field investigation and Ute Ladies'-tresses (ULT) Survey on September 15 and 16, 2021, and October 21, 2021 per USFWS survey protocol but outside of the accepted, open ULT flowering period. Becky Hendricks Miller holds an MS degree in Organismal Biology, with a concentration on Plant Physiology, and has over a dozen years of experience in field botany and plant ecology experience, and conducted the survey under the supervision of Autumn Foushee Davies, who is an accepted ULT surveyor and who holds a MS degree in Botany and has over 18 years of field biology and plant ecology experience. The survey was conducted for the proposed Woodruff Creek Watershed Plan Project in Rich County, Utah (Proposed Project).

Proposed Project Description

The purpose of the Proposed Project is to provide flood damage prevention and reduction and to improve agricultural water management for Rich County residents and water users. The Proposed Project would establish flood protection, improve irrigation water delivery and efficiency, and conserve water. Project measures include improvements to the Woodruff Creek Reservoir gate; reconstructing the splitter structure on Woodruff Creek; reconstructing the existing diversion structures on Woodruff Creek and Birch Creek; and, installation of measurement flumes and supervisory control and data acquisition (SCADA) technologies throughout the existing irrigation system. Flood protection would be provided by the reconstruction of the primary splitter on Woodruff Creek and the diversion structures throughout the existing system, allowing for

better flow control and gate opening response times during flood conditions. Funding for the planning phase of the Proposed Project has been provided from the NRCS under the Watershed Protection and Flood Prevention Act (PL83-566).

The ULT survey was completed to evaluate suitable habitat conditions within the Proposed Project footprint (Action Area) and to survey for any previously unidentified ULT populations, if present. The Action Area, and ULT survey area, included sections of Birch Creek and Woodruff Creek, and short auxiliary canals from these creeks that travel through agricultural lands. The creeks' banks are natural and are intermittingly interrupted by irrigation diversions and headgate structures. In total, within the Action Area, 2.2 miles of lower perennial stream, 1.3 miles of upper perennial stream, 0.2 miles of intermittent stream and 2.5 miles of canal were surveyed on September 15 and 16, 2021 and October 4, 2021.

This ULT survey has been completed to meet the environmental compliance requirements of the Proposed Project, and to provide documentation of survey results in accordance with the *USFWS Utah Field Office Guidelines for Conducting and Reporting Botanical Inventories and Monitoring of Federally Listed, Proposed and Candidate Plants* (USFWS 2011) and the *USFWS Interim Survey Requirements for Ute Ladies'-tresses Orchid* (USFWS 1992).

Due to known records of Ute ladies'-tresses (ULT) (*Spiranthes diluvialis*) occurring within a neighboring county, Cache County, Utah, the presence of potential suitable habitat for ULTs in Rich County, Utah, and because ULTs were included in the USFWS Utah Ecological Services Office IPaC species list for the Proposed Project Action Area (Action Area), a ULT habitat suitability survey was conducted for all areas with potential to have ULT habitat, such as canals, pastures, riparian zones and proposed staging areas within the Action Area. There are no known records of occurrence of ULTs in Rich County.

Site Location

The Proposed Project includes improvements to approximately 2.2 miles of lower perennial stream, 1.3 miles of upper perennial stream, 0.2 miles of intermittent stream and 2.5 miles of canal within Rich County, Utah.

The Action Area is in portions of the following sections:

- Township 9 North, Range 7 East, Sections 15, 16, 17, 18, and 22

- Township 9 North, Range 6 East, Sections 13, 19, 21, 22, 23, 24, 27, 28, 31, 32, and 33.

Site Features

The Action Area has elevations ranging from approximately 6,837 to 6,329 feet above mean sea level (AMSL). The Proposed Project would occur outside the community of Woodruff, along Birch Creek and Woodruff Creek, in Rich County, Utah, and along existing agricultural irrigation canals. Land uses in the surrounding area consist mainly of residential, agricultural, and open grazing uses. Within the Action Area, Birch Creek enters Woodruff Creek, which has floodplain connectivity with the Bear River and falls within the Upper Bear River Watershed. Portions of Birch Creek and Woodruff Creek are characterized as lower and upper perennial stream types. Due to the muddy channel bottom of Birch and Woodruff Creeks, the soil substrate dries up when flows are diverted or controlled upstream. Short sections of canals extend from Woodruff Creek, in the downstream portion of the Action Area.

Vegetation present within the Action Area was typical for agricultural fields in the region, where heavy grazing occurs. Woodruff Creek and Birch Creek primarily pass through open cattle pastures. Most of the alignment, for both creeks, lacks functional midstory or overstory vegetation structure, except in some locations where willow (*Salix spp*.) is tall and particularly dense. Ruderal grasses, common non-native species and wetland species occurring in low lying pastural areas were observed during site surveys. Willow, Woods' rose (*Rosa woodsii*), and rubber rabbitbrush (*Ericameria nauseosa*) were common in the shrub layer. The canal varied in hydrology at different locations. Throughout the creek alignments, sections were dry, due to controlled flows, and sometimes lined with riprap, concrete, or other fill material. Human trash debris, such as cars, tires, and household trash, were commonly found within the Woodruff Creek and Birch Creek, usually associated with a diversion or headgate point. Bare ground is common along portions of the creeks where erosion from grazing cattle has disturbed the edges.

Surveys

The Birch Creek and Woodruff Creek corridors, perennial streams, adjacent pastures and auxiliary irrigation canals within the Action Area were surveyed on September 15 and 16, 2021, and October 4, 2021 to evaluate habitat suitability and determine the need for protocol-level ULT surveys, per USFWS survey protocol.

Incidentally, no ULT vegetative structures were observed within the Action Area during the habitat suitability survey. All areas surveyed within this portion of the Action Area qualified as "Sites Not Requiring A Survey" under Section 5 within the *USFWS Interim Survey Requirements for Ute Ladies'-tresses Orchid* (USFWS 1992). The protocol states: "Some sites are either clearly not appropriate *Spiranthes diluvialis* habitat or have very low potential to be *Spiranthes diluvialis* habitat. A survey for *Spiranthes diluvialis* is not required for such sites. Sites below 6,500 feet elevation occurring within the areas described in Section 3 not requiring a survey for *Spiranthes* include [sites with these characteristics]". The following criteria were met to qualify these locations for exemption from survey for individual ULT plants, according to survey protocol:

- "Sites entirely composed of dense strands of: 1. Reed canarygrass (*Phalaris arundinacea*) 2. Tamarisk or Salt-cedar (*Tamarix ramosissima*) 3. Greasewood (*Sarcobatus vermiculatus*) 4. Teasel (*Dipsacus sylvestris*) 5. Common reed (*Phragmites australis*)" Dense vegetation, including reed canarygrass and teasel and cattail, were often present, growing within and along the edges of all creek sites and pasture sites within the ULT survey area;

- "Highly disturbed or modified sites… sites where vegetation has been stripped, exposing bare soil… [and where there are] Landscaped and maintained (mowed) bluegrass lawns." Creek edges and irrigation canal segments in many locations of the ULT survey area exhibit steep, barren and eroded slopes; in other locations, the creek is also reinforced with riprap, concrete or human trash; overall, creek and irrigation canal sites are highly disturbed and augmented by agricultural activities and grazing livestock; and

- "Upland sites" Pasture areas within the Action Area are upland sites and did not exhibit the appropriate hydrology for ULT presence.

Conclusion

The ULT survey area was evaluated for suitable ULT habitat. Approximately a total of 2.2 miles of lower perennial stream, 1.3 miles of upper perennial stream, 0.2 miles of intermittent stream and 2.5 miles of canal were surveyed under the accepted protocol for ULT habitat assessment. The survey area did not contain suitable conditions to support preferred habitat for ULT because of the vegetative assemblage (i.e., aggressive plant species), soil type and composition, which are

not suitable for ULT growth and persistence even where hydrology may be suitable within or along the creeks or irrigation canals and pasture areas, grazing pressure, and highly modified sites due to irrigation activities along the canals. Lastly, no remnant ULT vegetative structures were identified during the survey.

If you have any questions regarding the information presented herein, please contact me at: adavies@jub.com or via phone at 801-886-9052.

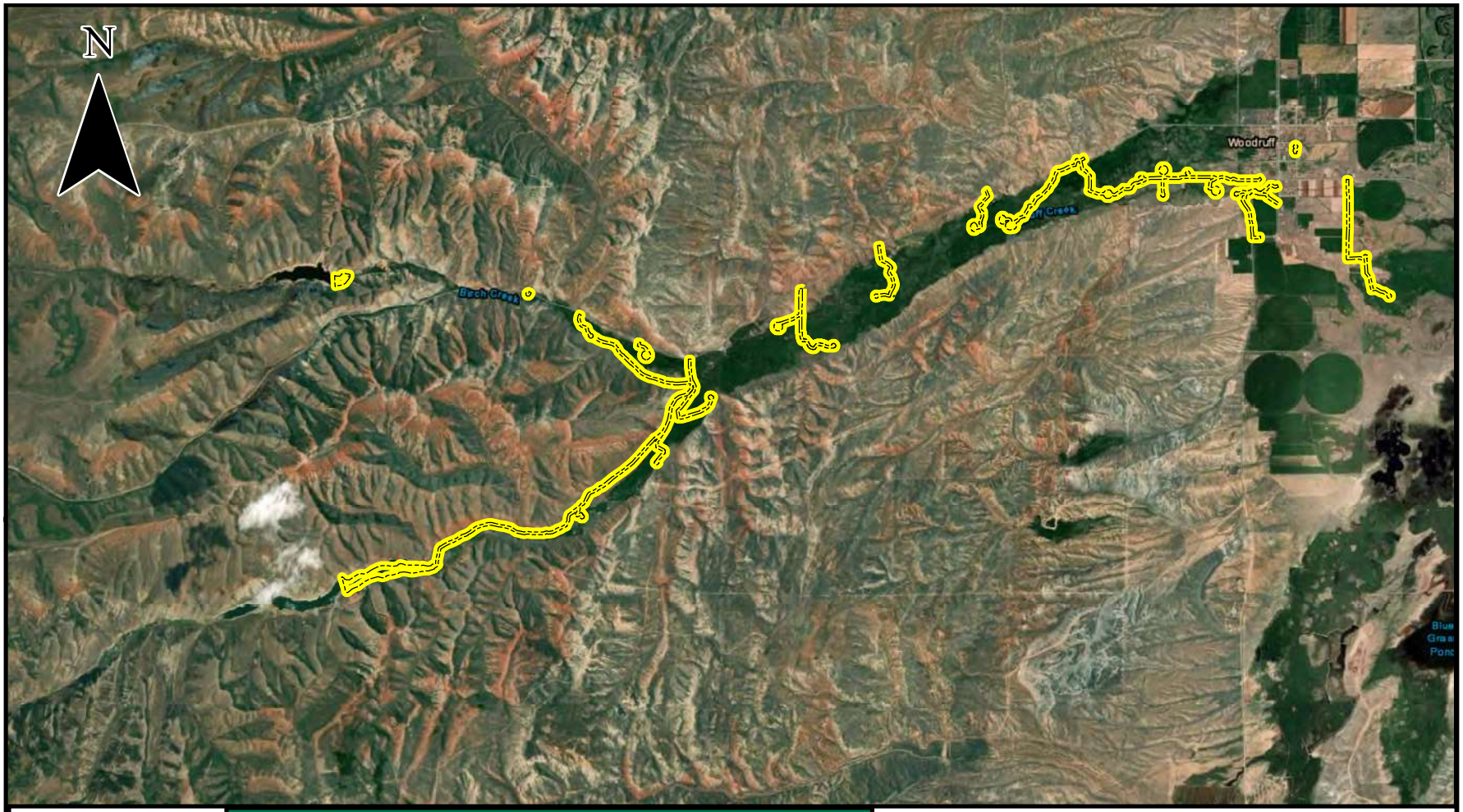
Attachments

1. ULT Survey Map
2. Photo Inventory

References

USFWS. 1992. Interim Survey Requirements for Ute Ladies'-tresses Orchid (Spiranthes diluvialis). https://www.fws.gov/utahfieldoffice/Documents/Plants/SPDI_interimSurveyRequirements_1992.pdf. Accessed 15 August 2021.

USFWS. 2011. USFWS Utah Field Office Guidelines for Conducting and Reporting Botanical Inventories and Monitoring of Federally Listed, Proposed, and Candidate Plants. https://www.fws.gov/utahfieldoffice/Documents/Plants/USFWS%20UtahFO%20Plant%20Survey%20Guidelines%20Final.pdf. Accessed 19 November 2021.



J·U·B ENGINEERS, INC.

ULT Survey Area Map

Woodruff Creek Watershed Plan Project
Rich County, Utah

Created on May 3, 2023

Legend

ULT Survey Area

0 0.5 1 2 Miles

Coordinate System: NAD 1983 StatePlane Utah North FIPS 4301 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

ULT Memo Photo Inventory

Photos taken during field surveys for ULT habitat suitability on September 15 and 16, and October 4, 2021.



Photo 1: Erosion due to cattle grazing is present along the banks of Woodruff Creek at the Witheral Diversion.



Photo 2: Dense bentgrass, reed canary grass, and timothy grass and willows grow on the banks of Birch Creek at the Cornia #1 Diversion.



Photo 4: Riprap and concrete have been placed in Birch Creek at the Putnam/Cornia Diversion.



Photo 5: Bentgrass grows abundantly at the dry Saxton Diversion on Woodruff Creek



Photo 6: Frazier #1 Diversion on Woodruff Creek. Bailing twine debris and denses grasses are present around and in the diversion.



Photo 7: Eastman Diversion #2 on Woodruff Creek. Old vehicles and human made debris are within the diversion structure.



Photo 10: The Tingey/Byson/Eastman Diversion on Woodruff Creek lies in a residential area in Woodruff. The canal adjacent to this diversion is dry. Human made debris is present in the canal.



Photo 11: The Shulthess Diversion on Woodruff Creek lies in a heavily grazed pasture. The canal adjacent to this diversion is dry and the edges are eroded.



Photo 12: The Buck Diversion on Woodruff Creek. The diversion was dry at the time of survey. Human-made debris is present in the creek bed and irrigation canal.



Photo 14: The Hagus Diversion on Woodruff Creek. Riprap and concrete have been used to construct the diversion.



Photo 15: Soil has been filled into the connected canal at the Hagus Diversion on Woodruff Creek.

Water Resource Assessment

Water Resource Assessment for the Woodruff Creek Watershed Agricultural Water Management Project

Rich County, Utah

Prepared for:

Rich County and Woodruff Creek Irrigating Company

Prepared by:



May 2023

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Chapter 1. Introduction

1.1 Introduction

J-U-B Engineers, Inc. (J-U-B) conducted a Water Resource Assessment (WRA) on September 15 – 16 and October 4, 2021 for the proposed Woodruff Creek Watershed Agricultural Water Management Project (Proposed Project) located in Rich County, Utah. This WRA was prepared on behalf of Rich County and co-sponsored by the Woodruff Creek Irrigating Company for the U.S. Department of Agriculture's (USDA) Natural Resources Conservation Service (NRCS). The objective of this assessment was to document Waters of the U.S. (WOTUS), including wetlands, located within the Proposed Project Survey Area (Survey Area).

1.2 Survey Area

The Proposed Project would occur within the agricultural area just east of Woodruff, Utah, between Monte Cristo Road and Woodruff Creek, along portions of Birch Creek, and south of the town of Woodruff. (See attached Vicinity and Topo Map). The Survey Area encompasses approximately 243 acres. The Proposed Project is located in portions of the following public land survey system areas:

- Township 9 North, Range 7 East, Sections 15, 16, 17, 18, and 22
- Township 9 North, Range 6 East, Sections 13, 19, 21, 22, 23, 24, 27, 28, 31, 32, and 33.

1.3 Proposed Project

The purpose of the Proposed Project is to provide flood damage prevention and reduction and to improve agricultural water management for Rich County residents and water users. The Proposed Project would establish flood protection, improve irrigation water delivery and efficiency, and conserve water. Project measures include improvements to the Woodruff Creek Reservoir gate; reconstructing the splitter structure on Woodruff Creek; reconstructing the existing diversion structures on Woodruff Creek and Birch Creek; and, installation of measurement flumes and supervisory control and data acquisition (SCADA) technologies throughout the existing irrigation system. Flood protection would be provided by the reconstruction of the primary splitter on Woodruff Creek and the diversion structures throughout the existing system, allowing for better flow control and gate opening response times during flood conditions.

1.4 Landscape Setting

The Proposed Project is located in the Lower Woodruff Creek (HUC 160101010604) and the Birch Creek-Walton Canyon (HUC 160101010603) subwatersheds, in the Upper Bear River Basin area. The Proposed Project is bounded by the town of Woodruff on the east, on the north by Monte Cristo Road and follows Woodruff Creek southwest to Woodruff Reservoir. A portion of the Proposed project also follows Birch Creek where it meets Woodruff Creek northwest to the Birch Creek Reservoirs. The Survey Area has elevations ranging from 6,837 above mean sea level (AMSL) near the Woodruff Reservoir to 6,329 AMSL near Woodruff. Land uses in the surrounding area consist mainly of residential, agricultural, and open grazing uses. For representative photos of the Survey Area, refer to the attached Photo Inventory.

1.2.1 Climate

The region is considered a warm summer continental climate. Climate Data was obtained from the Western Regional Climate Center's records: Woodruff, Utah station. The Woodruff climate station is located in Woodruff, Utah. Woodruff has an average annual high temperature of 55.0° Fahrenheit (F) and an average annual low temperature of 23.0° F (WRCC 2022a). Extreme temperatures are not uncommon, the highest recorded temperature was 115° F, occurring in in August, and the coldest temperature was -

49° F, occurring in December (WRCC 2022b). The average annual precipitation is 9.43 inches of rain and 45.4 inches of snowfall (WRCC 2022a). The nearest Agricultural Applied Climate Information System (AgACIS) Climate Analysis for Wetlands Tables (also known as WETS) station is located in Woodruff as well. Information obtained from this WETS station indicates that 2021 had a higher-than-average amount of total precipitation at 11.58 inches (NOAA 2022).

1.2.2 Vegetation

Vegetation within the Survey Area was typical for residential neighborhoods and agricultural fields in the region, with wetland species occurring in swales and low-lying areas. Dominant species are identified in Table 1.1 below.

Table 1.1 –Dominant Vegetation Within the Survey Area

Stratum	Common Name	Scientific Name	Indicator Status[1]
Trees	Bigtooth maple	*Acer grandidentatum*	FACU
	Boxelder maple	*Acer negundo*	FACW
	Fremont's cottonwood	*Populus fremontii*	FACW
	River birch	*Betula occidentalis*	FACW
	Russian olive	*Elaeagnus angustifolia*	FAC
Shrubs	Big sagebrush	*Artemisia tridentata*	UPL
	Booth's willow	*Salix boothii*	FACW
	Coyote willow	*Salix exigua*	FACW
	Golden currant	*Ribes aureum*	FAC
	Redtwig dogwood	*Cornus serecia*	FAC
	Rubber rabbitbrush	*Ericameria nauseosa*	UPL
	Wood's rose	*Rosa woodsii*	FACU
Herbs	Alsike Clover	*Trifolium hybridum*	FAC
	Baltic rush	*Juncus balticus*	FACW
	Bindweed	*Convolvulus arvensis*	FACU
	Blue wildrye	*Elymus glaucus*	FACU
	Bulrush	*Schoenoplectus acutus*	OBL
	Burdock	*Arctium minus*	FACU
	Canada thistle	*Cirsium arvense*	FACU
	Cattail	*Typha latifolia*	OBL
	Common bentgrass	*Agrostis capillaris*	FAC
	Common spike-rush	*Eleocharis palustris*	OBL
	Common teasel	*Dipsacus fullonum*	FAC
	Crested wheatgrass	*Agropyron cristatum*	FACU
	Dandelion	*Taraxacum officinale*	FACU
	Houndstongue	*Cynoglossum Officinale*	FACU
	Inland salt-grass	*Distichlis spicata*	FAC
	Longleaf aster	*Symphyotrichum ascendens*	FAC
	Meadow foxtail	*Alopecurus pratensis*	FACW
	Musk thistle	*Carduus nutans*	UPL
	Narrowleaf plantain	*Plantago lanceolata*	FAC
	Nebraska sedge	*Carex nebrascensis*	OBL
	Reed canary grass	*Phalaris arundinacea*	FACW
	Red clover	*Trifolium pratense*	FACU

Stratum	Common Name	Scientific Name	Indicator Status[1]
	Smooth horsetail	*Equisetum laevigatum*	FACW
	Water sedge	*Carex aquatilis*	OBL
	Wild licorice	*Glycyrrhiza lepidota*	FACU
	Yellow sweet clover	*Melilotus officinalis*	FACU

[1]***Obligate (OBL)*** *– Almost always occurs in wetlands.*
Facultative Wetland (FACW) *– Usually occurs in wetlands but may occur in non-wetlands.*
Facultative (FAC) *– Occurs in wetlands and non-wetlands equally.*
Facultative Upland (FACU) *– Usually occurs in non-wetlands but may occur in wetlands.*
Upland (UPL) *– Almost never occurs in wetlands.*

1.2.3 Soils

A review of the NRCS Web Soil Survey revealed that the Survey Area is comprised of 22 soil map units. The six most dominant soil map units are described in the following paragraphs (NRCS 2022). All soil map units are included in detail in the attached Soils Report. Only two of the soil map units had a hydric rating ranging from 6 percent to 94 percent. The highest hydric rating of the dominant soil map units is 94 percent, which occurs in the Bear Lake silt loam (see table 1.2 NRCS Soil Types Mapped within the Survey Area) (NRCS 2022).

Wader Loam

The Wader Loam component makes up 38.2 percent of the map unit complex. This component can be found on floodplains with slopes generally ranging from 0 to 2 percent. The parent material consists of alluvium derived from mixed sources. The natural drainage class is poorly drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is moderate. This soil is frequently flooded but is not ponded. This soil has a seasonal zone of water saturation within a depth of 24 inches during May, June, and July. Organic matter content in the surface horizon is about 3 percent. The calcium carbonate equivalent within 40 inches, typically, does not exceed 8 percent. The soil has a no saline horizon within 30 inches of the soil surface.

Saleratus Loam

The Saleratus Loam component makes up 14.3 percent of the map unit complex. This component can be found on floodplains with slopes generally ranging from 0 to 1 percent. The parent material consists of alluvium derived from mixed sources. The natural drainage class is poorly drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is high. This soil is rarely flooded and not ponded. This soil has a seasonal zone of water saturation within a depth of 24 inches during May, June, and July. Organic matter content in the surface horizon is about 1 percent. The calcium carbonate equivalent within 40 inches, typically, does not exceed 8 percent. The soil has a no saline horizon within 30 inches of the soil surface.

Cowco Loam

The Cowco Loam component makes up 10.2 percent of the map unit complex. This component can be found on flood plains and alluvial fans with slopes generally ranging from 0 to 3 percent. The parent material consists of alluvium derived from mixed sources. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is high. This soil is rarely flooded and not ponded. This soil has no seasonal zone of water

saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 4 percent. The calcium carbonate equivalent within 40 inches, typically, does not exceed 6 percent. The soil has no saline horizon and a maximum sodium adsorption ration of 3 within 30 inches of the soil surface.

Duckree Gravelly Silt Loam, 15-40%

The Duckree Gravelly Silt Loam component makes up 6.4 percent of the map unit complex. This component can be found on foothill hill slopes and valley sides with slopes generally ranging from 15 to 40 percent. The parent material consists of colluvium and/or slope alluvium derived from quartzite, sandstone, and chert. The natural drainage class is somewhat excessively drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches (or restricted depth) is low. This soil is not flooded nor ponded. This soil has no seasonal zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 24 percent. The calcium carbonate equivalent within 40 inches, typically, does not exceed 6 percent. The soil has no saline horizon and a maximum sodium adsorption ratio of 6 within 30 inches of the soil surface.

Bockston Loam, Cool

The Bockston loam component makes up 6.3 percent of the map unit complex. These components can be found on alluvial fans and stream terraces with slopes generally ranging from 3 to 6 percent. The parent material consists of alluvium derived from mixed sources. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is moderate. This soil is not flooded nor ponded. This soil has no seasonal zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 2 percent. The calcium carbonate equivalent within 40 inches, typically, does not exceed 20 percent. The soil has no saline horizon and a maximum sodium adsorption ratio of 3 within 30 inches of the soil surface.

Duckree-St. Marys Association, Dry

The Duckree-St. Marys Association component makes up 6.3 percent of the map unit complex. These components can be found on mountainsides and foothill hillslopes with slopes generally ranging from 25 to 50 percent. The parent material consists of colluvium and/or slope alluvium derived from quartzite, sandstone, and chert. The natural drainage class is somewhat excessively drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches (or restricted depth) is very low. This soil is not flooded nor ponded. This soil has no seasonal zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 4 percent. The calcium carbonate equivalent within 40 inches, typically, does not exceed 23 percent. The soil has no saline horizon and a maximum sodium adsorption ratio of 6 within 30 inches of the soil surface.

Table 1.2 – NRCS Soil Types Mapped within the Survey Area

Soil Series Name	Hydric	% of Project Area
Bear Lake silt loam	Yes - 94% hydric	0.1%
Bereniceton silt loam, cool, 1 to 3 percent slopes	No - 0% hydric	0.2%
Bockston loam, cool, 0 to 3 percent slopes	No - 0% hydric	0.1%
Bockston loam, cool, 3 to 6 percent slopes	No - 0% hydric	6.3%
Cowco loam, 0 to 3 percent slopes	No - 0% hydric	10.2%
Cowco loam, 3 to 6 percent slopes	No - 0% hydric	0.1%

Soil Series Name	Hydric	% of Project Area
Cutoff gravelly loam, 6 to 25 percent slopes	No - 0% hydric	1.5%
Dagan gravelly loam, moist, 25 to 40 percent slopes	No - 0% hydric	1.2%
Dennot loam, 25 to 40 percent slopes	No - 0% hydric	0.8%
Dennot very gravelly loam, 4 to 15 percent slopes	No - 0% hydric	3.5%
Duckree loam, 0 to 3 percent slopes	No - 0% hydric	1.6%
Duckree gravelly loam, 3 to 25 percent slopes	No - 0% hydric	0.3%
Duckree gravelly silt loam, 15 to 40 percent slopes	No - 0% hydric	6.4%
Duckree-St. Marys association, dry, 25 to 50 percent slopes	No - 0% hydric	6.3%
Ellett silt loam, 10 to 30 percent slopes	No - 0% hydric	2.7%
Pancheri silt loam, cool, 1 to 5 percent slopes	No - 0% hydric	1.3%
Saleratus loam	No - 0% hydric	14.3%
Slinger gravelly loam, 25 to 40 percent slopes	No - 0% hydric	0.0%
Solak gravelly loam, 10 to 50 percent slopes	No - 0% hydric	2.1%
Solak-Ranruff-Rock outcrop complex, 30 to 60 percent slopes	No - 0% hydric	0.9%
Water	No - 0% hydric	1.8%
Wader loam	Yes - 6% hydric	38.2%
Total		**100%**

1.2.4 National Wetland Inventory (NWI)

The U.S. Fish and Wildlife Service National Wetland Inventory (NWI) suggests that wetland features may be found throughout the Survey Area, many of which originate from Woodruff and Birch Creeks (See Attached NWI Maps). Freshwater emergent wetlands, freshwater forested/shrub wetlands, freshwater pond, and lake features are identified as occurring near the Survey Area, with many of the freshwater emergent wetlands and freshwater forested/shrub wetlands occurring on the banks of the Woodruff and Birch Creek (USFWS, 2022).

Chapter 2. Methods

2.1 Delineation Methodology for Waters of the U.S.

A WRA was completed on September 15 - 16, and October 4, 2021, in accordance with the U.S. Army Corps of Engineers (USACE) 1987 *Wetland Delineation Manual* (USACE 1987) and the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West (Version 2.0)* (USACE 2008). All portions of the Survey Area were evaluated for water resources, however due to limitations on access, some areas were not surveyed using soil pits, but rather were evaluated based on aerial imagery and vegetation signatures. Those areas, including wetlands, that were accessible, were investigated for wetland indicators in accordance with the USACE manuals. In areas where access was not available, wetland status was determined based on the presence of hydrophytic vegetation as determined through photo interpretation of similar field-verified wetlands in the Survey Area, landscape position and/or adjacency to verified wetlands. Many of the unsampled wetlands identified in this report consist of thick willow dominated thickets or along eroding stream banks where safe access was not feasible. For those sites where soil pit analysis was completed, the following procedures (Section 2.1.1 – 2.1.3) were implemented at each of the selected sample points to determine the presence of wetland indicators. These data were

recorded on Arid West wetland determination data forms. Photographs were also taken to document each sample point and are provided in the attached Photo Inventory.

2.1.1 Hydrophytic Vegetation

All plant species within a 5-foot radius were recorded for each sample point. The relative percent vegetative cover for each species was determined by estimating aerial coverage. The wetland indicator status of each species was determined using the *2018 National Wetland Plant List* (USACE 2018). Vegetation species comprising at least 20 percent of the total aerial cover in its stratum were considered dominant, following the guidelines of the USACE 50/20 rule. If more than 50 percent of the dominant plant species had an indicator status of obligate wetland species (OBL), facultative wetland species (FACW), or facultative species (FAC), or if the prevalence index was less than three, then the sample point met the hydrophytic vegetation parameter.

2.1.2 Hydric Soils

At each sample point, a soil pit was dug to assess soil characteristics and water conditions. These soil pits were dug to a depth sufficient to identify the presence or absence of hydric soils. 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 sample to the Munsell® Soil Color Charts (Munsell® 2009). Soil textures were determined by rubbing the wetted soil samples between the thumb and forefinger. If the soil characteristics met one of the primary hydric soil indicators, or two or more secondary hydric soil indicators, identified in the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West (Version 2.0)* (USACE 2008) and *the Field Indicators of Hydric Soils in the U.S.* Version 7 manual (USDA, 2018), the sample point met the hydric soils parameter.

2.1.3 Wetland Hydrology

Each soil pit was also examined for the presence or absence of hydrologic indicators. These hydrologic indicators are described in the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West* (Version 2.0) (USACE 2008). 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.

2.1.4 Wetland Boundary Delineation 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 tested for the presence of the three indicators described above. If the point did not meet all three parameters, the point was classified as occurring in an upland. The next step was to define the wetland boundary occurring between a wetland sample point and the upland sample point. The boundary was based on information gathered from the two sample points and observable changes in elevation and plant communities. Survey data was downloaded into ArcMap to produce a map that shows delineated wetland boundaries and sample point locations. The acreages for each wetland polygon were calculated in ArcMap and included on the map. The Cowardin Classification (Cowardin 1979) was used to designate the wetland type.

Chapter 3. Delineation Results

One emergent marsh wetland (0.122 acres), 166 freshwater emergent wetlands (24.176 acres), 162 scrub-shrub wetlands (22.639 acres) were delineated within the Survey Area. A total of 6,726 Linear Feet (LF) (3.518 acres) of upper perennial stream, 11,437LF (3.159 acres) of lower perennial stream, 1,160 LF (0.230 acres) of intermittent stream, and 13,154 LF (0.861 acres) of canal were delineated within the Survey Area. Additionally, 0.111 acres of pond and 0.113 acres of lake bed were identified within the Survey Area. No other wetlands or WOTUS were identified within the Survey Area (see Table 3.1 – Aquatic Resources).

Table 3.1 – Aquatic Resources

Aquatic Resource Name	Aquatic Resources Classification		Aquatic Resource Size (AC)	Aquatic Resource Length (linear feet)
	Cowardin	Sample Point		
Wetland Features				
Emergent Marsh	PEM1B	-	0.122	-
Freshwater Emergent	PEM1E	SP08, SP10, SP11, SP12, SC10, SC12, SC17, SC18, SC102, SC111, SC112, SC113, SC114, SC115,	24.176	-
Scrub-Shrub	PSS1E	SP09, SP13, SC02, SC06, SC12, SC14, SC15, SC16, SC18, SC19, SC20, SC21, SC23, SC105, SC107, SC108, SC109,	22.639	-
Total			**46.937**	**-**
Linear Features				
Upper Perennial Stream	R3UB1	SC02, SC06, SP10, SP11	3.518	6,726
Lower Perennial Stream	R2UB1	SC07. SC08, SC10, SC11, SC12, SC13, SC14, SC15, SC16, SC17, SC18, SC20, SC21, SC22, SC23, SC105, SC106, SC107, SC108, SC109, SC111, SC112, SC113, SC114, SC115,	3.159	11,437
Intermittent Stream	R4SB3	SC103, SC102,	0.230	1,160
Canal	-	SC09, SC18, SC104, SC105, SC106, SC107, SC108, SC109, SC112, SC113, SC114,	0.861	13,154
Total			**7.768**	**32,477**
Pond Features				
Pond	L2AB1	-	0.111	-
Lake Bed	-	-	0.113	-
Total			**0.224**	**-**
Grand Total			**54.929**	**32,477**

3.1 Aquatic Resources

Vegetation
Overall, Obligate (OBL), Facultative Wetland (FACW), and Facultative Neutral (FAC) classes represented the dominant vegetation present in the wetlands. These species included: Baltic rush, reed canary grass, meadow foxtail, Common bentgrass, Nebraska sedge, inland salt-grass, common spike rush, Booth's willow, and coyote willow. Uplands were dominated by big sagebrush, rubber rabbitbrush, Great Basin wildrye, intermediate wheatgrass, blue wildrye, and dandelion.

Soils
Wetland test pits contained evidence of one or more of the following hydric soil indicators: hydrogen sulfide (A4), sandy redox (S5), depleted matrix (F3), and redox dark surface (F6). The upland soils did not exhibit any indicators of hydric soils.

Hydrology
Each of the wetlands identified contained evidence of one or more of the following primary hydrology indicators: high water table (A2), saturation (A3), surface soil cracks, (B6), water-stained leaves (B9), hydrogen sulfide odor (C1), and oxidized rhizospheres along living roots (C3). Secondary hydrology indicators were also present at the wetland test pits and included: water marks (B1), sediment deposits (B2), and passing the FAC-neutral test (D5). No evidence of hydrology was recorded within the uplands.

3.1.1 Emergent Marsh Wetlands – PEM1B *(Palustrine, Emergent, Persistent, Saturated)*
One emergent marsh wetland (0.122 acres) was delineated within the Survey Area. In an average year, this wetland experiences persistently wet conditions and are typically saturated. Dominant vegetation included Nebraska sedge, Baltic rush, cattails, and bulrush. No soil pits were tested in this wetland. Soils and hydrology in this wetland were assumed to meet hydric parameters due to the presence of hydrophytic vegetation, landscape position, and proximity to adjacent saturated soils. Based on historical aerial imagery, it appears that this emergent marsh wetland is inundated though much of the growing season. This emergent marsh wetland has a direct connection to Woodruff Creek (a WOTUS) and would be considered jurisdictional.

3.1.2 Freshwater Emergent Wetlands – PEM1E *(Palustrine, Emergent, Persistent, Seasonally Flooded/ Saturated)*
A total of 166 freshwater emergent wetlands (24.176 acres) were delineated within the Survey Area. In an average year, these wetlands experience persistently wet conditions and are seasonally flooded and/or saturated. Dominant vegetation included Baltic rush, Nebraska sedge, inland salt-grass, reed canary grass, and smooth horsetail. Soils in these wetlands exhibited one or more of the following indicators: hydrogen sulfide odor, sandy redox, and or a redox dark surface. Hydrology for these wetlands was met through the presence of a high-water table, saturation, hydrogen sulfide odor, surface soil cracks, water-stained leaves, and/or oxidized rhizospheres along living roots. Each of the freshwater emergent wetlands have either a direct connection to Woodruff Creek (a WOTUS), or a connection to Birch Creek (a WOTUS). Therefore, the freshwater emergent wetlands identified in this report would be considered jurisdictional.

3.1.3 Scrub-Shrub Wetland – PSS1E *(Palustrine, Scrub-Shrub, Broad-Leaved Deciduous, Seasonally Flooded/Saturated)*

A total of 162 scrub-shrub wetlands (22.639 acres) were identified within the Survey Area. In an average year, these wetlands experience persistently wet conditions and are seasonally flooded/saturated. Dominant vegetation included Booth's willow, coyote willow, golden currant, reed canary grass, and Baltic rush. Two soil test pits (SP09 and SP13) were dug within the scrub-shrub wetlands and exhibited the presence of a depleted soil matrix. Hydrology for these wetlands were met through the presence of water-stained leaves, biotic crust, water marks, and passing the FAC-neutral test. Each of the scrub-shrub wetlands have either a direct connection to Woodruff Creek (a WOTUS), or a connection to Birch Creek (a WOTUS). Therefore, the scrub-shrub wetlands identified in this report would be considered jurisdictional.

3.1.4 Upper Perennial Stream – R3UB1 *(Riverine, Lower Perennial, Unconsolidated Bottom, Cobble-Gravel)*

A total of 6,726 LF (3.518 acres) of upper perennial stream with a cobble-gravel bed were delineated within the Survey Area. This includes 646 LF (0.303 acres) of Birch Creek and 6,080 LF (3.215 acres) of Woodruff Creek. The location of the OHWM was assessed based on the following indicators: change in average sediment texture, change in vegetation species, change in vegetation cover, and break in bank slope. Birch Creek is a tributary to Woodruff Creek, which ultimately empties into the Bear River. Both Birch Creek and Woodruff Creek are WOTUS and would therefore be considered jurisdictional.

3.1.5 Lower Perennial Stream – R2UB1 *(Riverine, Lower Perennial, Unconsolidated Bottom, Cobble-Gravel)*

A total of 11,437 LF (3.159 acres) of lower perennial stream was delineated within the Survey Area. This includes 1,449 LF (0.320 acres) of Birch Creek, 2,296 LF (0.455 acres) of Genes Creek, and 7,692 LF (2.384 acres) of Woodruff Creek. The location of the OHWM was assessed based on the following indicators: change in average sediment texture, change in vegetation species, change in vegetation cover, and break in bank slope. Genes Creek empties into the Randolph Woodruff Canal, which has a connection to the Bear River (a WOTUS). Therefore, Genes Creek, Birch Creek, and Woodruff Creek would be considered jurisdictional.

3.1.6 *Intermittent Stream – R4SB3* (*Riverine, Intermittent, Stream Bed, Cobble-Gravel)*

A total of 1,160 LF (0.230 acres) of intermittent stream were identified within the Survey Area. This includes two intermittent segments of Woodruff Creek near Woodruff Creek Road totaling 523 LF (0.194 acres). Woodruff Creek appears to go subterranean at these two segments as there is flowing water in the Creek just upstream and downstream of these segments. Six additional intermittent segments of Woodruff Creek totaling 637 LF (0.036 acres) are located on the eastern edges of the Survey Area, where most of the water is taken out of Woodruff Creek and used for irrigation. The location of the OHWM was assessed based on the following indicators: change in average sediment texture, change in vegetation species, change in vegetation cover, and break in bank slope. These intermittent segments of Woodruff Creek are considered WOTUS and would therefore be considered jurisdictional.

3.1.7 Canal

A total of 13,154 LF (0.861 acres) of canals were identified within the Survey Area. The canals identified in this report carry water throughout the growing season and exhibit indicators of an OHWM. The location of the OHWM was assessed based on the following indicators: break in bank slope, change in vegetation cover, and high-water marks on canal liners. The canals identified in this report appear to have a

connection to Woodruff Creek or Genes Creek, both of which are WOTUS. Therefore, the canals identified in this report would be considered jurisdictional.

3.1.8 Pond – L2AB1 (Lacustrine, Littoral, Aquatic Bed, Algal)

A total of two ponds (0.111 acres) were delineated within the Survey Area. Both of these ponds appear to be perennial features, retaining water throughout the year. The indicators of an OHWM for these two features include a break in bank slope, change in vegetation cover, and change in sediment texture. Both ponds appear to have a connection to Woodruff Creek (a WOTUS) through a canal, Therefore, these features would be considered jurisdictional.

3.1.9 Lake Bed

One lakebed (0.113 acres) was delineated within the Survey Area. This lakebed is situated within the lower Birch Creek Reservoir and appears to have been dry for much of the growing season. The indicators of an OHWM for this feature includes a break in bank slope, and a change in vegetation cover. This lakebed feature receives water from and directly drains into Birch Creek (a WOTUS). Therefore, this lakebed would be considered jurisdictional.

Chapter 4. Conclusions

Based on the findings of this study, a total of 46.937 acres of wetlands, 0.113 acres of lakebed, and 0.111 acres of pond occur within the Survey Area. Additionally, 6,726 LF (3.518 acres) of upper perennial stream, 11,437 LF (3.159 acres) of lower perennial stream, 1,160 LF (0.230 acres) of intermittent stream, and 13,154 LF (0.861 acres) of canal were delineated within the Survey Area. All of the aquatic features identified in this report would be considered jurisdictional and fall under the regulatory authority of the USACE. It should be noted that final authority with regards to wetland delineation and jurisdiction rests with the appropriate regulatory agency.

If you have any questions regarding this report, please contact J-U-B Biologist Becky Hendricks Miller. She may be reached by email at rhmiller@jub.com or by phone at 208-270-3169.

Attachments

1. References
2. Water Resource Delineation Maps
3. Datasheets and Photo Inventory
4. NRCS Soils Map
5. NWI Map

References

Cowardin, e. a. (1979). *Classification of Wetlands and Deepwater Habitats.* Washington E.C: U.S. Fish and Wildlife Service.

NOAA Regional Climate Center. 2022. Woodruff, UT. AgAcis for Cache County. *WETS Table.* Accessed February 24, 2022. agacis.rcc-acis.org/?fips=49033.

USACE. (1987). *Corps of Engineers Wetlands Delineation Manual.* Vicksburg, MS: Environmental Laboratory.

USACE. (September 2008). *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region (Version 2).* Vicksburg, MS: Environmental Laboratory.

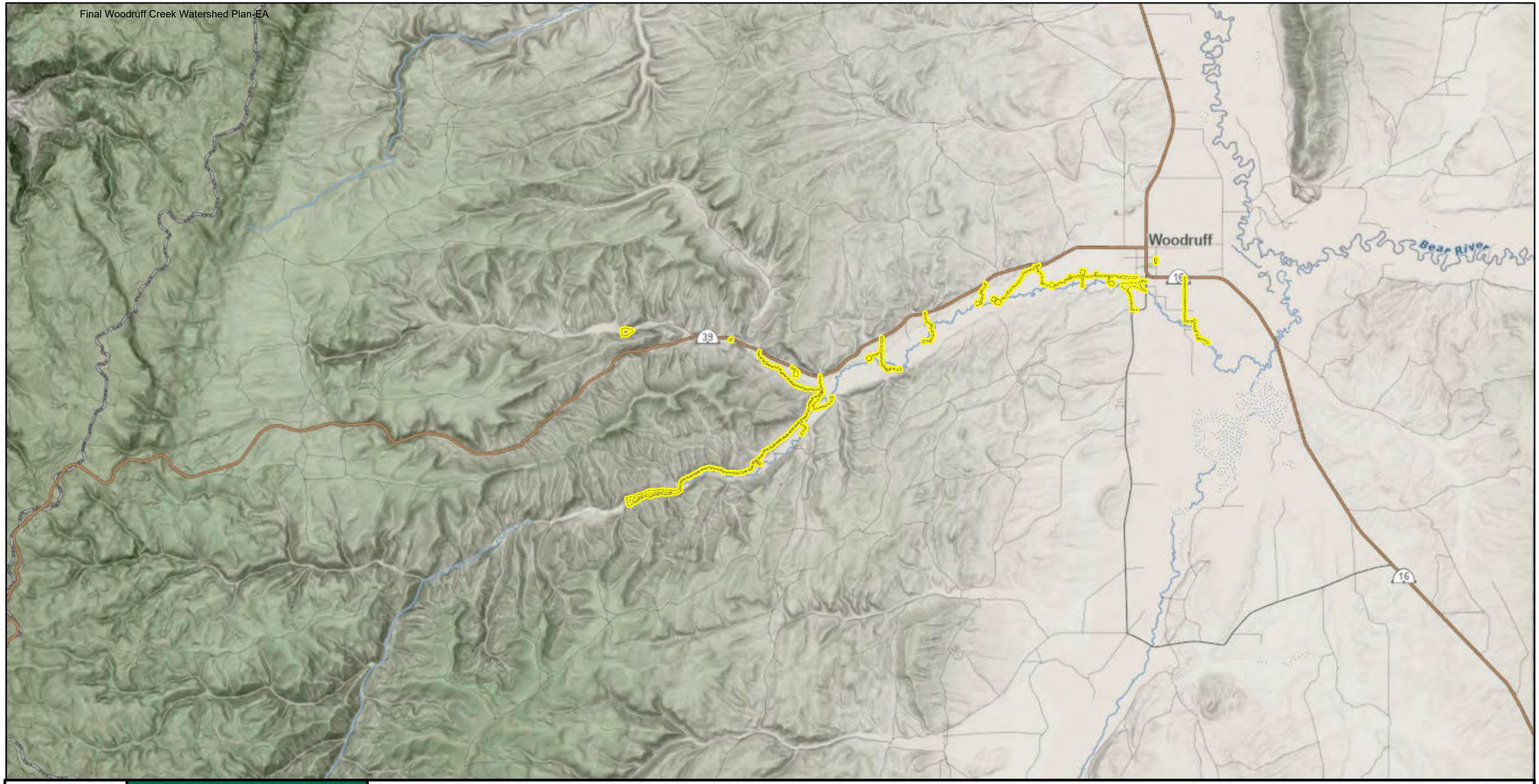
USDA. (2018). *Field Indicators of Hydric Soils in the United States - A guide for identifying and delineating hydric soils (Version 8.2).* United States Department of Agriculture.

U.S. Natural Resource Conservation Service. (2/24/22). *Web Soil Survey*. Custom Soil Resource Report for Rich County, Utah. *Woodruff Survey Area*. Retrieved from Soils Report: https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx.

USFWS. (2/24/22). *National Wetlands Inventory*. Retrieved from United States Fish and Wildlife Service: https://www.fws.gov/wetlands/data/Mapper.html

Western Regional Climate Center (WRCC). 2022a. Woodruff, Utah (429595). *Period of Record Monthly Climate Summary.* Accessed February 24, 2022. https://wrcc.dri.edu/cgi-bin/cliMain.pl?ut9595.

Western Regional Climate Center (WRCC). 2022b. Woodruff, Utah (49595). *Period of Record General Climate Summary - Temperature.* Accessed February 24, 2022. https://wrcc.dri.edu/cgi-bin/cliMain.pl?ut9595.



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Vicinity Map

Delineation of Wetlands and Other Waters of the U.S. - for the Woodruff Creek Watershed Agricultural Water Management Project

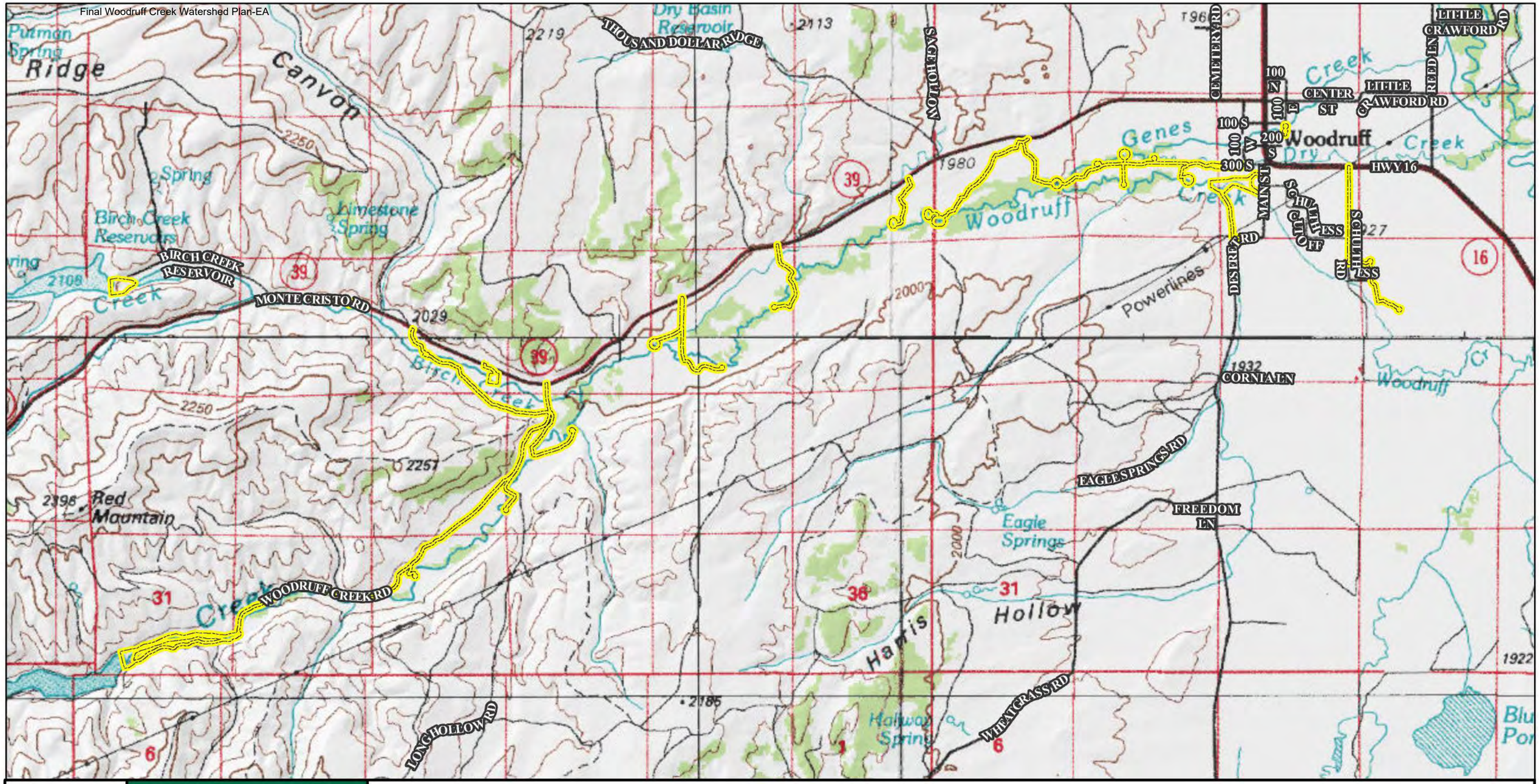
Created on March 31, 2022

Coord. System: NAD 1983 UTM 12N
Projection: Transverse Mercator
Datum: North American 1983

0 1 2 4 Miles

Legend

Survey Area (245 AC)



Topographic Map

Delineation of Wetlands and Other Waters of the U.S. - for the Woodruff Creek Watershed Agricultural Water Management Project

Created on March 31, 2022

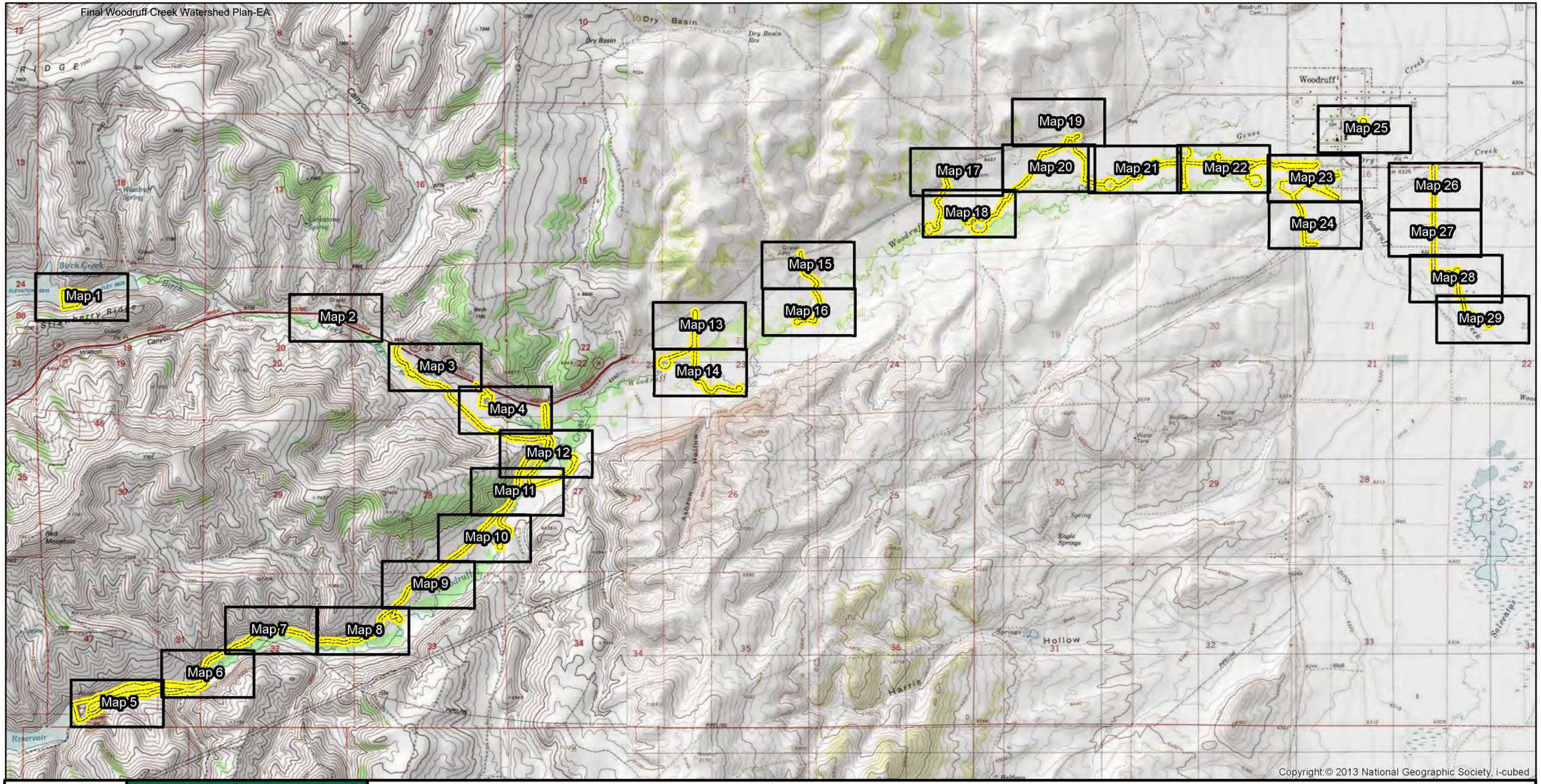
J·U·B ENGINEERS, INC.

Coord. System: NAD 1983 UTM 12N
Projection: Transverse Mercator
Datum: North American 1983

Legend

- Roads_Clip5
- Survey Area (245 AC)

0 0.475 0.95 1.9 Miles



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Index Map

Delineation of Wetlands and Other Waters of the U.S. - for the Woodruff Creek Watershed Agricultural Water Management Project

Created on March 31, 2022

Coord. System: NAD 1983 UTM 12N
Projection: Transverse Mercator
Datum: North American 1983

Legend

- Map Index
- Survey Area (245 AC)

0 0.425 0.85 1.7 Miles

Reserved for WRA Maps

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Woodruff City/County: Rich County Sampling Date: 9/15/2021

Applicant/Owner: Woodruff Irrigation Company State: Utah Sampling Point: SP08

Investigator(s): D. White Section, Township, Range: S19 T9N R6E

Landform (hillslope, terrace, etc.): Floodplain Local relief (concave, convex, none): Slight concave Slope (%): 2

Subregion (LRR): Greater Salt Lake Area Lat: 41.505066° Long: -111.318841° Datum: WGS84

Soil Map Unit Name: Solak gravelly loam, 10 to 50 percent slopes NWI classification: PEM1E

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 _____	**Is the Sampled Area within a Wetland?** Yes ✓ No _____
Hydric Soil Present?	Yes ✓ No _____	
Wetland Hydrology Present?	Yes ✓ No _____	

Remarks:

VEGETATION – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: _____)			
1.			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: _____)			
1.			
2.			
3.			
4.			
5.			
	_____ = Total Cover		
Herb Stratum (Plot size: _____)			
1. Juncus balticus	45	Y	FACW
2. Poa pratensis	20	Y	FAC
3. Potentilla anserina	10		OBL
4. Bromus inermis	10		FACU
5. Plantago sp.	5		NA
6.			
7.			
8.			
	90 = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum _____ % 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: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species _____	x 2 = _____
FAC species _____	x 3 = _____
FACU species _____	x 4 = _____
UPL species _____	x 5 = _____
Column Totals: _____ (A)	_____ (B)

Prevalence Index = B/A = _____

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, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✓ No _____

Remarks:

SOIL

Sampling Point: SP08

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

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-2	10 YR 5/1	100					VFSaL	
2-8	10 YR 3/1	96	5 YR 6/6	4	C	PL	Loam	
8-15	5 YR 4/4	100					Loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

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[3]:

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

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ✓ No ___

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ 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 Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ 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)
- ___ 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:



SP08 Typical Site Conditions | Soil



SP08 Typical Site Conditions | North

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Woodruff City/County: Rich County Sampling Date: 9/15/2021

Applicant/Owner: Woodruff Irrigation Company State: Utah Sampling Point: SP09

Investigator(s): D. White Section, Township, Range: S31 T9N R6E

Landform (hillslope, terrace, etc.): Floodplain Local relief (concave, convex, none): undulating Slope (%): 4

Subregion (LRR): Greater Salt Lake Area Lat: 41.467884° Long: -111.316808° Datum: WGS84

Soil Map Unit Name: Ellett silt loam, 10 to 30 percent slopes NWI classification: PSS1E

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 _____	**Is the Sampled Area within a Wetland?** Yes ✓ No _____
Hydric Soil Present?	Yes ✓	No _____	
Wetland Hydrology Present?	Yes ✓	No _____	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: _____)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: _____)			
1. Salix exigua	45	Y	FACW
2. Ribes aureum	30	Y	FAC
3.			
4.			
5.			
	75 = Total Cover		
Herb Stratum (Plot size: _____)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	_____ = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum _____ % 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: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species _____	x 2 = _____
FAC species _____	x 3 = _____
FACU species _____	x 4 = _____
UPL species _____	x 5 = _____
Column Totals: _____ (A)	_____ (B)

Prevalence Index = B/A = _____

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, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✓ No _____

Remarks:

SOIL

Sampling Point: SP09

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	Remarks
0-12	10 YR 3/2	100					GVL Loam	70 % gravel

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

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[3]:

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

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ✓ No ___

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ 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 Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ 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)
- ___ 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:



SP09 Typical Site Conditions | Soil



SP09 Typical Site Conditions | West

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Woodruff City/County: Rich County Sampling Date: 9/15/2021

Applicant/Owner: Woodruff Irrigation Company State: Utah Sampling Point: SP10

Investigator(s): D. White Section, Township, Range: S32 T9N R6E

Landform (hillslope, terrace, etc.): Floodplain Local relief (concave, convex, none): flat Slope (%): 2

Subregion (LRR): Greater Salt Lake Area Lat: 41.469595° Long: -111.303008° Datum: WGS84

Soil Map Unit Name: Wader loam NWI classification: PEM1E

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 _____	**Is the Sampled Area within a Wetland?** Yes ✓ No _____
Hydric Soil Present?	Yes ✓ No _____	
Wetland Hydrology Present?	Yes ✓ No _____	

Remarks:

VEGETATION – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: _____)			
1.			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: _____)			
1.			
2.			
3.			
4.			
5.			
	_____ = Total Cover		
Herb Stratum (Plot size: _____)			
1. Poa pratensis	30	Y	FAC
2. Equisetum arvense	25	Y	FAC
3. Hordeum pusilla	15		FAC
4. Plantago lanceolata	15		FAC
5.			
6.			
7.			
8.			
	85 = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum _____ % 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: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species _____	x 2 = _____
FAC species _____	x 3 = _____
FACU species _____	x 4 = _____
UPL species _____	x 5 = _____
Column Totals: _____ (A)	_____ (B)

Prevalence Index = B/A = _____

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, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✓ No _____

Remarks:

SOIL

Sampling Point: SP10

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	Remarks
0-4	5 YR 4/6	100					SiC	
4-12	7.5 YR 4/3	100					Sand	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

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[3]:

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

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ✓ No ___

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ 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 Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ 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)
- ___ 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:



SP10 Typical Site Conditions | Soil



SP10 Typical Site Conditions | West

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Woodruff City/County: Rich County Sampling Date: 9/15/2021

Applicant/Owner: Woodruff Irrigation Company State: Utah Sampling Point: SP11

Investigator(s): D. White Section, Township, Range: S33 T9N R6E

Landform (hillslope, terrace, etc.): Floodplain Local relief (concave, convex, none): flat Slope (%): 2

Subregion (LRR): Greater Salt Lake Area Lat: 41.475469° Long: -111.278857° Datum: WGS84

Soil Map Unit Name: Wader loam NWI classification: PEM1E

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 _____	**Is the Sampled Area within a Wetland?** Yes ✓ No _____
Hydric Soil Present?	Yes ✓ No _____	
Wetland Hydrology Present?	Yes ✓ No _____	

Remarks:

VEGETATION – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: _____)			
1.			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: _____)			
1.			
2.			
3.			
4.			
5.			
	_____ = Total Cover		
Herb Stratum (Plot size: _____)			
1. Poa pratensis	25	Y	FAC
2. Plantago lanceolata	20	Y	FAC
3. Equisetum arvense	25	Y	FAC
4.			
5.			
6.			
7.			
8.			
	70 = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum _____ % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

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

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:	
OBL species _____	x 1 =	_____
FACW species _____	x 2 =	_____
FAC species _____	x 3 =	_____
FACU species _____	x 4 =	_____
UPL species _____	x 5 =	_____
Column Totals: _____ (A)		_____ (B)

Prevalence Index = B/A = _____

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, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✓ No _____

Remarks:

SOIL

Sampling Point: SP11

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

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-3	10 YR 3/2	100					Loam	
3-5	10 YR 6/3	100					Sand	
5-12	10 YR 4/2	90	10 YR 6/8	10	C	PL	Sand	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

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[3]:

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

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ✓ No ___

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ 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 Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ 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)
- ___ 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:



SP11 Typical Site Conditions | Soils



SP11 Typical Site Conditions | West

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Woodruff City/County: Rich County Sampling Date: 9/15/2021

Applicant/Owner: Woodruff Irrigation Company State: Utah Sampling Point: SP12

Investigator(s): D. White Section, Township, Range: S20 T9N R6E

Landform (hillslope, terrace, etc.): Floodplain Local relief (concave, convex, none): Flat Slope (%): 2

Subregion (LRR): Greater Salt Lake Area Lat: 41.503379° Long: -111.287667° Datum: WGS84

Soil Map Unit Name: Bereniceton silt loam, cool, 1 to 3 percent slopes NWI classification: PEM1E

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 _____	**Is the Sampled Area within a Wetland?** Yes ✓ No _____
Hydric Soil Present?	Yes ✓ No _____	
Wetland Hydrology Present?	Yes ✓ No _____	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: _____)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: _____)			
1. Salix boothii	15	Y	FACW
2. Salix exigua	10	Y	FACW
3.			
4.			
5.			
	25 = Total Cover		
Herb Stratum (Plot size: _____)			
1. Plantago major	10		FAC
2. Carex nebrascensis	20	Y	OBL
3. Equisetum arvense	20	Y	FAC
4. Poa pratensis	15	Y	FAC
5.			
6.			
7.			
8.			
	65 = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum _____ % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 5 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	20	x 1 =	20
FACW species	25	x 2 =	50
FAC species	35	x 3 =	105
FACU species	0	x 4 =	0
UPL species	0	x 5 =	0
Column Totals:	90 (A)		225 (B)

Prevalence Index = B/A = 2.5

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, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✓ No _____

Remarks:

SOIL

Sampling Point: SP12

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 %	Redox Features Type[1]	Redox Features Loc[2]	Texture	Remarks
0-4	10 YR 3/2	100					VFSaL	
4-6	7.5 YR 3/3	100					Sand	
6-18	7.5 YR 3/3	60	10 YR 5/8	5	C	PL	SaL	
	10 YR 2/1	35						

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

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[3]:

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

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ✓ No ___

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ 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 Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ 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)
- ___ 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): 12

Saturation Present? (includes capillary fringe) Yes ✓ No ___ Depth (inches): 10

Wetland Hydrology Present? Yes ✓ No ___

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

Remarks:



SP12 Typical Site Conditions | Soils



SP12 Typical Site Conditions | West

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Woodruff City/County: Rich County Sampling Date: 9/15/2021

Applicant/Owner: Woodruff Irrigation Company State: Utah Sampling Point: SP13

Investigator(s): D. White Section, Township, Range: S21 T9N R6E

Landform (hillslope, terrace, etc.): Floodplain Local relief (concave, convex, none): Flat Slope (%): 3

Subregion (LRR): Greater Salt Lake Area Lat: 41.498364° Long: -111.277063° Datum: WGS84

Soil Map Unit Name: Wader loam NWI classification: PSS1E

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 _____	**Is the Sampled Area within a Wetland?** Yes ✓ No _____
Hydric Soil Present?	Yes ✓	No _____	
Wetland Hydrology Present?	Yes ✓	No _____	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: _____)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: _____)			
1. Salix exigua	45	Y	FACW
2.			
3.			
4.			
5.			
	45 = Total Cover		
Herb Stratum (Plot size: _____)			
1. Phalaris arundinacea	30	Y	FACW
2. Juncus balticus	35	Y	FACW
3.			
4.			
5.			
6.			
7.			
8.			
	65 = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum _____ % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

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

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	110	x 2 =	220
FAC species	0	x 3 =	0
FACU species	0	x 4 =	0
UPL species	0	x 5 =	0
Column Totals:	110 (A)		220 (B)

Prevalence Index = B/A = 2

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, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✓ No _____

Remarks:

SOIL

Sampling Point: SP13

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 %	Redox Features Type[1]	Redox Features Loc[2]	Texture	Remarks
0-4	10 YR 3/1	100					Loam	
4-12	10 YR 5/1	100					Loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

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[3]:

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

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ✓ No ___

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ 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 Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ 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)
- ___ 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:



SP13 Typical Site Conditions | Soils



SP13 Typical Site Conditions | North



SC02 Typical Site Conditions | South



SC03 Typical Site Conditions | North



SC06 Typical Site Conditions | West



SC07 Typical Site Conditions | South



SC08 Typical Site Conditions | West



SC09 Typical Site Conditions | West



SC10 Typical Site Conditions | South



SC11 Typical Site Conditions | West



SC12 Typical Site Conditions | South



SC13 Typical Site Conditions | East



SC14 Typical Site Conditions | West



SC15 Typical Site Conditions | South



SC16 Typical Site Conditions | East



SC17 Typical Site Conditions | East



SC18 Typical Site Conditions | North



SC19 Typical Site Conditions | South



SC20 Typical Site Conditions | North



SC21 Typical Site Conditions | East



SC22 Typical Site Conditions | East



SC23 Typical Site Conditions | East



SC100 Typical Site Conditions | West



SC101 Typical Site Conditions | North



SC102 Typical Site Conditions | South



SC103 Typical Site Conditions | North



SC104 Typical Site Conditions | East



SC105 Typical Site Conditions | North



SC106 Typical Site Conditions | West



SC107 Typical Site Conditions | East



SC108 Typical Site Conditions | West



SC109 Typical Site Conditions | West



SC111 Typical Site Conditions | Southeast



SC112 Typical Site Conditions | East



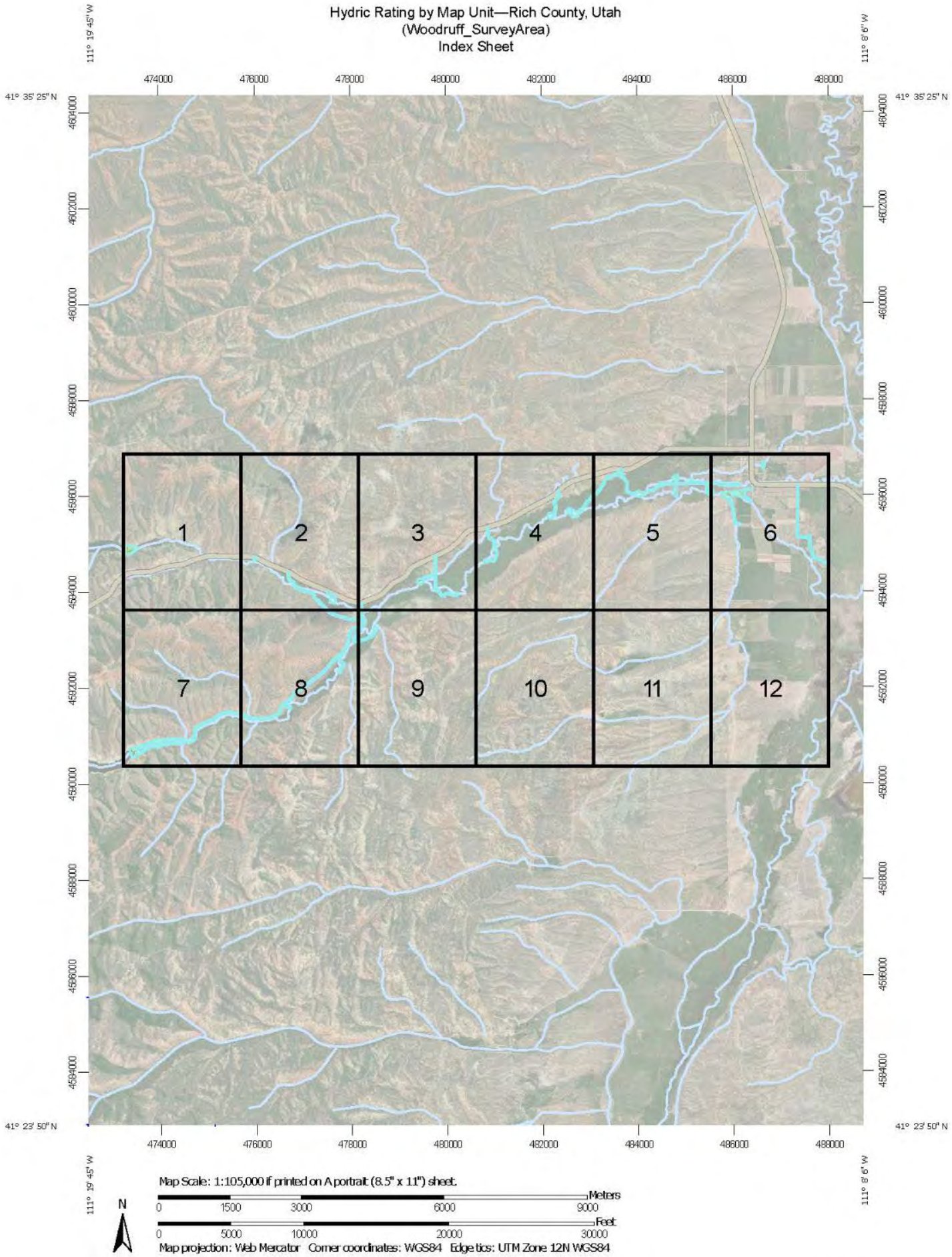
SC113 Typical Site Conditions | West



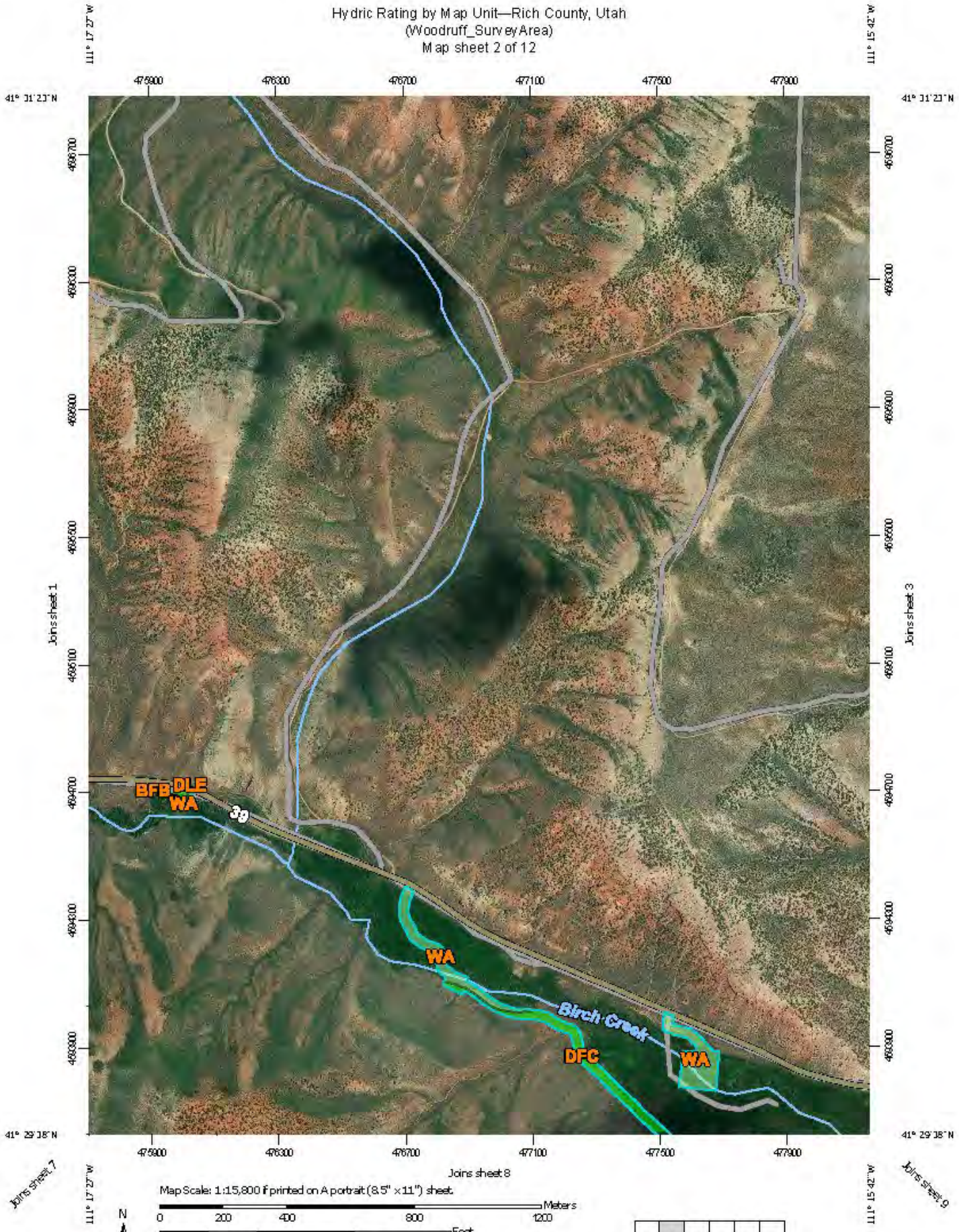
SC114 Typical Site Conditions | West



SC115 Typical Site Conditions | North


Hydric Rating by Map Unit—Rich County, Utah
(Woodruff_SurveyArea)
Index Sheet
111° 19' 45" W
111° 8' 6" W
41° 35' 25" N
41° 23' 50" N
474000
476000
478000
480000
482000
484000
486000
488000
4604000
4602000
4600000
4598000
4596000
4594000
4592000
4590000
4588000
4586000
4584000
1
2
3
4
5
6
7
8
9
10
11
12
Map Scale: 1:105,000 if printed on A portrait (8.5" x 11") sheet.
Meters
0
1500
3000
6000
9000
Feet
0
5000
10000
20000
30000
N
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 12N WGS84

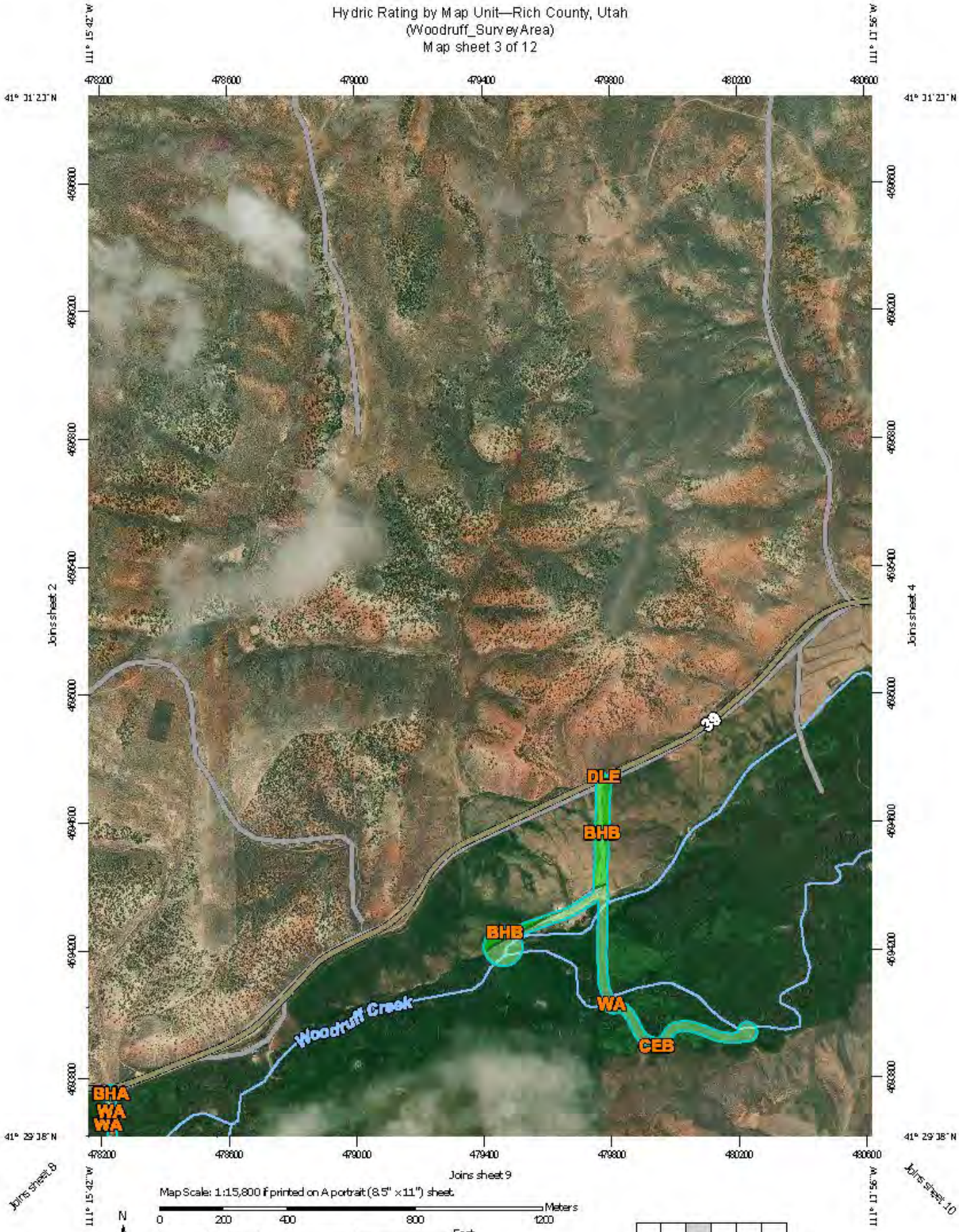

Hydric Rating by Map Unit—Rich County, Utah
(Woodruff_Survey Area)
Map sheet 1 of 12
111° 19' 17"W
111° 17' 27"W
473300
473700
474100
474500
474900
475300
475700
41° 31' 21" N
41° 29' 18" N
4696700
4696300
4695900
4695500
4695100
4694700
4694300
4693900
4693500
W
SHF
DEE
W
DEE
Birch Creek
State Hwy 39
39
Joins sheet 2
Joins sheet 7
Joins sheet 8
Map Scale: 1:15,800 if printed on A portrait (8.5" x 11") sheet.
Meters
0
200
400
800
1200
N
Feet
0
500
1000
2000
3000
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 12N WGS84
1
Map Sheet Location



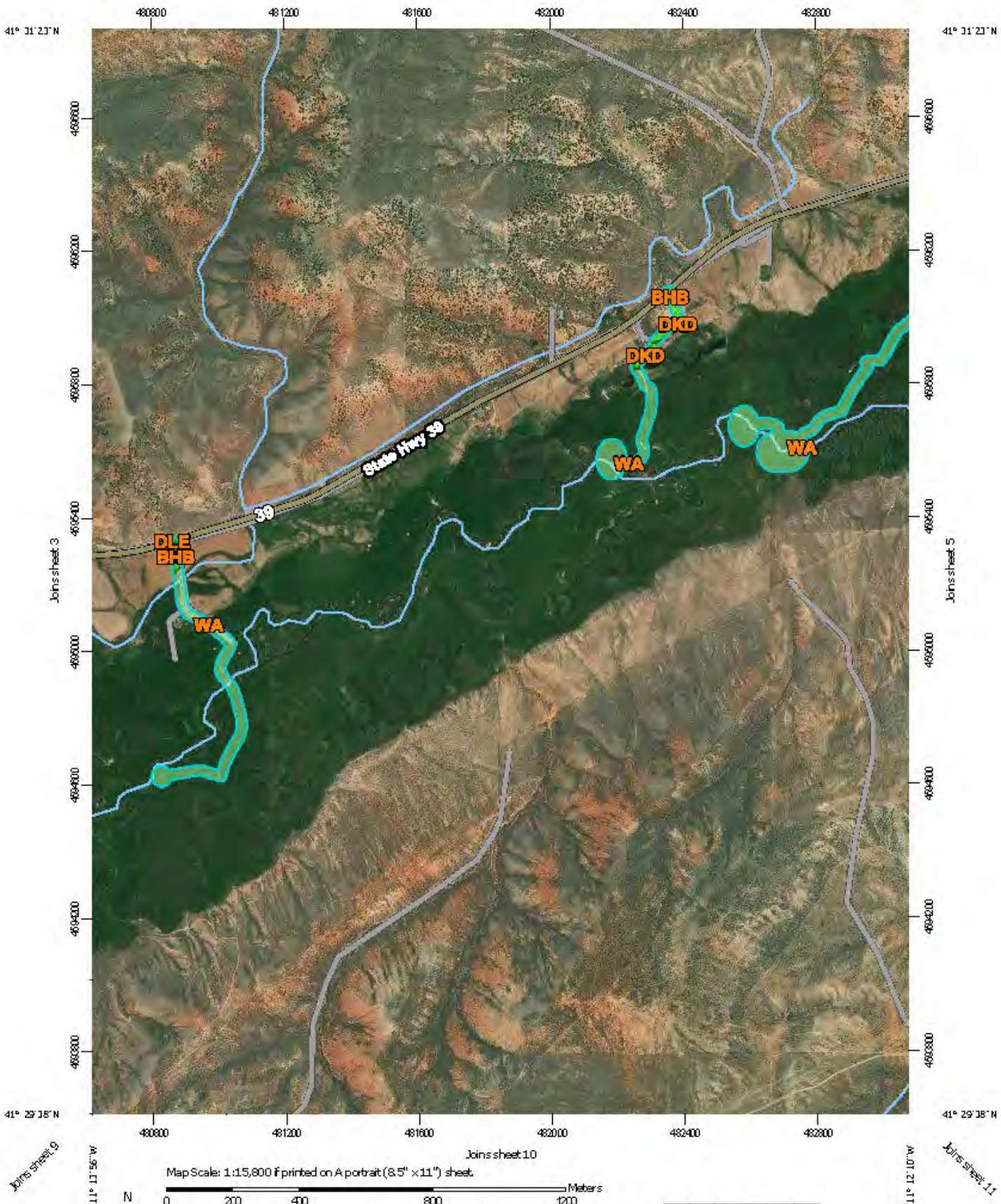
USDA **Natural Resources Conservation Service**

Web Soil Survey
National Cooperative Soil Survey

4/29/2022


Hydric Rating by Map Unit—Rich County, Utah
(Woodruff_Survey Area)
Map sheet 3 of 12
111° 15' 42" W
111° 11' 56" W
478200
478600
479000
479400
479800
480200
480600
41° 31' 23" N
41° 29' 18" N
4696800
4696200
4695600
4695000
4694400
4693800
Joins sheet 2
Joins sheet 4
Joins sheet 8
Joins sheet 9
Joins sheet 10
39
DLE
BHB
BHB
WA
CEB
Woodruff Creek
BHA
WA
WA
Map Scale: 1:15,800 if printed on A portrait (8.5" x 11") sheet.
Meters
0 200 400 800 1200
N
Feet
0 500 1000 2000 3000
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 12N WGS84
3
Map Sheet Location

Hydric Rating by Map Unit—Rich County, Utah
(Woodruff_SurveyArea)
Map sheet 4 of 12



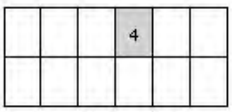
Map Scale: 1:15,800 if printed on A portrait (8.5" x 11") sheet.

Meters: 0, 200, 400, 800, 1200

Feet: 0, 500, 1000, 2000, 3000

N

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



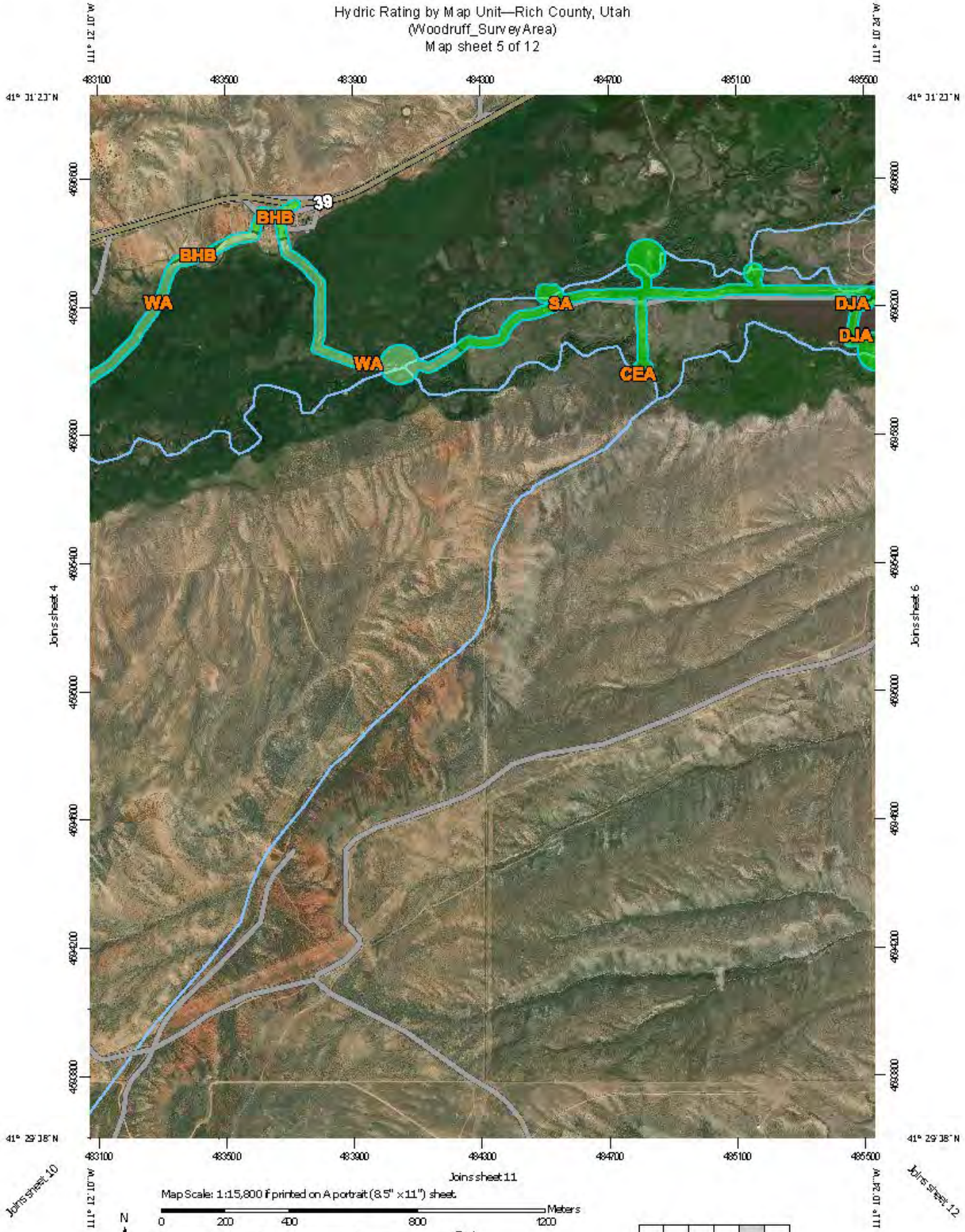
Map Sheet Location

USDA Natural Resources Conservation Service

Web Soil Survey
National Cooperative Soil Survey

4/29/2022
Page 5 of 18

Hydric Rating by Map Unit—Rich County, Utah
(Woodruff_SurveyArea)
Map sheet 5 of 12



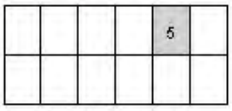
Map Scale: 1:15,800 if printed on A portrait (8.5" x 11") sheet.

Meters: 0 200 400 800 1200

Feet: 0 500 1000 2000 3000

N

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



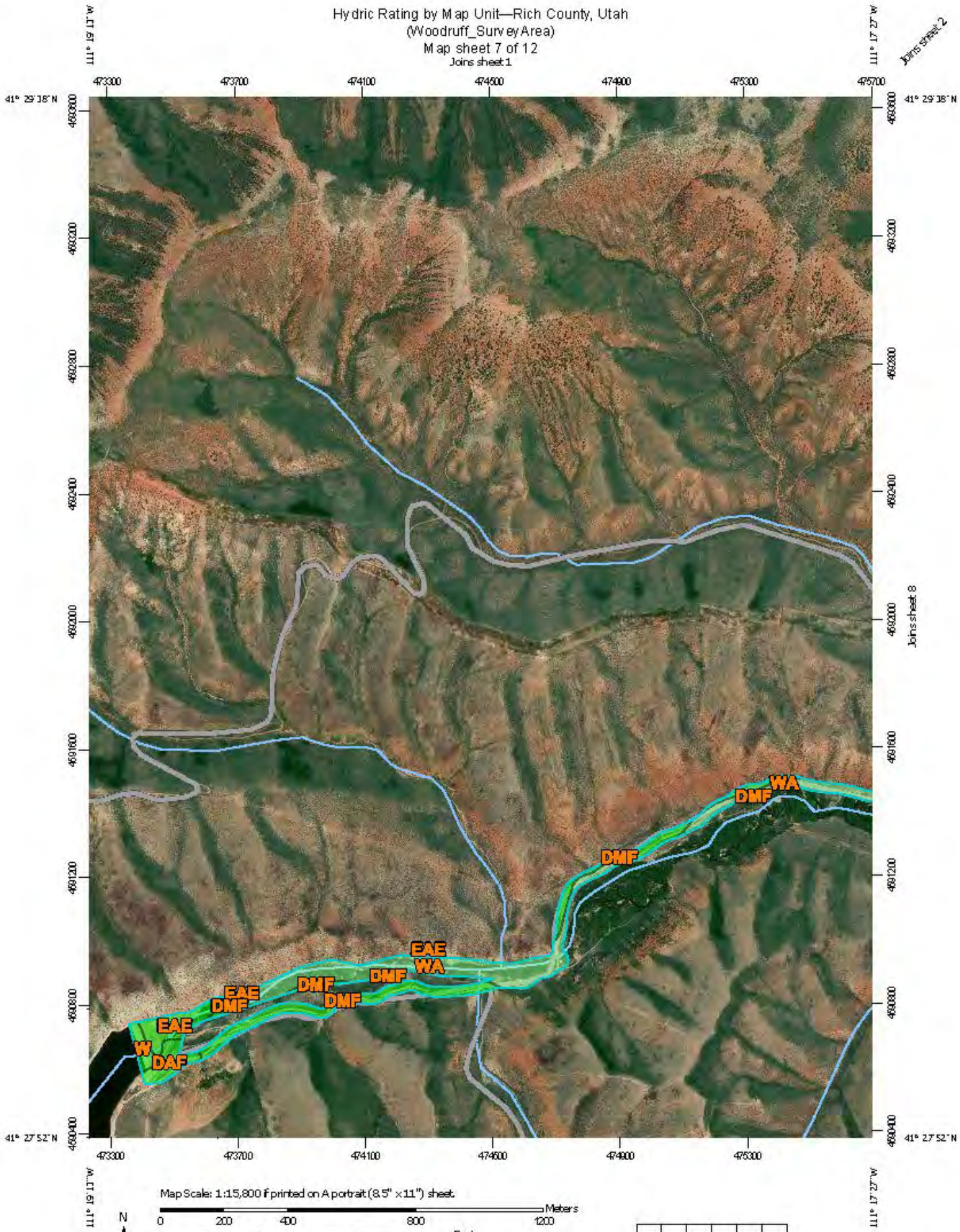
Map Sheet Location

USDA Natural Resources Conservation Service

Web Soil Survey
National Cooperative Soil Survey

4/29/2022

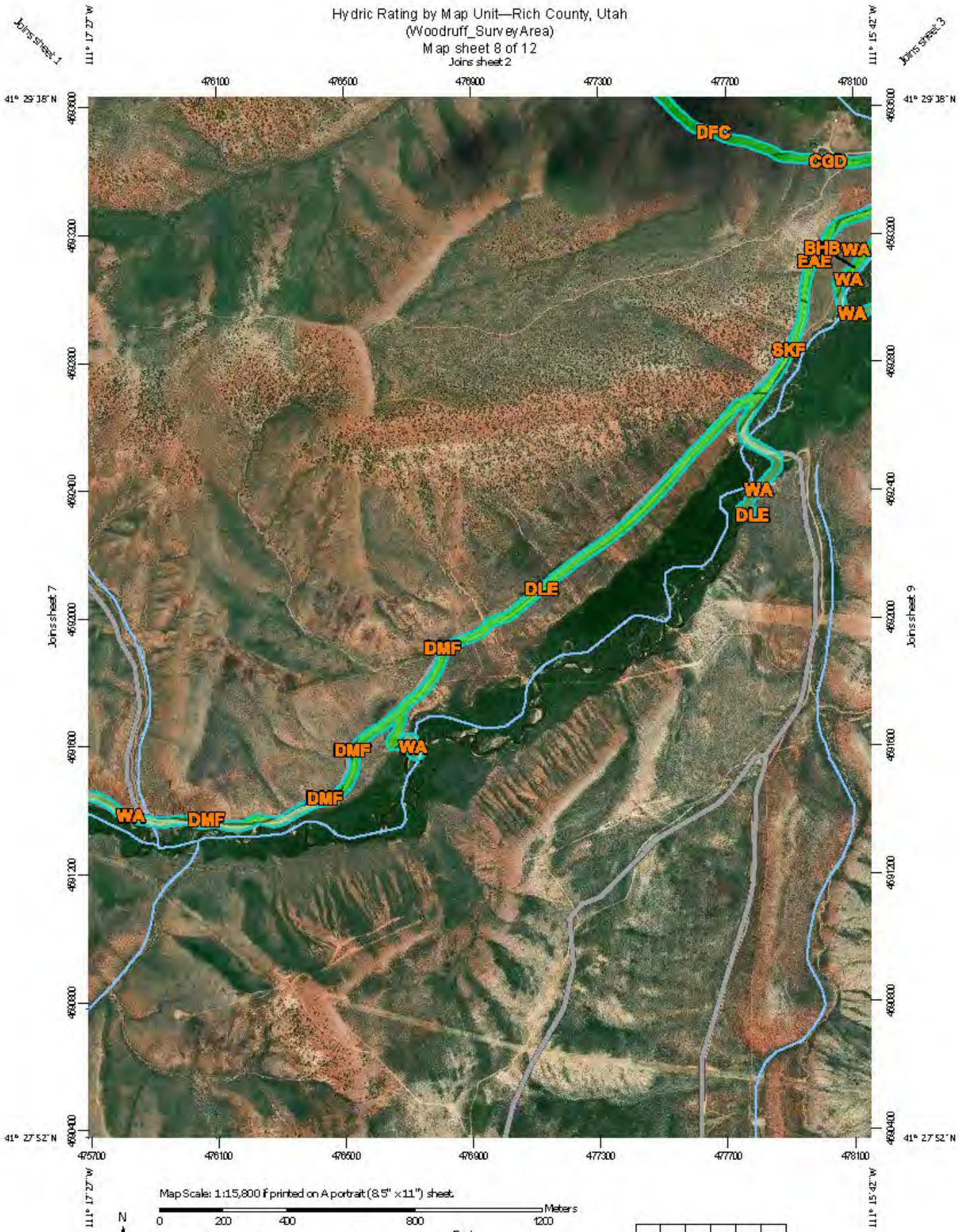

Hydric Rating by Map Unit—Rich County, Utah
(Woodruff_Survey Area)
Map sheet 6 of 12
DJA
CEA
Game's Creek
Dry Creek
16
DJA
DJA
SA
CEA
DJA
DJA
CEA
SA
CEA
PAC
CEA
CEA
Bathtub Ln
CEA
SA
Desert Rd
Corrin Ln
Joins sheet 5
Joins sheet 12
Joins sheet 11
Map Scale: 1:15,800 if printed on A portrait (8.5" x 11") sheet.
Meters
0 200 400 800 1200
Feet
0 500 1000 2000 3000
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 12N WGS84
N
6
Map Sheet Location



USDA Natural Resources Conservation Service

Web Soil Survey
National Cooperative Soil Survey

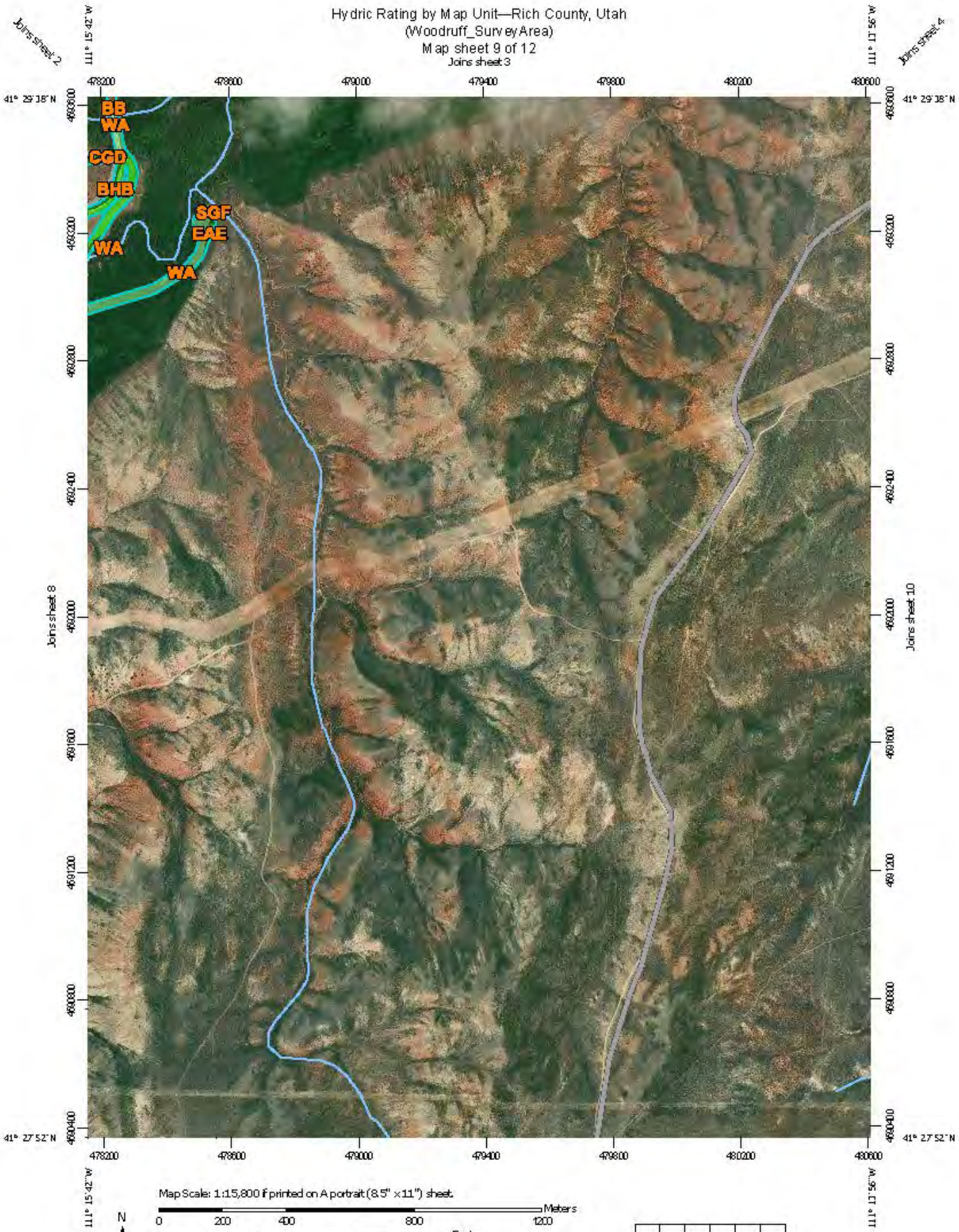
4/29/2022
Page 8 of 18



USDA **Natural Resources Conservation Service**

Web Soil Survey
National Cooperative Soil Survey

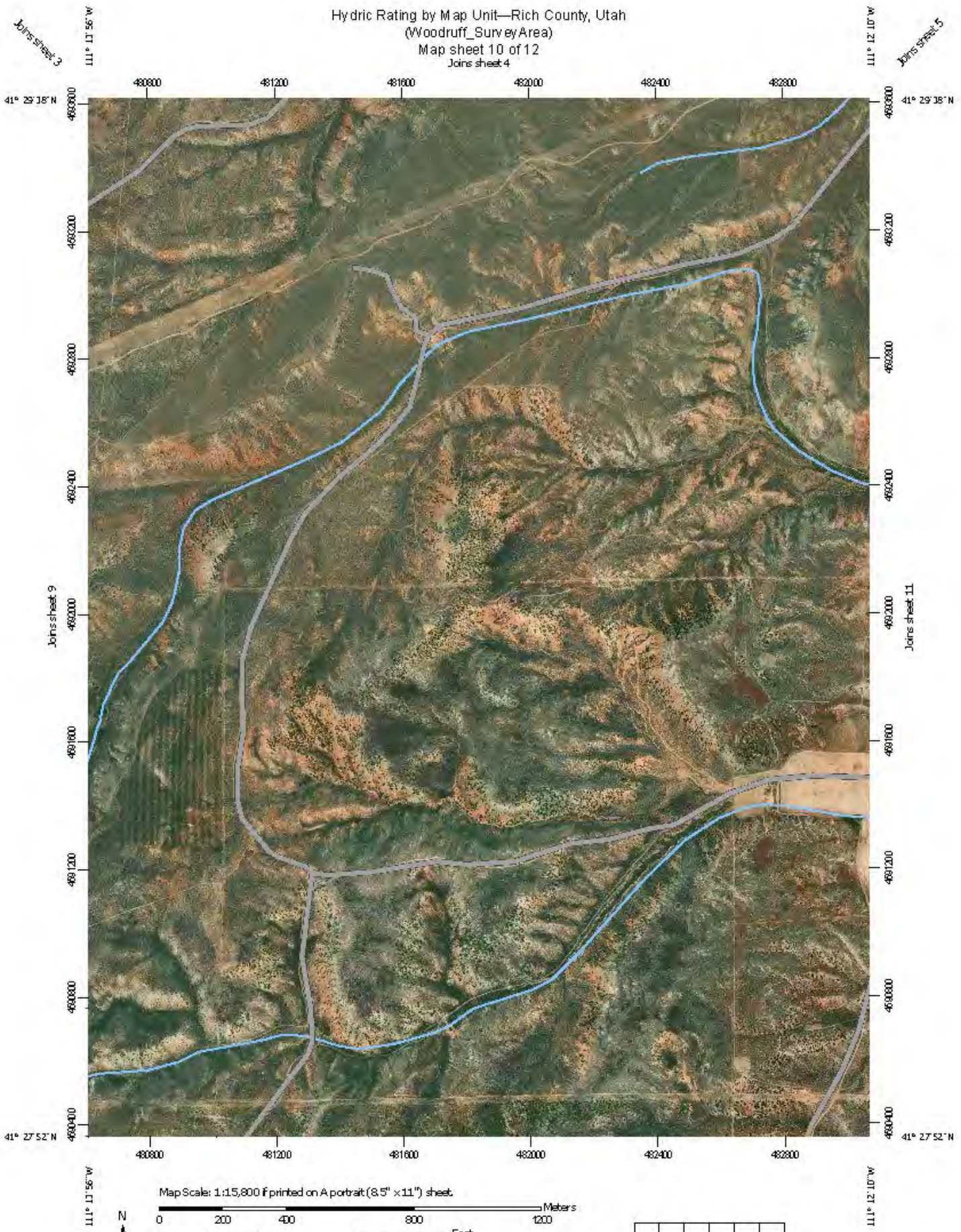
4/29/2022
Page 9 of 18



USDA **Natural Resources Conservation Service**

Web Soil Survey
National Cooperative Soil Survey

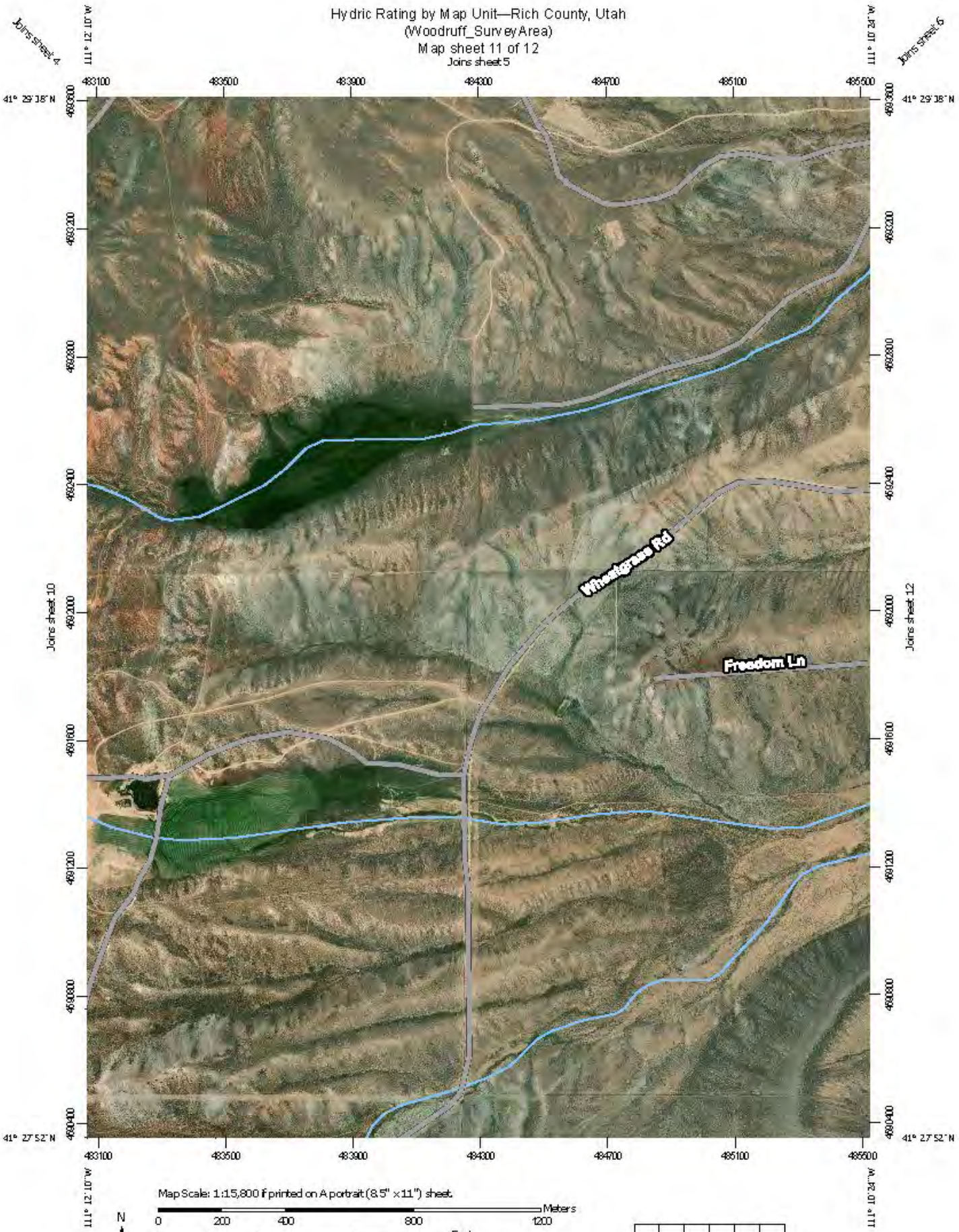
4/29/2022
Page 10 of 18



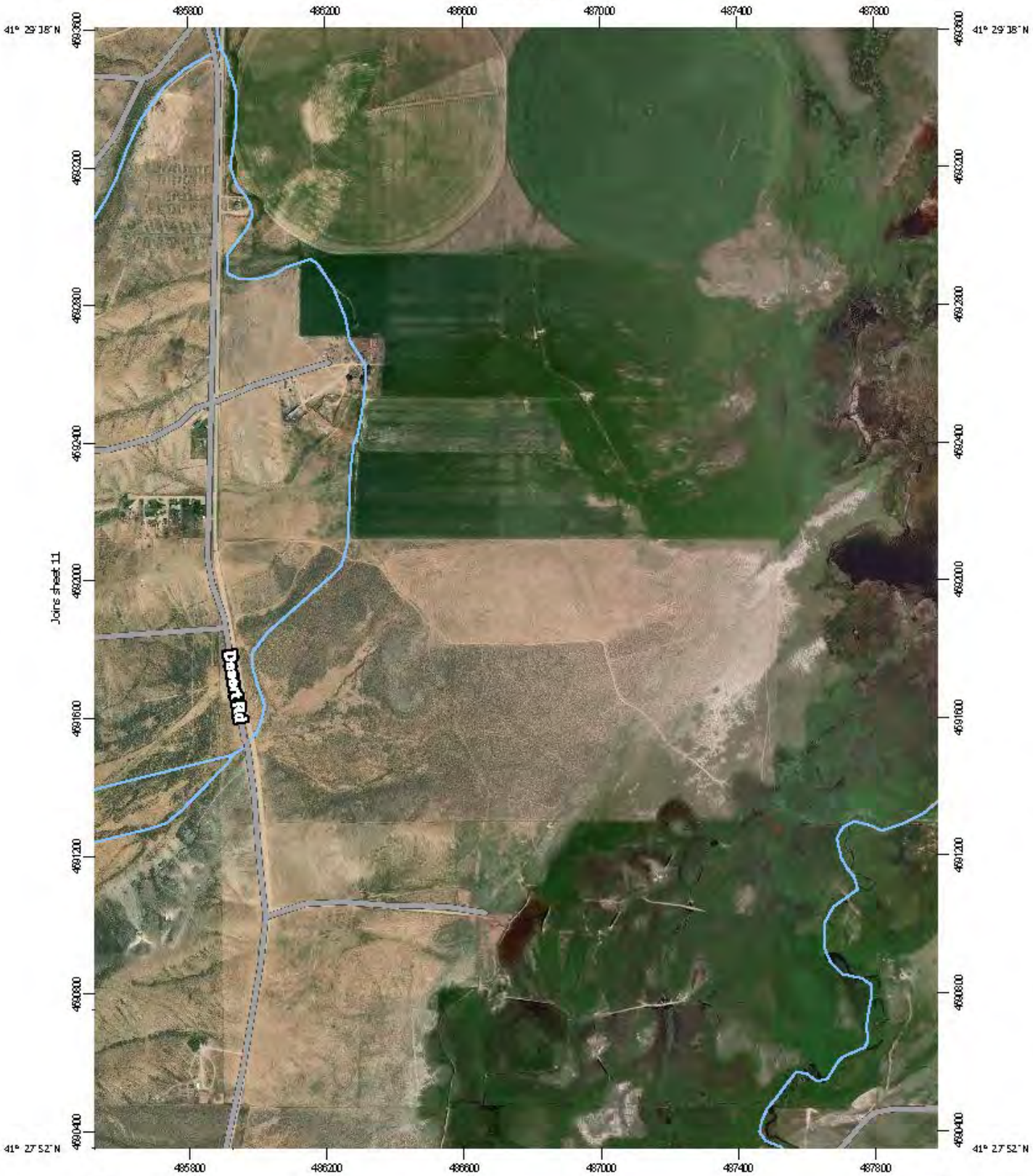
USDA **Natural Resources Conservation Service**

Web Soil Survey
National Cooperative Soil Survey

4/29/2022
Page 11 of 18


Hydric Rating by Map Unit—Rich County, Utah
(Woodruff_Survey Area)
Map sheet 11 of 12
Joins sheet 5
Joins sheet 4
Joins sheet 6
Joins sheet 10
Joins sheet 12
Wheelgrass Rd
Freedom Ln
483100
483500
483900
484300
484700
485100
485500
4692800
4692400
4692000
4691600
4691200
4690800
4690400
41° 29' 18" N
41° 27' 52" N
111° 21' 10" W
111° 20' 47" W
Map Scale: 1:15,800 if printed on A portrait (8.5" x 11") sheet.
Meters
0 200 400 800 1200
Feet
0 500 1000 2000 3000
N
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 12N WGS84
11
Map Sheet Location

Hydric Rating by Map Unit—Rich County, Utah
(Woodruff_Survey Area)
Map sheet 12 of 12

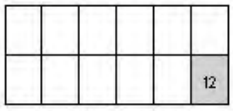


Map Scale: 1:15,800 if printed on A portrait (8.5" x 11") sheet.

Meters: 0 200 400 800 1200

Feet: 0 500 1000 2000 3000

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



Map Sheet Location

USDA **Natural Resources Conservation Service**

Web Soil Survey
National Cooperative Soil Survey

4/29/2022

MAP LEGEND

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

Soils

Soil Rating Polygons
- Hydric (100%)
- Hydric (66 to 99%)
- Hydric (33 to 65%)
- Hydric (1 to 32%)
- Not Hydric (0%)
- Not rated or not available

Soil Rating Lines
- Hydric (100%)
- Hydric (66 to 99%)
- Hydric (33 to 65%)
- Hydric (1 to 32%)
- Not Hydric (0%)
- Not rated or not available

Soil Rating Points
- Hydric (100%)
- Hydric (66 to 99%)
- Hydric (33 to 65%)
- Hydric (1 to 32%)
- Not Hydric (0%)
- 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 1:24,000.

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: Rich County, Utah
Survey Area Data: Version 16, 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: May 6, 2012—Nov 8, 2017

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.

Hydric Rating by Map Unit

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
BB	Bear Lake silt loam	94	0.3	0.1%
BFB	Bereniceton silt loam, cool, 1 to 3 percent slopes	0	0.5	0.2%
BHA	Bockston loam, cool, 0 to 3 percent slopes	0	0.4	0.1%
BHB	Bockston loam, cool, 3 to 6 percent slopes	0	15.2	6.2%
CEA	Cowco loam, 0 to 3 percent slopes	0	25.6	10.5%
CEB	Cowco loam, 3 to 6 percent slopes	0	0.2	0.1%
CGD	Cutoff gravelly loam, 6 to 25 percent slopes	0	3.6	1.5%
DAF	Dagan gravelly loam, moist, 25 to 40 percent slopes	0	3.0	1.2%
DEE	Dennot loam, 25 to 40 percent slopes	0	1.9	0.8%
DFC	Dennot very gravelly loam, 4 to 15 percent slopes	0	8.5	3.5%
DJA	Duckree loam, 0 to 3 percent slopes	0	3.8	1.6%
DKD	Duckree gravelly loam, 3 to 25 percent slopes	0	0.8	0.3%
DLE	Duckree gravelly silt loam, 15 to 40 percent slopes	0	15.6	6.4%
DMF	Duckree-St. Marys association, dry, 25 to 50 percent slopes	0	15.3	6.3%
EAE	Ellett silt loam, 10 to 30 percent slopes	0	6.5	2.7%
PAC	Pancheri silt loam, cool, 1 to 5 percent slopes	0	3.2	1.3%
SA	Saleratus loam	0	35.6	14.5%
SGF	Slinger gravelly loam, 25 to 40 percent slopes	0	0.0	0.0%
SHF	Solak gravelly loam, 10 to 50 percent slopes	0	5.0	2.1%
SKF	Solak-Ranruff-Rock outcrop complex, 30 to 60 percent slopes	0	2.3	0.9%

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
W	Water	0	4.3	1.8%
WA	Wader loam	6	92.7	37.9%
Totals for Area of Interest			**244.4**	**100.0%**

Description

This rating indicates the percentage of map units that meets the criteria for hydric soils. Map units are composed of one or more map unit components or soil types, each of which is rated as hydric soil or not hydric. Map units that are made up dominantly of hydric soils may have small areas of minor nonhydric components in the higher positions on the landform, and map units that are made up dominantly of nonhydric soils may have small areas of minor hydric components in the lower positions on the landform. Each map unit is rated based on its respective components and the percentage of each component within the map unit.

The thematic map is color coded based on the composition of hydric components. The five color classes are separated as 100 percent hydric components, 66 to 99 percent hydric components, 33 to 65 percent hydric components, 1 to 32 percent hydric components, and less than one percent hydric components.

In Web Soil Survey, the Summary by Map Unit table that is displayed below the map pane contains a column named 'Rating'. In this column the percentage of each map unit that is classified as hydric is displayed.

Hydric soils are defined by the National Technical Committee for Hydric Soils (NTCHS) as soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part (Federal Register, 1994). Under natural conditions, these soils are either saturated or inundated long enough during the growing season to support the growth and reproduction of hydrophytic vegetation.

The NTCHS definition identifies general soil properties that are associated with wetness. In order to determine whether a specific soil is a hydric soil or nonhydric soil, however, more specific information, such as information about the depth and duration of the water table, is needed. Thus, criteria that identify those estimated soil properties unique to hydric soils have been established (Federal Register, 2002). These criteria are used to identify map unit components that normally are associated with wetlands. The criteria used are selected estimated soil properties that are described in "Soil Taxonomy" (Soil Survey Staff, 1999) and "Keys to Soil Taxonomy" (Soil Survey Staff, 2006) and in the "Soil Survey Manual" (Soil Survey Division Staff, 1993).

If soils are wet enough for a long enough period of time to be considered hydric, they should exhibit certain properties that can be easily observed in the field. These visible properties are indicators of hydric soils. The indicators used to make onsite determinations of hydric soils are specified in "Field Indicators of Hydric Soils in the United States" (Hurt and Vasilas, 2006).

References:

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18.

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service. U.S. Department of Agriculture Handbook 436.

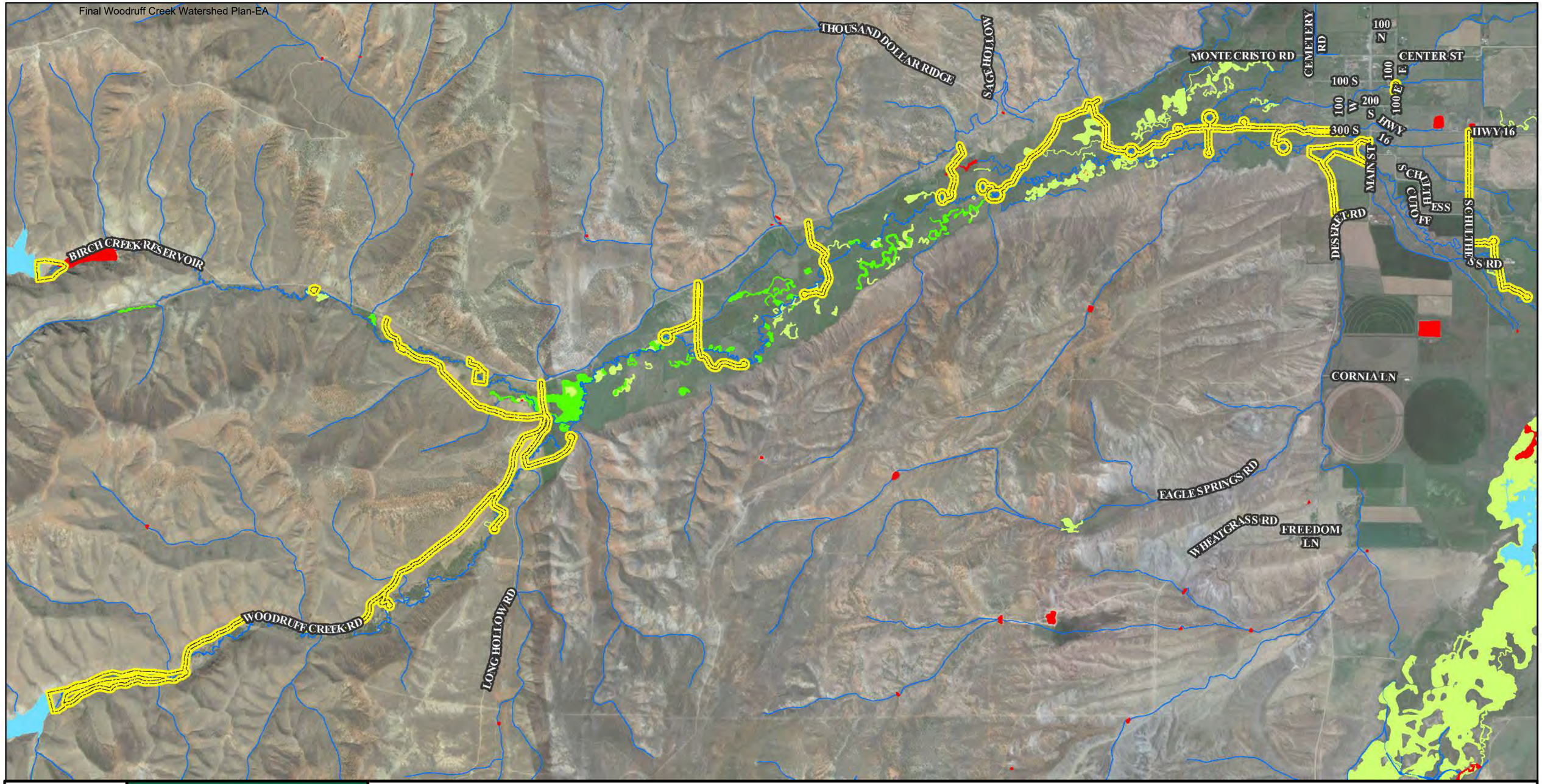
Soil Survey Staff. 2006. Keys to soil taxonomy. 10th edition. U.S. Department of Agriculture, Natural Resources Conservation Service.

Rating Options

Aggregation Method: Percent Present

Component Percent Cutoff: None Specified

Tie-break Rule: Lower



NWI Map

Delineation of Wetlands and Other Waters of the U.S. - for the Woodruff Creek Watershed Agricultural Water Management Project

Created on March 31, 2022

J-U-B ENGINEERS, INC.

Coord. System: NAD 1983 UTM 12N
Projection: Transverse Mercator
Datum: North American 1983
Imagery: Utah AGRC Basemap

0 0.25 0.5 1 Miles

Legend

- Survey Area (245 AC)
- Freshwater Emergent Wetland (QTY 10)
- Freshwater Forested/Shrub Wetland (QTY 6)
- Freshwater Pond (QTY 5)
- Lake (QTY 3)
- Riverine (QTY 22)

Technical Memorandum No. 1 – Hydraulics and Hydrology, Flood Control, Agricultural Analysis

J-U-B ENGINEERS, INC.

TECHNICAL MEMORANDUM 001

Date:	November 2023
To:	Bronson Smart, P.E. – State Conservation Engineer Norm Evenstad, P.E. – Water Resources Coordinator Aimee Rohner, P.E. – State Design Engineer NRCS - Utah
Cc:	Zan Murray, P.E. – J-U-B ENGINEERS, Inc.
From:	Paul Willardson, PE – J-U-B ENGINEERS, Inc.
Project:	Woodruff Irrigation Company-Watershed Plan-EA
Subject:	Hydraulics & Hydrology and Agriculture Analysis

1.0 Introduction

The Woodruff Irrigating Company (WIC) contracted with J-U-B Engineers, Inc. (J-U-B) to complete a Watershed Plan-Environmental Assessment (Plan-EA) of the WIC Agricultural Project. Part of the Scope of Work includes analysis of the hydraulics and hydrology for agricultural water management. This technical memorandum examines the hydraulics and hydrology of the Woodruff Creek watershed and its effects on the agricultural water management.

1.1 Purpose and Need

The purpose of this technical memorandum (TM001) is to present the hydraulics and hydrology analysis and the agriculture design conducted for the Woodruff Creek Watershed Plan-EA. A hydrologic study of a watershed is needed to determine the anticipated volume of water that will be discharged by an area during a specific storm event and how this volume moves through the watershed over time. A hydraulic study is needed to determine the response of existing natural and irrigation channels to convey the predicted volume of runoff, and to design diversion improvements to withstand expected design flows.

2.0 Agricultural Water Analysis

The WIC supplies agricultural water to approximately 5,800 acres. The agricultural water is stored and released from Woodruff and Birch Creek Reservoirs. There is typically about 6 weeks of available storage in the reservoirs, that has created a short irrigation season. The irrigators along upper sections of Woodruff Creek are typically flood irrigators where those on the lower end-use pressurized sprinkler systems. All the diversions operated by the WIC are old, deteriorating, and need replacement. On large water release years many of the diversions are washed out and require repair or reconstruction. Updated concrete diversion structures and head gates were evaluated at all diversion locations including the splitter structure. Added automation was also considered at the splitter structure and at the Woodruff Reservoir. These additions will increase the operational efficiency of the WIC system.

2.1 Agricultural Water Management Policies

The design of the Woodruff Reservoir low level outlet automation and irrigation diversion systems improvements will meet the requirements of the NRCS and Utah State Code. Design requirements are identified in Utah's Administrative Code R655-11, NRCS Practice Standards Codes 362 and 402, and American Concrete Institute (ACI) Code 350. For each of the design standards and guidelines included above, the applicable, most conservative sections will be provided to all members of the design team for their use on the Proposed Project.

2.2 Project

The proposed project will consist of removing, reconstructing, and/or improving hydraulic structures in 26 locations in existing irrigation system. Hydraulic structures to be improved include the outlet works on Woodruff Reservoir Dam, the splitter structure on Woodruff Creek, and 24 in-stream diversion structures along with their delivery headgates throughout the system. Additionally, the project includes the repair, relocation, and replacement of existing measurement structures in the system associated with the 24 in-stream diversion structures

2.3 Water Right

The WIC owns multiple water rights, many of which are supplemental to one another. Combined, these water rights allow WIC to divert 120 cfs of direct flows for irrigation use and stored 6,600 acre-feet of spring high flow water. The water from these rights is combined to irrigate approximately 5,800 acres. Water is stored in Woodruff Creek and Birch Creek Reservoirs. Water is released into Woodruff Creek and Birch Creek, which combines into Woodruff Creek downstream, see **Table 2-1** for a summary of WIC water rights.

Table 2-1 – Summary of WIC Water Right

Water Right Number	Flow (cfs)	Volume (acre-feet)	Storage (acre-feet)
23-1352	1.08	-	-
23-16	0.49	-	-
23-18	1.71	-	-
23-19	1.47	-	-
23-1952	2.16	45	-
23-1953	55.6	-	-
23-3513	-	90	-
23-362	0.70	-	-
23-3650[1]	-	-	5,400
23-3958	-	0.25	-
23-3999[2]	-	-	5,400
23-423	0.13	-	-
23-427	0.97	-	-
23-428	0.14	-	-
23-429	3.04	-	-
23-432	1.13	-	-
23-436	1.07	-	-
23-437	2.21	-	-
23-540	2.69	-	-
23-542	0.71	-	-
23-543	0.34	-	-

Water Right Number	Flow (cfs)	Volume (acre-feet)	Storage (acre-feet)
23-546	0.67	-	-
23-554	0.29	-	-
23-565	0.76	-	-
23-569	0.84	-	-
23-570	0.22	-	-
23-571	2.79	-	-
23-573	1.30	-	-
23-577	0.35	-	-
23-583	2.15	-	-
23-733	60.0	-	-
23-950	0.87	151.8	-
23-951	2.18	369	-
23-952	1.80	306	-

1. Lapsed water right
2. Unapproved water right

2.4 Hydrologic and Hydraulic Analysis

The hydrologic and hydraulic analyses for the valley aids in estimating and predicting the watershed's reaction to variations in flow volumes. The hydrology outcomes confirm the need for existing and future structure upgrades and designs in the project area. The site-specific hydraulic analyses, more specifically, are governed by channel capacity and irrigation demand through owners' shares. The following sections detail the models and calculations produced for the hydrologic and hydraulic analyses.

2.4.1 Hydrologic Analysis Using Watershed Modeling System

J-U-B analyzed the Woodruff Creek watershed with existing conditions to determine approximate flooding limits during various storm events. The Watershed Modeling System (WMS) software model was used for this evaluation to determine the inflow hydrograph of a 100-year storm event.

The hydrologic review was completed using the HEC-1 interface in the WMS software to estimate the range of modeled peak flows for the Woodruff Creek watershed. As described below, the contributing basin, land-use characterization, and design rainfall quantity and distribution were estimated based on data retrieved from online sources. Routing was determined iteratively based on results of the hydraulic analysis using several draft versions of inflow hydrographs generated through WMS.

2.4.1.1 Basin Delineation

The basin delineation aimed to narrow the contributing flow of the watershed to the desired outlet point. The basin was defined with elevations from an ArcGIS Digital Elevation Model (DEM) converted from a geographic information system (GIS)-based light detection and ranging (LiDAR) method using Topographic Parameterization Program (TOPAZ) to generate flow directions and accumulations. The watershed was divided into five sub-basins from outlet points selected based on hydraulic structure locations, and locations of flow combination and separation. The sub-basins averaged 23 square miles each while the entire basin approximated 119 square miles. The outlet points were chosen below Birch Reservoir, Woodruff Reservoir, Highway 39, the convergence point of the three previously stated points, and approximately five miles downstream. The separation of the watershed is useful in obtaining specific lag time analysis of each area of the watershed. **Appendix A** attached contains a map of the drainage area.

2.4.1.2 Curve Number

Curve numbers are based on the watershed's soil group, land use, and hydrologic conditions. When evaluating a watershed, curve numbers aid in the process of producing an accurate outflow hydrograph for the model influenced by infiltration volumes and excess rainfall. Initially, the project location was classified with GIS LiDAR data, land coverage, and hydrologic soil group (HSG) data. The GIS LiDAR data contains 3D points used for representing features on the Earth's surface and was converted to a DEM, an acceptable format for WMS. Coverages were then created for drainage, soil type, and land use. WMS utilized imported standardized NRCS codes associated with the soil type and land use so the input data could be matched. The overall weighted watershed curve number was calculated from the combined data as 59.

2.4.1.3 Precipitation Data

For each sub-basin, precipitation data was used in establishing the HEC-1 model. The data calculated and input include an average and temporal distribution of precipitation. The precipitation directly affected the flow and lag time within the basin and therefore contributed to the overall model production.

Design criteria storms are a series of theoretical precipitation events used to calculate the watershed runoff and required flood storage. The subbasins were each assigned a basin average precipitation based on the web feature in WMS for a 100-year 24-hour storm event. The precipitation average varied at each subbasin location; however, the precipitation temporal distribution stayed constant for each location. Hyetographs, demonstrating the watershed temporal distribution, were found typical for Utah "Volume 1" from the National Oceanic and Atmospheric Administration (NOAA) Hydrometeorological Design Studies Center - Precipitation Frequency Data Server. The chosen hyetograph was categorized as a 24-hour storm event and produced cumulative percentages of precipitation totals at various time steps. **Table 2-2** and **Table 2-3** demonstrate the average precipitation at each subbasin location and the 24-hour temporal precipitation distribution.

Table 2-2 – Subbasin Average Precipitation

Subbasin	Average Precipitation (in)
Birch Reservoir	3.999
Woodruff Reservoir	4.179
Highway 39	3.918
Convergence	3.092
Outlet	2.319

Table 2-3 – Hyetograph Temporal Distribution

Time (min)	Distribution
0	0
120	0.319
240	0.569
360	0.733
480	0.832
600	0.89
720	0.926
840	0.951
960	0.971
1080	0.985

Time (min)	Distribution
1200	0.995
1320	0.999
1440	1.000

2.4.1.4 Unit Hydrograph

To establish the unit hydrograph, the Soil Conservation Service (SCS) Method was used within WMS. For this method, the lag time for each sub-basin during the storm event was calculated. The lag time demonstrates the temporal distribution of flow within a runoff event. Precisely, the lag time is the ratio of travel length divided by the velocity. The end unit hydrograph encompassed the total volume, area, and peak discharge of the HEC-1 model for further analyses.

2.4.1.5 Routing

The Muskingum-Cunge method was used to model routing in the watershed. The normal parameters of this method have assumptions of Manning's coefficient, base width, and side slope of channel which, respectively, are 0.05, five feet, and 1:1. The channel shape was assumed trapezoidal. The calculated routing in HEC-1 established flow paths for surface water in the basin for further evaluation.

2.4.1.6 Reservoirs Model

The northernmost reservoir is Birch Reservoir fed by Birch Creek. The reservoir located immediately downstream of Birch Reservoir was excluded from the model as it is out of commission. Birch Reservoir was modelled in WMS by an area-capacity table applied from the Rich County plan set. The initial elevation of the dam was assumed four feet below the top of the spillway. The low-level outlet of the spillway is located at an elevation of 6,832 feet and has a cross-sectional area of two square feet. The spillway crest elevation is 6,915.3 feet and the spillway length is 22 feet. The dam crest elevation and width for overtopping are 6,924 feet and 24 feet, respectively. Commonly assumed coefficients in the weir equation across the spillway and dam overtopping are 1.5 for exponent of head and 3.3 for the discharge coefficient. The low-level outlet, with the same parameters, assume 0.5 for exponent of head and 0.97 for the discharge coefficient.

The model of Woodruff Reservoir, fed by Woodruff creek, utilized the Rollins, Brown, and Gunnell plan set for data input. The plans included area-capacity and outflow curves that were approximated into reservoir volume, elevation, and outflow inputs. Consistent with Birch Reservoir, the initial elevation was set to four feet below the spillway.

2.4.1.7 Highway 39 Model

The model for Highway 39 was included as an outlet point. Since the highway is a low point encircled by hills, it allows flow to run next to the road typically, and more so in storm events. The outlet point of Highway 39 is directly south of Birch Reservoir's outlet point. Highway 39 flow ultimately meets with Birch Creek before the full convergence with Woodruff Creek.

2.4.1.8 Results

The hydrologic model results produced hydrographs at each specified outlet location within the basin. The model gathered elevation, surface water, soil, and land characteristic data for flow predication. The model results exemplify the outcomes of flow near the necessary diversion structure improvements for a further design plan. The 100-year 24-hour storm event was chosen to proceed in the next steps of the hydrologic analysis and is shown in **Table 2-4**.

Table 2-4: 100-Year 24-Hour WMS Inflow Hydrograph

Time (hr:min)	Flow (cfs)	Time (hr:min)	Flow (cfs)	Time (hr:min)	Flow (cfs)	Time (hr:min)	Flow (cfs)	Time (hr:min)	Flow (cfs)	Time (hr:min)	Flow (cfs)
0:00	150.3	8:30	2131.3	17:00	2344.3	25:30:00	808.2	34:00:00	201.9	42:30:00	153.4
0:15	150.3	8:45	3155.5	17:15	2262.6	25:45:00	775.5	34:15:00	197.2	42:45:00	153.3
0:30	150.3	9:00	3773.1	17:30	2184.3	26:00:00	743.5	34:30:00	193.0	43:00:00	153.1
0:45	150.3	9:15	4212.6	17:45	2109.5	26:15:00	712.2	34:45:00	189.1	43:15:00	152.9
1:00	150.3	9:30	4542.2	18:00	2038.2	26:30:00	681.7	35:00:00	185.6	43:30:00	152.8
1:15	150.3	9:45	4769.4	18:15	1970.4	26:45:00	652.0	35:15:00	182.4	43:45:00	152.7
1:30	150.3	10:00	4920.3	18:30	1905.9	27:00:00	623.4	35:30:00	179.5	44:00:00	152.6
1:45	150.3	10:15	5012.3	18:45	1844.5	27:15:00	595.7	35:45:00	176.9	44:15:00	152.4
2:00	150.3	10:30	5057.1	19:00	1785.7	27:30:00	569.1	36:00:00	174.5	44:30:00	152.3
2:15	150.3	10:45	5062.6	19:15	1729.2	27:45:00	543.5	36:15:00	172.3	44:45:00	152.2
2:30	150.2	11:00	5034.7	19:30	1674.7	28:00:00	519.0	36:30:00	170.4	45:00:00	152.1
2:45	150.2	11:15	4978.9	19:45	1622.1	28:15:00	495.6	36:45:00	168.6	45:15:00	152.1
3:00	150.1	11:30	4900.6	20:00	1571.4	28:30:00	473.3	37:00:00	167.0	45:30:00	152.0
3:15	150.1	11:45	4805.4	20:15	1523.0	28:45:00	452.0	37:15:00	165.5	45:45:00	151.9
3:30	150.0	12:00	4697.6	20:30	1480.8	29:00:00	431.6	37:30:00	164.2	46:00:00	151.8
3:45	150.0	12:15	4580.3	20:45	1447.7	29:15:00	412.3	37:45:00	163.0	46:15:00	151.7
4:00	150.0	12:30	4455.7	21:00	1416.5	29:30:00	394.1	38:00:00	162.0	46:30:00	151.7
4:15	150.0	12:45	4325.3	21:15	1384.6	29:45:00	376.9	38:15:00	161.0	46:45:00	151.6
4:30	150.3	13:00	4190.4	21:30	1352.1	30:00:00	360.7	38:30:00	160.1	47:00:00	151.5
4:45	150.8	13:15	4053.8	21:45	1319.0	30:15:00	345.2	38:45:00	159.3	47:15:00	151.5
5:00	151.8	13:30	3921.2	22:00	1285.7	30:30:00	330.3	39:00:00	158.6	47:30:00	151.4
5:15	153.7	13:45	3791.1	22:15	1252.1	30:45:00	316.2	39:15:00	158.0	47:45:00	151.3
5:30	157.1	14:00	3660.4	22:30	1218.4	31:00:00	303.0	39:30:00	157.4		
5:45	162.6	14:15	3530.9	22:45	1184.6	31:15:00	290.7	39:45:00	156.8		
6:00	170.9	14:30	3403.3	23:00	1150.6	31:30:00	279.3	40:00:00	156.4		
6:15	182.7	14:45	3278.3	23:15	1116.5	31:45:00	268.7	40:15:00	155.9		
6:30	199.8	15:00	3156.0	23:30	1082.2	32:00:00	258.9	40:30:00	155.5		
6:45	223.7	15:15	3036.8	23:45	1047.6	32:15:00	249.6	40:45:00	155.2		
7:00	257.3	15:30	2921.0	24:00:00	1012.9	32:30:00	240.9	41:00:00	154.9		
7:15	319.6	15:45	2809.9	24:15:00	978.1	32:45:00	232.9	41:15:00	154.6		
7:30	415.6	16:00	2706.6	24:30:00	943.4	33:00:00	225.5	41:30:00	154.3		
7:45	515.9	16:15	2610.7	24:45:00	909.0	33:15:00	218.8	41:45:00	154.0		
8:00	613.9	16:30	2518.4	25:00:00	874.9	33:30:00	212.6	42:00:00	153.8		
8:15	792.6	16:45	2429.5	25:15:00	841.3	33:45:00	207.0	42:15:00	153.6		

2.4.2 Hydraulic Analysis

The valley and channel modeling were further enhanced through Hydrologic Engineering Center's River Analysis System (HEC-RAS) as it is supplemented by the WMS 100-year 24-hour hydrograph. The hydraulic model shows peak flows at each location's cross section which can be used to compare against the channel capacity and irrigation demand as design parameters. The HEC-RAS model looks at the entirety of the watershed downstream of Woodruff and Birch Creek Reservoirs, while the site-specific hydraulics may be narrowed to each diversion location through manning's and sharp crested weir equations.

2.4.2.1 HEC-RAS Flood Model

Incorporating another model software, HEC-RAS, aids in defining the area of interest and storm events in a more detailed 2D model. The same terrain as WMS was used with no modifications. The resolution of the terrain was imported as one meter which is sufficient to the large basin area. The model ran with unsteady flow computation and used input data from produced WMS peak flow hydrographs at Birch Reservoir, Woodruff Reservoir, and Highway 39 for upstream points. Furthermore, the downstream points were set for normal depth from the approximate bed slopes acquired in HEC-RAS. Boundary conditions were created at both upstream and downstream points which eliminated escaping flow in a non-naturally occurring matter. The minimum flow set for the five-minute incremental computational intervals was 25 cubic feet per second (cfs) for the 100-year 24-hour event. The geometry of the model had cell sizes of 150 meter by 150 meter assuming that the cells are large enough to allow flow through. There were no break lines incorporated and the Manning's n value was set to 0.04. The model runs in full momentum with no errors.

The peak flows at each diversion location for the 100-year 24-hour flood event was recorded and used to further detail designs of the diversion structures. The following sections use the HEC-RAS data to find limitations of the designs.

2.4.2.2 Geometric Flow Capacity

The geometric flow capacity was found by using survey data collected by J-U-B. At each diversion location and where survey is available, cross sections were created across the main creek and diversion canal. An approximate trapezoidal channel outline was obtained from the cross sections to measure the base width, top width, depth, and side slopes. The slopes of the creek and canal were estimated perpendicular to the cross section. Manning's equation determined the estimated geometric flow capacity at each diversion location with assumption that the project sites are windy, clean, and weedy channels, yielding a 0.035 Manning's n. A summary of the measurements and calculations for each diversion are attached in **Appendix C**.

2.4.2.3 Head Calculation

Embankment overtopping is a concern for the design of the diversion structures. To check flooding upstream of the check structure, the sharp crested weir equation was used to calculate the depth of water that is backed up. The depth of water is then compared to the embankment height upstream of the structure. Assumptions for the equation include a weir coefficient of 3.33, a rectangular channel, and a 4-foot weir crest length. The distance between water surface and crest, also known as the head, was calculated by forcing the calculated flow to equal the accumulated demand flow. The head was sufficiently low enough to avoid embankment flooding. See **Appendix C** for calculations table.

2.4.2.4 Irrigation Shares

The WIC provided information on the number of shares per stockholder. While the given share was in acre-feet, the flow of each share was calculated by assuming a 20-day or 40-day irrigation period in spring. The shares in acre-feet were converted to flow in cubic feet per second (cfs) by a conversion factor of 0.5. The highest demand occurs at Dean's diversion with 19.78 cfs while the lowest known demand is at Witheral diversion with 0.49 cfs. **Table 2-5** summarizes the demands at each diversion. J-U-B is waiting for further detail on demands that do not currently have a value.

Table 2-5 - WIC Demands

Diversion	Demand (Acre-feet)	Days Water Runs	Average Flow (cfs)
Smith Ditch	20.20	20	0.73
Cornia 1	52.80	20	1.90
Putnam-Cornia	136.65	40	2.56
Witheral	13.00	20	0.49
Cornia 2	42.75	20	1.54
Huffaker	159.30	40	2.75
Eastman-Fraizer	361.52	40	6.51
Saxton	50.00	20	1.80
Dugway	44.95	20	1.53
Eastman 1	50.00	20	1.80
Fraizer 1 & 2	435.60	40	8.60
Baxter	138.00	40	2.07
Dean's Ditch	1296.95	40	19.78
Church Brown	112.15	40	1.68
Schulthess Vernon	159.00	40	2.39
Tingey Bryson Eastman	469.00	40	7.03
Tic Chandler	40	40	0.60
Hagus Ditch	430.5	40	6.45
Buck	64.50	40	0.97
Co-Op	1213.75	40	18.20
Neville	80.00	20	1.20
Schulthess 1	420.60	40	6.31
Schulthess 2	-	-	-
Schulthess 3	-	-	-

2.4.3 Model Verification

The model was verified using multiple platforms such as StreamStats and U.S Army Corps of Engineers Statistical Software Package (HEC-SSP) to ensure accuracy within results. Both applications use outer sources of data within the Woodruff, Utah locations to compute comparative data. Overall, the outputs were within a reasonable range of collection; therefore, are appropriate to plan upon.

2.4.3.1 StreamStats

The model verification included using StreamStats which serves as a web application for water-resources planning and engineering. It is a map-based interface applied by analyzing site statistics for stream gages and regression-based scenarios. The basin was identified from a user-selective interactive map and noted the peak-flow statistics report of each storm event. The StreamStats basin included an area of 118 mi^2 which confirms the WMS model basin size. The software differences of flow are significant but may be explainable by StreamStats not recognizing multiple outlet points and lack of current and historical data in the area. The smaller the storm the more comparable the flow values become between StreamStats and HEC-RAS results; however, StreamStats has relatively large confidence intervals, upwards of 60%, for each flood year.

2.4.3.2 HEC-SSP

The software HEC-SSP assisted to verify the HEC-RAS model. The software performed statistical analyses of hydrologic data for locations of interest in Woodruff, Utah. Two inactive sites were located and used in analyses located below Woodruff Reservoir and downstream on Woodruff Creek. The Woodruff Reservoir

site had a higher peak streamflow than the downstream site, which is reasonable when collection dates are considered. The Woodruff Reservoir data was collected from 1983-1977 while the downstream site was collected from 1950-1961. The difference of flow is best explained by these non-overlapping water years. Although the stream gages used for the analyses were outdated and out of service, the recognition of past data is a useful comparison for predicted flows verification purposes.

2.5 Diversion Structure Design

From **Section 2.4.2**, diversion structures were designed to provide allotted irrigation shares, safety, and overflow caution. The designed structures described below were chosen over others due to their low maintenance, low cost, and sedimentation prevention which are all concerns of the current structures.

Twenty-four sites will include furnishing and installing concrete check structures and headgates. Two of the sites are non-typical for design, the splitter structure, and Woodruff Reservoir, which require a unique consideration and design for the best agricultural management.

2.5.1 Stream Channel Morphology

Base on the NRCS Web Soil the watershed is made of 38% fine silt and 57.7% loamy silt. The district deals with sediment transport throughout the WIC system and where the sediment settling out at the diversions. Because of these soil characteristics and the sediment transport within the WIC system it increases the risk of the failure of the existing structures. Repairs are required yearly on most of the diversion structures to help them operate throughout the irrigation season.

2.5.2 Check Structure Design

Concrete check structures are designed to maintain the water surface elevation required for upstream irrigation deliveries at the headgates. Each diversion location has an allotted share of water to supply the respective farmland with irrigation water. Currently, improvised check structures range from stacked logs to abandoned cars in the main channel. The designed concrete check structures will increase efficiency and safety to agricultural water management especially during flow variations.

The structures were designed at standards widths of 11, 20, and 30 feet based on the main channel's trapezoidal top widths. The design allows for widths to be extended in order to tie into existing banks, eliminating the need for 24 unique designs. Bays, where the water is urged to flow through, were designed at standard widths of four to five feet. The number of bays increase as the length of the structures increase, ranging from one to five bays. Within the bays, slots are designed for stacking two by four feet lumber to reach the desired backed up water elevation. Adding and removing the lumber is the main component of regulating the flow and pressure of water through the irrigation system. As previously described, the head is calculated at each location and compared to the embankment height to ensure no additional flooding is initiated with the proposed structures.

2.5.3 Headwall/Headgate Design

The headwall and headgate at each diversion location serves to divert water from the main channel to the stockholders' lot for irrigation purposes. Currently the headgates are damaged, difficult to operate, silted in, and leak at various points of diversion. The intent of the design was to make the headgate structures more reliable, safe to operate, and to some extent, more standardized. Furthermore, headgate locations were selected to reduce the volume and impacts of sedimentation at turnout locations.

In general, headgates were installed in two standard structure types. The headwall configuration consists of an eight-foot tall, variable width, partially embedded concrete wall. For most locations, headwall width was five feet, but varied according to pipe diameter. The second configuration consists of a concrete headgate

box. The pipe protrudes from an eight-foot-tall back wall supported by tapered walls connected to a 3.5 feet deep floor. The opening width between the side walls varies according to pipe diameter but is typically three feet for a typical 24-inch diameter pipe.

Pipe sizes were selected assuming half-full open channel pipe flow using Manning's equation. Standard assumptions of a 0.005 slope and a 0.015 manning's n were selected. Pipe diameters required to meet irrigation flows in the project area were found to range from six inches to 18 inches; so in circumstances with low certainty of site conditions, 24 inch diameter was assumed.

Slide gates were selected to control flow based on current usage by WIC. Flow measurement is currently conducted via Parshall flumes at nearly all diversions. However, it was assumed that each diversion location would require significant repair, relocation, and/or replacement of existing Parshall flumes due to their varied conditions.

2.5.4 Splitter Structure Design

The existing splitter structure is beyond its useful life. Various elements of the structure have failed, including the downstream concrete wall keeping split flow separate, panels of concrete walls. There are also numerous locations where the steel reinforcement is exposed, and the existing concrete is crumbling away. Despite these failures, WIC staff have field-fit solutions to maintain elements of functionality in the structure.

The structure splits flow among two downstream reaches of Woodruff Creek. During normal irrigating conditions, Woodruff Creek (North) serves five users and 2,175 irrigated acres, while Genes Creek (South) serves five users and 2,249 irrigated acres. During high-flow or flood conditions, as much flow as possible is diverted south to mitigate the effects of flooding the City of Woodruff.

WIC desires that this structure be capable of measuring discharge to the north and south reaches of Woodruff Creek such that when normal flows are present full allotments can be distributed and during low flows partial allotments can be distributed according to share agreements. WIC also desires to have SCADA capability at the splitter structure capable of interacting with the headgate control at Woodruff Reservoir. Flow rates for diversions downstream of the splitter structure were summed by downstream reach as shown in **Table 2-6** below:

Table 2-6 – Accumulated Demands Below Splitter Structure

Woodruff Creek – North Side of Splitter (cfs)	
Baxter	32.95
Dean's	30.88
Church Brown	11.10
Schulthess Vernon	7.42
Tingey Bryson Eastman	7.03

Genes Creek – South Side of Splitter (cfs)	
Tic Chandler	33.73
Hagus	33.13
Buck	26.68
Co-Op	25.71
Neville	7.51
Schulthess	6.31
Schulthess 2 & 3	-

To improve the current splitter structure, the design proposes removing the existing concrete retaining walls; pedestrian bridge; and control structure. In place of these, concrete retaining walls; control structure foundation; Rubicon Gates; and a pedestrian bridge will be furnished and installed to improve structure longevity, agricultural management, and flooding efficiency. The sizing of the two Rubicon Flume Gates are 46.6 inches and 71.2 inches, each being 40.7 inches tall. The selected gate sizing accounts for a typical

irrigating season providing 40% of flow north and 60% of flow south. Between the Rubicon Gates, the splitter wall is designed as one foot wide by 37 feet long to ensure water is diverted to its respective side, while tying in at the embankment across from the gates. A three feet wide flashboard bay is proposed between the south diverting gate and the embankment for high flow precautionary flow diversion. Once the gates cannot handle flow during a storm event, the flashboards would be lifted from the extra bay.

2.5.5 Woodruff Reservoir Outlet Works Design

The current outlet structure at Woodruff Reservoir includes a low-level outlet gate at the base of the dam crest and a pipe that runs beneath the dam crest. There are no automated controls at the outlet structure and the existing Parshall Flume downstream has deteriorated. Automating and improving Woodruff Reservoir is highly beneficial to the safety and agricultural water management to all diversions downstream by better controlling the amount of flow released.

The proposed design for the outlet works structure includes an automated low-level outlet gate. The gate is sized for the existing pipe with a 3.5 feet diameter. With automation, the flow through the pipe would be regulated by the gate actuator, controls panels, telemetry, and solar panel. The housing for the controls is proposed in a gate controls enclosure on top of the dam crest. The controls lift and lower the cover to the outlet gate based on the needs of the WIC system downstream. For construction and controls access, a two-foot-wide by 25-foot-long pedestrian bridge across the existing emergency spillway is needed. Flow measurement at the outlet structure downstream includes a Parshall Flume. The 10-foot throat width of the flume is designed to withstand the peak flow through the pipe of 664 cfs. Automation of the flow measurements communicate with the outlet gate to instruct the amount of water to release from the reservoir. The flow measurement communications enclosure's proposed location is approximately 150 feet away for flood safety.

3.0 Statement of Limitations

The hydrologic and hydraulic models used in this analysis were created based on land use and hydrologic soil group conditions at the time of the study, of which land use is especially prone to change over time. Since the model is based on these parameters, it is critical to update the model over time to reflect up-to-date conditions. The model is considered sufficiently accurate based on the current data available and for its intended purpose on the date this report was submitted.

Model output from this study will be available to the WIC District. This information is intended for use by flood district staff for overall system management. The limitations described above apply to the model output as well.

Limited survey in the area as well as aerial images with blocked views of the creeks were provided. Using the best judgement of what naturally may be occurring was approximated; however, design changes should be monitored as site visits and survey assist in clearer terrain.

4.0 References

Aquaveo WMS Version 11.1

StreamStats 4.10

HEC-SSP 2.2

HEC-RAS 6.2.2

Appendix A – Drainage Coverage Map



APPENDIX A: DRAINAGE COVERAGE

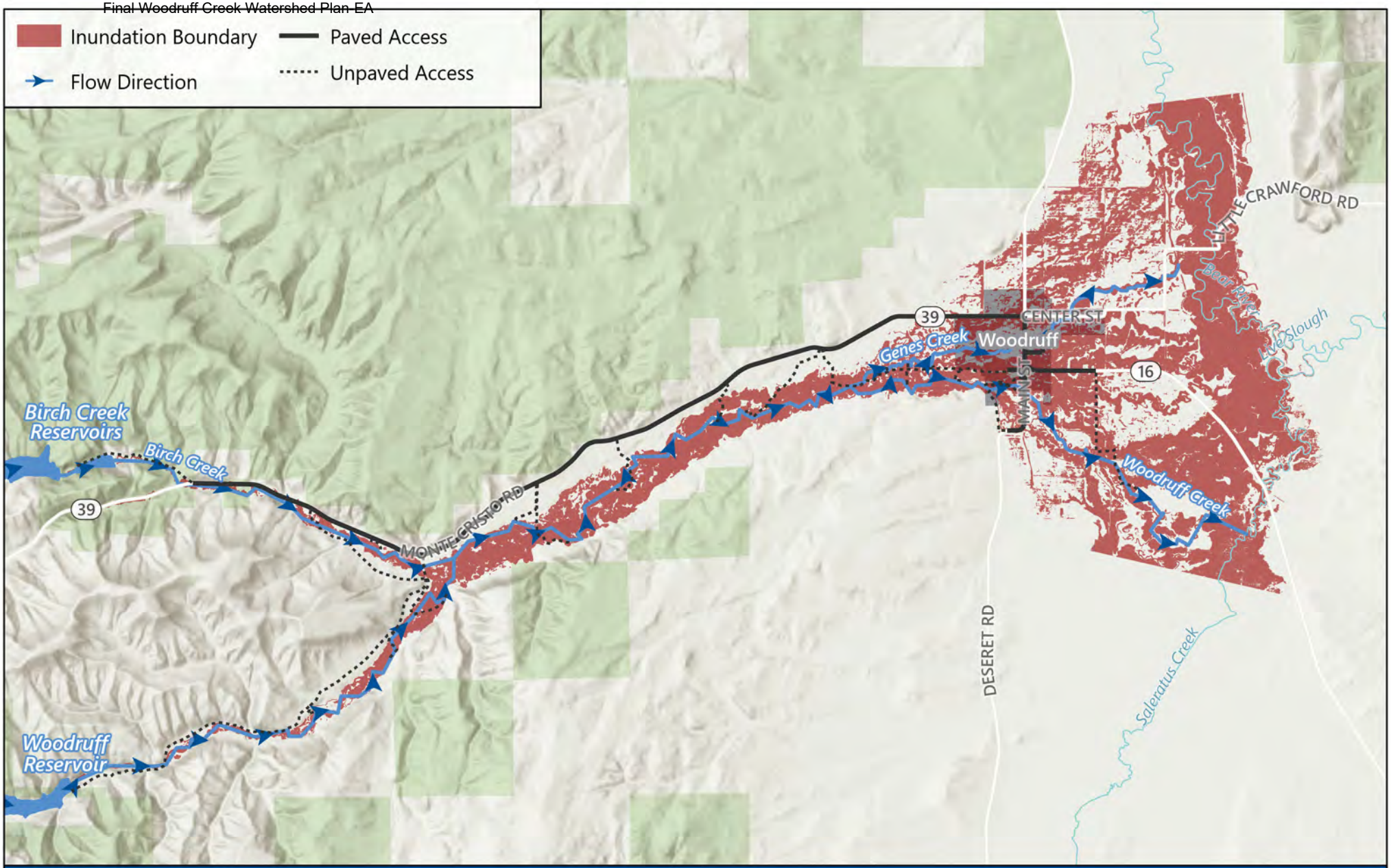
0 2 4
Miles

N

Woodruff Creek Watershed Plan - EA

May 2023

Appendix B – 100-Year Flood Inundation Map



APPENDIX B: INUNDATION BOUNDARY

0 1 2
Miles

N

Woodruff Creek Watershed Plan - EA

May 2023

Appendix C – Calculations

- Irrigation Demands/Shares
- Geometric Flow Capacity
- Sharp Crested Weir

Name	Trapezoidal Channel				
	Base Width (ft)	Depth (ft)	Side Slope 1	Side Slope 2	Top Width (ft)
Smith Ditch	11.29	1.13	1.04	0.51	18.25
Cornia 1	2.04	2.41	0.79	1.50	6.45
Putnam-Cornia	4.26	4.09	1.39	1.13	10.89
Witheral	5.36	2.12	0.49	0.20	31.10
Cornia 2	4.13	1.82	1.45	0.69	6.90
Huffaker	1.14	1.06	0.17	0.30	9.88
Eastman-Fraizer	3.45	0.98	0.35	0.48	8.29
Saxton	7.26	1.42	0.67	0.83	10.99
Dugway	5.36	1.46	0.34	0.15	17.99
Eastman 1	14.34	1.38	0.50	0.35	20.94
Fraizer 1	25.28	1.18	0.45	1.20	29.03
Fraizer 2	19.48	1.29	0.48	0.48	24.99
Splitter Structure	16.99	2.80	0.66	0.35	29.98
Woodruff Creek Post Splitter	9.86	1.21	0.37	0.51	15.40
Genes Creek Post Splitter	12.73	0.81	0.38	0.28	17.38
Baxter	18.51	1.57	0.25	0.20	34.85
Dean's Ditch	16.30	2.75	0.58	0.36	28.30
Church Brown	8.46	1.60	0.44	0.55	15.42
Schulthess Vernon	10.11	0.71	0.49	1.15	12.60
Tingey Bryson Eastman	-	-	-	-	-
Tic Chandler	10.25	2.34	0.33	0.32	24.92
Hague Ditch	10.14	2.11	0.31	0.31	23.76
Buck	10.55	1.39	0.24	0.91	17.58
Co-Op	4.85	4.40	0.85	0.47	19.87
Neville	11.13	1.74	0.34	0.25	22.70
Schulthess 1	10.50	2.11	0.38	0.32	23.14
Schulthess 2	8.89	0.58	0.18	0.20	15.74
Schulthess 3	-	-	-	-	-

Name	Manning's Eqn						Demand/Shares	
	Area (ft^2)	Wetted Perimter (ft)	Manning's Roughness Coefficient	Hydraulic Radius (ft)	Slope (ft/ft)	Geometric Flow (cfs)	Demand Flow (cfs)	Accumulated Flow (cfs)
Smith Ditch	16.69	14.55	0.035	1.15	0.0011	25.82	0.73	35.30
Cornia 1	10.23	8.18	0.035	1.25	0.012	56.06	1.90	34.57
Putnam-Cornia	30.98	18.27	0.035	1.70	0.010	187.58	2.56	32.67
Witheral	38.65	10.08	0.035	3.83	0.013	459.49	0.49	34.89
Cornia 2	10.04	10.54	0.035	0.95	0.013	46.42	1.54	34.40
Huffaker	5.84	3.29	0.035	1.77	0.0055	27.01	2.75	32.86
Eastman-Fraizer	5.75	5.53	0.035	1.04	0.0010	7.95	6.51	60.22
Saxton	12.96	10.68	0.035	1.21	0.0051	44.82	1.80	53.71
Dugway	17.05	8.44	0.035	2.02	0.010	115.90	1.53	51.91
Eastman 1	24.34	17.43	0.035	1.40	0.098	405.41	1.80	50.38
Fraizer 1	32.04	27.87	0.035	1.15	0.015	183.36	8.60	48.58
Fraizer 2	28.68	22.34	0.035	1.28	0.0083	131.41	-	39.98
Splitter Structure	65.76	23.70	0.035	2.77	0.0013	199.28	-	39.98
Woodruff Creek Post Splitter	15.28	12.44	0.035	1.23	0.011	78.27	-	15.99
Genes Creek Post Splitter	12.19	14.46	0.035	0.84	0.0042	30.03	-	23.99
Baxter	41.89	21.75	0.035	1.93	0.0013	99.53	2.07	32.95
Dean's Ditch	61.33	22.66	0.035	2.71	0.013	584.73	19.78	30.88
Church Brown	19.10	11.96	0.035	1.60	0.0031	61.89	1.68	11.10
Schulthess Vernon	8.06	11.69	0.035	0.69	0.0053	19.50	2.39	9.42
Tingey Bryson Eastman	-	-	-	-	-	-	7.03	7.03
Tic Chandler	41.15	15.18	0.035	2.71	0.0060	263.82	0.60	33.73
Hague Ditch	35.76	14.56	0.035	2.46	0.012	308.63	6.45	33.13
Buck	19.55	13.41	0.035	1.46	0.080	302.69	0.97	26.68
Co-Op	54.38	16.40	0.035	3.32	0.013	593.76	18.20	25.71
Neville	29.43	14.81	0.035	1.99	0.038	386.66	1.20	7.51
Schulthess 1	35.49	15.01	0.035	2.36	0.011	281.18	6.31	6.31
Schulthess 2	7.14	10.07	0.035	0.71	0.0082	21.90	-	-
Schulthess 3	-	-	-	-	-	-	-	-

Name	Sharp Crested Weir Equation (accumulated flow)						
	Weir Coefficient	Length of Weir Crest (ft)	Head (ft)	Q (cfs)	Top Width (ft)	# of bays	Accumulated Flow (cfs)
Smith Ditch	3.33	4.0	0.92	11.77	18.25	3	35.30
Cornia 1	3.33	4.0	1.89	34.57	6.45	1	34.57
Putnam-Cornia	3.33	4.0	1.82	32.67	10.89	1	32.67
Witheral	3.33	4.0	0.65	6.98	31.10	5	34.89
Cornia 2	3.33	4.0	1.88	34.40	6.90	1	34.40
Huffaker	3.33	4.0	1.82	32.86	9.88	1	32.86
Eastman-Fraizer	3.33	4.0	2.73	60.22	8.29	1	60.22
Saxton	3.33	4.0	1.22	17.90	10.99	3	53.71
Dugway	3.33	4.0	1.19	17.30	17.99	3	51.91
Eastman 1	3.33	4.0	0.83	10.08	20.94	5	50.38
Fraizer 1	3.33	4.0	0.81	9.72	29.03	5	48.58
Fraizer 2	3.33	4.0	0.71	8.00	24.99	5	39.98
Splitter Structure	3.33	9.8	1.14	39.98	29.98	1	39.98
Woodruff Creek Post Splitter	3.33	3.9	1.15	15.99	15.40	1	15.99
Genes Creek Post Splitter	3.33	5.9	1.14	23.99	17.38	1	23.99
Baxter	3.33	4.0	0.63	6.59	34.85	5	32.95
Dean's Ditch	3.33	4.0	0.60	6.18	28.30	5	30.88
Church Brown	-	-	-	-	15.42	-	-
Schulthess Vernon	3.33	4.0	0.38	3.14	12.60	3	9.42
Tingey Bryson Eastman	-	-	-	-	-	-	-
Tic Chandler	3.33	4.0	0.6	6.75	24.92	5	33.73
Hague Ditch	3.33	4.0	0.6	6.63	23.76	5	33.13
Buck	3.33	4.0	0.8	8.89	17.58	3	26.68
Co-Op	3.33	4.0	0.7	8.57	19.87	3	25.71
Neville	3.33	4.0	0.3	2.50	22.70	3	7.51
Schulthess 1	3.33	4.0	0.3	2.10	23.14	3	6.31
Schulthess 2	-	-	-	-	15.74	-	-
Schulthess 3	-	-	-	-	-	-	-

Less than<0.5
Between
Greater than>1.5

PR&G Report

Woodruff Creek Watershed Plan-EA Benefit-Cost Analysis

1. Introduction

This report estimates the benefits and costs of proposed water management measures proposed as part of the Woodruff Creek Watershed Flood Prevention and Irrigation Improvement Project (Project) in northeastern Utah's Woodruff Creek (watershed), situated in Rich County. Woodruff Creek begins in the Bear Mountains, a northern extension of the Wasatch Mountain Range, and is a tributary of the Bear River, itself a tributary of the Great Salt Lake.

A portion of the watershed's irrigated agricultural lands are served by the Woodruff Irrigation Company (WIC), a non-profit organization started in the early 19th century to serve agricultural interests in the area. WIC owns and operates the Woodruff Creek Reservoir and Birch Creek Resevoir to store spring runoff that is used to irrigate farmland later in the growing season.

The stored water is released from Woodruff Reservoir via a manually operated gate and conveyed to agricultural land via a system of 23 unlined earthen canals and ditches that use primitive and dilapidated diversion structures to direct flows within the system. The Woodruff Creek Irrigation Company diversions act as a system to convey natural flow in Woodruff Creek from west to east. Each diversion serves to divert adjacent agricultural land of varied acreage. The construction of each diversion not only provides water to the adjacent land, it provides stability to the natural stream to maintain flow in its natural alignment. If a diversion on the system were not improved to adequately convey the flood flows, there could a realignment of the natural channel that would impact downstream flow to the lower diversions. For this reason, we have based the benefit-cost ratio for the project on the collective system of diversions.

WIC relies extensively on manual deliveries and gates, visual inspections, and other labor-intensive, slow-to-respond methods for water management within its service area. As a result, WIC's water supply infrastructure operates with an elevated level of inefficiency. Water deliveries, for example, are imprecise, and existing operations frequently release more water than is needed into downstream canals, resulting in inefficiencies in water distribution and increased risk of supply disruptions across WIC's service area.

The diversion structures take a variety of forms, including structurally unsound concrete, old cars, earth, and other obstructions that can be used to back up Woodruff Creek for the purpose of diverting flows. The poor condition of the reservoir gate and diversion structures places the watershed's irrigated agriculture land at risk. Due to the areas high altitude and the need to wet ditches before irrigation flows can reach fields, the growing season only lasts four to six weeks. If a the reservoir gate or any of the various diversion structures failed at any point in the season, it would result in the complete loss of production since it could not be repaired in time to restore supplies before the growing season ends.

The project, would install a series of improvements intended to alleviate these existing inefficiencies and risks. Key elements include automated gates to control water flow and delivery from Woodruff

Reservoir, and a new SCADA system to support centralized monitoring and controls, and more than a dozen control structures. As a result of these system improvements the project is expected to result in a significant reduction in labor and supply disruption risk.

This report considers the benefits and costs of improvements and replacements to the WIC's existing reservoir gate and diversion structures as well as a new splitter structure proposed to eliminate or limit damages from infrastructure failures and improve water management in the watershed. Specifically, this report considers the benefits and costs of nine primary projects and 16 secondary projects, which constitute the Action Alternative.

The vast majority of the works of improvement included in the Action Alternative involve installing new diversion structures on WIC's various ditches and canals. However, the Action Alternative also includes the installation of an automated gate, power, and Supervisory Control and Data Acquisition (SCADA) system at Woodruff Reservoir and a splitter structure downstream of the reservoir. The benefits and costs of the action alternative are compared against a baseline of no action, which is also referred to as the Future Without Federal Investment (FWOFI).

This report is structured into the following sections:

- Federal Guidelines of Benefit-Cost Analysis of Irrigation Supply and Water Management Investments
- Alternatives and Ecosystem Services Evaluated
- National Economic Efficiency Analysis Data and Methodology
- Current Economic Damages
- Economic and Structural Tables

2. Federal Guidelines of Benefit-Cost Analysis of Flood Mitigation Measures

The National Economic Efficiency Benefit-Cost Analysis (NEE BCA) conducted as part of this report uses federal water resource project and National Resources Conservation Service (NRCS) guidelines for the evaluation of benefits and costs of the no action and action alternatives, relying primarily on the Principles, Requirements and Guidelines (PR&G), the NRCS Natural Resources Economics Handbook, and the National Watershed Program Manual.[1,2,3]

With the federal Law passage of the 2007 Water Resources Development Act, Congress directed the federal government to update and consolidate its past guidance on evaluating the costs and benefits of

[1] The White House. 2014. Interagency Principles, Requirements, and Guidelines for Federal Investments in Water Resources. Available at: https://obamawhitehouse.archives.gov/sites/default/files/docs/prg_interagency_guidelines_12_2014.pdf

[2] U.S. Department of Agriculture, Natural Resource Conservation Service. 1998. Part 611 National Resource Economics Handbook for Economics. Available at: https://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=28583.wba

[3] U.S. Department of Agriculture, Natural Resource Conservation Service. 2014. Title 390 – National Watershed Program Handbook, Part 600 – Watershed Program Management. Available at: https://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=35136.wba

federal investments. The original Principles and Guidelines (P&G) was replaced by Principles, Requirements and Guidelines (PR&G) as of April 2019. The PR&G allow for:

> *… maximizing public benefits (of all types) relative to costs, the use of quantified and unquantified information in the tradeoff analysis, flexibility in decision making to promote localized solutions, ability to rely on the best available science and objectivity, and advance transparency for Federal investments in water resources.*

The PR&G further state:

> *Federal investments in water resources as a whole should strive to maximize public benefits, with appropriate consideration of costs. Public benefits encompass environmental, economic and social goals; include monetary and non-monetary effects; and allow for the consideration of both quantified and unquantified measures.*

The PR&G also require benefits and costs to be evaluated in an ecosystem service framework. An ecosystem is a natural unit of living and non-living things that function together to create goods and services valued by people.[4] Ecosystem services is a broad term used to describe the benefits humanity receives from ecosystems as a byproduct of their functioning.

By putting nature at the center, ecosystem services frameworks give economic, social, and environmental costs and benefits equal standing in decision-making processes and therefore help to accomplish the federal objective of maximizing national economic efficiency, ensuring federal investments protect and restore ecosystem functions and values and avoid irreversible impacts.[5] Economic efficiency requires that resources are used in their highest valued use. Projects that create more benefits than costs utilize resources more efficiently than baseline conditions and therefore increase NEE.

The four-category ecosystem framework adopted in the PR&G, and utilized in this report, is shown in Table 1.

Table 1. Ecosystem Services Framework Used to Evaluate Benefits and Costs Project

Service Type	Examples
Provisioning	The supply of food, fuel, fiber, water, timber, and genetic resources
Regulating	The regulation of air, climate, natural hazards, water quality, pests, and disease
Cultural	Services that enhance cultural values, like aesthetics, recreation, tourism, and spiritual or religious values
Supporting	Nutrient cycling, soil formation, and primary production

[4] Olander, Lydia, Urban, D., Johnston, R., Van Houtven, G., Kagan, J. 2016. Proposal for Increasing Consistency When Incorporating Ecosystem Services Into Decision Making. National Ecosystem Service Partnership, Policy Brief 16-01. Available at: https://nicholasinstitute.duke.edu/sites/default/files/publications/nesp_pb_16-01.pdf

[5] The White House. 2014. Interagency Principles, Requirements, and Guidelines for Federal Investments in Water Resources. Available at: https://obamawhitehouse.archives.gov/sites/default/files/docs/prg_interagency_guidelines_12_2014.pdf

Source: U.S. Department of Agriculture, Natural Resource Conservation Service. 2014. Title 390 – National Watershed Program Handbook, Part 600 – Watershed Program Management. Available at: https://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=35136.wba

As Table 1 shows, ecosystem services can be placed into one of four categories. Provisioning services supply goods that directly benefit people. The production of crops, fuel, water, timber, and other raw materials are all provisioning services. Regulating services describe the benefits people receive from an ecosystem's ability to regulate things like air quality, climate, and hazards, both natural and manmade. Cultural services describe the benefits people derive from an ecosystem's ability to provide a good view, a recreation opportunity, a place to travel and visit, or spiritual or religious values.

2.1. Guiding Principles.[6] In addition to requiring projects to be evaluated using an ecosystem service framework, the PR&G also seek to promote projects that fulfill guiding principles related to federal investments in water resources. These include:

- Healthy and Resilient Ecosystems – Federal investments in water resources should protect and restore functions of ecosystems and mitigate any unavoidable damage to these natural systems.

- Sustainable Economic Development – Federal investments in water resources should encourage sustainable economic development that improve the economic well-being of the Nation for present and future generations through the sustainable use and management of water resources.

- Floodplains – Federal investments in water resources should avoid the unwise use of flood prone-areas and avoid and minimize adverse impacts and vulnerabilities in any case in which a flooprone area must be used. Federal investments should seek to reduce the Nation's vulnerability to floods and storms.

- Public Safety – Federal investments in water resources should avoid, reduce, or mitigate risks to people, including both loss of life and injury, from natural events.

- Environmental Justice – Federal investments in water resources should ensure that disproportionately high and adverse public safety, human health, or environmental burdens of projects on tribal, minority, or low-income populations are identified, mitigated, or eliminated.

- Watershed Approach - Federal investments in water resources should use a watershed approach that properly frames a problem by evaluating it on a systems level that identifies root causes and interconnectedness of watershed problems that enables the design of solutions that considers the benefits of water resources for a wide range of stakeholders within and around the watershed.

The Watershed Plan and Environmental Assessment (Plan-EA) for the Project considered these principles in the characterization of water management challenges faced by stakeholders in the watershed and the formulation of solutions as defined in the Action Alternative.

[6] NRCS, 2014.

3. Alternatives and Ecosystem Services Evaluated

To reduce the risk of infrastructure failure and improve water management in the watershed, the project sponsors developed an Action Alternative that was evaluated alongside a No Action Alternative as part of the NEE BCA analysis. The No Action Alternative, also known as the Future Without Federal Investment (FWOFI), describes the most likely future if no federal investment is made in the watershed. The Action Alternative describes the proposed actions to be taken to reduce infrastructure failure risk and improve water management in the watershed.

3.1. Alternatives Evaluated. Under the FWOFI, WIC's service area would be at continued risk of infrastructure failures at multiple points with the associated impacts on ecosystem services. WIC's ability to convey water would be at continued risk of infrastructure failure, and water management would remain an ongoing challenge. Under the Action Alternative, both of these challenges would be addressed through specific works of improvement as shown in Table 2. Figure 1 displays the location of each canal and ditch in WIC's system.

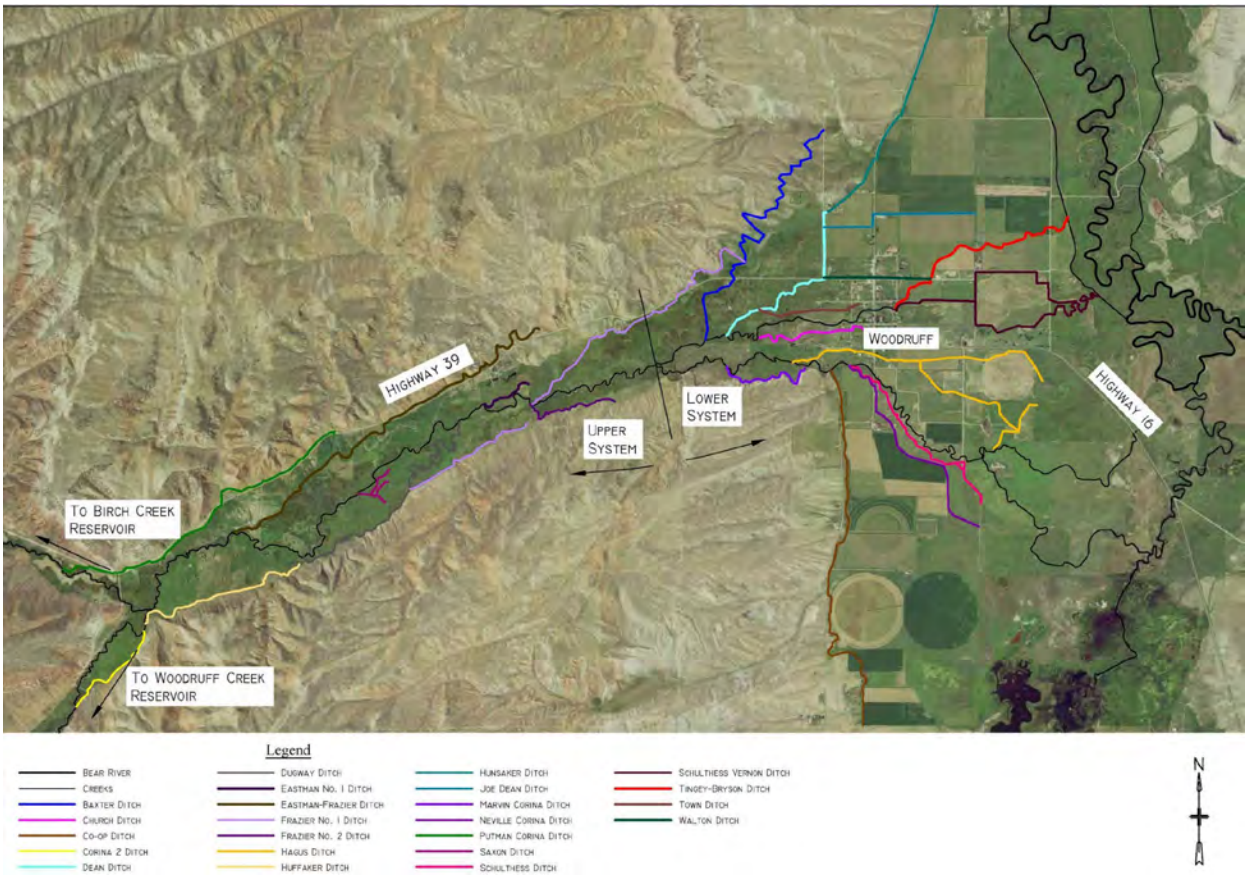
Table 2. Works of Improvement Proposed as Part of the Woodruff Creek Watershed Plan-EA.

Purpose/Work of Improvement	Description
Agricultural Water Management	
Woodruff Reservoir	Measured flow and real time adjustments with automation, ease of operation, flood prevention
Splitter	Measured flow and real time adjustments with automation, ease of operation, flood prevention
Avoided Agricultural Damages	
Putnam-Cornia	Reduced losses and measured flow
Huffaker	Reduced losses and measured flow
Eastman-Frazier	Reduced losses and measured flow
Frazier 1&2	Reduced losses and measured flow
Hagus	Reduced losses and measured flow
Co-Op	Reduced losses and measured flow, flood prevention
Dean's	Reduced losses and measured flow, flood prevention
Smitch Ditch	Reduced losses and measured flow
Cornia 1	Reduced losses and measured flow
Cornia 2	Reduced losses and measured flow
Witheral	Reduced losses and measured flow
Saxton	Reduced losses and measured flow
Dugway	Reduced losses and measured flow
Eastman 1	Reduced losses and measured flow
Baxter	Reduced losses and measured flow
Church Brown	Reduced losses and measured flow
Schulthess Vernon	Reduced losses and measured flow
Tingey Bryson Eastman	Reduced losses and measured flow
Tic Chandler	Reduced losses and measured flow
Buck	Reduced losses and measured flow
Schulthess 1 & Neville	Reduced losses and measured flow

Schulthess 2	Reduced losses and measured flow
Schulthess 3	Reduced losses and measured flow

Source: J-U-B ENGINEERS, Inc.

Figure 1. Map of Woodruff Irrigation Company's Irrigation System



Source: U.S. Department of Interior, Bureau of Reclamation, Provo Area Office. 2016. Draft Environmental Assessment Woodruff Pressurized Irrigation Project.

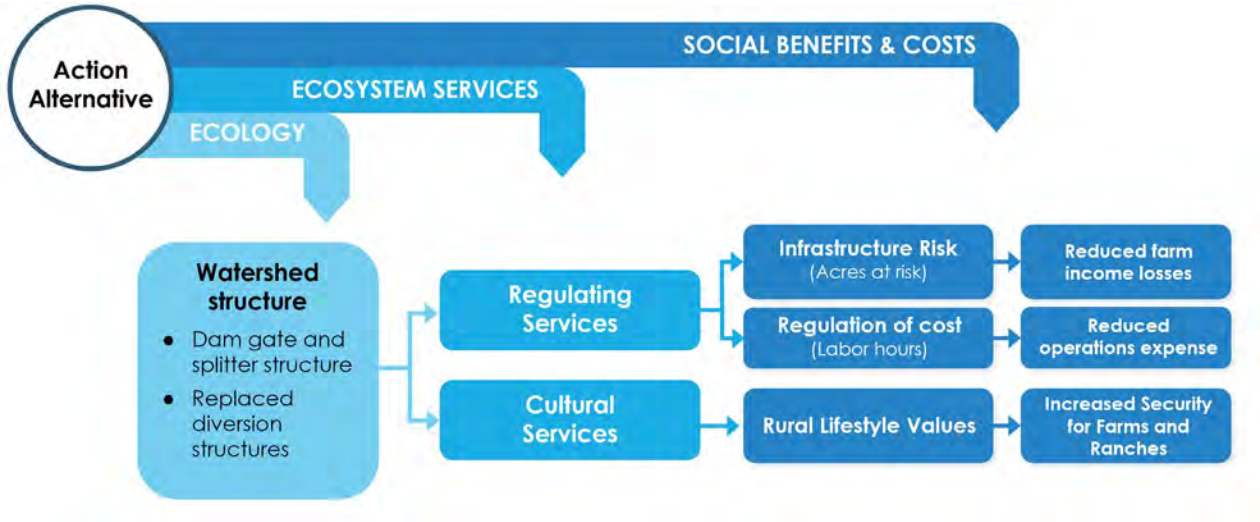
3.2. Types of Services Impacted. Public scoping comments, planning documents, watershed plans from surrounding areas, and discussions with the project sponsors suggest that the project's primary benefits will result from reducing the risk of infrastructure failures that could inhibit WIC from conveying irrigation water to its customers for part or all of a growring season, resulting in damages to farm incomes in the watershed. Theses risks would be reduced or eliminated under the Action Alternative as compared to the FWOFI. The Action Alternative would also improve agricultural water management by installing a remotely operated gate with SCADA at Woodruff Reservoir as well as a splitter structure downstream of the reservoir. In addition to reducing failure risk and improving water management, these changes would also reduce operational expenses.

Figure 2 shows the causal chain describing how the Action Alternative would create social benefits and costs as part of the Woodruff Creek Watershed Project. Causal chains are models describing how changes to the structure of an ecosystem affect its functioning and the goods and services it provides to society (Olander et al., 2016). When used as part of a NEE analysis, a causal chain assessment of

ecosystem services impacts traces changes in ecosystem composition all the way through to effects on social outcomes and human well-being.

As Figure 2 shows, the Action Alternative would change the ecological structure of the watershed through the construction of the works of improvement described in Table 2.

Figure 2. Description of Alternatives Evaluated Part of the Woodruff Creek Watershed Plan-EA and Anticipated Impacts on Ecosystem Services



The change in watershed structure would primarily impact regulating services by reducing the risk of infrastructure failure, thereby reducing expected losses of farm income. The change in watershed structure would also regulate operational expenses by reducing the number of labor hours required for ditch riders to manage and repair diversion structures and operate the reservoir control gate and splitter. Additionally, the improvement in water management would impact cultural services by supporting rural lifestyle values and providing increased security to farmers and ranchers by protecting their ability to earn a livelihood.

3.3. Ability to Characterize, Quantify, and Monetize Services. The regulating ecosystem services described in Figure 2 can be characterized, quantified, and monetized using publically available information and accepted methodologies that relate biophysical values to economic values. The methods to quantify and value regulating ecosystem service evaluated as part of this analysis are described in more detail in Section 4. Cultural values are more difficult to quantify and are evaluated qualitatively.

3.4. Metrics to Evaluate Services. The metrics used to evaluate the change in regulating ecosystem service values under the Action Alternative are shown in Figure 2. Regulating services are evaluated by quantifying and valuing changes to the acres of farmland that would be removed from the risk of infrastructure failure and the reduction in labor hours required to operate the system. Impacts to cultural values are discussed qualitatively.

3.5. Prioritizing Services. Services were prioritized based on their expected contribution to the project's primary purposes of reducing damages from infrastructure failure and improving agricultural water management. As a result, the regulating services shown in Figure 2 were prioritized for analysis

as part of the evaluation of the Action Alternative's impact on National Economic Efficiency (NEE). The project may also result in smaller, secondary changes to other ecosystem services. For example, many operates in irrigation districts like the WIC have farmed or ranched for multiple generations and have a strong cultural connection to that way of life. Knowing that potential risks to their livelihoods are dimished or removed would likely create significant cultural benefits for the the project's direct beneficiaries. Ensuring that irrigated lands continue to receive water could also support some provisioning services, like providing important habitat and forage for wildlife, supporting biological diversity, and other similar provisioning services.

3.6. Summary and Comparison of Ecosystem Service Changes. A summary of the Action Alternative's impact on ecosystem services in the watershed and fulfillment of federal investment principles in water resources are shown in Table 3. The Action Alternative was created and supported through a local stakeholder process. As part of this process, stakeholders were invited to provide public comment and input into the design and evaluation of the Action Alternative. As a result of this input, the Action Alternative is the locally preferred alternative. The FWOFI is the no action alternative; without federal investment, there would be no other changes to the structures in the watershed, other than those already planned through regular maintenance. Non-structural alternatives were eliminated from detailed study because none were brought forward that would meet the purpose and need of the Project. The Action Alternative is the alternative that increases National Economic Efficiency by reducing damages from infrastructure failures, enhancing the provision of farm income, and reducing operating expensesa, thereby increasing the value of ecosystem services produced by the watershed. The Action Alternative is also the environmentally preferred alternative as defined in Section 101 of the National Environmental Policy Act.[7]

[7] Section 101 of NEPA states that "…It is the continuing responsibility of the Federal Government to (1) fulfill the responsibilities of each generation as trustee of the environment for succeeding generations; (2) assure for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings; (3) attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences; (4) preserve important historic, cultural, and natural aspects of our national heritage, and maintain wherever possible an environment which supports diversity and variety of individual choice; (5) achieve balance between population and resource use which will permit high standards of living and wide sharing of life's amenities; and (6) enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources."

Table 3. Summary of Project Alternatives and Associated Ecosystem Services Evaluated as Part of the National Economic Efficiency (NEE) Benefit-Cost Analysis (2023 $).

	Alternatives	
	FWOFI	**Action Alterative[1]**
Alternatives		
Locally Preferred		X
Non-structural[2]	-	-
National Economic Efficiency		X
Environmentally Preferable		X
Guiding Principles		
Healthy and Resilient Ecosystems		X
Sustainable Economic Development		X
Watershed Approach		X
Environmental Justice		X
Public Safety		X
Floodplains		X
Total Project Investment (Annualized Average)[3]	**$-**	**$164,813**
Monetized Net Benefits (Annualized Average)[4]	**-$388,464**	**$388,464**
Regulating Services (Annualized Average)		
Reduced farm income losses	-$384,306	$384,306
Reduced O&M expenses	-$4,158	$4,158
Cultural Services		
Cultural values	Ongoing risk to rural lifestyle	Increased security for farmers and ranches

Notes: (1) Note that all costs and benefits for Action Alternative are compared to the Future Without Federal Investment (FWOFI) here and elsewhere in this document. Benefits and costs were calculated over a 102 year analysis period using a discount rate of 2.5 percent. All values reported in 2023 dollars.

(2) Non-structural alternatives, if they exist, may be included in the final analysis (see Section 6c(2)(c) of PR&G, NRCS 2014a). Non-structural alternatives were eliminated from detailed study because none were brought forward that would meet the purpose and need of the Project.

(3) Annualized costs for the Action Alternative include design, engineering, administration, permitting, construction, and operations and maintenance.

(4) The net benefits of the FWOFI are negative to reflect the annualized damages and expenses in the study area due to expected damages and monetary expenditures.

The Action Alternative, which used a watershed approach to characterize problems and solutions in the watershed, meets the federal principles for investments in water resources. The Action Alternative would restore the watershed's ability to regulate infrastructure damages impacting the Woodruff Creek Watershed, thereby increasing the health and resiliency of the ecosystem. By reducing expected damages, the Action Alternative improves sustainable economic development by improving the economic well-being of present and future generations living within the watershed. Action Alternative

would not adversely affect environmental justice communities because there are no such communities located within the watershed.

In terms of benefits and costs, the Action Alternative's investment in the watershed would generate economic returns in excess of the upfront installation and ongoing management costs as compared to the FWOFI. Under the FWFOI, average annualized economic damages and expenses are approximately $388,464. These damages are the result of farm income losses and excess operations and maintenance costs that could be avoided under the Action Alternative. The Action Alternaitve would invest an average annual amount of $164,813 in built infrastructure to avoid these damages and expenses, thereby enhancing farm incomes and reducing costs in the watershed. The annualized discounted value of the enhanced regulating service benefits generated by the project amount to $388,464, outweighing the Action Alternative's annualized expense.[8] Cultural benefits, while not quantified, would also be enhanced as a result of the project.

4. National Economic Efficiency Analysis Data and Methodology

To evaluate the extent to which the Action Alternative would maximize public benefits relative to costs, the expected effects of the Action Alternative were quantified, valued, and compared against the FWOFI or No Action Alternative. The NEE BCA analysis evaluated the costs of the Action Alternative based on cost estimates for each work of improvement from J-U-B ENGINEERS, Inc. (J-U-B), which included costs for engineering, permitting, administration, construction, operations, and maintenance. These costs were compared against benefits received by regulating damages, avoiding expenses, and enhancing cultural values in the watershed.

Projected benefits and costs are based on a full employment economy and assume no change in relative prices during the period of analysis. Effects of the Action Alternative were evaluated over a 102-year time horizon including the two years required to complete installation and the 100-year useful life of the improvements. This analysis period is equal to the length of time over which the works of improvement are expected to have significant beneficial effects. Benefits are expected to begin accruing the year after the works of improvement are installed and continue to accrue until the end of the 102-year time horizon. Since all the project elements have design lives of 100-years, replacement costs were not included in the analysis as the project time horizon does not exceed the life of the measures (PR&G Section 9, NWPM 501.37.B and the Economics Handbook, Part 611, 1.12.).

Benefits and costs are discounted using the discount rate for federal projects of 2.5 percent for 2023.[9] Results are reported in average annualized values in 2023 dollars. The unit of analysis in this study is the Action Alternative. For this study, costs and benefits are estimated jointly for all works of improvement for the Action Alternative. However, Section 6 considers the impact of each work of improvement separately, beginning with the most beneficial improvement and ending with the least

[8] Benefits and costs were calculated over a 102 year analysis period using a discount rate of 2.5 percent. All values reported in 2023 dollars.

[9] U.S. Department of Agriculture. 2023. Discount Rate for Fiscal Year 2023 Water Resource Planning Evaluation. Available at: https://directives.sc.egov.usda.gov/viewerFS.aspx?hid=48743#:~:text=Any%20project%20that%20relies%20on,Circular%20A%2D94%20Appendix%20C.

beneficial improvement, as part of the incremental analysis (390-NWPH, Part 606, Subpart B, Section 606.20).

4.1. Reduced Farm Income Losses. WIC serves an area of approximately 5,800 irrigated acres. The irrigated land served by WIC is primarily used to grow alflafla and grass hay. As described above, water stored in Woodruff Reservoir and Birch Creek Reservoir is conveyed through dozens of canals and ditches as shown in Figure 1, above. Rudimentary and dilapted diversion structures are currently used to divert the water to various parts of the WIC system, which poses operational challenges and risks for irrigators. The antiquated nature and poor state of the diversion structures makes them prone to catastrophic failure. In the event of a failure, there is a strong possibility that the WIC would be unable to convey irrigation water to the impacted ditch, posing a risk to agricultural production and farm incomes.

Each year, producers face the risk of infrastructure failure. The expected annual cost of this risk can be estimated as an expected value calculation, where the annual risk of failure is multiplied by the value of farm income at risk. This section estimates this value using information on the annual probability of diversion structure failures, the number of acres at risk for each diversion structure, and the net farm income that would be lost in the event of a failure. To simplify the analysis, alfalfa production is modeled as the primary use of agricultural land in the study area.

4.1.1. Value of agricultural production at risk. The primary benefit of avoiding the failure risks shown above is avoiding the resulting damages to crop production and farm incomes. Table 4 shows the estimated production costs of alfalfa production in Rich County based on a crop enterprise budget from Utah State University. The cost of the budgeted items were updated to 2023 values using the Consumper Price Index. As the budget shows, the average cost of production is approximately $299.76 per acre.

Table 4. Crop Enterprise Budget for Irrigated Alfalfa in Rich County, Utah (2023 $)

Expense Category	Quantity Per Acre	Unit	Unit Cost	Cost Per Acre
Operation Cost				
Fertilization				
Phosphate	96	Pounds	$0.27	$26.27
Custom application	1	Acre	$11.89	$11.89
Irrigation				
Labor	1.33	Hours	$15.20	$20.22
Water assessment	1	Share	$15.20	$15.20
Repairs/maintenance	1	Acre	$3.50	$3.50
Harvesting				
Swathing	2	Acre	$6.13	$12.25
Turning/Raking	2	Acre	$2.11	$4.23
Bailing	2.6	Ton	$7.28	$18.93
Hauling/stacking	2.6	Ton	$5.52	$14.35
Interest on operating capital		7.61%	$2.98	$2.98
Ownership Costs				
Farm insurance	1	Acre	$3.04	$3.04
Machinery	1	Acre	$154.39	$154.39
Irrigation equipment	1	Acre	$12.54	$12.54
Total Annual Cost				**$299.76**

Source: Utah State University Extension Economics. 2006. Costs and Returns per Acre from Growing Alfalfa Hay. Rich County. Available at: https://extension.usu.edu/apec/agribusiness-food/enterprise-budgets

Table 5 shows the average yield for alfalfa in Rich County and the average price received for the state of Utah, in 2023 dollars. As the table shows, average yields in Rich County averaged 2.6 tons per acre between 2008 and 2017, the most recent years for which data are available. Over the last 10 years, alfalfa prices have averaged $225 per ton in Utah, in 2023 dollars. The data suggest the gross revenue of growing alfalfa in Rich County is approximately $585.75 per acre. Netting out the production costs reported above yields and net income of approximately $285.99 per acre. This value was used to estimate the expected value of reduced farm income losses under the Action Alternative.

Table 5. Average Annual Yield and Price Received for Alfalfa and Grass Hay (2023 $)

Note:

(1) Crop yields are reported for Rich County, Utah.

(2) Prices are reported for the state of Utah.

Source:

USDA National Agricultural Statistics Service (2008-2022). NASS - Quick Stats. USDA National Agricultural Statistics Service. https://data.nal.usda.gov/dataset/nass-quick-stats. Accessed March 2023.

	Alfalfa	
Year	**Yield (Ton/Acre)[1]**	**Price ($/Ton)[2]**
2022		$318.86
2021		$271.40
2020		$218.79
2019		$218.40
2018		$208.12
2017	2.5	$166.16
2016	3.0	$161.29
2015	2.7	$208.98
2014	1.7	$242.52
2013	2.3	$238.42
2012	2.7	
2011	2.8	
2010	2.8	
2009	2.8	
2008	2.4	
Average	**2.6**	**$225.29**
Average Revenue		**$585.75**
Average Cost		**$299.76**
Net Income		**$285.99**

4.1.2. Failure probabilities and expected income losses . The WIC irrigation distribution system is plagued by the poor state of its diversion structures, leading to the constant threat of infrastructure failure and its resulting damages to crop yields and farm incomes. Based on this history, J-U-B was able to estimate both the probability (frequency) of catastrophic component failures and the number of acres at risk for each diversion structure proposed for replacement under the Action Alterntative. As shown in Table 6, the diversion structures have a uniform risk of failure that J-U-B estimated at 15 percent each year. Depending on the location of the structure, the acres at risk from a failure range from a low of 13 acres (Witheral) to a high of 1,297 acres (Dean's). The probability of failure of the gate at Woodrfuff Reservoir was estimated at 1 percent per year and the splitter structure was estimated at 20 percent per year.

Table 6. Annual Probability of Failure, Acres at Risk, and Expected Farm Income Losses in WIC Irrigation Distribution System Under the FWOFI

Diversion Structure	Annual Probability of Failure (FWOFI)	Acres at Risk[1]	Expected Damages
Woodruff Reservoir Gate	1%	5,800	$16,587
Splitter	20%	2,249	$128,638
Putnam-Cornia	15%	137	$5,877
Huffaker	15%	159	$6,821
Eastman-Frazier	15%	362	$15,529
Frazier 1&2	15%	436	$18,704
Hagus	15%	431	$18,489
Co-Op	15%	1,214	$52,079
Dean's	15%	1,297	$55,639
Smitch Ditch	15%	20	$858
Cornia 1	15%	53	$2,274
Cornia 2	15%	43	$1,845
Witheral	15%	13	$558
Saxton	15%	50	$2,145
Dugway	15%	45	$1,930
Eastman 1	15%	50	$2,145
Baxter	15%	138	$5,920
Church Brown	15%	112	$4,805
Schulthess Vernon	15%	159	$6,821
Tingey Bryson Eastman	15%	469	$20,119
Tic Chandler	15%	40	$1,716
Buck	15%	65	$2,788
Neville	15%	80	$3,432
Schulthess 1[2]	15%	140	$6,006
Schulthess 2[2]	15%	140	$6,006
Schulthess 3[2]	15%	140	$6,006
Total		**5,800**	**$393,737**

Note: (1) Shulthess diversions operate as one. The total area at risk is 421 acres.

(2) Acres at risk total to the area served by the Woodruff Reservoir.

Source: J-U-B ENGINEERS Inc., 2023.

As illustrated in Table 6, most lands in the irrigation system face the risk of failure from multiple structures. For example, all of the land in the WIC system is at risk of failure from the gate at Woodruff Reservoir. Several thousand acres are also at risk from the failure of the splitter. Below the reservoir and the splitter, land is at risk from the failure of specific diversion structures. While the odds of multiple pieces of infrastructure failing at once are lower than the risk of a single piece of infrastructure failing, a severe flood event could create a cascading failure in the WIC system. However, only the risk associated with the failure of individual infrastructure elements was considered in this analysis.

The expected value of annual damages is equal to the net income produced per acre multiplied by the annual probability of failure. The total value of expected annual farm income losses is equal to $393,737 per year, as shown in Table 6, above.

4.2. Reduced Operations, Maintenance, and Repair Costs. The Action Alternative would reduce operational and maintenance costs in the WIC system. The installation of the new gate and SCADA system at Woodrfuff Reservoir and the installation of a new splitter would reduce the need for WIC staff to make multiple trips from the town of Woodruff to the reservoir and splitter to assess flows and make adjustments as these activites could be monitored and conducted remotely. In addition, the installation of new diversion structures would further reduce the time required to operate the WIC system.

WIC staff estimate operation and maintenance expenses under the FWOFI and the Action Alternative as shown in Table 7.

Table 7. Annual Costs for Operations and Maintenance Under the Future without Federal Invesmtnet (FWOFI) and the Action Alternative (AA) in the Woodruff Creek Wateshed Plan-EA, Rich County, Utah (2023 $)

	Woodruff Reservoir		Splitter		Diversion Structures	
O&M Action	**AA**	**FWOFI**	**AA**	**FWOFI**	**AA**	**FWOFI**
Daily Flow Check	$2,520	$3,276	$2,520	$3,276	$560	$728
Routine O&M						
Management	$450	$585	$450	$585	$100	$130
Debris Removal	$56	$73	$56	$73	$13	$16
Repairs & Tools	$1,125	$1,463	$1,125	$1,463	$250	$325
Equipment & Vehicles	$2,250	$2,925	$2,250	$2,925	$500	$650
Annual Tasks						
Diversion Repair	$90	$117	$90	$117	$20	$26
Sediment Removal	$135	$176	$135	$176	$30	$39
Total	**$6,626**	**$8,614**	**$6,626**	**$8,614**	**$1,473**	**$1,914**

Source: J-U-B ENGINEERS, Inc., March, 2023.

Costs in Table 7 are estimates reported by WIC staff based on typical year. Daily flow checks require four hours pre trip and the company estimates staff make a total of 56 trips a year. Based on an average hourly wage of $25 per hour, these trips cost a total of $7,280 under the FWOFI. Under the Action Alternative, daily flow checks are estimated to cost 30 percent less, or a total of $5,600 per year. Routine O&M activities and annual tasks are also expected to see a 30 percent reduction in costs under the Action Alternative compared to the FWOFI. Routine O&M activities costs a total of $11,102 under the FWOFI and would be reduced to an annual total of $8,625 under the Action Alternative. Annual tasks cost $650 under the FWOFI and would cost $500 under the FWOFI. In total, the Action Alternative is expected to save approximately $4,400 per year in operations and maintenance costs.

4.3. Cultural Values. Irrigated agriculture has been a defining component of the cultural and economic landscape of northern Utah since settlers first arrived in the mid 19th century. Since that time, it has become a defining feature of the region's history and its cultural values, shaping the lives and relationships of its residents and sustaining local economies. Agriculture in the region has historically been a family-based enterprise, with many farms and ranches being passed down between generations.

This continuity has helped to build a strong sense of local identity and belonging among residents, who take pride in their agricultural heritage and traditions. For example, the Woodruff Days festival, held on the 4th of July each year, features a parade and rodeo that celebrates the region's ranching and agricultural heritage. Events like the Woodruff Days festival bring the community's farmers, ranchers, and residents together, further forging bonds of trust and mutual support that are essential to the region's social fabric.

In recent years, the importance of maintaining the region's agriculture has increased as rapid growth and development have put pressure on farm and ranchland. For many residents, these trends have underscored the importance of investing in the infrastructure that supports their rural lifestyles and the region's agricultural heritage. Investments in the WIC system proposed under the Action Alternative would provide a substantial benefit to the areas local farmers and ranchers by making land more predictably productive and reducing incentives to use land for other types of development.

4.4. Costs. Project costs include all expenses incurred as part of the development, installation, operation, and maintenance of a project. Preliminary engineering work was completed by J-U-B, who was hired by the Sponsoring Local Organization to lead design and planning work on the project. J-U-B is the lead engineer on the project. Based on this work, J-U-B provided cost estimates for the Action Alternative. The cost estimates were allocated to particular categories, which included:

- Permitting;
- Administration;
- Engineering and design;
- Construction; and
- Operations and Maintenance.

Each cost was allocated to federal sources or the project sponsor.

4.4.1. Installation costs. Installation costs were estimated using the bottom-up approach. This method breaks projects and structures into lower-level components and then costs those components for their direct costs, including labor, materials, and professional services. In addition, installation cost estimates include cost contingencies of 30 percent of construction costs.

Tables 8 through 33 show the estimated installation costs for the structures included in the Action Alternative.

Table 8. Estimated Installation Costs of Woodruff Reservoir Gate Automation of the Action Alternative (2023 $).[1]

ESTIMATE OF QUANTITIES					
Item #	**Description**	**Unit**	**Quantity**	**Unit Price**	**Total**
1.	Mobilization/Demobilization (7%)	LS	1	$22,348	$22,348
2.	Environmental Protection	LS	1	$20,000	$20,000
3.	Removal and Control of Water	LS	1	$100,000	$100,000
4.	Clearing, Grubbing, and Stripping	AC	0.10	$7,500	$750
5.	Dust Abatement	LS	1	$3,500	$3,500
6.	Furnish and Install Low-Level Outlet Automated Gate Controls, Power, Scada, and Other Appurtenances	LS	1	$100,000	$100,000
7.	Furnish and Install Parshall Flume Flow Measurment Structure	LS	1	$60,000	$60,000
8.	Furnish and Install Pedestrian Walkway over Spillway	LS	1	$25,000	$25,000
				Contingency (30%)	$102,479
				Total Opinion of Cost - Construction	**$444,077**
PROFESSIONAL SERVICES					
1.	Engineering (10% Construction, 10% Construction Management)	LS	1	$68,320	$68,320
2.	Administration (NRCS, 2%)	LS	1	$6,832	$6,832
3.	Local Administration	LS	1	$200	$200
4.	Permitting	LS	1	$600	$600
				Total Professional Services Estimated Cost	**$75,952**
				Total Project Cost	**$520,029**

Note: (1) Totals may not sum due to rounding.

Source: J-U-B ENGINEERS, Inc. Prepared March 2023.

Table 9. Estimated Installation Costs of Putnam-Corina Control Structure of the Action Alternative (2023 $).[1]

ESTIMATE OF QUANTITIES					
Item #	**Description**	**Unit**	**Quantity**	**Unit Cost**	**Total**
1.	Mobilization/Demobilization (7%)	LS	1	$7,051	$7,051
2.	Environmental Protection	LS	1	$12,500	$12,500
3.	Removal and Control of Water	LS	1	$12,500	$12,500
4.	Clearing, Grubbing, and Stripping	AC	0.10	$15,000	$1,500
5.	Dust Abatement	LS	1	$5,000	$5,000
6.	Remove and Dispose - Existing Headgate	LS	1	$1,500	$1,500
7.	Unclassified Excavation and Stockpile	CY	23	$30	$680
8.	Furnish and Install Cast-In-Place Concrete Headwall	CY	2	$1,300	$2,741
9.	Furnish and Install 36" Headgate with Manual Controls, Trash Rack	LS	1	$2,500	$2,500
10.	Placement and Compaction of Crushed Aggregate Base	CY	7	$65	$460
11.	Earthfill Zone IV Fill	CY	16	$38	$592
12.	Furnish and Install Concrete Check Structure with Bays, Flashboards, and Concrete Spillway	CY	7	$1,500	$9,908
13.	Furnish and Install Flow Measurement Weir/Parshall Flume	LS	1	$15,000	$15,000
14.	Furnish and Install Class 300 Riprap	CY	3	$260	$847
15.	Furnish and Install Access Walkway	EA	1	$20,000	$20,000
16.	Site Restoration and Rehabilitation	LS	1	$15,000	$15,000
				Contingency (30%)	**$32,334**
				Total Opinion of Cost - Construction	**$140,113**
PROFESSIONAL SERVICES					
1.	Engineering (10% Construction, 10% Construction Management)	LS	1	$21,556	$21,556
2.	Administration (NRCS, 2%)	LS	1	$2,156	$2,156
3.	Local Administration	LS	1	$200	$200
4.	Permitting	LS	1	$600	$600
				Total Professional Services Estimated Cost	**$24,512**
				Total Project Cost	**$164,625**

Note: (1) Totals may not sum due to rounding.

Source: J-U-B ENGINEERS, Inc. Prepared March 2023.

Table 10. Estimated Installation Costs of Huffaker Control Structure of the Action Alternative (2023 $).[1]

ESTIMATE OF QUANTITIES					
Item #	**Description**	**Unit**	**Quantity**	**Unit Cost**	**Total**
1.	Mobilization/Demobilization (7%)	LS	1	$9,111	$9,111
2.	Environmental Protection	LS	1	$12,500	$12,500
3.	Removal and Control of Water	LS	1	$12,500	$12,500
4.	Clearing, Grubbing, and Stripping	AC	0.10	$15,000	$1,500
5.	Dust Abatement	LS	1	$5,000	$5,000
6.	Remove and Dispose - Existing Improvised Check Structure	LS	1	$3,500	$3,500
7.	Unclassified Excavation and Stockpile	CY	79	$30	$2,376
8.	Furnish and Install Cast-In-Place Concrete Headwall	CY	2	$1,300	$2,151
9.	Furnish and Install 24" Headgate with Manual Controls	LS	1	$1,000	$1,000
10.	Placement and Compaction of Crushed Aggregate Base	CY	28	$65	$1,836
11.	Earthfill Zone IV Fill	CY	51	$38	$1,936
12.	Furnish and Install Concrete Check Structure with Bays, Flashboards, and Concrete Spillway	CY	23	$1,500	$34,187
13.	Furnish and Install Flow Measurement Weir/Parshall Flume	LS	1	$15,000	$15,000
14.	Furnish and Install Class 300 Riprap	CY	6	$260	$1,677
15.	Furnish and Install Access Walkway	LS	1	$20,000	$20,000
16.	Site Restoration and Rehabilitation	LS	1	$15,000	$15,000
				Contingency (30%)	**$41,782**
				Total Opinion of Cost - Construction	**$181,057**
PROFESSIONAL SERVICES					
1.	Engineering (10% Construction, 10% Construction Management)	LS	1	$27,855	$27,855
2.	Administration (NRCS, 2%)	LS	1	$2,785	$2,785
3.	Local Administration	LS	1	$200	$200
4.	Permitting	LS	1	$600	$600
				Total Professional Services Estimated Cost	**$31,440**
				Total Project Cost	**$212,497**

Note: (1) Totals may not sum due to rounding.

Source: J-U-B ENGINEERS, Inc. Prepared March 2023.

Table 11. Estimated Installation Costs of Frazier 1 and 2 Control System of the Action Alternative (2023 $).[1]

ESTIMATE OF QUANTITIES					
Item #	**Description**	**Unit**	**Quantity**	**Unit Cost**	**Total**
1.	Mobilization/Demobilization (7%)	LS	1	$12,700	$12,700
2.	Environmental Protection	LS	1	$20,000	$20,000
3.	Removal and Control of Water	LS	1	$25,000	$25,000
4.	Clearing, Grubbing, and Stripping	AC	0.10	$15,000	$1,500
5.	Dust Abatement	LS	1	$5,000	$5,000
6.	Remove and Dispose - Existing Improvised Check Structure	LS	1	$4,500	$4,500
7.	Unclassified Excavation and Stockpile	CY	61	$30	$1,832
8.	Furnish and Install Cast-In-Place Concrete Headwall	CY	4	$1,300	$5,255
9.	Furnish and Install 30" Headgate with Manual Controls	EA	2	$1,500	$3,000
10.	Placement and Compaction of Crushed Aggregate Base	CY	14	$65	$924
11.	Earthfill Zone IV Fill	CY	47	$38	$1,780
12.	Furnish and Install Concrete Check Structure with Bays, Flashboards, and Concrete Spillway	CY	18	$1,500	$27,250
13.	Furnish and Install Flow Measurement Weir/Parshall Flume	EA	2	$15,000	$30,000
14.	Furnish and Install Class 300 Riprap	CY	50	$260	$12,894
15.	Furnish and Install Access Walkway	LS	1	$20,000	$20,000
16.	Site Restoration and Rehabilitation	LS	1	$22,500	$22,500
				Contingency (30%)	**$58,240**
				Total Opinion of Cost - Construction	**$252,375**
PROFESSIONAL SERVICES					
1.	Engineering (10% Construction, 10% Construction Management)	LS	1	$38,827	$38,827
2.	Administration (NRCS, 2%)	LS	1	$3,883	$3,883
3.	Local Administration	LS	1	$200	$200
4.	Permitting	LS	1	$600	$600
				Total Professional Services Estimated Cost	**$43,510**
				Total Project Cost	**$295,885**

Note: (1) Totals may not sum due to rounding.

Source: J-U-B ENGINEERS, Inc. Prepared March 2023.

Table 12. Estimated Installation Costs of Cornia 1 Control System of the Action Alternative (2023 $).[1]

ESTIMATE OF QUANTITIES					
Item #	**Description**	**Unit**	**Quantity**	**Unit Cost**	**Total**
1.	Mobilization/Demobilization (7%)	LS	1	$7,360	$7,360
2.	Environmental Protection	LS	1	$12,500	$12,500
3.	Removal and Control of Water	LS	1	$12,500	$12,500
4.	Clearing, Grubbing, and Stripping	AC	0.10	$15,000	$1,500
5.	Dust Abatement	LS	1	$5,000	$5,000
6.	Remove and Dispose - Existing Headgate	LS	1	$3,500	$3,500
7.	Remove and Dispose - Existing Improvised Check Structure	LS	1	$3,500	$3,500
8.	Unclassified Excavation and Stockpile	CY	25	$30	$756
9.	Furnish and Install Cast-In-Place Concrete Headwall	CY	2	$1,300	$2,151
10.	Furnish and Install 24" Headgate with Manual Controls	LS	1	$1,000	$1,000
11.	Placement and Compaction of Crushed Aggregate Base	CY	6	$65	$391
12.	Earthfill Zone IV Fill	CY	19	$38	$729
13.	Furnish and Install Concrete Check Structure with Bays, Flashboards, and Concrete Spillway	CY	7	$1,500	$10,722
14.	Furnish and Install Flow Measurement Weir/Parshall Flume	LS	1	$15,000	$15,000
15.	Furnish and Install Class 300 Riprap	CY	3	$260	$889
16.	Furnish and Install Access Walkway	LS	1	$20,000	$20,000
17.	Site Restoration and Rehabilitation	LS	1	$15,000	$15,000
				Contingency (30%)	**$33,750**
				Total Opinion of Cost - Construction	**$146,248**
PROFESSIONAL SERVICES					
1.	Engineering (10% Construction, 10% Construction Management)	LS	1	$22,500	$22,500
2.	Administration (NRCS, 2%)	LS	1	$2,250	$2,250
3.	Local Administration	LS	1	$200	$200
4.	Permitting	LS	1	$600	$600
				Total Professional Services Estimated Cost	**$25,550**
				Total Project Cost	**$171,798**

Note: (1) Totals may not sum due to rounding.

Source: J-U-B ENGINEERS, Inc. Prepared March 2023.

Table 13. Estimated Installation Costs of Cornia 2 Control System of the Action Alternative (2023 $).[1]

ESTIMATE OF QUANTITIES					
Item #	**Description**	**Unit**	**Quantity**	**Unit Cost**	**Total**
1.	Mobilization/Demobilization (7%)	LS	1	$8,975	$8,975
2.	Environmental Protection	LS	1	$12,500	$12,500
3.	Removal and Control of Water	LS	1	$12,500	$12,500
4.	Clearing, Grubbing, and Stripping	AC	0.10	$15,000	$1,500
5.	Dust Abatement	LS	1	$5,000	$5,000
6.	Remove and Dispose - Existing Improvised Check Structure	LS	1	$3,500	$3,500
7.	Unclassified Excavation and Stockpile	CY	55	$30	$1,652
8.	Furnish and Install Cast-In-Place Concrete Headwall	CY	2	$1,300	$2,151
9.	Furnish and Install 24" Headgate with Manual Controls	LS	1	$1,000	$1,000
10.	Placement and Compaction of Crushed Aggregate Base	CY	17	$65	$1,112
11.	Earthfill Zone IV Fill	CY	38	$38	$1,442
12.	Furnish and Install Concrete Check Structure with Bays, Flashboards, and Concrete Spillway	CY	23	$1,500	$34,187
13.	Furnish and Install Flow Measurement Weir/Parshall Flume	LS	1	$15,000	$15,000
14.	Furnish and Install Class 300 Riprap	CY	6	$260	$1,677
15.	Furnish and Install Access Walkway	LS	1	$20,000	$20,000
16.	Site Restoration and Rehabilitation	LS	1	$15,000	$15,000
				Contingency (30%)	**$41,149**
				Total Opinion of Cost - Construction	**$178,355**
PROFESSIONAL SERVICES					
1.	Engineering (10% Construction, 10% Construction Management)	LS	1	$27,439	$27,439
2.	Administration (NRCS, 2%)	LS	1	$2,744	$2,744
3.	Local Administration	LS	1	$200	$200
4.	Permitting	LS	1	$600	$600
				Total Professional Services Estimated Cost	**$30,983**
				Total Project Cost	**$209,338**

Note: (1) Totals may not sum due to rounding.

Source: J-U-B ENGINEERS, Inc. Prepared March 2023.

Table 14. Estimated Installation Costs of Witheral Control System of the Action Alternative (2023 $).[1]

ESTIMATE OF QUANTITIES					
Item #	**Description**	**Unit**	**Quantity**	**Unit Cost**	**Total**
1.	Mobilization/Demobilization (7%)	LS	1	$8,798	$8,798
2.	Environmental Protection	LS	1	$12,500	$12,500
3.	Removal and Control of Water	LS	1	$12,500	$12,500
4.	Clearing, Grubbing, and Stripping	AC	0.10	$15,000	$1,500
5.	Dust Abatement	LS	1	$5,000	$5,000
6.	Remove and Dispose - Existing Headgate	LS	1	$3,500	$3,500
7.	Remove and Dispose - Existing Improvised Check Structure	LS	1	$3,500	$3,500
8.	Unclassified Excavation and Stockpile	CY	52	$30	$1,566
9.	Furnish and Install Cast-In-Place Concrete Headwall	CY	2	$1,300	$2,151
10.	Furnish and Install 24" Headgate with Manual Controls	LS	1	$1,000	$1,000
11.	Placement and Compaction of Crushed Aggregate Base	CY	13	$65	$826
12.	Earthfill Zone IV Fill	CY	39	$38	$1,501
13.	Furnish and Install Concrete Check Structure with Bays, Flashboards, and Concrete Spillway	CY	18	$1,500	$27,250
14.	Furnish and Install Flow Measurement Weir/Parshall Flume	LS	1	$15,000	$15,000
15.	Furnish and Install Class 300 Riprap	CY	11	$260	$2,893
16.	Furnish and Install Access Walkway	LS	1	$20,000	$20,000
17.	Site Restoration and Rehabilitation	LS	1	$15,000	$15,000
				Contingency (30%)	**$40,345**
				Total Opinion of Cost - Construction	**$174,830**
PROFESSIONAL SERVICES					
1.	Engineering (10% Construction, 10% Construction Management)	LS	1	$26,897	$26,897
2.	Administration (NRCS, 2%)	LS	1	$2,690	$2,690
3.	Local Administration	LS	1	$200	$200
4.	Permitting	LS	1	$600	$600
				Total Professional Services Estimated Cost	**$30,387**
				Total Project Cost	**$205,217**

Note: (1) Totals may not sum due to rounding.

Source: J-U-B ENGINEERS, Inc. Prepared March 2023.

Table 15. Estimated Installation Costs of Saxton Control System of the Action Alternative (2023 $).[1]

ESTIMATE OF QUANTITIES					
Item #	**Description**	**Unit**	**Quantity**	**Unit Cost**	**Total**
1.	Mobilization/Demobilization (7%)	LS	1	$8,656	$8,656
2.	Environmental Protection	LS	1	$12,500	$12,500
3.	Removal and Control of Water	LS	1	$12,500	$12,500
4.	Clearing, Grubbing, and Stripping	AC	0.10	$15,000	$1,500
5.	Dust Abatement	LS	1	$5,000	$5,000
6.	Remove and Dispose - Existing Headgate	LS	1	$3,500	$3,500
7.	Remove and Dispose - Existing Improvised Debris Check Structure and Other Misc Debris	LS	1	$4,500	$4,500
8.	Remove and Dispose - Existing Parshall Flume	LS	1	$2,500	$2,500
9.	Unclassified Excavation and Stockpile	CY	38	$30	$1,139
10.	Furnish and Install Cast-In-Place Concrete Headwall	CY	2	$1,300	$2,151
11.	Furnish and Install 24" Headgate with Manual Controls	LS	1	$1,000	$1,000
12.	Placement and Compaction of Crushed Aggregate Base	CY	9	$65	$597
13.	Earthfill Zone IV Fill	CY	29	$38	$1,093
14.	Furnish and Install Concrete Check Structure with Bays, Flashboards, and Concrete Spillway	CY	16	$1,500	$24,028
15.	Furnish and Install Flow Measurement Weir/Parshall Flume	LS	1	$15,000	$15,000
16.	Furnish and Install Class 300 Riprap	CY	6	$260	$1,656
17.	Furnish and Install Access Walkway	LS	1	$20,000	$20,000
18.	Site Restoration and Rehabilitation	LS	1	$15,000	$15,000
				Contingency (30%)	**$39,696**
				Total Opinion of Cost - Construction	**$172,016**
PROFESSIONAL SERVICES					
1.	Engineering (10% Construction, 10% Construction Management)	LS	1	$26,464	$26,464
2.	Administration (NRCS, 2%)	LS	1	$2,464	$2,646
3.	Local Administration	LS	1	$200	$200
4.	Permitting	LS	1	$600	$600
				Total Professional Services Estimated Cost	**$29,910**
				Total Project Cost	**$201,926**

Note: (1) Totals may not sum due to rounding.

Source: J-U-B ENGINEERS, Inc. Prepared March 2023.

Table 16. Estimated Installation Costs of Dugway Control System of the Action Alternative (2023 $).[1]

ESTIMATE OF QUANTITIES					
Item #	**Description**	**Unit**	**Quantity**	**Unit Cost**	**Total**
1.	Mobilization/Demobilization (7%)	LS	1	$8,656	$8,656
2.	Environmental Protection	LS	1	$12,500	$12,500
3.	Removal and Control of Water	LS	1	$12,500	$12,500
4.	Clearing, Grubbing, and Stripping	AC	0.10	$15,000	$1,500
5.	Dust Abatement	LS	1	$5,000	$5,000
6.	Remove and Dispose - Existing Headgate	LS	1	$3,500	$3,500
7.	Remove and Dispose - Existing Improvised Debris Check Structure and Other Misc Debris	LS	1	$4,500	$4,500
8.	Remove and Dispose - Existing Parshall Flume	LS	1	$2,500	$2,500
9.	Unclassified Excavation and Stockpile	CY	38	$30	$1,139
10.	Furnish and Install Cast-In-Place Concrete Headwall	CY	2	$1,300	$2,151
11.	Furnish and Install 24" Headgate with Manual Controls	LS	1	$1,000	$1,000
12.	Placement and Compaction of Crushed Aggregate Base	CY	9	$65	$597
13.	Earthfill Zone IV Fill	CY	29	$38	$1,093
14.	Furnish and Install Concrete Check Structure with Bays, Flashboards, and Concrete Spillway	CY	16	$1,500	$24,028
15.	Furnish and Install Flow Measurement Weir/Parshall Flume	LS	1	$15,000	$15,000
16.	Furnish and Install Class 300 Riprap	CY	6	$260	$1,656
17.	Furnish and Install Access Walkway	LS	1	$20,000	$20,000
18.	Site Restoration and Rehabilitation	LS	1	$15,000	$15,000
				Contingency (30%)	**$39,696**
				Total Opinion of Cost - Construction	**$172,016**
PROFESSIONAL SERVICES					
1.	Engineering (10% Construction, 10% Construction Management)	LS	1	$26,464	$26,464
2.	Administration (NRCS, 2%)	LS	1	$2,646	$2,646
3.	Local Administration	LS	1	$200	$200
4.	Permitting	LS	1	$600	$600
				Total Professional Services Estimated Cost	**$29,910**
				Total Project Cost	**$201,926**

Note: (1) Totals may not sum due to rounding.

Source: J-U-B ENGINEERS, Inc. Prepared March 2023.

Table 17. Estimated Installation Costs of Eastman 1 Control System of the Action Alternative (2023 $).[1]

ESTIMATE OF QUANTITIES					
Item #	**Description**	**Unit**	**Quantity**	**Unit Cost**	**Total**
1.	Mobilization/Demobilization (7%)	LS	1	$10,131	$10,131
2.	Environmental Protection	LS	1	$12,500	$12,500
3.	Removal and Control of Water	LS	1	$12,500	$12,500
4.	Clearing, Grubbing, and Stripping	AC	0.10	$15,000	$1,500
5.	Dust Abatement	LS	1	$5,000	$5,000
6.	Remove and Dispose - Existing Headgate	LS	1	$3,500	$3,500
7.	Remove and Dispose - Existing Improvised Check Structure	LS	1	$3,500	$3,500
8.	Unclassified Excavation and Stockpile	CY	292	$30	$8,766
9.	Furnish and Install Cast-In-Place Concrete Headwall	CY	2	$1,300	$2,151
10.	Furnish and Install 24" Headgate with Manual Controls	LS	1	$1,000	$1,000
11.	Furnish and Install 24" Culvert	LF	12	$250	$3,000
12.	Placement and Compaction of Crushed Aggregate Base	CY	13	$65	$826
13.	Earthfill Zone IV Fill	CY	279	$38	$10,621
14.	Furnish and Install Concrete Check Structure with Bays, Flashboards, and Concrete Spillway	CY	18	$1,500	$27,250
15.	Furnish and Install Flow Measurement Weir/Parshall Flume	LS	1	$15,000	$15,000
16.	Furnish and Install Class 300 Riprap	CY	10	$260	$2,621
17.	Furnish and Install Access Walkway	LS	1	$20,000	$20,000
18.	Site Restoration and Rehabilitation	LS	1	$15,000	$15,000
				Contingency (30%)	**$46,460**
				Total Opinion of Cost - Construction	**$201,325**
PROFESSIONAL SERVICES					
1.	Engineering (10% Construction, 10% Construction Management)	LS	1	$30,973	$30,973
2.	Administration (NRCS, 2%)	LS	1	$3,097	$3,097
3.	Local Administration	LS	1	$200	$200
4.	Permitting	LS	1	$600	$600
				Total Professional Services Estimated Cost	**$34,870**
				Total Project Cost	**$236,195**

Note: (1) Totals may not sum due to rounding.

Source: J-U-B ENGINEERS, Inc. Prepared March 2023.

Table 18. Estimated Installation Costs of Baxter Control System of the Action Alternative (2023 $).[1]

ESTIMATE OF QUANTITIES					
Item #	**Description**	**Unit**	**Quantity**	**Unit Cost**	**Total**
1.	Mobilization/Demobilization (7%)	LS	1	$9,206	$9,206
2.	Environmental Protection	LS	1	$12,500	$12,500
3.	Removal and Control of Water	LS	1	$12,500	$12,500
4.	Clearing, Grubbing, and Stripping	AC	0.10	$15,000	$1,500
5.	Dust Abatement	LS	1	$5,000	$5,000
6.	Remove and Dispose - Existing Headgate	LS	1	$3,500	$3,500
7.	Remove and Dispose - Existing Improvised Check Structure	LS	1	$3,500	$3,500
8.	Unclassified Excavation and Stockpile	CY	52	$30	$1,566
9.	Furnish and Install Cast-In-Place Concrete Headwall	CY	2	$1,300	$2,151
10.	Furnish and Install 24" Headgate with Manual Controls	LS	1	$1,000	$1,000
11.	Furnish and Install 24" Culvert	LF	24	$250	$6,000
12.	Placement and Compaction of Crushed Aggregate Base	CY	13	$65	$826
13.	Earthfill Zone IV Fill	CY	39	$38	$1,501
14.	Furnish and Install Concrete Check Structure with Bays, Flashboards, and Concrete Spillway	CY	18	$1,500	$27,250
15.	Furnish and Install Flow Measurement Weir/Parshall Flume	LS	1	$15,000	$15,000
16.	Furnish and Install Class 300 Riprap	CY	10	$260	$2,725
17.	Furnish and Install Access Walkway	LS	1	$20,000	$20,000
18.	Site Restoration and Rehabilitation	LS	1	$15,000	$15,000
				Contingency (30%)	**$42,218**
				Total Opinion of Cost - Construction	**$182,943**
PROFESSIONAL SERVICES					
1.	Engineering (10% Construction, 10% Construction Management)	LS	1	$28,145	$28,145
2.	Administration (NRCS, 2%)	LS	1	$2,815	$2,815
3.	Local Administration	LS	1	$200	$200
4.	Permitting	LS	1	$600	$600
				Total Professional Services Estimated Cost	**$31,760**
				Total Project Cost	**$214,703**

Note: (1) Totals may not sum due to rounding.

Source: J-U-B ENGINEERS, Inc. Prepared March 2023.

Table 19. Estimated Installation Costs of Church Brown Control System of the Action Alternative (2023 $).[1]

ESTIMATE OF QUANTITIES					
Item #	**Description**	**Unit**	**Quantity**	**Unit Cost**	**Total**
1.	Mobilization/Demobilization (7%)	LS	1	$8,506	$8,506
2.	Environmental Protection	LS	1	$12,500	$12,500
3.	Removal and Control of Water	LS	1	$12,500	$12,500
4.	Clearing, Grubbing, and Stripping	AC	0.10	$15,000	$1,500
5.	Dust Abatement	LS	1	$5,000	$5,000
6.	Remove and Dispose - Existing Headgate	LS	1	$3,500	$3,500
7.	Remove and Dispose - Existing Check Structure	LS	1	$4,500	$4,500
8.	Unclassified Excavation and Stockpile	CY	25	$30	$735
9.	Furnish and Install Cast-In-Place Concrete Headwall	CY	2	$1,300	$2,317
10.	Furnish and Install 36" Headgate with Manual Controls	LS	1	$2,000	$2,000
11.	Placement and Compaction of Crushed Aggregate Base	CY	10	$65	$621
12.	Earthfill Zone IV Fill	CY	15	$38	$568
13.	Furnish and Install Concrete Check Structure with Bays, Flashboards, and Concrete Spillway	CY	16	$1,500	$24,028
14.	Furnish and Install Integrated Concrete or Steel Pedestrian Bridge Crossing on Check Structure	LS	1	$20,000	$20,000
15.	Furnish and Install Flow Measurement Weir/Parshall Flume	LS	1	$15,000	$15,000
16.	Furnish and Install Class 300 Riprap	CY	7	$260	$1,740
17.	Site Restoration and Rehabilitation	LS	1	$15,000	$15,000
				Contingency (30%)	**$39,004**
				Total Opinion of Cost - Construction	**$169,019**
PROFESSIONAL SERVICES					
1.	Engineering (10% Construction, 10% Construction Management)	LS	1	$26,003	$26,003
2.	Administration (NRCS, 2%)	LS	1	$2,600	$2,600
3.	Local Administration	LS	1	$200	$200
4.	Permitting	LS	1	$600	$600
				Total Professional Services Estimated Cost	**$29,403**
				Total Project Cost	**$198,422**

Note: (1) Totals may not sum due to rounding.

Source: J-U-B ENGINEERS, Inc. Prepared March 2023.

Table 20. Estimated Installation Costs of Schulthess Vernon Control System of the Action Alternative (2023 $).[1]

ESTIMATE OF QUANTITIES					
Item #	**Description**	**Unit**	**Quantity**	**Unit Cost**	**Total**
1.	Mobilization/Demobilization (7%)	LS	1	$9,996	$9,996
2.	Environmental Protection	LS	1	$12,500	$12,500
3.	Removal and Control of Water	LS	1	$12,500	$12,500
4.	Clearing, Grubbing, and Stripping	AC	0.10	$15,000	$1,500
5.	Dust Abatement	LS	1	$5,000	$5,000
6.	Remove and Dispose - Existing Headgate	LS	1	$3,500	$3,500
7.	Remove and Dispose - Existing Check Structure	LS	1	$4,500	$4,500
8.	Unclassified Excavation and Stockpile	CY	23	$30	$684
9.	Furnish and Install Cast-In-Place Concrete Headwall	CY	2	$1,300	$2,151
10.	Furnish and Install 36" Headgate with Manual Controls	LS	1	$2,000	$2,000
11.	Furnish and Install 24" Culvert	LF	8	$250	$2,000
12.	Placement and Compaction of Crushed Aggregate Base	CY	9	$65	$561
13.	Earthfill Zone IV Fill	CY	14	$38	$538
14.	Furnish and Install Concrete Check Structure with Bays, Flashboards, and Concrete Spillway	CY	16	$1,500	$24,028
15.	Furnish and Install Integrated Concrete or Steel Pedestrian Bridge Crossing on Check Structure	LS	1	$20,000	$20,000
16.	Furnish and Install Flow Measurement Weir/Parshall Flume	LS	1	$15,000	$15,000
17.	Furnish and Install Class 300 Riprap	CY	5	$260	$1,342
18.	Furnish and Install Access Walkway	LS	1	$20,000	$20,000
19.	Site Restoration and Rehabilitation	LS	1	$15,000	$15,000
				Contingency (30%)	**$45,840**
				Total Opinion of Cost - Construction	**$198,641**
PROFESSIONAL SERVICES					
1.	Engineering (10% Construction, 10% Construction Management)	LS	1	$30,560	$30,560
2.	Administration (NRCS, 2%)	LS	1	$3,056	$3,056
3.	Local Administration	LS	1	$200	$200
4.	Permitting	LS	1	$600	$600
				Total Professional Services Estimated Cost	**$34,416**
				Total Project Cost	**$233,057**

Note: (1) Totals may not sum due to rounding.

Source: J-U-B ENGINEERS, Inc. Prepared March 2023.

Table 21. Estimated Installation Costs of Tingey Bryson Easteman Control System of the Action Alternative (2023 $).[1]

ESTIMATE OF QUANTITIES					
Item #	**Description**	**Unit**	**Quantity**	**Unit Cost**	**Total**
1.	Mobilization/Demobilization (7%)	LS	1	$7,364	$7,364
2.	Environmental Protection	LS	1	$12,500	$12,500
3.	Removal and Control of Water	LS	1	$12,500	$12,500
4.	Clearing, Grubbing, and Stripping	AC	0.10	$15,000	$1,500
5.	Dust Abatement	LS	1	$5,000	$5,000
6.	Remove and Dispose - Existing Headgate	LS	1	$3,500	$3,500
7.	Remove and Dispose - Existing Improvised Check Structure	LS	1	$3,500	$3,500
8.	Unclassified Excavation and Stockpile	CY	25	$30	$756
9.	Furnish and Install Cast-In-Place Concrete Headwall	CY	2	$1,300	$2,151
10.	Furnish and Install 24" Headgate with Manual Controls	LS	1	$1,000	$1,000
11.	Placement and Compaction of Crushed Aggregate Base	CY	6	$65	$391
12.	Earthfill Zone IV Fill	CY	19	$38	$729
13.	Furnish and Install Concrete Check Structure with Bays, Flashboards, and Concrete Spillway	CY	7	$1,500	$10,722
14.	Furnish and Install Flow 48" Parshall Flume	LS	1	$15,000	$15,000
15.	Furnish and Install Class 300 Riprap	CY	4	$260	$943
16.	Furnish and Install Access Walkway	LS	1	$20,000	$20,000
17.	Site Restoration and Rehabilitation	LS	1	$15,000	$15,000
				Contingency (30%)	**$33,767**
				Total Opinion of Cost - Construction	**$146,323**
PROFESSIONAL SERVICES					
1.	Engineering (10% Construction, 10% Construction Management)	LS	1	$22,511	$22,511
2.	Administration (NRCS, 2%)	LS	1	$2,251	$2,251
3.	Local Administration	LS	1	$200	$200
4.	Permitting	LS	1	$600	$600
				Total Professional Services Estimated Cost	**$25,562**
				Total Project Cost	**$171,885**

Note: (1) Totals may not sum due to rounding.

Source: J-U-B ENGINEERS, Inc. Prepared March 2023.

Table 22. Estimated Installation Costs of Tic Chandler Control System of the Action Alternative (2023 $).[1]

ESTIMATE OF QUANTITIES					
Item #	**Description**	**Unit**	**Quantity**	**Unit Cost**	**Total**
1.	Mobilization/Demobilization (7%)	LS	1	$8,786	$8,786
2.	Environmental Protection	LS	1	$12,500	$12,500
3.	Removal and Control of Water	LS	1	$12,500	$12,500
4.	Clearing, Grubbing, and Stripping	AC	0.10	$15,000	$1,500
5.	Dust Abatement	LS	1	$5,000	$5,000
6.	Remove and Dispose - Existing Headgate	LS	1	$3,500	$3,500
7.	Remove and Dispose - Existing Improvised Check Structure	LS	1	$3,500	$3,500
8.	Unclassified Excavation and Stockpile	CY	52	$30	$1,566
9.	Furnish and Install Cast-In-Place Concrete Headwall	CY	2	$1,300	$2,151
10.	Furnish and Install 24" Headgate with Manual Controls	LS	1	$1,000	$1,000
11.	Placement and Compaction of Crushed Aggregate Base	CY	13	$65	$826
12.	Earthfill Zone IV Fill	CY	39	$38	$1,501
13.	Furnish and Install Concrete Check Structure with Bays, Flashboards, and Concrete Spillway	CY	18	$1,500	$27,250
14.	Furnish and Install Flow Measurement Weir/Parshall Flume	LS	1	$15,000	$15,000
15.	Furnish and Install Class 300 Riprap	CY	10	$260	$2,725
16.	Furnish and Install Access Walkway	LS	1	$20,000	$20,000
17.	Site Restoration and Rehabilitation	LS	1	$15,000	$15,000
				Contingency (30%)	**$40,292**
				Total Opinion of Cost - Construction	**$174,597**
PROFESSIONAL SERVICES					
1.	Engineering (10% Construction, 10% Construction Management)	LS	1	$26,861	$26,861
2.	Administration (NRCS, 2%)	LS	1	$2,686	$2,686
3.	Local Administration	LS	1	$200	$200
4.	Permitting	LS	1	$600	$600
				Total Professional Services Estimated Cost	**$30,347**
				Total Project Cost	**$204,944**

Note: (1) Totals may not sum due to rounding.

Source: J-U-B ENGINEERS, Inc. Prepared March 2023.

Table 23. Estimated Installation Costs of Buck Control System of the Action Alternative (2023 $).[1]

ESTIMATE OF QUANTITIES					
Item #	**Description**	**Unit**	**Quantity**	**Unit Cost**	**Total**
1.	Mobilization/Demobilization (7%)	LS	1	$8,656	$8,656
2.	Environmental Protection	LS	1	$12,500	$12,500
3.	Removal and Control of Water	LS	1	$12,500	$12,500
4.	Clearing, Grubbing, and Stripping	AC	0.10	$15,000	$1,500
5.	Dust Abatement	LS	1	$5,000	$5,000
6.	Remove and Dispose - Existing Headgate	LS	1	$3,500	$3,500
7.	Remove and Dispose - Existing Improvised Debris Check Structure and Other Misc Debris	LS	1	$4,500	$4,500
8.	Remove and Dispose - Existing Parshall Flume	LS	1	$2,500	$2,500
9.	Unclassified Excavation and Stockpile	CY	38	$30	$1,139
10.	Furnish and Install Cast-In-Place Concrete Headwall	CY	2	$1,300	$2,151
11.	Furnish and Install 24" Headgate with Manual Controls	LS	1	$1,000	$1,000
12.	Placement and Compaction of Crushed Aggregate Base	CY	9	$65	$597
13.	Earthfill Zone IV Fill	CY	29	$38	$1,093
14.	Furnish and Install Concrete Check Structure with Bays, Flashboards, and Concrete Spillway	CY	16	$1,500	$24,028
15.	Furnish and Install Flow Measurement Weir/Parshall Flume	LS	1	$15,000	$15,000
16.	Furnish and Install Class 300 Riprap	CY	6	$260	$1,656
17.	Furnish and Install Access Walkway	LS	1	$20,000	$20,000
18.	Site Restoration and Rehabilitation	LS	1	$15,000	$15,000
				Contingency (30%)	**$39,696**
				Total Opinion of Cost - Construction	**$172,016**
PROFESSIONAL SERVICES					
1.	Engineering (10% Construction, 10% Construction Management)	LS	1	$26,464	$26,464
2.	Administration (NRCS, 2%)	LS	1	$2,646	$2,646
3.	Local Administration	LS	1	$200	$200
4.	Permitting	LS	1	$600	$600
				Total Professional Services Estimated Cost	**$29,910**
				Total Project Cost	**$201,926**

Note: (1) Totals may not sum due to rounding.

Source: J-U-B ENGINEERS, Inc. Prepared March 2023.

Table 24. Estimated Installation Costs of Splitter of the Action Alternative (2023 $).[1]

ESTIMATE OF QUANTITIES					
Item #	**Description**	**Unit**	**Quantity**	**Unit Cost**	**Total**
1.	Mobilization/Demobilization (7%)	LS	1	$18,970	$18,970
2.	Environmental Protection	LS	1	$20,000	$20,000
3.	Removal and Control of Water	LS	1	$25,000	$25,000
4.	Clearing, Grubbing, and Stripping	AC	0.10	$15,000	$1,500
5.	Dust Abatement	LS	1	$5,000	$5,000
6.	Remove and Dispose - Existing Improvised Splitter Structure	LS	1	$5,500	$5,500
7.	Remove and Dispose - Existing Control Structure	LS	1	$1,500	$1,500
8.	Remove and Dispose - Existing Concrete Retaining Walls	LS	1	$5,500	$5,500
9.	Remove and Dispose - Existing Pedestrian Bridge	LS	1	$2,000	$2,000
10.	Unclassified Excavation and Stockpile	CY	162	$30	$4,869
11.	Furnish and Install Concrete Splitter Structure	CY	29	$1,500	$43,191
12.	Furnish and Install Concrete Sediment Trap/Clean Out	CY	13	$1,300	$16,370
13.	Furnish and Install Rubicon Gates	LS	1	$63,000	$63,000
14.	Furnish and Install Concrete Retaining Walls	CY	12	$1,500	$17,778
15.	Furnish and Install Integrated Concrete/Steel Pedestrian Bridge Crossing on Control Structure	LS	1	$25,000	$25,000
16.	Placement and Compaction of Crushed Aggregate Base	CY	33	$65	$2,167
17.	Earthfill Zone IV Fill	CY	129	$38	$4,901
18.	Furnish and Install Class 300 Riprap	CY	10	$260	$2,725
19.	Site Restoration and Rehabilitation	LS	1	$25,000	$25,000
20.	Mobilization/Demobilization (7%)	LS	1	$18,970	$18,970
				Contingency (30%)	**$86,991**
				Total Opinion of Cost - Construction	**$376,963**
PROFESSIONAL SERVICES					
1.	Engineering (10% Construction, 10% Construction Management)	LS	1	$57,994	$57,994
2.	Administration (NRCS, 2%)	LS	1	$5,799	$5,799
3.	Local Administration	LS	1	$200	$200
4.	Permitting	LS	1	$600	$600
				Total Professional Services Estimated Cost	**$64,593**
				Total Project Cost	**$441,556**

Note: (1) Totals may not sum due to rounding.

Source: J-U-B ENGINEERS, Inc. Prepared March 2023.

Table 25. Estimated Installation Costs of Eastman-Frazier of the Action Alternative (2023 $).[1]

ESTIMATE OF QUANTITIES					
Item #	**Description**	**Unit**	**Quantity**	**Unit Cost**	**Total**
1.	Mobilization/Demobilization (7%)	LS	1	$7,582	$7,582
2.	Environmental Protection	LS	1	$12,500	$12,500
3.	Removal and Control of Water	LS	1	$12,500	$12,500
4.	Clearing, Grubbing, and Stripping	AC	0.10	$15,000	$1,500
5.	Dust Abatement	LS	1	$5,000	$5,000
6.	Remove and Dispose - Existing Headgate	LS	1	$3,500	$3,500
7.	Remove and Dispose - Existing Improvised Check Structure	LS	1	$3,500	$3,500
8.	Unclassified Excavation and Stockpile	CY	25	$30	$756
9.	Furnish and Install Cast-In-Place Concrete Headwall	CY	2	$1,300	$2,151
10.	Furnish and Install 24" Headgate with Manual Controls	LS	1	$1,000	$1,000
11.	Furnish and Install 24" Culvert	LF	13	$250	$3,250
12.	Placement and Compaction of Crushed Aggregate Base	CY	6	$65	$391
13.	Earthfill Zone IV Fill	CY	19	$38	$729
14.	Furnish and Install Concrete Check Structure with Bays, Flashboards, and Concrete Spillway	CY	7	$1,500	$10,722
15.	Furnish and Install Flow Measurement Weir/Parshall Flume	LS	1	$15,000	$15,000
16.	Furnish and Install Class 300 Riprap	CY	3	$260	$818
17.	Furnish and Install Access Walkway	LS	1	$20,000	$20,000
18.	Site Restoration and Rehabilitation	LS	1	$15,000	$15,000
				Contingency (30%)	**$34,770**
				Total Opinion of Cost - Construction	**$150,669**
PROFESSIONAL SERVICES					
1.	Engineering (10% Construction, 10% Construction Management)	LS	1	$23,180	$23,180
2.	Administration (NRCS, 2%)	LS	1	$2,318	$2,318
3.	Local Administration	LS	1	$200	$200
4.	Permitting	LS	1	$600	$600
				Total Professional Services Estimated Cost	**$26,298**
				Total Project Cost	**$176,967**

Note: (1) Totals may not sum due to rounding.

Source: J-U-B ENGINEERS, Inc. Prepared March 2023.

Table 26. Estimated Installation Costs of Hagus Control System of the Action Alternative (2023 $).[1]

ESTIMATE OF QUANTITIES					
Item #	**Description**	**Unit**	**Quantity**	**Unit Cost**	**Total**
1.	Mobilization/Demobilization (7%)	LS	1	$8,859	$8,859
2.	Environmental Protection	LS	1	$12,500	$12,500
3.	Removal and Control of Water	LS	1	$12,500	$12,500
4.	Clearing, Grubbing, and Stripping	AC	0.10	$15,000	$1,500
5.	Dust Abatement	LS	1	$5,000	$5,000
6.	Remove and Dispose - Existing Headgate	LS	1	$3,500	$3,500
7.	Remove and Dispose - Existing Improvised Debris Check Structure and Other Misc Debris	LS	1	$4,500	$4,500
8.	Remove and Dispose - Existing Parshall Flume	LS	1	$2,500	$2,500
9.	Unclassified Excavation and Stockpile	CY	38	$30	$1,139
10.	Furnish and Install Cast-In-Place Concrete Headwall	CY	2	$1,300	$2,151
11.	Furnish and Install 24" Headgate with Manual Controls	LS	1	$1,000	$1,000
12.	Furnish and Install 24" Culvert	LF	10	$250	$2,500
13.	Placement and Compaction of Crushed Aggregate Base	CY	9	$65	$597
14.	Earthfill Zone IV Fill	CY	29	$38	$1,093
15.	Furnish and Install Concrete Check Structure with Bays, Flashboards, and Concrete Spillway	CY	16	$1,500	$24,028
16.	Furnish and Install Flow Measurement Weir/Parshall Flume	LS	1	$15,000	$15,000
17.	Furnish and Install Class 300 Riprap	CY	8	$260	$2,053
18.	Furnish and Install Access Walkway	LS	1	$20,000	$20,000
19.	Site Restoration and Rehabilitation	LS	1	$15,000	$15,000
				Contingency (30%)	**$40,626**
				Total Opinion of Cost - Construction	**$176,045**
PROFESSIONAL SERVICES					
1.	Engineering (10% Construction, 10% Construction Management)	LS	1	$27,084	$27,084
2.	Administration (NRCS, 2%)	LS	1	$2,708	$2,708
3.	Local Administration	LS	1	$200	$200
4.	Permitting	LS	1	$600	$600
				Total Professional Services Estimated Cost	**$30,592**
				Total Project Cost	**$206,637**

Note: (1) Totals may not sum due to rounding.

Source: J-U-B ENGINEERS, Inc. Prepared March 2023.

Table 27. Estimated Installation Costs of Co-Op Control System of the Action Alternative (2023 $).[1]

ESTIMATE OF QUANTITIES					
Item #	**Description**	**Unit**	**Quantity**	**Unit Cost**	**Total**
1.	Mobilization/Demobilization (7%)	LS	1	$11,318	$ 11,318
2.	Environmental Protection	LS	1	$12,500	$12,500
3.	Removal and Control of Water	LS	1	$12,500	$12,500
4.	Clearing, Grubbing, and Stripping	AC	0.10	$15,000	$1,500
5.	Dust Abatement	LS	1	$5,000	$5,000
6.	Remove and Dispose - Existing Headgate	LS	1	$3,500	$3,500
7.	Remove and Dispose - Existing Check Structure	LS	1	$4,500	$4,500
8.	Remove and Dispose - Existing 24" Culvert	LF	24	$60	$1,440
9.	Unclassified Excavation and Stockpile	CY	24	$30	$705
10.	Furnish and Install Cast-In-Place Concrete Headwall	CY	3	$1,300	$3,921
11.	Furnish and Install 36" Headgate with Manual Controls	LS	1	$2,000	$2,000
12.	Furnish and Install 24" Culvert	LF	24	$250	$6,000
13.	Furnish and Install Slipmeter	LS	1	$32,000	$32,000
14.	Placement and Compaction of Crushed Aggregate Base	CY	9	$65	$595
15.	Earthfill Zone IV Fill	CY	14	$38	$545
16.	Furnish and Install Concrete Check Structure with Bays, Flashboards, and Concrete Spillway	CY	15	$1,500	$23,194
17.	Furnish and Install Integrated Concrete or Steel Pedestrian Bridge Crossing on Check Structure	LS	1	$20,000	$20,000
18.	Furnish and Install Flow Measurement Weir/Parshall Flume	LS	1	$15,000	$15,000
19.	Furnish and Install Class 300 Riprap	CY	7	$260	$1,780
20.	Site Restoration and Rehabilitation	LS	1	$15,000	$15,000
				Contingency (30%)	**$51,899**
				Total Opinion of Cost - Construction	**$224,897**
PROFESSIONAL SERVICES					
1.	Engineering (10% Construction, 10% Construction Management)	LS	1	$34,599	$34,599
2.	Administration (NRCS, 2%)	LS	1	$3,460	$3,460
3.	Local Administration	LS	1	$200	$200
4.	Permitting	LS	1	$600	$600
				Total Professional Services Estimated Cost	**$38,859**
				Total Project Cost	**$263,756**

Note: (1) Totals may not sum due to rounding.

Source: J-U-B ENGINEERS, Inc. Prepared March 2023.

Table 28. Estimated Installation Costs of Deans Control System of the Action Alternative (2023 $).[1]

ESTIMATE OF QUANTITIES					
Item #	**Description**	**Unit**	**Quantity**	**Unit Cost**	**Total**
1.	Mobilization/Demobilization (7%)	LS	1	$10,801	$10,801
2.	Environmental Protection	LS	1	$12,500	$12,500
3.	Removal and Control of Water	LS	1	$16,500	$16,500
4.	Clearing, Grubbing, and Stripping	AC	0.10	$15,000	$1,500
5.	Dust Abatement	LS	1	$5,000	$5,000
6.	Remove and Dispose - Existing Headgate	LS	1	$3,000	$3,000
7.	Remove and Dispose - Existing 36" Culvert	LS	1	$5,000	$5,000
8.	Unclassified Excavation and Stockpile	CY	58	$30	$1,751
9.	Furnish and Install Cast-In-Place Concrete Headwall	CY	2	$1,300	$2,317
10.	Furnish and Install 36" Headgate with Manual Controls	LS	1	$2,000	$2,000
11.	Furnish and Install 36" Culvert	LF	13	$380	$4,940
12.	Placement and Compaction of Crushed Aggregate Base	CY	22	$65	$1,432
13.	Earthfill Zone IV Fill	CY	36	$38	$1,380
14.	Furnish and Install Concrete Check Structure with Bays, Flashboards, and Concrete Spillway	CY	18	$1,500	$27,250
15.	Furnish and Install Flow Measurement Weir/Parshall Flume	LS	1	$15,000	$15,000
16.	Furnish and Install Concrete Sediment Trap/Clean Out	CY	9	$1,300	$11,652
17.	Furnish and Install Class 300 Riprap	CY	12	$260	$3,083
18.	Furnish and Install Access Walkway	LS	1	$20,000	$20,000
19.	Site Restoration and Rehabilitation	LS	1	$20,000	$20,000
				Contingency (30%)	**$49,532**
				Total Opinion of Cost - Construction	**$214,638**
PROFESSIONAL SERVICES					
1.	Engineering (10% Construction, 10% Construction Management)	LS	1	$33,021	$33,021
2.	Administration (NRCS, 2%)	LS	1	$3,302	$3,302
3.	Local Administration	LS	1	$200	$200
4.	Permitting	LS	1	$600	$600
				Total Professional Services Estimated Cost	**$37,123**
				Total Project Cost	**$251,761**

Note: (1) Totals may not sum due to rounding.

Source: J-U-B ENGINEERS, Inc. Prepared March 2023.

Table 29. Estimated Installation Costs of Smith Ditch Control System of the Action Alternative (2023 $).[1]

ESTIMATE OF QUANTITIES					
Item #	**Description**	**Unit**	**Quantity**	**Unit Cost**	**Total**
1.	Mobilization/Demobilization (7%)	LS	1	$6,811	$6,811
2.	Environmental Protection	LS	1	$12,500	$12,500
3.	Removal and Control of Water	LS	1	$12,500	$12,500
4.	Clearing, Grubbing, and Stripping	AC	0.10	$15,000	$1,500
5.	Dust Abatement	LS	1	$5,000	$5,000
6.	Remove and Dispose - Existing Headgate	LS	1	$3,500	$3,500
7.	Remove and Dispose - Existing Improvised Check Structure	LS	1	$3,500	$3,500
8.	Remove and Dispose - Existing Culvert	LF	6	$60	$360
9.	Unclassified Excavation and Stockpile	CY	10	$30	$306
10.	Furnish and Install Cast-In-Place Concrete Headwall	CY	2	$1,300	$2,641
11.	Furnish and Install 24" Headgate with Manual Controls	LS	1	$1,000	$1,000
12.	Placement and Compaction of Crushed Aggregate Base	CY	3	$65	$181
13.	Earthfill Zone IV Fill	CY	7	$38	$282
14.	Furnish and Install Concrete Check Structure with Bays, Flashboards, and Concrete Spillway	CY	2	$1,500	$3,135
15.	Furnish and Install Flow Measurement Weir/Parshall Flume	LS	1	$15,000	$15,000
16.	Furnish and Install Class 300 Riprap	CY	3	$260	$889
17.	Furnish and Install Access Walkway	LS	1	$20,000	$20,000
18.	Site Restoration and Rehabilitation	LS	1	$15,000	$15,000
				Contingency (30%)	**$31,232**
				Total Opinion of Cost - Construction	**$135,337**
PROFESSIONAL SERVICES					
1.	Engineering (10% Construction, 10% Construction Management)	LS	1	$20,821	$20,821
2.	Administration (NRCS, 2%)	LS	1	$2,082	$2,082
3.	Local Administration	LS	1	$200	$200
4.	Permitting	LS	1	$600	$600
				Total Professional Services Estimated Cost	**$23,703**
				Total Project Cost	**$159,040**

Note: (1) Totals may not sum due to rounding.

Source: J-U-B ENGINEERS, Inc. Prepared March 2023.

Table 30. Estimated Installation Costs of Schulthess 1 and Neville Control System of the Action Alternative (2023 $).[1]

ESTIMATE OF QUANTITIES					
Item #	**Description**	**Unit**	**Quantity**	**Unit Cost**	**Total**
1.	Mobilization/Demobilization (7%)	LS	1	$10,502	$10,502
2.	Environmental Protection	LS	1	$12,500	$12,500
3.	Removal and Control of Water	LS	1	$12,500	$12,500
4.	Clearing, Grubbing, and Stripping	AC	0.10	$15,000	$1,500
5.	Dust Abatement	LS	1	$5,000	$5,000
6.	Remove and Dispose - Existing Headgate	LS	1	$3,500	$3,500
7.	Remove and Dispose - Existing Improvised Debris Check Structure and Other Misc Debris	LS	1	$4,500	$4,500
8.	Remove and Dispose - Existing Parshall Flume	LS	1	$2,500	$2,500
9.	Unclassified Excavation and Stockpile	CY	43	$30	$1,283
10.	Furnish and Install Cast-In-Place Concrete Headwall	CY	2	$1,300	$2,151
11.	Furnish and Install 24" Headgate with Manual Controls	LS	1	$20,000	$20,000
12.	Furnish and Install 24" Culvert	LF	28	$250	$7,000
13.	Placement and Compaction of Crushed Aggregate Base	CY	10	$65	$681
14.	Earthfill Zone IV Fill	CY	32	$38	$1,226
15.	Furnish and Install Concrete Check Structure with Bays, Flashboards, and Concrete Spillway	CY	16	$1,500	$24,028
16.	Furnish and Install Flow Measurement Weir/Parshall Flume	LS	1	$15,000	$15,000
17.	Furnish and Install Class 300 Riprap	CY	6	$260	$1,656
18.	Furnish and Install Access Walkway	LS	1	$20,000	$20,000
19.	Site Restoration and Rehabilitation	LS	1	$15,000	$15,000
				Contingency (30%)	**$48,158**
				Total Opinion of Cost - Construction	**$208,685**
PROFESSIONAL SERVICES					
1.	Engineering (10% Construction, 10% Construction Management)	LS	1	$32,105	$32,105
2.	Administration (NRCS, 2%)	LS	1	$3,210	$3,210
3.	Local Administration	LS	1	$200	$200
4.	Permitting	LS	1	$600	$600
				Total Professional Services Estimated Cost	**$36,116**
				Total Project Cost	**$244,801**

Note: (1) Totals may not sum due to rounding.

Source: J-U-B ENGINEERS, Inc. Prepared March 2023.

Table 31. Estimated Installation Costs of Schulthess 2 Control System of the Action Alternative (2023 $).[1]

ESTIMATE OF QUANTITIES					
Item #	**Description**	**Unit**	**Quantity**	**Unit Cost**	**Total**
1.	Mobilization/Demobilization (7%)	LS	1	$4,950	$4,950
2.	Environmental Protection	LS	1	$12,500	$12,500
3.	Removal and Control of Water	LS	1	$12,500	$12,500
4.	Clearing, Grubbing, and Stripping	AC	0.10	$15,000	$1,500
5.	Dust Abatement	LS	1	$5,000	$5,000
6.	Remove and Dispose - Existing Headgate	LS	1	$3,500	$3,500
7.	Unclassified Excavation and Stockpile	CY	2	$30	$51
8.	Furnish and Install Cast-In-Place Concrete Headwall	CY	2	$1,300	$2,786
9.	Furnish and Install 24" Headgate with Manual Controls	LS	1	$1,000	$1,000
10.	Placement and Compaction of Crushed Aggregate Base	CY	1	$65	$84
11.	Earthfill Zone IV Fill	CY	0	$38	$15
12.	Furnish and Install 48" Parshall Flume	LS	1	$15,000	$15,000
13.	Furnish and Install Class 300 Riprap	CY	7	$260	$1,780
14.	Site Restoration and Rehabilitation	LS	1	$15,000	$15,000
				Contingency (30%)	**$22,700**
				Total Opinion of Cost - Construction	**$98,366**
PROFESSIONAL SERVICES					
1.	Engineering (10% Construction, 10% Construction Management)	LS	1	$15,133	$15,133
2.	Administration (NRCS, 2%)	LS	1	$1,513	$1,513
3.	Local Administration	LS	1	$200	$200
4.	Permitting	LS	1	$600	$600
				Total Professional Services Estimated Cost	**$15,133**
				Total Project Cost	**$115,812**

Note: (1) Totals may not sum due to rounding.

Source: J-U-B ENGINEERS, Inc. Prepared March 2023.

Table 32. Estimated Installation Costs of Schulthess 3 Control System of the Action Alternative (2023 $).[1]

ESTIMATE OF QUANTITIES					
Item #	**Description**	**Unit**	**Quantity**	**Unit Cost**	**Total**
1.	Mobilization/Demobilization (7%)	LS	1	$7,902	$7,902
2.	Environmental Protection	LS	1	$12,500	$12,500
3.	Removal and Control of Water	LS	1	$12,500	$12,500
4.	Clearing, Grubbing, and Stripping	AC	0.10	$15,000	$1,500
5.	Dust Abatement	LS	1	$5,000	$5,000
6.	Remove and Dispose - Existing Headgate	LS	2	$3,500	$7,000
7.	Unclassified Excavation and Stockpile	CY	7	$30	$201
8.	Furnish and Install Cast-In-Place Concrete Headwall	CY	6	$1,300	$7,842
9.	Furnish and Install 36" Headgate with Manual Controls	LS	2	$2,000	$4,000
10.	Furnish and Install Rubicon SlipMeter	LS	1	$32,000	$32,000
11.	Placement and Compaction of Crushed Aggregate Base	CY	4	$65	$229
12.	Earthfill Zone IV Fill	CY	3	$38	$121
13.	Furnish and Install Flow Measurement Weir/Parshall Flume	LS	1	$15,000	$15,000
14.	Site Restoration and Rehabilitation	LS	1	$15,000	$15,000
				Contingency (30%)	**$36,238**
				Total Opinion of Cost - Construction	**$157,033**
PROFESSIONAL SERVICES					
1.	Engineering (10% Construction, 10% Construction Management)	LS	1	$24,159	$24,159
2.	Administration (NRCS, 2%)	LS	1	$2,416	$2,416
3.	Local Administration	LS	1	$200	$200
4.	Permitting	LS	1	$600	$600
				Total Professional Services Estimated Cost	**$27,375**
				Total Project Cost	**$184,408**

Note: (1) Totals may not sum due to rounding.

Source: J-U-B ENGINEERS, Inc. Prepared March 2023.

4.4.2. Other direct costs & adverse effects. According to the NRCS PR&G:

> *Other direct costs and adverse effects include uncompensated losses caused by the installation, operation, maintenance, and replacement of a project or group of projects. These other direct costs and adverse impacts can include costs caused by downstream flood damages cause by channel modifications, levies, dikes, and other structures, erosion of land along streambanks created by dams that prevent sediment export downstream, and through lost use value of the land where flood mitigation structures are cited (NRCS, 2014).*

The Action Alternative has only one primary category of other direct costs. The nature of and methods used to calculate these other direct costs are discussed in more detail, below.

4.4.2.1. Operations and maintenance. Once the works of improvement are built, overheads for operations and maintenance will be required for the works of improvement to continue generating the benefits for which they were designed. The project sponsor estimated operations and maintenance expenses under the FWOFI and the Action Alternative based on historical expenses and expected savings that would result if the works of improvement proposed under the Action Alternative were installed as shown in Table 33, below.

Table 33: Estimated Annual Operations and Maintenance Costs for Works of Improvement Included in the Action Alternative (2023 $)

Note:

Annual operations and maintenance (O&M) costs were estimated by the project sponsor based on historical expenses and expected savings under the Action Alternative (AA).

Work of Improvement	Annual O&M Costs (FOWFI)	Annual O&M Costs (AA)
Woodruff Reservoir	$8,614	$6,626
Splitter	$8,614	$6,626
Putnam-Cornia	$80	$61
Huffaker	$80	$61
Eastman-Frazier	$80	$61
Frazier 1&2	$80	$61
Hagus	$80	$61
Co-Op	$80	$61
Dean's	$80	$61
Smitch Ditch	$80	$61
Cornia 1	$80	$61
Cornia 2	$80	$61
Witheral	$80	$61
Saxton	$80	$61
Dugway	$80	$61
Eastman 1	$80	$61
Baxter	$80	$61
Church Brown	$80	$61
Schulthess Vernon	$80	$61
Tingey Bryson Eastman	$80	$61
Tic Chandler	$80	$61
Buck	$80	$61
Neville	$80	$61
Schulthess 1	$80	$61
Schulthess 2	$80	$61
Schulthess 3	$80	$61
Total	***$19,142***	***$14,725***

5. Current Annualized Economic Losses and Costs

Average annual expenses and on-farm losses and under the FWOFI were estimated to serve as a benchmark of comparison with the Action Alternative and are shown in Table 34, below (NWPM 501.36). In total, average annualized expected farm income losses under the FWOFI are approximately $384,306 per year and O&M expenses are $18,035, for a total annualized average of $402,241.

Table 34. Average Annualized Farm Inccome Losses and O&M Expenses Under the FWOFI (2023 $).[1]

Alternative	Agriculture-related		Average Annualized Losses and Costs
	Expected Farm Income Losses	O&M Costs	Total
FWOFI	$384,306	$18,035	$402,241
Total	**$384,306**	**$18,035**	**$402,241**

Notes: Totals may not sum due to rounding. Prepared: March 2023.

1. Price base: 2023 dollars; amortized over 102 years at a discount rate of 2.5 percent.

6. Economic and Structural Tables

The results of the NEE analysis for the Action Alternative are compared against the FWOFI or No Action Alternative and serve as the best estimate of the additional economic value that would be created under the Action Alternative. Results are presented using the Economic and Structural Tables (NWPM Part 506, NRCS 2014b) as shown below.

Table 35 (National Watershed Program Manual [NWPM] 506.11, Economic Table 1; NRCS 2014), Table 36 (NWPM 506.12, Economic Table 2; NRCS 2014), and Table 37 (NWPM 506.18, Economic Table 4) below summarize installation costs, distribution of costs, and total annual average costs for the Action Alternative.

Table 35. Economic Table 1—Estimated Installation Cost of the Action Alternative for Woodruff Creek Watershed Plan-EA (2023 $).[1,2]

Works of Improvement	Unit	Number			Esmtiated Project Cost		Project Total
		Federal Land	Non-Federal Land	Total	Public Law 83-566 Funds (Non-Federal land)	Other Funds (Non-Federal land)	
Woodruff Reservoir	Acres/LF	0	0.1	0.1	$408,210	$111,819	$520,029
Putnam-Cornia	Acres	0	0.1	0.1	$128,797	$35,828	$164,625
Huffaker	Acres	0	0.1	0.1	$166,433	$46,064	$212,497
Eastman-Frazier	Acres	0	0.1	0.1	$138,500	$38,467	$176,967
Frazier 1&2	Acres	0	0.1	0.1	$231,991	$63,894	$295,885
Splitter	Acres	0	0.1	0.1	$346,515	$95,041	$441,556
Hagus	Acres	0	0.1	0.1	$161,826	$44,811	$206,637
Co-Op	Acres	0	0.1	0.1	$206,723	$57,024	$263,756
Dean's	Acres	0	0.1	0.1	$197,301	$54,459	$251,761
Smith Ditch	Acres	0	0.1	0.1	$124,405	$34,634	$159,040
Cornia 1	Acres	0	0.1	0.1	$134,436	$37,362	$171,798
Cornia 2	Acres	0	0.1	0.1	$163,949	$45,389	$209,338
Witheral	Acres	0	0.1	0.1	$160,710	$44,508	$205,217
Saxton	Acres	0	0.1	0.1	$158,122	$43,804	$201,926
Dugway	Acres	0	0.1	0.1	$158,122	$43,804	$201,926
Eastman 1	Acres	0	0.1	0.1	$185,064	$51,131	$236,195
Baxter	Acres	0	0.1	0.1	$168,167	$46,536	$214,703
Church Brown	Acres	0	0.1	0.1	$155,367	$43,055	$198,422
Schulthess Vernon	Acres	0	0.1	0.1	$182,596	$50,460	$233,057
Tingey Bryson Eastman	Acres	0	0.1	0.1	$134,505	$37,381	$171,885
Tic Chandler	Acres	0	0.1	0.1	$160,495	$44,449	$204,944
Buck	Acres	0	0.1	0.1	$158,122	$43,804	$201,926
Schulthess 1 & Neville	Acres	0	0.2	0.2	$191,830	$52,971	$244,801
Schulthess 2	Acres	0	0.1	0.1	$90,420	$25,391	$115,812
Schulthess 3	acres	0	0.1	0.1	$144,350	$40,058	$184,408
Total	**Acres**	**0**	**2.7**	**2.7**	**$4,456,966**	**$1,232,146**	**$5,689,112**

Notes: Totals may not sum due to rounding. Prepared: March 2023.

1. Price base: 2023 dollars. 2. Project cost prepared by J-U-B ENGINEERS, Inc.

Table 36. Economic Table 2 —Estimated Cost Distribution of the Action Alternative for Woodruff Creek Watershed Plan-EA (2023 $).[1,2]

Works of Improvement	Installation Costs—PL 83-566 Funds					Installation Cost—Other Funds					Total
	Construction	Engineering	Permitting	Administration	Total PL 83-566	Construction	Engineering	Permitting	Administration	Total Other	
Woodruff Creek Watershed Project Action Alternative	$3,636,439	$745,935	$0	$74,592	$4,456,966	$1,212,146	$0	$15,000	$5,000	$1,232,146	$5,689,112
Total	**$3,636,439**	**$745,935**	**$0**	**$74,592**	**$4,456,966**	**$1,212,146**	**$0**	**$15,000**	**$5,000**	**$1,232,146**	**$5,689,112**

Notes: Totals may not sum due to rounding. Prepared: March 2023.

1. Price base: 2023 dollars. 2. Project cost prepared by J-U-B ENGINEERS, Inc.

In addition to the installation costs, the Action Alternative will entail costs associated with operations and maintenance of the works of improvement. These costs are included as "Other Direct Costs" in Table 37. The total annualized cost of installing, operating, and maintaining the various works of improvement included in the Action Alternative is approximately $164,813 over the 102-year analysis period.

Table 37. Economic Table 4—Estimated Average Annualized NEE Costs of Woodruff Creek Watershed Plan-EA (2023 $).[1]

Action Alternative Component	Project Outlays (Amortization of Installation Cost)	Other Direct Costs[2]	Total Cost
Woodruff Reservoir Gate	$13,795	$6,279	$20,074
Splitter	$11,713	$6,279	$17,992
Putnam-Cornia	$4,367	$58	$4,425
Huffaker	$5,637	$58	$5,695
Eastman-Frazier	$4,695	$58	$4,753
Frazier 1&2	$7,849	$58	$7,907
Hagus	$5,482	$58	$5,540
Co-Op	$6,997	$58	$7,055
Dean's	$6,679	$58	$6,737
Smitch Ditch	$4,219	$58	$4,277
Cornia 1	$4,557	$58	$4,615
Cornia 2	$5,553	$58	$5,611
Witheral	$5,444	$58	$5,502
Saxton	$5,357	$58	$5,415
Dugway	$5,357	$58	$5,415
Eastman 1	$6,266	$58	$6,324
Baxter	$5,696	$58	$5,754
Church Brown	$5,264	$58	$5,322
Schulthess Vernon	$6,182	$58	$6,240
Tingey Bryson Eastman	$4,560	$58	$4,618
Tic Chandler	$5,437	$58	$5,495
Buck	$5,357	$58	$5,415
Neville & Schulthess 12	$6,494	$58	$6,552
Schulthess 2[2]	$3,072	$58	$3,130
Schulthess 3[2]	$4,892	$58	$4,950
Total	**$150,921**	**$13,892**	**$164,813**

Notes: Totals may not sum due to rounding. Prepared: March 2023.

1. Price base: 2023 dollars, amortized over 102 years at a discount rate of 2.5 percent.

2. Other direct costs include annual operations and maintenance associated with each work of improvement.

The impact of the Action Alternative on ecosystem flows and values is shown in Table 38 below. The Action Alternative would positively impact regulating and cultural services in the watershed by avoided damages to farm incomes, decreasing O&M costs, and improving cultural values. In total, the Action Alternative would create average annual gross benefits of approximately $388,464 per year.

Table 38. Economic Table 5a—Estimated Average Annualized Benefits of the Action Alternative for Woodruff Creek Watershed Plan-EA (2023 $).[1]

Benefit/Avoided Damage	Agricultural-related	Non-Agricultural-related
Onsite		
Reduced farm income losses	$384,306	
Reduced operation & maintenance cost	$4,158	
Increased cultural values	Increase in cultural values	
Subtotal	**$388,464**	**-**
Offsite		
N/A	-	-
Subtotal	**$388,464**	**-**
Total Quantified Benefits	**$388,464**	

Notes: Totals may not sum due to rounding. Prepared: March 2023.

1. Price base: 2023 dollars amortized over 102 years at a discount rate of 2.5 percent.

Using the resulting benefits and costs from the previous two tables, Table 39 (NWPM 506.21, Economic Table 6) presents a comparison of the NEE average annual benefits and average annual costs for the Action Alternative. In total, the Action Alternative will generate average annual benefits of $388,464 compared to average annual costs of $164,813, for a benefit-cost ratio of 2.4.

The increments of benefit and cost for each work of improvement of the Action Alternative are also shown in Table 39. The BCRs for each work of improvement ranged from a low of 0.1 to replace the diversion structure on the Witheral ditch to a high of 7.8 to replace the diversion structure for Dean's ditch. In general, diversion structures that serve more land are more beneficial given that the cost of diversion structures is fairly uniform, while the number of acres served by each diversion structure are not. However, the structures exhibit a degree of interdependendence in that upstream structures may have implications for how downstream structures function. This interdependence is not accounted for in the incremental analysis.

Table 39. Economic Table 6—Comparison of Average Annualized Costs, Reduced Farm Income Losses, and Reduced O&M Costs of the Action Alternative of the Woodruff Creek Watershed Plan-EA (2023 $).[1]

Works of Improvement	Agriculture-related		Average Annual Benefits	Average Annual Cost	Benefit Cost Ratio
	Reduced Farm Income Losses	Reduced O&M Costs	Total		
Dean's	$52,494	$17	$52,511	$6,737	7.8
Co-Op	$49,118	$17	$49,135	$7,055	7.0
Splitter	$121,326	$1,875	$123,201	$17,992	6.8
Tingey Bryson Eastman	$18,976	$17	$18,993	$4,618	4.1
Hagus	$17,438	$17	$17,455	$5,540	3.2
Eastman-Frazier	$14,647	$17	$14,664	$4,753	3.1
Frazier 1&2	$17,641	$17	$17,658	$7,907	2.2
Schulthess 2[2]	$5,664	$17	$5,681	$3,130	1.8
Woodruff Reservoir Gate	$31,289	$1,875	$33,164	$20,074	1.7
Neville & Schulthess 12	$8,901	$34	$8,935	$6,552	1.4
Putnam-Cornia	$5,543	$17	$5,560	$4,425	1.3
Schulthess 3[2]	$5,664	$17	$5,681	$4,950	1.1
Huffaker	$6,433	$17	$6,450	$5,695	1.1
Schulthess Vernon	$6,433	$17	$6,450	$6,240	1.0
Baxter	$5,583	$17	$5,600	$5,754	1.0
Buck	$2,630	$17	$2,647	$5,415	0.5
Cornia 1	$2,144	$17	$2,161	$4,615	0.5
Saxton	$2,023	$17	$2,040	$5,415	0.4
Church Brown	$1,821	$17	$1,838	$5,322	0.3
Dugway	$1,821	$17	$1,838	$5,415	0.3
Eastman 1	$2,023	$17	$2,040	$6,324	0.3
Cornia 2	$1,740	$17	$1,757	$5,611	0.3
Tic Chandler	$1,618	$17	$1,635	$5,495	0.3
Smitch Ditch	$809	$17	$826	$4,277	0.2
Witheral	$526	$17	$543	$5,502	0.1
Total	**$384,306**	**$4,158**	**$388,464**	**$164,813**	**2.4**

Notes: Totals may not sum due to rounding. Prepared: March 2023.

1. Price base: 2023 dollars amortized over 102 years at a discount rate of 2.5 percent.

MEMORANDUM

DATE: August 12, 2026

SUBJECT: Revised Economic Evaluation Period for the Woodruff Creek Watershed Plan-EA Benefit-Cost Analysis

This memorandum documents a revision to the economic evaluation period and project useful life used in the Benefit-Cost Analysis for the Woodruff Creek Watershed Plan-EA. The initial Benefit-Cost Analysis originally evaluated the Action Alternative over a 102-year project life, consisting of a 2-year construction period followed by a 100-year useful life for the proposed works of improvement. The analysis used a 2.5 percent discount rate and reported average annualized benefits of approximately $388,464, average annualized costs of approximately $164,813, and a benefit-cost ratio of 2.4.

For purposes of providing a more realistic evaluation of the project's economic performance and project useful life, the project life has been revised to 52 years, consisting of the same 2-year construction period followed by a 50-year useful life. No changes were made to the underlying project costs, the types of benefits evaluated, the avoided agricultural damages, the estimated operations and maintenance savings, or the discount rate. The revision affects only the period over which project costs and benefits are annualized. Because the same upfront installation cost is recovered over a shorter period, the average annualized project cost increases. In addition, because the benefit stream is shortened from 100 years of post-construction benefits to 50 years of post-construction benefits, the annualized value of benefits decreases.

Using the revised 52-year evaluation period, the Action Alternative would generate approximately $390,455 in average annualized benefits and approximately $214,172 in average annualized costs. This results in annualized net benefits of approximately $176,283 and a revised benefit-cost ratio of 1.8. Although the benefit-cost ratio is lower than the originally reported ratio of 2.4, the revised analysis continues to demonstrate that the Action Alternative is economically viable. The project's quantified benefits continue to exceed its costs, and the benefit-cost ratio remains greater than 1.0, indicating that the project would generate positive net economic benefits under the National Economic Efficiency framework. Table 1 below shows the differences between the initial 100-year life and the revised 50-year life of the project.

Table 1. Benefit-Cost Analysis Differences

Economic Measures	Original BCA: 102-Year Evaluation period	Revised Scenario: 52-Year Evaluation period	Effect of Revision
Average annualized benefits	$388,464	$390,455	Increase of $1,991
Average annualized costs	$164,813	$214,172	Increase of $49,359
Average annualized net benefits	$223,651	$176,283	Decrease of $47,368
Benefit-cost ratio	2.4	1.8	Decreases, but remains above 1.0

The revised results support the same general economic conclusion as the original Benefit-Cost Analysis. The Action Alternative remains justified because it would reduce expected agricultural income losses associated with infrastructure failure, reduce operations and maintenance costs, and provide additional non-monetized cultural and community benefits associated with improved reliability of agricultural water management infrastructure. The shortened evaluation period represents a more conservative assumption regarding the useful life of the proposed improvements, but it does not change the overall finding that the project would provide benefits in excess of costs.

Cultural Resource Report, redacted

Form UT-8100-3
(November 2015)

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

Summary Report of Cultural Resources Inspection

PROJECT NUMBER: U22HO0567

Report Title: Cultural Resource Inventory for Woodruff Creek Watershed Plan-EA, Rich County, Utah

1. Report Date: October 2022

2. Date(s) of Survey: September 20-22, 2022

3. Development Company: JUB Engineers

4. Responsible Institution: Bighorn Archaeological Consultants, LLC.

5. Principal Investigator: Jon Baxter

6. BLM Field Office: Salt Lake City

7. County(ies): Rich

8. NEPA Number:

9. Fieldwork Location:
USGS Map: Birch Creek Reservoir, Meachum Ridge, Woodruff, Neponset Reservoir NW, Utah

Township	Range	Section(s)
T 9N	R 6E	13-14, 19-24, 27-28, 31, 33
T 9N	R 7E	16-18, 21-22

10. Description of the Undertaking (including the Area of Potential Effects)

The United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS), with the Woodruff Irrigating Company and Rich County as the project sponsors, are proposing to use funds through the Watershed Protection and Flood Prevention Act (Public Law [PL] 83-566) to establish flood protection, improve irrigation water delivery and efficiency, and conserve water. Planned project measures may include reconstructing diversion structures, splitter structures, improvements/stabilization of the Woodruff Creek dam outlet pipe, and improvements at or downstream of Birch Creek Reservoir. The NRCS is serving as the Lead Federal Agency for purposes of Section 106 of the National Historic Preservation Act, with the BLM as a Cooperating Agency.

This project is located on lands administered by the Bureau of Land Management (BLM), State of Utah School and Institutional Trust Lands Administration (SITLA), and private property. The cultural inventory for the project was undertaken at the request of JUB Engineering to assist the NRCS, BLM and SITLA in fulfilling requirements under various state and federal environmental protection laws, including the National Historic Preservation Act (NHPA) and the National Environmental Policy Act (NEPA). Bighorn Archaeological Consultants, LLC, (Bighorn) was asked to complete the cultural resource inventory for the proposed project area in Rich County, Utah. The APE is within existing agricultural fields, stream bed, or floodplain. The area of potential effect was inventoried with 15 m (50 ft.) transect centered over the APE covering 95 acres.

11. Location(s) and Date(s) of Literature Review:
    1. Field Office: N/A
    2. Utah Division of State History/SEGO database: 09/19/22
    3. Historic Records and Maps: 09/19/22
    4. Satellite imagery: 09/19/22

12. Results of Literature Review (½ mile buffer):

Table 1. Previous Inventories within a ½ Mile Buffer

Project Number	Project Name	No. of Sites within the APE
U76BL0008	Arlo Eastmen Trespass #1123 on Tract 2	0
U76BL0009	Deveryl Putnam Trespass #1124 on Tract 3	0
U77BL0020	Randolph Planning Unit	0
U80UA0051	Five Drill Pads and Access Roads	0
U80PX0976	Rich County Architectural Survey Summary, Garden City, Laketown, Randolph & Woodruf	0
U81BL0039	Eastman Fence Survey	0
U83SJ0044	Survey of Seismic Line Segments for HR Exploration	0
U83SJ0053	CRM Survey CGG 3-D Program	0
U83SJ0720	Mountain Fuel Woodruff-Hyrum Gas Pipeline	0
U83BC0722	Northern Geophysical Seismic Line Near Woodruff	0
U84BL0550	Corina Sale	0
U85UA0566	5 Seismic Lines & Access Roads/Reports of Invest #85-04	0
U00BL0279	Lower Cutoff Canyon Well Pipeline & Tank	0
U08A10075	Ruby Pipeline	1
U08SH0449	Orson Cornia Fence	0
U09UQ0229	Cornia's Middle Ridge	0
U12SH1028	Cultural Resources Inventory for An Environmental Quality Incentives Program (EWIP) Range Project for Crawford Mountain Angus Inc. Rich County Utah	0
U15HO0740	A Cultural Resource Inventory for The Proposed Woodruff Irrigation Project in Woodruff, Rich County, Utah	0
U18HO0041	Addendum to a Cultural Resource Inventory for the Proposed Woodruff Pressurized Irrigation Project in Woodruff, Rich County, Utah	2

Table 2. Previously Recorded Sites within a ½ Mile Buffer

Site Number	Description	Eligibility
42RI120	Historic Road	Eligible
42RI180	Historic Coop Ditch	Non-eligible
42RI181	Historic Artifact Scatter	Non-eligible
42RI205	Historic Homestead	Eligible
42RI285	Historic Debris	Not Eligible
42RI286	Historic Ditch	Not Eligible

Table 3. Historic Utah Buildings within a ½ Mile Buffer

Property Record Number	Property Type	Building Address/Relation to Project	NRHP Status
40813	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
40814	RESIDENTIAL (GEN.)	Not Provided	OUT-OF-PERIOD
40815	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
40816	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
40817	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
40818	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
40819	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
40820	RESIDENTIAL (GEN.)	Not Provided	OUT-OF-PERIOD
40821	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
40822	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
40823	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
40824	RESIDENTIAL (GEN.)	Not Provided	OUT-OF-PERIOD
45564	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
45565	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
45566	RESIDENTIAL (GEN.)	Not Provided	OUT-OF-PERIOD
45567	RESIDENTIAL (GEN.)	Not Provided	OUT-OF-PERIOD
45568	RESIDENTIAL (GEN.)	Not Provided	OUT-OF-PERIOD
45569	RESIDENTIAL (GEN.)	Not Provided	OUT-OF-PERIOD
45570	RESIDENTIAL (GEN.)	Not Provided	OUT-OF-PERIOD
45571	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
45572	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
45573	RESIDENTIAL (GEN.)	Not Provided	OUT-OF-PERIOD
45574	RESIDENTIAL (GEN.)	Not Provided	OUT-OF-PERIOD
45616	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
45617	RESIDENTIAL (GEN.)	Not Provided	OUT-OF-PERIOD
45618	RESIDENTIAL (GEN.)	Not Provided	OUT-OF-PERIOD
45619	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
45620	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
45621	RESIDENTIAL (GEN.)	90 S MAIN	ELIGIBLE/CONTRIBUTING
45623	RESIDENTIAL (GEN.)	Not Provided	OUT-OF-PERIOD
45624	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
45625	SCHOOL	Not Provided	OUT-OF-PERIOD
45626	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
45627	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
45767	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
45907	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
45908	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
45909	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
45910	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
45911	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
45912	SINGLE DWELLING	Not Provided	ELIGIBLE/CONTRIBUTING
45913	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
45914	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
45915	RESIDENTIAL (GEN.)	Not Provided	OUT-OF-PERIOD
45916	RESIDENTIAL (GEN.)	Not Provided	OUT-OF-PERIOD
45917	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
45918	RESIDENTIAL (GEN.)	Not Provided	OUT-OF-PERIOD
47207	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING

Property Record Number	Property Type	Building Address/Relation to Project	NRHP Status
47208	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
47209	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
47210	RESIDENTIAL (GEN.)	Not Provided	OUT-OF-PERIOD
47211	RESIDENTIAL (GEN.)	Not Provided	OUT-OF-PERIOD
47212	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
47213	RESIDENTIAL (GEN.)	Not Provided	OUT-OF-PERIOD
47214	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
47215	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
47216	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
47217	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
47218	RESIDENTIAL (GEN.)	Not Provided	OUT-OF-PERIOD
47749	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
47750	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
47751	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
47752	RESIDENTIAL (GEN.)	Not Provided	OUT-OF-PERIOD
47753	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
47754	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
47755	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
47756	RESIDENTIAL (GEN.)	Not Provided	OUT-OF-PERIOD
47757	RESIDENTIAL (GEN.)	Not Provided	OUT-OF-PERIOD
47758	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
47863	RESIDENTIAL (GEN.)	Not Provided	OUT-OF-PERIOD
47864	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
47865	RESIDENTIAL (GEN.)	Not Provided	OUT-OF-PERIOD
47866	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
47867	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
47868	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
47869	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
47870	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
47872	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
47873	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
47874	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
51107	SINGLE DWELLING	Not Provided	ELIGIBLE/CONTRIBUTING
57903	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
57904	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
57905	RESIDENTIAL (GEN.)	Not Provided	OUT-OF-PERIOD
57906	RESIDENTIAL (GEN.)	Not Provided	OUT-OF-PERIOD
57907	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
57908	RESIDENTIAL (GEN.)	Not Provided	OUT-OF-PERIOD
57909	RESIDENTIAL (GEN.)	Not Provided	OUT-OF-PERIOD
57911	RESIDENTIAL (GEN.)	Not Provided	OUT-OF-PERIOD
57912	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
57913	RESIDENTIAL (GEN.)	Not Provided	ELIGIBLE/CONTRIBUTING
57914	RESIDENTIAL (GEN.)	Not Provided	OUT-OF-PERIOD
67381	RELIGIOUS (GENERAL)	50 S Main	ELIGIBLE/CONTRIBUTING
260168	FIRE STATION	284 E Center	OUT-OF-PERIOD
260169	SINGLE DWELLING	75 W Center	INELIG./NON-CONTRIBUTING
260170	SINGLE DWELLING	10 E 100 N	ELIGIBLE/CONTRIBUTING
260171	SINGLE DWELLING	55 W 100 S	INELIG./NON-CONTRIBUTING

Property Record Number	Property Type	Building Address/Relation to Project	NRHP Status
260172	SINGLE DWELLING	140 E Center	OUT-OF-PERIOD
260173	SINGLE DWELLING	90 E 100 N	INELIG./NON-CONTRIBUTING
260174	ANIMAL FACILITY	60 E Center	ELIGIBLE/CONTRIBUTING
260175	SINGLE DWELLING	338 S Main	ELIGIBLE/CONTRIBUTING
260176	SINGLE DWELLING	15 E 100 N	ELIGIBLE/CONTRIBUTING
260177	SINGLE DWELLING	110 W Center	ELIGIBLE/CONTRIBUTING
260178	SINGLE DWELLING	95 E 200 S	ELIGIBLE/CONTRIBUTING
260179	SINGLE DWELLING	500 W Center	INELIG./NON-CONTRIBUTING
260180	SINGLE DWELLING	10 S Main	ELIGIBLE/CONTRIBUTING
260181	SINGLE DWELLING	65 N 100 W	ELIGIBLE/CONTRIBUTING
260182	SINGLE DWELLING	235 S Main	INELIG./NON-CONTRIBUTING
260183	SINGLE DWELLING	175 S Main	ELIGIBLE/CONTRIBUTING
260184	SINGLE DWELLING	285 E Center	OUT-OF-PERIOD
260185	SINGLE DWELLING	350 E Center	INELIG./NON-CONTRIBUTING
260186	SINGLE DWELLING	75 N 100 W	OUT-OF-PERIOD
260187	RESIDENTIAL (GEN.)	190 S 100 E	INELIG./NON-CONTRIBUTING
260188	PUBLIC WORKS	65 S Main	INELIG./NON-CONTRIBUTING
260189	SINGLE DWELLING	25 W 200 S	OUT-OF-PERIOD
260190	SINGLE DWELLING	85 N 100 E	OUT-OF-PERIOD
260191	SINGLE DWELLING	35 W 100 S	ELIGIBLE/CONTRIBUTING
260192	SINGLE DWELLING	75 E 100 S	ELIGIBLE/CONTRIBUTING
260193	SINGLE DWELLING	20 S 100 E	ELIGIBLE/CONTRIBUTING
260194	SINGLE DWELLING	310 S Main	INELIG./NON-CONTRIBUTING
260195	SINGLE DWELLING	40 N 100 W	INELIG./NON-CONTRIBUTING
260196	SINGLE DWELLING	95 W Center	ELIGIBLE/CONTRIBUTING
260197	SINGLE DWELLING	10 E Center	ELIGIBLE/CONTRIBUTING
260198	SINGLE DWELLING	165 W Center	ELIGIBLE/CONTRIBUTING
260199	SINGLE DWELLING	385 S Main	ELIGIBLE/CONTRIBUTING
260200	SINGLE DWELLING	55 E 100 S	ELIGIBLE/CONTRIBUTING
260201	RELIGIOUS FACILITY	180 S Main	INELIG./NON-CONTRIBUTING
260202	RELIGIOUS FACILITY	50 S Main	ELIGIBLE/CONTRIBUTING
260203	GROCERY	55 N Main	INELIG./NON-CONTRIBUTING
260204	COMMERCIAL (GEN.)	5 S Main	INELIG./NON-CONTRIBUTING
260205	SCHOOL	315 S Main	INELIG./NON-CONTRIBUTING
260206	CITY HALL	195 S Main	INELIG./NON-CONTRIBUTING
260207	POST OFFICE	40 S Main	INELIG./NON-CONTRIBUTING
260208	SINGLE DWELLING	265 S 100 E	OUT-OF-PERIOD
260209	SINGLE DWELLING	350 S Main	INELIG./NON-CONTRIBUTING
260210	SINGLE DWELLING	110 S 100 W	INELIG./NON-CONTRIBUTING
260211	SINGLE DWELLING	285 S 100 E	OUT-OF-PERIOD
260212	SINGLE DWELLING	130 S 100 E	OUT-OF-PERIOD
260213	SINGLE DWELLING	155 S 100 E	OUT-OF-PERIOD
260214	SINGLE DWELLING	75 E 100 S	OUT-OF-PERIOD
260216	SINGLE DWELLING	81 N Main	OUT-OF-PERIOD
260217	SINGLE DWELLING	10 N 100 E	OUT-OF-PERIOD
260218	SINGLE DWELLING	88 S 100 E	OUT-OF-PERIOD
260219	SINGLE DWELLING	235 S 100 E	OUT-OF-PERIOD
260220	SINGLE DWELLING	50 N 110 W	INELIG./NON-CONTRIBUTING
260221	SINGLE DWELLING	65 E 200 S	OUT-OF-PERIOD

Property Record Number	Property Type	Building Address/Relation to Project	NRHP Status
260222	SINGLE DWELLING	155 W Center	OUT-OF-PERIOD
260223	SINGLE DWELLING	60 E 100 S	OUT-OF-PERIOD
260224	SINGLE DWELLING	65 E 100 S	OUT-OF-PERIOD
260225	SINGLE DWELLING	209 W 100 S	ELIGIBLE/CONTRIBUTING
260226	SINGLE DWELLING	250 W Center	INELIG./NON-CONTRIBUTING
260227	SINGLE DWELLING	170 S 100 W	OUT-OF-PERIOD
260228	SINGLE DWELLING	90 S Main	ELIGIBLE/CONTRIBUTING
260229	SINGLE DWELLING	45 S Main	INELIG./NON-CONTRIBUTING
260230	SINGLE DWELLING	97 S 100 W	INELIG./NON-CONTRIBUTING
260231	SINGLE DWELLING	160 W 100 S	OUT-OF-PERIOD
260232	SINGLE DWELLING	180 E Center	OUT-OF-PERIOD
260233	SINGLE DWELLING	90 E 100 S	ELIGIBLE/CONTRIBUTING
260234	SINGLE DWELLING	85 S Main	ELIGIBLE/CONTRIBUTING
260235	SINGLE DWELLING	185 N Main	ELIGIBLE/CONTRIBUTING
260236	SINGLE DWELLING	260 S 100 W	ELIGIBLE/CONTRIBUTING
260237	SINGLE DWELLING	50 E 100 S	ELIGIBLE/CONTRIBUTING
260238	SINGLE DWELLING	256 S 100 W	ELIGIBLE/CONTRIBUTING
260239	SINGLE DWELLING	215 S 100 E	ELIGIBLE/CONTRIBUTING
260240	SINGLE DWELLING	155 S 100 E	ELIGIBLE/CONTRIBUTING
260241	SINGLE DWELLING	145 W Center	INELIG./NON-CONTRIBUTING
260242	SINGLE DWELLING	80 S Main	ELIGIBLE/CONTRIBUTING
260243	SINGLE DWELLING	172 S 100 E	OUT-OF-PERIOD
260244	SINGLE DWELLING	145 S 100 E	ELIGIBLE/CONTRIBUTING
260245	SINGLE DWELLING	220 E Center	INELIG./NON-CONTRIBUTING
260246	SINGLE DWELLING	260 S Main	INELIG./NON-CONTRIBUTING
260247	SINGLE DWELLING	75 N Main	ELIGIBLE/CONTRIBUTING
260248	SINGLE DWELLING	90 E Center	ELIGIBLE/CONTRIBUTING
260249	SINGLE DWELLING	215 S Main	OUT-OF-PERIOD
260250	RESIDENTIAL (GEN.)	275 S 100 E	OUT-OF-PERIOD
260251	RESIDENTIAL (GEN.)	50 Center	OUT-OF-PERIOD

Summary and Expectations:

Results of the literature review and file search indicated 19 cultural resource surveys have been conducted and six previously recorded sites were located within ½ mile of the proposed project area. Three of the previously recorded sites (42RI180, 42RI205, 42RI286) were plotted within the direct APE. Additionally, the 1875 GLO map (T 9N, R6E), indicated the historic "Road to Woodruff" (Sections 13, 17-18, 21-23) and "Cabin" (Section 23), and the 1870 GLO map (T 9N, R 7E), showed the "Road from Wahsatch to Bear Lake" road (Section 16) within or near the project area.

It was anticipated that a low density of cultural resource sites would be encountered within the proposed project area. Historic sites that may occur include trail and road segments and perhaps structural remnants from ranching sites such as building foundations. Homesteads and irrigation systems are most likely to be found near reliable water, while trails and roads might be anywhere throughout the project.

Previous research regarding the prehistoric sites in the area indicates lithic scatters are not common for this area and surrounding the project corridor. Other prehistoric sites throughout the general area contain a variety of tool types and debitage types but lack features that indicate that the site was used for camping or longer-term habitation. Other than attributes of lithic tool manufacture, function cannot be more specifically defined based on existing information.

The Historic Utah Buildings (HUB) database indicated that a Reconnaissance Level Survey was conducted around Woodruff, Utah in 1980 (U80PX0976). A total of 176 NRHP properties were plotted within a ½ mile (Table 3). Of those, 93 are eligible contributing/eligible, and none were individually listed on the National Register. All eligible/listed properties were located outside the project area with the exception of one property (Property #57904). Property 30822 is a residential property, unknow plan type, structure built in 1920 and has an NRHP evaluation of eligible/contributing.

13. Description of Field Methods:

The cultural resource inventory for the proposed Woodruff Irrigation Project, Rich County, Utah involved a pedestrian survey to identify cultural resources within the APE. The APE for project was inventoried by walking a 15-m (50 ft) wide pedestrian transect centered over the proposed linear areas (access road and linear areas), and 15-m (50f ft) wide transects around diversion structures to provide intensive coverage for a total of 95 acres.

Cultural resources encountered during the inventory were recorded as sites or isolates, as defined in the National Register Bulletin No. 16A as the "location of a significant event, a prehistoric occupation or activity, or a building or structure, whether standing, ruined, or vanished, where the location itself possesses historic, cultural, or archaeological value regardless of any existing structure." To clarify, historic, prehistoric, or archaeological features or any archaeological or historic anomaly that contains, at a minimum, greater than ten artifacts in a 10-meter diameter area, multiple features, a single feature for which sufficient information is available to raise the possibility that it may be significant, or a combination of a feature and artifacts were considered a site. All other cultural materials that do not meet the above criteria were considered isolated artifacts, or single artifacts or features of which little is known and possessing no possibility for significance to be determined.

If located, each site and/or isolated find was recorded using data obtained from a Trimble Geo 7x global positioning system (GPS) and based on NAD 83. All GPS data will be submitted to the appropriate agency to incorporate into their databases. All previously and newly recorded sites were evaluated against the criteria set forth by the NRHP.

14. Area Surveyed:

Land Owner		BLM	Other Federal	State	Private	TOTAL
Acreage	Class III:	1.5		0.2	93.3	95

15. Sites Recorded:

Land Owner		BLM		Other Federal		State		Private		TOTAL
		#	Site Number	#	Site Number	#	Site Number	#	Site Number	
Revisits (updated forms)	Eligible:							1	42RI205	1
	Not Eligible:							1	42RI180	1
Revisits (not updated)	Eligible:									
	Not Eligible:							1	42RI286	1
Newly Recorded	Eligible:							1	42RI301	1
	Not Eligible:	1	42RI299					1	42RI300	2
TOTAL		1						5		6

16. Individual Site Descriptions and Determinations of Eligibility and Effect

Site Summary:

A total of six sites were located within the project area, three previously recorded (42RI180, 42RI205, 42RI286), and three newly recorded (42RI299, 42RI300, 42RI301). Of the three previously recorded sites, only two required an update (42RI180, 42RI205). No GLOs were located in the project area.

***Site Number**:* 42RI180
***Site Type and Summary**:* Site 42RI180 is the historic Co-op ditch. The Ditch is located along the western edge of the Bear River Valley, approximately 0.75 miles southwest of Woodruff, Utah and generally runs in a north to south direction. The ditch traverses along the western edge of several agricultural fields. The site was originally recorded by Alpine Archaeological Consultants (Alpine) in 2008. At that time 158 m (0.09 miles) were recorded. Alpine noted that the ditch was constructed in 1884, with water being diverted from Woodruff Creek by means of a concrete dam measuring 24 ft. long, 18 ft. wide, and 3 ft. in height. Utah Board of Water Resources records state that 60 cfs was diverted into the ditch, which was capable of irrigating 1,122 acres of land.

In October of 2015 Bighorn revisited the site. At that time Bighorn extended the site to the south, recording a total segment length of 4,097 m (2.55 miles). In the site form update, it was noted that the Co-op ditch was constructed in a cut-and-fill manner, with the fill of the ditch placed along its eastern edge, which acts as a containment layer. Ditch width varied, but in general averaged 3.7 m (12 ft) across. Maximum depth was .6 m (2 ft), but the high containment layer of ditch fill makes the ditch appear to be much deeper. It appeared to be regularly maintained and cleared out, as much of the material on the east bank was free of vegetation and appeared to have been recently deposited. The Co-op Ditch carried water diverted from Woodruff Creek to the south over a maximum distance of 2.5 miles, where the water is used to irrigate pasture lands and hay fields. The site was revisited again in 2017 by Bighorn and recorded only a small segment crossing under Desert Road.

In September 2022, Bighorn once again revisited the site and found it to be unchanged and exactly as they had previously recorded through the years. Bighorn determined that the original site form, as well as the subsequent site form update, were accurate. A new segment measuring 167 m (550 ft) in length was recorded which started at the head gate diversion point of Woodruff Creek.
***National Register Eligibility Determination**:* Site 42RI180 has previously been recommended not eligible to the NRHP with SHPO concurrence. Although it is a good example of rural irrigation ditches, it is not unique in design or construction; it was used to divert water from Woodruff Creek to irrigate agricultural and grazing fields, and only serves a limited number of ranch properties. The ditch had only a limited role in the agricultural and water development history of the region and is not associated in any way with individuals important to the area. Although one small segment was added to the site, no additional details were observed which would alter the eligibility recommendation, and Bighorn agrees that the site is not eligible to the NRHP under any criteria.
***Recommendation of Effect**:* Two existing diversion structures (Buck and Co-op) will be replaced/upgraded with new cast-in-place concrete automated structures. Access walkway will be installed on top of diversions to access gates. Temporary impacts from over-excavation of diversion reconstructions are estimated to be 5ft each upstream and downstream and 2ft on sides of each structure. Sites will be accessed using adjacent existing dirt access road which will be temporarily widened slightly. No impacts to nearby linear ditch features should occur except at two diversions. If road widening requires temp impacts to ditch, ditch will be returned to existing conditions after construction. In addition, existing access over the ditch to the project area is already in use by local ranchers and recreational use and the site is recommend not eligible to the NRHP. As such, construction of the project will have a no effect on the ditch and no avoidance measures are recommended.

***Site Number**:* 42RI205
***Site Type and Summary**:* Site 42RI205 is a historic homestead originally recorded by Alpine Archaeological Consultants (Alpine) in 2008. At that time, Alpine described the site as a historic homestead 5.5 miles (8.9 km) west-southwest of Woodruff, Utah at the toe of the east-facing slope of the Woodruff Creek drainage above the floodplain associated with the Birch Creek/Woodruff Creek confluence. Alpine further noted that cultural remains at the site include a log cabin with an addition, a foundation depression, and an artifact scatter of glass, ceramics, and metal. A hay enclosure and corral are located east of the residence but were not included in the site boundary due to their distance from the project area. As part of the

historical research carried out when originally recording the site, Alpine states the site is part of the land received by John Melvin Cornia as an original Homestead Entry Patent (No. 5553) on Jan 12, 1897.

In September 2022, Bighorn revisited the site as part of the Woodruff Creek Watershed Plan EA Project. During the revisit Bighorn observed that the site was generally unchanged and exactly as Alpine had previously recorded 14 years ago. After a thorough re-inventory of the site, Bighorn determined that the site only needed GIS, feature locations, and photos updated. Structure 1 is the homestead, Feature 1 is a possible foundation depression, Feature 2 is the hay enclosure, and Feature 3 is the holding pen.

Structure 1 is the single-story log cabin was recorded as rectangular in layout, measuring 30 ft. east-west by 22 ft. north-south. The original description stated it is built upon an original, single-pen log cabin. The cabin is constructed of square-hewn logs joined by square-notching, which has been sealed with gray cement mortar. Several logs on the northeastern and southeastern corners are untrimmed and jut out from the corner a maximum of 2 ft. Windows are rectangular and wood-framed and have recently been fitted with a single sheet of plexiglass. The door on the east elevation is rectangular and also wood framed.

Feature 1 was also described to represent a foundation depression and is parallel to Structure 1, measures 25 ft. east-west by 27 ft. north-south. The foundation depression is cut sharply into the slope west of Structure 1, to a maximum depth of 4 ft. The southern, western, and northern sides of the depression are characterized by rocky earthen berms approximately 1 ft. above the surrounding ground surface and as much as 4 ft. wide. The western side contains a deteriorated wooden beam approximately 3 ft. below the ground surface. The shovel test probe was also completed in 2008 yielding 63 artifacts, mostly glass sherds, nails and nail fragments, metal fragments, and miscellaneous items.

Features 2 and 3 is the corral and hay complex made up of a combination of wood planks, wood poles, metal poles, metal fencing, and metal livestock gates. The wood planks used in the construction of the various walls of the corral vary in length and width. The tallest wood planks measured 8 feet high and the shortest 5 feet high. This area was previously noted but not documented in the intial recording by Alpine in 2008. As part of the revisit to the site and research, Bighorn reviewed GLO maps, topo maps, and historical aerial photos of the site's location and determined that that Feature 2 (hay enclosure) was constructed between 1981 and 1993. Thus, Feature 2 is not historic but is referenced on the sketch map.

Feature 3 (corral complex) located 30 meters southeast of the cabin can clearly be seen in a 1959 aerial photo as well as every aerial photo of the site after. As a result of this fact, Bighorn is including the corral complex in this site form update as it is clearly associated with the historic homestead. Feature 3 measures approximately 31 meters (102 feet) by 31 meters (102 feet) square and is comprised of a primary large holding pen which makes up the corral's entire east half. Set into the southeast corner of this large holding pen is a metal livestock gate which serves as an entry/exit point for the pen. Set into the northwest corner of the corral complex at the exact opposite end of the gate, and leading into the corral, are two large, narrow shoots which serve to both divide and lead into one of three small holding pens. Each small pen leads into the larger pen. A small shoot has been set in the corral outer fence just leading from the southern most small holding pen and just before the beginning of the large pen.

The loose scattering of artifact debris which is dispersed across the site and originally documented by Alpine in 2008 continues to be present around the corral complex in the form of a few fragments of glass, ceramics, and metal debris.

National Register Eligibility Determination*:* The original part of the habitation structure represents a good example of a regionally important method of construction for vernacular log cabin architecture. This part of the site retains integrity of location, setting, design, materials, workmanship, and feeling. For this reason, the site is evaluated as eligible for inclusion on the NRHP under Criterion C. In addition, a shovel probe has demonstrated that the site contains buried cultural deposits, which have the potential to yield additional information concerning the age and function of the site. For this reason, site 42RI205 is also evaluated as eligible for inclusion on the NRHP under Criterion D. Bighorn agrees with the previous recommendation of eligible under Criteria C and D.

Recommendation of Effect*:* This site is adjacent to Woodruff Creek Road and bisected by an existing unnamed dirt road. Both of these existing roads will be used as access roads for various project components. Woodruff Creek Road would be used to access multiple components including two diversions for reconstruction and the Woodruff Creek Reservoir. The unnamed dirt road that cuts the historic homestead in half would be used to access one diversion for reconstruction. There are no diversions located within the boundary of 42R1205 that would be reconstructed as part of this project. While the existing dirt roads may need to be temporarily widened for construction equipment, the historic homestead will be avoided. No impacts to the historic

homestead are anticipated. Any widened portion of the existing access roads would be reclaimed post-construction. However, the existing roads would remain as access roads to the diversions in case of future maintenance needs. Although construction of the project will have a no adverse effect to the site and will not diminish the integrity of the historic property, temporary fencing is recommended.

***Site Number**:* 42RI286
***Site Type and Summary**:* Site 42RI286 is the Eastman/Fraser Ditch (W. Tingey, personal communication, Jan 31, 2018) originally recorded in 2017 by Bighorn. The ditch is constructed in a cut-and-fill manner, with the fill of the ditch placed along its southern edge. The Eastman/Fraser Ditch carries water diverted from Woodruff Creek to the east towards Woodruff, Utah, where the water is used to irrigate pasture lands and hay fields. The original construction date is unknown. According to Wes Tingey (personal communication, Jan 31, 2018), President of Woodruff Irrigation Company, no records exist about time and materials used to build the ditch. He stated the ditch had been built before his birth (70+ years) and was completed by local residents needing irrigation for crops. He stated no records exist in the company minutes within the Woodruff Irrigation Company regarding the maintenance or construction of the ditch.

The ditch width varies, but in general averages 2 m (6.5 ft) across. Maximum depth is .6 m (2 ft), but the high containment layer of ditch fill makes the ditch appear to be much deeper. It appears to have been maintained and cleared out, but vegetation is encroaching on the ditch, and it may not have been used for some time. The recorded segment of the earthen ditch measures 2,348 m (7,703 feet) in length. A total of four water control features were recorded along the recorded segment of the ditch.

In September 2022, Bighorn revisited the site and found it to be unchanged and exactly as they had previously recorded through the years. Bighorn determined that the original site form was accurate, and no updates were made.
***National Register Eligibility Determination**:* Site 42RI286 has previously been recommended not eligible to the NRHP. The ditch is not known to have played an important role in historical events of the area and is not known to be associated with any other significant historical feature or persons. Additionally, the ditch is only known locally and had only a limited role in the agricultural and water development history of the area and not known within the region and therefore not eligible under Criteria A or B. Although the Eastman/Fraser Canal is a good example of rural irrigation ditches, it is not unique in design or construction; it was used to divert water from Woodruff Creek to irrigate agricultural and grazing fields, and only serves a limited number of ranch properties and therefore not eligible under Criterion C.
***Recommendation of Effect**:* One existing diversion structure (Eastman-Frazier) will be replaced/upgraded with new cast-in-place concrete automated structure. Access walkway installed on top of diversion to access gate. Temporary impacts from over-excavation of diversion reconstruction are estimated to be 5ft each upstream and downstream and 2ft on sides of structure. The site will be accessed using adjacent existing dirt access road which will be improved & widened slightly. Access road will cross linear ditch features twice. No impacts to nearby linear ditch features should occur except at diversion. If road widening requires temp impacts to ditch, ditch will be returned to existing conditions after construction. In addition, existing access over the ditch to the project area is already in use by local ranchers and recreational use and the site is recommend not eligible to the NRHP. As such, construction of the project will have a no effect on the ditch and no avoidance measures are recommended.

***Site Number**:* 42RI299
***Site Type and Summary**:* Site 42RI299 is the newly recorded Birch Creek Reservoir historic earthen dam built in 1951. A review of historic maps and aerial photographs of the area indicate that the dam was present in the first photo of the area in 1959. The site is located within a 120 x 155 m (18,660 m2) area west of Woodruff, Utah along Birch Creek. Soils in the area consist of tan, fine grained, alluvial sand and silt with occasional river cobbles and limestone rock fragments. Vegetation in the area includes sagebrush and various bunch grasses and forbs. The site is in stable condition and has been impacted by erosion.

The historic dam is located at the base of Strawberry Ridge Mountains along the Birch Creek channel and consists of a U-shaped earthen berm that is about 442 ft. (135 m) in length and 96 feet tall that forms the reservoir basin to the west. The berm is about 262 ft. (80 m) wide but difficult to accurate measure due to water. A 6.5 ft. by 6.5 ft. wood slat structure rests upon a 3 ft. concrete foundation on the crest of the dam. Inside is an 8 in. diameter section of vertical steel pipe extending up from the ground. Just north of the structure is a horizontal 4 in. galvanized pipe in-bedded into the top of the berm, or crest of the dam, and is protected by two vertical steel posts. The overflow spillway is located on the south side of the dam and has been carved into the existing rock and flows to the east. At the base of the eastern side of the dam is a 22 in. steel pipe encased in concrete for a basin filter. Modifications to the dam were completed in 2019.

***National Register Eligibility Determination**:* Site 42RI299 is a historic earthen dam dating from the mid-late 20th century. It appears to retain overall integrity of location, design, setting, and feeling, with intact features that are present amongst native vegetation. The site also maintains integrity of materials, workmanship, and association as demonstrated by the intact earthen dam and related features. However, the site is not associated with significant events or individuals in history. The dam is not distinctive in character, exhibit a unique construction or engineering design of construction, or embody the work of a master. The site is unlikely to provide additional information important in understanding the history of the area. As such, it is recommended not eligible for the NRHP.
***Recommendation of Effect**:* This site is no longer part of the proposed project. As such, there will be no impacts to site.

***Site Number**:* 42RI300
***Site Type and Summary**:* Site 42RI300 is the Woodruff Creek Reservoir historic earthen dam built in 1970. A review of historic maps and aerial photographs of the area support this as the aerial photos indicate the dam not built in 1968 but shows up in 1981. The site is located within a 185 x 200 m (21,660 m2) area (estimation based off water in reservoir), west of Woodruff, Utah along Woodruff Creek. Soils in the area consist of tan, fine grained, alluvial sand and silt with occasional river cobbles and limestone rock fragments. Vegetation in the area includes sagebrush and various bunch grasses and forbs. The site is in stable condition and has been impacted by erosion.
The historic dam is located in a mountainous region along Woodruff Creek channel and consists of a U-shaped earthen berm that measures approximately 200 m in length and 27 m in height that forms the reservoir basin to the west. The crest at the top of the berm is about 10 m wide. A lift gate at the top of the crest has two pipes (5- inch and 8-inch diameter) and extend into the water. The outlet pipe (42-inch diameter) is on the east toe of the dam encased in concrete. The overflow spillway is located on the south side of the dam and is made of concrete (cast in place) and flows to the east. The spillway measures 150 m and 4.6 m wide with a small portion enclosed.
***National Register Eligibility Determination**:* Site 42RI300 is a historic earthen dam dating from the mid-late 20th century. It appears to retain overall integrity of location, design, setting, and feeling, with intact features that are present amongst native vegetation. The site also maintains integrity of materials, workmanship, and association as demonstrated by the intact earthen dam and related features. However, the site is not associated with significant events or individuals in history. The dam is not distinctive in character, exhibit a unique construction or engineering design of construction, or embody the work of a master. The site is unlikely to provide additional information important in understanding the history of the area. As such, it is recommended not eligible for the NRHP.
***Recommendation of Effect**:* Gate improvements include installation of an electric motor gate actuator and electronic hardware for power & communications, which will interface with existing low-level outlet gate wheel. Dam crest access will be improved by installing an expanded metal pedestrian walkway over the emergency spillway. A dam discharge measurement device made of cast-in-place concrete will be installed in a stilling well in the channel downstream of the dam. Temporary impacts from over-excavation for gate improvements and improved access at dam crest are estimated to be 5ft each upstream and downstream and 2ft on sides of structure. Existing access roads will be used to access site as currently used by local ranchers and recreational use. Additionally, the site is recommended not eligible to the NRHP, and no avoidance measures are recommended.

***Site Number**:* 42RI301
***Site Type and Summary**:* Site 42RI301 is a historic wood home located 3.2 miles (5.2 km) west-southwest of Woodruff, Utah above the floodplain associated with Woodruff Creek. The cultural remains at the site include a hewn log house built on a concrete foundation. The house measures 25 ft by 25 feet and mixed with recent and historic debris scattered around the edges, including but not limited to car parts, water conveyance pipes, metal drum barrels, lumber in various sizes, tires from various autos/farm equipment, truck bed, farming equipment and parts, small engine parts, rims, metal fragments, coil spring mattress, truck bed, and motorcycle. The structure is constructed of square-hewn logs joined by square-notching, which has been sealed with gray cement mortar on the western side. The eastern half of the structure appears to have been added later (date unknown) with 2 x 4 in. studs. Windows are rectangular and wood-framed, some of which are broken or covered with a single sheet of plywood. The door on the south is rectangular and also wood-framed. The associated two-track road is 3.5 meters wide and 375 meters in length and runs along the west side of the structure.

Historic research indicated the eastern half of section 23 was owned by Isaac V. Eastman and his wife Abbie A. Eastman containing 320 acres. Sources specify that Isaac was the son of George Eastman and Dorothy Putnam Eastman. He was born in Rumford Falls, Maine, the second youngest of seven children. Isaac married Abbie Angie Twombly about 1884. They had at least 13 children. In 1903 Issac and his wife were listed as the mortgage holders of title lands at the Rich County Assessor's

Office in 1903. In the 1910 US Census, Isaac's occupation is listed as being a farmer raising stock. He and his family are living in Woodruff, Utah at the time of this census, as they were for the census of 1900. Isaac died in 1916 and is buried at the Eastman Family Cemetery, Woodruff, Rich County, Utah along with his wife and many of his children. Thus, the house was most likely associated with Isaac or his posterity.
National Register Eligibility Determination*:* Site 42RI301 is recommended eligible to the NRHP. The site may have been associated with significant historical persons in the area. The eastern half of section 23 was owned by Isaac V. Eastman and his wife Abbie A. Eastman containing 320 acres. He died in 1916 and contributed to the establishment and economic development of Woodruff, Utah. Although the associated artifacts are mostly modern debris and lack historic integrity, the site may yield information important in history regarding ranching, settlement studies, ethnicity, consumerism and subsistence, and regional research questions for this area. As such, Bighorn recommends the site eligible under Criteria A and D.
Recommendation of Effect*:* This site is adjacent to an existing access road that will be used to access the Saxton diversion (located outside the identified 42RI301 site boundary). While the existing access road may need to be temporarily widened, the historic home will be avoided. No impacts on the historic home are anticipated. Any widened portion of the existing access road would be reclaimed post-construction. Although construction of the project will have a no adverse effect to the site and will not diminish the integrity of the historic property, temporary fencing is recommended for avoidance.

17. Isolated Finds:
One isolated find was recorded (Appendix A). An earthen ditch identified on historic aerial photographs of the area was present crossing through the project area. This ditch was considered an isolated find as it was not named or well established with historical significance, had not risen to the level of topographic mapping, was a small segment that truncated into a field, and had no significant effort in the design or construction. The ditch is not present on the 1959 historic aerial photo but appears in 1963. This ditch is abandoned.

18. Summary of Findings:
Examination of the project area resulted in the location of six cultural sites within the project area, including three newly recorded sites (42RI299-301) and three previously recorded (42RI180, 42RI205, 42RI286). Only two previously recorded sites (42RI180, 42RI205) were updated. Finally, of the six sites, only two were recommended eligible to the NRHP (42RI205, 42RI301). One isolated find was recorded.

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19. Collection Yes__ No _X_
(If Yes) Curation Facility: Accession Number(s):

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20. Conclusion/Recommendation of Effect:
The cultural resource inventory to establish flood protection, improve irrigation water delivery and efficiency, and conserve water involved a pedestrian inventory for a total of 95 acres. The field inventory determined the presence/absence of cultural resources to assist in fulfilling requirements under various federal and state environmental protection laws, including the NHPA and NEPA. The area is consistently used for farming, cattle grazing, and flood irrigation.

Examination of the project area resulted in three new cultural sites, revisiting three previously recorded sites, and one isolated find. Of these sites, only two (42RI205, 42RI301) were recommended eligible to the NRHP. Although project construction is located outside the eligible site boundaries, the existing two track roads passing through each site may temporarily be widened but would be reclaimed post-construction. Although construction of the project will have a no adverse effect to the eligible sites and will not diminish the integrity of the historic properties, temporary fencing is recommended for avoidance as a precaution.

Throughout the project area, the potential for subsurface remains was low as the historic period used this area primarily as a stream channel and agriculture. Field conditions were poor, as bunch grasses covered 80% - 85% of the ground. As previously mentioned, the visual impacts to historic structures, recommended eligible to the NRHP, were assessed by reviewing the existing data from SHPO. All eligible/listed properties were located outside the project area with the exception of one property (Property #57904). Property 30822 is a residential property, unknow plan type, structure built in 1920 and has an NRHP evaluation of eligible/contributing. The property will be avoided during any construction and will not have a visual impact on the direct APE.

21. Personal Background:
Jon Baxter (PLPCO #137) is one of the Principal Investigators at Bighorn. He received both his MA and BS degrees in Anthropology from Brigham Young University and has over 28 years of experience in archaeology and cultural resource management in Utah, Arizona, Idaho, Wyoming, and Nevada.



Figure 1. Project Overview Looking East



Figure 2. Project Overview Looking West

Appendix A
Project and Isolated Find

Appendix B
Qualifications

Jon R. Baxter, M.A.

Bighorn Archaeological Consultants, LLC., Principal Investigator

Years of Experience: 27

Relevant Experience

Jon received both his MA and BS degrees in Anthropology from Brigham Young University. He has over 27 years of experience in archaeology and cultural resource management in Utah, Idaho, Wyoming, and Nevada. He has worked as a principal investigator, field supervisor, and crew chief on a number of survey and excavation projects within Utah, including several in Southwestern Utah, i.e. Capitol Reef National park, the Grand Staircase-Escalante National Monument, and Sand Hollow near St. George. In Northern Utah, Nevada, Wyoming, and Idaho he has been involved with several types of inventories for power lines, water lines, fiber-optics, fire rehabs, mineral extractions, and development projects.

His experience also involves knowledge of field archaeology, site testing and excavation, data recovery, and monitoring construction activity. In addition, he has experience in the preparation of technical reports, including writing, editing, formatting, and generating graphics. Jon is proficient with the use of global positioning systems, total station mapping, and archival research. Jon's knowledge of computers is also a key resource to manage and troubleshoot the company's network and workstations.

Jon's experience is an integral part of why the company is successful as evinced by coordinating large scale projects and being the liaison between the client and land managing agencies with respect to cultural resources.

Areas of Expertise

Government Agency Liaison
Project Management
Mitigation
Archaeological Monitoring
Environmental Compliance
Environmental Permitting
Data Analysis
GIS

Education

- M.A., Anthropology, Brigham Young University, 2002
- B.S., Anthropology, Brigham Young University 1998

Professional History

- Bighorn Archaeological Consultants, LLC., Co-owner/Principal Investigator, 2004 – Present
- Baseline Data, Inc. Project Manager/Field Supervisor, 2002-2004
- SWCA Environmental Consultants, 2000-2002
- Office of Public Archaeology, Crew Chief, 1996-1999

Permits

- Arizona Bureau of Land Management (Statewide)
- Arizona State Lands (Statewide)
- Idaho (project specific)
- Nevada Bureau of Land Management (East side)
- Nevada State Lands (Statewide)
- Utah Bureau of Land Management (Statewide)
- Utah State Lands (Statewide)
- Wyoming (project specific)

Curation Agreements

- College of Eastern Utah
- Arizona State Museum

Historic Structures in 100-Yr Floodplain

Historic Structures Within Spring City

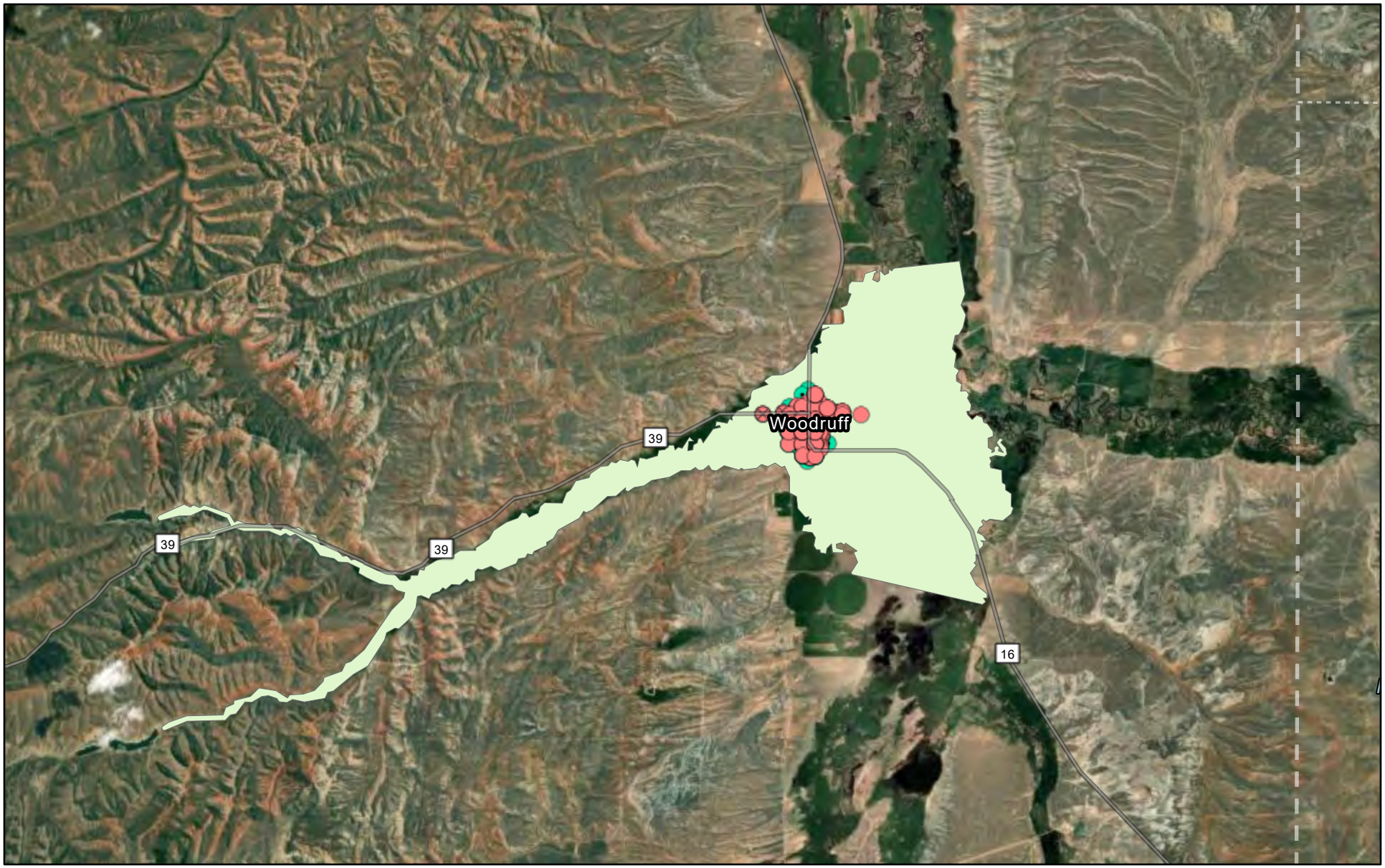
Historic Structures Summary

There are 93structures within the 100-yr flood zone that are eligible for listing in the NR Historic District. See Table 1 for a detailed list of historic structures within the 100-yr flood zone.

Historic Structures within the 100-Yr Flood Zone Summary				
Structure General Use	**Structures in 100-Yr Flood Zone**	**Listed in NR Historic District**	**Not Listed in NR Historic District***	**Types of structures**
Ag. Storge & Outbuildings	-	-	-	
Animal Facility	1	0	1	
Single Dwelling	74	0	74	
Residential Aux.	-	-	-	
Religious	2	1	1	Woodruff Stake House
Government	-	-	-	
Industrial	-	-	-	
Commercial	-	-	-	
Other	16	0	16	Cox House
Irrigation	-	-	-	

* Includes structures whose listing status is not specified.

UTSHPO HUB Application Map



10/8/2024, 9:25:29 AM

Select Records Intersecting Another Layer _Query result

ELIGIBLE/CONTRIBUTING

INELIG./NON-CONTRIBUTING

OUT-OF-PERIOD

20240923_Woodruff_InundationBoudanryShapefile - WoodruffInundationBoundary100

1:144,448

0 0.75 1.5 3 mi

0 1.5 3 6 km

Earthstar Geographics, Utah Geospatial Resource Center, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of

ArcGIS Web AppBuilder

Utah State Historic Preservation Office HUB Application Export

Table 1 – Historic Structures within the 100-Yr Flood Zone									
PR ID	**House Number**	**Street Direction**	**Street Name**	**Property Name, if applicable**	**Const. Year**	**Original Use**	**Listing Status**	**Longitude**	**Latitude**
260174	60	E	Center		1880	ANIMAL FACILITY		-12374400.24	5089992.886406749
67381	50	S	MAIN	WOODRUFF STAKE HOUSE	1900	RELIGIOUS (GENERAL)	NR Individually Listed Property	-12374570.08	5089769.1629853705
260202	50	S	Main		1900	RELIGIOUS FACILITY		-12374570.08	5089769.162987384
47864	0				1890	RESIDENTIAL (GEN.)	Not Listed	-12375130.87	5089458.776
45564	0				1925	RESIDENTIAL (GEN.)	Not Listed	-12375130.87	5089458.776
45565	0				1885	RESIDENTIAL (GEN.)	Not Listed	-12375130.87	5089458.776
45911	0				1910	RESIDENTIAL (GEN.)	Not Listed	-12375130.24	5089136.080291318
45616	0				1890	RESIDENTIAL (GEN.)	Not Listed	-12375114.05	5090131.505758351
47208	0				1885	RESIDENTIAL (GEN.)	Not Listed	-12375102.08	5089792.901057549
47207	0				1890	RESIDENTIAL (GEN.)	Not Listed	-12375102.08	5089792.901057549
47749	0				1885	RESIDENTIAL (GEN.)	Not Listed	-12375102.08	5089792.901057549
47751	0				1880	RESIDENTIAL (GEN.)	Not Listed	-12375102.08	5089792.901057549
57903	0				1910	RESIDENTIAL (GEN.)	Not Listed	-12375102.08	5089792.901057549
47212	0				1910	RESIDENTIAL (GEN.)	Not Listed	-12374768	5089129.961049428
47754	0				1905	RESIDENTIAL (GEN.)	Not Listed	-12374768	5089129.961049428
47755	0				1910	RESIDENTIAL (GEN.)	Not Listed	-12374768	5089129.961049428
47868	0				1885	RESIDENTIAL (GEN.)	Not Listed	-12374768	5089129.961049428
47874	0				1935	RESIDENTIAL (GEN.)	Not Listed	-12374768	5089129.961049428
45626	0				1895	RESIDENTIAL (GEN.)	Not Listed	-12374766.36	5089457.205762586
45917	0				1905	RESIDENTIAL (GEN.)	Not Listed	-12374766.36	5089457.205762586
47873	0				1890	RESIDENTIAL (GEN.)	Not Listed	-12374766.36	5089457.205762586
57913	0				1910	RESIDENTIAL (GEN.)	Not Listed	-12374766.36	5089457.205762586
47216	0				1930	RESIDENTIAL (GEN.)	Not Listed	-12374766.36	5089457.205762586
47872	0				1935	RESIDENTIAL (GEN.)	Not Listed	-12374764.71	5089779.916004997
40822	0				1900	RESIDENTIAL (GEN.)	Not Listed	-12374764.71	5089779.916004997
45624	0				1905	RESIDENTIAL (GEN.)	Not Listed	-12374764.71	5089779.916004997
47758	0				1885	RESIDENTIAL (GEN.)	Not Listed	-12374764.71	5089779.916004997
40816	0				1890	RESIDENTIAL (GEN.)	Not Listed	-12374747.07	5088835.0383498175
57904	0					RESIDENTIAL (GEN.)	Not Listed	-12374747.07	5088835.0383498175
47214	0				1880	RESIDENTIAL (GEN.)	Not Listed	-12374437.44	5090125.298281271
45571	0				1905	RESIDENTIAL (GEN.)	Not Listed	-12374437.44	5090125.298281271
45914	0				1905	RESIDENTIAL (GEN.)	Not Listed	-12374437.44	5090125.298281271

Table 1 – Historic Structures within the 100-Yr Flood Zone									
PR ID	**House Number**	**Street Direction**	**Street Name**	**Property Name, if applicable**	**Const. Year**	**Original Use**	**Listing Status**	**Longitude**	**Latitude**
47215	0				1890	RESIDENTIAL (GEN.)	Not Listed	-12374437.44	5090125.298281271
45909	0				1882	RESIDENTIAL (GEN.)	Not Listed	-12374435.22	5089135.589900079
40817	0				1900	RESIDENTIAL (GEN.)	Not Listed	-12374436.44	5089790.082160308
40818	0				1905	RESIDENTIAL (GEN.)	Not Listed	-12374436.44	5089790.082160308
40821	0				1890	RESIDENTIAL (GEN.)	Not Listed	-12374436.44	5089790.082160308
45913	0				1920	RESIDENTIAL (GEN.)	Not Listed	-12374436.44	5089790.082160308
45910	0				1905	RESIDENTIAL (GEN.)	Not Listed	-12374432.35	5088812.909541136
45767	0				1905	RESIDENTIAL (GEN.)	Not Listed	-12374429.03	5089460.570596827
45627	0				1905	RESIDENTIAL (GEN.)	Not Listed	-12374429.03	5089460.570596827
47753	0				1885	RESIDENTIAL (GEN.)	Not Listed	-12374103.61	5089788.428
40815	0				1910	RESIDENTIAL (GEN.)	Not Listed	-12374103.61	5089788.428
45620	0				1895	RESIDENTIAL (GEN.)	Not Listed	-12374099.65	5090095.244678446
47867	0				1880	RESIDENTIAL (GEN.)	Not Listed	-12374091.13	5089152.135652495
260170	10	E	100 N		1960	SINGLE DWELLING		-12374548.41	5090318.6285563195
260225	209	W	100 S		1960	SINGLE DWELLING		-12375235.14	5089598.828916337
260178	95	E	200 S		1900	SINGLE DWELLING		-12374312.94	5089261.927447894
260193	20	S	100 E		1940	SINGLE DWELLING		-12374245.3	5089906.2704691775
260242	80	S	Main		1945	SINGLE DWELLING		-12374571.78	5089689.830526414
260236	260	S	100 W		1900	SINGLE DWELLING		-12374895.77	5089095.488105653
260175	338	S	Main		1925	SINGLE DWELLING		-12374581.86	5088832.372430813
260233	90	E	200 S		1940	SINGLE DWELLING		-12374310.5	5089331.503755817
260237	50	E	100 S		1910	SINGLE DWELLING		-12374422.66	5089663.049213004
260191	35	W	100 S		1940	SINGLE DWELLING		-12374713.57	5089596.823
260238	256	S	100 W		1925	SINGLE DWELLING		-12374895.77	5089095.488105653
260240	155	S	100 E		1945	SINGLE DWELLING		-12374307.99	5089432.244385267
260248	90	E	Center		1940	SINGLE DWELLING		-12374315.04	5089991.601301884
260197	10	E	Center		1895	SINGLE DWELLING		-12374546.94	5089993.283
260177	110	W	Center		1900	SINGLE DWELLING		-12374975.9	5089995.637920934
260198	165	W	Center		1895	SINGLE DWELLING		-12375143.92	5089929.699750962
260235	185	N	Main		1890	SINGLE DWELLING		-12374618.35	5090594.686914401
260199	385	S	Main		1900	SINGLE DWELLING		-12374637.72	5088674.657642906
260239	215	S	100 E		1945	SINGLE DWELLING		-12374288.13	5089162.538432939
260200	55	E	100 S		1970	SINGLE DWELLING		-12374447.05	5089596.121258312
260192	75	E	100 S		1930	SINGLE DWELLING		-12374375.87	5089595.759017047
260244	145	S	100 E		1900	SINGLE DWELLING		-12374307.99	5089432.244385267

Table 1 – Historic Structures within the 100-Yr Flood Zone									
PR ID	**House Number**	**Street Direction**	**Street Name**	**Property Name, if applicable**	**Const. Year**	**Original Use**	**Listing Status**	**Longitude**	**Latitude**
260228	90	S	Main		1890	SINGLE DWELLING		-12374570.85	5089669.038140698
260180	10	S	Main		1900	SINGLE DWELLING		-12374567.69	5089910.314299689
260247	75	N	Main		1950	SINGLE DWELLING		-12374632.05	5090159.504616044
260234	85	S	Main		1920	SINGLE DWELLING		-12374633.04	5089672.014135812
260183	175	S	Main		1910	SINGLE DWELLING		-12374634.15	5089402.784795006
260196	95	W	Center		1935	SINGLE DWELLING		-12374975.9	5089995.637920934
260176	15	E	100 N		1900	SINGLE DWELLING		-12374530.65	5090272.789402943
260181	65	N	100 W		1900	SINGLE DWELLING		-12374910.63	5090121.848366169
45912	0				1940	SINGLE DWELLING	Not Listed	-12374768	5089129.961049428
51107	0			LEE, HENRY, HOUSE	1882	SINGLE DWELLING	Not Listed	-12374742.91	5089217.166033026
45621	90	S	MAIN	COX HOUSE	1885		Not Listed	-12374570.86	5089669.035718201
45907	0						Not Listed	-12375130.87	5089458.776
47750	0						Not Listed	-12375102.08	5089792.901057549
45908	0				1890		Not Listed	-12374770.51	5090452.852348262
47209	0				1890		Not Listed	-12374764.71	5089779.916004997
57912	0				1905		Not Listed	-12374764.71	5089779.916004997
47866	0				1895		Not Listed	-12374747.07	5088835.0383498175
47869	0						Not Listed	-12374437.44	5090125.298281271
47870	0				1885		Not Listed	-12374437.44	5090125.298281271
40819	0				1895		Not Listed	-12374436.44	5089790.082160308
45572	0				1882		Not Listed	-12374435.22	5089135.589900079
47217	0				1885		Not Listed	-12374435.22	5089135.589900079
45619	0				1890		Not Listed	-12374432.35	5088812.909541136
57907	0						Not Listed	-12374432.35	5088812.909541136
40823	0				1900		Not Listed	-12374429.03	5089460.570596827
40813	0				1895		Not Listed	-12374099.65	5090095.244678446