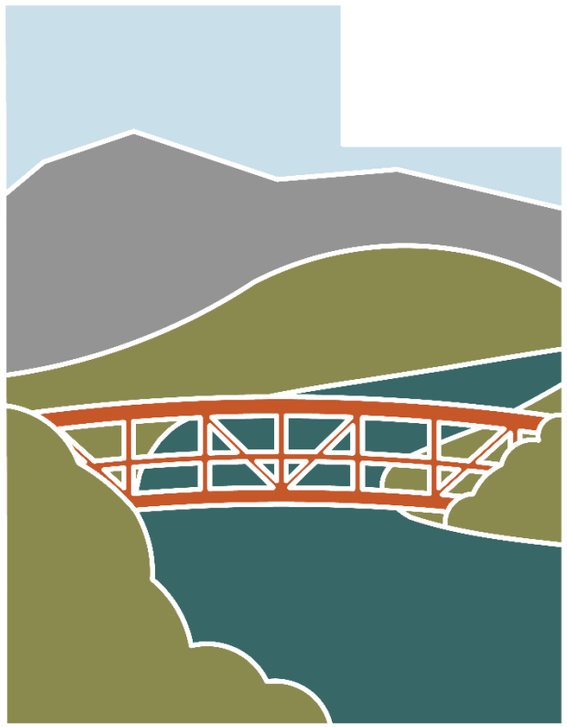


JORDAN RIVER COMPREHENSIVE MANAGEMENT PLAN

Public Draft

Utah Division of Forestry, Fire & State Lands
1594 W. North Temple, Suite 3520
Salt Lake City, Utah 84114-5703

May 23, 2016

TABLE OF CONTENTS

APPENDICES

FIGURES

TABLES

ABBREVIATIONS

BMP	best management practices
CFR	Code of Federal Regulations
cfs	cubic feet per second
cmp	comprehensive management plan
CWA	Clean Water Act
DO	dissolved oxygen
DSPR	Utah Division of State Parks and Recreation
DWQ	Utah Division of Water Quality
DWR	Utah Division of Wildlife Resources
DWRe	Utah Division of Water Resources
DWRi	Utah Division of Water Rights
E. coli	*Escherichia coli*
EPA	U.S. Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FFSL	Utah Division of Forestry, Fire & State Lands
GIS	geographic information systems
I-15	Interstate 15
I-215	Interstate 215
JRC	Jordan River Commission
JRCMP	Jordan River Comprehensive Management Plan
m	meter
NFIP	National Flood Insurance Program
NPS	National Park Service
NRHP	National Register of Historic Places
OHWM	ordinary high water mark
PDF	portable document format
RDCC	Resource Development Coordinating Committee
SHPO	State Historic Preservation Office
TDS	total dissolved solids
TMDL	total maximum daily load
UDEQ	Utah Department of Environmental Quality
UDOT	Utah Department of Transportation
UDSH	Utah Division of State History
USACE	U.S. Army Corps of Engineers
USC	United States Code
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WWTP	wastewater treatment plant

1.1 Project Vision and Goals

The Utah Department of Natural Resources Division of Forestry, Fire & State Lands (FFSL) is developing the Jordan River Comprehensive Management Plan (JRCMP) to prescribe sovereign land management goals and objectives for the Jordan River, and to ensure that all uses on, beneath, or above the bed of the Jordan River are regulated to protect navigation, fish and wildlife habitat, aquatic beauty, public recreation, and water quality (Public Trust resources) pursuant to Utah Administrative Code R652-2. The Jordan River is a sovereign land body that flows through Utah, Salt Lake, and Davis Counties (Figure 1.1). Primary management responsibility for the river's resources lies with FFSL, pursuant to Title 65A of the Utah Code, which governs management of all state lands within the jurisdiction of FFSL. Utah Code 65A-2-1 states that "[t]he division [of Forestry, Fire and State Lands] shall administer state lands under comprehensive land management programs using multiple-use, sustained-yield principles." Briefly stated, the overarching management objectives of FFSL are to protect and sustain the Public Trust resources and to provide for reasonable beneficial uses of those resources, consistent with their long-term protection and conservation.

FFSL's vision for this process and ultimate plan is as follows:

> *The State of Utah, through the Equal Footing doctrine, has fee title ownership of the bed and banks of Jordan River. FFSL has direct management jurisdiction over lands between the banks (i.e., ordinary high water marks) as identified at statehood. FFSL recognizes the importance of the Jordan River ecosystem and its natural, cultural, recreational, and aesthetic amenities, including those resource values and uses that extend beyond its banks and affect or are affected by actions on sovereign lands. Accordingly, FFSL considers it imperative that management of the Jordan River include coordination in planning and actions by other agencies with jurisdictional responsibility over these resources.*
>
> *The Jordan River is a valuable ecosystem of statewide importance. Sustainable management in the context of multiple-use of the Jordan River will ensure that the ecological health (e.g., water quality, bank stability, riparian zones, aquatic organisms, wildlife, and wetlands), scenic attributes, and recreation opportunities (e.g., bird watching, biking, and boating) are maintained into the future. FFSL will coordinate, as necessary, to ensure that the management of this resource is based on a holistic view—including the use of adaptive management, as necessary—to ensure long-term sustainability. Responsible stewardship of the Jordan River's resources will provide a lasting benefit to the Public Trust.*

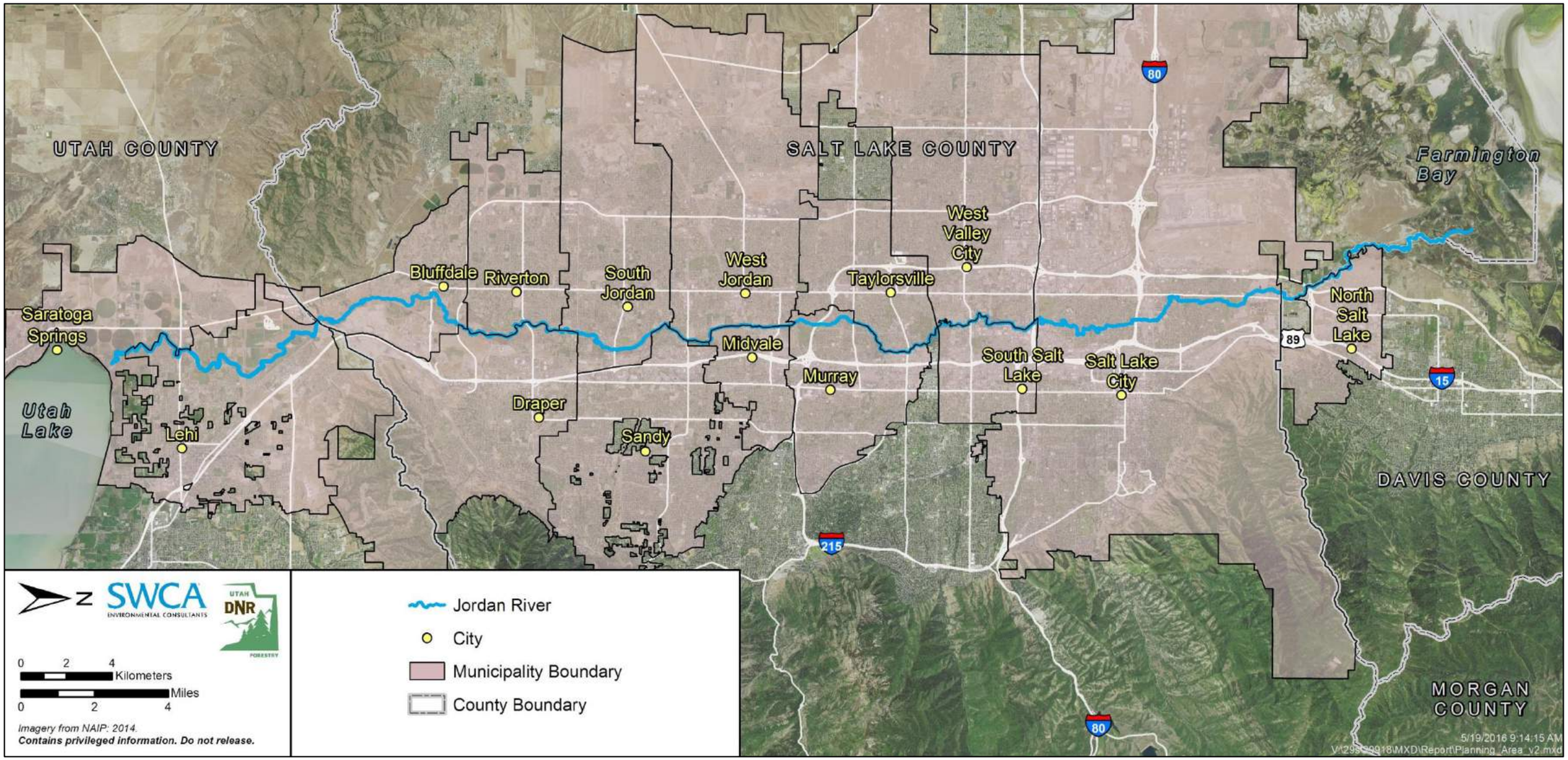


Figure 1.1. Jordan River planning area map.

To meet our land management mandates, FFSL's overarching goal of the JRCMP process is to ensure that we maintain clear and consistent guidance on the management of Jordan River resources. Specifically, the goals for the JRCMP process are as follows:

- Create the first comprehensive management plan (CMP) for Jordan River sovereign lands (i.e., the planning area).
- Ensure that sovereign lands management remains consistent with Public Trust obligations.
- Incorporate principles of multiple-use while conserving natural and cultural resources.
- Integrate existing information, data, and scientific research that have been developed on the Jordan River into clear and consistent management practices.

Coordinate with Utah Department of Natural Resource divisions, Utah Department of Environmental Quality (UDEQ) divisions, and other government entities regarding management, permitting, maintenance, planning, and research on the Jordan River.

Drafting the Plan

A comprehensive review of existing information and written management practices for the Jordan River was conducted to inform the development of the JRCMP. This review ensured that the JRCMP would build on previously compiled data sources and current management strategies, instead of "reinventing the wheel." See Appendix A for a review of existing information and management practices for the Jordan River. Throughout the JRCMP, colored boxes called "Further Reading" are used to refer the reader to other Jordan River–related documents or websites.

In addition to existing data, development of the JRCMP relied on feedback from the public, municipalities, and other stakeholders, as per Utah Administrative Code R652-90-600. Technical information, comments, and land use information, for example, were obtained during planning meetings or through the project website and were incorporated into the JRCMP. For a summary of the public involvement process and FFSL's response to public comments see Appendices B and C, respectively.

Other state agencies and local governments contributed to the development of the JRCMP by providing data, insight into management and jurisdictional roles, and oversight of content. These participants formed the planning team. A list of planning team members is found in Appendix D.

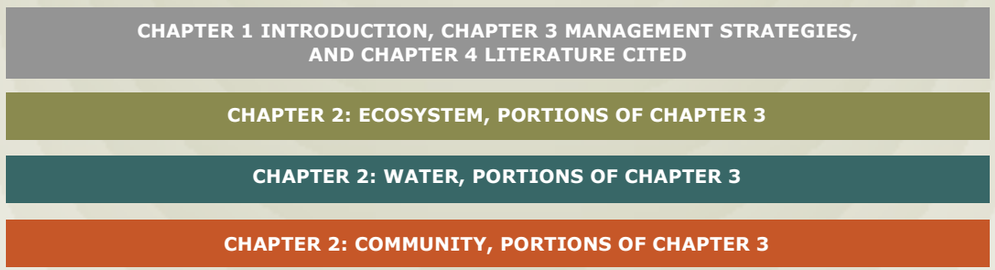
The JRCMP will be revised approximately every 10 years with amendments occurring if issues arise or as rules or statues change. The revision process is, by administrative code, open to the public for comment.

How to Use this Plan

The JRCMP is intended to provide easy access to data, river use class information, and best management practices (BMPs) to aid all stakeholders in planning and implementing projects that may affect Jordan River sovereign lands. This introductory chapter provides an overview of the regulatory environment and sets the stage for the management plan and how it applies to different leasing scenarios, including a description of the leasing process itself. The leasing process has been incorporated as part of the plan to facilitate better communication and understanding between permit applicants and the FFSL. The mapbook at the end of this chapter (Figure 1.7 [maps 1–20]) provides an accessible visual reference of the river's use classes as described in Utah Administrative Code R652-70-200. Chapter 2 summarizes the existing conditions of the river and focuses on ecosystem, water, and community resources. This, in combination with public involvement, provides the basis for Chapter 3, which discusses desired future conditions, management goals and objectives, and BMPs that may apply to ongoing management and permitting decisions for projects proposed by state government agencies, local governments, stakeholders, and private entities. Chapter 4 provides a list of literature cited for this plan.

COLOR THEORY

The colors in the JRCMP logo are also used in the headers of the plan. These colors are intended to help the reader distinguish between the different chapters, and specifically the different resource sections in Chapters 2 and 3. Green, blue, and orange are used for Chapter 2 and 3's ecosystem, water, and community sections, respectively, and gray is used for Chapter 1, the introductory sections of Chapter 2 and Chapter 3, and Chapter 4.



Information in the JRCMP is supported by three online resources: 1) a JRCMP interactive portable document format (PDF), 2) a JRCMP Esri story map, and 3) a geographic information systems (GIS) spatial data viewer. All of these resources are found on the FFSL website and provide supplemental formats with which to view the JRCMP, understand the regulatory context behind the JRCMP, and visualize available data used to make management decisions. Although the interactive PDF will remain the same until it is updated, both the Esri story map and GIS spatial data viewer can be updated as new data and other information are available for the Jordan River. These three only resources are discussed further below.

1. Interactive PDF: This electronic document viewable in Adobe Reader is identical to a hard copy of the JRCMP, but this format provides the reader with hyperlinks to additional reading (see colored boxes), a nimble Table of Contents to navigate from one section to another, and the ability to make electronic notes in the document and print copies without concern for browser or word processing differences.
2. Esri story map: This format combines the text and graphics in the plan with geospatial data to create maps that guide users along the Jordan River and provide important information such as river use classes and current conditions. These maps are static but do allow the user to zoom in to a specific area of interest. The Esri story map is organized by tabs and includes background and resource information. Along the left side of each tab is a bar that includes a selection of text and graphics taken from the JRCMP. GIS data layers included in the Esri story map are found in colored boxes throughout this plan.
3. GIS spatial data viewer: To see all GIS spatial data compiled and catalogued for the JRCMP, users can use this GIS data viewing tool without support from GIS professionals or a background in this field. To better understand current conditions, users can turn data layers (there are over 50) on and off, which allows a unique perspective and virtual tour of the Jordan River. Combining existing lease locations, river use class, and stream alteration permit information can help municipalities plan the next utility crossing or bank restoration project. Similarly, combining habitat data, river access locations, and navigational hazards can allow boaters to prepare for their next float trip down the Jordan River.

1.2 Ownership, Regulatory, and Management Context

Jordan River Bed Ownership

Because the Jordan River was navigable at statehood in 1896, by virtue of the Equal Footing Doctrine, the State of Utah owns the bed of the Jordan River. The bed of the Jordan River is considered "sovereign land." The Utah State Legislature defines *sovereign land* as "those lands lying below the ordinary high water mark [OHWM] of navigable bodies of water at the date of statehood and owned by the state by virtue of its sovereignty" (Utah Code 65A-1-1). As noted in this definition, the state's ownership extends to the OHWM. To date, the OHWM has not been

mapped continuously along the Jordan River. As part of the leasing process, a case-by-case investigation of the OHWM is required. Similarly, variation between the current OHWM and the OHWM at statehood must be determined on a case-by-case basis. In natural riverine systems, the OHWM is recognized as a physical demarcation on the bank of a river that corresponds to the transition between the active floodplain and a low terrace (Figure 1.2). In highly managed or channelized systems that do not experience the range and regularity of flood events and that lack an obvious floodplain, the OHWM may correspond simply to the top of the bank.

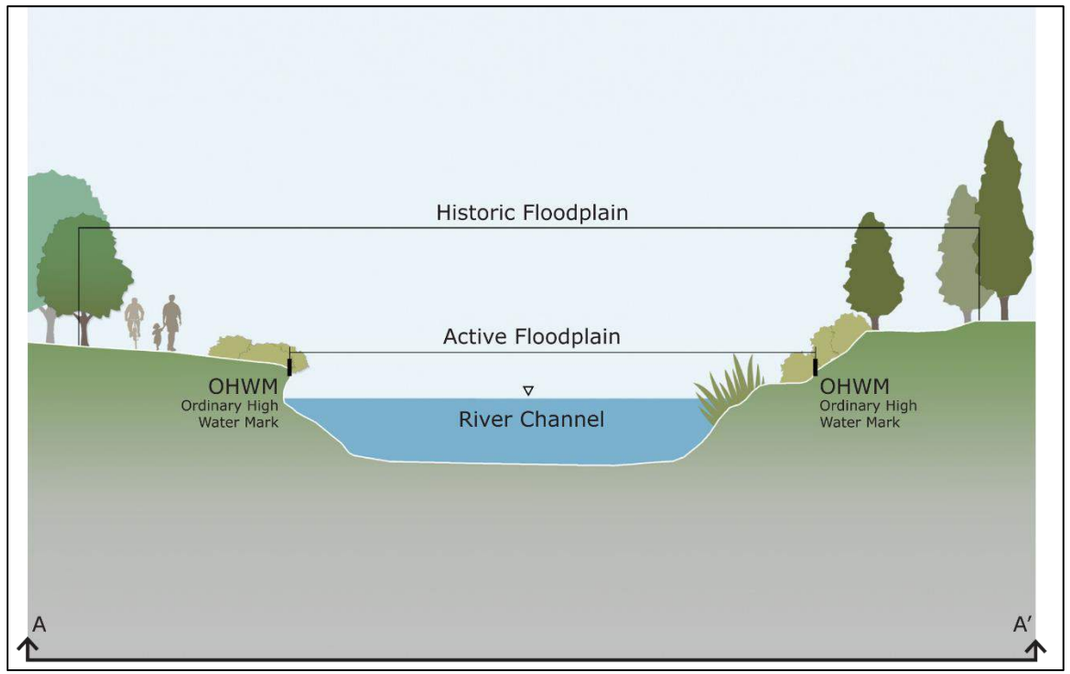


Figure 1.2. Jordan River cross section showing an ordinary high water mark.

Jordan River Management

The Utah State Legislature has designated FFSL as the executive authority for the management of sovereign lands in Utah, including the Jordan River. FFSL generally manages the Jordan River from the top of the riverbank to the top of the opposite riverbank.

Jordan River Sovereign Land Boundaries

The boundary of a sovereign river is intrinsically more difficult to define than that of a sovereign lake. This difficulty arises because rivers are more susceptible to movement and shifts in location over time. A thorough examination of the laws of water boundaries, particularly as it pertains to rivers, is complex and beyond the scope of this management plan. However, there are a few basic concepts that are important to understand in the management of rivers as sovereign lands.

Most rivers naturally meander over time unless human-made or natural barriers exist to prevent such movement. As the course of the river changes over time, natural and artificial processes of erosion, reliction, avulsion, and accretion may affect landownership. Generally, the gradual processes of accretion, reliction, and erosion change the property boundaries between private and public ownership. An adjacent upland landowner may obtain title to any dry land added by accretion or reliction, and/or may lose title to dry land eroded and now covered by water.

For the purposes of sovereign land management, state ownership of the riverbed generally follows the movement of the river over time as it naturally meanders through erosion, reliction, and accretion processes. However, landownership remains fixed by sudden avulsive events. Avulsive events can result from natural occurrences such as flash floods or from human-made causes such as channel straightening or artificial channel relocation. In such cases, because of ownership and boundary concerns, FFSL may be interested in exchanging or acquiring riverbed land.

Currently, FFSL is not planning to initiate a boundary settlement process for the Jordan River similar to those processes currently underway at Utah Lake and Bear Lake. FFSL has settled

boundaries with some adjacent upland landowners on a case-by-case basis and plans to continue with this approach as boundary issues along the Jordan River may arise.

The Public Trust over Sovereign Lands

The State of Utah recognizes and declares that the bed and banks of navigable waters within the state are owned by the state and are among the basic resources of the state, and that there exists, and has existed since statehood, a Public Trust over and upon these waters. The Jordan River is included in this category of navigable waters and is therefore managed by FFSL for public benefit consistent with the Public Trust doctrine.

Multiple-Use Approach

In keeping with the Public Trust doctrine, the State of Utah also recognizes that protection of **navigation**, **fish and wildlife habitat**, **aquatic beauty**, **public recreation**, and **water quality** is given due consideration and balanced against the need for, justification of, or benefit from any proposed use. Additionally, FFSL is required to manage the Jordan River consistent with multiple-use principles.

1.3 Current Department of Natural Resources Management Responsibilities

Utah Division of Forestry, Fire & State Lands

The State of Utah claims fee title ownership of the bed of the Jordan River. FFSL has direct management jurisdiction from top of bank to top of bank of the river (Figure 1.3) and manages the river under the Public Trust doctrine for the use and enjoyment by the public. To ensure effective implementation of Utah's multiple-use approach, FFSL strives to assure public access to navigable waters for commerce, navigation, fishing, swimming, and recreational boating, while also working to preserve these lands in their natural state. The Jordan River, an important resource in its own right, connects Utah Lake with Great Salt Lake, two waterbodies also considered state sovereign lands. Holistic management of these three waterbodies is recommended.

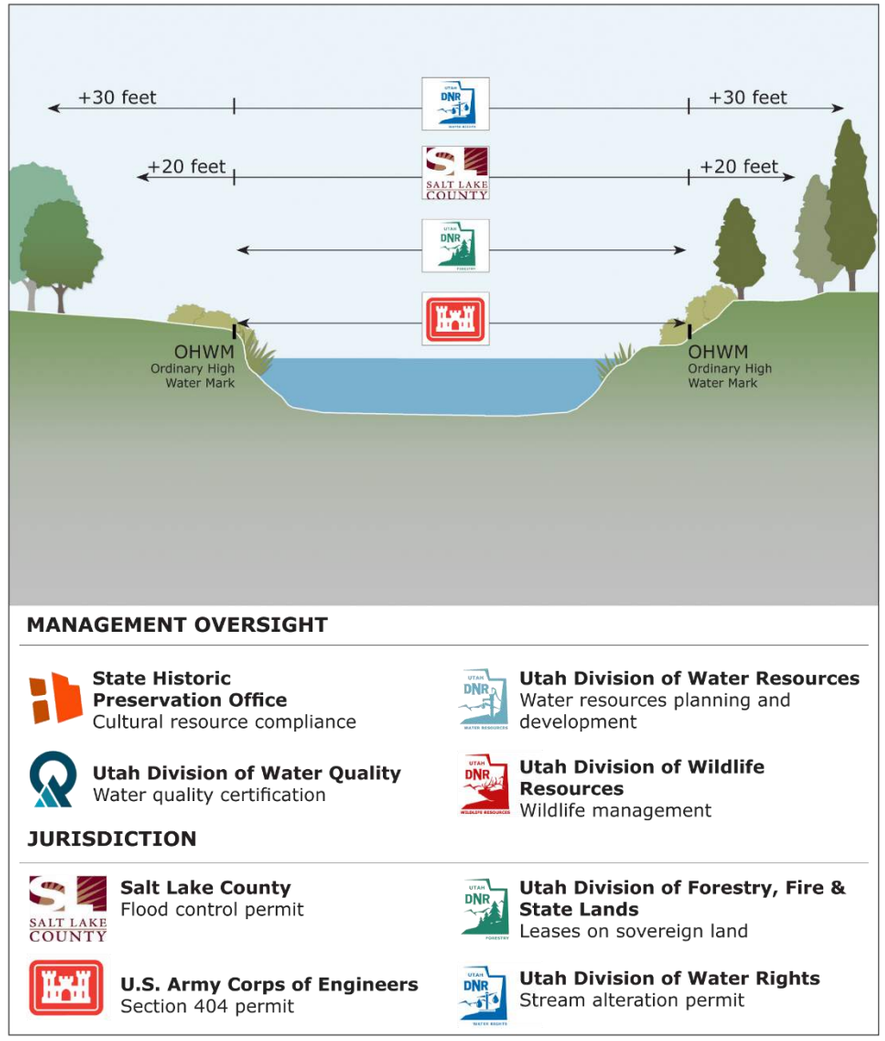


Figure 1.3. Jordan River cross section showing agency management jurisdiction for the river.

Utah Division of Wildlife Resources

Title 23 of the Utah Code establishes the Utah Division of Wildlife Resources (DWR) and the Wildlife Board and sets forth their duties and powers. Utah Code 23-14-1 states that "The Division of Wildlife Resources [DWR] is the wildlife authority for Utah and is vested with the functions, powers, duties, rights and responsibilities provided in this title and other law." The section goes on to state that "Subject to the broad policy making authority of the Wildlife Board, the Division of Wildlife Resources [DWR] shall protect, propagate, manage, conserve and distribute protected wildlife throughout the state."

Utah Division of State Parks and Recreation

Title 79-4 of the Utah Code establishes the Utah Division of State Parks and Recreation (DSPR) and the Board of Parks and Recreation and sets forth their responsibilities. Under Utah 79-4-802, the DSPR has the discretion to give grants to local governments and state agencies for riverway enhancement projects with funds appropriated by the Utah State Legislature for that purpose. Grants for riverway enhancement projects must be for rivers or stream that are impacted by high-density populations or are prone to flooding, and these grants must include a plan to provide employment opportunities for youth, including at-risk youth.

Utah Division of Water Rights

The Utah Division of Water Rights (DWRi) regulates the appropriation and distribution of water in the state of Utah, pursuant to Title 73 of the Utah Code. The State Engineer, who is the director of DWRi, gives approval for the diversion and use of any water, regulates the alteration of natural streams such as the Jordan River, and has the authority to regulate dams to protect public safety. All projects within twice the width of the Jordan River up to 30 feet are regulated by DWRi under the Stream Alteration Program. DWRi has authority to regulate dam safety and inspects the Utah Lake outlet dam.

Utah Division of Water Resources

The mission of the Utah Division of Water Resources (DWRe) and the Board of Water Resources is to direct the orderly and timely planning, conservation, development, protection, and preservation of Utah's water resources used to meet the beneficial needs of Utah citizens. DWRe conducts studies, investigations, and planning for water use within the Jordan River watershed.

1.4 Other State and Local Entities

Utah Division of Water Quality

The Utah Water Quality Board and the UDEQ Division of Water Quality (DWQ) are responsible for maintaining, protecting, and enhancing the quality of Utah's surface and groundwater resources. Title 19, Chapter 5 of the Utah Code charges the board and division to develop programs for the prevention and abatement of water pollution. The board is also responsible for establishing water quality standards throughout the state; enforcing technology-based, secondary treatment effluent standards, or establishing and enforcing other more stringent discharge standards to meet instream standards; reviewing plans, specifications, and other data relative to wastewater disposal systems; and establishing and conducting a continuing planning process for control of water pollution. DWQ is in the process of completing a total maximum daily load (TMDL) report for the Jordan River. DWQ also administers the Water Quality Certification Program under Section 401 of the Clean Water Act (CWA) and the Nonpoint Source Management Program under Section 319 of the CWA.

Utah Department of Transportation

The Utah Department of Transportation (UDOT) adheres to state and federal environmental laws and regulations when designing and implementing transportation projects such as bridges that cross the Jordan River. Although there are no specific guidelines or regulations associate with the Jordan River, UDOT recognizes the importance of maintaining environmental quality for citizens of Utah and implements measures to minimize harm to the environment.

Utah State Historic Preservation Office

The State Historic Preservation Office (SHPO) within the Utah Division of State History (UDSH) provides comment and guidance to agencies needing to comply with cultural resource compliance actions. For state agencies, Utah Code 9-8-404 requires those agencies to take into account their actions on historic properties and provide the Utah SHPO an opportunity to comment on those actions. Section 106 of the National Historic Preservation Act (codified in 36 Code of Federal Regulations [CFR] 800) applies similarly in cases where there is a federal undertaking (money, land, permitting, etc.), but that federal agency is required to consult with SHPO. Generally, for both state and federal actions, a historic property is something over 50 years old, retains integrity, and is eligible for, or listed on, the National Register of Historic Places (NRHP). The Utah SHPO does not have regulatory authority over state or federal projects, but instead offers advice and comment on a proposed undertaking to hopefully avoid or minimize effects to a historic property. Under federal statute, the Utah SHPO is the central clearinghouse for historical and archaeological information for Utah, including federal, state, and private lands. Architectural information is available freely to the public; however, archaeological site information is protected by federal law (Archaeological Resources Protection Act) and state law (Government Records Access and Management Act), whereby only approved archaeologists can view the sensitive information. Outside the formal compliance process, the Utah SHPO can provide advice on how to manage historic properties and can offer potential funding opportunities in certain cases.

Jordan River Commission

The Jordan River Commission (JRC) was created by an Interlocal Cooperation Agreement in August 2010 to facilitate regional implementation of the *Blueprint Jordan River* (Envision Utah 2008); serve as a technical resource to local communities; and provide a forum for coordination of planning, restoration, and responsible development along the Jordan River corridor. The commission is a governmental entity that operates much like a non-profit. It is not an advocacy organization, nor does it hold regulatory or maintenance authority of the Jordan River.

Local Government

Cities and counties with property abutting the Jordan River have important management responsibilities, are river stakeholders, and are partners with FFSL in ongoing and future projects. Local government performs functions related to public safety, education, recreation, and weed management among other initiatives. Salt Lake County government in particular provides flood control and floodplain management services through its jurisdiction.

1.5 Federal Agencies

U.S. Army Corps of Engineers

Under Section 404 of the CWA, the U.S. Army Corps of Engineers (USACE) is responsible for regulating placement of fill material and excavation in the nation's waters, including the Jordan River. USACE's management responsibilities under the CWA are to protect the nation's aquatic resources from unnecessary adverse impacts.

U.S. Fish and Wildlife Service

The U.S. Fish and Wildlife Service (USFWS) is responsible for protecting migratory birds, complying with the Bald and Golden Eagle Protection Act, as well as protecting threatened and endangered species found in and near the Jordan River.

National Park Service

Although no National Park Service (NPS) land exists adjacent to the Jordan River, NPS contributes funding to projects along the Jordan River through the Rivers, Trails, and Conservation Assistance Program.

U.S. Environmental Protection Agency

The U.S. Environmental Protection Agency (EPA) jointly administers the CWA Section 404 permit program with USACE. EPA also has direct regulatory responsibilities for the Superfund Program under the Comprehensive Environmental Response, Compensation, and Liability Act and provides oversight on all delegated CWA programs.

Federal Emergency Management Agency

The Federal Emergency Management Agency (FEMA) administers the National Flood Insurance Program (NFIP), which is fundamental to reducing flood loses. In the case of this program, *floodplain management* is defined to include all actions that states and communities can take to minimize damage to new and existing buildings and infrastructure. As is the case with the Jordan River, communities incorporate NFIP requirements into their zoning codes, subdivision ordinances, and/or building codes or adopt special-purpose floodplain management ordinances. The NFIP requirements apply to areas mapped as the 100-year flood on Flood Insurance Rate Maps issued by FEMA. Local officials, e.g., Salt Lake County, are responsible for administering and enforcing local floodplain management regulations within their jurisdiction.

1.6 County and Municipal Zoning

FFSL is responsible for managing sovereign lands. In the case of the Jordan River, this management extends to the OHWM. The Jordan River is an urban waterway bordering 15 municipalities and three counties. Each municipality and county entity along the Jordan River has the authority to authorize land uses up to the OHWM. However, the biological and physical systems of the Jordan River do not observe physical property boundaries. Management decisions made by FFSL regarding the river will affect and are affected by the land uses and associated activities on adjacent lands. As population growth and urban infrastructure expansion continue along the Wasatch Front, a range of land uses will continue to occur and change. Development in and around the Jordan River will continue to place increasing pressures on the river corridor. The priority for FFSL's management of the riverbed is to continue protecting and sustaining the Public Trust resources of the Jordan River while recognizing that local governments need to provide services to their constituents, including transportation, utilities, and other infrastructure that may have an impact on the natural environment. As such, it is important to understand the types of land uses and projects authorized by each entity's general plan and zoning ordinance. Given the impact on developments within floodplains, coordination regarding riparian overlays and development patterns is an ongoing discussion for the wellbeing of adjacent residents and for the river.

The JRCMP is considered within the context of other guiding and regulatory tools for the surrounding environment and local situations. The plan recognizes FFSL's commitment to maintaining environmental quality for citizens of Utah and specifically minimizing impacts to the environment used by current and future generations. The JRCMP and FFSL have no authority over regulations on any land along the river. The information provided here is intended to summarize the current and planned conditions and how they inform the JRCMP, and to summarize decisions made by FFSL for the Jordan River.

The counties and municipalities use their own land use zoning designations to indicate the allowed uses for properties adjacent to the Jordan River. In addition to the current zoning maps and ordinances, future land use maps and general plans portray expected and anticipated uses, which may differ from the current zoning and/or existing land uses in place. A summary of the current zoning for land uses within each county is provided in the following sections.

Utah County

Utah County contains approximately 8 miles of the Jordan River corridor. Of this, 100% is within the municipal jurisdictions of Saratoga Springs and Lehi. Utah County owns land along the corridor but is not the regulating entity.

Saratoga Springs currently has seven different zones along the river corridor. Three are residential (Low [R-3], Medium [R-10], and High Density [R-14]) and four are Agricultural (A), Mixed Use (MU), Planned Community (PC), and Regional Commercial (RC) (Saratoga Springs 2012).

Lehi City has a range of uses and zones along the river corridor. Six zones cover the corridor: Agricultural (A-1 and A-5), Residential Agriculture (RA-1), Residential (R-1-15), Resort Community (RC), and Transitional Holding (TH-5). The RC zone covers the Thanksgiving Point area, whereas the TH-5 zone is primarily used for annexation areas where no water is dedicated or planned to be provided by the city. Properties annexed into Lehi City within the TH zone are anticipated to comply with the general plan designation (Lehi City 2013, 2014).

Lehi's general plan land use map indicates Very Low Density Residential, Resort Community, Business Park, and Public Facilities as uses along the corridor, which correspond with the current zoning. Additionally, much of the river corridor and adjacent wetlands are given the designation of Environmentally Sensitive Areas. Lehi is considering adopting a riparian corridor overlay zone, which would regulate development along the river (Lehi City 2013).

Salt Lake County

Salt Lake County contains approximately 34 miles of the river corridor. Land use planning and zoning along the river are under the control of 13 different governmental entities: Salt Lake County and 12 municipalities. A range of land uses and zoning occurs adjacent to the river, with over 95% under municipal authority.

Salt Lake County oversees the land use of only a few small portions of the river, within Millcreek Township near 3900 South, and on the north end of the river on the west bank. The north end is zoned agricultural, whereas the area near 3900 South is a mix of agricultural and residential.

Municipalities with jurisdiction over adjacent land uses are as follows:

- Salt Lake City
- South Salt Lake City
- West Valley City
- Taylorsville City
- Murray City
- Midvale City
- West Jordan City
- Sandy City
- South Jordan City
- Draper City
- Riverton City
- Bluffdale City

In 2013, the Salt Lake County Surveyor's Office collaborated with the JRC to produce a comprehensive compilation of the different municipal and county zoning designations along the entire length of the river within county boundaries (Salt Lake County 2013). An aggregated zoning nomenclature was crafted, with nine general zoning categories, listed below. All are present along the length of the river within Salt Lake County, with residential uses dominating.

- Commercial
- Residential
- Mixed Use
- Agriculture
- Open Space
- Industrial
- Institutional
- Public Facilities
- Public Lands

An interactive map of the zoning is available through Salt Lake County's online mapping portal (Salt Lake County 2013). Additionally, the zoning can be viewed in the Jordan River development map book, a compilation of 47 maps classifying the zoning of parcels to an approximately 1/4-mile extent to either side of the Jordan River (JRC 2013a).

Davis County

Depending on fluctuations of Great Salt Lake, between 9 and 12 miles of the Jordan River are within the boundaries of Davis County, where the mouth of the river flows into Great Salt Lake. Regulation of land uses is under the purview of Davis County and North Salt Lake City, on the east bank of the river only, with the exception of a small portion on the south edge of Davis County where it adjoins Salt Lake County. Within North Salt Lake, most of the land is zoned as Natural Open Space (NOS), with sections of Manufacturing-Distribution (MD) and General Commercial (CG) along the southern portion of the river within city boundaries (City of North Salt Lake; Davis County 2011).

The portions regulated by Davis County are primarily wetlands, with a section of the Legacy Nature Preserve abutting the Jordan River to the north of the North Salt Lake municipal boundary. County zoning is divided between Agriculture and Farm Industry (A-5) and General Manufacturing (M-1). The M-1 section is directly south of the Interstate 215 (I-215) interchange where the roadway meets up with the Legacy Parkway and then Interstate 15 (I-15) to the east.

The *Davis County Shorelands Comprehensive Land Use Master Plan* (Sear-Brown and Bio West 2001), one of the county's guiding documents, identifies four land use types along the Jordan River:

1. Managed Open Space (land primarily held in ownership by the Duck Club)
2. Nature Preserves (current Legacy Nature Preserve and agricultural land within North Salt Lake; mitigation for the construction of the Legacy Parkway highway)
3. Business Park
4. Preserved Open Space

1.7 Utah Division of Forestry, Fire & State Lands Lease Process

FFSL is the executive authority for the management of sovereign lands and is required to prescribe standards and conditions for the leasing and development of surface resources on sovereign lands. Leases issued by FFSL must be in compliance with the Public Trust doctrine and adhere to multiple-use, sustained yield principles. Each lease must also comply with this JRCMP. Figure 1.4 demonstrates FFSL lease processes (processes are subject to change depending on the proposed activity and permit).

Types of Leases

EASEMENTS

An easement (Utah Administrative Code R652-40) across the Jordan River may be issued by FFSL for bridges, above- and below-grade utility lines, or pipelines. Easement fees are based on determined rates, which may include linear rate or appraised value. Easements are granted for no more than a term of 30 years and are subject to a 20-day review by the state's Resource Development Coordinating Committee (RDCC).

GENERAL PERMITS

General permits are issued for public or private use of sovereign lands. Public use may include roads, bridges, recreation areas, dikes, or flood control structures. Private use may include boat docking or mooring facilities that are constructed adjacent to upland private property. General permits are issued for no more than 30 years and are subject to a 20-day review by the RDCC.

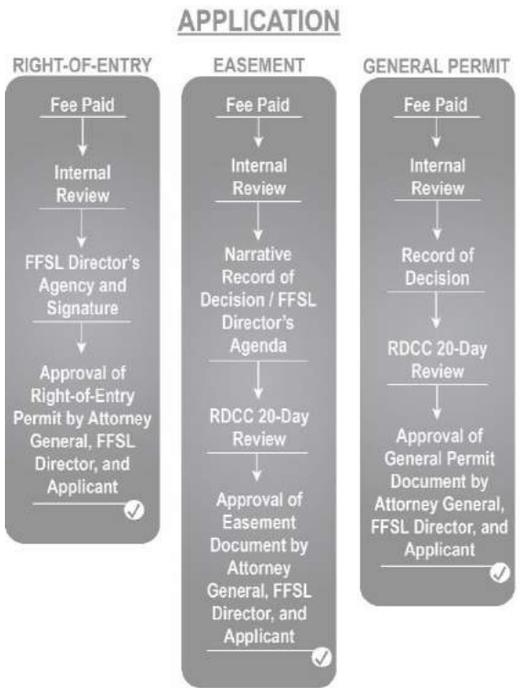


Figure 1.4. Lease process diagram for general permits.

RIGHTS-OF-ENTRY

A right-of-entry permit (Utah Administrative Code R652-41) allows non-exclusive, non-permanent, or occasional commercial or non-commercial use of sovereign lands for a short-term period of generally no more than 1 year. Right-of-entry permits are generally issued for filming, commercial recreation ventures, research, organized events, and non-commercial ventures lasting more than 15 days.

Application and Review Process

Figure 1.5. Application content checklist.

1.8 River Use Class System and Maps

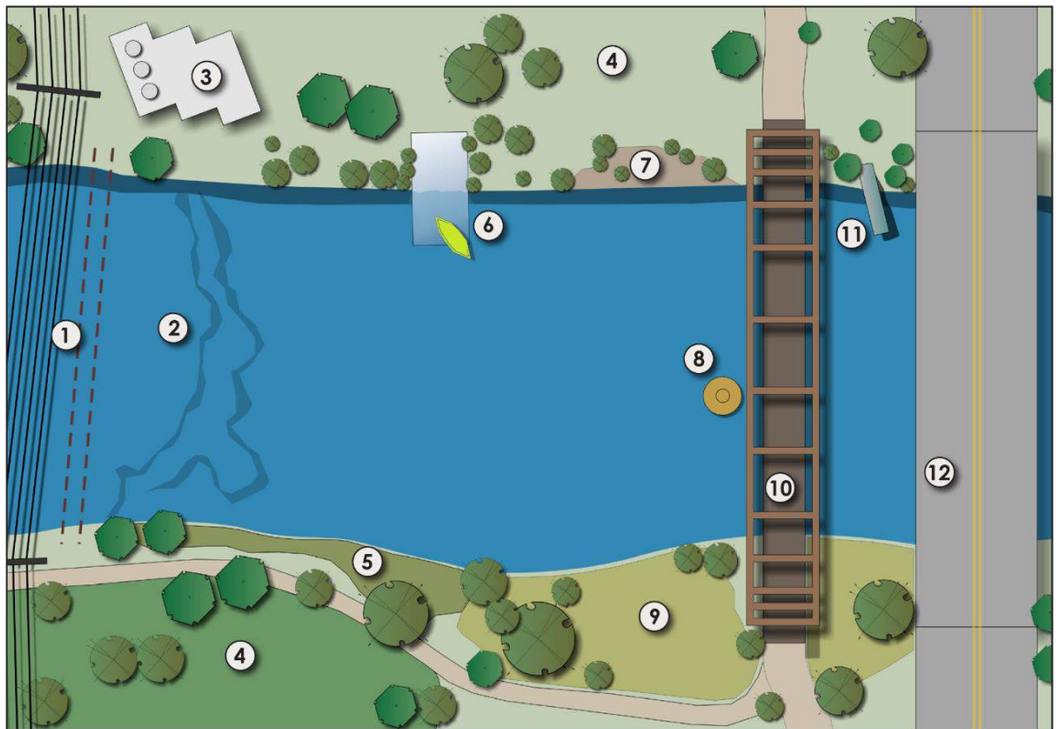
Sovereign lands are classified in Utah Administrative Code R652-70-200 based on their current and planned uses. Table 1.1 illustrates the five classes used to guide management and use on the Jordan River. River use classes are applied to specific locations along the Jordan River based on multiple parameters, including municipal and county zoning adjacent to the Jordan River, existing leases, environmental factors, and established deed restrictions or conservation easements. Table 1.1 also describes the specific parameters used to designate sovereign land use classes along the Jordan River. A numerical breakdown of river use classes by segment is found in Chapter 3.

Table 1.1. Classification of Sovereign Lands along the Jordan River

River Use Class	Description	Example along the Jordan River	Percentage Based on Acreage of each Class	Parameters
Class 1	Manage to protect existing resource use options.	Existing FFSL utility easement.	4%	Areas with existing lease. In some cases established, permanent structures without a current easement from FFLS.
Class 2	Manage to protect potential resource use options.	Areas adjacent to existing FFSL utility where clustering of future projects is beneficial.	16%	Buffer areas around existing lease with the goal of clustering future uses. Areas zone for development without a trail, landscaped parks, or golf course.
Class 3	Manage as open for consideration of any use provided that there is no net loss of wildlife habitat, navigation, and water quality by the project or compensated for with mitigation.	Reaches of the river adjacent to the Utah Off-High Vehicle training facility.	32%	Areas zoned agricultural. Areas zoned for development with a trail, landscaped park, or golf course.
Class 5	Manage to protect potential resource preservation options.	Rose Park Golf Course.	42%	Areas zoned open space. Environmental factors (e.g., scour, extensive 100-year floodplain, wetlands).
Class 6	Manage to protect existing resource preservation uses.	Legacy Nature Preserve.	6%	Local, county, state, or federal conservation protection. Restoration and mitigation sites. Parcels holding conservation easements.

Note: Class 4 (manage for resource inventory and analysis) is not applied to the Jordan River.

Examples of how specific uses and classes were assigned to a river system based on current and potential use are found on Figures 1.6 and 1.7, respectively. For example, permitted bridges and utilities (items 1 and 12 on Figure 1.6) are considered Class 1 reaches of the river because they are authorized as an existing use. Reaches between Class 1 areas, if it makes sense to concentrate future utilities and infrastructure, are reserved as Class 2 areas. Segments of the river not developed but that have potentially low impact uses (item 4 on Figure 1.6) that are not zoned specifically as open space are considered Class 3 areas. Finally, reaches of the river associated with zoned open space (item 5 on Figure 1.6) and afforded legal conservation protection (item 9 on Figure 1.6) are considered Class 5 and Class 6 areas, respectively.



Legend

1. Aboveground and Belowground Utilities
2. Navigational Hazard
3. Industrial Use
4. Municipal Park
5. Restoration/Open Space
6. Portage/Ramp/Dock/Launch
7. Erosion Mitigation
8. Water Quality Equipment
9. Mitigation/Protected Habitat
10. Historic Structure
11. Outfall
12. Road/Bridge

Figure 1.6. Jordan River plan view showing conceptual river use.

Legend

Class 1
Manage to protect existing resource use

Class 3
Open management but with conditions

Class 6
Manage to protect existing resource preservation

Class 2
Manage to protect potential resource use

Class 5
Manage to protect potential resource preservation

Figure 1.7. Jordan River plan view showing conceptual river use classes.

Where Table 1.1 illustrates the five river use classes, Figure 1.8—a mapbook of the Jordan River made up of 20 individual maps—shows the reader the specific locations of these five river use classes along the Jordan River along its entire stretch from Utah County to Davis County. Note: Some river use class locations, e.g., Class 1, can be difficult to see because of their width and the scale at which the mapbook is made. For the most accurate view of all river use class locations, please use the GIS spatial data viewer available on the FFSL website.

Further Reading

Blueprint Jordan River (Envision Utah 2008)

Best Practices for Riverfront Communities (JRC 2013b)

Esri Story Map Data Layers

River Classification; Zoning; Political Boundaries; Division of Forestry, Fire & State Lands easements; Division of Water Rights Stream Alteration permits

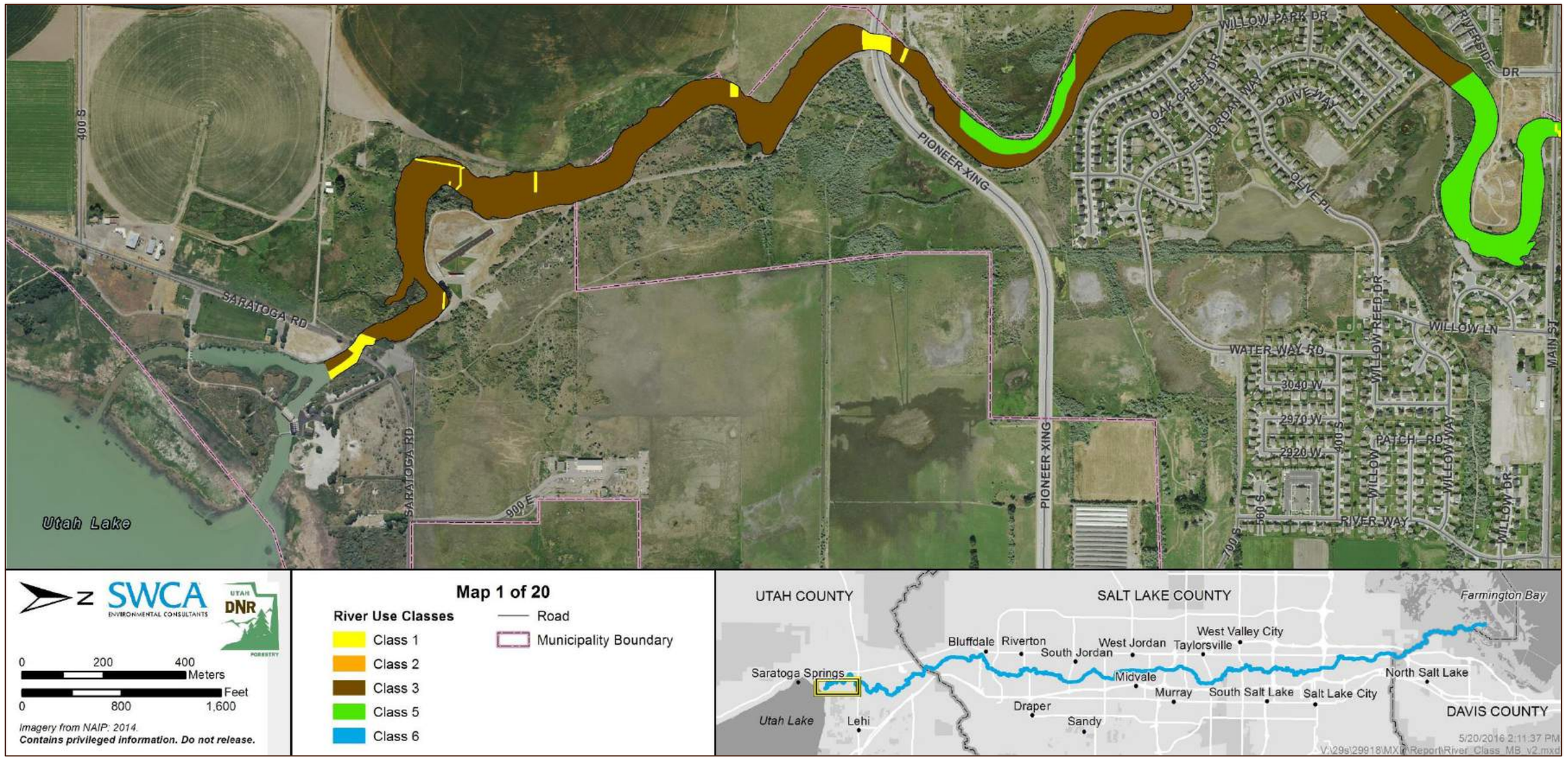


Figure 1.8. River use classes for the Jordan River, map 1.

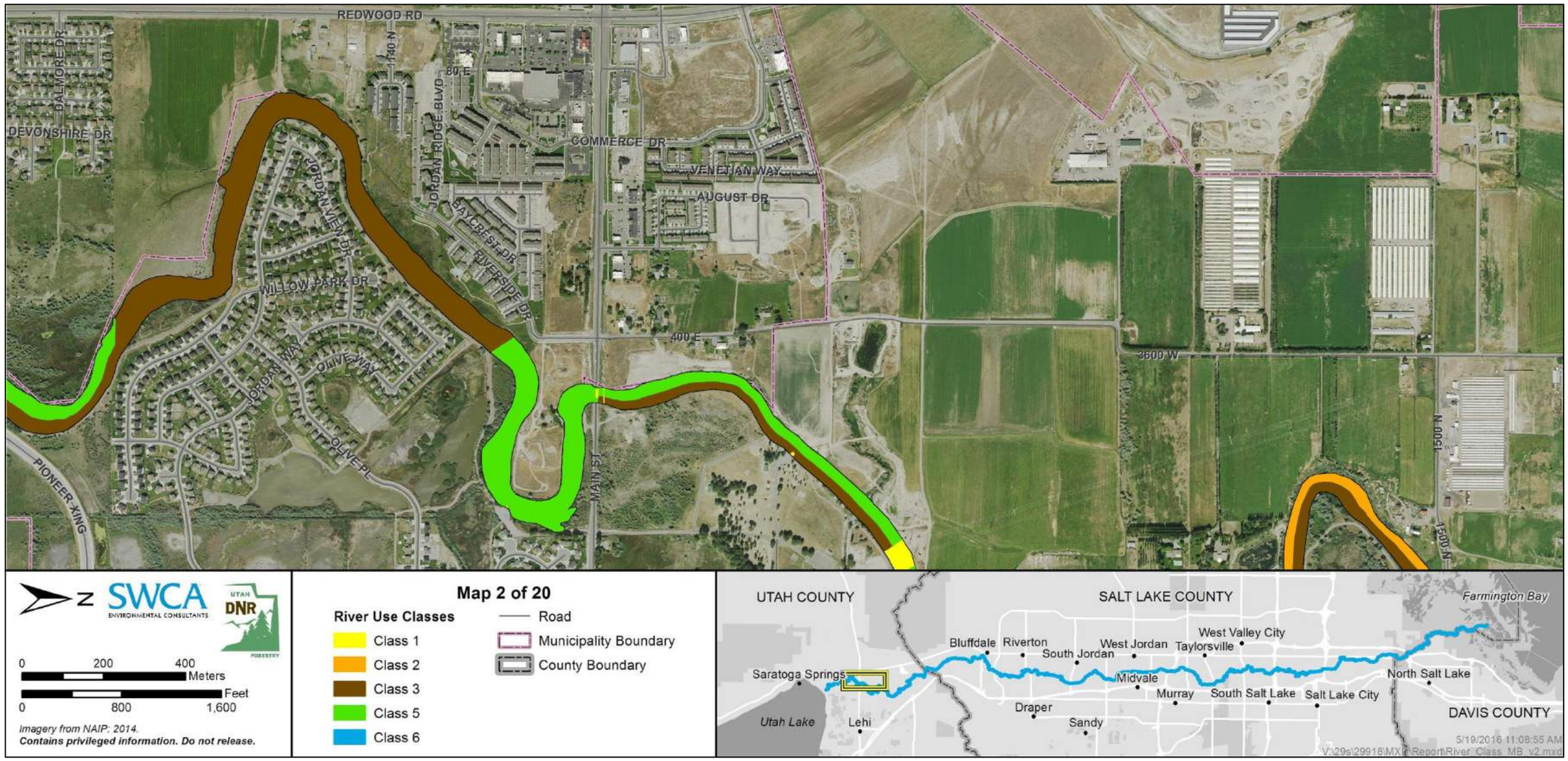


Figure 1.8. River use classes for the Jordan River, map 2.

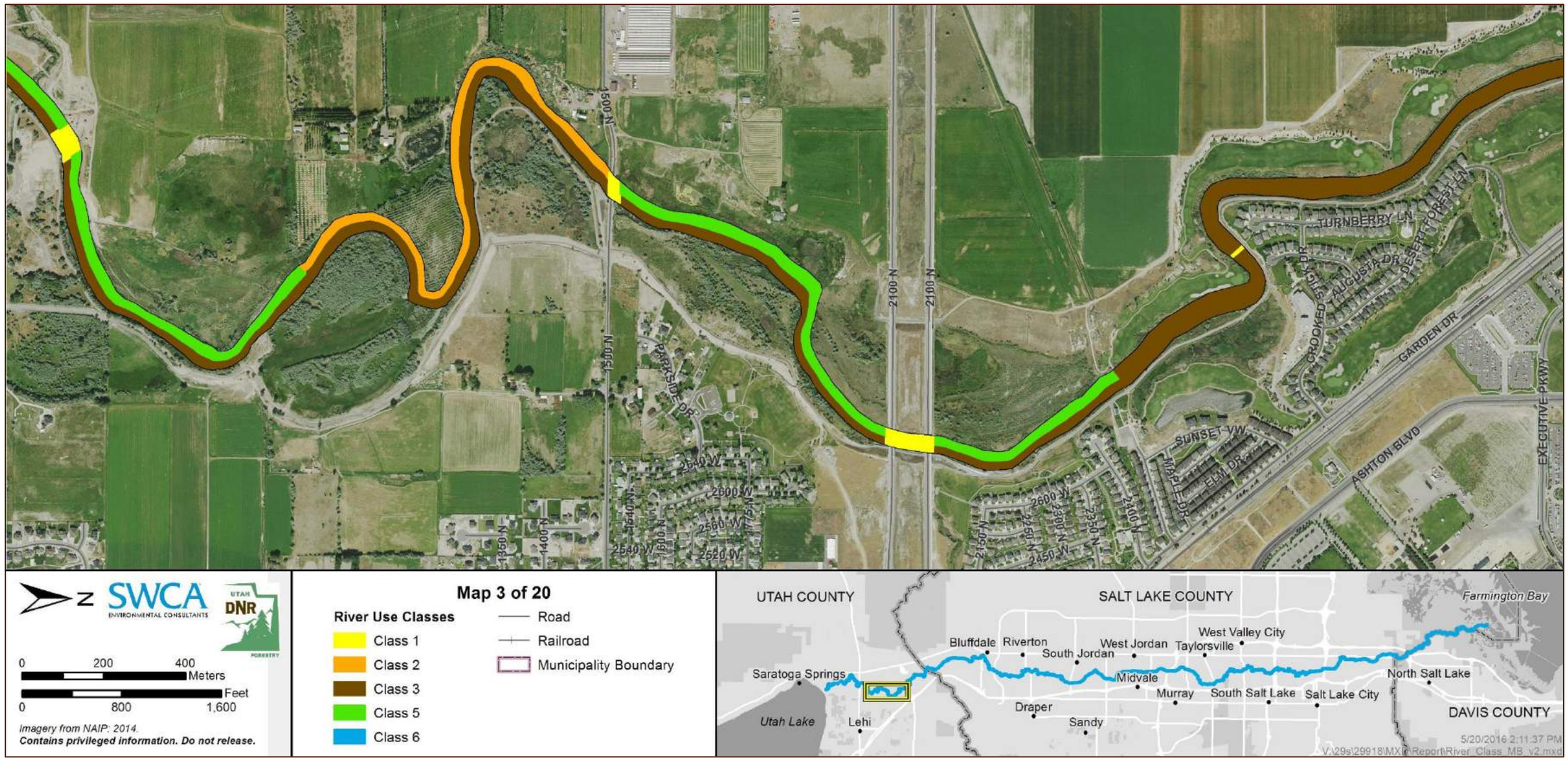


Figure 1.8. River use classes for the Jordan River, map 3.

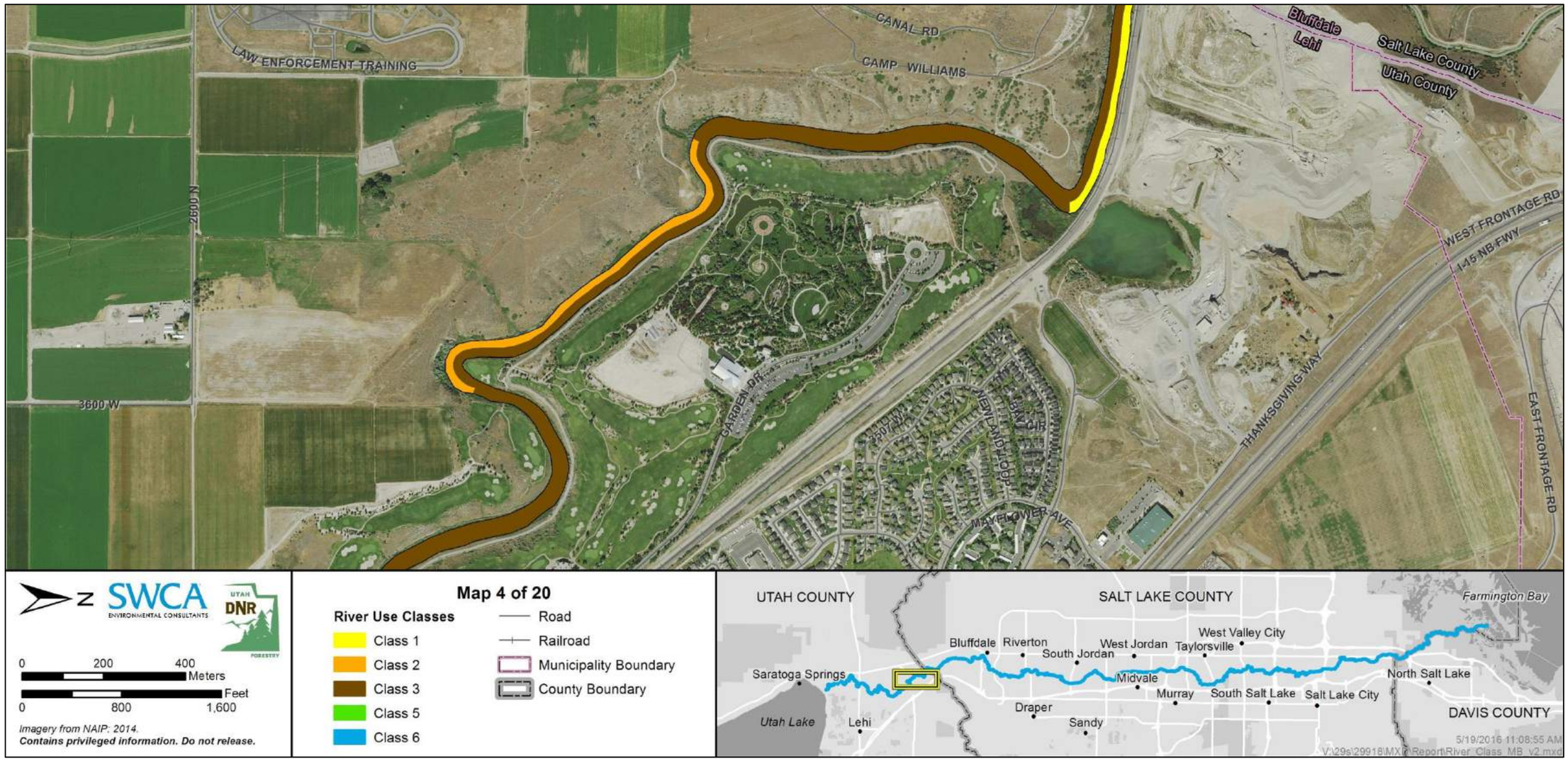


Figure 1.8. River use classes for the Jordan River, map 4.

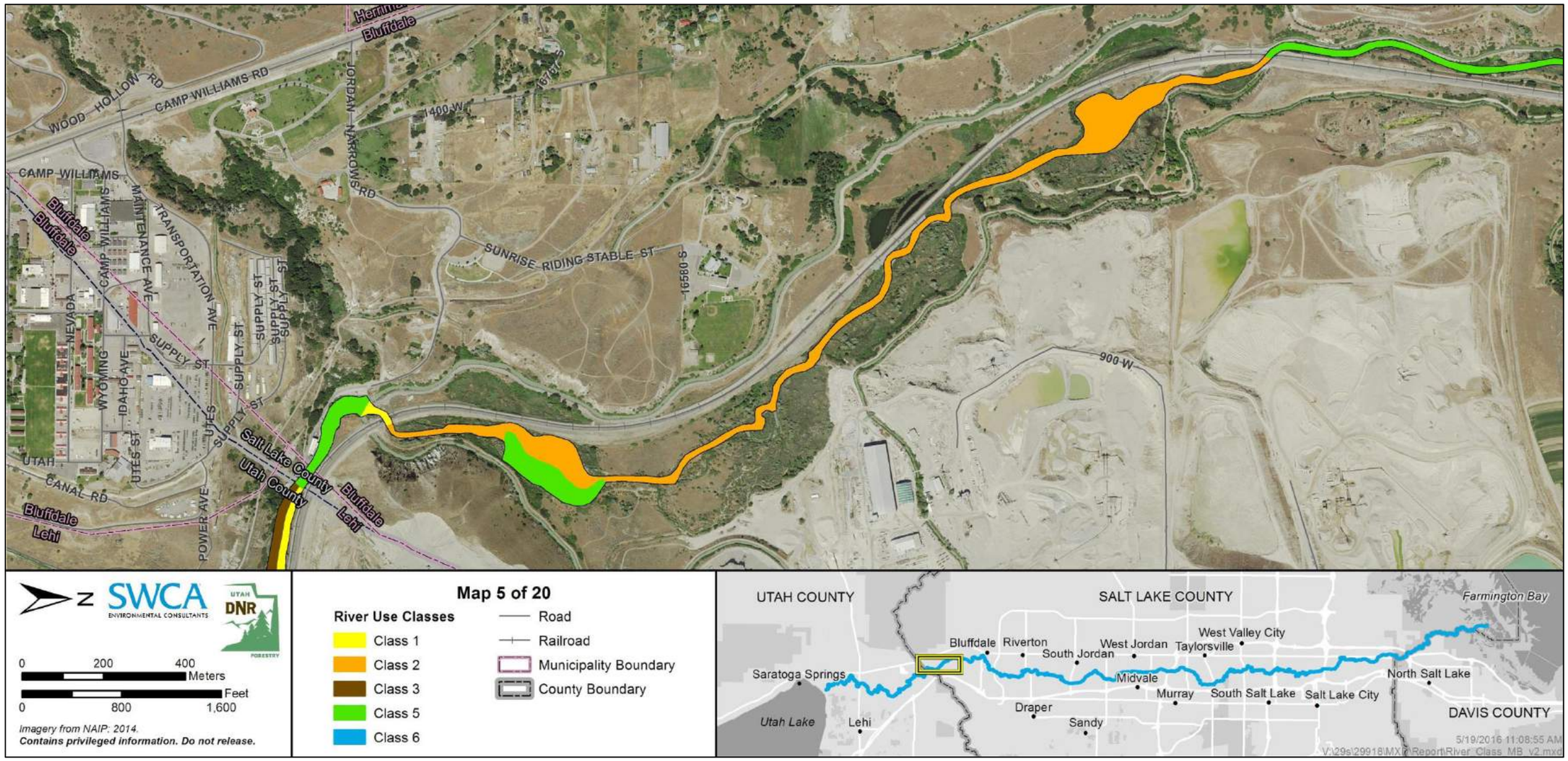


Figure 1.8. River use classes for the Jordan River, map 5.

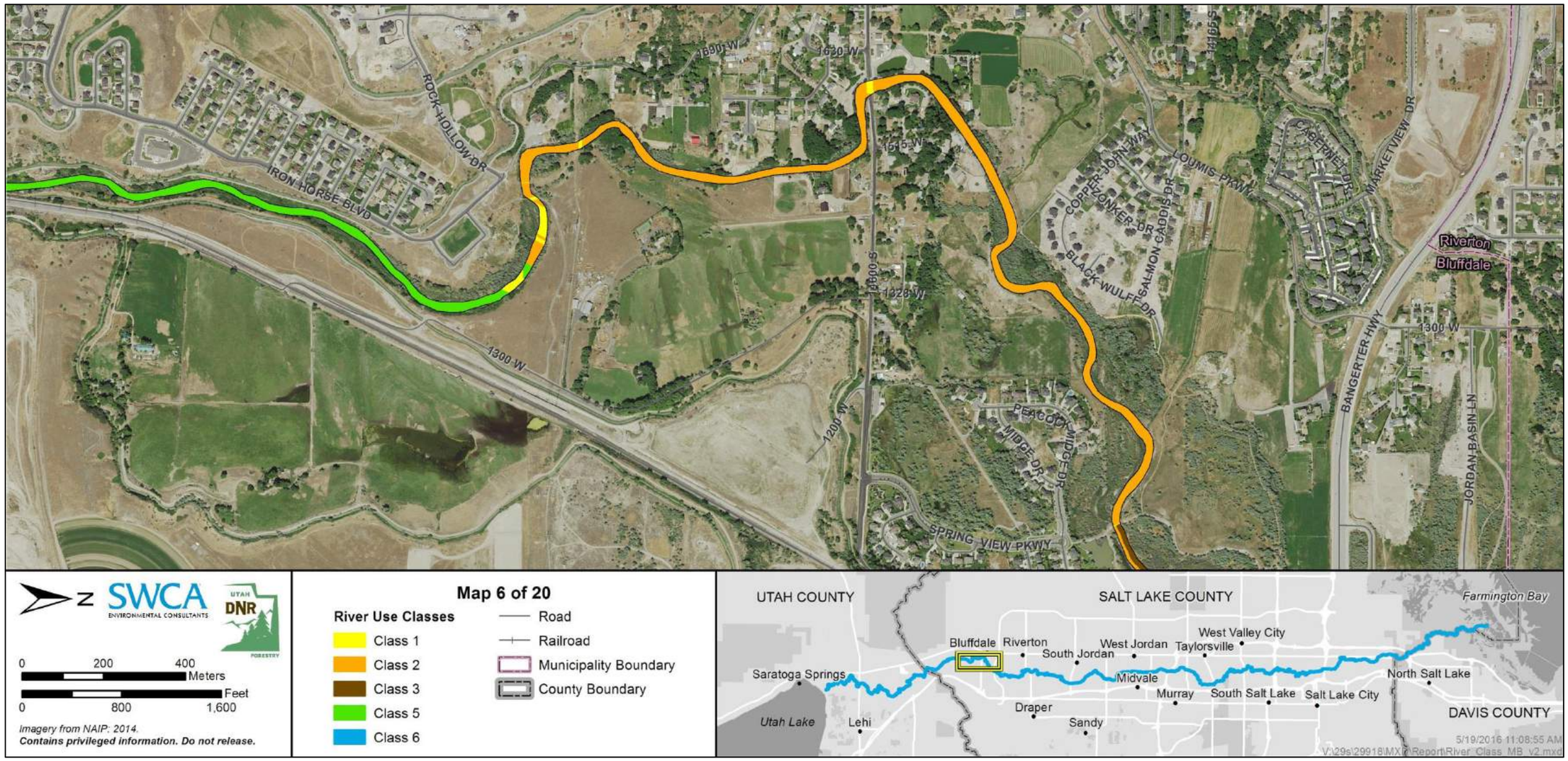


Figure 1.8. River use classes for the Jordan River, map 6.

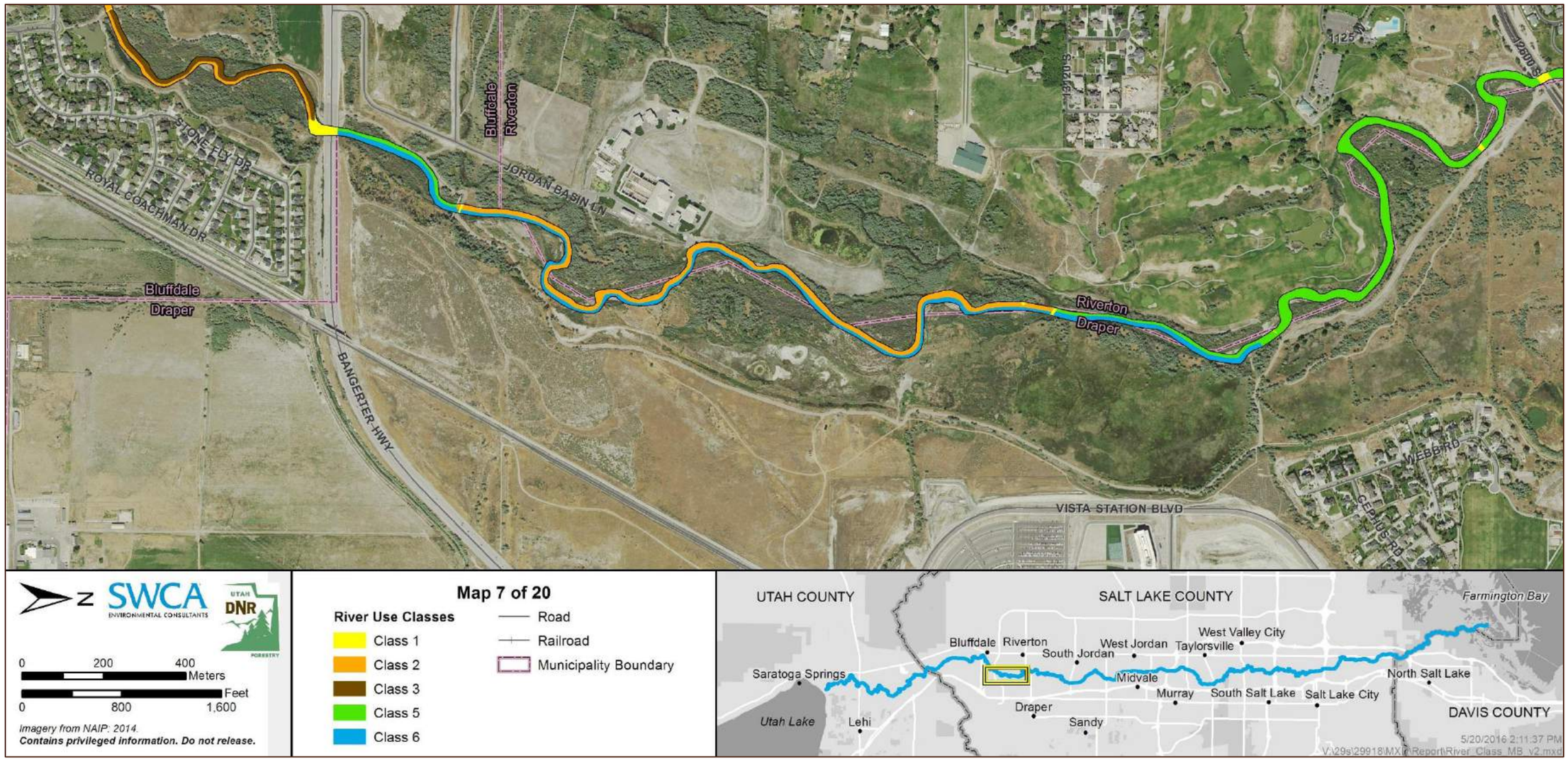


Figure 1.8. River use classes for the Jordan River, map 7.

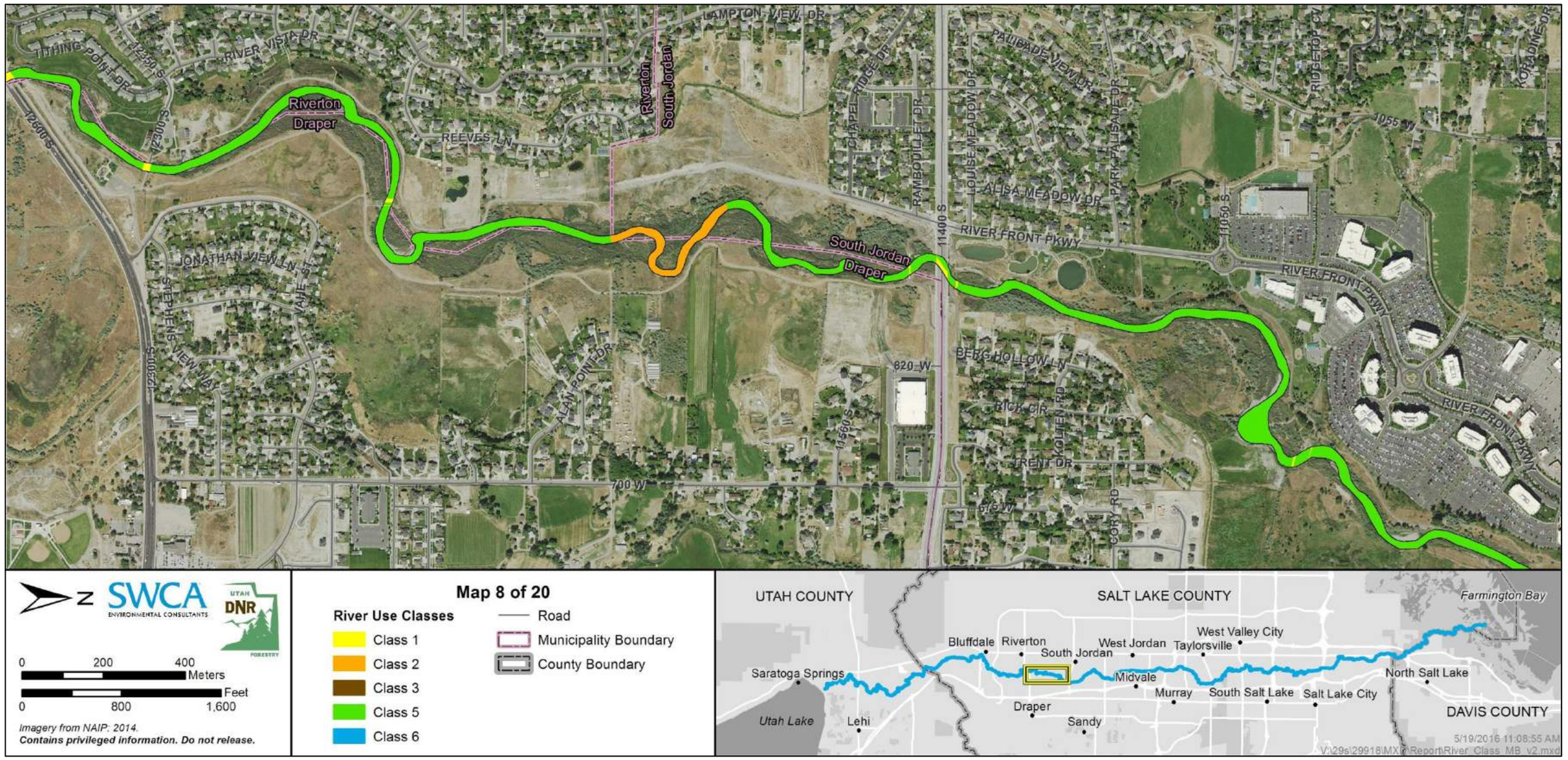


Figure 1.8. River use classes for the Jordan River, map 8.

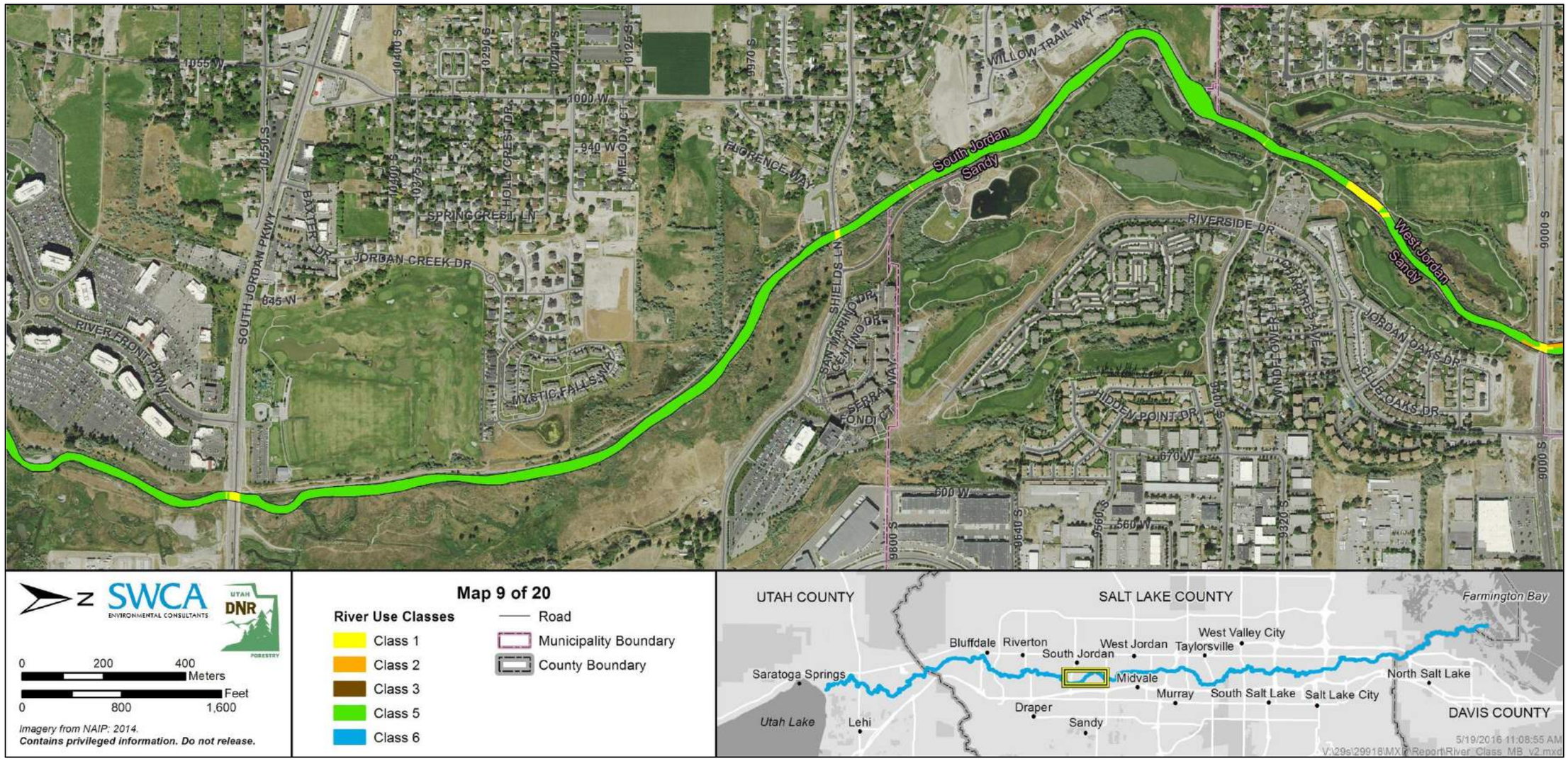


Figure 1.8. River use classes for the Jordan River, map 9.

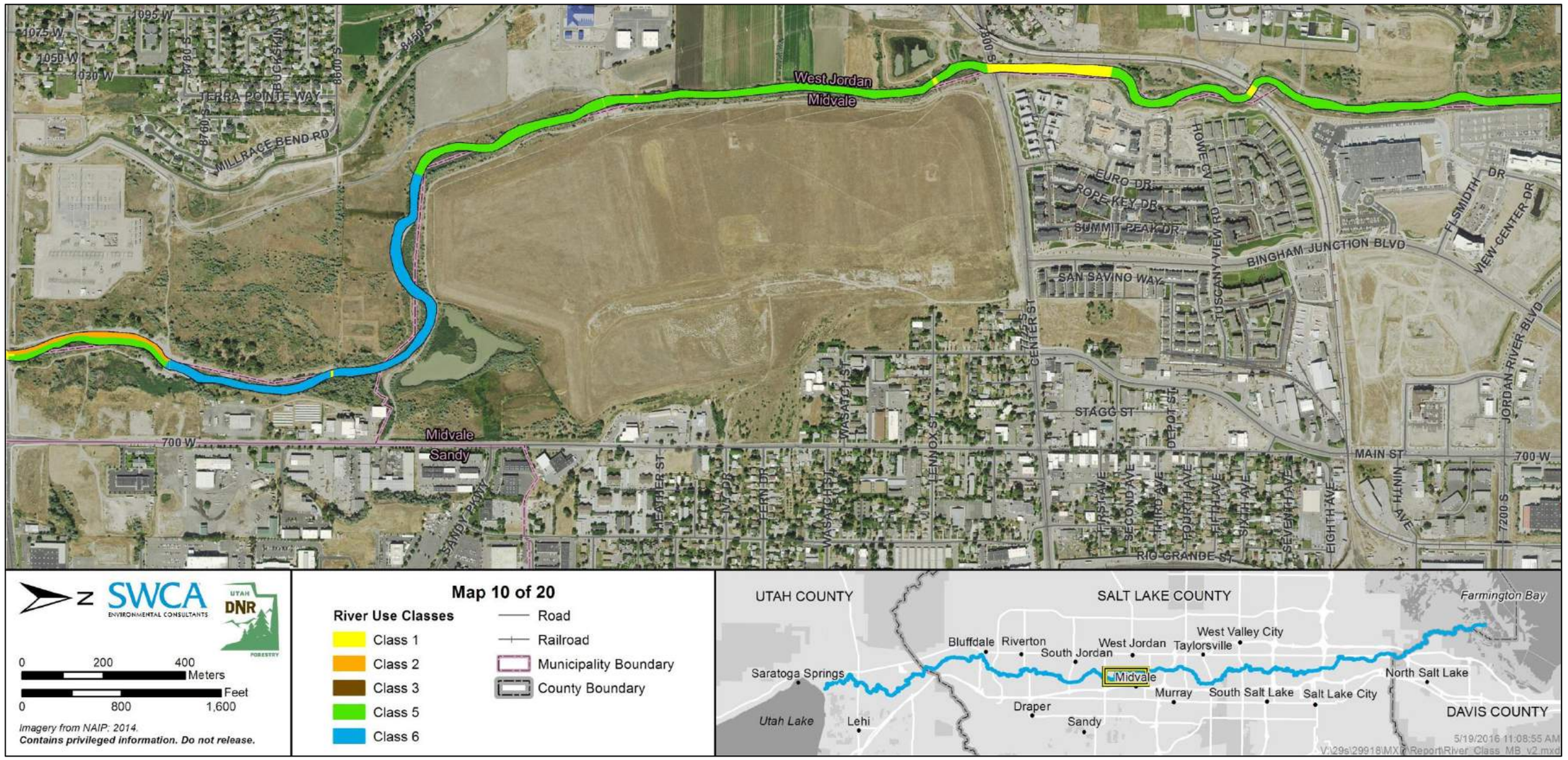


Figure 1.8. River use classes for the Jordan River, map 10.

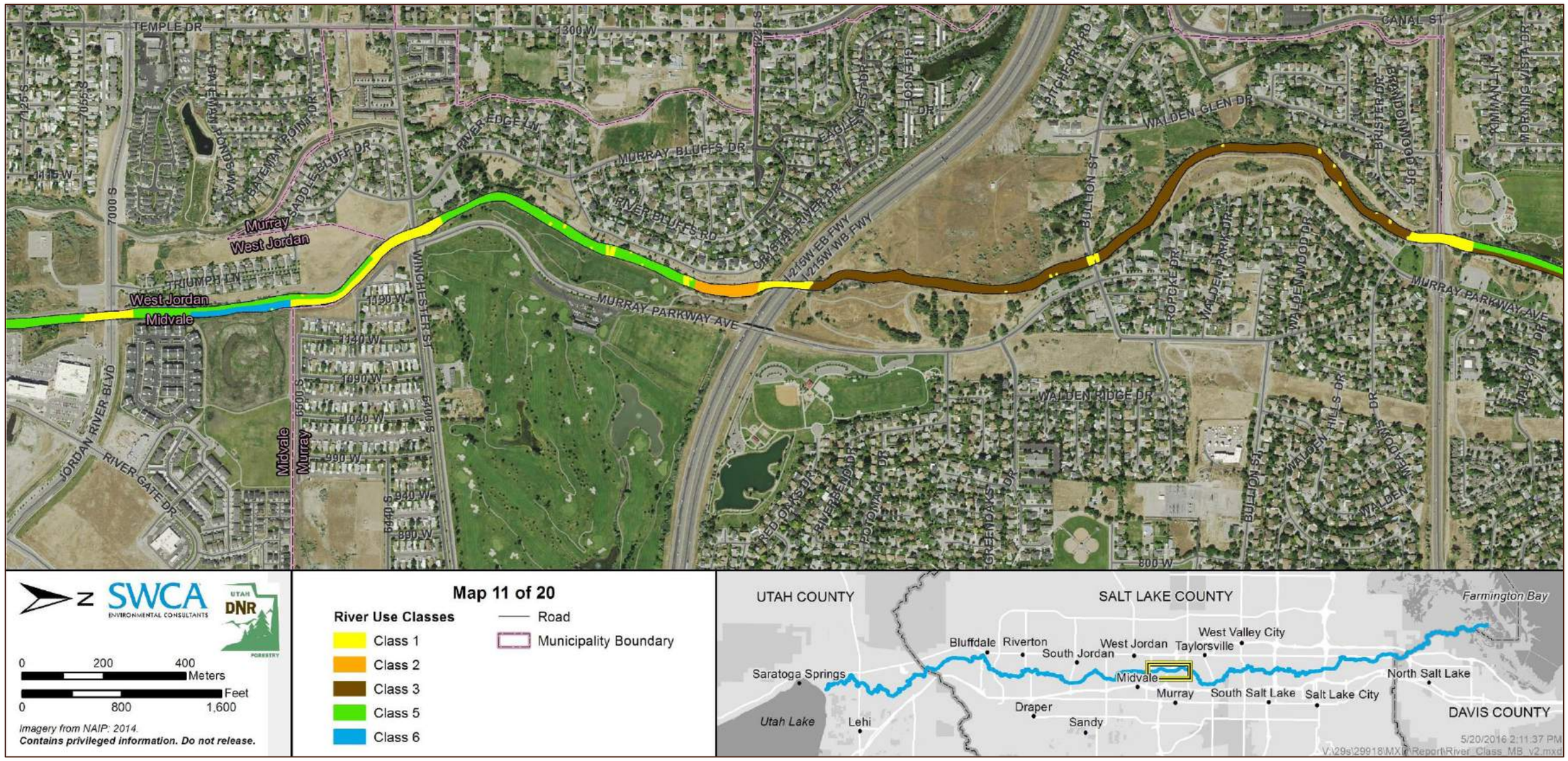


Figure 1.8. River use classes for the Jordan River, map 11.

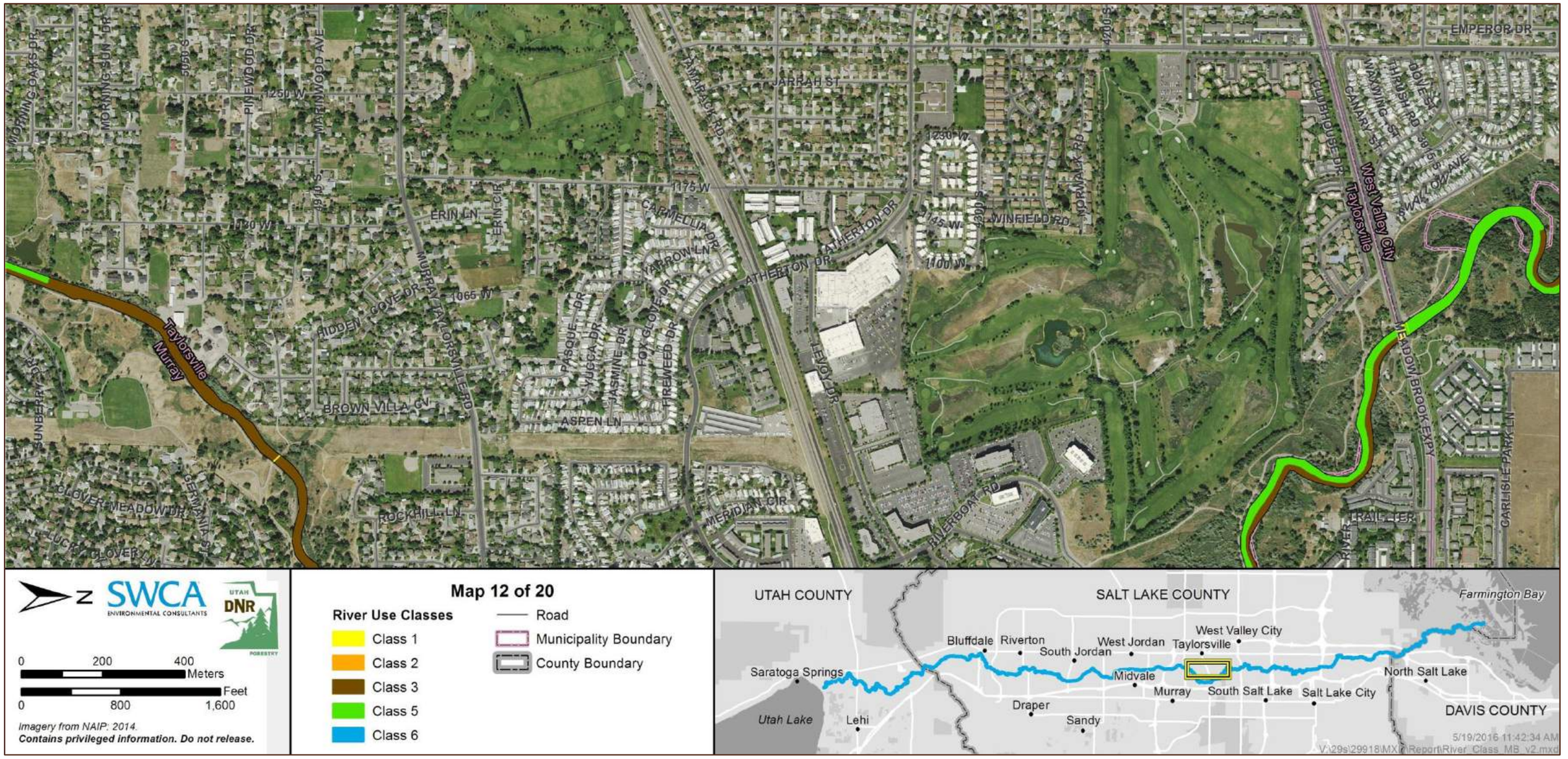


Figure 1.8. River use classes for the Jordan River, map 12.

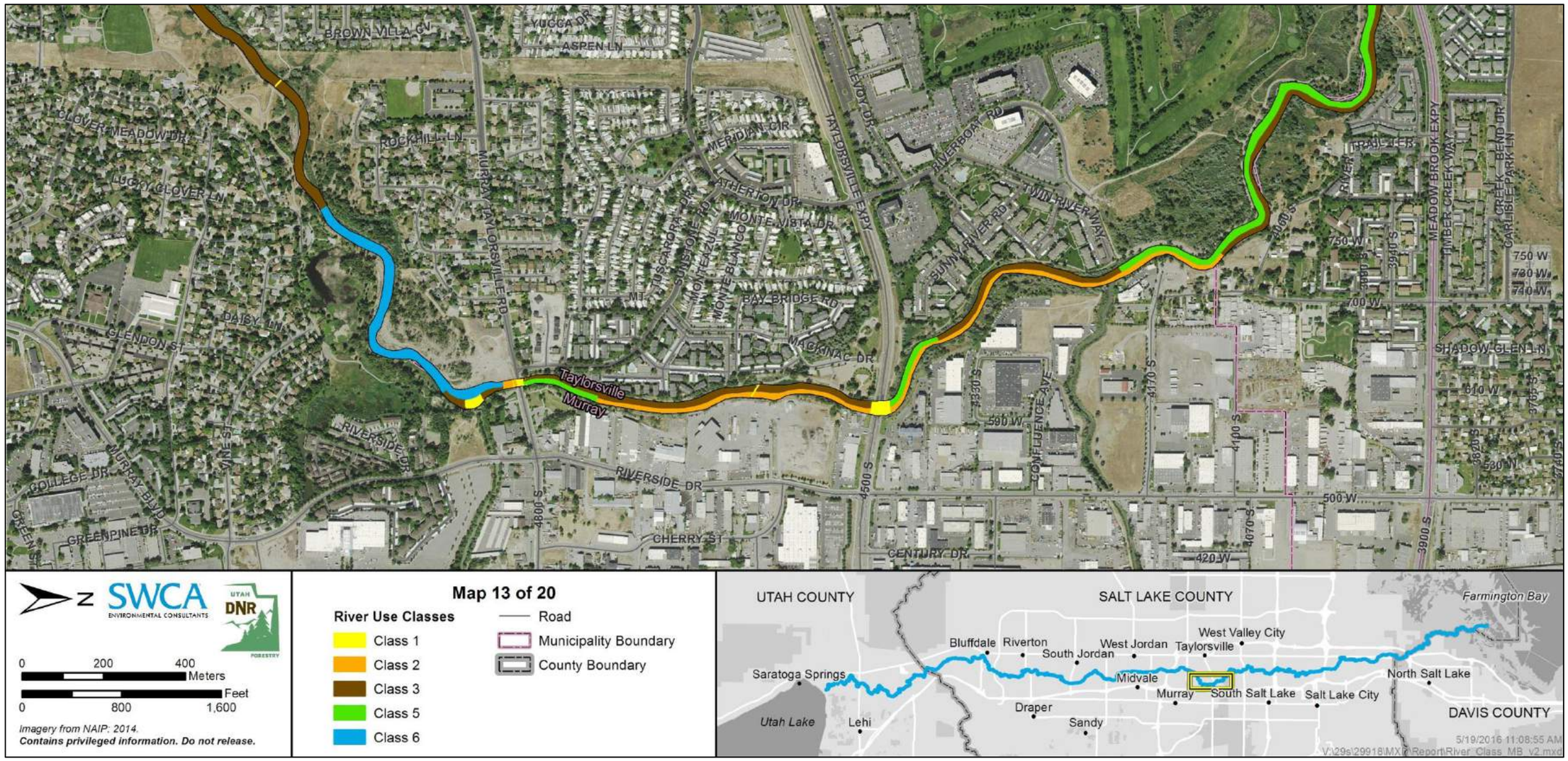


Figure 1.8. River use classes for the Jordan River, map 13.

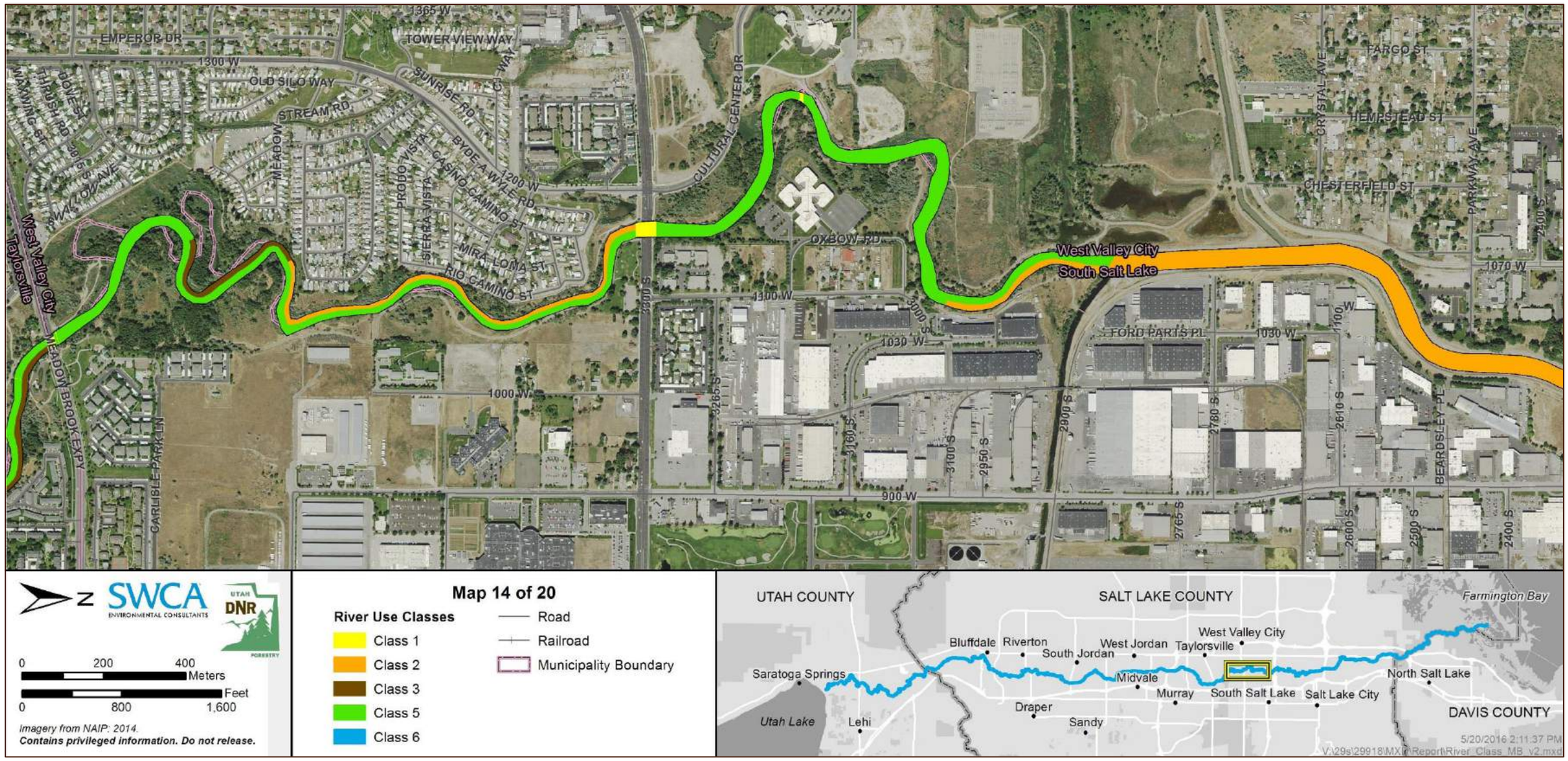


Figure 1.8. River use classes for the Jordan River, map 14.

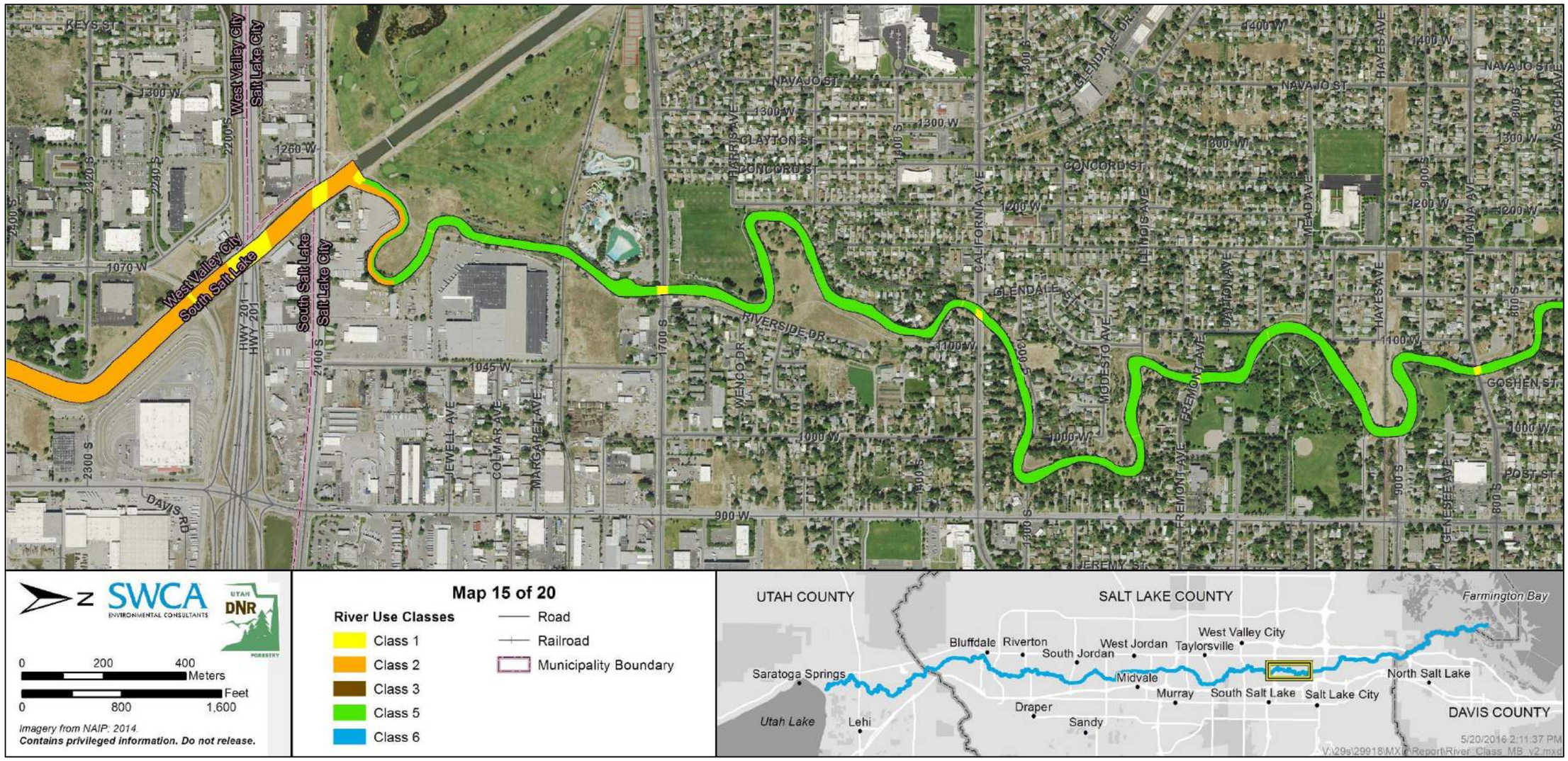


Figure 1.8. River use classes for the Jordan River, map 15.

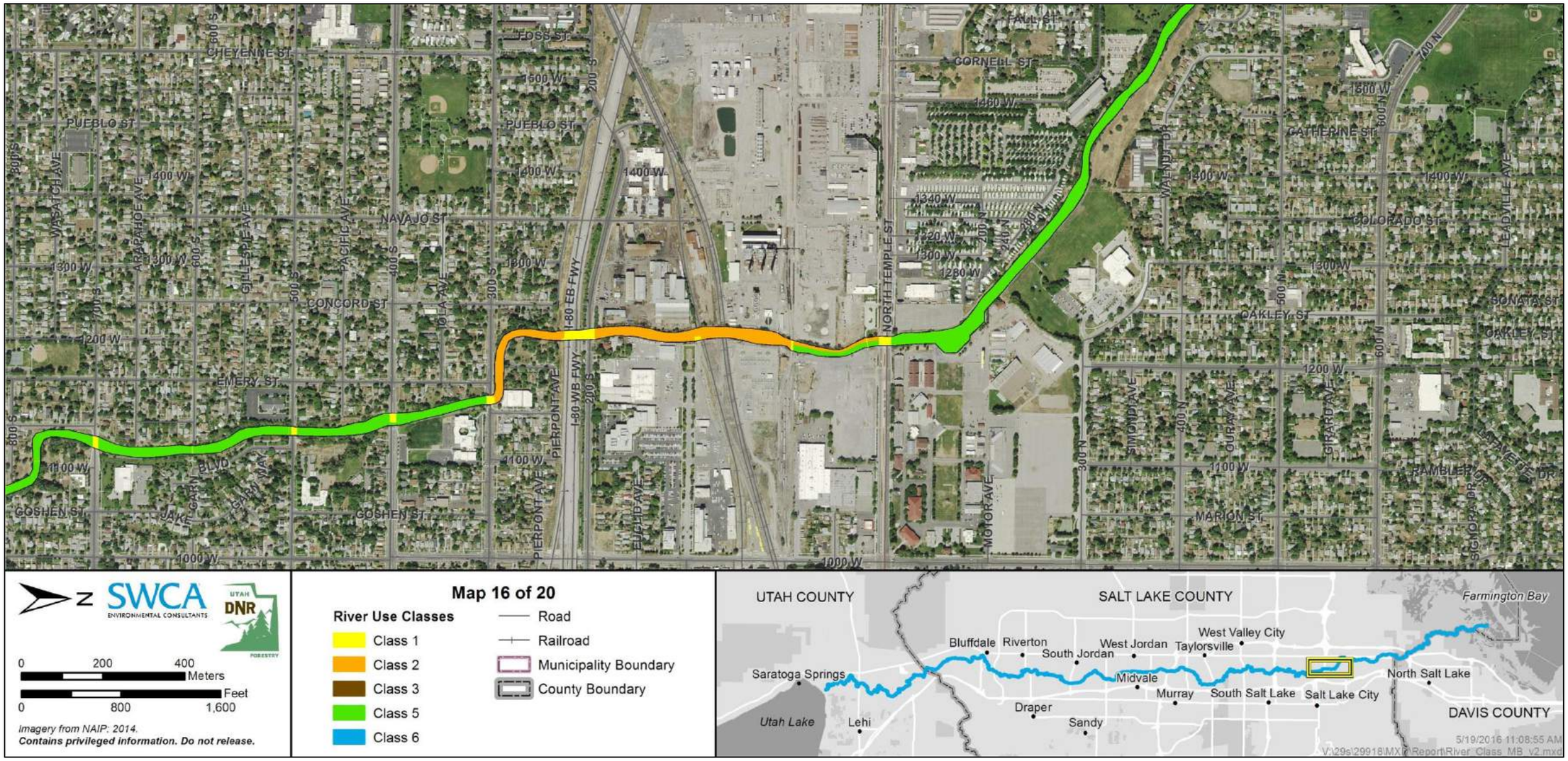


Figure 1.8. River use classes for the Jordan River, map 16.

Figure 1.8. River use classes for the Jordan River, map 17.

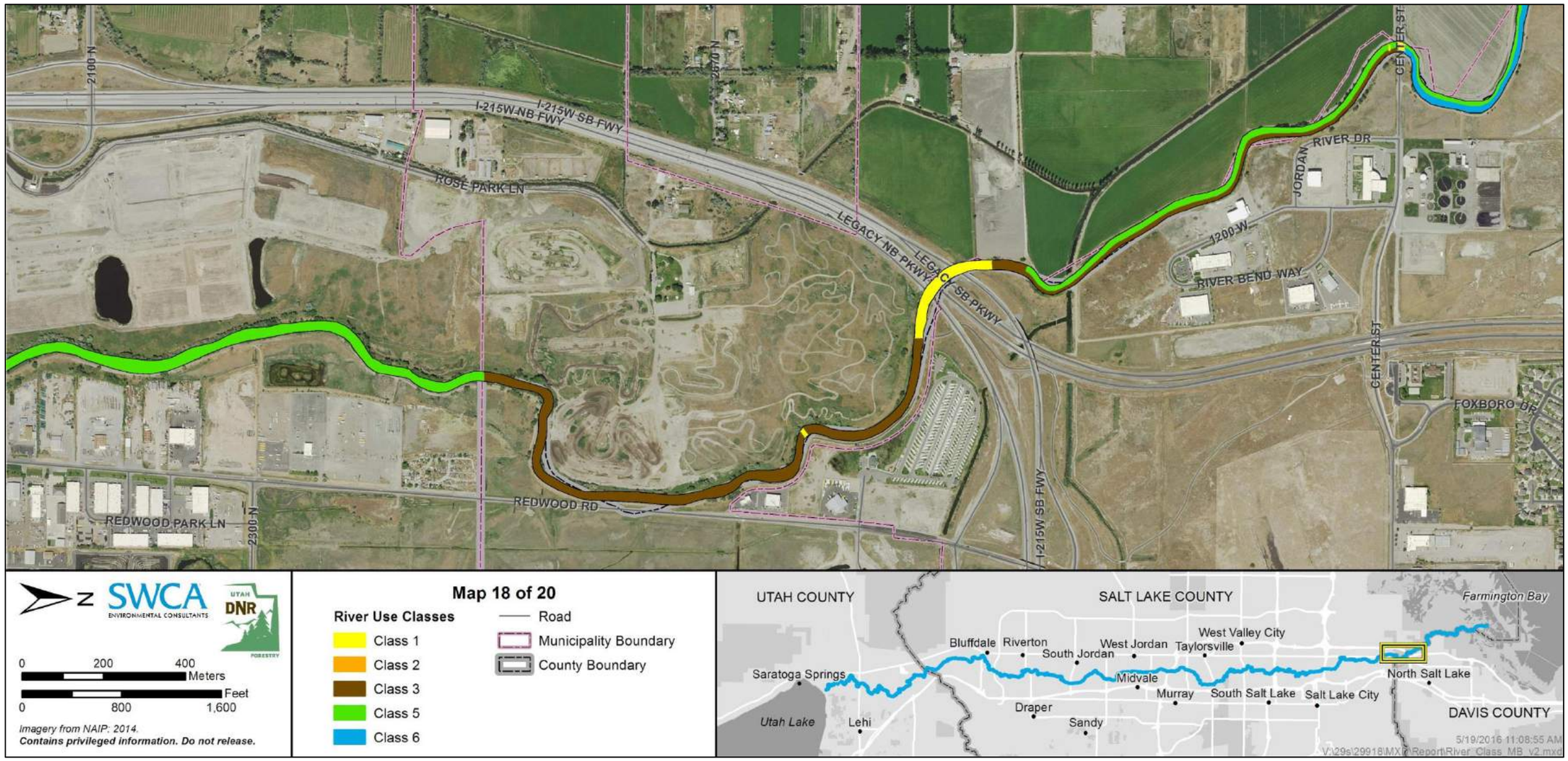


Figure 1.8. River use classes for the Jordan River, map 18.

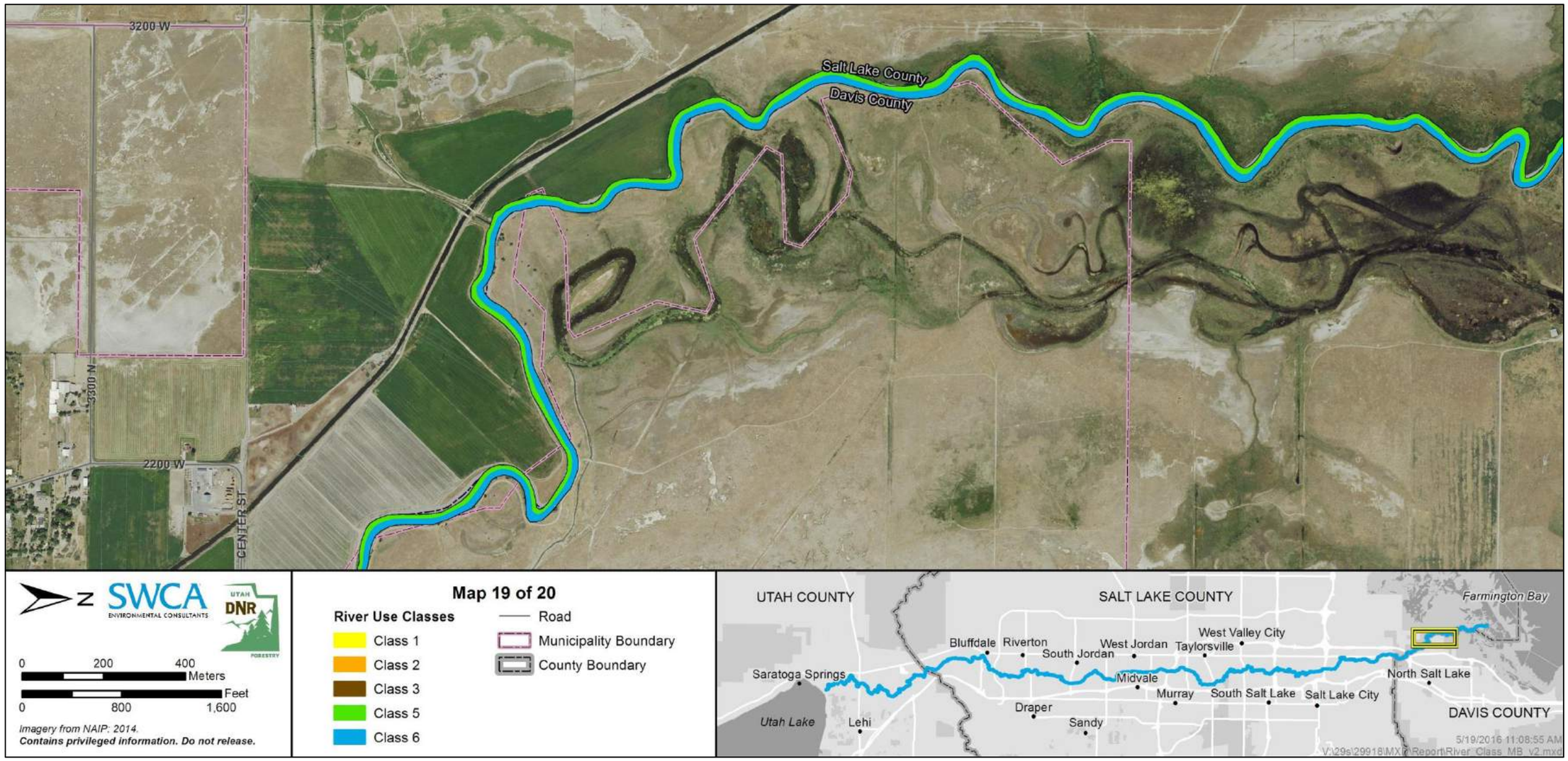


Figure 1.8. River use classes for the Jordan River, map 19.

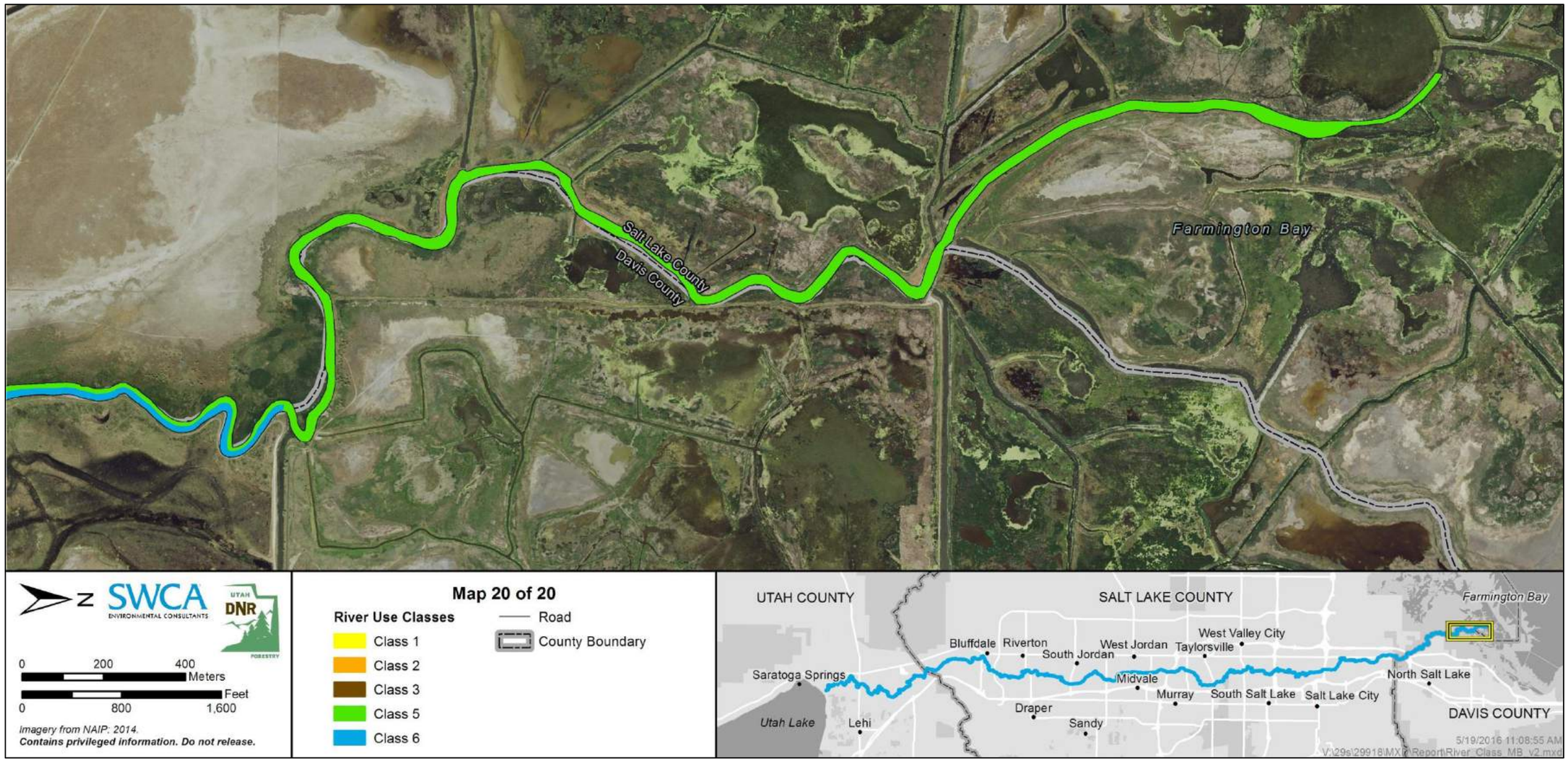


Figure 1.8. River use classes for the Jordan River, map 20.

This page intentionally blank

2.1 Introduction

The Jordan River has arguably been a focal point for humans since their initial arrival in the Salt Lake and Utah Lake Valleys thousands of years ago. Approximately 50 miles long, the Jordan River corridor connects Great Salt Lake and Utah Lake. Over time, the river has provided irrigation, transportation, food and water, building materials, recreation, sewer, and other community and ecosystem services.

In an excerpt from Our Changing World published in the *Audubon News* (1949), C.W. Lockerbie recounts homesteading along the Jordan River in 1890:

> *The Jordan River carried much more water then, consequently had a broader and more sharply defined channel than today. The banks on the undercut slope were generally vertical and unvegetated, while the opposite sites was covered with sand bar willow from the [main] stream edge back over the reclaimed channel to the valley floor. But before reaching the valley level, there often was a terrace on which grew an apparently different type of willow. Today in many places one cannot tell from a short distance where the river channel is located and the former sand bars are now mud bars, which support a thick growth of cattails, a plant I never saw on the Jordan in the 90s. Factors contributing to this change are: impounding of all Utah County's spring run-off in Utah Lake, to be diverted through various irrigation projects about the south end of Salt Lake Valley; the diversion of nearly all the Salt Lake County streams to city water mains or irrigation canals; the construction of a succession of dams along the river which retards the current and permits silting along most of its course; and the Surplus Canal which has been deepened below 21st South so that there is too little water current to keep the channel washed out.*

Conditions along the river have changed dramatically as a result of natural processes and human habitation. Under current conditions, vegetation communities, flow regimes, channel location, and water quality are likely different from what they were 1,000, 100, or even 10 years ago. Figure 2.1 illustrates a snapshot in time and demonstrates how a growing Salt Lake City in 1891 is beginning to encroach on the Jordan River and its floodplain. Figure 2.2 shows flooding in the area of 500 South and 800 South in Salt Lake City. As described by Lockerbie, the Jordan River was put to use, and Figures 2.3 and 2.4 illustrate construction of a dam near the Jordan Narrows and a water wheel, respectively. Finally, Figures 2.5 and 2.6 demonstrate what a difference 80 years can make and depict the North Temple bridge in 1933 and 2013, respectively.

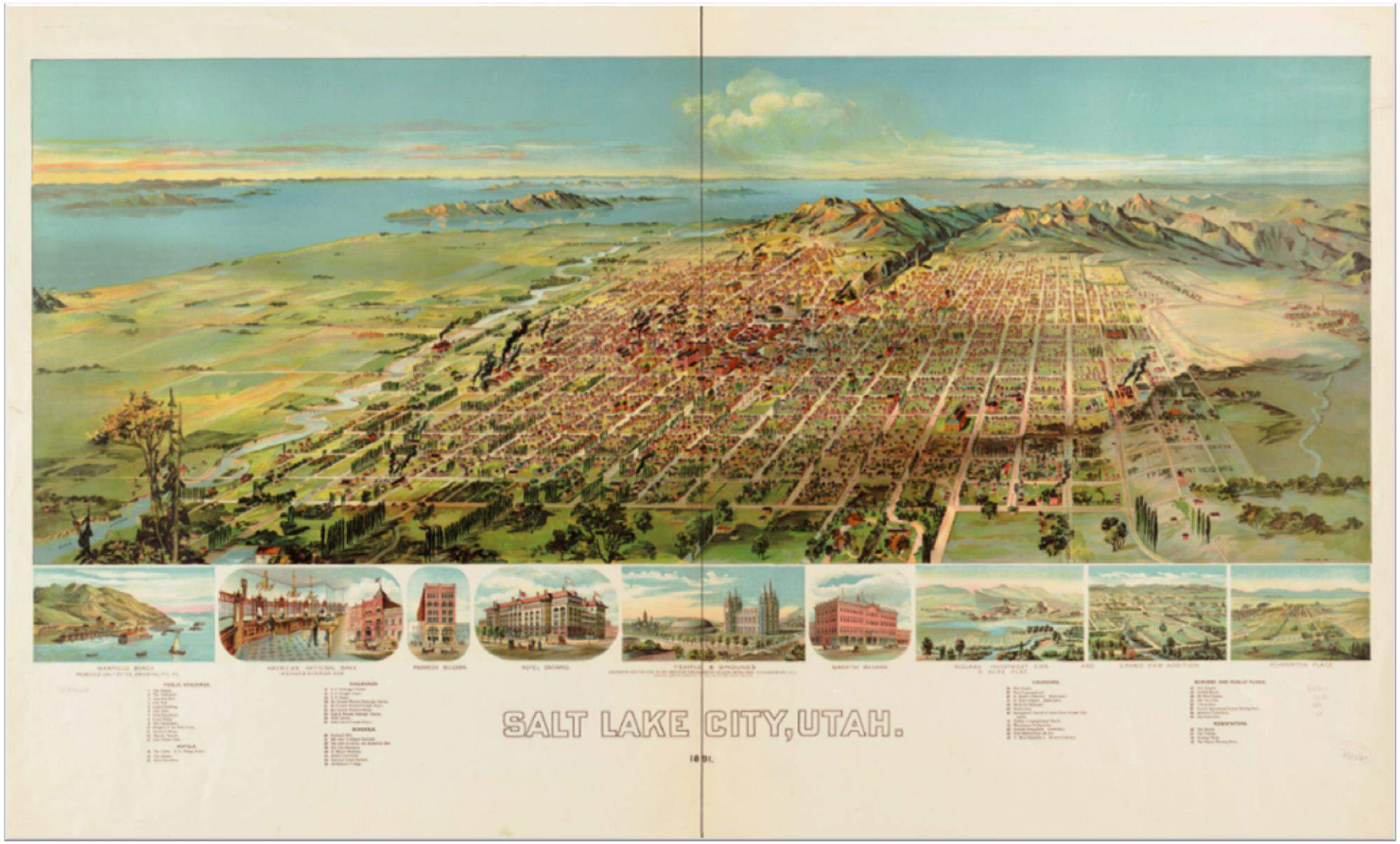


Figure 2.1. Jordan River in proximity to Salt Lake City, 1891. Used by permission, Utah State Historical Society.

HISTORIC JORDAN RIVER

Figure 2.2. Flooding near 800 South and 500 West in Salt Lake City. Used by permission, Utah State Historical Society.

Figure 2.3. Construction of a dam near the Jordan Narrows. Used by permission, Utah State Historical Society.

Figure 2.4. Water wheel on the Jordan River. Used by permission, Utah State Historical Society.

JORDAN RIVER THROUGH TIME

Figure 2.5. North Temple bridge in 1933. Used by permission, Utah State Historical Society.

Figure 2.6. North Temple bridge in 2013. Used by permission, Utah State Historical Society.

This chapter provides a description of current conditions on Jordan River sovereign lands. It is based on the best available data, but recognizes that a management document like this cannot be a complete inventory of all information, and gaps in our understanding of the Jordan River exist. Where applicable, the JRCMP calls out additional reading under each specific resources section in "Further Reading" boxes. For example, stakeholders who wish to know more about important habitats can reference the *Utah Comprehensive Wildlife Conservation Strategy* (DWR 2005a), whereas readers interested in water quality can review the *Jordan River Total Maximum Daily Load Water Quality Study – Phase 1* (Cirrus Ecological Solutions, LC [Cirrus] 2013).

Information in this chapter is provided because it offers a perspective on developing management goals and objectives and in that sense is more useful than other available information. As new data appear and management strategies change, the JRCMP can be updated in response. Planning documents like this typically provide comprehensive maps illustrating the resources and data presented. Because of the length of the Jordan River, the amount of resources, and the number of data layers, including a mapbook for each resource is too great for the planning document itself. Instead, these data are included in two online formats on the FFSL website: 1) an Esri story map, and 2) GIS spatial data viewer. Both formats are discussed in detail in Chapter 1.

Finally, as an organizational construct, the Jordan River has been broken into eight segments, A through H, beginning at Utah Lake and terminating at Great Salt Lake. These segments correspond to DWQ's assessment units and are currently used for water quality management. These segments also correspond to political boundaries, e.g., the boundary between Segments A and B at the Jordan Narrows is approximately the Utah-Salt Lake County line. Separation of Segments G and H is the Salt Lake-Davis County line. There are also differences in river slope and adjacent land use that correspond roughly to segment breaks. That said, FFSL management decisions are more closely associated with river use classes than river segments, as described in Chapter 1. Ultimately, river segments provide a format to discuss similarities and differences in river condition, use, and local government programs, e.g., weed control and restoration. Table 2.1 illustrates the distribution of river use classes by segment in percentages.

Table 2.1. River Use Class Percentages by River Segment

Segment	Class 1	Class 2	Class 3	Class 5	Class 6
A	2	7	72	19	0
B	11	47	12	30	0
C	3	21	2	61	13
D	14	0	0	86	0
E	6	24	28	37	5
F	7	33	0	60	0
G	4	13	16	67	0
H	3	0	17	54	26

This page intentionally blank

2.2 Ecosystem Resources

Ecosystem resources in the Jordan River planning area are discussed in two sections: Wildlife Habitat and Wildlife Species.

Wildlife Habitat

INTRODUCTION

For the purposes of the plan, the term *habitat* refers to wildlife habitat. Wildlife habitat is a complex mix of plant and animal communities, water, geography, elevation, and other environmental components that provide food and cover for individual species. A system such as the Jordan River and its adjacent lands and tributaries can provide wildlife species with a corridor where they can find food and cover. A healthy river corridor can also provide migration routes for wildlife to move through contiguous habitats and move between fragmented habitats.

This section discusses wildlife habitats, vegetation, and restoration. Vegetation is a key element of wildlife habitat because healthy plant communities support the ecological integrity of habitats. Restoration is the primary management activity for improving and rehabilitating impaired habitats.

HABITATS

Generally speaking, Jordan River sovereign lands contain many of the high-priority key habitats for species of greatest conservation need according to the *Utah Comprehensive Wildlife Conservation Strategy* (DWR 2005a). These include lowland riparian, wetland, wet meadow, open water (standing), and open water (flowing). Identification of these key habitats allows river stakeholders to prioritize conservation and restoration focus areas. However, to create a broader understanding of the landscape context and what DWR considers to be threats to habitats, the JRCMP uses Southwest Regional Gap Analysis Project (SWReGAP) data to define the variety of cover types through which the Jordan River flows. It should be noted that SWReGAP is intended to be used at a scale of 1:100,000 and may be less accurate for linear subjects like the Jordan River. Using this readily available mapping data, vegetation was classified using the major land cover types predicted to occur in the planning area. Land cover types are defined as recurring groups of biological communities found in similar physical environments and influenced by similar ecological process, such as fire or flooding (U.S. Geologic Survey [USGS] National GAP Analysis Program 2005). Similar land cover types were then grouped together into more generic habitats, resulting in seven terrestrial and aquatic wildlife habitats:

1. Aquatic (key habitat, open water flowing and standing)
2. Wetland (key habitat, both wetland and wet meadow habitats)
3. Annual grassland
4. Agriculture
5. Developed
6. Shrubland
7. Riparian (key habitat)

Physical features and common and characteristic species of the seven planning area habitats are described and illustrated below (Figures 2.7 through 2.13).

AQUATIC

Physical features

- Consists of the approximately 50-mile-long Jordan River.
- Comprises the riverine portion of the planning area.
- Overlaps other habitats.

Plant species

- Submerged aquatic vegetation includes fineleaf pondweed (*Stuckenia filiformis*), sago pondweed (*Stuckenia pectinata*), longleaf pondweed (*Potamogeton nodosus*), and spiral ditchgrass (*Ruppia cirrhosa*).
- Floating vegetation includes duckweeds (*Lemna* spp.).

Mammal species

- Muskrat (*Ondatra zibethicus*) and North American beaver (*Castor canadensis*).

Waterfowl and wading bird species

- Western grebe (*Aechmophorus occidentalis*), northern pintail (*Anas acuta*), gadwall (*Anas strepera*), northern shoveler (*Anas clypeata*), and blue-winged teal (*Anas discors*).

Other bird species

- Northern rough-winged swallow (*Stelgidopteryx serripennis*) and belted kingfisher (*Megaceryle alcyon*).

Fish species

- Carp (*Cyprinus* spp.), Bonneville cutthroat trout (*Oncorhynchus clarki utah*), brown trout (*Salmo trutta*), redside shiner (*Richardsonius balteatus*), speckled dace (*Rhinichthys osculus*), Utah chub (*Gila atraria*), Utah sucker (*Catostomus ardens*), and mountain sucker (*Catostomus platyrhynchus*).

Reptile species

- Common slider (*Pseudemys scripta*) and common snapping turtle (*Chelydra serpentina*).

Sensitive species

- American white pelican (*Pelecanus erythrorhynchos*), Bonneville cutthroat trout, California floater (*Anodonta californiensis*), June sucker (*Chasmistes liorus*), and western pearl shell (*Margaritifera falcate*).

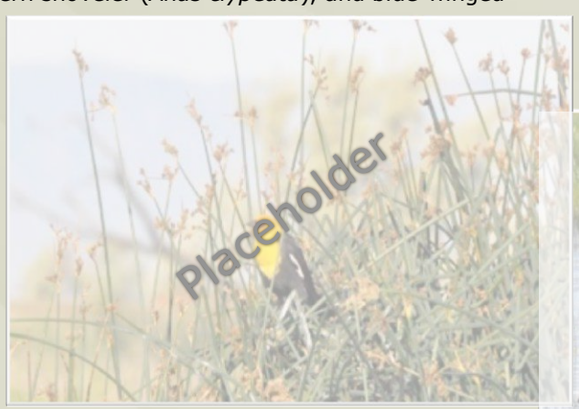


Figure 2.7. Aquatic habitat and associated species.

WETLAND

Physical features

- Covers approximately 4% of the planning area*.
- Includes emergent marsh wetlands and woody wetlands.
- May occur in depressions in the landscape and along slow-moving areas of the river.

Plant species

- Common emergent and floating vegetation includes bulrushes (*Schoenoplectus* spp. and/or *Scirpus* spp.), cattails (*Typha* spp.), rushes (*Juncus* spp.), pondweeds (*Potamogeton* spp.), knotweeds (*Polygonum* spp.), duckweeds, common reed (*Phragmites australis*), and reed canarygrass (*Phalaris arundinacea*).
- Woody wetland areas are typically dominated or co-dominated by greasewood (*Sarcobatus vermiculatus*). Other species include fourwing saltbush (*Atriplex canescens*), shadscale saltbush (*Atriplex confertifolia*), and winterfat (*Krascheninnikovia lantata*). If an herbaceous layer is present, it is usually dominated by graminoids (grasses, sedges, and rushes).

Mammal species

- Muskrat, North American beaver, and common raccoon (*Procyon lotor*).

Waterfowl and wading bird species

- Ruddy duck (*Oxyura jamaicensis*), cinnamon teal (*Anas cyanoptera*), American avocet (*Recurvirostra americana*), black-necked stilt (*Himantopus mexicanus*), white-faced ibis (*Plegadis chihi*), and mallard (*Anas platyrhynchos*).

Other bird species

- Red-winged blackbird (*Agelaius phoeniceus*), yellow-headed blackbird (*Xanthocephalus xanthocephalus*), and marsh wren (*Cistothorus palustris*).

*Physical feature percentages were calculated from SWReGAP polygons that extend outside the planning area.

Amphibian and reptile species

- Spring peeper (*Pseudacris crucifer*), Woodhouse's toad (*Anaxyrus woodhousii*), spadefoot toads (*Scaphiopus* spp. and *Spea* spp.), and western garter snake (*Thamnophis elegans*).

Sensitive species

- American white pelican, bobolink (*Dolichonyx oryzivorus*), and smooth greensnake (*Opheodrys vernalis*).

Figure 2.8. Wetland habitat and associated species.

ANNUAL GRASSLAND

Physical features

- Covers less than 1% of the planning area*.

Plant species

- Dominated by introduced annual grass species such as cheatgrass (*Bromus tectorum*) and other brome species (*Bromus* spp.), oat species (*Avena* spp.), and Mediterranean grasses (*Schismus* spp.).

Mammal species

- Rock squirrel (*Otospermophilus variegatus*), mule deer (*Odocoileus hemionus*), mountain cottontail (*Sylvilagus nuttallii*), muskrat, red fox (*Vulpes vulpes*), coyote (*Canis latrans*), sagebrush vole (*Lemmiscus curtatus*), and western jumping mouse (*Zapus princeps*).

*Physical feature percentages were calculated from SWReGAP polygons that extend outside the planning area.

Waterfowl and wading bird species

- Northern pintail, northern shoveler, Canada goose (*Branta canadensis*), great blue heron (*Ardea herodias*), eared grebe (*Podiceps nigricollis*), pied-billed grebe (*Podilymbus podiceps*), and American avocet.

Other bird species

- Vesper sparrow (*Pooecetes gramineus*), green-tailed towhee (*Pipilo chlorurus*), and horned lark (*Eremophila alpestris*).

Sensitive species

- Long-billed curlew (*Numenius americanus*), short-eared owl (*Asio flammeus*), and smooth greensnake.

Figure 2.9. Annual grassland habitat and associated species.

AGRICULTURE

Physical features

- Covers approximately 22% of the planning area*.

Plant species

- Areas of grasses, legumes, or grass-legume mixtures planted for the production of seed or hay crops, or for livestock grazing.

Mammal species

- Western harvest mouse (*Reithrodontomys megalotis*), deer mouse (*Peromyscus maniculatus*), mule deer, mountain cottontail, and striped skunk (*Mephitis mephitis*).

*Physical feature percentages were calculated from SWReGAP polygons that extend outside the planning area.

Waterfowl and wading bird species

- Mallard, snowy egret (*Egretta thula*), white-faced ibis, and Canada goose.

Other bird species

- Western meadowlark (*Sturnella neglecta*), barn swallow (*Hirundo rustica*), and horned lark.

Sensitive species

- Long-billed curlew and short-eared owl.

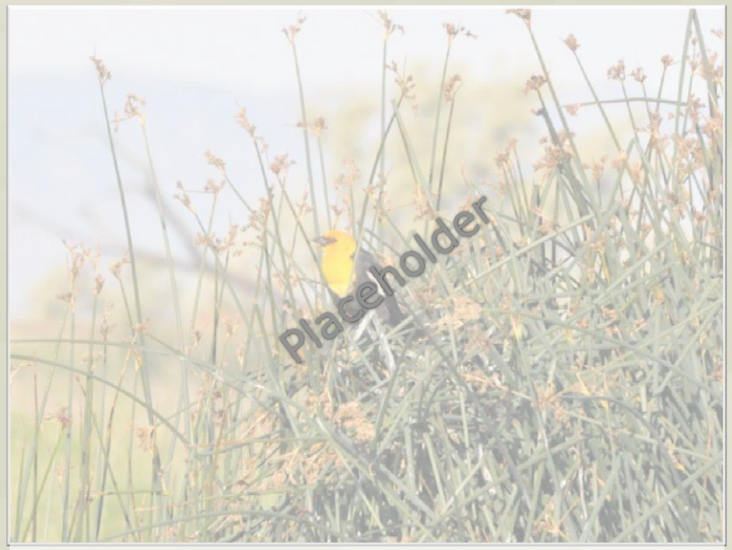


Figure 2.10. Agriculture habitat and associated species.

DEVELOPED

Physical features

- Covers approximately 52% of the planning area*. This includes SWReGAP land cover classifications for open space to low intensity development and medium to high intensity development.
- Developed, open space to low intensity includes areas with a mixture of constructed materials and vegetation, with impervious surfaces accounting for < 20% to 49% of total cover. This habitat includes open spaces, golf courses, preserves, parks, natural areas, parkways, gardens, and single-family housing units.
- Developed, medium to high intensity includes areas with a mixture of constructed materials and vegetation, with impervious surface accounting for 50% to 100% of total cover. This habitat includes single-family housing units; apartment complexes; and commercial, industrial, and disturbed areas.

Plant species

- Dominated by vegetation in the form of lawn grass species, trees, and shrubs.

*Physical feature percentages were calculated from SWReGAP polygons that extend outside the planning area.

Mammal species

- Common raccoon, striped skunk, mule deer, and deer mouse.

Waterfowl and wading bird species

- American coot (*Fulica americana*) and mallard.

Other bird species

- American robin (*Turdus migratorius*), house finch (*Haemorhous mexicanus*), black-capped chickadee (*Poecile atricapillus*), mourning dove (*Zenaida macroura*), and savannah sparrow.

Sensitive species

- None.

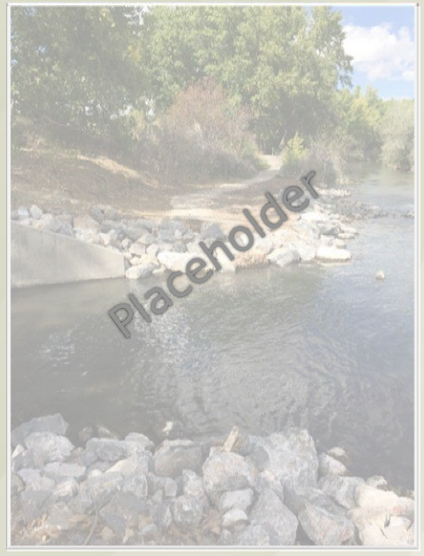


Figure 2.11. Developed habitat and associated species.

SHRUBLAND

Physical features

- Covers less than 1% of the planning area*.

Plant species

- Dominated by black sagebrush (*Artemisia nova*), and co-dominated by Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) or yellow rabbitbrush (*Chrysothamnus viscidiflorus*). Other shrubs present include shadscale saltbush, joint fir species (*Ephedra* spp.), rabbitbrush species (*Ericameria* spp.), spiny hopsage (*Grayia spinosa*), and greasewood.
- The herbaceous layer is typically sparse and composed of perennial bunchgrasses.

Mammal species

- Rock squirrel, mountain cottontail, red fox, coyote, mule deer, sagebrush vole, and western jumping mouse.

*Physical feature percentages were calculated from SWReGAP polygons that extend outside the planning area.

Waterfowl and wading bird species

- Mallard, Canada goose, and great blue heron.

Other bird species

- Vesper sparrow, savannah sparrow, green-tailed towhee, and horned lark.

Sensitive species

- Short-eared owl and smooth greensnake.

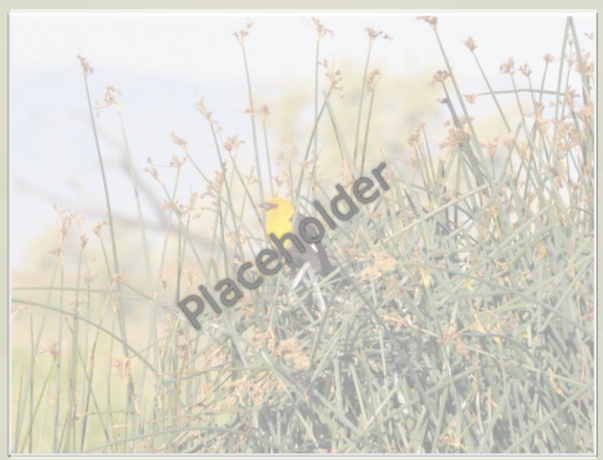


Figure 2.12. Shrubland habitat and associated species.

RIPARIAN

Physical features

- Covers approximately 20% of the planning area*.
- Commonly occurs as a mosaic of multiple vegetation types that are dominated by trees and have a diverse shrub component.
- Disturbance-driven system that requires annual to episodic flooding.

Plant species

- Dominant trees include boxelder (*Acer negundo*), gray alder (*Alnus incana*), water birch (*Betula occidentalis*), and cottonwoods (*Populus* spp.).
- Introduced tree species such as Russian olive (*Elaeagnus angustifolia*) and tamarisk (*Tamarix* spp.) are also common.
- Shrubs include willows (*Salix* spp.), redosier dogwood (*Cornus sericea*), silver sagebrush (*Artemisia cana*), Rocky Mountain maple (*Acer glabrum*), chokecherry (*Prunus virginiana*), and skunkbush sumac (*Rhus trilobata*).
- Herbaceous layers are often dominated by sedges (*Carex* spp.), rushes (*Juncus* spp.), perennial grasses, and mesic forbs. Cheatgrass, a weedy annual grass, is present in disturbed stands.

Mammal species

- Least chipmunk (*Tamias minimus*), long-tailed vole (*Microtus longicaudus*), hoary bat (*Lasiurus cinereus*), vagrant shrew (*Sorex vagrans*), long-tailed weasel (*Mustela frenata*), mule deer, and American beaver.

*Physical feature percentages were calculated from SWReGAP polygons that extend outside the planning area.

Waterfowl and wading bird species

- Double-crested cormorant (*Phalacrocorax auritus*), black-crowned night heron (*Nycticorax nycticorax*), and snowy egret.

Other bird species

- Common yellowthroat (*Geothlypis trichas*), yellow warbler (*Setophaga petechia*), western scrub-jay (*Aphelocoma californica*), warbling vireo (*Vireo gilvus*), song sparrow (*Melospiza melodia*), marsh wren, red-winged blackbird, and yellow-headed blackbird.

Sensitive species

- Bald eagle (*Haliaeetus leucocephalus*) and short-eared owl.

Figure 2.13. Riparian habitat and associated species.

Habitat Location and Condition

Habitats in the planning area are described and listed by river segment in Figure 2.14. Using a cross section of the river, Figure 2.15 shows specific aquatic and riverbank habitats and characteristics along the Jordan River. The condition and quality of habitat in the planning area can be negatively affected through habitat degradation, fragmentation, and loss. Such impacts can stem from development, the introduction or spread of invasive species, the presence of noise and light, and pollution (e.g., sewage and sedimentation). Hence, habitat in the planning area has been altered from its pre-settlement condition. In general, gradual urbanization has fragmented habitat and decreased the riparian corridor width along the river. In addition, invasive species and human disturbances have been introduced to river habitats. Over time, habitats in the planning area were altered through the draining and filling of wetlands, channelization and dredging of the river, and the degradation of water quality (National Audubon Society 2000). More recently, a concerted effort has been taken to protect and restore wildlife habitat associated with the Jordan River. Two examples are the Legacy Nature Preserve in Davis County and the Galena/Soo'nkahni Property in Salt Lake County. Both of these are examples of habitat restored and/or enhanced as part of CWA mitigation, and they are both now set aside in perpetuity. Other examples of smaller mitigation sites and parcels with conservation easement also occur throughout the planning area.

VEGETATION

A major "structural" component of habitat is vegetation. Vegetation is often classified by layers such as grasses, forbs, shrubs, and trees. Together, a mosaic of these kinds of plants provides the structure upon which different wildlife species depend. Vegetation in the planning area can also be categorized in terms of native or desirable species, special-status species, and invasive and noxious weeds. These categories are not necessarily mutually exclusive but are the focus of management decisions such as restoration, regulations, and weed treatment, respectively. The amount and distribution of plant species can be influenced by disturbance; the proximity of disturbance to the river; and seed dispersal by wildlife, water, wind, and recreation activities.

Native Plant Species

A native plant is one that occurs naturally in a particular region, habitat, or ecosystem without direct or indirect human intervention (The United States National Arboretum 2006). Native plant communities provide a range of ecological functions such as increased native wildlife habitat and species diversity, erosion control, flood moderation, water filtration, and development and enrichment of soil. Table 2.2 lists recommended aquatic and wetland species, and tree, shrub, forb, and grass species native to the planning area, along with their wetland indicator status. The wetland indicator status of a plant reflects the likelihood of its presence in a wetland. This list was developed by restoration practitioners and has been used in restoration projects along the Jordan River. It should serve as a guide when planning restoration or revegetation projects; it is not meant to be exhaustive and does not reflect current availability.

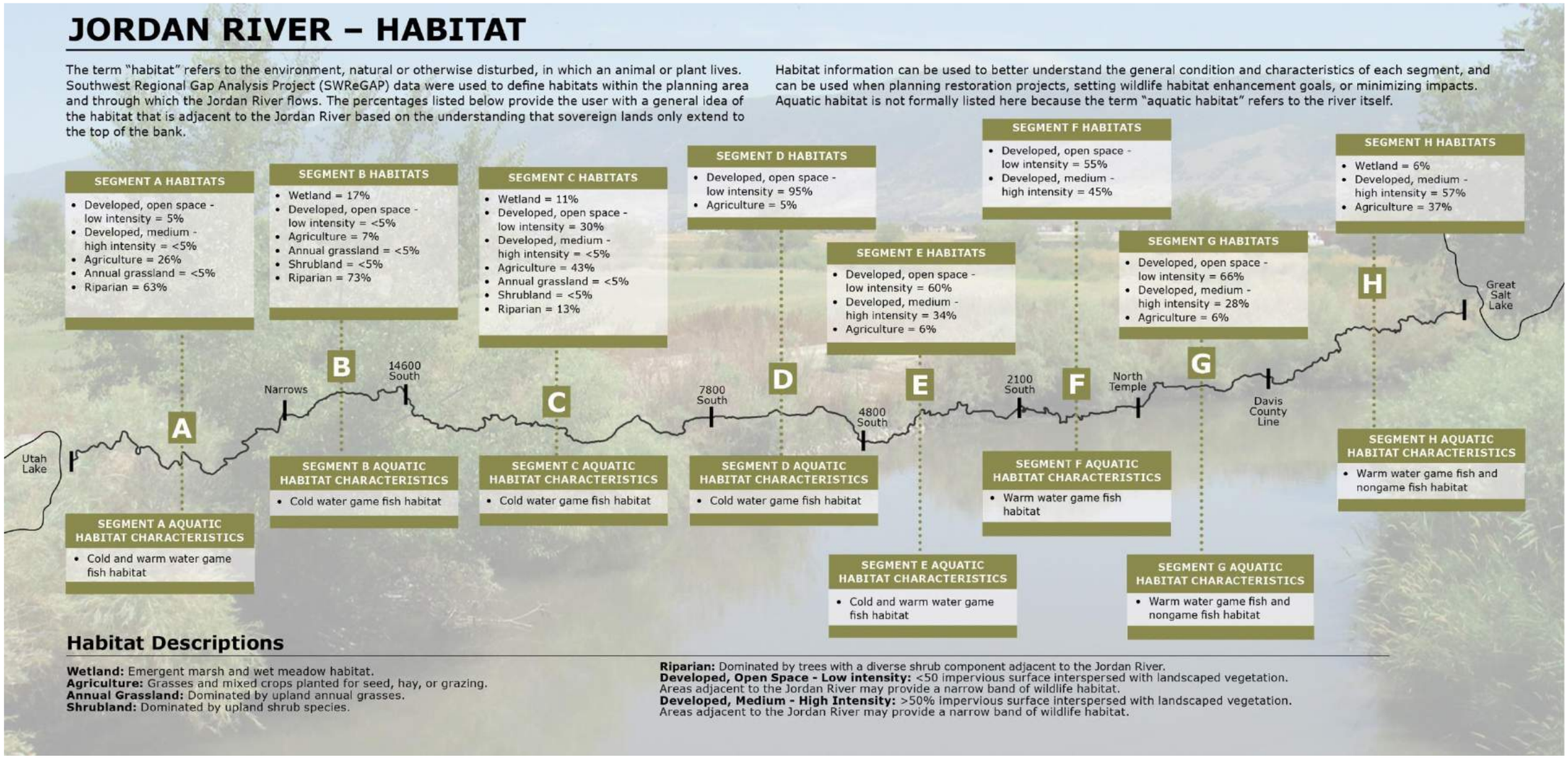


Figure 2.14. Habitats in the planning area by river segment.

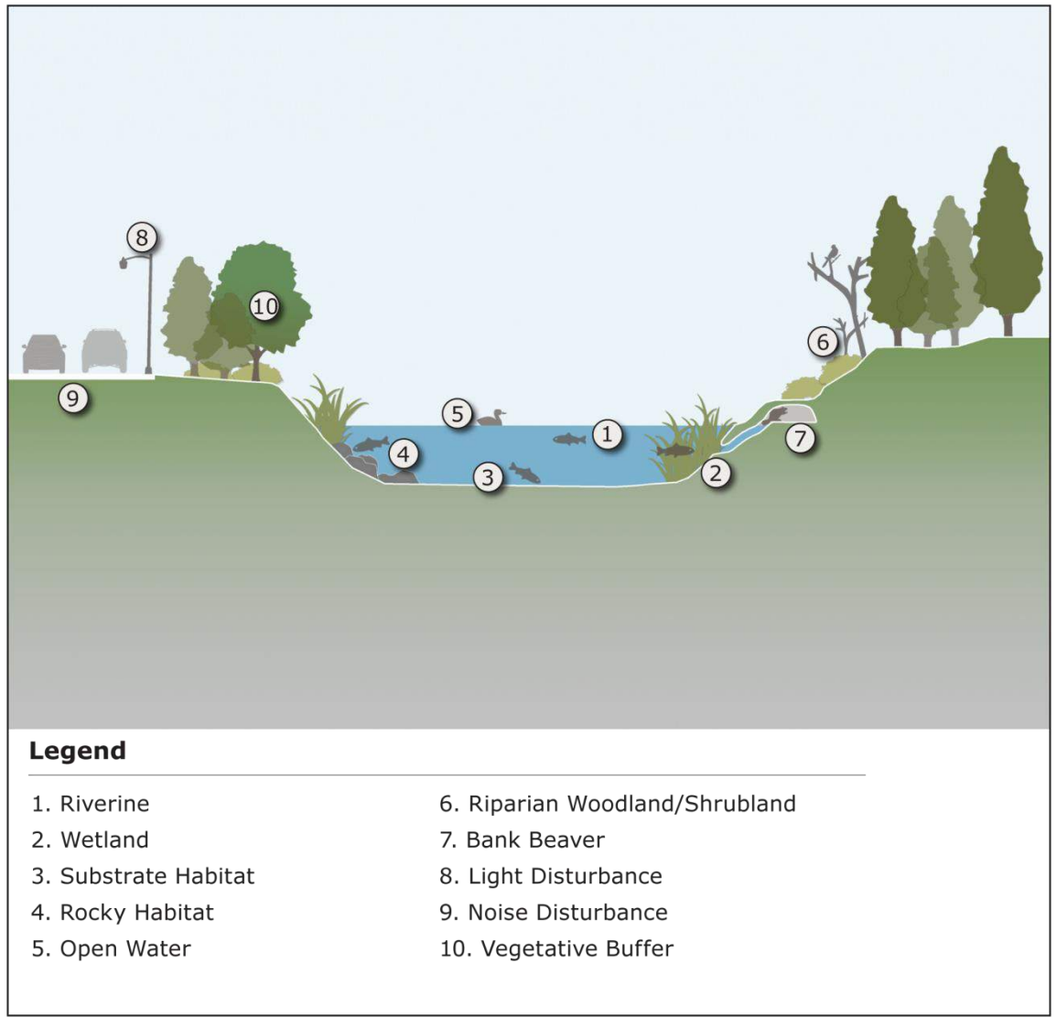


Figure 2.15. Jordan River cross section showing aquatic and riverbank habitats and characteristics along the Jordan River.

Table 2.2. Native Plant Recommendations for the Planning Area

Common Name	Scientific Name	Indicator Status*
NATIVE AQUATIC AND WETLAND SPECIES		
Duckweed species	*Lemna* spp.	OBL
Longleaf pondweed	*Potamogeton nodosus*	OBL
Fineleaf pondweed	*Stuckenia filiformis*	OBL
Sago pondweed	*Stuckenia pectinata*	OBL
Spiral ditchgrass	*Ruppia cirrhosa*	OBL
Bulrush species	*Schoenoplectus* spp.	OBL
Cattail species	*Typha* spp.	OBL
NATIVE RIPARIAN TREE SPECIES		
Box Elder	*Acer negundo*	FACW
Narrowleaf cottonwood	*Populus angustifolia*	FACW
Fremont cottonwood	*Populus fremontii*	FACW
Black cottonwood	*Populus trichocarpa*	FACW
Peachleaf willow	*Salix amygdaloides*	FACW
Whiplash willow	*Salix lasiandra*	FACW
NATIVE SHRUB SPECIES		
Big sagebrush	*Artemisia tridentata*	FACU
Fourwing saltbush	*Atriplex canescens*	UPL
Black hawthorn	*Crataegus douglasii*	FAC
Rubber rabbitbrush	*Ericameria nauseosa*	UPL
Broom snakeweed	*Gutierrezia sarothrae*	NI
Chokecherry	*Prunus virginiana*	FAC
Skunkbush sumac	*Rhus trilobata*	FACU
Golden currant	*Ribes aureum*	FAC

Common Name	Scientific Name	Indicator Status*
Woods' rose	*Rosa woodsii*	FACU
Sandbar willow	*Salix exigua*	FACW
Greasewood	*Sarcobatus vermiculatus*	FAC
Silver buffaloberry	*Shepherdia argentea*	FACU
NATIVE FORB SPECIES		
White sagebrush	*Artemisia ludoviciana*	FACU
Milkweed species	*Asclepias* spp.	Varies by species
Hairy false goldenaster	*Chrysopsis villosa*	NI
Rocky Mountain beeplant	*Cleome serrulata*	NI
Blanket flower species	*Gaillardia* spp.	FACU
Lewis flax	*Linum lewisii*	NI
NATIVE GRASS SPECIES		
Saltgrass	*Distichlis spicata*	FAC
Common spikerush	*Eleocharis palustris*	OBL
Arctic rush	*Juncus arcticus*	FACW
Western wheatgrass	*Pascopyrum smithii*	FAC
Sandberg bluegrass	*Poa secunda*	FACU
Nuttall's alkaligrass	*Puccinellia nuttalliana*	FACW
Alkali sacaton	*Sporobolus airoides*	FAC
Sand dropseed	*Sporobolus cryptandrus*	FACU

*UPL = upland (almost never occurs in wetlands); FACU = facultative upland (usually occurs in non-wetlands, but may occur in wetlands); FACW = facultative wetland (usually occurs in wetlands); FAC = facultative (occurs in wetlands and non-wetlands); OBL = obligate (almost always occurs in wetlands); NI = non-indicator (USACE 2016).

Special-Status Plant Species

Special-status species are species for which state or federal agencies afford an additional level of protection by law, regulation, or policy. The presence of potential habitat for special-status plant species was determined by comparing individual species habitat requirements to the SWReGAP land cover types predicted to occur in the planning area and local elevation.

Utah County has three federally listed plant species, Salt Lake County has one federally listed plant species, and Davis County does not have any federally listed plant species (DWR 2015a). Table 2.3 provides a list of special-status plant species known to occur in Utah and Salt Lake Counties and indicates whether potential habitat for these species occurs in the planning area.

Table 2.3. Special-Status Plant Species and their Potential to Occur in the Planning Area

Common and Scientific Name	Status	Habitat	County	Potential to Occur in the Planning Area
Ute ladies'-tresses *Spiranthes diluvialis*	Threatened	Moist to wet meadows, along streams; in abandoned stream meanders; near lake shores, seeps, and springs; and in loamy or sandy soils that are typically mixed with gravel.	Salt Lake and Utah	Low in Salt Lake County; historical occurrences. Low to moderate in Utah County.
Deseret milkvetch *Astragalus desereticus*	Threatened	Open sagebrush and pinyon-juniper communities on steep slopes with sandy-gravelly soils derived from the Moroni Formation.	Utah	None; suitable habitat not present.
Clay phacelia *Phacelia argillacea*	Endangered	Barren, precipitous hillsides in sparse mountain brush and pinyon-juniper communities with fine-textured soils and shale fragments derived from the Green River Formation.	Utah	None; suitable habitat not present. Plant is only known to occur in Spanish Fork Canyon.

Source: DWR (2015a, 2015b).

Introduced, Invasive, and Noxious Weed Species

A weed is any plant that is not desired in a particular location and may be introduced, invasive, and/or noxious. Weedy plant species terminology and definitions are provided in Figure 2.16.

As defined by Title 4, Chapter 17 of the Utah Noxious Weed Act, a *noxious weed* is, "any plant the commissioner determines to be especially injurious to public health, crops, livestock, land, or other property" (Utah Code 4-17-2). Invasive plant species, including most noxious weeds, are early successional species that possess numerous adaptations for rapid colonization and spread in disturbed habitats. These adaptations include high reproductive rates; rapid germination and growth; and annual life histories in which the plant grows, flowers, sets seed, and dies in a single season. Noxious plant species may also have superior abilities to use soil and water resources, possess allelopathic mechanisms to suppress competing species, and have been removed from their native predators and pathogens in their new environment (Coombs et al. 2004; Mack et al. 2000; Sperry et al. 2006). These factors can result in a shift in the plant community toward dominance of exotic, invasive plant species (Mack et al. 2000). In general, non-native and invasive plants do not provide the same habitat function as native plants. In addition, non-native or invasive species can outcompete native vegetation, resulting in a reduction of plant diversity and a decrease in overall habitat physical structure and function.

Figure 2.16. Weedy plant species terminology and definitions.

Two invasive and one noxious weed species of particular concern in the planning area are common reed (*Phragmites australis*), Russian olive (*Elaeagnus angustifolia*), and saltcedar (*Tamarix ramosissima*). Concerns about these specific species include fire safety, the high potential for spreading, impeded access to the river, degradation to wildlife habitat, and impairment of the viewshed. Brief descriptions of these three species are provided in Figure 2.17.

Common reed, also known as *Phragmites*, is of particlar concern to stakeholders in the planning area. Common reed occurs in all segments of the river; however, infestations of *Phragmites* were noted in Segments C and G during the public comment process.

Other introduced, invasive, and/or noxious plant species are present in the planning area but are not discussed in detail in this management plan because they are less problematic and easier to control (Table 2.4).

Table 2.4. Other Introduced, Invasive, and/or Noxious plant Species Present in the Planning Area

Common Name	Scientific Name
Cheatgrass	*Bromus tectorum*
Bull thistle	*Cirsium vulgare*
Common teasel	*Dipsacus fullonum*
Burdock	*Arctium minus*
Mullein	*Verbascum thapsus*
Cocklebur	*Xanthium strumarium*
Common ragweed	*Ambrosia artemisiifolia*
Yellow sweetclover	*Melilotus officinalis*
Punctureviné	*Tribulus terrestris*
Purple loosestrife	*Lythrum salicaria*
Hoary cress (whitetop)	*Cardaria draba*
Quackgrass	*Elymus repens*
Field bindweed	*Convolvulus arvensis*
Houndstongue	*Cynoglossum officinale*
Pepperweed	*Lepidium* sp.

WEED SPECIES OF PARTICULAR CONCERN IN THE PLANNING AREA

Common reed (*Phragmites australis*)

- Common reed is an invasive, large perennial rhizomatous grass, or reed, forming monotypic stands in wetland areas. It is common in alkaline and brackish environments, and can also thrive in highly acidic wetlands. Growth is greater in fresh water, but it may be outcompeted in these areas by other species. It can survive in stagnant waters where the sediments are poorly aerated by providing the underground parts of the plant with a relatively fresh supply of air from the air spaces in the aboveground stems and rhizomes. The buildup of litter from the aerial shoots within stands prevents or discourages other species from germinating and becoming established. The rhizomes and adventitious roots themselves form dense mats that discourage annual and perennial native establishment. Killing frosts may knock the plants back temporarily, but can ultimately increase stand densities by stimulating bud development (Colorado State University 2000).

Russian olive (*Elaeagnus angustifolia*)

- Russian olive is an invasive species originally from Europe that has been used as an ornamental tree in the United States. The fruits can be a valuable food source, and the tree often provides habitat for birds and wildlife. It grows well in meadows, pasturelands, and along waterways. Reproduction is from seed and rootstock, and thick stands can develop if left unchecked (Belliston et al. 2004). Russian olive often outcompetes native vegetation, altering the plant community structure and reducing wildlife habitat for some species (Zouhar 2005). Additionally, some have suggested that Russian olive can alter nutrient cycling and stream hydrology (Tu 2003). Russian olive is a common invasive tree throughout Utah, Salt Lake, and Davis Counties.

Saltcedar (*Tamarix ramosissima*)

- Saltcedar, also known as tamarisk, is an aggressive, woody noxious plant that has become established over as much as a million acres of the western United States. Saltcedar crowds out native stands of riparian and wetland vegetation. It increases the salinity of surface soil, rendering the soil inhospitable to native plant species. Saltcedar provides generally lower wildlife habitat value than native vegetation, and uses more water than comparable native plant communities. These plants can widen floodplains by clogging stream channels and increase sediment deposition due to the abundance of saltcedar stems in dense stands (Colorado State University 2000). This species is a Class C declared noxious weed in Utah. Class C weeds are found extensively throughout Utah and are thought to be beyond control. Statewide efforts are aimed at containment of smaller infestations (Utah Weed Control Association 2015).

Figure 2.17. Descriptions of weed species of particular concern in the planning area.

RESTORATION

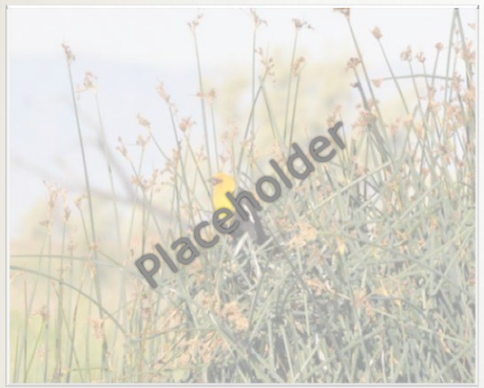
Human encroachment on a river corridor can have a negative impact on the natural functionality of the waterway and its surrounding habitat. Negative impacts from human encroachment near the Jordan River specifically include increased water and air pollution, land-use changes, erosion, a reduction in species diversity, and the proliferation of invasive species. The restoration of species diversity and habitats can combat the negative effects of these impacts and provide important ecosystem services to the surrounding areas and the waterway itself. Restoring native plant diversity and improving habitats throughout the Jordan River corridor can reduce erosion and flooding hazards, increase pollination for urban and agricultural environments, reduce water pollution, benefit wildlife, and improve visual aesthetics. It can also increase the river's aesthetic appeal and create recreational opportunities for the general public.

In addition to restoring native plant diversity and improving habitats, restoration activities should also focus on the physical river channel itself. As development continues around and across the Jordan River, more of the waterway is isolated from its floodplain and forced through impervious channels. This can heighten the risk of flooding and cause costly scour damage downstream during periods of high flow. Erosional damage to the riverbanks not only hinders responsible development near the river, but can also cause dangerous navigational hazards to boaters and other recreationists. Along with erosional effects, sediment loads and deposition caused by increasing development can have an adverse effect on aquatic species, damaging fragile fish and aquatic invertebrate habitats. Restoring riverbanks and channels with more permeable and natural design methods reduces erosion and flood risk, while at the same time increasing habitat quality and recreational opportunity.

Areas of Focus

Restoration focus areas are vegetation, instream habitat, and streambank stability (Figure 2.18). An overarching focus area could be the naturalization of Jordan River flows. Because of human encroachment and the highly managed nature of the Jordan River for flood control, drinking water, irrigation, water rights, and pollution, a return to a hydrograph with high spring runoff driven by melting snow is unlikely in the near future.

Figure 2.19 illustrates the primary restoration concerns and an overview of restoration locations by river segment. Figure 2.20 illustrates the conceptual difference between a degraded riverbank with limited habitat value, limited stability, and invasive species versus a restored riverbank with native vegetation communities that improve habitat and river function. Figure 2.21 provides a plan view example of a restoration project completed by Salt Lake City along the Jordan River intended to improve native vegetation and streambank conditions.



Vegetation

Invasive plant species such as *Phragmites* form large monocultures that displace native plants and reduce habitat quality for wildlife. They can be introduced to the river system with a new disturbance or by seed spread through trail users or animals. Not only do invasive species cause habitat degradation, they also decrease the aesthetic value of the river as a recreational resource. Revegetation with desirable, native plant species provides structured plant communities for quality wildlife habitat and bank stability. Controlling invasive species and revegetating with native plants comprise a major goal of restoration efforts along the Jordan River.

Streambanks

Increasing development along the river has created areas with significant bank erosion. Impermeable surfaces result in more runoff and increase scour along the banks of the river. In many locations, vertical cut banks are present that cannot support vegetation, making them more likely to erode. The lowering of the channel bottom has also caused major undercutting in places and significantly decreased bank stability. Physically restoring banks and channels using natural design methods while maintaining connections to floodplains and riparian areas is crucial to restoring a variety of habitats along the river.

Instream

Many serious navigational hazards along the course of the river were identified during the public involvement phase of this planning effort. These hazards include large rocks or trees that have blocked access to downstream portions of the river and abandoned bridge pylons, low bridges, and head dams that create dangerous situations for recreational boaters and fishermen. Addressing such hazards through instream restoration using vane and weir structures will increase recreational opportunities, reduce streambank erosion, facilitate sediment transport, and promote public support for a natural landscape in a heavily urbanized area.

Figure 2.18. Restoration focus areas along the Jordan River.

Further Reading

Stream Corridor Restoration: Principles, Processes, and Practices (The Federal Interagency Stream Restoration Working Group 2001)

The Practical Streambank Bioengineering Guide (National Resources Conservation Service 1998)

National Resources Conservation Service Stream Restoration website (National Resources Conservation Service 2016)

Sample seed mix from completed restoration projects (see Jordon River Project Portal website)

The Jordan River Natural Conservation Corridor Report (National Audubon Society 2000)

Jordan River Stability Study (CH2M Hill 1992)

Esri Story Map Data Layers

National Wetlands Inventory; Southwest Regional Gap Analysis; Soils; Weed Data; Navigational Hazard Locations; Streambank Erosion Locations; Restoration Sites

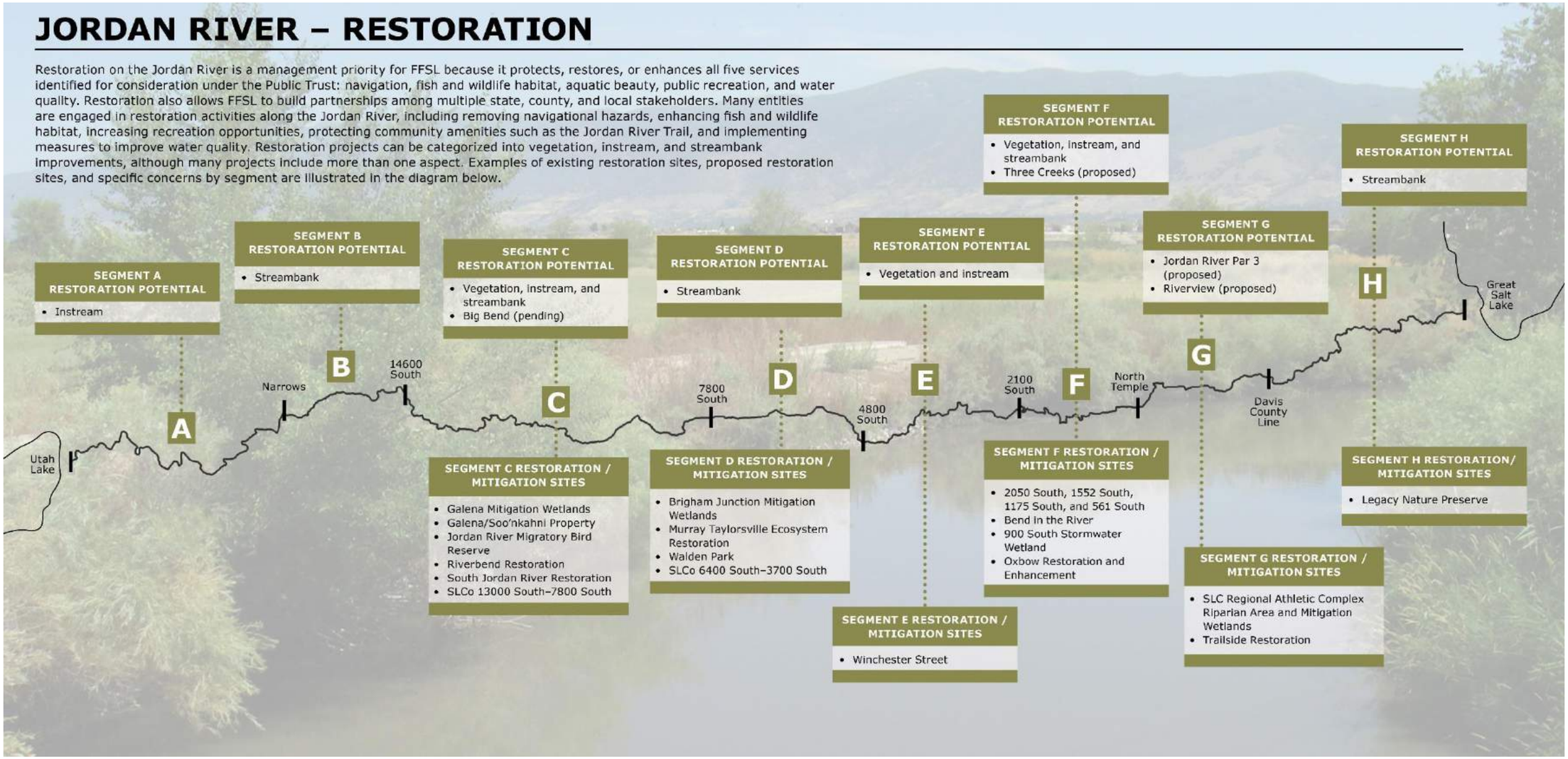


Figure 2.19. Primary restoration concerns and an overview of restoration locations by river segment.

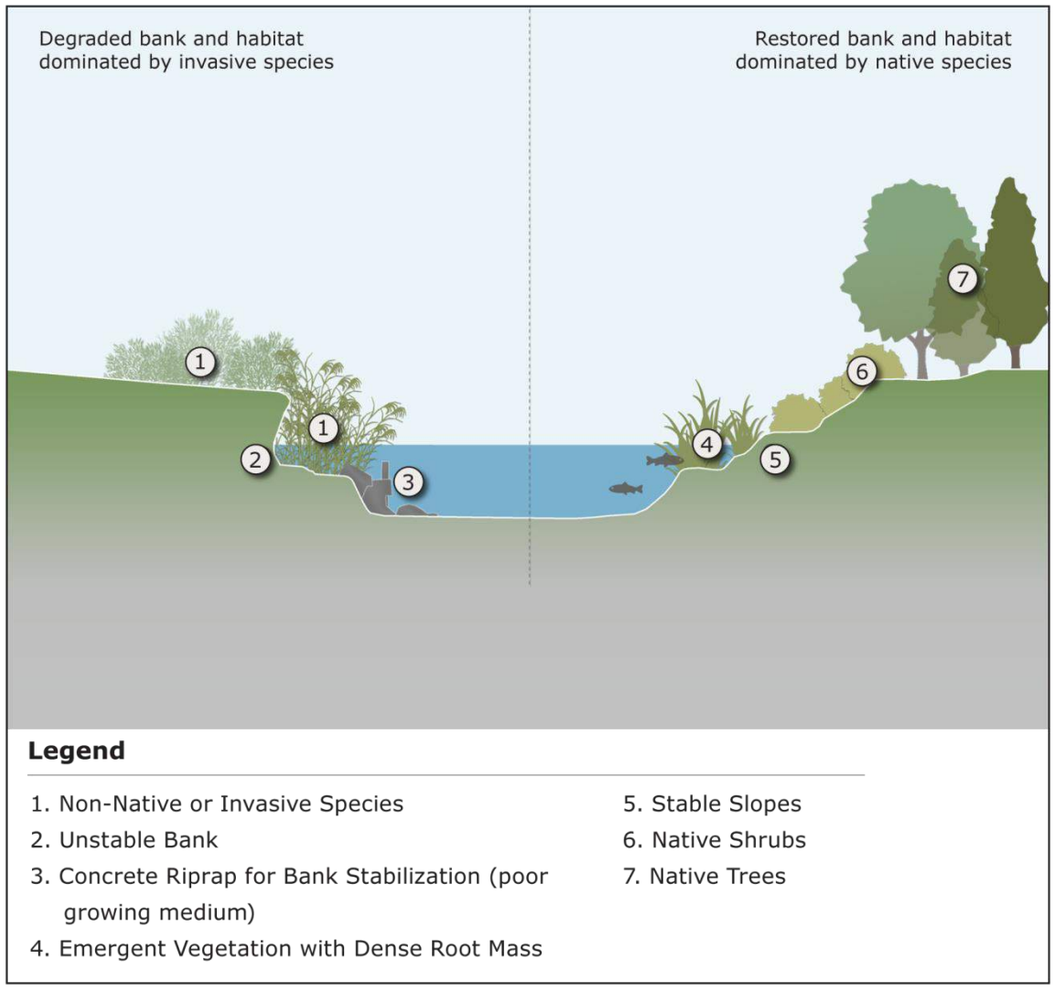


Figure 2.20. River restoration cross section showing degraded banks versus restored riverbank with diverse habitats.

Figure 2.21. Jordan River restoration example: Oxbow Restoration and Enhancement Project.

Wildlife Species

INTRODUCTION

This section provides information on known populations of terrestrial, bird, and fish species known to occur in or adjacent to the Jordan River. It is intended to complement the Wildlife Habitat section by identifying priority wildlife species on which to base development of habitat restoration, enhancement, and/or preservation goals and provide information regarding certain species of regulatory and management concern. The Jordan River corridor provides habitat for many native wildlife species, as well as important stop-over areas and foraging opportunities for migratory birds. Given high levels of disturbance in some areas, populations of non-native wildlife species are also found. Habitat associations for particular wildlife can be found in the Wildlife Habitat section.

Stakeholders working in the planning area should understand that certain wildlife are classified as special-status species, are legally protected, and may require special management under federal or state law. Stakeholders should also understand that certain wildlife species add to, or detract from, the overall health of the Jordan River ecosystem, such as beavers (*Castor canadensis*) and common carp (*Cyprinus carpio*). Planning area stakeholders may also be interested in wildlife species that have recreational value, such as birds. During the *Blueprint Jordan River* public participation process, 34% of survey participants identified wildlife viewing areas as an important recreational activity along the river (Envision Utah 2008). Not only does the presence of a variety of wildlife provide recreational opportunities, it is also an indicator of a healthy ecosystem.

Figure 2.22 illustrates the segments of the river that are likely to contain a variety of wildlife species. Riparian forests, agriculture fields, and parks and golf courses generally support a range of wildlife species.

The following sections describe special-status species, fish species, one key mammal species (beaver), and bird species found within the planning area.

SPECIAL-STATUS WILDLIFE SPECIES

Special-status species include federally listed species that are protected under the Endangered Species Act (threatened and endangered species), species considered as candidates for such listing (candidate species), Utah wildlife species of concern, and species receiving special management under a conservation agreement to preclude the need for federal listing. Two species listed as threatened or endangered under the Endangered Species Act occur in the planning area: the June sucker (*Chasmistes liorus*) and the western yellow-billed cuckoo (*Coccyzus americanus*). June sucker is occasionally found in the southern end of the Jordan River between Utah Lake and the Salt Lake-Utah County line. However, the Jordan River most likely does not support a substantial population of this species. The yellow-billed cuckoo is most likely to occur at the southern end of the Jordan River where the largest, contiguous riparian habitat occurs. However, nesting yellow-billed cuckoos have not been documented along the Jordan River.

Twelve additional species of concern may occur in or directly adjacent to the Jordan River: seven bird species, two mammal species, one amphibian, one reptile, and one invertebrate. There are also two species receiving special management under a conservation agreement (one amphibian and one fish) with the potential to occur in the Jordan River. Table 2.5 provides a summary of these species, including their status, general habitat association, and potential for occurrence in the Jordan River or adjacent habitat.

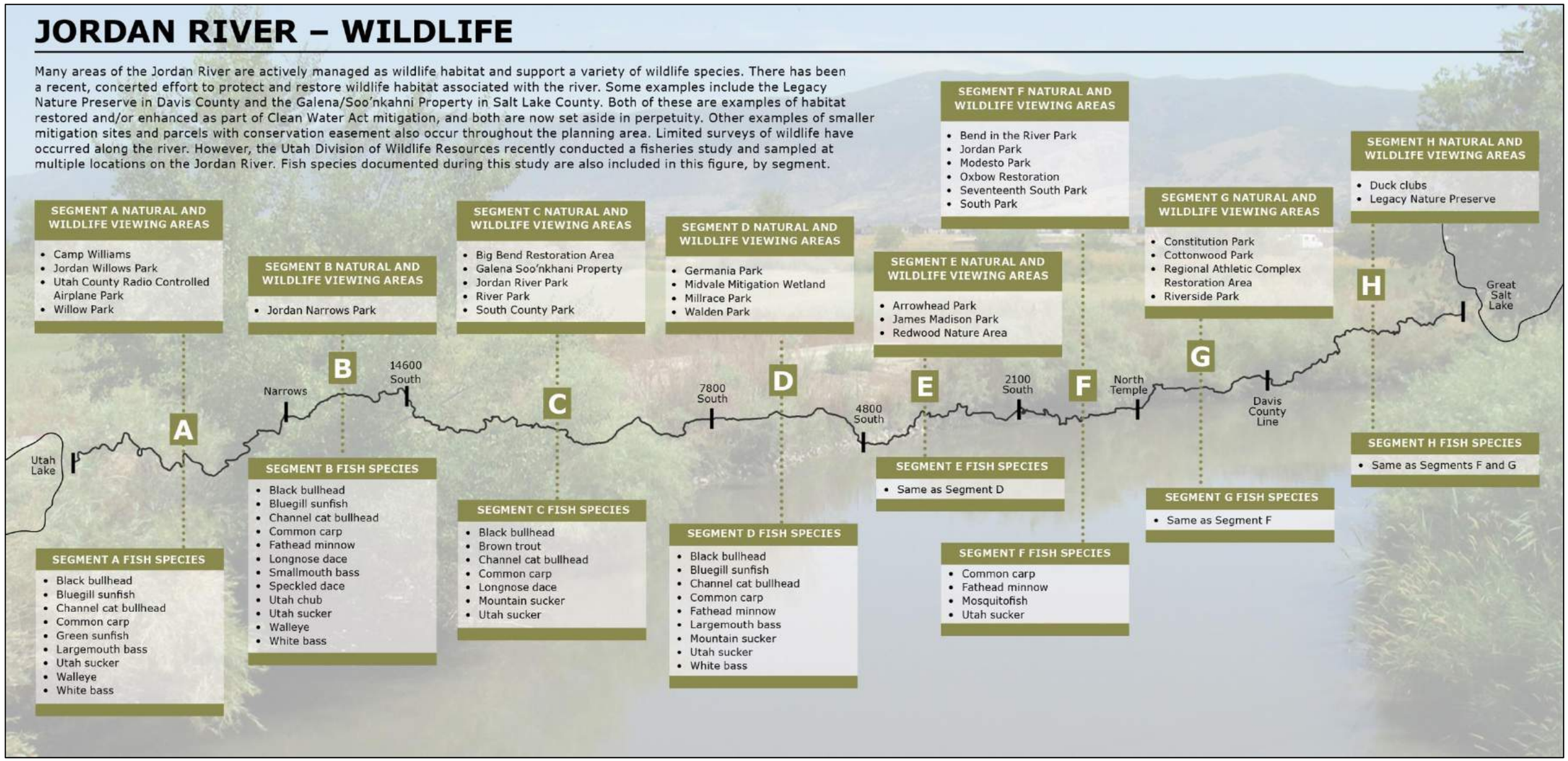


Figure 2.22. Wildlife viewing areas along Jordan River per segment and Division of Wildlife Resources fish occurrence data per segment.

Table 2.5. Special-Status Wildlife Species and their Potential to Occur in the Planning Area

Common Name and Scientific Name	Status	General Habitat Association	Potential to Occur in the Planning Area
BIRDS			
Western yellow-billed cuckoo *Coccyzus americanus*	T-ESA	This species nests in large riparian areas generally made up of cottonwood trees, willows, and several other species.	This species is rare along the Jordan River and only occurs in the summer (Olson 2015). Additionally, there have been eight records of cuckoos being taken by the nesting peregrine falcons (*Falco peregrinus*) in downtown Salt Lake City. Seven of these were documented between 1986 and 1993, but the most recent was documented on July 4, 2014 (Pope 2015). It is not known if these taken cuckoos were from the Jordan River or if they were nesting or migrating at the time they were taken.
American white pelican *Pelecanus erythrorhynchos*	SPC	Foraging sites for this species are often less than 8 feet deep where they feed on small fish, generally less than half of their bill length. The only known breeding area in Utah is on Gunnison Island in Great Salt Lake.	This species can be observed year-round along the Jordan River foraging or flying over.
Bald eagle *Haliaeetus leucocephalus*	SPC	This species tends to nest within 200 meters of water. They eat mainly fish and carrion.	There is one bald eagle nest on the Jordan River. In 2015, the nest was active and produced one chick that successfully fledged (Walters 2015). Several hundred bald eagles winter along the Jordan River every year. They sometimes roost in large trees near the river and feed on carp and carcasses.
Ferruginous hawk *Buteo regalis*	SPC	This species generally nests and forages in open country, primarily prairies, plains, and desert. It tends to nest on cliffs, trees, or in power poles.	This species does not nest along the Jordan River but can be observed in the spring and fall migrating along the river.
Lewis's woodpecker *Melanerpes lewis*	SPC	This species generally occurs in open woodland. It is a cavity nester.	This species has been documented as a rare permanent resident of the Jordan River (Olson 2015).
Bobolink *Dolichonyx oryzivorus*	SPC	This species nests in marshes, grasslands, and in hayfields.	This species has been documented as a rare migrant through the Jordan River (Olson 2015).
Long-billed curlew *Numenius americanus*	SPC	This species primarily nests in short grass and prairies. Migratory habitat includes shortgrass prairies, wetlands, and some agricultural areas such as alfalfa and barley fields.	This species can be observed along the Jordan River in the spring, summer, and fall. They prefer short grass habitats, including shortgrass and mixed-grass prairies as well as agricultural fields.
Short-eared owl *Asio flammeus*	SPC	This species nests and forages in open grasslands, shrublands, and other open habitats.	This species does not nest along the Jordan River but can be observed foraging or migrating along the river in the spring, summer, and fall.
MAMMALS			
Fringed myotis *Myotis thysanodes*	SPC	This species is migratory. It occurs in desert and woodland areas. It roosts in caves, mines, and buildings.	This species most likely migrates by the Jordan River.

Common Name and Scientific Name	Status	General Habitat Association	Potential to Occur in the Planning Area
Western red bat *Lasiurus blossevillii*	SPC	This species is migratory. It roosts and forages in a variety of habitats including forests, grasslands, and croplands.	Though little is known about this species, it is likely to occur at least sporadically along the Jordan River.
AMPHIBIANS AND REPTILES			
Columbia spotted frog *Rana luteiventris*	CS	In Utah, this species is usually found in semi-permanent ponds (Welch and MacMahon 2005) with cool, clear spring-fed water and organic substrates (Dumas 1966; Morris and Tanner 1969).	This species is historically believed to have occurred on the Jordan River. However, surveys conducted in the 1990s failed to detect any spotted frogs, and they are generally thought to have been extirpated from the Jordan River (USFWS 2002).
Western toad *Anaxyrus boreas*	SPC	This species is generally a high elevation species that occurs in wetlands surrounded by a variety of habitats.	This species is thought to still be common on the Jordan River (Potts 2011a). However according to the *Boreal Toad Conservation Plan* (DWR 2005b), no known populations occur near the Jordan River.
Smooth greensnake *Opheodrys vernalis*	SPC	This species prefers moist, grassy areas.	This species is thought to still be rare on the Jordan River (Potts 2011a).
FISH			
Bonneville cutthroat trout *Oncorhynchus clarkia utah*	CS	Like other salmonids, this species generally requires clean, well-oxygenated water and a complexity of inland habitat and overhanging banks for cover.	This species is generally found in and near tributary creeks to the Jordan River.
June sucker *Chasmistes liorus*	E-ESA	Endemic to Utah Lake and Provo River, this species is actually not a bottom feeder but can collect zooplankton from the mid-water.	This is a lake species but is still found in surrounding rivers. It may occur in the southern end of the Jordan River.
INVERTEBRATES			
California floater *Anodonta californiensis*	SPC	This species is found in lakes and lake-like stream environments.	Known from the Jordan River watershed, although the Jordan River is likely too polluted for this invertebrate to survive.

Status: E-ESA = endangered under the ESA, T-ESA = threatened under the ESA, SPC = Utah Wildlife Species of Concern, CS = species receiving special management under a Conservation Agreement to preclude the need for federal listing.

FISH SPECIES

Sixteen dominant fish species have been detected in the Jordan River (Table 2.6). Of these dominant species, five are native, and 11 are introduced. Common carp (*Cyprinus carpio*), a pervasive exotic, is the most common fish species found in the Jordan River. The Utah sucker (*Catostomus ardens*), a native fish, is the second most common fish species in the river.

Table 2.6. Jordan River Fish Species

Common Name	Scientific Name	Notes and Location in Planning Area
NATIVE FISH		
Speckled dace	*Rhinichthys osculus*	Found in Segment B.
Longnose dace	*Rhinichthys cataractae*	Found in Segments B and C.
Utah chub	*Glia atraria*	Found in Segment B.
Utah sucker	*Catostomus ardens*	This species accounts for the second largest amount of fish biomass in the river. Found in Segments A, B, C, D, and E.
Mountain sucker	*Catostomus platythychus*	Smaller than and not as common as the Utah sucker. Found in Segments C, D, and E.
INTRODUCED EXOTIC FISH		
Brown trout	*Salmo trutta*	Generally found in and near tributary creeks to the Jordan River. Found in Segment C.
Common carp	*Cyprinus carpio*	Pervasive. Accounts for the majority of fish biomass throughout the river. This species causes significant negative impacts to native species. Found in all segments.
Fathead minnow	*Pimephales promelas*	Introduced to Utah lake as prey species. Found in Segments B, D, E, F, G, and H.
Black bullhead	*Ameiurus melas*	Found in Segments A, B, and C.
Channel catfish	*Ictalurus punctatus*	Occasionally stocked. Found in Segments A–E.
Mosquitofish	*Gambusia affinis*	Stocked for mosquito abatement. Often found in shallow backwater areas. Found in Segments F, G, and H.
White bass	*Morone chrysops*	Found in Segments A, B, D, and E. This species causes significant negative impacts to native species.
Green sunfish	*Lepomis cyanellus*	Found in shallow areas with cover. Found in Segment A.
Bluegill	*Lepomis macrochirus*	Primarily found in calm backwater areas. Found in Segments A and B.
Largemouth bass	*Micropterus slamoides*	Primarily found in backwater areas. Found in Segment A, D and E.
Walleye	*Stizostedion vitreum*	Found in Segments A and B, especially during the spring spawning run, but found throughout the river.

Sources: DWR (2016); Hatton (1932); Potts (2011b); and Sigler and Sigler (1996).

BIRD SPECIES

A variety of sporadic and anecdotal data regarding bird species is found in the planning area. Many groups, including the DWR and National Audubon Society groups, have historically conducted bird monitoring. More recently, Tracy Aviary developed a citizen science project and is currently monitoring bird use at the Big Bend Restoration Area (Olson 2015). Table 2.7 illustrates those species recorded, their abundance, and their status.

Table 2.7. Bird Species Recorded at Big Bend Restoration Area on July 4, 2015

Common Name	Scientific Name	Abundance/Status
DUCKS AND GEESE		
Cackling goose	*Branta hutchinsii*	RW
Canada goose	*Branta canadensis*	CP
Wood duck	*Aix sponsa*	OP
Gadwall	*Anas strepera*	US
Mallard	*Anas platyrhynchus*	CP

Common Name	Scientific Name	Abundance/Status
Cinnamon teal	*Anas cyanoptera*	US
Northern shoveler	*Anas clypeata*	US, UW
Green-winged teal	*Anas crecca*	US, UW
Ring-necked duck	*Aythya collaris*	RS, UW
Common goldeneye	*Bucephala clangula*	UW
PHEASANTS, GROUSE, AND QUAIL		
California quail	*Callipepla californica*	CP
Ring-necked pheasant	*Phasianus colchicus*	CP
LOONS AND GREBES		
Pied-billed grebe	*Podilymbus podiceps*	US, UW
Western grebe	*Aechmophorus occidentalis*	US, UW
PELICANS AND CORMORANTS		
Neotropic cormorant	*Phalacrocorax brasilianus*	US
Double-crested cormorant	*Phalacrocorax auritus*	CS, UW
American white pelican	*Pelecanus erythrorhynchos*	CS, UW
EGRETS AND IBIS		
Great blue heron	*Ardea Herodias*	UP
Great egret	*Ardea alba*	US, RW
Black-crowned night-heron	*Nycticorax nycticorax*	US, UW
White-faced ibis	*Plegadis chihi*	CS, UW
VULTURES, HAWKS, AND EAGLES		
Turkey vulture	*Cathartes aura*	US
Osprey	*Pandion haliaetus*	US
Northern harrier	*Circus cyaneus*	UP
Sharp-shinned hawk	*Accipiter striatus*	UP
Cooper’s hawk	*Accipiter cooperi*	UP
Swainson’s hawk	*Buteo swainsoni*	FS
Red-tailed hawk	*Buteo jamaicensis*	CP

Common Name	Scientific Name	Abundance/Status
RAILS AND CRANES		
American coot	*Fulica americana*	UP
Sandhill crane	*Grus canadensis*	US
PLOVERS, SANDPIPERS, AND GULLS		
American avocet	*Recurvirostra americana*	US, UW
Killdeer	*Charadrius vociferus*	CP
Spotted sandpiper	*Actitis macularius*	US
Long-billed curlew	*Numenius americanus*	US
Franklin’s gull	*Leucophaeus pipixcan*	FS
Ring-billed gull	*Larus delawarensis*	US, FW
California gull	*Larus californicus*	CS, UW
Caspian tern	*Hydroprogne caspia*	US
Forster’s tern	*Sterna forsteri*	US
PIGEONS AND DOVES		
Rock pigeon	*Columba livia*	CP
Eurasian collared-dove	*Stretopelia decaocto*	CP
Mourning dove	*Zenaida macroura*	CP
HUMMINGBIRDS		
Black-chinned hummingbird	*Archilochus alexandri*	CS
Broad-tailed hummingbird	*Selasphorus platycercus*	CT, RS
KINGFISHERS		
Belted kingfisher	*Megaceryle alcyon*	CP
WOODPECKERS		
Downy woodpecker	*Picoides pubescens*	UP
Northern flicker	*Colaptes auratus*	CP

Common Name	Scientific Name	Abundance/Status
FALCONS		
American kestrel	*Falco sparverius*	CP
Merlin	*Falco columbarius*	UW
Peregrine falcon	*Falco peregrinus*	UP
FLYCATCHERS		
Dusky flycatcher	*Empidonax oberholseri*	US
Say's phoebe	*Sayornis saya*	US
Western kingbird	*Tyrannus verticalis*	CS
VIREOS		
Warbling vireo	*Vireo gilvus*	US
JAYS AND CROWS		
Pinyon jay	*Gymnorhinus cyanocephalus*	UP
Western scrub-jay	*Aphelocoma californica*	UP
Black-billed magpie	*Pica hudsonia*	CP
American crow	*Corvus brachyrhynchos*	UP
Common raven	*Corvus corax*	UP
LARKS		
Horned lark	*Eremophila alpestris*	UP
SWALLOWS		
Northern rough-winged swallow	*Stelgidopteryx serripennis*	CS
Tree swallow	*Tachycineta bicolor*	US
Violet-green swallow	*Tachycineta thalassina*	US
Bank swallow	*Riparia riparia*	FS
Barn swallow	*Hirundo rustica*	CS
Cliff swallow	*Petrochelidon pyrrhonota*	FS
CHICKADEES		
Black-capped chickadee	*Poecile atricapillus*	UP

Common Name	Scientific Name	Abundance/Status
NUTHATCHES AND CREEPERS		
Brown creeper	*Certhia americana*	UP
WRENS		
Marsh wren	*Cistothorus palustris*	US, UW
GNATCATCHERS AND KINGLETS		
Blue-gray gnatcatcher	*Polioptila caerulea*	FS
Ruby-crowned kinglet	*Regulus calendula*	UP
THRUSHES		
American robin	*Turdus migratorius*	CP
THRASHERS		
Gray catbird	*Dumetella carolinensis*	US
STARLING		
European starling	*Sturnus vulgaris*	CP
PIPETS		
American pipit	*Anthus rubescens*	US, UW
WAXWING		
Cedar waxwing	*Bombycilla cedrorum*	US, CW
WARBLERS		
Orange-crowned warbler	*Oreothlypis celata*	US
Virginia's warbler	*Oreothlypis virginiae*	US
MacGillivray's warbler	*Geothlypis tolmiei*	US
Common yellowthroat	*Geothlypis trichas*	US
Yellow warbler	*Setophaga petechia*	US
Yellow-rumped warbler	*Setophaga coronata*	FW
Townsend's warbler	*Setophaga townsendi*	UT
Wilson's warbler	*Cardellina pusilla*	US
Yellow-breasted chat	*Icteria virens*	US

Common Name	Scientific Name	Abundance/Status
SPARROWS		
Spotted towhee	*Pipilo maculatus*	CP
Chipping sparrow	*Spizella passerina*	US
Brewer's sparrow	*Spizella breweri*	US
Vesper sparrow	*Pooecetes gramineus*	US
Song sparrow	*Melospiza melodia*	CP
Lincoln's sparrow	*Melospiza lincolnii*	US, RW
Harris's sparrow	*Zonotrichia querula*	RW
White-crowned sparrow	*Zonotrichia leucophrys*	CP
Dark-eyed junco	*Junco hyemalis*	FW
TANAGERS, GROSBEAKS, AND BUNTINGS		
Western tanager	*Piranga ludoviciana*	US
Black-headed grosbeak	*Pheucticus melanocephalus*	FS
Lazuli bunting	*Passerina amoena*	US
BLACKBIRDS AND ORIOLES		
Red-winged blackbird	*Agelaius phoeniceus*	CP
Western meadowlark	*Sturnella neglecta*	UP
Yellow-headed blackbird	*Xanthocephalus xanthocephalus*	US
Brewer’s blackbird	*Euphagus cyanocephalus*	UP
Common grackle	*Quiscalus quiscula*	RS
Brown-headed cowbird	*Molothrus ater*	FS
Bullock’s oriole	*Icterus bullockii*	CS
FINCHES		
House finch	*Haemorhous mexicanus*	CP
Pine siskin	*Spinus pinus*	UP
Lesser goldfinch	*Spinus psaltria*	FP
American goldfinch	*Spinus tristis*	FP
Evening grosbeak	*Coccothraustes vespertinus*	RS, IW(R-C)
House sparrow	*Passer domesticus*	CP

SPECIES OF MANAGEMENT CONCERN

Beaver

Based on restoration practitioner experience, beavers are common along the Jordan River. Depending on habitat, beavers either build dams or become what are known as “bank beavers.” Bank beavers build their lodges into the banks of rivers if the river is too large or too fast moving to build a traditional dam. Most beavers on the Jordan River are bank beavers. Bank lodges tend to have entrances at or below the water level. Bank beavers will often still build a lodge on top of the streambank to expand the available habitat and to access food with greater safety.

Beavers are often considered a nuisance species because they may cause flooding and because they cut down trees for food and dam building. However, beavers are also recognized as a keystone species for the restoration and conservation of natural resources associated with aquatic and riparian systems (DeVries et al. 2012; Pollock et al. 2012; Polvi and Wohl 2013; Wohl 2013). Beaver dams and lodges are beneficial to many species of wildlife, such as birds, amphibians, small mammals, and big game, as well as fish, by functioning as habitat. Beaver activity as it relates to dam building can also create wildlife habitat; for example, when beavers feed on willows, it encourages shrubbier growth the following year, which can in turn provide excellent habitat for riparian passerine species. Beaver dams also help reduce erosion and filter anthropogenic pollutants from water.

Adaptive beaver management plans have been created for some areas of Utah, such as Park City (Wheaton 2013). The Jordan River does not have a beaver adaptive management plan. The purpose of a beaver adaptive management plan is to advise on how best to manage populations by balancing the habitat needs of the beaver and associated wildlife, the aesthetic value of an area, and the need to protect public and private resources (Wheaten 2013). A beaver management plan for the Jordan River could help benefit both wildlife and recreational use of the river while avoiding damage to public and private infrastructure.

Bird Species

As illustrated in Table 2.7, the list of bird guilds and bird species (>100) observed along the Jordan River is extensive. Using DWR's list of priority habitats (DWR 2005a) and specifically those found in the planning area, i.e., lowland riparian, wetland, and open water (flowing/standing) (see Figure 2.15), the JRCMP recommends using specific guilds or species when developing habitat-related management goals (enhancement, restoration, and preservation). The following sections provide information about these habitats and key bird species that depend on them.

Lowland Riparian and Wetland Habitat

Wetland and riparian habitats, like those adjacent to the Jordan River, are generally more productive and biologically diverse than surrounding upland habitats. Bird communities especially have greater diversity in riparian and wetland habitats than in upland habitats (Skagen et al. 2005; Woinarski et al. 2000). Roughly 50% of the bird species in the American Southwest nest exclusively in riparian and wetland habitat, and another 21% nest in higher densities in these habitats than in surrounding habitats (Johnson et al. 1985; Skagen et al. 2005). Increasing evidence also highlights the importance of riparian habitats during bird migration. Structurally complex riparian areas appear to have a higher abundance of birds and a higher diversity of bird species than do less complex areas (Krueper et al. 2003; Scott et al. 2003).

Key Riparian Species

The yellow warbler (*Setophaga petechia*), found throughout Utah, including the Jordan River, generally nests in small riparian trees. Given the yellow warbler's relative abundance in the area and its nesting habitat parameters, it can be used as a Jordan River indicator species to suggest a benchmark has been achieved in the development of restored riparian habitat.

Key Wetland Species

The American avocet (*Recurvirostra americana*), which is found in northern Utah, inhabits shallow wetlands and mudflats during the breeding season. The presence of this species may be used as an indication that a certain level of wetland restoration success has been achieved.

Open Water (flowing and standing)

Open water combines both flowing and standing aquatic habitats. It comprises approximately 3.4% of the total area of Utah (DWR 2005a) and includes lakes, reservoirs, streams, and rivers. Aquatic habitats on the Jordan River in many ways reflect the larger diversity of open water systems because there are areas of moderate gradient (flowing water) and areas of extremely low gradient (standing water) along various segments. Common types of birds seen in these habitats include ducks, geese, and swans. This family (Anatidae) of birds has evolved to float on the water's surface. Some species also dive for food in shallow areas. Sixteen different species in this guild can be observed on the Jordan River: Canada goose (*Branta canadensis*), tundra swan (*Cygnus columbianus*), wood duck (*Aix sponsa*), mallard (*Anas platyrhynchus*), gadwall (*Anas strepera*), northern pintail (*Anas acuta*), northern shoveler (*Anas clypeata*), cinnamon teal (*Anas cyanoptera*), green-winged teal (*Anas crecca*), blue-winged teal (*Anas discors*), American wigeon (*Anas americana*), redhead (*Aythya americana*), ruddy duck (*Oxyura jamaicensis*), bufflehead (*Bucephala albeola*), common goldeneye (*Bucephala clangula*), and common merganser (*Mergus merganser*).

Also represented on the Jordan River are Clark's grebe (*Aechmophorus clarkii*), western grebe (*Aechmophorus occidentalis*), eared grebe (*Podiceps nigricollis*), and pied-billed grebe (*Podilymbus podiceps*). These species in the Podicipediformes family can be seen floating on the water but dive underwater to forage for fish.

Key Open Water Species

The **American coot** (*Fulica americana;* Rallidae family) is also common on the surface of the Jordan River. This species is found throughout northern Utah on still or slow-moving open waters. They will readily use water areas that are not heavily polluted.

Carp

Because carp account for the majority of fish biomass in the Jordan River (Potts 2011b), additional information on this species is included here. Carp are an exotic, pervasive fish that has the following negative effects on aquatic systems:

- Reduction of water quality by disturbing sediments.
- Riverbank erosion (carp feeding habits can undermine banks and cause them to collapse).
- Impacts to invertebrates (as carp increase in size, they begin eating native invertebrates).
- Impacts to aquatic plants through direct grazing and the uprooting of plants when feeding.
- Introduction of disease (carp often carry a range of parasites, fungal bacteria, and viral diseases).
- Impacts to native fish through competition for food and the effects of recruitment (population replenishment).

Rotenone, a natural chemical extracted from several tropical plants, is the most widely used toxicant to control carp populations. It is nontoxic to humans or waterfowl and is environmentally non-persistent (Wydoski and Wiley 1999). It was used for years in Farmington Bay to control carp populations. Other methods to control carp populations include physical barriers, harvesting through seining or trapping, and improving water clarity.

Further Reading

Tracy Aviary Bird Monitoring at Big Bend Restoration Area Report (Roe 2015; not available online)

Utah Comprehensive Wildlife Conservation Strategy (Utah Division of Wildlife Resources 2005a)

Utah Partners in Flight Avian Conservation Strategy, Version 2.0. (Parish et al. 2002)

Esri Story Map Data Layers

National Wetlands Inventory; Southwest Regional Gap Analysis; Monitoring Locations; Utah Division of Wildlife Resources Habitat Data Layers; Watchable Wildlife Locations

This page intentionally blank

2.3 Water Resources

Water resources in the Jordan River planning area are discussed in two sections: Hydrology and Water Quality.

Hydrology

The hydrology of the Jordan River is a study in the quantity, distribution, and timing of the flow of the river. The term *hydrology* represents a wide array of elements that when considered collectively describe the life of the river. The Jordan River is unique in that it generally operates much like a managed irrigation facility rather than a natural river that ebbs and flows in response to precipitation. The exception is during high snowmelt runoff events when the river functions more naturally. Many factors have coalesced to shape the river as it is today, including its natural position in the landscape and human-induced factors such as regulated releases from Utah Lake, irrigation diversions and returns, managed tributary flows, flood control practices, and development both within the banks of the river itself and the associated floodplain. Because of its hydrologic complexity, the river system is best described through an in-depth look at several of its primary elements: geomorphic setting, water budget, and surface water flow.

GEOMORPHIC SETTING

Geomorphic setting refers to the form of the landscape and other natural features that govern the physical layout of the river. The Jordan River begins its journey at the outlet of Utah Lake where it flows northward through the Salt Lake Valley for approximately 50 miles and terminates in Great Salt Lake. It is a slightly sinuous perennial stream with sinuosity increasing in the upstream direction (CH2M Hill 1992). An illustration of the longitudinal profile of the river was developed as a part of the *Lower Jordan River: Phase 1 Report* using a HEC-RAS model provided by Salt Lake County (SWCA and Hansen, Allen, & Luce 2013). HEC-RAS is a one-dimensional, steady state hydraulic model developed by the USACE. The *Lower Jordan River: Phase I Report* model includes cross sections of the river beginning at Utah Lake and extending north to Burnham Dam. Each cross section contains data such as channel shape and the location of the left and right bank. The longitudinal profile illustrates a parabolic shape with slope decreasing in the downstream direction beginning at Turner Dam (Figure 2.23). The channel is steepest just below Turner Dam and becomes progressively less steep moving downstream. As the Jordan River approaches Great Salt Lake, gradients become very small.

Consideration of the geomorphology of the river requires understanding the concept of river stability. For the purposes of this document, stability is defined in the context of a riverine system, one that contains key physical features such as a historic floodplain, active floodplain, and a river channel. These features are illustrated in a plan view in Figure 2.24 (a corresponding cross section is shown in Figure 1.2). A stable river is one in which meanders migrate throughout the active floodplain and bank locations change over time. For the Jordan River, migration of meander bends and erosion of banks are part of the river's dynamic equilibrium (CH2M Hill 1992). A more detailed description of these concepts as they apply to specific reaches of the river can be found in the *Jordan River Stability Study* (CH2M Hill 1992) and the *Jordan River Corridor Preservation Study* (JE Fuller/Hydrology & Geomorphology and CH2M Hill 2007). Additionally, FFSL maintains a map recording the historic locations of the Jordan River channel in 1856, 1937, 1963, 1992, and 1997 (FFSL 2016). This map illustrates changes in the channel over time as a result of both natural channel migration and channel manipulation.

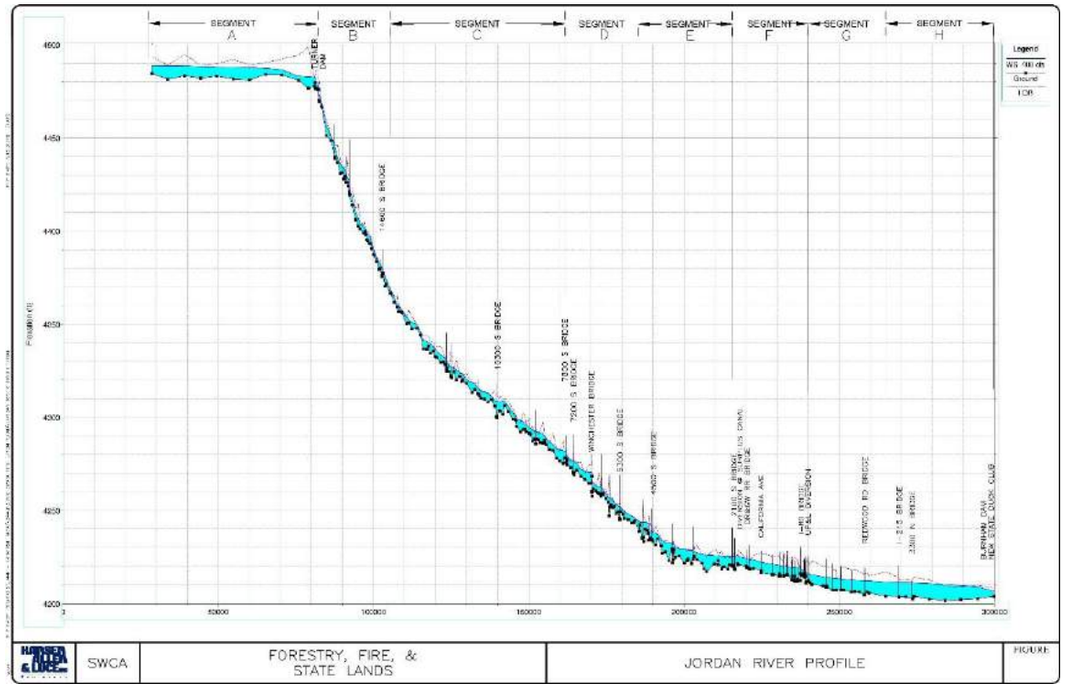


Figure 2.23. Longitudinal profile of the Jordan River.

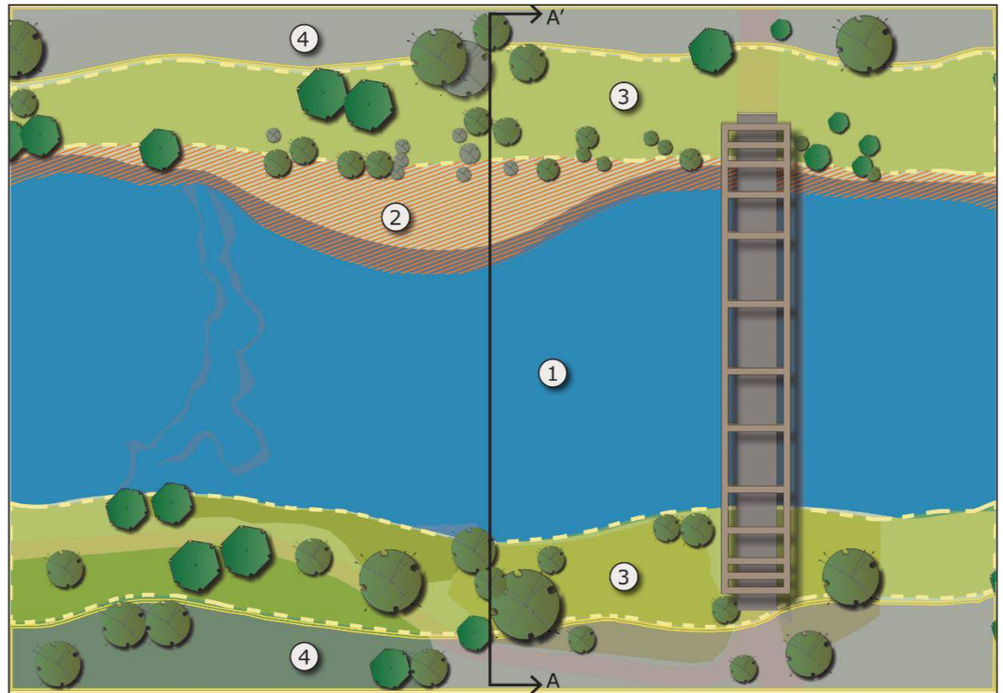


Figure 2.24. Jordan River plan view showing physical features such as a historic floodplain, active floodplain, and a river channel. *Note*: "A" represents the span of the river that is also shown on the corresponding cross section in Figure 1.2.

When channel manipulation occurs, the natural dynamic equilibrium of the river is disrupted. Several changes have occurred over the past century that affect the equilibrium along the Jordan River, including river straightening, dredging, channel relocation, and stabilization. For example, Figure 2.25 illustrates the river extent and location in Murray both before (1937) and after (1990) the construction of I-215. The replacement of the floodplain with high density development, in addition to other channel manipulation activities, forces the river to adjust to these changes. The pace at which the adjustment occurs is much more rapid than what would naturally occur. This can lead to significant bank erosion (Figure 2.26), among other problems.

Figure 2.25. Comparison of the Jordan River before and after Interstate 215 construction.

Figure 2.26. Bank erosion along the Jordan River.

WATER BUDGET

A water budget reflects the relationship between the inputs, outputs, and changes in the amount of water in a specific region by breaking the water cycle into components. A general description of the sources and associated volume of water moving through the Jordan River watershed is important for understanding water use by both natural and human systems. It also lays the groundwork to illustrate a more detailed flow network. A water budget for the Jordan River Basin was developed by DWRe (2010) and is recreated here in Table 2.8. DWRe defines the Jordan River Basin as comprising all of Salt Lake County, with the exception of the northwest portion of the county that lies in Great Salt Lake. It includes all streams tributary to the Jordan River from the Salt Lake County line north to Great Salt Lake (DWRe 2010). For a more detailed description of the budget estimate methodology, see Section 2 of *Jordan River Basin Planning for the Future* (DWRe 2010).

Table 2.8. Water Budget for the Jordan River Basin

Category	Water Supply (acre-feet/year)
Total precipitation *(used by vegetation and natural systems + basin yield)*	900,000
Used by vegetation and natural systems	503,000
Basin yield *(groundwater recharge + surface water flow)*	397,000
Groundwater recharge	219,000
Surface water flow	178,000
Inflow to the Jordan River Basin	295,000
Imports to the Jordan River Basin	171,000
Total available supply (basin yield + inflow + imports)	**863,000**
Groundwater withdrawals	165,000
Agricultural depletions	32,000
M & I depletions	181,000
Other depletions	95,000
Flow to Great Salt Lake *(total available supply - groundwater recharge + groundwater withdrawals - depletions)*	501,000

Source: DWRe (2010).

The Jordan River Basin receives approximately 900,000 acre-feet of precipitation annually, over half of which is used by vegetation and natural systems. The remaining portion, plus inflow to the basin from the Jordan River at the Utah County line and imports to the basin, equates to a total available supply of 863,000 acre-feet annually. This is largely used through groundwater withdrawals and municipal and industrial depletions.

SURFACE WATER FLOW

The Jordan River originates at Utah Lake, an approximately 150-square-mile natural lake that is the single largest contributor to flow in the river (Cirrus 2013). In 1902, a gated structure and pumping plant were constructed at the Utah Lake outlet so that releases from the lake could be regulated. Releases are regulated based on two guiding principles that were developed as a part of a legal settlement known as the "Compromise Agreement" and that are currently part of the *Utah Lake and Jordan River Operating Procedures and Flood Management Plan* (DWRi 1992). These guiding principles are as follows:

- A maximum lake elevation of 4,489 feet above sea level. The gate outlet is opened when lake stage exceeds this elevation, and release rate is determined by the outlet capacity of Utah Lake or the current flows of the river.
- Minimum flows are released into the river when the lake level falls below 4,489 feet; flows are determined by the water rights of downstream users. However, Jordan River flows at the 2100 South diversion are limited to less than 3,400 cubic feet per second (cfs).

Gates are typically opened during the irrigation season (February–October 15) and remain closed during the non-irrigation season until sufficient storage is accumulated in the lake to meet downstream water rights for the following year (Cirrus 2013). During years of potentially high spring snowmelt runoff, flows are released to decrease lake elevation in anticipation of high tributary contribution.

In addition to flows from Utah Lake, the Jordan River receives flow from seven perennial tributaries (all on the east side of the basin) and nine intermittent tributaries. Flow from the seven perennial tributaries and the combined average annual flow from all Wasatch Mountains streams are shown in Table 2.9. Average annual flow from the Wasatch Mountains streams is 173,500 acre-feet compared to 4,500 acre-feet from the Oquirrh Mountains streams. For most of the year, flow from City Creek, Parley's Creek, Little Cottonwood Creek, and Big Cottonwood Creek are diverted for culinary purposes. All other perennial tributaries are diverted for irrigation during

the irrigation season before reaching the Jordan River, with the exception being during spring snowmelt or storm events when water quality is poor and diversion works are exceeded. In this case, tributary flow reaches the river, along with a large quantity of sediment. Urbanization of tributary watersheds has resulted in the routing of four of the seven perennial tributaries through conduits to reach the river. These include City Creek, which enters the river through the North Temple outfall and Red Butte, Emigration, and Parley's Creeks, which primarily enter the river through an outfall at 1300 South or conduits at 800 and 900 South.

Other sources of flow to the river consist of permitted discharges from wastewater treatment plants (WWTPs), stormwater, diffuse runoff, irrigation diversions and return flows, and groundwater. A detailed description of each source of flow is provided in Appendix C of the *Jordan River Total Maximum Daily Load Water Quality Study – Phase 1* (Cirrus 2013).

Table 2.9. Annual Flow for Major Tributaries to the Jordan River

Canyon Stream	Flow	
	Average (acre-feet)	90% Reliability
City Creek	11,750	7,730
Red Butte Creek	2,450	1,330
Emigration Creek	4,440	1,290
Parley's Creek	18,130	9,090
Mill Creek	10,760	7,020
Big Cottonwood Creek	51,240	36,300
Little Cottonwood Creek	46,190	32,950
Other tributaries	28,540	–
Wasatch Mountains Streams	173,500	115,550

Note: 90% reliability indicates that the stated flow will be exceeded in 9 out of 10 years.
Source: DWRe (2010).

An extensive canal system is present in the Salt Lake Valley to transport water for crops, flood control, and public water supply purposes. An inventory of irrigation diversions conducted during the TMDL process (Cirrus 2013) indicates that there are eight major diversions supporting 11 canals on both the east and west side of the river. For irrigation purposes, water is typically diverted from late spring to early fall; however, water may be moved year-round for flood control and water supply use, as is the case with the North Jordan Canal. The diversion network is illustrated in Figure 2.28 in the Existing Hydrologic Condition by Segment section. One of the larger diversions is the Surplus Canal, which extends from the Jordan River at 2100 South to Great Salt Lake and is managed as a flood control feature. Approximately 70% of water in the Jordan River can be diverted through the Surplus Canal at any given time (Salt Lake County 2009).

The flow of the Jordan River can be illustrated with a hydrograph, which shows the rate of flow versus time past a specific point in the river. Gages along the river regularly measure flow. The past 20 years of approved flow data (1995–2014) were used for each of two gages to create monthly mean hydrographs. Select gages illustrate flow both above (Gage #150) and below the Surplus Canal diversion (Gage #10171000). Information and general location of flow gages are presented in Table 2.10.

Table 2.10. Select U.S. Geological Survey and Salt Lake County Flow Gages on the Jordan River

Flow Gage Number	Operator	Description	Time Period Used in the Analysis	Average Annual Flow (cfs)
150*	Salt Lake County	Jordan River at 90th South	1995–2011	307
10171000†	USGS	Jordan River at 1700 South	1995–2014	126

* Data from Salt Lake County (2016a).
† Data from USGS (2016).

The hydrograph presented in Figure 2.27 clearly illustrates the effect of the Surplus Canal diversion on flow in the Jordan River. The variability in flow above the diversion (90th South) is similar to typical flows in montane watersheds in Utah in that there is a spring runoff period driven by snowmelt followed by a decline throughout the summer. In contrast, flows in the river below the diversion (1700 South) are much more stable and reflect the extent to which flow is regulated by the Surplus Canal.

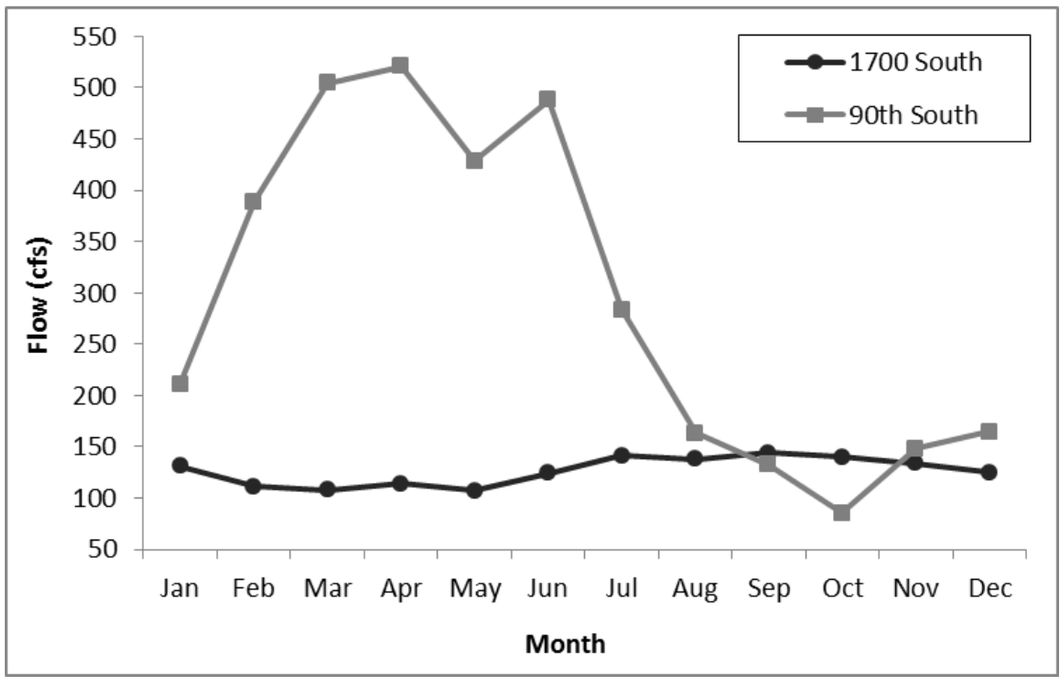


Figure 2.27. Monthly mean hydrograph for flow gages above and below the Surplus Canal.

FLOODING

Flooding and flood control efforts have had significant effects on the shape, alignment, and condition of the Jordan River. Information on flood control is provided here and in the Infrastructure Flood Control section of this chapter. Salt Lake County's flood control access points are shown on the Esri story map and GIS spatial data viewer for the JRCMP on the FFSL website. No information on flood control in Utah and Davis Counties is included given the ability to manage high water using the Utah Lake Outlet Dam and the Surplus Canal, respectively. Flooding on the Jordan River in Davis County is also influenced by water levels in Great Salt Lake.

The FEMA flood insurance study report for Salt Lake County provides the following summary of flood protection efforts in the county:

> Efforts to control flooding in Salt Lake County extend back to 1885 when local interests constructed the Surplus Canal from 2100 South Street to the Great Salt Lake. The purpose of this flood control structure was to divert upstream the Jordan River runoff around Salt Lake City. Enlargement of the canal was completed by the USACE in 1960. In order to supply downstream water rights, a gated structure was constructed at the head of the Surplus Canal and on the adjacent diversion to the Jordan River north of 2100 South. During periods of high runoff, the gates to the Jordan River north of 2100 South are closed, diverting all water in the Jordan River upstream of 2100 South into the Surplus Canal. This action reduces flood damage along the Jordan River in Salt Lake City by reserving channel capacity for inflow from the Salt Lake City streams … As part of this same project, levees were also constructed on the Jordan River from the head of the Surplus Canal to the Mill Creek confluence. (FEMA 2012)

EXISTING HYDROLOGIC CONDITION BY SEGMENT

The existing hydrologic condition of the Jordan River by segment, including major inflows and outflows, WWTP discharges, and current and historical flow gages is presented in Table 2.11 and Figure 2.28.

Table 2.11. Existing Hydrologic Condition by Segment on the Jordan River

Segment	Major Inflows	Wastewater Treatment Plant Discharge	Major Outflows	Current and Historical Flow Gages (period of record)
A	Utah Lake	–	–	USGS 10166605 (1985–1987)
B	–	–	East Jordan Canal, Utah Canal, Salt Lake Canal, South Jordan Canal	USGS 10167000 (1935–1991)
C	–	–	North Jordan Canal	SLCo 150 (1979–present)
D	–	South Valley Water Reclamation Facility	–	–
E	Little Cottonwood Creek, Big Cottonwood Creek, Mill Creek	Central Valley WWTP - discharges to Mill Creek	Brighton Canal	USGS 10167300 (1980–1985)
F	Parley's Creek, Emigration Creek, Red Butte at 1300 South; also includes irrigation returns, City Creek	–	Surplus Canal	USGS 10171000 (1942–present) USGS 10170490 (1942–2014)
G	–	–	–	SLCo 960 (1975–present)
H	–	South Davis WWTP	State Canal	–

For Further Reading

Jordan River Stability Study (CH2MHill 1992)

Utah Lake and Jordan River Operating Procedures and Flood Management Plan (Utah Division of Water Rights 1992)

Jordan River Basin Planning for the Future (Utah Division of Water Resources 2010)

Jordan River Total Maximum Daily Load Water Quality Study – Phase 1 (Cirrus Ecological Solutions, LC. 2013).

Esri Story Maps Data Layers

Perennial Tributaries; Flood Control Data; Floodplain; Cross-Section Data, Restoration Channel Geometry; Flow Data; Diversions; Watershed Boundary; Jordan River Meander Corridor; National Hydrography Dataset; Wastewater Treatment Plant Locations; Longitudinal Profile of the Jordan River; Historic Jordan River Channel

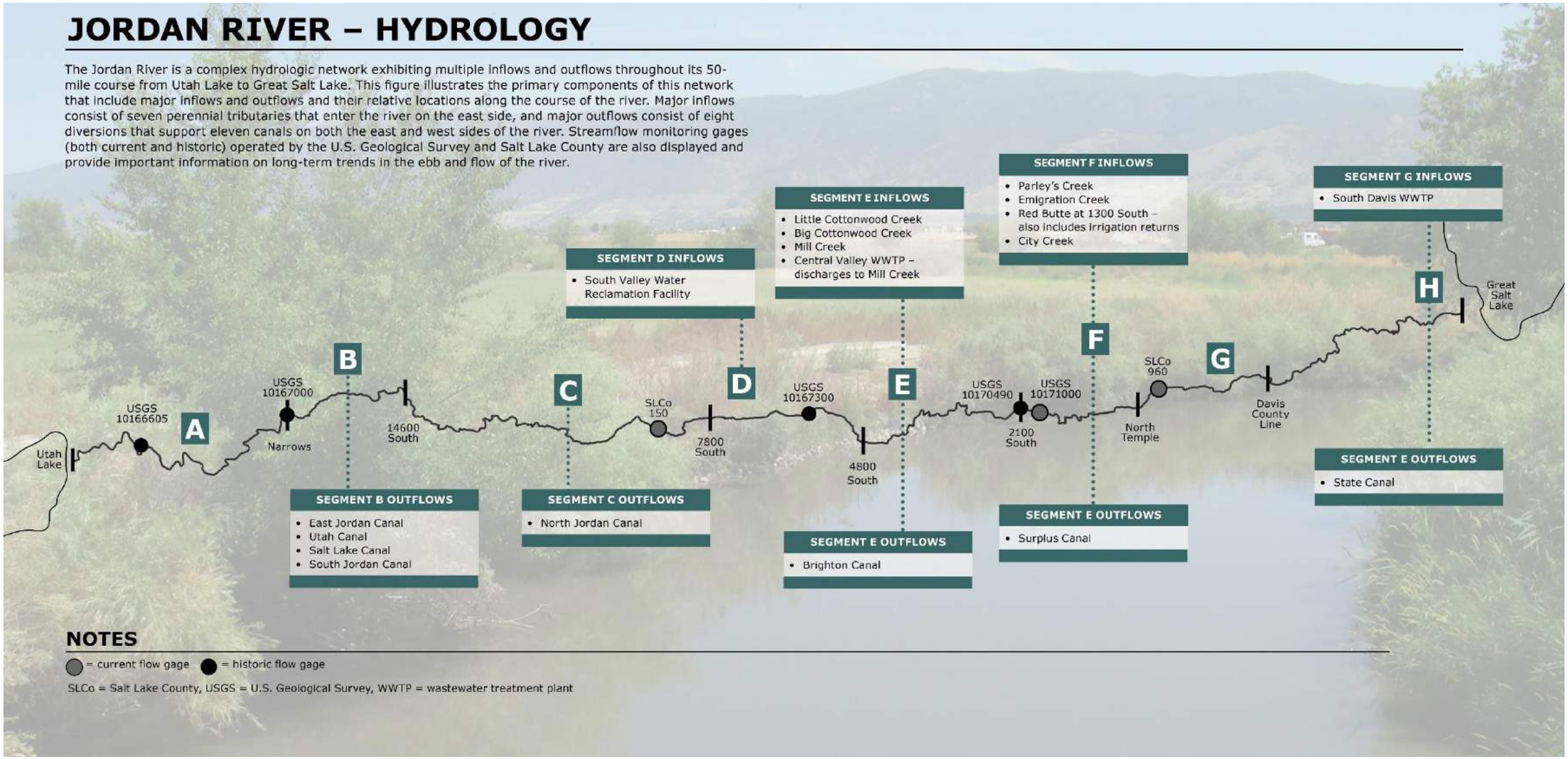


Figure 2.28. Existing hydrologic condition of the Jordan River by river segment.

Water Quality

Water quality refers to the chemical, physical, biological, and radiological characteristics of water. It is a measure of the suitability of water for a particular use. The State of Utah has developed and adopted over 190 water quality numeric criteria (chemical concentrations that should not be exceeded) to protect water quality and designated uses of surface waters. The water quality criteria for a pollutant can vary depending on the beneficial use assigned to a waterbody. To identify the use and value of a waterbody, DWQ has developed four major beneficial use classifications to characterize the uses of surface waters within the state. Table 2.12 lists Utah's four major beneficial use classifications and sub-classifications.

Table 2.12. Utah's Beneficial Use Classifications

Major Beneficial Use Classifications	Beneficial Use Sub-Classifications
1 Domestic Water Systems	1C Drinking Source Water
2 Recreational Use and Aesthetics	2A Frequent Contact Recreation
	2B Infrequent Contact Recreation
3 Aquatic Wildlife	3A Cold Water Aquatic Life
	3B Warm Water Aquatic Life
	3C Nongame Aquatic Life
	3D Waterfowl/Shorebirds
4 Agricultural	4 Agriculture

Source: Utah Administrative Code R317-2-6.

For the purposes of evaluating water quality and beneficial use support of the Jordan River, DWQ has subdivided the river into eight units, which coincide with the segments used in this plan (Table 2.13, Figure 2.29). Beneficial uses for the various segments of the Jordan River include domestic uses (Class 1C); secondary contact recreation such as boating, wading, and fishing (Class 2B); cold water fisheries (Class 3A); warm water fisheries (Class 3B); nongame fish (Class 3C); wildlife (Class 3D) and agricultural irrigation (Class 4). These uses are protected by a variety of water quality numeric criteria. Some segments of the Jordan River have been found to be non-supporting of one or more beneficial uses (i.e., impaired) due to the exceedance of one or more water quality criteria. Descriptions of water quality impairments that occur in the Jordan River are provided in Table 2.14.

Table 2.13. River Segments and Corresponding Utah Division of Water Quality Assessment Units

FFSL River Segments	Utah Division of Water Quality Assessment Units*
Segment A	Unit 8
Segment B	Unit 7
Segment C	Unit 6
Segment D	Unit 5
Segment E	Unit 4
Segment F	Unit 3
Segment G	Unit 2
Segment H	Unit 1

* Data from Utah Administrative Code R317-2-6.

Table 2.14. Descriptions of Water Quality Impairments that Occur in the Jordan River

Impairment	Description
Escherichia coliform (E. Coli)	Elevated concentrations of *E. coli* have been measured in Segments D, E, F, G, and H. Processes and pollutant sources that contribute to impairment from high levels of *E. coli* are currently under investigation by DWQ. *E. coli* in water is an indicator of pathogen presence and is therefore a public health concern.
Total dissolved solids (TDS)	Elevated levels of TDS have been identified in Segments A, C, D, and E. Some of the larger known sources of TDS pollution that enter the Jordan River include discharge from Utah Lake, groundwater, wastewater discharge, irrigation return flow, and tributary inflow. High levels of TDS can negatively influence both livestock health and crop production.
Temperature	Temperature levels that exceed the Class 3A cold water aquatic life standard (20°C) have been measured in Segments B, C, and D. Warm waters discharged from Utah Lake and a lack of vegetative canopy in the riparian corridor in these segments influence water temperatures in the Jordan River. Temperature exceedances are a concern for aquatic species that have a limited temperature range within which they can survive and reproduce.
Dissolved oxygen (DO)	Low levels of DO are currently a concern in Segments C, F, G, and H, although a TMDL has been completed and approved for DO in Segments F, G, and H. DO levels in the Jordan River are part of a complex and dynamic system with many factors and processes influencing concentrations such as 1) physical factors, 2) aerobic decomposition and 3) nighttime algal consumption of DO associated with the transition from plant photosynthesis to respiration.
Copper	High levels of copper are currently a concern in Segment H. Although an essential nutrient at low concentrations, copper can be toxic to aquatic organisms at higher concentrations.
OE bioassessment	OE bioassessment is the biological health of a waterway that includes the protection of fish and the organisms on which they depend. Biological health is currently a concern in Segments B, C, E, F, G, and H.
Total phosphorus	Total phosphorus is a concern in Segment F. Phosphorus occurs naturally and is important for supporting aquatic food webs; however, high levels promote excess algae growth that can degrade lakes and streams.
Selenium	Selenium is a concern in Segment C. It is a naturally occurring element but can be toxic to aquatic life and other organisms (e.g., birds) that consume aquatic organisms.
Arsenic	High levels of arsenic are a concern in Segment A, primarily as it relates to drinking water. Arsenic is toxic to humans when consumed at certain concentrations.

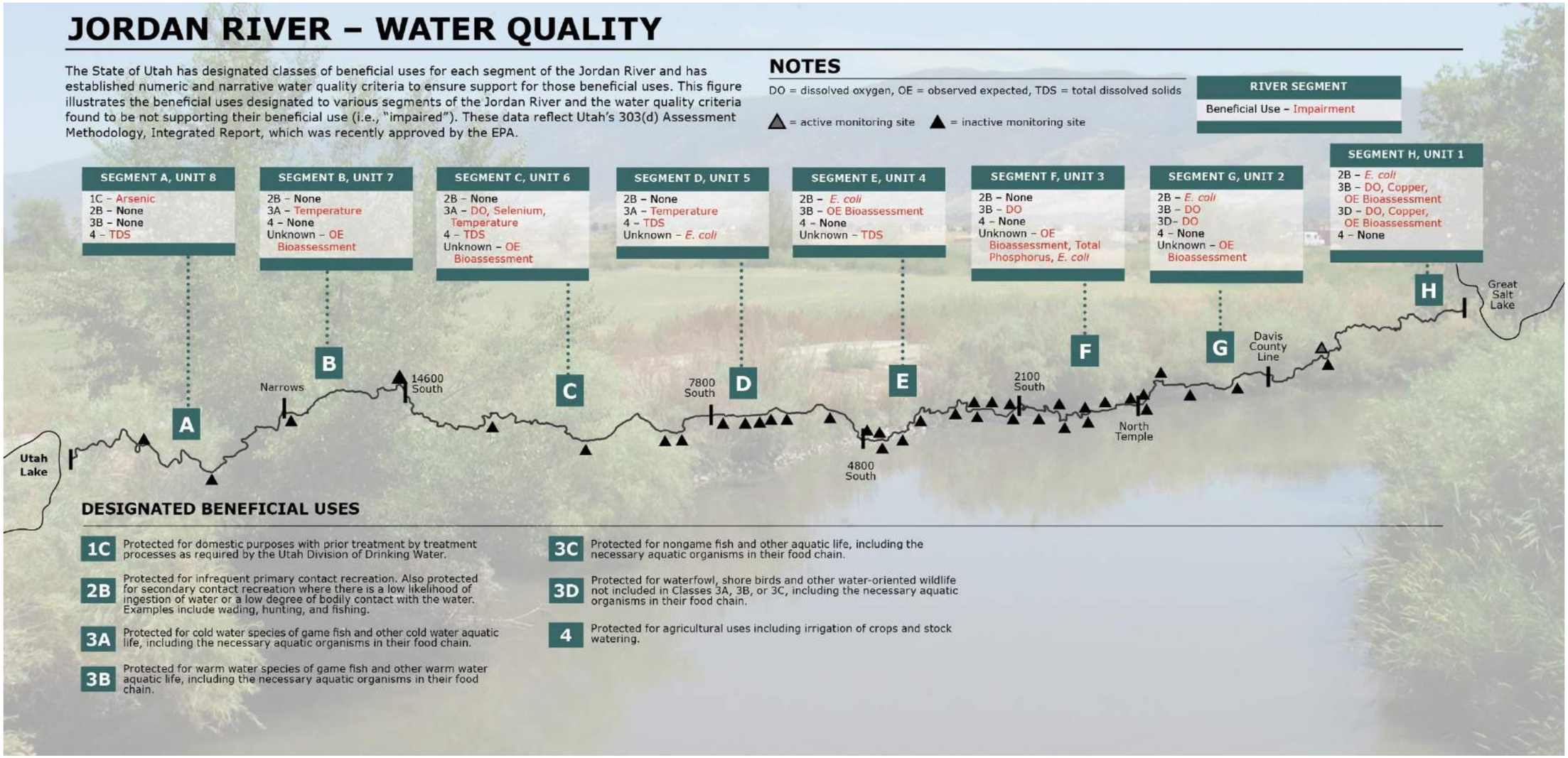


Figure 2.29. Beneficial uses and impaired segments of the Jordan River.

DWQ initiated water quality investigations of the Jordan River in 1996, and these have been ongoing since that time. The results of these investigations have shown that levels of dissolved oxygen (DO), total dissolved solids (TDS), temperature, and *Escherichia coliform* (*E. coli*) exceed Utah's water quality criteria for some segments of the Jordan River (see Figure 2.29). When levels of a pollutant such as *E. coli* exceed state water quality criteria, the waterbody is considered to be impaired, and the state is required by the CWA to develop a TMDL. A TMDL is the amount of a given pollutant that a waterbody can receive and still meet water quality standards. The methodology used by DWQ for assessing water quality conditions and determining beneficial use support is included in *Utah's 303(d) Assessment Methodology, Integrated Report* (Flemer et al. 2016).

In 2013, DWQ completed a TMDL for the Jordan River (Cirrus 2013). The 2013 TMDL addresses the maximum concentration of total organic matter that will maintain the state's instantaneous DO water quality numeric criteria for the lower Jordan River. Impairments from other pollutants (TDS, *E. coli*, and temperature) are also addressed in the 2013 TMDL; however, the report does not include a TMDL for TDS, temperature, or *E. coli*. Exceedances of the numeric criteria for temperature and TDS are largely due to natural causes, including shallow water, hot summer air temperatures, and groundwater high in natural thermal discharges and TDS (Cirrus 2013). A separate analysis of these factors is being undertaken that may include proposals for site-specific criteria. In addition, *E. coli* measurements are currently being collected throughout the Jordan River watershed to support a future TMDL study for this pollutant.

Segments D through H are high priority for TMDL development by 2022 for both *E coli* and DO because 1) a TMDL is already in progress, 2) the Jordan River supports high levels of recreational use, and 3) the Jordan River is considered an important fishery. Also, Segment A is listed as high priority for arsenic because it is a drinking water source.

A synopsis of all documents produced as part of the Jordan River TMDL study from 2005 through 2010 is included in Appendix B of the 2013 TMDL (Cirrus 2013).

For Further Reading

Jordan River Total Maximum Daily Load Water Quality Study – Phase 1 (Cirrus Ecological Solutions, LC. 2013).

Esri Story Maps Data Layers

Water Quality Sampling Locations; Utah Division of Water Quality Assessment Units

2.4 Community Resources

Community resources are those resources associated with the Jordan River that are valued, enjoyed, used, or needed by the public at large. The public includes, but is not limited to, stakeholder groups who participated in the planning process (see Appendix B). Community resources in the Jordan River planning area are discussed in six sections: Infrastructure, Cultural Resources, Recreation, Access, Public Safety, and Education.

Infrastructure

Infrastructure in the Jordan River includes bridges, utilities, outfall structures, diversion dams, and levees. Infrastructure elements either treat the river as an obstacle to be crossed (bridges and utility crossings) or as a resource (outfall structures and diversion dams). Each of these infrastructure elements is described in more detail below. When considering infrastructure development and construction, project proponents must operate in accordance with the FFSL leasing process and other applicable federal, state, and county requirements. Most of the existing infrastructure on the Jordan River sovereign land is authorized with an associated FFSL lease; however, some infrastructure, especially older infrastructure, is not. Some bridges, outfall structures, diversions, and other infrastructure improvements have already been deemed eligible for the NRHP because of their local significance. Chapter 1 describes the permitting process and provides information on what to do when considering construction of new infrastructure or permitting facilities that do not have current leases. The infrastructure section of Chapter 3 describes design specifications for certain types of infrastructure.

Infrastructure for recreation users in the planning area, such as boater access points, is discussed in the Recreation section of Chapter 2.

Careful planning and placement of infrastructure, such as bridges along the Jordan River, are important, because poorly spaced infrastructure can damage the resource, inhibit navigation, and detract from aquatic beauty and the public recreation experience.

BRIDGES

Bridges serve as transportation links across the river for vehicles, trains, and pedestrians. Existing bridges crossing the Jordan River are shown on the Esri story map and GIS spatial data viewer for the JRCMP on the FFSL website. They are of various ages, design, and construction materials. Newer bridges generally span the main channel without obstructions, whereas many older bridges have piers and constrict the main channel. Low clearances and bridge piers can present obstructions to navigation and can cause accumulation of large woody debris behind them, as shown in Figure 2.30.

Figure 2.30. Large woody debris causing an obstruction in the Jordan River.

UTILITY CROSSINGS

Utility crossings include water pipelines, sewer pipelines, gas pipelines, fiber optic lines, and powerlines. Leases for utility crossings are shown on the Esri story map and GIS spatial data viewer for the JRCMP on the FFSL website.

Crossing types include below grade and above grade. Below-grade crossings cross the river below the bed of the river and are generally not visible. Above-grade crossings either stand alone (such as powerlines) or are attached to an existing bridge (Figures 2.31 and 2.32).

Figure 2.31. Stand-alone above-grade crossing on the Jordan River.

Figure 2.32. Above-grade crossing attached to a bridge on the Jordan River.

OUTFALL STRUCTURES

The Jordan River serves as the major outlet for almost all drainage systems in the Salt Lake Valley. Outfall structures include storm drain outlets, treatment plant outlets, irrigation return flows, and cooling water outlets. Existing outlet locations are presented on the Esri story map and GIS spatial data viewer for the JRCMP on the FFSL website. Figure 2.33 shows a typical outfall structure on the Jordan River.

Figure 2.33. Typical outfall structure on the Jordan River.

DIVERSION DAMS

Several diversion structures (dams) have been constructed in the Jordan River to divert its water resources for other uses. Existing diversion dams are listed in Table 2.15.

Table 2.15. Jordan River Diversion Dams

Diversion Dam	Location	Facilities Served
Utah Lake outlet dam	At the junction with Utah Lake	Jordan River and all of its associated users
Turner Dam	Jordan Narrows	East Jordan Canal, Utah and Salt Lake Canal, Utah Lake Distributing Canal, Provo Reservoir Canal, Jordan Aqueduct
Joint diversion dam	1.5 miles downstream of the Turner Dam; approximately 2 miles upstream of 14600 South	Jordan and Salt Lake City Canal, South Jordan Canal
North Jordan Canal diversion dam	Near 9400 South	North Jordan Canal
Brighton Canal diversion dam	Near 4600 South	Brighton Canal
Surplus Canal – North Jordan River diversion dam	North of 2100 South	Surplus Canal, North Jordan River
PacifiCorp (Utah Power & Light Company) diversion dam (also known as Gadsby dam)	South Temple	PacifiCorp power plant
Burnham Dam (also known as State dam)	Approximately 1900 South Woods Cross	New State duck club

LEVEES

Levees have been constructed for flood control along portions of the Jordan River and permitted through the FEMA. Levees that are recognized by FEMA in Flood Insurance Rate Maps for the Jordan River are summarized in Table 2.16. Other areas along the Jordan River may appear to have levees, but these are most likely dredge spoils from flood control activities. Levee accreditation is tied directly to the management of the levee system, and it determines those activities and structures permitted within the levee prism so that levee operation and maintenance are not compromised.

Table 2.16. Jordan River Levees

Levee Location	Bank	Flood Protection Benefit
Approximately 8500 to 7900 South	East	Protects a portion of the Old Sharon Steel reclamation site.
Approximately 4170 to 4070 South	East	Does not have sufficient height or freeboard. Property east of the levee is zoned AH* with a 1% chance flood elevation designated as the same elevation as the river.
From Mill Creek to the Surplus Canal	East and west	The west-side levee does not have sufficient freeboard and is discounted as flood protection. The east-side levee is accredited and provides flood protection to areas east of the river.
Between North Temple and approximately 1800 North	West	Provides protection from floods up to a 1% chance (100-year) flood event for a large area.

* An AH zone is an area subject to inundation by a 1% annual chance of shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Mandatory flood insurance purchase requirements and floodplain management standards apply to this zone (FEMA 2015a).

Source: FEMA (1994).

Levees accredited by FEMA for flood control must comply with FEMA inspection and maintenance requirements to maintain accreditation. FEMA requirements for vegetation control are described in *Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams, and Appurtenant Structures* (USACE 2014). The guidelines require a "vegetation-free zone," which is free of all vegetation except grass "to provide a reliable corridor of access to, and along, levees."

FLOOD CONTROL

FEMA Flood Insurance Rate Maps designate both a floodway and a floodplain for the Jordan River. A *regulatory floodway* is defined as the channel of a river and the adjacent land areas that must be reserved to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height (FEMA 2015b). The floodway concept allows encroachment into the floodplain, but not into the floodway. Proposed development that would encroach into the floodway must have a "no-rise" effect on flood elevations. Communities must regulate development in floodways to ensure that there are no increases in upstream flood elevations. The FEMA floodway schematic is shown in Figure 2.34.

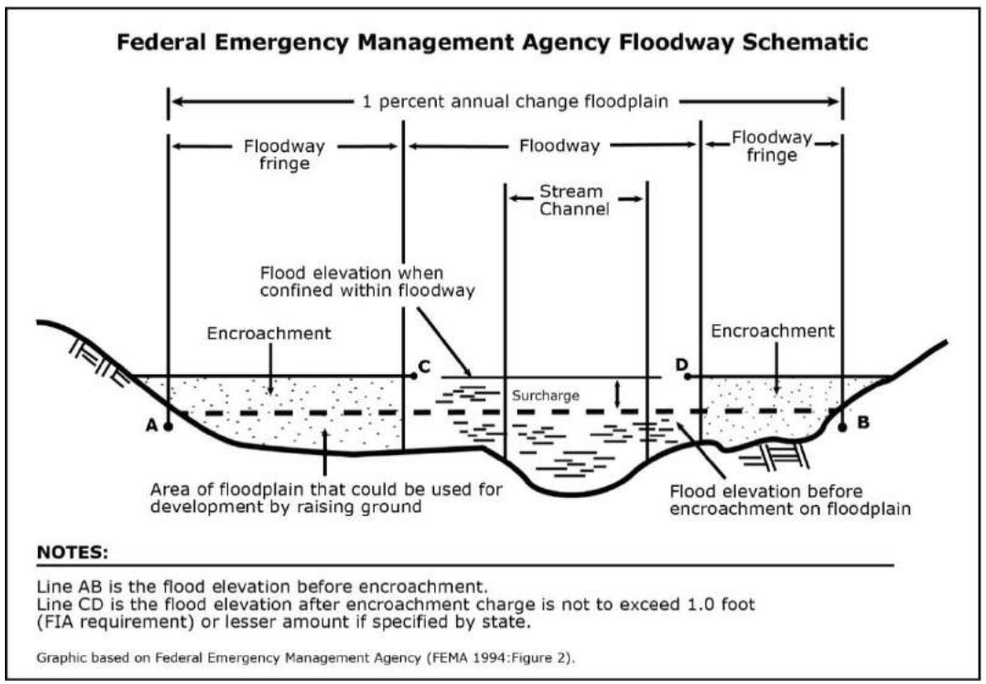


Figure 2.34. Federal Emergency Management Agency floodway schematic.

Specific areas where Salt Lake County regularly accesses the river for flood control maintenance are shown on the Esri story map and GIS spatial data viewer for the JRCMP on the FFSL website. Salt Lake County Flood Control requires the right to access the entire length of the Jordan River to maintain the river and to respond to emergency flooding situations; approximately 68 points of access are used along the river between 14600 South in Bluffdale and 3300 North near the Salt Lake-Davis County line (Moncur 2015).

Major tributaries convey sediment loads into the Jordan River, especially during flood events. Areas downstream of major tributary confluences (such as Big Cottonwood Creek, Little Cottonwood Creek, and the 1300 South conduit) are accessed as needed by Salt Lake County to remove sediment accumulations.

EXISTING CONDITIONS BY RIVER SEGMENT

Figure 2.35 presents an overview of key existing infrastructure on the Jordan River by segment.

Further Reading

Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams, and Appurtenant Structures (U.S. Army Corps of Engineers 2014)

Best Practices for Riverfront Communities (Jordan River Commission 2013b)

Esri Story Map Data Layers

Infrastructure Locations (FFSL lease data); Dams; FEMA Flood Control Levees; Municipal Stormwater Data (if available); Utah Division of Water Rights stream alteration permit data

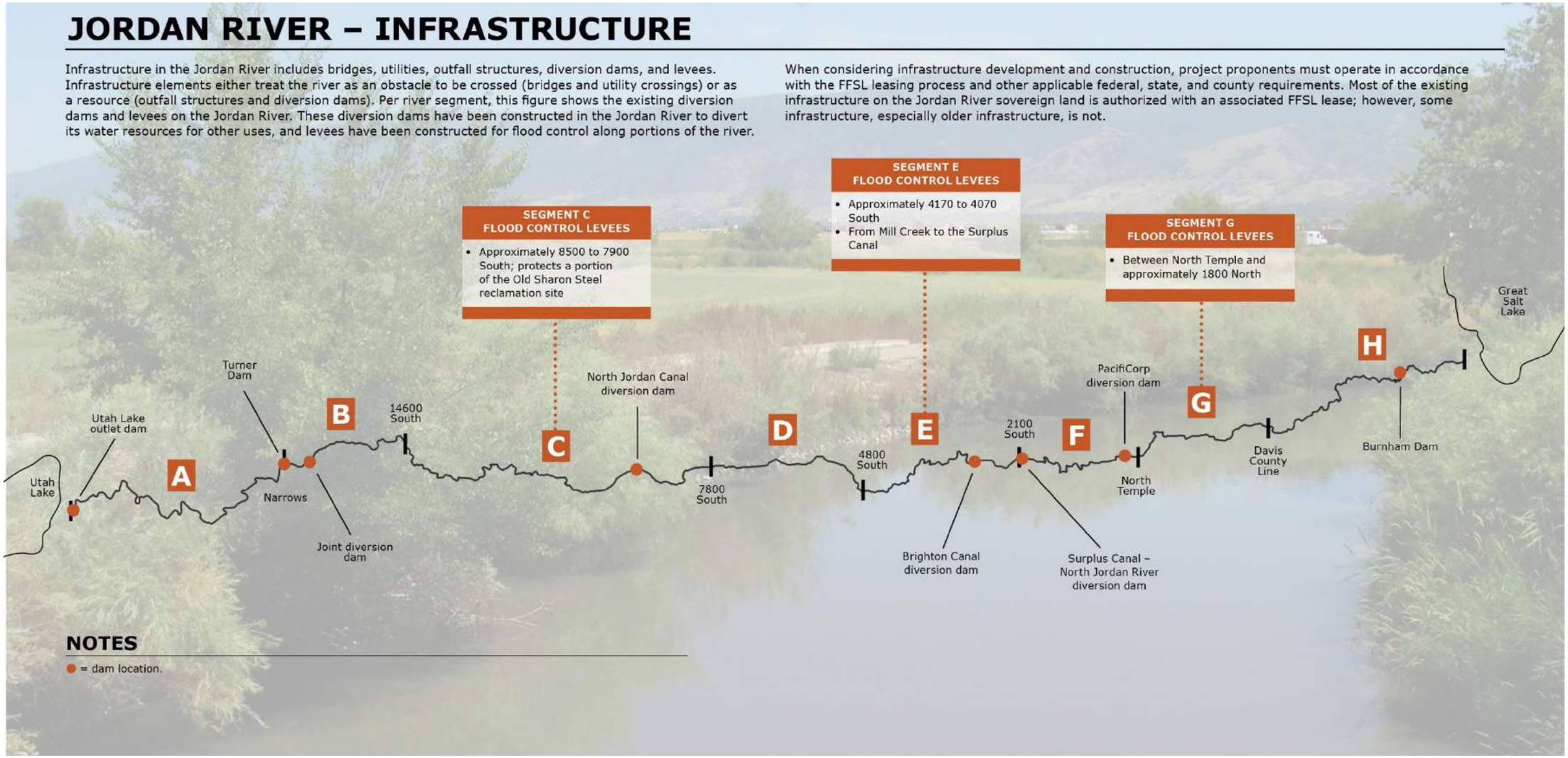


Figure 2.35. Key existing infrastructure on the Jordan River by segment.

Cultural Resources

A *cultural resource* is defined as "a building, structure, district, [archaeological] site, or object that is historically significant" (Hardesty and Little 2000:161). A cultural resource may also be referred to as a "historic property." The National Historic Preservation Act (NHPA) defines *historic property* as "any prehistoric or historic district, site, building, structure, or object included on, or eligible for inclusion on, the National Register, including artifacts, records, and material remains relating to the district, site, building, structure, or object" (54 United States Code [USC] 300308). Section 9-8-404 of the Utah Code Annotated requires that FFSL take into account the effects of their actions on historic properties.

Prehistoric cultural resources refer to any site, feature, structure, or artifact that predates Euro-American contact in Utah in A.D. 1776. Based on existing data, previously documented prehistoric sites along the Jordan River consist of open campsites, lithic scatters, and artifact scatters. One such prehistoric site is 42SL186 (the Prison Site), which contains Archaic and Fremont period components. Data recovery activities conducted at the site identified a few Fremont components consisting of several artifacts as well as two Archaic housepits and a variety of artifacts. The Archaic component features and artifacts indicate the site was likely used during seasonal occupations for tool maintenance and repair, as well as food procurement and processing. Housepits are a very rare find in the Salt Lake Valley, and are even rarer along the Jordan River (Yenstch and Rood 2007).

Historic resources, as defined in the United States, refer to any site, feature, structure, or artifact that dates to A.D. 1500 through 50 years before present. In Utah, the Historic period dates from A.D. 1776, when Dominquez and Escalante reached Utah Lake, to 50 years before present, based on Euro-American contact. According to existing data, previously documented historic sites on the Jordan River consist of canals, a railroad, bridges, grade-control structures, transmission lines, buildings, structures, and artifact scatters.

Most of the cultural resources in the planning area are either prehistoric or historic resources, but some are multicomponent. Multicomponent sites consist of both prehistoric and historic resources at the same location. In addition, two historic properties adjacent to the Jordan River, the Fisher Mansion and the Utah State Fairgrounds, are listed on the NRHP. Other sites such as the Utah Lake Pump Station in Utah County and the Surplus Canal in Salt Lake County have been determined eligible for the NRHP but have not yet been listed. The types of cultural resources found along the Jordan River are described in Figure 2.36. Heritage and historic sites on the Jordan River are generally underutilized as a recreation option.

TYPES OF CULTURAL RESOURCES ALONG THE JORDAN RIVER

Bridges

- Bridge types along the Jordan River may include pedestrian, vehicle, or railroad.
- The Jordan River has many historic crossings, e.g., 900 South Railroad Bridge in Salt Lake City. Many but not all historic bridges over river have been removed and replaced with newer bridges.

River Campsites

- Historic and prehistoric peoples often camped by waterbodies such as the Jordan River.
- Prehistoric and historic campsites, although dispersed, are likely to exist on the banks of the Jordan River and may be exposed during bank or bed disturbance.
- One known example along the Jordan River associated with a historic and prehistoric river crossing is the Indian Ford site in Utah County

Historic Buildings

- Buildings are good examples of a specific architectural style or are connected with important state and national history.
- Historic buildings, e.g., Fisher Mansion, are built adjacent to the Jordan River corridor and range from private homes to public spaces.

Artifact Scatters

- Artifact scatters can have both historic and prehistoric artifacts, historic homesteads, and trash scatters.
- Scatters can appear on the ground surface, but can also be several inches to several feet below the surface.

Utilities

- Utilities include telephone, electric, sewer, water, and transmission lines, e.g., Jordan Narrows Pumping Plan Water System.
- Utility lines can be placed above grade or bored under the Jordan River.

Diversions/Canals

- Canals are important to the history of Utah because they provided, and in many cases still provide, water for crops grown nearby or flood abatement, e.g., Surplus Canal.
- Canals vary in size and shape.

Figure 2.36. Types of cultural resources on the Jordan River.

All data examined were obtained from the UDSH's web-based data management system, the UDSH's preservation files, and NRHP files. The primary data gap for cultural resources along the Jordan River is a lack of archaeological and architectural surveys that are less than 10 years old.

Figure 2.37 provides a river plan view of cultural resources that could be encountered during development authorized with a FFSL lease.

EXISTING CULTURAL RESOURCES BY RIVER SEGMENT

Figure 2.38 presents historic properties/cultural sites and NRHP-listed sites on the Jordan River by river segment.

Further Reading

A History of Salt Lake County (Sillitoe 1996; not an online resource)

A History of Davis County (Leonard 1999; not an online resource)

A History of Utah County (Holzapfel 1999; not an online resource)

The Prison Site: Evidence for Late Archaic Housepits in the Salt Lake Valley (Yenstch and Rood 2007)

Esri Story Map Data Layers

Archaeology Surveys; Architectural Surveys; Historic Districts ; Sites Listed on the National Register of Historic Places; Historic Sites

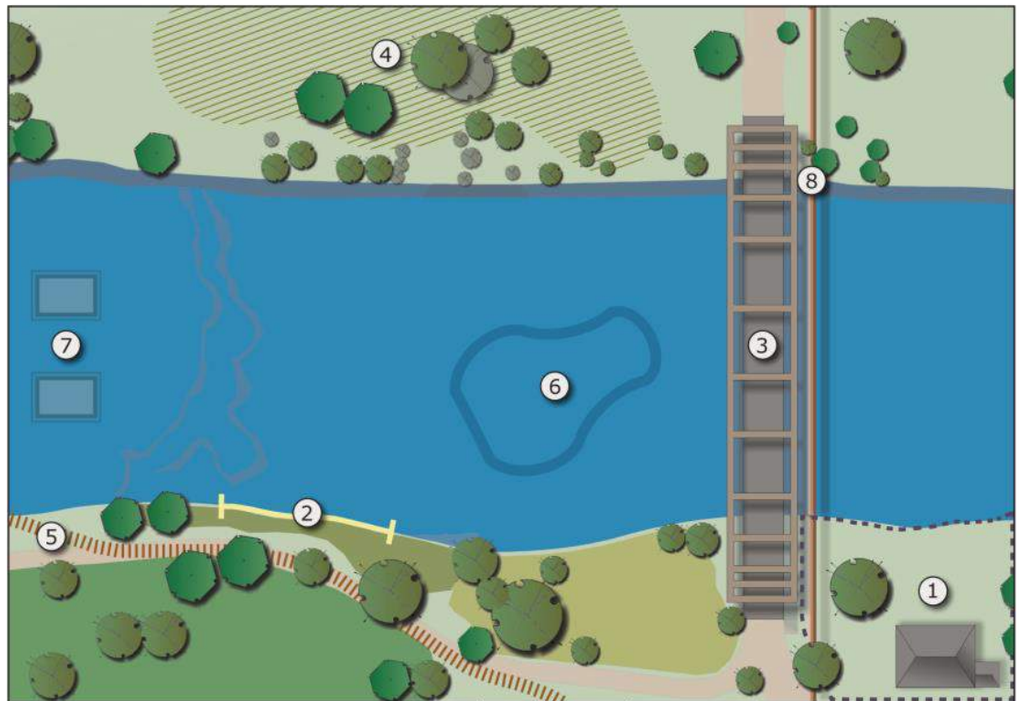


Figure 2.37. Jordan River plan view showing types of possible cultural resources in the planning area.

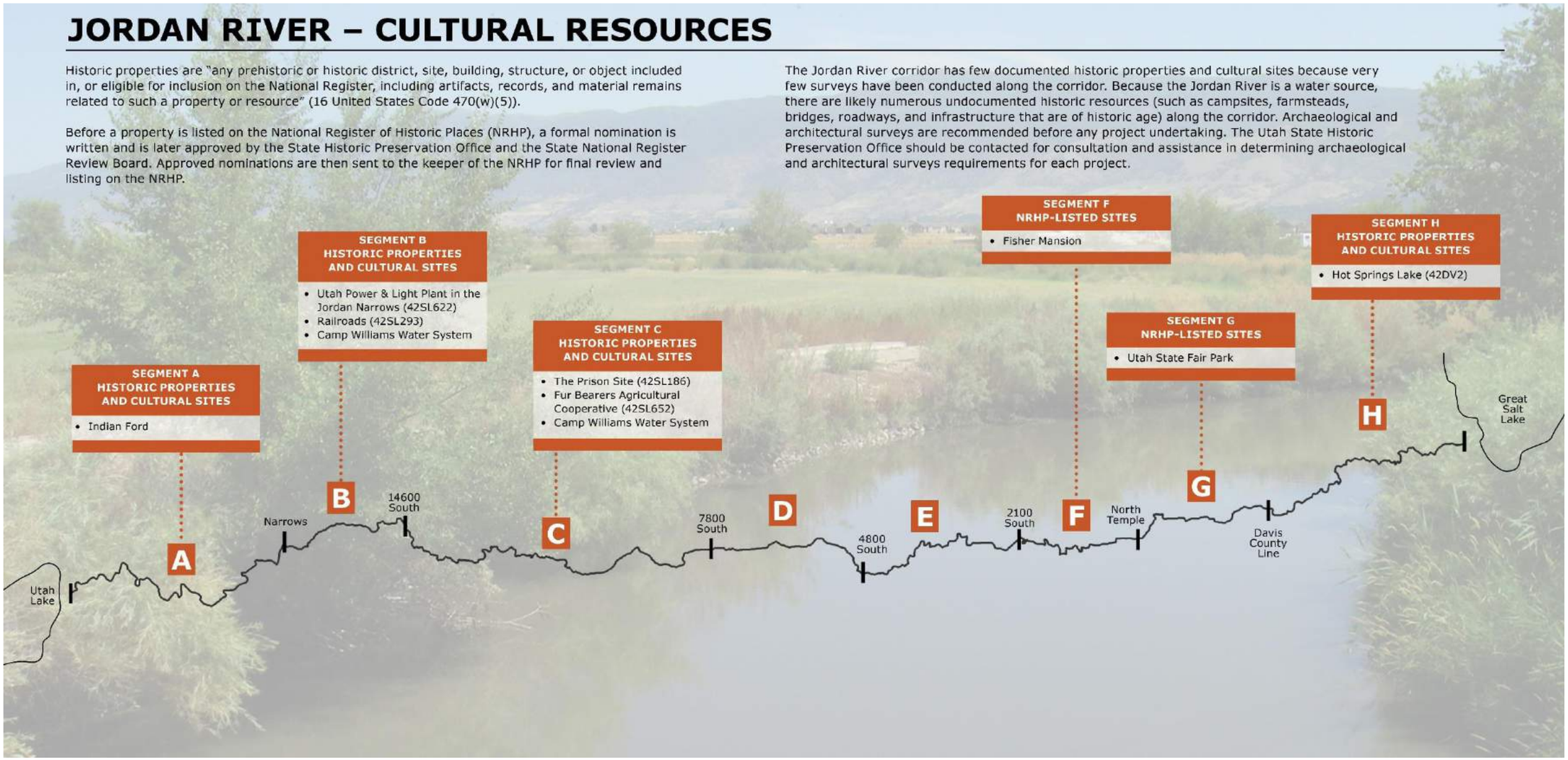


Figure 2.38. Historic properties/cultural sites and NRHP-listed sites on the Jordan River by river segment.

Recreation

As described in the passages below from the *Blueprint Jordan River* (Envision Utah 2008) and *Best Practices for Riverfront Communities* (JRC 2013b) documents, recreation is a key activity in the Jordan River corridor.

Blueprint for the Jordan River

"The Jordan River has had many different uses over the years, some good and some detrimental. The time has come to recognize the incredible asset that the Jordan River is to the surrounding communities. The river's central location makes it an ideal recreation center for the Wasatch Front region."

Best Practices for Riverfront Communities

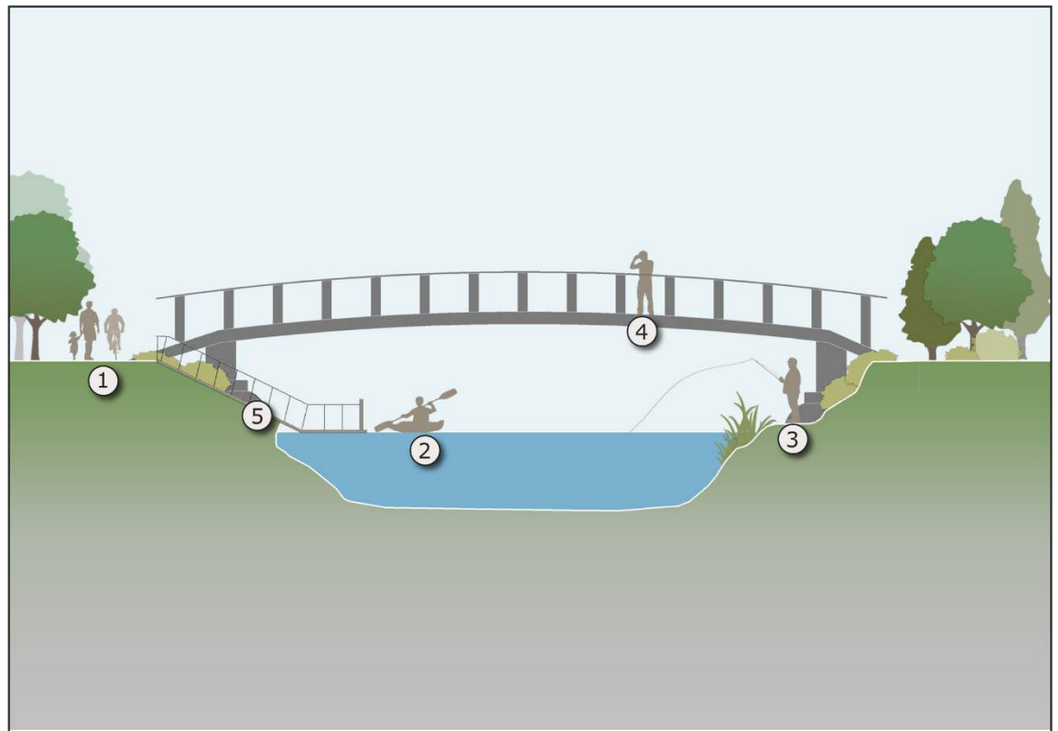
"The Jordan River corridor is a regional recreation resource that provides all ages and abilities an opportunity to experience nature in the city and build support for river stewardship. Recreation facilities also have the potential to be developed in such a way that they contribute to a robust green infrastructure network that can mitigate negative impacts of development, contribute to natural habitat, and provide valuable transportation linkages."

Recreation in the planning area consists primarily of boating (kayaking, canoeing, and rowing) on the water trail. Fishing and wildlife viewing may also occur in the planning area (often where spur trails lead to the banks of the river or at river access points). Boaters require infrastructure such as put-ins where they can launch their boat into the river and take-outs where they can remove their boat from the river. Put-ins, take-outs, boat ramps, and boat launches are described as "boater access points" in this document. The condition of boater access points on the river varies, and some boating infrastructure may be unpermitted. FFSL does not own or maintain boater access points; however, FFSL recognizes that protection of navigation is part of managing for the Public Trust and supports the development of appropriate boating infrastructure. Note that boater access points are different than the general access to the Jordan River discussed in the Access section.

Recreation in the larger river corridor outside the planning area centers around a trail system called the Jordan River Parkway Trail, which is a multiple-use trail paralleling the Jordan River (Figure 2.39). The trail system includes a paved trail, an equestrian trail, several connecting neighborhood trails, and in the long term will include the water trail for boaters (JRC 2016a). Users of the surface trail include bicyclists, pedestrians and runners, and horseback riders. The FFSL planning area typically does not include the surface trail. Using a cross section of the Jordan River, Figure 2.40 illustrates some of the types of recreation users along the river.

Survey participants for the *Blueprint Jordan River* identified multiple-use trails as the most important recreational activity that the river corridor should support (Envision Utah 2008).

Figure 2.39. Recreation on the Jordan River.



Legend

1. Surface Trail Pedestrians and Cyclist
2. Water Trail Boater
3. Fisherman
4. Wildlife Viewer
5. Boat Access

Figure 2.40. Jordan River cross section showing recreation types along the river.

BOATING AND FISHING

Section R651-205-9 of the Utah Administrative Code states that the use of motors is prohibited on the Jordan River, with one exception. Motors whose manufacturer-listed horsepower is less than 10 are allowed on the Utah County portion of the river.

Unofficial Jordan River water trail maps for boating indicate that there are currently 35.26 miles of water trail on the river consisting of 14 distinct navigable sections, divided by four gaps that are not boatable (Mott 2015). These maps illustrate boater access points for each section and note some of the river hazards. The northern section of the Jordan River is essentially a non-stop float with numerous boater access points and portages (Thompson 2016). Portages are areas where boaters must carry their watercraft around an obstacle in the river, such as a diversion dam. Figure 2.41 lists the most popular floats from south to north. Fishing is popular all over the river (Thompson 2016); some hot spots are listed in Figure 2.41 and shown in Figure 2.42.

Boating

- Jordan Narrows
- 14600 to 10000 South
- 9000 South to Winchester
- Winchester to 4800 South
- 4500 South with mandatory portages at 9000 and 4700 South for low head dams
- 1700 South to Fisher Mansion

Fishing

- 12300 South Rotary Park
- 7600 South overlook and bridge
- Winchester Park
- Little Cottonwood confluence
- 1700 South
- 1300 South
- 900 South
- 500 North
- State Route 73 in Lehi

Figure 2.41. Hot spots for boating and fishing along the Jordan River (Thompson 2016).

In 2008, Salt Lake County published a preliminary water trail master plan within the *Jordan River Trail Master Plan* (Landmark Design, Inc. 2008). The county intends to update and refine this plan in 2016 and is seeking funding to implement the plan upon its completion. The overall vision for the water trail includes consistent signage, formalized boater access points, and safety interventions and signage at boater hazards. In Utah County, the City of Saratoga Springs plans to install three boater access points in 2016, with plans for two more to be installed in the future. Salt Lake City has identified six locations for new or improved boater access points. In addition, the City of North Salt Lake is constructing a boater access point and parking area at Center Street in 2016. Several rowing or paddling groups recreate on the Jordan River. The Wasatch Rowing Foundation currently uses the river from approximately 2850 South to 2100 South (a section approximately 6,560 feet [2,000 meters] long) and the Surplus Canal from the junction of Indiana Avenue and Delong Street to California Avenue, next to Redwood Road (a section approximately 4,260 feet [1,300 meters] long). The Surplus Canal section typically does not have enough water for spring rowing until around April 15. Among other projects such as removing river obstacles, Wasatch Rowing is currently raising funds to build a boathouse on the Jordan River at approximately 1200 South next to the Surplus Canal (Wasatch Rowing Foundation 2016). Other rowing groups that use the Jordan River are Splore, which offers adaptive paddling trips (canoeing and paddleboarding) on various river sections, and Utah Outdoors, which leads regular trips down the Jordan River on Friday and Saturday mornings.

RECREATION AREAS AND CONCERNS BY RIVER SEGMENT

Figure 2.42 illustrates existing boater access points, proposed boater access points, and other recreation uses by river segment. Recreation information such as navigational hazards, boater access points and portages, wildlife viewing locations, fishing locations, signage locations, Jordan River Parkway Trail location, and parks intersecting the planning area can be viewed on the Esri story map and GIS spatial data viewer for the JRCMP on the FFSL website.

Further Reading

Blueprint Jordan River (Envision Utah 2008)

Best Practices for Riverfront Communities (Jordan River Commission 2013b)

Jordan River Commission website

Salt Lake County Water Trail

Esri Story Map Data Layers

Navigational Hazards; Boater Access Points and Portages; Wildlife Viewing Locations; Fishing Locations; Signage Locations; Jordan River Parkway Trail Location; Parks Intersecting the Planning Area

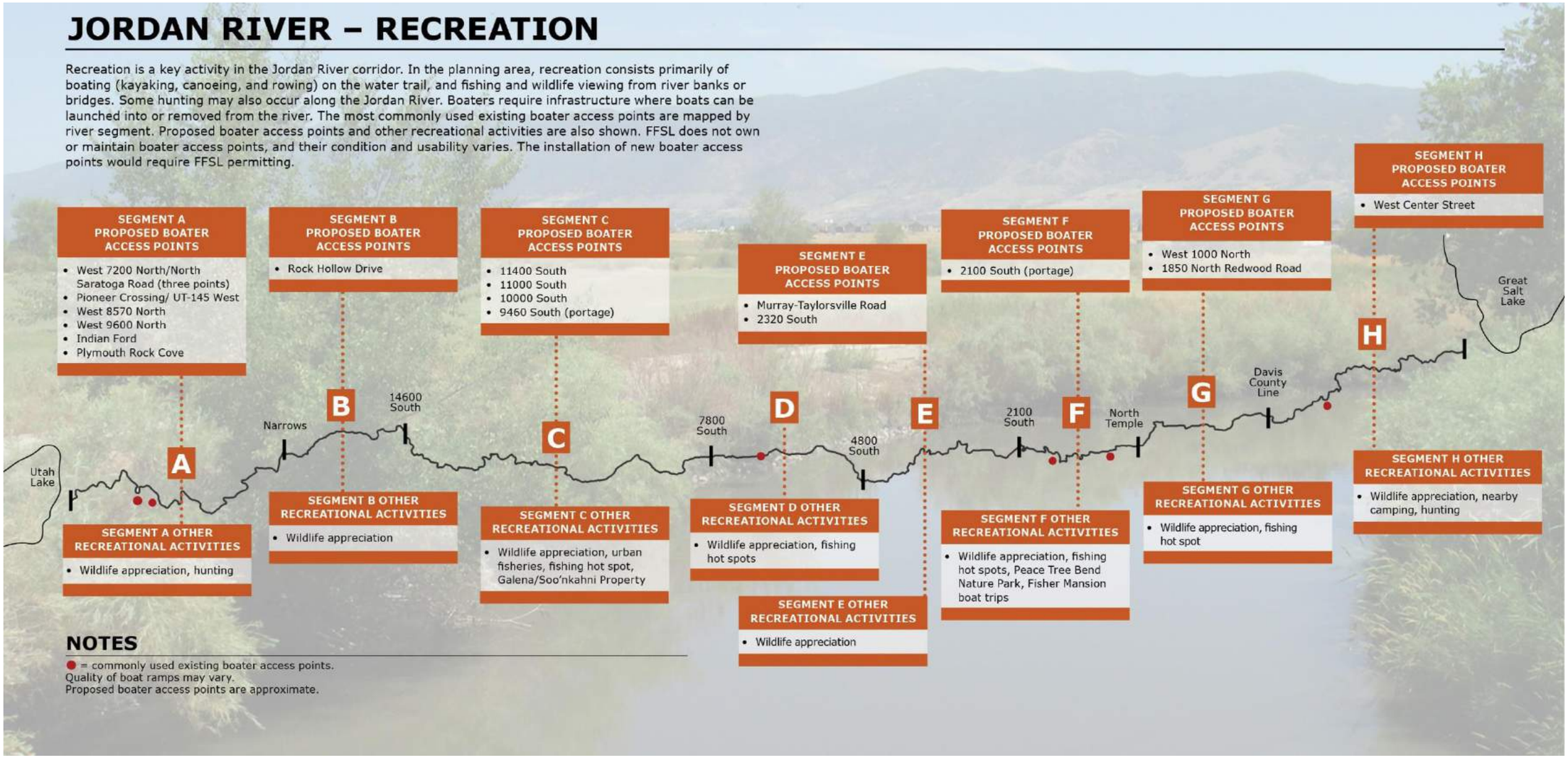


Figure 2.42. Existing and proposed boater access points and other recreational uses by river segment.

Access

Access is the ability to approach and use the Jordan River for recreation, development, education, research, or other purposes such as flood control. From a legal standpoint, the bed and banks of the Jordan River are always open to public use because they are sovereign lands. Much of the Jordan River corridor is open access, and many municipalities have actively planned for use of the Jordan River Parkway Trail by developing connecting spurs. However, some areas along the river are inaccessible because they are privately owned or because they are blocked by non-native vegetation such as *Phragmites*. Privately owned areas can only be accessed with the consent of the landowner.

Access to the planning area for the development of infrastructure or other projects requires a lease such as an easement, general permit, or right-of-entry from FFSL (see Section 1.7 in Chapter 1). Access to infrastructure such as utilities and outfall structures must be protected so that maintenance and repairs can be conducted. Access for flood control must also be protected (see Infrastructure section). Infrastructure for recreation users in the planning area may include wildlife viewing and fishing platforms, boating-related structures for the water trail, surface trail bridges and pedestrian crossings, and signage. As discussed in the Recreation section, boating-related infrastructure includes boater access points and portages. Infrastructure should be safe for the public, protect natural resources, take into account river fluctuations, and be Americans with Disabilities Act–accessible as required by law. Figure 2.43 shows a picture of typical boater access along the Jordan River. Figure 2.44 further illustrates several types of access available along the river, as well as access concerns.

Good public access fosters stewardship and support for the protection and enhancement of the river corridor. Access should take into account and tie into regional transportation networks (i.e., other trails and public transit) where possible. By doing so, it can provide an alternative transportation network for the region. Access must be balanced to protect the resource. Too many access points can damage the resource and associated infrastructure; too few access points can limit opportunities to experience the river, create crowding at access areas, and reduce the public constituency for the river. For these reasons, spacing of access points is important.

Although there are no recommended distances between access points, FFSL will take into account safety, the number and type of existing access points, the presence of roads, river use class, and other factors when deciding how close access points should be placed along the river.

Figure 2.43. Typical boating access point on the Jordan River.

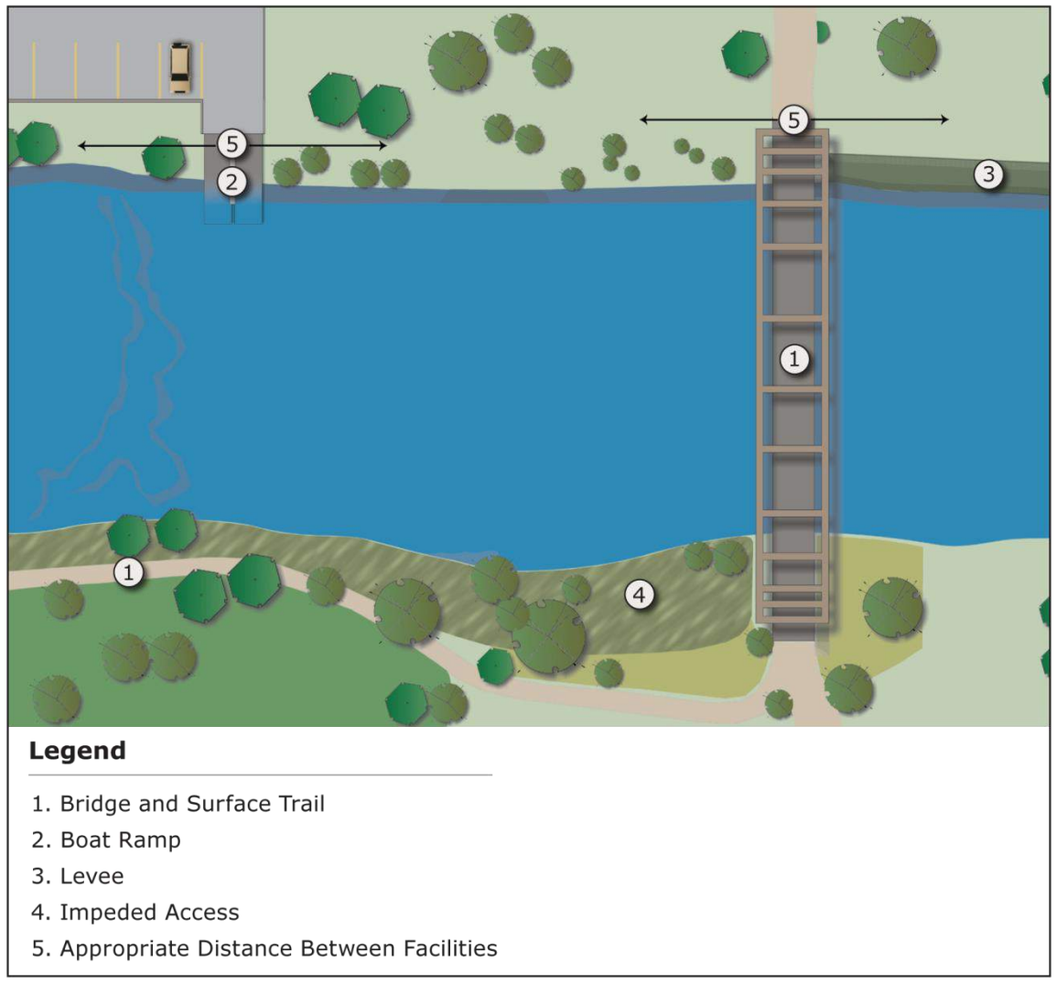


Figure 2.44. Jordan River plan view showing types of access points.

ACCESS AND PUBLIC SAFETY CONCERNS BY RIVER SEGMENT

Figure 2.45 illustrates by river segment existing access and public safety concerns, as well as educational facilities along the river.

Further Reading

Blueprint Jordan River (Envision Utah 2008)

Jordan River Water Trail Guide Maps (Mott 2015; not available online)

Jordan River Trail Master Plan (Landmark Design, Inc. 2008)

Jordan River Commission website

Esri Story Map Data Layers

Navigational Hazards; Weed Occurrences; Boater Access Points and Portages; Wildlife Viewing Locations; Fishing Locations; Signage Locations; Jordan River Parkway Trail Location

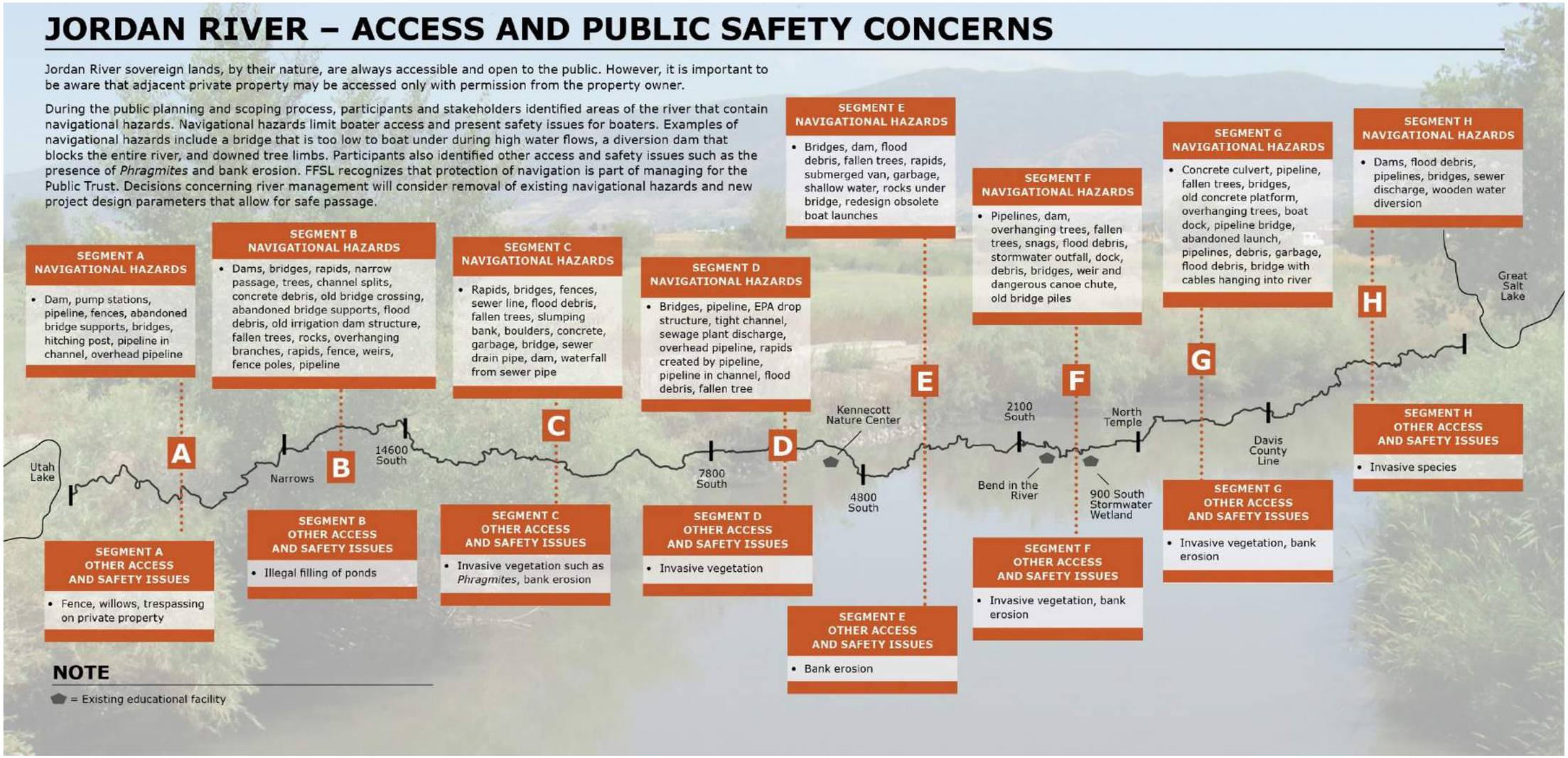


Figure 2.45. Existing access problems, safety concerns, and educational facilities by river segment.

Public Safety

Public safety refers to the welfare and protection of the general public. With respect to the planning area, it primarily applies to recreational use of the water trail (use of the Jordan River by boaters) and the associated boater access points and navigational hazards. It could also apply to other recreational uses in the planning area, such as wildlife viewing and fishing on spurs of the surface trail that lead to the banks of the river and at river access points. Typically, the surface trail is located away from the banks of the river and does not fall under the jurisdiction of FFSL. However, there are a few instances where the surface trail extends onto the riverbanks and is used by pedestrians, cyclists, and equestrians. In addition, the surface trail crosses the river at multiple locations.

Public use of facilities such as parking lots, trailheads, and restrooms is outside of FFSL jurisdiction, and safety at these locations is the responsibility of other entities. The safety of workers during the construction, operation, and maintenance of utility lines, bridges, dams, and other facilities in the planning area is protected through regulations administrated by the federal Occupational Safety and Health Administration.

Water quality is not considered a public safety issue because the beneficial uses for various segments of the river do not include frequent contact recreation (such as swimming). Designated uses include secondary contact recreation, which includes boating, wading, and fishing.

PUBLIC SAFETY ISSUES

In 2008, most of the *Blueprint Jordan River* survey participants (51%) indicated that they felt safe using the Jordan River Parkway Trail (20% indicated they did not feel safe, 22% were unsure, and 7% were "other") (Envision Utah 2008). Although most trail users feel safe, specific public safety issues have been identified in the planning area and are presented in Figure 2.46.

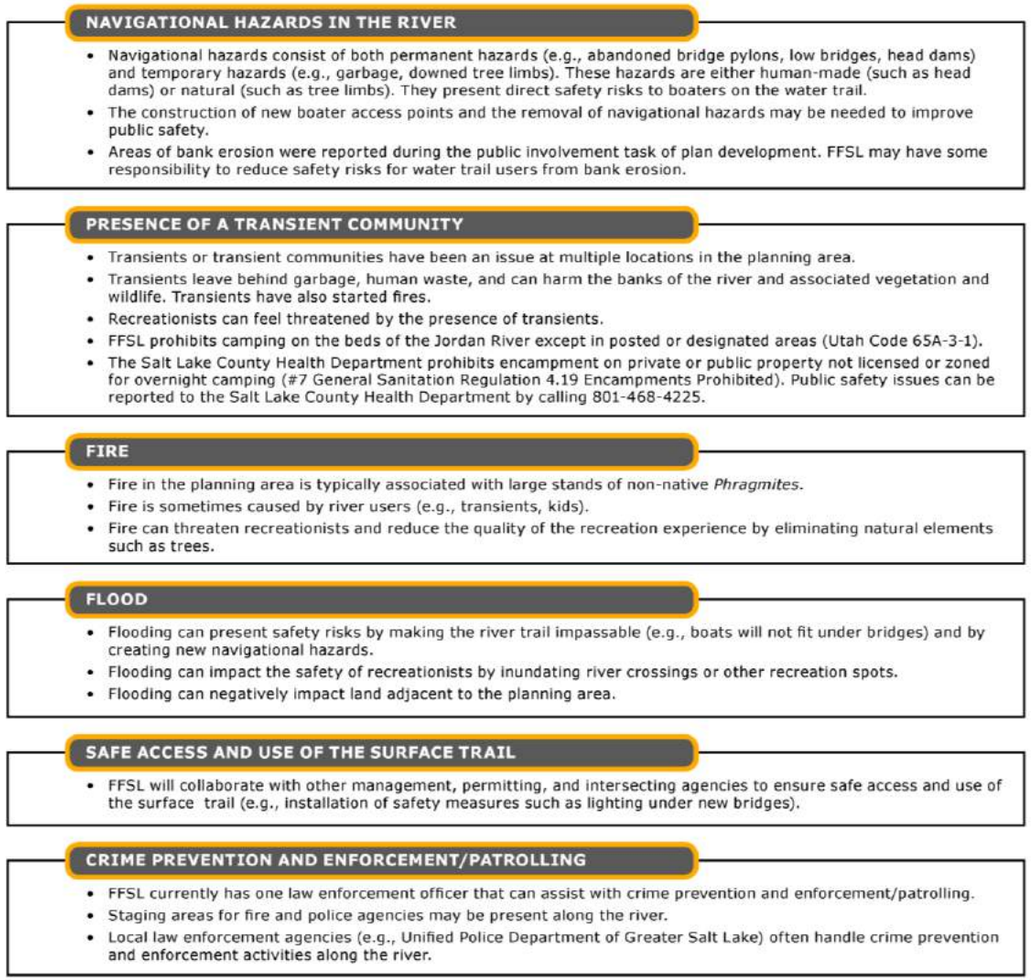


Figure 2.46. Public safety issues in the planning area.

As noted in Figure 2.46, FFSL prohibits camping on the beds of navigable rivers except in posted or designated areas (Utah Code 65A-3-1).

Public safety concerns on the Jordan River identified during the planning and scoping process are shown in Figure 2.47.

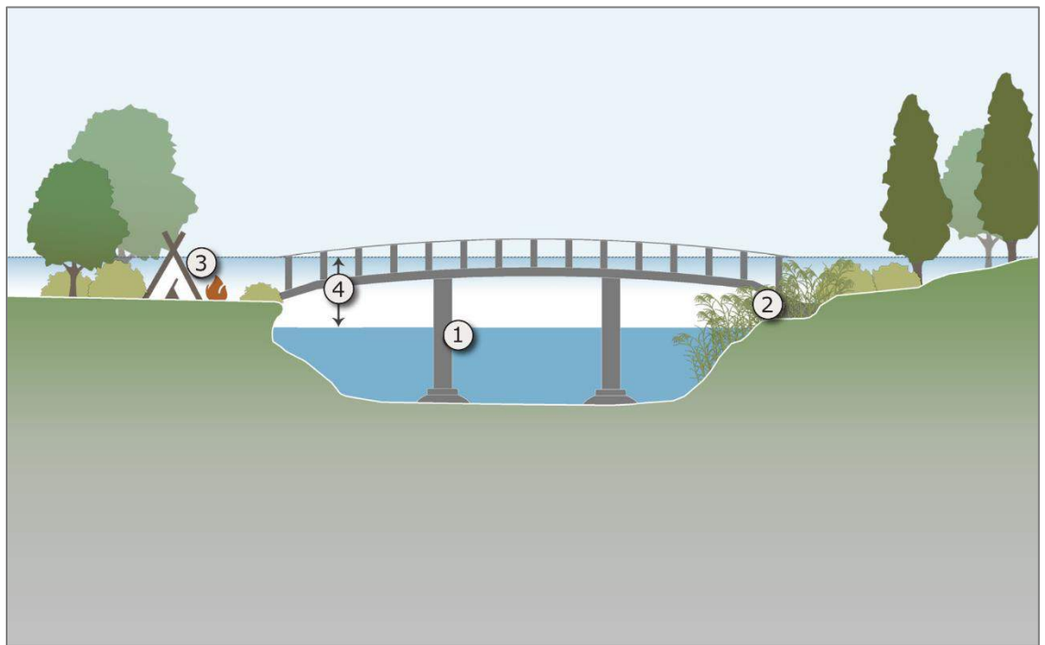


Figure 2.47. Cross section showing potential public safety hazards on the Jordan River.

Further Reading

Utah Code 65A-3-1

Salt Lake County Health Department, #14 Watershed Regulation (Salt Lake County 2006)

Salt Lake County Flood Preparedness Manual (Salt Lake County 2016b)

Esri Story Map Data Layers

Navigational Hazards; Weed Occurrences; Flood Zones

Education

Education is an important component of successfully managing the planning area because it provides direction to user groups for the appropriate use of the Jordan River, clarifies FFSL's jurisdiction and management authority, and fosters public appreciation of the river and understanding of its value and the need to protect it.

In addition, educating Jordan River planners and managers through the dissemination of research data and results can improve their understanding of the ecosystem and enhance the management and stewardship of the resource. Research on the Jordan River is often conducted in the planning area and may require permits for access and equipment installation. Researchers may be associated with universities, other educational facilities, private or public entities, non-profit organizations, or government agencies. FFSL encourages research on the Jordan River and would support partnerships with organizations doing research.

User groups that benefit from educational efforts are listed in Figure 2.48.

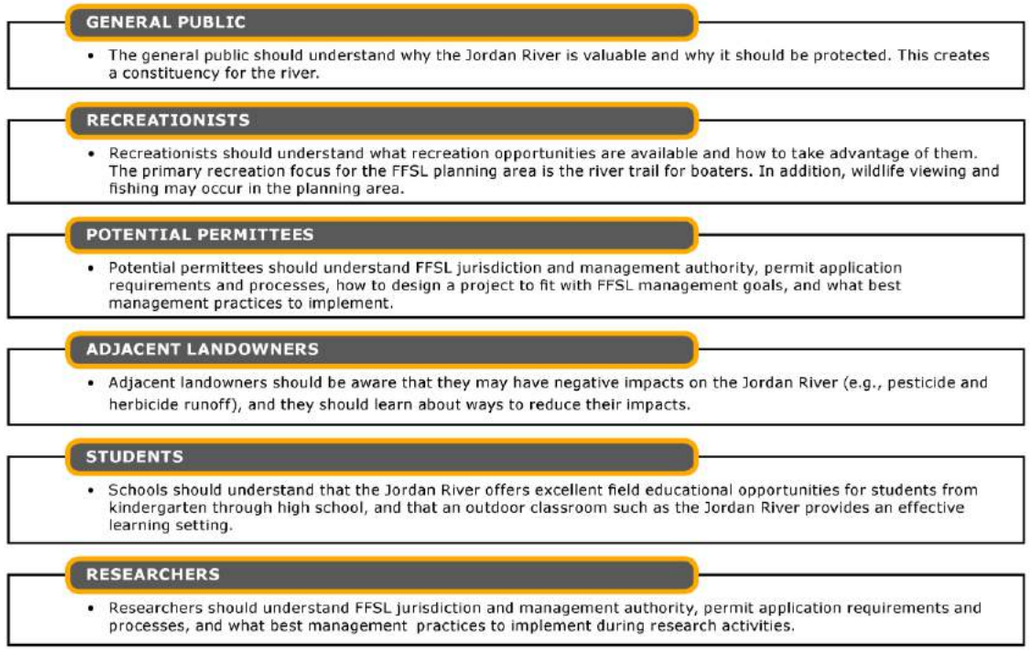


Figure 2.48. User groups in the planning area.

EDUCATIONAL FACILITIES AND PROGRAMS

Three educational facilities are currently along the Jordan River (see Figure 2.49):

- The Kennecott Nature Center (5044 South Lucky Clover Lane, Murray) provides opportunities for children from Murray School District and selected Granite School District 4th-grade classes to observe and learn about nature through hands-on experiences.

- At Bend in the River (1030 West Fremont Avenue, Salt Lake City), city employees, community residents, elementary and university students, and other volunteers work on a continual basis to restore wildlife habitat, cultivate native plants, maintain and improve the grounds, and bring educational events to the site (Figure 2.49). Interpretive displays with information on local flora and fauna are present.

- 900 South Stormwater Wetland (900 South 900 West, Salt Lake City) includes riparian and water conservation demonstration gardens with pathways and overlooks in restored wetlands. Interpretive materials are also available for visitors.

Figure 2.49. Bend in the River educational facility on the Jordan River.

Two self-guided tours are along the Jordan River: 1) the Rose Park Self-Guided Tour and the 2) Meadowbrook Natural Area Self-Guided Tour (JRC 2016a). The JRC provides a paper trail map for river users, a digital trail guide that includes educational/interpretive stops (JRC et al. 2016), a digital working map of the water trail, tour guides for birds of the Jordan River corridor and the ecology of the Jordan River, and native and invasive species pocket field guides. Other Jordan River educational programs discussed on the JRC website include the following:

- The Center for Documentary Expression and Art operates an 8-week school residency program for students in 7th through 12th grades. Students explore the Jordan River and the environmental movement through photography, creative writing, science experiments, and hands-on restoration work.

- The Salt Lake City Department of Public Utilities lends out water quality and invertebrate field kits, and a Jordan River watershed–specific teacher/student guide.

- A Streamside Science Curriculum from Utah State University uses hands-on stream monitoring techniques to teach middle- and high-school students about water pollution and water functions (the curriculum can also be adapted to teach students in 5th through 12th grade). It engages students directly in their local watersheds.

- The Utah Lake Commission has curriculum focused on Utah Lake, the primary source of water for the Jordan River. Much of the curriculum can be adapted to a Jordan River lesson.

- The JRC has developed a series of lesson plans (in-class and a field activity) to introduce 3rd, 4th, and 5th grade students to the Jordan River ecosystem and watershed (JRC 2016b).

Currently, Salt Lake County Parks and Recreation has not installed any educational signage along the Jordan River, but plans to place two interpretive signs at the Little Confluence Trailhead, west of the river and south of 4800 South, and eight interpretive signs at the Redwood Nature Area on the west side of the river at approximately 3100 South. These signs will be located outside the planning area (Larsen 2016).

CURRENT RESEARCH

Current research on the Jordan River focuses on water quality impairments and the management of river flow. Organizations such as Splore, Utah Water Watch, Project Budburst, Tracy Aviary, and the Living Planet Aquarium conduct "citizen-science" research on the river.

Further Reading

Blueprint Jordan River (Envision Utah 2008)

Best Practices for Riverfront Communities (Jordan River Commission 2013b)

Jordan River Commission website

Esri Story Map Data Layers

Educational Facilities

This page intentionally blank

CHAPTER 3 – MANAGEMENT STRATEGIES

3.1 Introduction

This chapter focuses on management strategies that FFSL will implement to meet the needs of Jordan River resources described in Chapter 2 of this plan. The management strategies are organized around each resource area and consist of management goals and objectives. The goals and objectives focus on management actions and decisions that are within FFSL's jurisdiction. In instances where FFSL does not have direct management authority over a particular resource, FFSL will endeavor to coordinate with and support agencies and other stakeholders that do have management and/or permitting jurisdiction over the resource. The management strategies allow numerous opportunities for coordination with respect to Jordan River resources, a fundamental responsibility of FFSL according to Utah Code 65A-10-1. Collectively, the management strategies discussed in this chapter are designed to facilitate FFSL's management of Jordan River and its resources under multiple-use, sustained-yield principles, as stated in Utah Code 65A-2-1.

Managing for the Public Trust

As described in Chapter 1, in managing for the Public Trust, FFSL recognizes that the protection of navigation, fish and wildlife habitat, aesthetic beauty, public recreation, and water quality should be considered and balanced against other uses. The following general management strategies reflect FFSL's commitment to these Jordan River services when considering specific projects, decisions, and lease applications:

- Navigation: Management of Jordan River sovereign lands will work to maintain or improve navigation along the Jordan River. Decisions concerning river management will consider mitigation and removal of existing navigation hazards, and design parameters for new projects that allow for passage.
- Fish and wildlife habitat: Management of Jordan River sovereign lands will work to maintain, enhance, or restore aquatic, wetland, riparian, and terrestrial habitat under its jurisdiction.
- Aesthetic beauty: Management of Jordan River sovereign lands will work to maintain or improve visual conditions along the Jordan River, recognizing that aesthetic beauty increases the value of the Jordan River as a community resource.
- Public recreation: Management of Jordan River sovereign lands will support diverse recreation activities and facilities at sustainable levels.
- Water quality: Management of Jordan River sovereign lands will subscribe to the State of Utah's anti-degradation policy for water quality.

River Use Classes

Also as described in Chapter 1, FFSL has codified sovereign land use classes to guide management of areas with diverse current and desired future conditions. A mapbook of how these use classes are applied to Jordan River sovereign lands is found in Chapter 1 in Figure 1.8. From a management perspective, FFSL recognizes that different activities have different impacts on sovereign lands. Table 3.1 provides a list of common actions requiring FFSL authorization and guidance for applicants seeking an easement, general permit, or right-of-entry. Actions presented to FFSL not listed in Table 3.1 will be reviewed on a case-by-case basis to arrive at a use determination.

In most cases, these use determinations pertain to public and commercial actions. Actions by private, residential landowners are generally not permitted (e.g., private boat docks or ramps). Use determinations for management actions consist of allowable (A), potentially allowable (P),

and not allowable (N) except with certain conditions. An "A" use determination will likely require no site-specific analysis of resources within a project area. For "P" use determinations, certain BMPs must be incorporated into the project design and long-term maintenance to preclude a site-specific analysis of the project area. For "N" use determinations, a site-specific analysis is required to determine project feasibility and mitigation opportunities. Suitability of proposed easements, general permits, and rights-of-entry will also be considered in the context of existing leases to avoid conflict of use, e.g., boat ramps and utilities in the same location. Finally, under certain jurisdictions such as CWA permit conditions or FEMA-accredited levee operation and maintenance, some management actions may not be authorized regardless of FFSL river use class or use determination.

Desired Future Condition

Desired future condition is a planning construct used by the U.S. Forest Service to establish a benchmark for what a resource will look like through implementation of a management plan and associated goals and objectives. As with any planning construct, a desired future condition has limitations, but in the case of the JRCMP, it allows for multiple-use management, can be modified over time based on new data, and avoids the pitfalls of setting a "restored" ecological condition as a management target. For example, in highly managed systems like the Jordan River, setting restoration goals must account for new normal conditions—e.g., invasive species and hydrologic modifications—that make restoration to some earlier condition unrealistic or in some cases unattainable. The JRCMP has established desired future conditions for each of the three resources headings: Ecosystem, Water, and Community. The subsequent management goals and objectives for each subresource provide a means for working toward a **desired future condition** for the Jordan River.

Table 3.1. Use Determinations for Management Actions by River Use Class

Management Action*	Class 1	Class 2	Class 3	Class 4	Class 5
Aboveground utilities	P	P	N	N	N
Belowground or buried utilities	A	A	A	A	P
Bridges (vehicle)	A	A	A	P	N
Bridges (pedestrian)	A	A	A	P	N
Boat docks (temporary)	A	A	A	P	P
Boat docks (permanent)	P	P	P	P	P
Boat ramps	A	A	A	A	P
Outfall structures	A	A	A	P	P
Vegetation removal	A	A	A	P	P
Vegetation planting	A	A	A	A	A
Herbicide treatment	A	A	A	A	A
Bank stabilization (bio-engineering)	A	A	A	A	A
Bank stabilization (hardened)	A	A	P	P	P
Grade controls	A	A	P	P	P
Scientific research instruments	A	A	A	A	A
Diversion structures	A	A	P	P	P
Fire prevention treatments	A	A	A	P	P
Survey and monitoring activities	A	A	A	A	A
Recreation structures (temporary)	A	A	A	P	P
Recreation structures (permanent)	A	A	P	P	P
Dredging	A	A	A	A	P
Emergency clean up	A	A	A	A	A
Emergency rescue training	A	A	A	A	P
Navigation hazard removal	A	A	A	A	A
Dams	P	P	P	N	N
Trash booms	A	A	A	P	P
Wildlife habitat/nesting structures	A	A	A	A	A
Aquatic habitat structures	A	A	A	A	A
Fisheries management	A	A	A	A	P

Notes: A = allowable, N = not allowable except with certain conditions, P = potentially allowable with certain conditions.
* Use determinations pertain to public and commercial actions. In the interest of supporting the Public Trust, utilities, bridges, boat docks, boat ramps, dredging, and other similar actions proposed by private landowners will generally not be permitted.

Resource Management Issues

Throughout the 2015–2016 JRCMP planning process, numerous management issues regarding each Jordan River resource were raised during the public comment period, municipal meetings, stakeholder meetings, and JRCMP planning team meetings. Within each resource, broader management issues were distilled down into a few substantive resource management issues over which FFSL has jurisdiction or would be a cooperating agency. Some of the resource issues raised overlap with other resource issues such as navigational hazards, which can be discussed from recreation, infrastructure, and public safety perspectives. As a result, developing management goals and objectives for one resource issue may incorporate management of other resources. In this case, the management goal is included once and in the resource section most pertinent to the objectives for achieving the goal.

The management strategies in this chapter are organized by resource and follow in the same order as they appear in Chapter 2 (Current Conditions). Each resource section includes a list of desired future conditions for that resource. Additionally, each resource section includes a management strategy table that includes goals, subsequent objectives, and applicable agencies, and a list of BMPs applicable to that resource. Each of these is discussed in more detail below.

Management Goals and Objectives

The goals and objectives reflect the intention of FFSL to protect and sustain the Pubic Trust resources while providing for their use. Each goal is supported by a number of objectives that can be used to achieve it. In some cases, objectives equate to specific management prescriptions with potential for implementation by FFSL (e.g., inventory and map noxious weeds that align the Jordan River), but also include coordination (e.g., coordination with restoration partners on projects that benefit habitat on sovereign land) and general support (e.g., support flow studies and releases that would benefit the riverine ecosystem and fluvial processes).

Interagency Coordination

Effective coordination and communication with government agencies regarding Jordan River resources are vital to ensuring the health and long-term stability of the ecosystem. Coordination between FFSL and other agencies will vary in timing and intensity based on the resource issue at hand. For the purposes of developing the JRCMP management strategies, the government agencies involved fall into three different categories depending on their participation in each unique resource issue:

1. Management agency: A management agency is directly responsible for the management of a particular resource. As mandated through Utah Code, administrative rule, or agency objectives, the agency is responsible for on-the-ground management and/or monitoring.
2. Permitting agency: A permitting agency is responsible for authorizing Jordan River resource-related permits. They are limited in most cases to FFSL, USACE, DWRi, and Salt Lake County Flood Control, who can each issue permits for projects in or adjacent to the Jordan River. Each agency has the potential to impact the resource through permit authorizations including mitigation. The agency is responsible for monitoring permit compliance.
3. Intersecting agency: An intersecting agency is an agency that does not have direct responsibility for managing a particular resource or permitting activities on the Jordan River but is tangentially related. The decisions of these agencies may directly or indirectly impact a particular resource. FFSL management decisions have the ability to impact resources managed, influenced, and/or researched by intersecting agencies. These agencies have the tools, data, and information that could be used by FFSL to make well-informed management decisions. Intersecting agencies may be responsible for research and/or monitoring at a broad scale.

By identifying which agency (or agencies) has management, permitting, or other responsibility for a particular resource, FFSL can ensure that they are coordinating with the appropriate agency to efficiently address resource concerns. It is important to note that although adjacent private landowners, businesses, special interest groups land managers, and local universities are not listed as responsible parties within each resource issue, FFSL is interested and available to discuss resource-specific matters with concerned entities.

Throughout the Management Strategies chapter, terms such as *participate*, *coordinate*, *support*, and *promote* occur often. These terms are used to highlight FFSL's responsibility to coordinate activities of various Utah Department of Natural Resources revisions under Utah Code 65A-10-8. They are used to promote FFSL's involvement with the diverse range of resources within sovereign land boundaries. Further, FFSL is interested in supporting other agencies and being involved in projects and resource issues that impact (or have the potential to impact) the Jordan River ecosystem. The levels to which FFSL will coordinate, support, participate, and promote will depend on the project or resource issue. For example, a right-of-entry permit to conduct a riparian restoration training event would require less communication between agencies than would an easement to place a new bridge or stormwater outfall structure in the river. Ultimately, FFSL is optimistic that participation and communication between agencies and entities throughout the stages of project planning or while addressing resource concerns will lead to beneficial outcomes for the Jordan River.

Best Management Practices

Implementation of the BMPs for each resource helps avoid or minimize impacts to Jordan River sovereign lands. These range from examples of desired plant lists and seed species mix to be used for revegetation to design specifics for buried utility lines. Most BMPs pertain specifically to the bed and bank of the Jordan River. For a list of BMPs relevant to land uses that extend from the river and beyond, see *Best Practices for Riverfront Communities* (JRC 2013b). Users of the JRCMP should review the BMPs during their project planning process and demonstrate in lease application documents how BMPs are incorporated and/or why they are not practicable.

3.2 Ecosystem Resources

Desired Future Conditions:

- A sustainable river system that supports diverse populations of native plant and animal species with limited constraints from invasive and non-native species.
- Recognition that natural disturbance can be beneficial and of the need to avoid anthropogenic disturbance to the extent practicable.
- Understanding that certain areas, although not pristine, exhibit natural and wild character, and that preservation of these areas and the restoration of degraded ecosystems enhance overall ecological condition.

Table 3.2 describes what the river use classes mean for ecosystem management.

Table 3.2. River Use Classes and Ecosystem Management

River Use Class	What the Use Class Means for Ecosystem Management
Class 1	Greater potential for actual loss or degradation of habitat. Balance between existing leases and uses and potential for wildlife habitat. High potential for streambank and instream restoration. Limited opportunity/priority for wildlife habitat restoration.
Class 2	Potential future loss or degradation of habitat. Balance between existing leases and uses and potential for wildlife habitat. High potential for streambank and instream restoration. Limited opportunity/priority for wildlife habitat restoration.
Class 3	Allows for conservation of wildlife habitat through implementation of BMPs and other types of mitigation.
Class 5	High-priority ecosystem protection and conservation. Potential for conservation easement status. No current regulatory restrictions on use or protection.
Class 6	Preservation of ecosystem services and ongoing opportunities for adaptive management and habitat improvement projects. Current regulatory protection of adjacent land use

Wildlife Habitat

As discussed in Section 1.8 in Chapter 1, river use classes are applied to specific locations along the Jordan River based on a variety of parameters. Table 3.3 presents management goals and objectives for wildlife habitat.

Table 3.3. Wildlife Habitat Management Goals and Objectives Common to All Classes

Wildlife Habitat Goal 1: Protect and sustain native habitats along the Jordan River.
Objective: Cooperate with partners to identify and maintain areas with high wildlife habitat value.
Objective: Cooperate with partners to consider the cumulative impacts of past, present, and reasonably foreseeable future projects on instream and adjacent habitat through consultation with management, permitting, and intersecting agencies below.
Management Agencies: FFSL, DWR, local cities and counties
Permitting Agencies: FFSL, DWRi, USACE
Intersecting Agencies: JRC
Wildlife Habitat Goal 2: Restore and enhance native habitats along the Jordan River.
Objective: Support restoration of the riparian zone, emphasizing connectivity along the river corridor.
Objective: Use native or desirable species in plant lists and seed mixes when conducting restoration or enhancement activities.
Objective: Coordinate with agencies and restoration partners to re-establish floodplains and other geomorphic features (e.g., point bars and low emergent benches).
Objective: Support removal of human-made structures that degrade native habitats.
Management Agency: FFSL, DWR, local cities and counties
Permitting Agency: FFSL, DWRi, USACE, DWQ/UDEQ
Intersecting Agencies: JRC
Wildlife Habitat Goal 3: Support habitat restoration or enhancement on lands adjacent to the Jordan River.
Objective: Coordinate with restoration partners on projects that benefit habitat on sovereign lands.
Objective: Cooperate with partners to inventory adjacent lands where restoration or enhancement would benefit navigation, water quality, wildlife habitat, recreation, or aesthetic beauty.
Management Agency: FFSL, DWR, local cities and counties
Permitting Agency: FFSL, DWRi, USACE
Wildlife Habitat Goal 4: Manage invasive and noxious weed species along the Jordan River.
Objective: Inventory/map noxious weed occurrences along the Jordan River.
Objective: Identify concentrations and dispersal vectors for *Phragmites* within the river corridor.
Objective: Target and treat invasive weed species (especially *Phragmites*) and treat colonizing invasive species in the planning area.
Management Agencies: FFSL, local cities and counties
Permitting Agencies: FFSL, DWRi, DWQ/UDEQ
Intersecting Agencies: DWR, JRC

BMPs for wildlife habitat in the planning area are shown in Figure 3.1.

BEST MANAGEMENT PRACTICES FOR WILDLIFE HABITAT THE PLANNING AREA

- Manage invasive and noxious weed species.
- Improve and restore native plant diversity.
- Enhance the river vegetative buffer to minimize noise and light pollution.
- Protect undisturbed areas and open space.
- Improve natural river function, e.g., floodplain connectivity.
- Improve bank stability.
- Manage nuisance wildlife species.
- Enhance connectivity between habitat patches.

Figure 3.1. Best management practices for wildlife habitat management in the planning area.

Wildlife Species

As discussed in Section 1.8 in Chapter 1, river use classes are applied to specific locations along the Jordan River based on a variety of parameters. Table 3.4 presents management goals and objectives for wildlife. BMPs for wildlife in the planning area are shown in Figure 3.2.

Table 3.4. Wildlife Management Goals and Objectives Common to All Classes

Wildlife Species Goal 1: Recognize the importance and support the sustainability of viable populations of native fisheries and migratory bird species and their habitats.
Objective: Coordinate with partners to encourage the maintenance of a diversity of habitats and adequate food supply for fish and migratory birds.
Objective: Support inventory, monitoring, and research of fisheries and migrating bird populations with partners, including non-governmental organizations and citizen science groups.
Objective: Support wildlife-related beneficial uses and help ensure compliance with numeric criteria for pollutants.
Management Agencies: FFSL, DWR, local cities and counties
Permitting Agencies: FFSL, DWRi, USACE
Intersecting Agencies: JRC
Wildlife Species Goal 2: Recognize the importance of watchable wildlife opportunities along the Jordan River.
Objective: Coordinate with partners to increase the biodiversity and numbers of birds and other wildlife species along the Jordan River through habitat restoration and enhancement.
Objective: Support establishment of viewing stations along the Jordan River at key locations.
Management Agency: FFSL, DWR, local cities and counties
Permitting Agency: FFSL, DWRi, USACE
Wildlife Species Goal 3: Support the management of existing exotic species and prevent introduction of new species to the Jordan River.
Objective: Support control of exotic pests that are presently in the river system through coordination with DWR and other agencies.
Objective: Coordinate with DWR on public awareness programs and other strategies for keeping exotic pest species out of the Jordan River.
Management Agency: USFWS, DWR
Permitting Agency: Not applicable
Intersecting Agencies: USFWS, JRC

BEST MANAGEMENT PRACTICES FOR WILDLIFE IN THE PLANNING AREA

- Adhere to all federal regulations (Endangered Species Act, Migratory Bird Treaty Act, and Bald and Golden Eagle Protection Act).
- Apply seasonal bird nesting guidelines described in *Utah Field Office Guidelines for Raptor Protection from Human and Land Use Disturbances* (Romin and Muck 2002) during project implementation.
- Follow herbicide application protocol especially during use near aquatic resources.

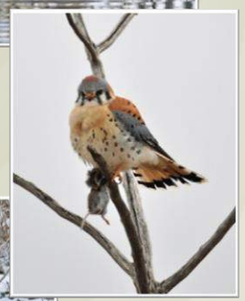



Figure 3.2. Best management practices for wildlife management in the planning area.

3.3 Water Resources

Desired Future Conditions:

- A sustainable river system with naturalized flows and floodplain connectivity.
- Maintenance of seasonal variation in discharge and minimum instream flows that support sediment transport and enhance riparian plant communities.
- Reduction in the effects of bank hardening and channelization on navigability, aquatic habitat, and water quality impairment of recognized beneficial uses.

Table 3.5 describes what the river use classes mean for water resource management.

Table 3.5. River Use Classes and Water Resource Management

River Use Class	What the Use Class Means for Water Resource Management
Class 1	High potential for monitoring, modifying, and replacing existing instream structures that may have a negative effect on hydrology and water quality, which may currently be degrading local hydrology.
Class 2	Potential degradation of local hydrology and water quality is possible without implementation of BMPs and other mitigation measures.
Class 3	Potential degradation of local hydrology and water quality is possible without implementation of BMPs and other mitigation measures.
Class 5	Emphasis is placed on protection of hydrology and water quality, and certain activities may be under additional scrutiny beyond regulation BMPs.
Class 6	Emphasis is placed on protection of hydrology and water quality, and certain activities may be under additional scrutiny beyond regulation BMPs.

Hydrology

As discussed in Section 1.8 in Chapter 1, river use classes are applied to specific locations along the Jordan River based on a variety of parameters. Some variation may existing with regard to hydrology management from one class to the next. Table 3.6 presents management goals and objectives for hydrology.

Table 3.6. Hydrology Management Goals and Objectives Common to All Classes

Hydrology Goal 1: Support instream structure removal and facilitate appropriate instream infrastructure design and management to maintain and improve hydrology.
Objective: Support comprehensive mapping and inventory of instream structures.
Objective: Assess condition of instream structures to determine impact on hydrology.
Objective: Consider removal or repair of instream structures that are degrading hydrologic conditions.
Objective: Ensure that placement and design of new instream infrastructure will not degrade hydrology (see BMPs following this table).
Management Agencies: FFSL, lessees
Permitting Agencies: FFSL, USACE, DWRi
Intersecting Agencies: DWR, JRC
Hydrology Goal 2: Support restoration efforts to increase river stability.
Objective: Manage river restoration efforts with regard to geomorphologic characteristics (e.g., in river segments where slope is steep, consider the likelihood of scour versus in segments where slope is gentle, and consider the likelihood of deposition).
Management Agency: FFSL, landowners along the river corridor
Permitting Agency: FFSL, USACE, DWRi
Intersecting Agencies: DWR, JRC
Hydrology Goal 3: Recognize the importance of natural flows that support aquatic, adjacent habitat, and instream processes.
Objective: Support flow studies and releases that would benefit the riverine ecosystem and fluvial processes.
Objective: Coordinate with DWR on establishment of instream flows to support fisheries and associated aquatic and wildlife habitat.
Management Agency: DWRi, DWRe
Permitting Agency: DWRi
Intersecting Agencies: DWQ

BMPs for hydrology management in the planning area are shown in Figure 3.3 and are adapted from the *Jordan River Corridor Preservation Study* (JE Fuller/Hydrology & Geomorphology and CH2MHill 2007).

BEST MANAGEMENT PRACTICES FOR HYDROLOGY MANAGEMENT IN THE PLANNING AREA

- Demonstrate no adverse impact on hydraulic, hydrologic, and scour/erosion conditions for new projects through engineering analyses.
- Replace and/or enhance bank vegetation disturbed by construction.
- Ensure that steep channel bank slopes should be 2.5:1 or flatter to support vegetative growth.
- Ensure that structural measures should be adequately toed down below the design scour depth, or grade control should be provided to limit long-term scour.
- Design bank stabilization measures to overtop.
- Use bioengineering.

Figure 3.3. Best management practices for hydrology management in the planning area.

Water Quality

Water quality is part of FFSL's multiple-use framework; therefore, water quality concerns do not vary from one class to the next. In addition, FFSL will draw on beneficial use and not the river use class system for water quality management. Table 3.7 presents management goals and objectives for water quality.

Table 3.7. Water Quality Management Goals and Objectives Common to All Classes

Water Quality Goal 1: Promote the antidegradation of Jordan River water quality.
Objective: Coordinate with DWQ to ensure compliance with Utah Water Quality Act regulations (Utah Administrative Code R317).
Objective: Require water quality certifications per Utah Administrative Code R317-15. The purpose of certification is to ensure that the federally permitted or licensed activities will be conducted in a manner that will comply with applicable discharge and water quality requirements to maintain the chemical, physical, and biological integrity of waters of the U.S. within the state.
Objective: Promote the maintenance and improvement of existing water quality to protect the existing beneficial uses designated for the Jordan River.
Management Agencies: DWQ
Permitting Agencies: DWQ
Intersecting Agencies: Local cities and counties
Water Quality Goal 2: Recognize the importance of minimizing pollutant loads to the river, specifically those that have been identified as contributing to low DO concentrations (i.e., organic matter).
Objective: Coordinate with DWQ to ensure compliance with numeric criteria for parameters of concern, e.g., DO.
Objective: Coordinate with municipal stormwater management entities, WWTPs, and other entities that discharge on reducing pollutant loads to the river.
Objective: Communicate new project proposals to DWQ to help ensure impacts do not affect compliance with the existing narrative standard and the numeric DO standard.
Objective: Support maintenance of existing and/or restore degraded wetland, riparian, and vegetated infiltration buffers adjacent to sovereign lands.
Management Agency: FFSL
Permitting Agency: DWRi, DWQ
Intersecting Agencies: Local cities and counties

BMPs for water quality management in the planning area are shown in Figure 3.4.

BEST MANAGEMENT PRACTICES FOR WATER QUALITY MANAGEMENT IN THE PLANNING AREA

- Use sediment and erosion control fencing during construction activities.
- Use bio-engineering practices for bank stabilization.
- Limit construction activities within the stream corridor, particularly during low flow periods.
- Treat WWTP discharges.
- Treat stormwater through the use of constructed wetlands, bio-swales, and other natural features.
- Revegetate the riparian corridor to provide filtration and thermal protection.

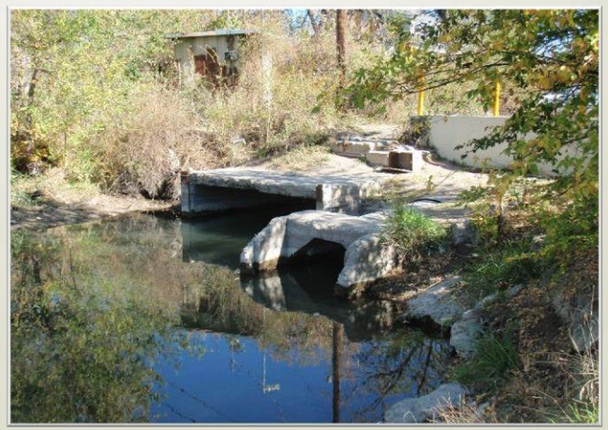


Figure 3.4. Best management practices for water quality management in the planning area.

3.4 Community Resources

Desired Future Conditions:

- A sustainable river system that supports multiple uses and provides navigability and safe access for diverse stakeholders.
- Acknowledgement of the inherent benefits and constraints of the urban and rural landscape through which the river flows.
- Preservation and enhancement of the aesthetic beauty of the river ecosystem and human environment without diminished use for the benefit of recreation, education, and art.

Table 3.8 describes what the river use classes mean for community resource management.

Table 3.8. River Use Classes and Community Resource Management

River Use Class	What the Use Class Means for Community Resource Management
Class 1	Clustering of community resources such as infrastructure and recreation facilities may occur in this class with concern for safety, practicality, and potential degradation of cultural resources.
Class 2	Clustering of community resources such as infrastructure and recreation facilities may occur in this class with concern for safety, practicality, and potential degradation of cultural resources.
Class 3	Emphasis on mitigation to avoid impacts to natural, water, and cultural resources with consideration of multiple-use practices.
Class 5	Preference for activities and mitigation that maintain potential for future resource preservation and restoration.
Class 6	New leases may have to adhere to mitigation standards and regulations associated with conditions of conservation easements, deed restrictions, and other state or federal laws.

Infrastructure

Table 3.9 presents management goals and objectives for infrastructure.

Table 3.9. Infrastructure Management Goals and Objectives Common to All Classes

Infrastructure Goal 1: Minimize impact of new infrastructure.
Objective: Avoid creating new navigational hazards as a result of infrastructure development.
Objective: Restore instream and adjacent habitat damaged during construction of new infrastructure.
Objective: Coordinate with DWQ to ensure compliance with Utah Water Quality Act regulations (Utah Administrative Code R317) and numeric criteria for pollutants of concern to protect beneficial uses.
Management Agencies: FFSL, lessees
Permitting Agencies: FFSL, Salt Lake County Flood Control
Intersecting Agencies: Utility and infrastructure companies, JRC
Infrastructure Goal 2: Minimize impact of infrastructure removal.
Objective: Avoid damage to adjacent habitats during infrastructure removal.
Objective: Restore habitat, as per a revegetation or restoration plan, damaged during infrastructure removal.
Objective: Coordinate with DWQ to ensure compliance with Utah Water Quality Act regulations (Utah Administrative Code R317) and numeric criteria for pollutants of concern to protect beneficial uses.
Management Agency: FFSL, lessees
Permitting Agency: FFSL, Salt Lake County Flood Control
Intersecting Agencies: Utility and infrastructure companies, JRC

Infrastructure Goal 3: Support flood control measures that minimize impacts to the bed and bank of the Jordan River.
Objective: Coordinate with river management agencies to maintain access to existing dredging and flood control locations.
Objective: Coordinate with Salt Lake County and other river management agencies during emergency or high flow events that require flood control action.
Objective: Support restoration of habitat damaged during dredging and flood control activities with an emphasis on bank stabilization and re-vegetation with appropriate species.
Management Agency: FFSL, Salt Lake County Flood Control, other cities and counties, DSPR, DWRe
Permitting Agency: FFSL, Salt Lake County Flood Control
Intersecting Agencies: JRC
Infrastructure Goal 4: Support projects that apply bioengineering methods to address bank and channel stability as appropriate.
Objective: Replace impermeable and hardened surfaces where possible.
Objective: Use woody and herbaceous plant material to protect banks and decrease excessive erosion or scour.
Management Agency: FFSL
Permitting Agency: USACE, FFSL, DWRi
Intersecting Agencies: DWRe, JRC

Figure 3.5 illustrates the correct placement of infrastructure along the Jordan River.

BMPs for the permitting, construction, and removal of infrastructure in the planning area are shown in Figure 3.6.

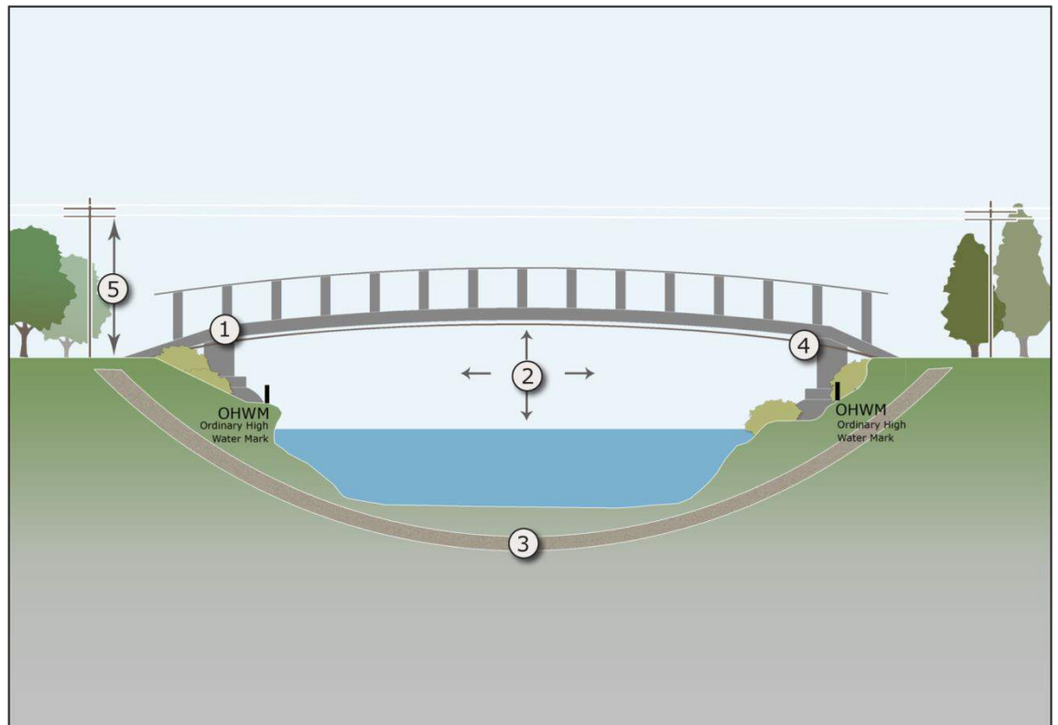


Figure 3.5. Correct placement of infrastructure along the Jordan River.

BEST MANAGEMENT PRACTICES FOR THE PERMITTING, CONSTRUCTION, AND REMOVAL OF INFRASTRUCTURE IN THE PLANNING AREA

General

- When the removal of existing bridges, above-grade utility crossings, outfall structures, and diversion dams is necessary, it should be completed in accordance with applicable CWA and county permits. These permits will require that removal of the infrastructure be completed without significant adverse water quality effects and bank stability effects. Below-grade utility crossings should generally be abandoned in place after assuring that pipes are plugged.
- Habitat damaged during infrastructure removal should be restored during the same growing season as project implementation and as seasonal conditions allow.
- Although no minimum spacing of infrastructure is stipulated, the proximity of one facility to another should be considered as part of the permitting process. In general, pedestrian bridges should not be authorized within 500 feet of one another unless there are safety concerns, e.g., busy road. Proposals for new vehicle bridges should be accompanied by a transportation analysis demonstrated need. Utilities can be clustered to minimize disturbance. New utilities crossing the river should be buried according to the below-grade utility BMPs discussed below. If above-ground utilities must be installed, they should be attached to existing infrastructure.

Design and infrastructure for new **bridges:**

- The clear span of the bridge should cross the main channel without piers or other obstructions in the channel.
- The bridge should not impact the 10-year (10% annual chance) flood flow depth, velocity, water surface elevation, and channel section.
- The bridge should be located (if possible) on a straight channel segment and oriented perpendicular to flow.
- The bridge should provide sufficient freeboard above the 10-year flood flow event to allow for clear navigation.

Figure 3.6. Best management practices for the permitting, construction, and removal of infrastructure in the planning area.

BEST MANAGEMENT PRACTICES FOR THE PERMITTING, CONSTRUCTION, AND REMOVAL OF INFRASTRUCTURE IN THE PLANNING AREA (CONTINUED)

Design and construction of new **below-grade utilities:**

- Below-grade utility crossings should be buried below the 100-year (1% annual chance) local scour depth plus the long-term scour (local and general scour), and below the dredge depth of Salt Lake County Flood Control.
- The depth should be maintained across the floodplain or beyond a public structure, which will protect the utility from exposure by bank erosion.

Design and construction of **new outfall structures** to the Jordan River:

- New outfall structures should provide for dissipation of excess energy prior to discharge to the river.
- New outfall structures to the Jordan River should have means for removal of settleable solids (e.g., sediment traps) prior to discharge.
- Outfall structures should be designed to not impede navigation.

New proposed **diversion dams:**

- New diversion dams should not impede navigation.
- Proposed new dams should obtain a FEMA Conditional Letter of Map Revision, including mitigation of all adverse flooding impacts.
- New diversion dams should provide for dissipation of excess energy prior to flows entering the downstream river channel.
- New diversion dams should have stable dam designs meeting all State Dam safety requirements.
- DWRi, CWA, and Salt Lake County permits should be obtained for new diversion dams.

Construction near **levees:**

- Proposed construction on or adjacent to an accredited levee should obtain FEMA authorization prior to construction.
- FEMA regulations likely restrict tree planting, structures, horizontal and vertical bores, right-of-way encroachments, and bridges within the levee prism, or any other action that restricts levee operation and maintenance.

Figure 3.6. Best management practices for the permitting, construction, and removal of infrastructure in the planning area (continued).

Cultural Resources

There is a higher likelihood of encountering intact prehistoric cultural resources in river use classes with less development and fewer alterations. However, historic river meandering and ongoing erosional process can expose resources in most any location or use class. In addition, sections of the river that have significant development of, and alteration to, the natural environment have the potential for the discovery of cultural resources, especially historic structures. Table 3.10 presents management goals and objectives for cultural resources.

Table 3.10. Cultural Resource Management Goals and Objectives Common to All Classes

Cultural Resources Goal 1: Recognize the importance of cultural resource protection on sovereign lands.
Objective: Collaborate with SHPO on the management of known cultural resource sites on Jordan River sovereign lands.
Objective: Consider how future projects using state funds would affect historic properties, according to Utah Code 9-8-404.
Objective: Adhere to Utah Code 9-9-402 and Utah Administrative Code R230-1 regarding the discovery of human remains on sovereign lands.
Objective: Establish a programmatic agreement with SHPO to facilitate lease review and other management decisions along the Jordan River.
Management Agencies: SHPO
Permitting Agencies: Not applicable
Intersecting Agencies: FFSL, DWR

BMPs for the cultural resources in the planning area are listed in Figure 3.7.

BEST MANAGEMENT PRACTICES FOR CULTURAL RESOURCES IN THE PLANNING AREA

- For archaeological surveys, SHPO recommends resurveying areas if the previous survey is 10 or more years old, because the older survey may not use current inventory methods and requirements. For architectural surveys, "there is no formally established protocol or policy regarding when to redo or update site forms. The rule of thumb or general recommendation is that if a survey or site form is older than 10 years then a new one should be completed. If it is less than 10 years, then it should be updated with a new photograph and any changes should be noted (or if new information about the property has come to light, then that should be added)." (Hansen 2015)
- Under Utah Code 9-9-307, "any person who discovers any archaeological resources on lands owned or controlled by the state or its subdivisions shall promptly report the discovery to the division." In addition, "any person who discovers any archaeological resources on privately owned lands shall promptly report the discovery to the division [Utah Division of State History]."
- Before issuing any permits for projects adjacent to, over, or in the Jordan River, FFSL should notify SHPO before a project starts and before a permit is issued. Project notification will also allow FFSL to informally consult with SHPO on how to best complete FFSL's legal responsibilities regarding cultural resources. Treatment of unanticipated discoveries (i.e., cultural resources unexpectedly found during a project) along the Jordan River should be discussed during initial consultations to create a plan if these occur. For any Native American consultations, FFSL should follow the Utah Department of Natural Resources consultation plan created per the executive order issued by Governor Herbert on July 30, 2014.
- A cultural resource site may be considered a recreation destination or it may enhance the aesthetics of a place to a recreation user. Consider highlighting several well-known cultural resource sites for public education and recreation purposes.

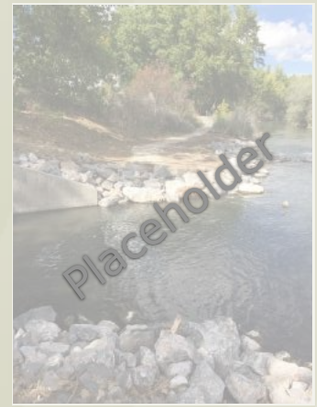


Figure 3.7. Best management practices for cultural resources in the planning area.

Recreation

Recreation includes many activities, and the management goals and objectives in this section seek to enhance and provide safe recreation experiences. The JRCMP does not intend to limit recreation but in some cases does support limited use in certain areas of high wildlife habitat value. For this reason, there is some difference in recreation management decisions between river use classes. Table 3.11 presents management goals and objectives for recreation.

Table 3.11. Recreation Management Goals and Objectives Common to All Classes

Recreation Goal 1: Balance recreation needs, development, and protection of the natural environment.
Objective: Support the identification and development of areas where recreation infrastructure is most needed and is also appropriate.
Objective: Minimize the impacts of recreation infrastructure on the river environment and on existing and potential development (e.g., utility corridors) through lease conditions.
Management Agencies: FFSL, local cities and counties, DSPR
Permitting Agencies: FFSL, USACE, DWRi, Salt Lake County Flood Control
Intersecting Agencies: JRC, utility and infrastructure companies
Recreation Goal 2: Encourage recreational opportunities along the Jordan River where appropriate and allow for a variety of recreation interests.
Objective: Coordinate with cities, counties, and other entities to improve or add existing recreation infrastructure and create new recreation opportunities in the planning area (e.g., wildlife viewing platforms, boater access points, kayak "play" areas, and urban fisheries).
Objective: Support creation of a comprehensive water trail map to provide information on boating, wildlife viewing, fishing, and other recreation opportunities in the planning area.
Objective: Encourage the application of design standards (e.g., U.S. Forest Service, Americans with Disability Act, or *Salt Lake County Jordan River Trail Master Plan* standards) to support increased visibility and recreational use of the river. See BMPs.
Objective: Coordinate with management partners to update and disseminate recreation information (e.g., brochures, website, and signage) when changes occur or as needed.
Management Agency: FFSL, local cities and counties, DSPR
Permitting Agency: FFSL
Intersecting Agencies: JRC
Recreation Goal 3: Support development and maintenance of recreation infrastructure.
Objective: Supplement the in-house database of recreation infrastructure with information on maintenance responsibility.
Objective: Consider and support the removal of recreation infrastructure that is dysfunctional, obsolete, or incompatible with other uses or river classes as opportunities allow.
Management Agency: FFSL, local cities and counties, DSPR
Permitting Agency: FFSL
Intersecting Agencies: JRC, DSPR
Recreation Goal 4: Integrate recreation and restoration opportunities along river as appropriate.
Objective: Integrate restoration projects into the Jordan River Trail system.
Objective: Consider recreational navigation of the river when designing restoration projects.
Management Agency: FFSL, local cities and counties
Permitting Agency: USACE, FFSL, DWRi, DWQ/UDEQ
Intersecting Agencies: JRC, DWR, DSPR

BMPs for the recreation in the planning area are shown in Figure 3.8.

BEST MANAGEMENT PRACTICES FOR RECREATION IN THE PLANNING AREA

- Replace structural water-conveyance devices with alternatives that allow for recreation improvements.
- Develop boater access points and portages with safe, flexible, and functional designs that meet water trail user needs at different flow levels of the river and that accommodate boating parties of varying sizes and skill levels.
- Although no minimum spacing for recreation infrastructure such as boater access points is stipulated, consideration of the proximity of one facility to another will occur as part of the leasing process.
- Maintain or improve aesthetic beauty when designing new recreation facilities.
- Promote lake-to-lake boat trips with associated boater access points.
- Consider development of a boater slalom course with hydraulic features and timing gates.
- Promote the planning area as an urban bird watching area.
- Limit new bridges because they tend to degrade the experience of boaters on the river.
- Recreation infrastructure should protect as much native and sensitive habitat as feasible; enhance developed areas when needed with additional planting of native vegetation.
- Avoid sensitive environments and encourage new recreation infrastructure construction in previously disturbed areas.
- Choose recreation infrastructure (sustainable, green infrastructure) that maintains river function and wildlife habitat.
- Install trash and recycling receptacles near recreation infrastructure and at other places where users approach the river.
- Avoid creating barriers to wildlife movement with new recreation infrastructure.
- Refer to the NPS's *Design Guide for Canoe and Kayak Launches* (2004), as well as water trail guidelines in the *Jordan River Trail Master Plan* (Salt Lake County 2008), which include recommendations for boat launch specifications, portages, and signage.
- The preferred concept for boater access points includes associated parking with room for boat trailers, safe access to the ramp such as wood stairs or gentle slopes, retaining structures along the ramp to protect banks, appropriate ramp slopes for boat launching and/or take-out, planting of vegetation to protect banks and provide aesthetic beauty, and a nearby area for portable restrooms and waste bins.

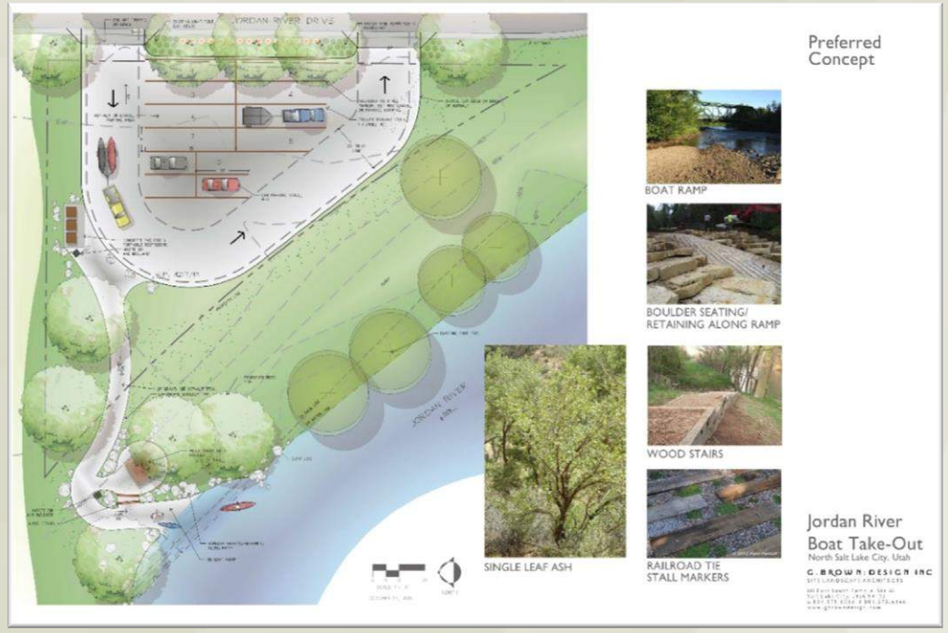


Figure 3.8. Best management practices for recreation in the planning area.

Access

Access to Jordan River sovereign lands is inherent in their status. Management goals and objectives generally seek to facilitate safe access while protecting private landowners' rights adjacent to the river. Proper spacing and minimizing impacts resulting from intense access are a priority for FFSL. In support of public safety, private landowner access in the form of trails, boat docks, boat ramps, etc. are generally not permitted. Table 3.12 presents management goals and objectives for access.

Table 3.12. Access Management Goals and Objectives Common to All Classes

Access Goal 1: Balance needs for access with river protection.
Objective: Evaluate access points in an area before approving new access as part of a lease application process.
Objective: Support development of new public access points where appropriate.
Objective: Minimize the impacts of new access points on the river environment through appropriate design and siting during the lease application process.
Objective: Work with cities, counties, and communities to identify the most appropriate locations for new access facilities and encourage the sharing of access points to minimize new infrastructure (e.g., bridges).
Management Agencies: FFSL, local cities and counties, DSPR
Permitting Agencies: FFSL
Intersecting Agencies: JRC, utility and infrastructure companies
Access Goal 2: Through the permitting process, ensure that new development does not unnecessarily impede access.
Objective: Evaluate lease applications to confirm that projects do not limit, conflict with, or prevent current or future access (e.g., a low clearance bridge may stop boaters, and construction of an outfall structure could prevent access for flood control).
Objective: Support siting new river access points in areas that connect to other trails and public transit.
Management Agency: FFSL
Permitting Agency: FFSL
Intersecting Agencies: Utility and infrastructure companies, Salt Lake County Flood Control
Access Goal 3: Where possible, remove obstacles that limit or prevent access.
Objective: Improve water trail access and increase the mobility of boats on the river through the removal of navigational hazards, installation of new portages, and the use of signage.
Objective: Support public access infrastructure that adheres to Americans with Disabilities Act accessibility guidelines and other design specifications.
Objective: Work to mitigate *Phragmites* infestations and other non-native species that may impede river access.
Management Agency: FFSL, local cities and counties, DSPR, DWR
Permitting Agency: FFSL
Intersecting Agencies: JRC

BMPs for access in the planning area are listed in Figure 3.9 and shown in Figure 2.44.

BEST MANAGEMENT PRACTICES FOR ACCESS IN THE PLANNING AREA

- Encourage accessibility of the planning area through appropriate signage.
- Manage invasive and nuisance species through the permitting process where possible.
- Within permits, require restoration of vertical riverbanks to a more gentle relief using laying back dredge berms or levees where possible to reduce erosion and improve public access and safety.
- Locate bridges frequently enough to provide adequate access but not so frequently to affect riparian habitat and use of the water trail.
- Locate bridges and boater access points in areas that already have human impacts and are easily visible from both the river and shore for water trail users.
- Require new construction of bridge pilings at a spacing of 25 feet to allow passage of rowing shells.
- Decommission bridges and boater access points located in low value areas or that are poorly designed.
- Refer to the NPS design guide for canoe launches, as well as guidelines in the *Jordan River Trail Master Plan* (Salt Lake County 2008) for developing access infrastructure.
- Encourage floating ramps, stairs, and fishing piers, rather than fixed structures, because they respond better to changing river levels.
- Work with local general plans and planning organizations and stakeholders in the site selection of new utility facilities; avoid siting utilities in areas with flood.
- Share rights-of-way with other utilities such as roads, canals, and railroads; use land adjacent to other infrastructure to minimize access points.
- Assist Salt Lake County Flood Control with access.

Figure 3.9. Best management practices for access in the planning area.

Public Safety

The five river use classes are generally not important in terms of managing public safety because safety should be addressed along the entire river, regardless of class. However, safety concerns may be lower in Class 5 and 6 areas because of the reduced presence of infrastructure. In addition, some safety measures may not be applicable in Class 5 and 6 areas because of limited compatibility with resource preservation goals. Table 3.13 presents management goals and objectives for public safety.

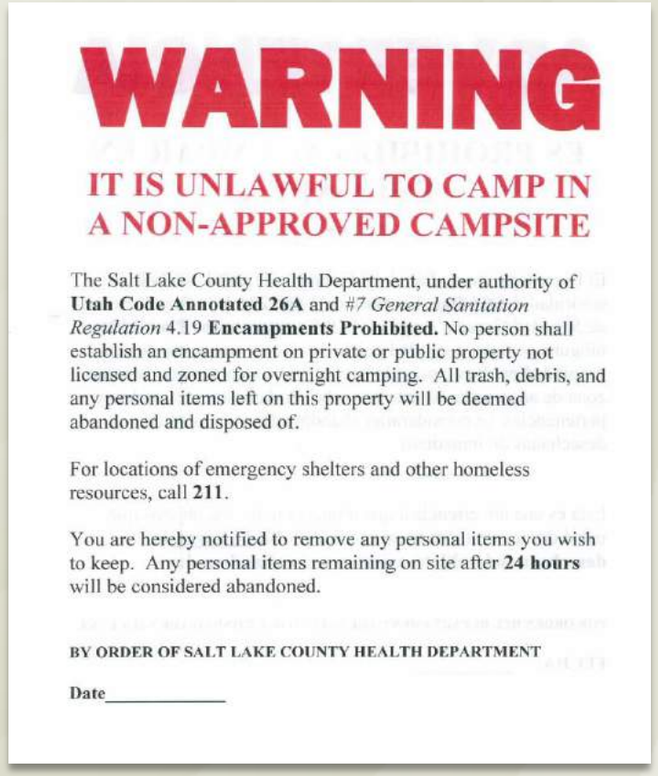
Table 3.13. Public Safety Management Goals and Objectives Common to All Classes

Public Safety Goal 1: Improve water trail safety (boater safety) by addressing permanent and temporary navigational hazards.
Objective: Collaborate with partners, including JRC and the recreation community on the installation of a consistent and clear signage system to identify potential navigational hazards in the river.
Objective: Support removal (or maintenance) of temporary navigational hazards such as large woody debris, garbage rafts, and eroding banks.
Objective: Remove permanent navigational hazards when possible or incorporate into restoration activities that allow for avoidance (e.g., installation of boater access points for portaging around an obstacle).
Management Agencies: FFSL, local cities and counties, infrastructure owners, DWR
Permitting Agencies: FFSL
Intersecting Agencies: JRC
Public Safety Goal 2: Evaluate new permit applications with public safety in mind and require any needed public safety measures.
Objective: Require the installation of portages and related signage when appropriate.
Objective: Review new infrastructure design to reduce the potential for navigational hazards (e.g., water flow can expose buried pipes, bridge height can affect boater clearance) or other public safety concerns.
Objective: Evaluate new projects to determine if safety issues are adequately addressed (e.g., navigation, lighting, fire prevention, traffic, health, and project design specifications).
Management Agency: FFSL, local cities and counties, DSPR
Permitting Agency: FFSL
Intersecting Agencies: JRC
Public Safety Goal 3: Address safety issues in the planning area.
Objective: Coordinate with state and local agencies (e.g., law enforcement and public health departments) to address safety issues such as transient communities, fire, and flood.
Objective: Support crime prevention and enforcement/patrolling by coordinating with other entities providing such services.
Management Agency: FFSL, local cities and counties, public health departments, local law enforcement departments
Permitting Agency: None
Intersecting Agencies: JRC

BMPs for the public safety in the planning area are listed in Figure 3.10.

BEST MANAGEMENT PRACTICES FOR PUBLIC SAFETY IN THE PLANNING AREA

- Carefully consider new infrastructure design to maintain enough clearance for water trail users and ensure maximum space for natural river movement (e.g., bridges can be constriction points and may cause flood control issues).
- Locate boater access points in river eddies of sufficient size to accommodate several boats to protect the boaters, ramps, and docks from the river current and reduce erosion. Avoid steep slopes.
- Refer to the National Park Service or other agency design guidelines and standards for canoe launches and trails, as well as guidance in the *Jordan River Trail Master Plan* (Landmark Design, Inc. 2008) for launches, portages, and signage.
- Support adherence to Americans with Disability Act accessibility guidelines in project designs.
- Educate adjacent landowners on defensible space measures to protect against fire.
- Require bioengineering methods to stabilize shorelines (and protect vegetation) for sheltering put-ins and take-outs.
- Reduce stands of *Phragmites* and other non-native vegetation to lower the fire risk and discourage the development of transient camps.
- Contact Salt Lake County Public Health Department Environmental Health Division to report encampments or other public health concerns (385-468-3860).
- Direct other public safety concerns to the local police departments.



WARNING

IT IS UNLAWFUL TO CAMP IN A NON-APPROVED CAMPSITE

The Salt Lake County Health Department, under authority of **Utah Code Annotated 26A** and *#7 General Sanitation Regulation* 4.19 **Encampments Prohibited.** No person shall establish an encampment on private or public property not licensed and zoned for overnight camping. All trash, debris, and any personal items left on this property will be deemed abandoned and disposed of.

For locations of emergency shelters and other homeless resources, call **211**.

You are hereby notified to remove any personal items you wish to keep. Any personal items remaining on site after **24 hours** will be considered abandoned.

BY ORDER OF SALT LAKE COUNTY HEALTH DEPARTMENT

Date_____

Figure 3.10. Best management practices for public safety in the planning area.

Education

Education about FFSL's role and jurisdiction and the value of the Jordan River is important across all use classes. Table 3.14 presents management goals and objectives for education.

Table 3.14. Education Management Goals and Objectives Common to All Classes

Education Goal 1: Support education about the importance of the Jordan River and the need to protect it as a healthy, functioning ecosystem.
Objective: Support consistent and appropriate use of educational signage in the planning area, especially along the Jordan River Water Trail.
Objective: Support development of information and public awareness programs for adjacent landowners and lessees on how to reduce negative impacts to the river.
Objective: Support partnerships, research programs, and school education programs in the planning area; integrate research results into management and planning.
Management Agencies: FFSL, DSPR, local cities and counties
Permitting Agencies: FFSL
Intersecting Agencies: JRC, Envision Utah
Education Goal 2: Expand informational material regarding FFSL's role in management, jurisdiction, and application of multiple-use management strategies of the Jordan River.
Objective: Provide potential lessees with a clear permit application process through the FFSL website and other media.
Management Agency: FFSL, lessees, local cities and counties
Permitting Agency: FFSL
Intersecting Agencies: JRC
Education Goal 3: Provide education on recreation opportunities and safety along the Jordan River when appropriate.
Objective: Support development of information and public awareness programs for boaters about the water trail, including consistent, clear signage on the water trail itself.
Objective: Support development of information, signage, and public awareness programs for other recreation opportunities in the planning area (e.g., fishing and wildlife viewing).
Management Agency: FFSL, DSPR, local cities and counties
Permitting Agency: FFSL
Intersecting Agencies: JRC

BMPs for education in the planning area are shown in Figure 3.11.

BEST MANAGEMENT PRACTICES FOR EDUCATION IN THE PLANNING AREA

- Provide a list of good practices for adjacent landowners regarding dumping, oil changes, use of native landscaping, herbicide/pesticide use, etc.
- Coordinate with other agencies and establish partnerships to meet education and research goals and objectives.
- Use education requirements as potential mitigation for development projects.
- Regularly identify any research needs that could result in better management of the planning area.

Figure 3.11. Best management practices for education in the planning area.

3.5 Coordination Framework

Introduction

Multiple cities, counties, and state and federal agencies are involved in management and permitting in the planning area. Although FFSL has management jurisdiction from top of bank to top of bank, we are responsible for considering the protection of navigation, fish and wildlife habitat, aquatic beauty, public recreation, and water quality in keeping with the Public Trust. Because of this, FFSL has an interest in improving coordination with other agencies and Jordan River stakeholders with respect to management, permitting, and research. Permitting new activities can have important implications on the management of the Jordan River. Research can inform and improve Jordan River management objectives and actions. Currently there is a need for more frequent coordination between and within these spheres. Table 3.15 shows the primary role of state, federal, and other regulatory and coordinating bodies in permitting, management, and research on the Jordan River.

Table 3.15. Primary Role of State, Federal, and other Regulatory and Coordinating Bodies in Permitting, Management, and Research on the Jordan River

Agency		Permitting and Compliance	Management	Research
Utah Department of Natural Resources	FFSL	X	X	X
	DWR		X	X
	DSPR		X	
	DWRi	X		
	DWRe		X	X
Other state agencies	DWQ	X	X	X
	UDOT		X	
	SHPO	X	X	X
Federal agencies	USACE	X		
	USFWS		X	X
	NPS			X
	EPA		X	
Local government	Utah County		X	
	Salt Lake County	X	X	
	Davis County		X	
	Municipalities		X	X
Coordinating bodies	JRC		X	X

Broader geographic coordination is also required. As described in Chapter 1, FFSL has jurisdiction over Utah Lake and Great Salt Lake, in addition to the Jordan River. Each of the three sovereign land areas has some form of associated government commission, although the mandate of each may vary. In some cases, management activities, e.g., weed treatment, should be implemented at a scale that extends beyond the Jordan River.

The JRC is a mix of governmental and non-governmental members who work to increase and improve the implementation of projects identified in *Blueprint Jordan River*, raise public awareness, and help promote coordination among stakeholders. FFSL, together with the commission (which also oversees a technical advisory committee), can provide a long-term management vision that affects not only the Jordan River itself but the watershed and upstream and downstream ecosystems.

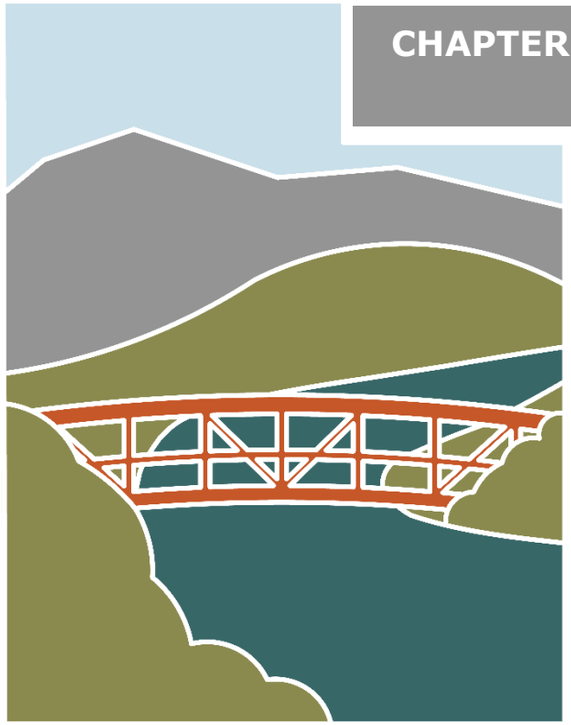
Permitting

As illustrated in Figure 1.3 in Chapter 1, multiple entities have jurisdiction over the Jordan River and its immediate environs. At this time, each entity requires a different permit, in part because each focuses on a different aspect of river management, e.g., DWRi water rights and recreation and USACE placement of fill below the OHWM. During the public involvement process, stakeholders recommended consolidating permits. FFSL will review the practicality of this relative to our mandate of sovereign lands management.

Research and Management Implementation

Current research on the Jordan River ranges from water chemistry processes to fisheries and bird population inventories and is implemented by academic researchers, state agencies, local governments, and stakeholder groups. Much of this research has practical application and may inform future management of flows and restoration to improve water quality and habitat condition among other aspects of the Public Trust. Ongoing coordination of research and management implementation is necessary for the success of projects such as *Phragmites* treatment, navigational hazard removal, and bank stabilization. For large projects, especially those with multiple components like Big Bend and Three Creeks, partnerships are needed, with different actors taking on roles as champion, planner, funder, and installer. Although this plan does not prioritize specific projects, FFSL supports those projects that improve conditions of the Public Trust: water quality, navigation, wildlife habitat, recreation, and aesthetic beauty.

This page intentionally blank



CHAPTER 4 – LITERATURE CITED

Belliston, N., J. Merritt, R. Whitesides, S. Dewey, and S. Burningham. 2009. *Noxious Weed Field Guide for Utah.* Utah State University Extension, Logan, Utah. Available at: http://extension.usu.edu/files/publications/publication/pub__8746541.pdf. Accessed March 16, 2016.

CH2MHill. 1992. *Jordan River Stability Study.* Submitted to Salt Lake County. Available at: http://www.jordanrivercommission.com/wp-content/uploads/JRstabilityStudy1of3.pdf. Accessed March 24, 2106.

Cirrus Ecological Solutions, LC. (Cirrus) 2013. *Jordan River Total Maximum Daily Load Water Quality Study – Phase 1.* Prepared for Utah Department of Environmental Quality, Division of Water Quality. Available at: http://www.deq.utah.gov/ProgramsServices/programs/water/watersheds/jordanriver/docs/2012/10Oct/JordanRiverTMDL_Approved%20Document%20for%20EPA%209.26.2012.pdf. Accessed March 24, 2016.

City of North Salt Lake. 2015. North Salt Lake Zoning Map. Available at: http://www.nslcity.org/index.aspx?NID=245. Accessed March 30, 2016.

Coombs, E.M., J.K. Clark, and G.L. Piper. 2004. *Biological Control of Invasive Plants in the United States.* Corvallis, Oregon: Oregon State University Press.

Colorado State University. 2000. *Creating an Integrated Weed Management Plan: A Handbook for Owners and Managers of Lands with Natural Values.* Caring for the Land Series, Volume IV. Colorado Department of Agriculture. Colorado State University Division of Plant Industry. Available at: http://www.blm.gov/style/medialib/blm/wy/programs/invasiveplants/docs.Par.42434.File.dat/IWMhandbook.pdf. Accessed March 24, 2016.

Davis County. 2011. County Zoning Maps. Davis County Land Use 2011. Available at: http://www.daviscountyutah.gov/planning/planning-documents-applications/planning-maps. Accessed March 30, 2016.

DeVries P, K.L. Fetherston, A. Vitale, and S. Madsen. 2012. Emulating riverine landscape controls of beaver in stream restoration. *Fisheries* 37(6):246–255.

Dumas, P.C. 1966. Studies of the Rana species complex in the Pacific Northwest. *Copeia* 1966:60-74.

Envision Utah. 2008. *Blueprint Jordan River.* Available at: http://www.slco.org/blueprint/index.html. Accessed March 18, 2016.

Federal Emergency Management Agency (FEMA). 1994. *Flood Insurance Study, Salt Lake County, Utah, Unincorporated Areas, Volume 1.* Available at: http://digitalcommons.usu.edu/cgi/viewcontent.cgi?article=1195&context=govdocs. Accessed on March 16, 2016.

———. 2015a. Zone AH. Available at: https://www.fema.gov/zone-ah. Accessed March 18, 2016.

———. 2015b. Floodway. Available at: https://www.fema.gov/floodway. Accessed February 19, 2016.

Flemer, E. J. Harris, B. Holcomb, J. Ostermiller, and C. Seese. 2016. *Utah's 303(D) Assessment Methodology. 2016 Integrated Report.* Available at: http://www.deq.utah.gov/ProgramsServices/programs/water/wqmanagement/assessment/docs/2015/03Mar/303d_AsseesmentMethodology.pdf. Accessed March 24, 2016.

Hansen, C. 2015. Personal Communication between Anne Oliver, Architectural Historian, SWCA Environmental Consultants and Christopher Hansen, Architectural Historian, Utah State Historic Preservation Office, February 24, 2015

Hardesty, D.L., and B.J. Little. 2000 Assessing Site Significance: A Guide for Archaeologists and Historians. Walnut Creek, California: AltaMira Press.

Hatton, S.R. 1932. The Fish Fauna of Utah Lake. Master's Thesis. Provo, Utah: Bingham Young University.

Holzapfel, R.N. 1999. *A History of Utah County.* Utah Centennial County History Series. Salt Lake City, Utah: Utah State Historical Society, Utah County Commission.

JE Fuller/Hydrology & Geomorphology and CH2M Hill. 2007. *Jordan River Corridor Preservation Study*. Available at: http://jordanrivercommission.com/wp-content/uploads/FinalJordanRiverCorridorPreservationStudyv11.pdf. Accessed on February 19, 2016.

Johnson, R.R., L.T. Haight, and J.M. Simpson. 1985. Endangered species vs. endangered habitats: A management challenge. *Western Birds* 18:89–96.

Jordan River Commission (JRC). 2013a. Jordan River Development Map Book. Available at: http://jordanrivercommission.com/resource-maps/. Accessed [pending online posting].

———. 2013b. *Best Practices for Riverfront Communities.* Available at: http://jordanrivercommission.com/wp-content/uploads/BP-high-res-for-web.pdf. Accessed March 21, 2016.

———. 2016a. Resources. Self-Guided Tours. Available at: http://jordanrivercommission.com/resources/. Accessed May 3, 2016.

.———. 2016b. Curriculum. Available at: http://jordanrivercommission.com/curriculum/. Accessed May 3, 2016.

Jordan River Commission, Center for Documentary Expression & Art, and Salt Lake Couty Watershed and Planning Department. 2016. My Jordan River. Available at: http://www.myjordanriver.org/. Accessed May 4, 2016.

Krueper, D.J., J.L. Bart, and T.D. Rich. 2003. Response of breeding birds to the removal of cattle on the San Pedro River, Arizona. *Conservation Biology* 17(2):607–615.

Landmark Design, Inc. 2008. *Jordan River Trail Master Plan.* Prepared for Salt Lake County Parks and Recreation Division. Available at: http://www.slco.org/recreation/planning/html/jordanRiver.html. Accessed March 22, 2016.

Larsen L. 2016. Email communication from Lynn Larsen, Landscape Architect/Project Manager, Salt Lake County Parks and Recreation to Gretchen Semerad, SWCA Environmental Consultants, February 23, 2016.

Lehi City. 2013. Lehi City General Plan Land Use Map. Available at: https://www.lehi-ut.gov/planning/maps-2/. Accessed March 30, 2016.

———. 2014. Lehi City Planning Zone Map. Available at: https://www.lehi-ut.gov/planning/maps-2/. Accessed March 30, 2016.

Leonard, G.M. 1999. *A History of Davis County.* Utah Centennial County History Series. Salt Lake City, Utah: Utah State Historical Society.

Lockerbie, C.W. 1949. Our Changing World. *Audubon News* 1(2):3.

Mack, R.N., D. Simberloff, W.M. Lonsdale, H. Evans, M. Clout, and F.A. Bazzaz. 2000. Biotic invasions: causes, epidemiology, global consequences, and control. *Ecological Applications* 10:689–710.

Moncur, K.D. 2015. Email communication from Kade D. Moncur, Salt Lake County Flood Control Engineering to Brian Nicholson, SWCA Environmental Consultants, December 3, 2015.

Morris, R.L., and W.W. Tanner. 1969. The ecology of the western spotted frog, Rana pretiosa Baird and Girard, a life history study. *The Great Basin Naturalist* 24(2):45–81.

Mott, E. 2015. Jordan River Water Trail Section and Maps. Author's personal collection.

National Audubon Society. 2000. *The Jordan River Natural Conservation Corridor Report.* Prepared for the Mitigation Commission and the U.S. Fish and Wildlife Service. Available at: http://www.mitigationcommission.gov/wetlands/pdf/wetlands_jornac.pdf. Accessed March 24, 2016.

National Park Service. 2004. *Logical Lasting Launches Design Guidance for Canoe and Kayak Launches.* Available at: https://www.nps.gov/ncrc/programs/rtca/helpfultools/launchguide.pdf. Accessed March 31, 2016.

National Resources Conservation Service. 1998. *The Practical Streambank Bioengineering Guide.* User's Guide for Natural Streambank Stabilization Techniques in the Arid and Semi-Arid Great Basin and Intermountain West. Aberdeen, Idaho: NRCS Plant Materials Center. Available at: http://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/idpmcpu116.pdf. Accessed March 24, 2016.

———. 2016. Stream Restoration. Available at: http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/water/manage/restoration/. Accessed March 24, 2016.

Olson, B. 2015. *Jordan River Bird List. Citizen Science Project.* Salt Lake City, Utah: Tracy Aviary.

Parrish, J.R., F.P. Howe, and R.E. Norvell. 2002. *Utah Partners in Flight Avian Conservation Strategy Version 2.0.* UDWR Publication Number 02-27. Salt Lake City, Utah: Utah Partners in Flight Program, Utah Division of Wildlife Resources. Available at: https://wildlife.utah.gov/publications/pdf/utah_partners_in_flight.pdf. Accessed March 25, 2016.

Pollock M, J.M. Bouwes, C. Volk, N. Weber, and C.E. Jordan. 2012. *Working with Beaver to Restore Salmon Habitat in the Bridge Creek Intensively Monitored Watershed: Design Rationale and Hypotheses.* NMFS-NWFSC-120. Seattle, Washington: U.S. Department of Commerce, National Oceanic and Atmospheric Administration. Available at: http://www.nwfsc.noaa.gov/research/divisions/fe/documents/NMFS-NWFSC-120.pdf. Accessed March 24, 2016.

Polvi, L.E., and E. Wohl. 2013. Biotic drivers of stream planform: implications for understanding the past and restoring the future. *BioScience.* 63(6):439–452.

Pope, T. 2015. Personal communication between Terri Pope, Utah Division of Wildlife Resources, and Thomas Sharp, SWCA Environmental Consultants, December 14, 2015.

Potts, D. 2011a. Amphibians of the Jordan River. Available at: http://jordanrivercommission.com/wp-content/uploads/2011/11/Amphibians-of-the-Jordan-River-2011.pdf. Accessed March 24, 2106.

———. 2011a. Fishes of the Jordan River. Available at: http://jordanrivercommission.com/wp-content/uploads/2011/04/Fish-Species-of-the-Jordan-River-2011.pdf. Accessed March 24, 2016.

Roa, C. 2015. *Bird Monitoring at Big Bend Restoration Area.* Citizen Science Project. Tracy Aviary.

Romin, L.A., and J.A. Muck. 2002. *Utah Field Office Guidelines for Raptor Protection from Human and Land Use Disturbances.* Salt Lake City, Utah: U.S. Fish and Wildlife Service, Utah Field Office. Available at: http://www.fws.gov/utahfieldoffice/Documents/MigBirds/Raptor%20Guidelines%20(v%20March%2020,%202002).pdf. Accessed March 2016.

Salt Lake County. 2006. #14 Watershed Regulation. Adopted by the Salt Lake Valley Board of health. Available at: http://slcohealth.org/envRegs/reg14watershed.html#prohibited42. Accessed March 25, 2016.

———. 2009. *Salt Lake Countywide Watershed – Water Quality Stewardship Plan.* Available at: http://www.slco.org/watershed/wtrQualSteward/index.html. Accessed February 19, 2016.

———. 2013. Jordan River zoning map book, Salt Lake County Surveyor. Jordan River Zoning. Available at: http://slco.maps.arcgis.com/apps/OnePane/basicviewer/index.html?appid=63c62ea514cc4e6b86f6d0398eac33f1 and at http://jordanrivercommission.com/resource-maps/. Accessed March 30, 2016.

———. 2016a. Real Time Streamflow Totals. Available at: http://slco.org/flood-control/real-time-streamflow-totals/. Accessed March 23, 2016.

———. 2016b. Flood Preparedness Manual. Available at: http://slco.org/flood-control/flood-preparedness-manual/. Accessed March 25, 2016.

Saratoga Springs. 2012. Saratoga Springs Zoning and Land Use Plan maps. Available at: http://www.saratogaspringscity.com/index.asp?SEC=BDC19C2B-76D9-4953-9B47-C5B8069DE73C&Type=B_BASIC. Accessed March 30, 2016.

Scott, M.L., S.K. Skagen, and M.F. Mergliano. 2003. Relating geomorphic change and grazing to avian communities in riparian forests. *Conservation Biology* 17:284–296.

Sear-Brown and Bio West. 2001. *Davis County Shorelands Comprehensive Land Use Master Plan.* Available at: http://www.mitigationcommission.gov/wetlands/pdf/Shorelands_Masterplan.pdf. Accessed March 24, 2016.

Sigler, W.F. and J.W. Sigler. 1996. *Fishes of Utah.* Salt Lake City, Utah: University of Utah Press.

Sillitoe, L. 1996. *A History of Salt Lake County.* Utah Centennial County History Series. Salt Lake City, Utah: Utah State Historical Society.

Skagen, S.K., R. Hazlewood and M.L. Scott. 2005. *The Importance and Future Condition of Western Riparian Ecosystems as Migratory Bird Habitat.* USDA Forest Service Gen. Tech. Rep. PSW-GTR-191. Available at: http://www.fs.fed.us/psw/publications/documents/psw_gtr191/psw_gtr191_0525-0527_skagen.pdf. Accessed March 24, 2016.

Sperry, L.J., J. Belnap, and R.D. Evans. 2006. *Bromus tectorum* invasion alters nitrogen dynamics in an undisturbed arid grassland ecosystem. *Ecology* 87(3):603–615.

SWCA Environmental Consultants and Hansen, Allen & Luce. 2013. *Lower Jordan River: Phase 1 Report.* Available at: http://jordanrivercommission.com/wp-content/uploads/jordanlabphase1report.pdf. Accessed February 19, 2016.

The Federal Interagency Stream Restoration Working Group. 2001. *Stream Corridor Restoration: Principles, Processes, and Practices.* Available at: http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1044574.pdf. Accessed March 24, 2016.

The United States National Arboretum. 2006. Native Plant Frequently Asked Questions. Available at: http://www.usna.usda.gov/Gardens/faqs/nativefaq2.html. Accessed on December 23, 2015.

Thompson, B. 2016. Email communication from Bob Thompson, Program Manager, Salt Lake County, Watershed Planning and Restoration to Gretchen Semerad, SWCA Environmental Consultants, January 7, 2016.

Tu, M. 2003. *Element Stewardship Abstract for* Elaeagnus angustifolia *L. Russian olive, oleaster.* The Nature Conservancy wildland invasive species program. Arlington, Virginia: The Nature Conservancy. Available at: http://www.invasive.org/weedcd/pdfs/tncweeds/elaeang.pdf. Accessed on March 24, 2016.

U.S. Army Corps of Engineers (USACE). 2014. *Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams, and Appurtenant Structures.* ETL 1110-2-583. Available at: http://www.mvs.usace.army.mil/Portals/54/docs/LeveeSafety/Documents/2014-04-30_ETL_1110-2-583_Vegetation.pdf. Accessed March 18, 2016.

———. 2016. National Wetland Plant List. Plant Identification – Wetland Ratings. Available at: http://rsgisias.crrel.usace.army.mil/nwpl_static/plants/plants.html. Accessed March 16, 2016.

U.S. Fish and Wildlife Service (USFWS). 2002. *Status review for the Columbia Spotted Frog (*Rana luteiventris*) on the Wasatch Front, Utah.* Denver, Colorado: USFWS Region 6. Available at: http://www.fws.gov/mountain-prairie/species/amphibians/spottedfrog/statusreport0802.pdf. Accessed March 24, 2016.

U.S. Geologic Survey (USGS) National GAP Analysis Program. 2005. Southwestern Regional GAP Analysis Project-Land Cover Descriptions. Logan, Utah: RS/GIS Laboratory, College of Natural Resources, Utah State University. Available at: http://earth.gis.usu.edu/swgap/. Accessed March 24, 2016.

———. 2016. USGS 10171000 JORDAN RIVER @ 1700 SOUTH @ SALT LAKE CITY, UT. Available at: http://waterdata.usgs.gov/ut/nwis/uv/?site_no=10171000&PARAmeter_cd=00065,00060,72020,00010,00095,00400,00300,00045. Accessed March 23, 2016.

Utah Division of Forestry, Fire & State Lands (FFSL). 2016. Historic Jordan River Channel. Available at: http://jordanrivercommission.com/historic-jordan-river-channel-locations/. Accessed March 31, 2016.

Utah Division of Water Resources (DWRe). 2010. *Jordan River Basin Planning for the Future.* Utah State Water Plan. March 2010. Available at: http://www.infrastructureusa.org/wp-content/uploads/2010/03/jordanriverbasin.pdf. Accessed March 23, 2016.

Utah Division of Water Rights (DWRi). 1992. *Utah Lake and Jordan River Operating Procedures and Flood Management Plan.* Utah Division of Water Rights, Utah Department of Natural Resources. Available at: http://www.slcdocs.com/utilities/PDF%20Files/utah&jordan.PDF. Accessed March 24, 2016.

Utah Division of Wildlife Resources (DWR). 2005a. *Utah Comprehensive Wildlife Conservation Strategy*. DWR Publication No. 01-19. Available at: https://wildlife.utah.gov/cwcs/11-03-09_utah_cwcs_strategy.pdf. Accessed March 25, 2016.

———. 2005b. *Boreal Toad (*Bufo boreas boreas*) Conservation Plan*. Publication number 05-37.

———. 2015a. Utah Conservation Data Center. County Lists of Utah's Federally Listed. Available at: http://dwrcdc.nr.utah.gov/ucdc/ViewReports/te_cnty.pdf. Accessed on December 23, 2015.

———. 2015b. Utah Conservation Data Center. Plant Species Profiles. Available at: http://dwrcdc.nr.utah.gov/rsgis2/Search/SearchSelection.asp?Group=PLANT&Species=PLANT. Accessed on December 23, 2015.

———. 2016. Jordan River Stream species present by section 2016. Excel data provided to SWCA Environmental Consultants by email on March 1, 2016.

Utah Weed Control Association. 2015. Utah's Noxious Weed List. Available at: http://www.utahweed.org/weeds.htm. Accessed on December 23, 2015.

Walters, B. 2015. Personal communication between Bob Walters, Utah Division of Wildlife Resources, and Thomas Sharp, SWCA Environmental Consultants, December 5, 2015.

Wasatch Rowing Foundation. 2016. Doing Better. Available at http://www.wasatchrowingfoundation.org/doing-better. Accessed March 9, 2016.

Welch, N.E., and J.A. MacMahon. 2005. Identifying habitat variables important to the rare Columbia Spotted Frog in Utah (USA): an information-theoretic approach. *Conservation Biology* 19:473–481.

Wheaton J.M. 2013. *Scoping Study and Recommendations for an Adaptive Beaver Management Plan*. Prepared for Park City Municipal Corporation. Logan, Utah. Available at: http://etal.usu.edu/Reports/Beaver_Management_Plan_Recc_Park_City_%20Report_FINAL.pdf. Accessed March 24, 2016.

Wohl E. 2013. Landscape-scale carbon storage associated with Beaver Dams. *Geophysical Research Letters* 40(14):3636–3636.

Woinarski, J.C.Z., C. Brock, M. Armstrong, C. Hempel, D. Cheal, and K. Brennan. 2000. Bird distribution in riparian vegetation in the extensive natural landscape of Australia's tropical savannas: A broad-scale survey and analysis of a distributional database. *Journal of Biogeography* 27:843–868.

Wydoski, R.S., and R.W, Wiley. 1999. Management of undesirable fish species. In *Fisheries management in North America. Second Edition*, edited by C.C. Kohler and W.A. Hubert, pp. 403–430. Bethesda, Maryland: American Fisheries Society.

Yenstch, A.T., and R.J. Rood. 2007. The Prison Site: Evidence for Late Archaic Housepits in the Salt Lake Valley. *Utah Archaeology* 20(1):41–56. Available at: http://www.upaconline.org/journal/PDF/Utah%20Archaeology%202007.pdf. Accessed March 24, 2016.

Zouhar, K. 2005. Elaeagnus angustifolia. In *Fire Effects Information System*. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. Available at: http://www.fs.fed.us/database/feis/plants/tree/elaang/all.html#180. Accessed on March 24, 2016