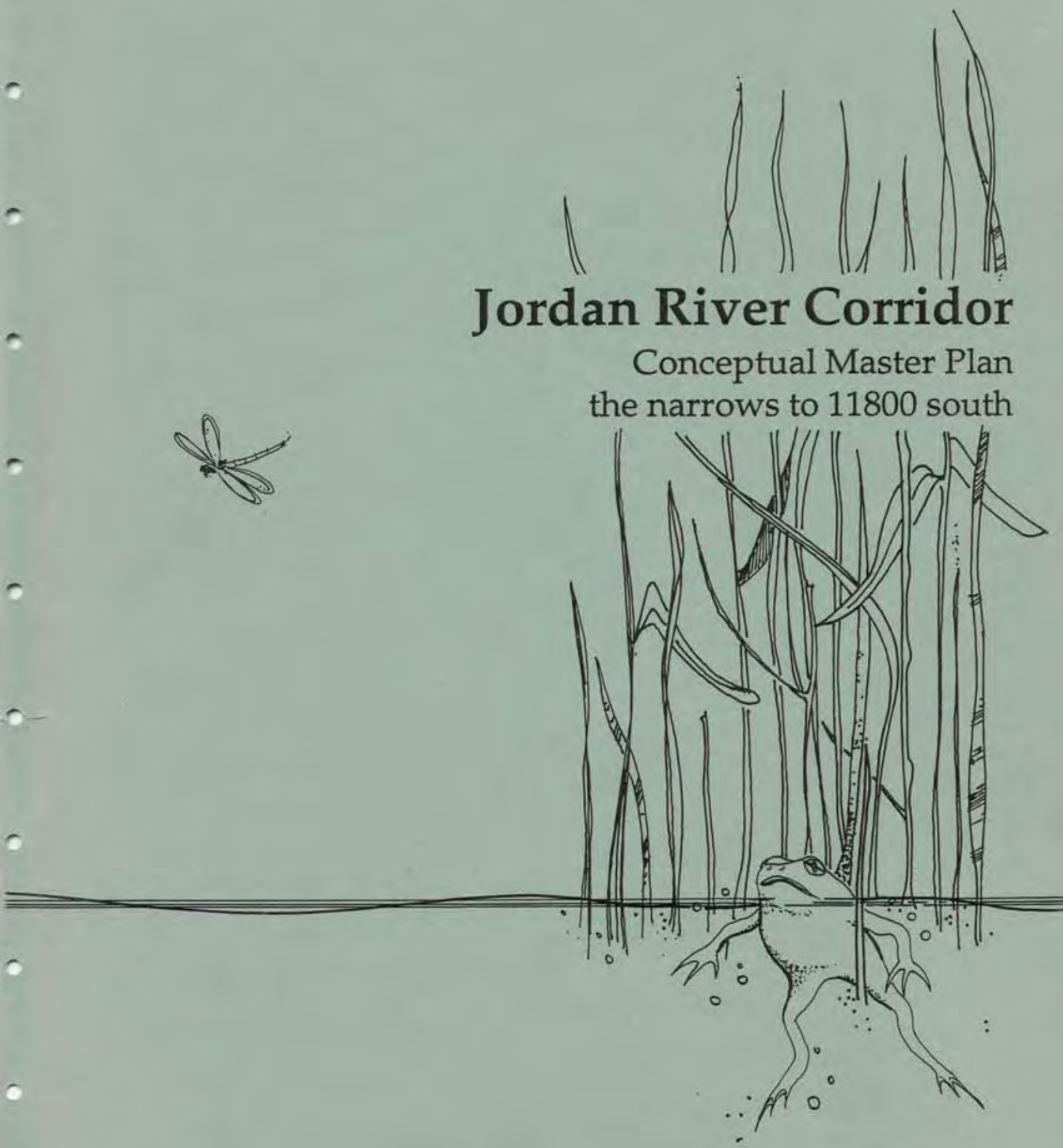


Jordan River Corridor

Conceptual Master Plan
the narrows to 11800 south

Bluffdale Draper Riverton

Project Director
Professor Craig W. Johnson
Department of Landscape Architecture
and Environmental Planning

Project Managers
M. Sarah Creachbaum
Jeffrey D. Gilbert
Scott Mendenhall
Rebecca I. Sobol
Benjawan Ubonsri

Graphics Coordinators
Jereck R. Boss
Brock W. Hill
Alvin R. Yariwon

Editors
Denna Howell
Andrea Sorensen

Research Assistants
Jason Bench
Angie Brisendine
Greg Brown
Alan J. Buckingham
Jackie Cochran
Troy Herold
David E. Kurtz
Stephen Siddoway
Robert Stevenson
Paul C. Valcarce
Christopher R. Warner
Burton K. Yuen

Administrative Unit
The Environmental Field Service Program
Department of Landscape Architecture and Environmental Planning
Utah State University

Funded by
Bluffdale, Draper and Riverton
May 1993

An Introduction

The Jordan River has been the lifeblood of Salt Lake Valley agriculture, industry and urban living. Before the Mormon pioneers entered the Salt Lake Valley, the Jordan River meandered back and forth across its broad flood plain. Seasonal flooding created a landscape richly patterned and structurally diverse; a dynamic yet stable habitat for wildlife. Early settlers record, "The Jordan River waters are not quite so transparent as the mountain streams generally in this area." Yet the Jordan supported a highly productive fishery. Native Americans made extensive use of the corridors resources.

The Mormon pioneers were the first to impose the geometric patterns of permanent settlement along the Jordan River. Grazing, agricultural practices and later urban development diminished the Jordan River's quality and quantity. Thus began a chain of events which have damaged the integrity of the river's ecosystem. Its ability to sustain a productive wildlife habitat and fishery began to decline. Battling seasonal floods, communities and counties channelized and rip-rapped the river to protect development along its' banks. The result has been the demise of riparian vegetation, increased stream velocity, head-cutting and erosion of the river's channel and banks. This in turn has devastated once productive wetland and riparian habitats that thrived along the banks. The Jordan River floodplain no longer sustains the diverse wildlife population that once resided there.

Despite the deterioration, much of the wildlife habitat potential remains and could be partially reclaimed. Through proper planning, management, revegetation, clean-up, and non-point-source pollution control the Jordan River could once again become a productive riparian ecosystem. The Jordan River corridor has the potential of becoming a sustainable habitat for existing and new wildlife species, with recreational and educational opportunities for the communities of Draper, Bluffdale and Riverton. It could also become the amenity that adds beauty and elegance to new urban development on adjacent uplands.

Purpose of the Jordan River Corridor Master Plan

The purpose of this master plan is to illustrate the potential the Jordan River corridor has of becoming a vital urban open space that meets the habitat needs of existing wildlife, increases potential habitat for new wildlife species, improves water quality, reduces flooding, meets the recreational and educational needs of Draper, Bluffdale and Riverton residents, preserves agricultural uses where compatible, and enhances the development value of adjacent uplands.

Benefits of Corridor Development

Numerous aesthetic, recreational, educational, economic and ecological benefits that will be of value to the surrounding communities of Draper, Riverton and Bluffdale can be realized

through the preservation and enhancement of the Jordan River corridor. A parkway along the Jordan River will provide needed open space within the urban setting. This open space can serve as a link between the urban development and the natural environment. Expansion of the Jordan River Parkway in South Salt Lake County will not only offer visual relief from the hard surfaces of the city, but also afford citizens unique recreational opportunities.

Several educational opportunities can also be realized with the expansion of the Jordan River Parkway. These opportunities include historical interpretation of the Salt Lake Valley and the role that the Jordan River played in the its settlement. Local schools would have an outdoor laboratory for teaching students awareness of the environment and environmental issues associated with the Jordan River.

Wetlands within the parkway provide valuable services such as effective pollutant filters for the treatment of storm water runoff which are of economic benefit to the region. Restoration of disturbed wetlands will enhance their function as flood detention basins, protecting bordering properties and down stream areas. Constructed wetlands and retention ponds along the Jordan River, could be used to treat urban stormwater runoff before it is released into the river.

The Goal of the Corridor Master Plan

The goal of the Jordan River Corridor project is to provide present and future residents of Riverton, Draper, and Bluffdale with a unique, accessible, natural open space, along the Jordan River linked to a regional trails network.

Objectives of the Corridor Master Plan

To achieve this goal, several objectives must be met. Community support must be mobilized, funds must be raised, parkway lands must be acquired and protective zoning strategies must be implemented. The damaged aspects of the ecosystem must be reclaimed; function and structure restored. Only through a coordinated effort between the communities of Riverton, Draper and Bluffdale working with Federal, State, and County agencies will the full potential of the parkway be realized.

Implementation

Over 90% of the land in the Jordan River Corridor project site is privately owned. Realizing a public open space plan in the corridor will require an integrated implementation strategy of acquisition, incentives, and regulations.

An estimated 35% of the corridor (all the jurisdictional wetlands) is currently regulated under section 404 of the Clean Water Act. Additional land within the 100 year flood plain may be regulated by

the Federal Emergency Management Agency (FEMA).

Land acquisition must be an integral part of the implementation strategy. Funding of the magnitude required to protect the corridor will be difficult for small rural communities. Riverton, Bluffdale and Draper should investigate the possibilities of revenue bonds for land acquisition. This strategy was used effectively by Murray City for its parkway land acquisition program. Mitigation monies from the Central Utah Project are another potential source of revenue. Several committees are presently meeting to develop criteria for determining how these funds should be used.

Additional potential funding sources include: Land and Water Conservation Fund, Utah River Enhancement Fund, Conservation Reserve Program, State Urban Forestry Program, Community Development Block Grants, Soil Conservation Service Resource Conservation Plan Program, and the Utah Division of Wildlife Resources Critical Habitat Acquisition Program. The Nature Conservancy and The Trust for Public Lands may also be potential sources for funding if specific sites within the corridor meet their criteria for acquisition.

Incentive programs integrated into land use regulations that encourage landowners/developers to participate in the open space plan will also be important in implementation. Land use regulations should be designed to encourage innovative site plans that augment the corridor open space while remaining profitable for the developer. Regulations that afford these possibilities include performance based zoning, permit systems, transferable development rights and planned unit development. Overlay zones that protect natural resources through specific performance standards should also be considered.

The combination of acquisition, incentives and regulations that are finally adopted must reflect the values of the community. Each community must draft an ordinance that reflects its specific resources and politics.

Development of this segment of the Jordan River Parkway has excellent potential for volunteer participation. Planting, trail construction and habitat restoration are just a few of the possible activities that could be effectively accomplished by volunteers. Service clubs, special interest organizations, scouts and church groups can all contribute. Funding can also be supplemented with in-kind contributions of time, materials, and equipment.

The contributions of volunteers goes well beyond the projects built. Volunteer contributions also build community pride and a sense of ownership in the project.

Summary

The Jordan River has been a valued resource for centuries. Native Americans utilized it for hunting and fishing and as a movement corridor between Utah Lake and the Great Salt Lake. Trappers and traders plied the Jordan waters in search of beaver. Early Mormon settlers farmed pockets of rich floodplain soils, grazed cattle on wet meadows, and later diverted the Jordan's waters to irrigate upland areas.

Today, the Jordan River corridor and the adjacent uplands is a landscape in transition. It has been substantially disturbed over the past 100 years. Presettlement woody riparian vegetation has been removed or died out because of human induced environmental changes. This and other disturbances has resulted in a decline in biological diversity, animal and fish food chains have been altered and erosion and sedimentation has increased. Upstream water diversions have lowered summer water flows. Typically summer water temperatures are high with low oxygen levels causing adverse impacts on fish populations. Channelization has caused the downcutting of the river bed and the drying out of adjacent wetlands. Many of the functional values traditionally associated with these wetlands such as floodwater detention, groundwater recharge, and habitat for wildlife have been either compromised or eliminated. The visual quality of the corridor has been degraded by gravel extractions, channelization and poorly planned developments. The trend line for the quality of both the physical and biological resources in the Jordan River corridor is downward.

Yet the project site remains an unfragmented patch of landscape utilized by a diverse array of wildlife species. The fishery still has potential. Substantial areas of high quality agricultural land remain. Some wetland functions could be reestablished and aspects of the riparian ecosystem reclaimed.

The increasing demands of urban development are putting new pressures on an already overtaxed landscape. Citizens in the communities of Riverton, Draper and Bluffdale have expressed their concern about the future of the Jordan River corridor. The vast majority of residents would like to see the corridor remain natural with improved access for hikers, cyclists and horseback riders and interpretive educational opportunities for all. Federal, State and County agencies continue to urge conservation of soil, water, wetland, wildlife, and recreation resources within the corridor.

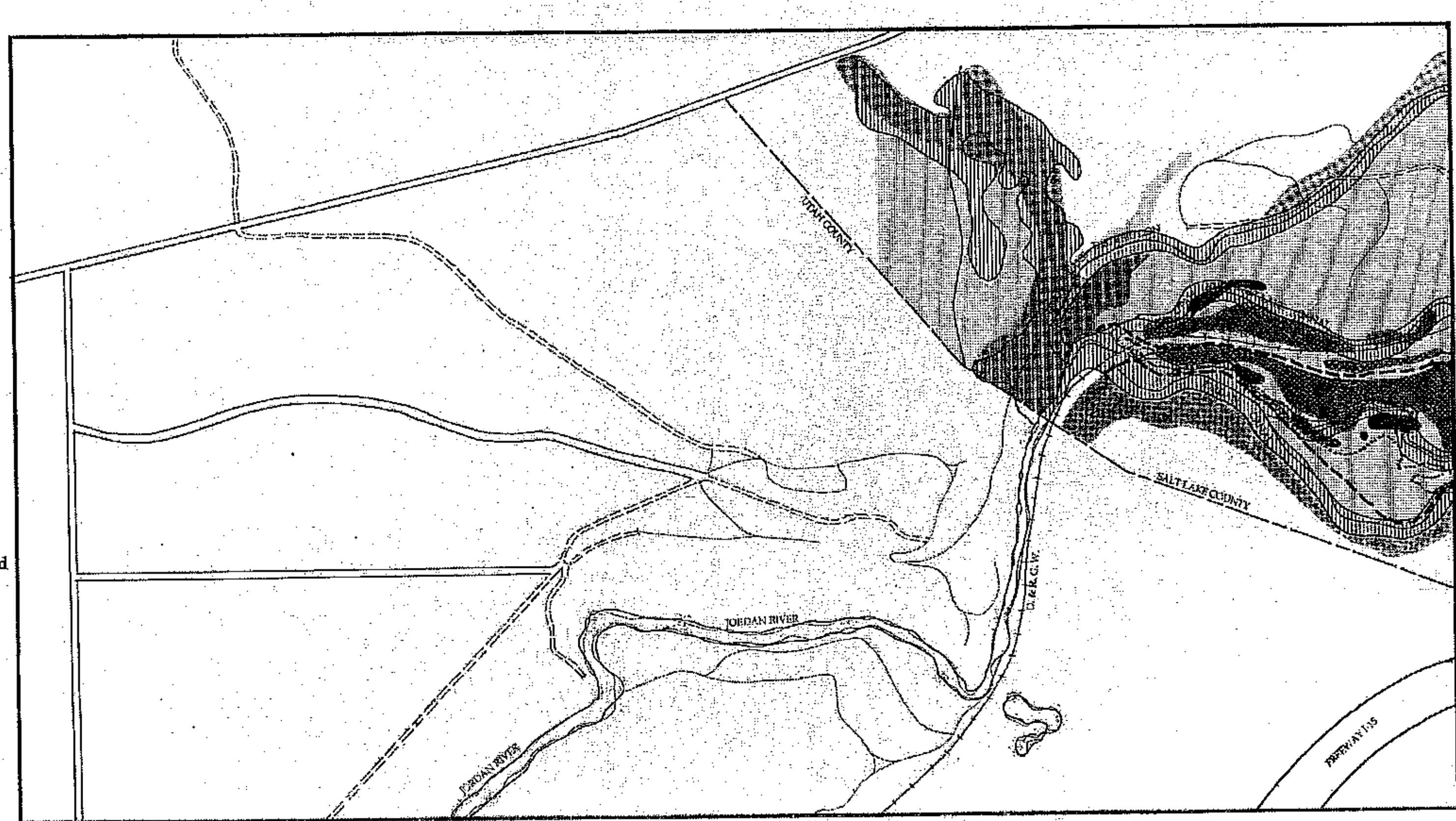
Expressions of public and agency concern can be turned into action that initiates wise long term planning, economically and politically sound implementation programs, and the phased implementation of landscape restoration and reclamation procedures. The negative quality trend line that reflects the Jordan's recent past can be reversed. The Jordan River Corridor can once again return to its status as a valued resource in a new more urban context.

Critical Habitats

Critical habitats are areas essential to the function, structure and stability of the Jordan River ecosystem. they are often areas most sensitive to disturbance. Critical habitats on the study site include:

- Meander corridor
- 100 year flood plain
- Wetlands
- Lateral drainage ways
- Primary and secondary wildlife habitats
- Patches of undisturbed native vegetation
- Steep slopes.

Over 2500 acres of critical habitat were estimated for the project site. Nearly 35% of this estimated acreage is comprised of wetlands. Many critical habitat areas have suffered previous abuses. Restoration of the previous physical and biological characteristics of these areas will be required if their full potential is to be realized. The key to a successful critical habitat plan for the Jordan River Corridor will be to connect as many critical habitats as possible into an integrated open space system.



Primary Habitat Wildlife and Vegetation

Secondary Habitat Wildlife and Vegetation

Limits of Meander Corridor

Limits of 100 Year Floodplain

Limits of Wetlands

Steep Slopes

JORDAN RIVER CORRIDOR Conceptual Master Plan

The Narrows to 11800 South

CRITICAL HABITATS

PREPARED BY THE DEPARTMENT OF LANDSCAPE ARCHITECTURE AND ENVIRONMENTAL PLANNING ENVIRONMENTAL FIELD SERVICE

UTAH STATE UNIVERSITY PROJECT DIRECTOR: CRAIG JOHNSON JUNE 1993

SCALE 1"= 400'

NORTH

Team Members: Jason Beach–Jereck Boss–Angie Brisendine–Greg Brown–Alan Buckingham–Jackie Cochran–Sarah Cruickshank–Jeff Gilbert–Troy Herold–Brack Hill–Donna Howell–David Kurtz–Scott Mendenhall–Steve Siddoway–Rebecca Sobol–Andrea Sorensen–Robert Stevenson–Benjawan Uberuri–Paul Valcarce–Chris Warner–Alvin Yaowan–Burton Yuen–

Primary Habitat Wildlife and Vegetation

Secondary Habitat Wildlife and Vegetation

Limits of Meander Corridor

Limits of 100 Year Floodplain

Limits of Wetlands

Steep Slopes

JORDAN RIVER CORRIDOR Conceptual Master Plan

The Narrows to 11800 South

CRITICAL HABITATS

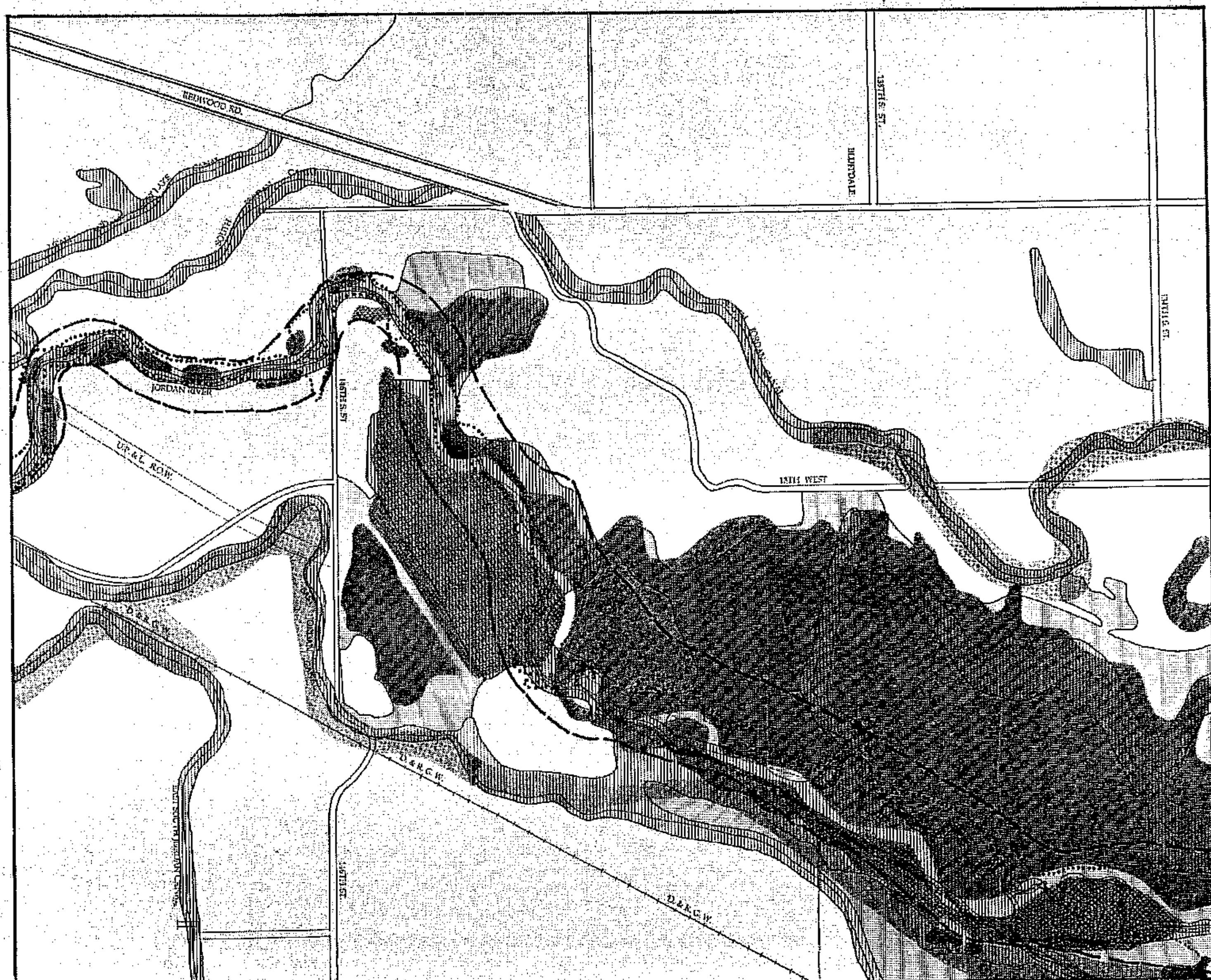
PREPARED BY THE DEPARTMENT OF LANDSCAPE ARCHITECTURE AND ENVIRONMENTAL PLANNING ENVIRONMENTAL FIELD SERVICE

UTAH STATE UNIVERSITY PROJECT DIRECTOR: CRAIG JOHNSON JUNE 1993

SCALE 1"= 400'

NORTH

Team Members: Jason Bench–Jerock Bess–Angie Brisendine–Greg Brown–Alan Buckingham–Jackie Cochran–Sarah Creachbaum–Jeff Gilbert–Troy Herold–Brock Hill–Donna Howell–David Kurtz–Scott Mendenhall–Steve Siddoway–Rebecca Sobol–Andrea Sorensen–Robert Stevenson–Benjawan Ubosari–Paul Valcarce–Chris Warner–Alvin Yarlwmn–Burton Yuen–



Primary Habitat Wildlife and Vegetation

Secondary Habitat Wildlife and Vegetation

Limits of Meander Corridor

Limits of 100 Year Floodplain

Limits of Wetlands

Steep Slopes

JORDAN RIVER CORRIDOR Conceptual Master Plan

The Narrows to 11800 South

CRITICAL HABITATS

PREPARED BY THE DEPARTMENT OF LANDSCAPE ARCHITECTURE AND ENVIRONMENTAL PLANNING ENVIRONMENTAL FIELD SERVICE

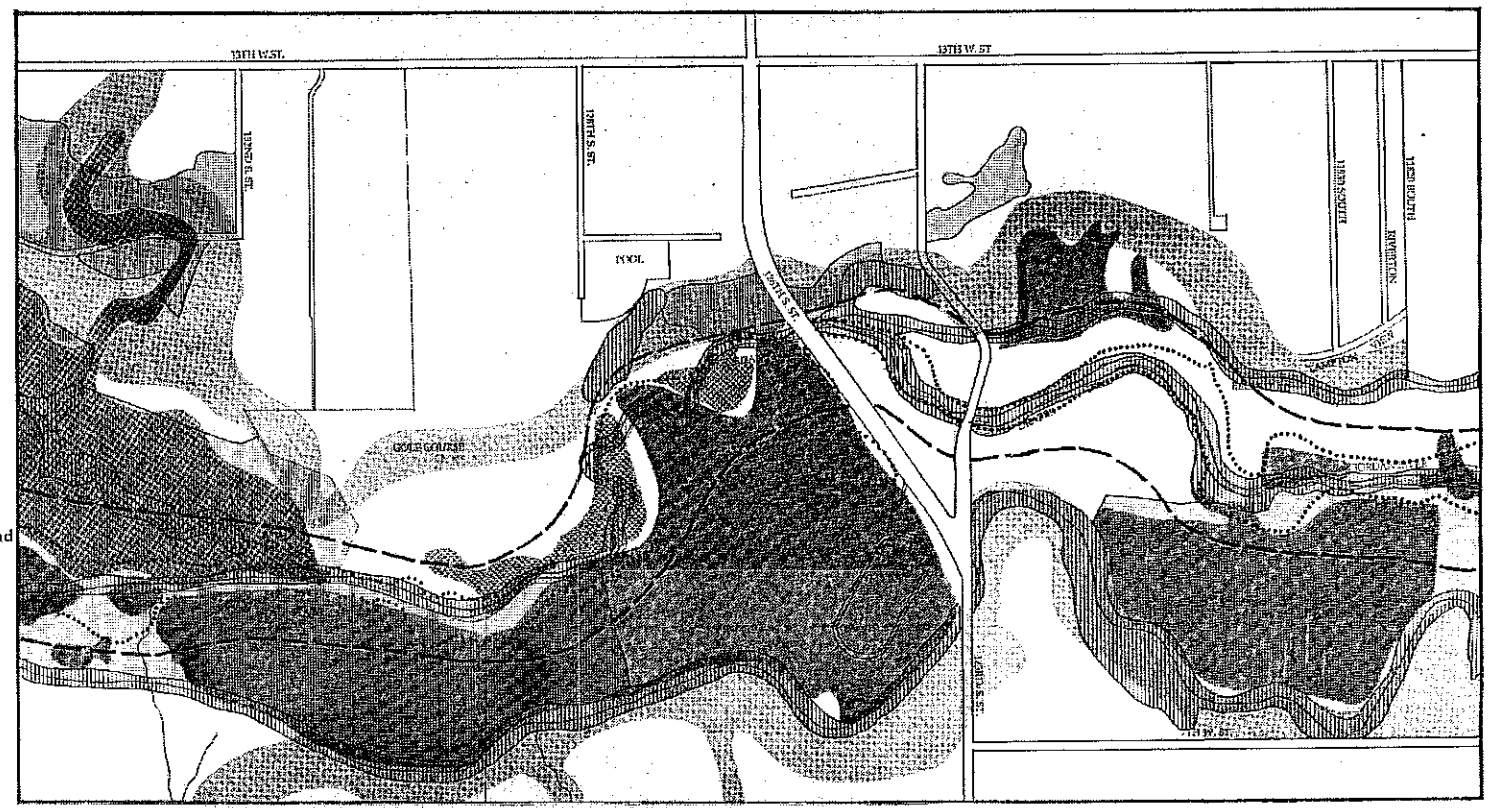
UTAH STATE UNIVERSITY PROJECT DIRECTOR: CRAIG JOHNSON JUNE 1993

SCALE 1"= 400'

3/5

NORTH

Team Members-Jason Beah-Jereck Boss-Angie Dikendine-Greg Brown-Alan Buckingham-Jackie Cochran-Sarah Cruickshank-Jeff Gilbert-Troy Herald-Brock Hill-Donna Howell-David Kunz-Scott Mendenhall-Steve Siddoway-Rebecca Sobol-Andrea Stevenson-Robert Stevenson-Benjawan Uhonsri-Paul Valcarce-Chris Warner-Alvin Yarbrow-Burton Yuen-



JORDAN RIVER CORRIDOR Conceptual Master Plan

CRITICAL HABITATS

The Narrows to 11800 South

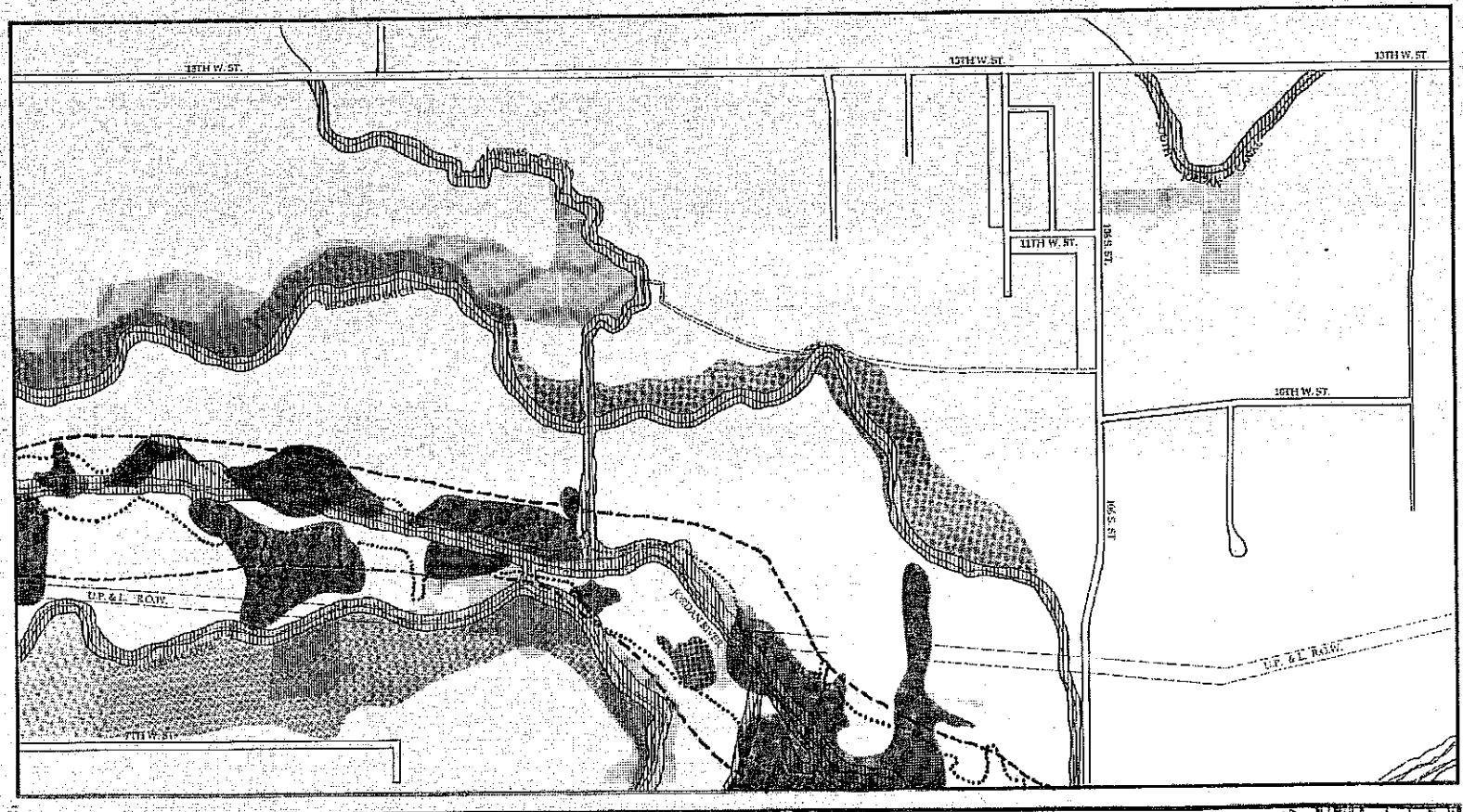
PREPARED BY THE DEPARTMENT OF LANDSCAPE ARCHITECTURE AND ENVIRONMENTAL PLANNING ENVIRONMENTAL FIELD SERVICE

UTAH STATE UNIVERSITY PROJECT DIRECTOR: CRAIG JOHNSON JUNE 1993

SCALE 1"= 400'

NORTH

Team Members: Jacqi Beech-Jerack Bass-Angie Brisendine-Greg Brown-Alan Buckingham-Jackie Cochran-Sarah Crutchfield-Jeff Gilbert-Troy Herold-Brock Hill-Penna Howell-David Kurtz-Scott Mendenhall-Steve Siddoway-Rebecca Sokol-Andrea Sorensen-Robert Stevenson-Benjawan Utsonri-Paul Velarde-Chris Warner-Alvin Yarbrow-Burton Yuen-



- Primary Habitat Wildlife and Vegetation
- Secondary Habitat Wildlife and Vegetation
- Limits of Meander Corridor
- Limits of 100 Year Floodplain
- Limits of Wetlands
- Steep Slopes

JORDAN RIVER CORRIDOR Conceptual Master Plan

CRITICAL HABITATS

The Narrows to 11800 South

PREPARED BY THE DEPARTMENT OF LANDSCAPE ARCHITECTURE AND ENVIRONMENTAL PLANNING ENVIRONMENTAL FIELD SERVICE
UTAH STATE UNIVERSITY PROJECT DIRECTOR: CRAIG JOHNSON JUNE 1993
Team Members: Jason Beach–Jerrick Bres–Angie Brizendine–Greg Brown–Alan Buckingham–Jackie Cochran–Sarah Crutchfield–Jeff Gilbert–Troy Herold–Brock Hill–Darin Howell–David Kurtz–Scott Meadendall–Steve Siddaway–Rebecca Sobol–Andrea Sorensen–Brad Stevenson–Benjawan Ubonsri–Paul Valcarce–Chris Warner–Alvin Yanwon–Burton Yuen–

SCALE 1"= 400'

NORTH

Conceptual Plans

Three different concepts were prepared for the Jordan River corridor project site. Each concept emphasize different philosophical perspectives yet all three meet the stated project objectives.

Implementation of any one of the three concepts would ensure the integrity of the meander corridor and associated riparian habitat, preservation, enhancement or restoration of adjacent wetlands, and protection of steep slopes and other sensitive areas. Likewise, any of the three concepts would provide a trail system that connects the Jordan River Corridor with each community and with other trails in the Parkway network. The level of trail development, however, varies between the concepts.

The concepts differ in the types and intensities of land uses proposed. The three concepts developed were:

1. Conservation
2. Recreation/Education
3. Mixed uses

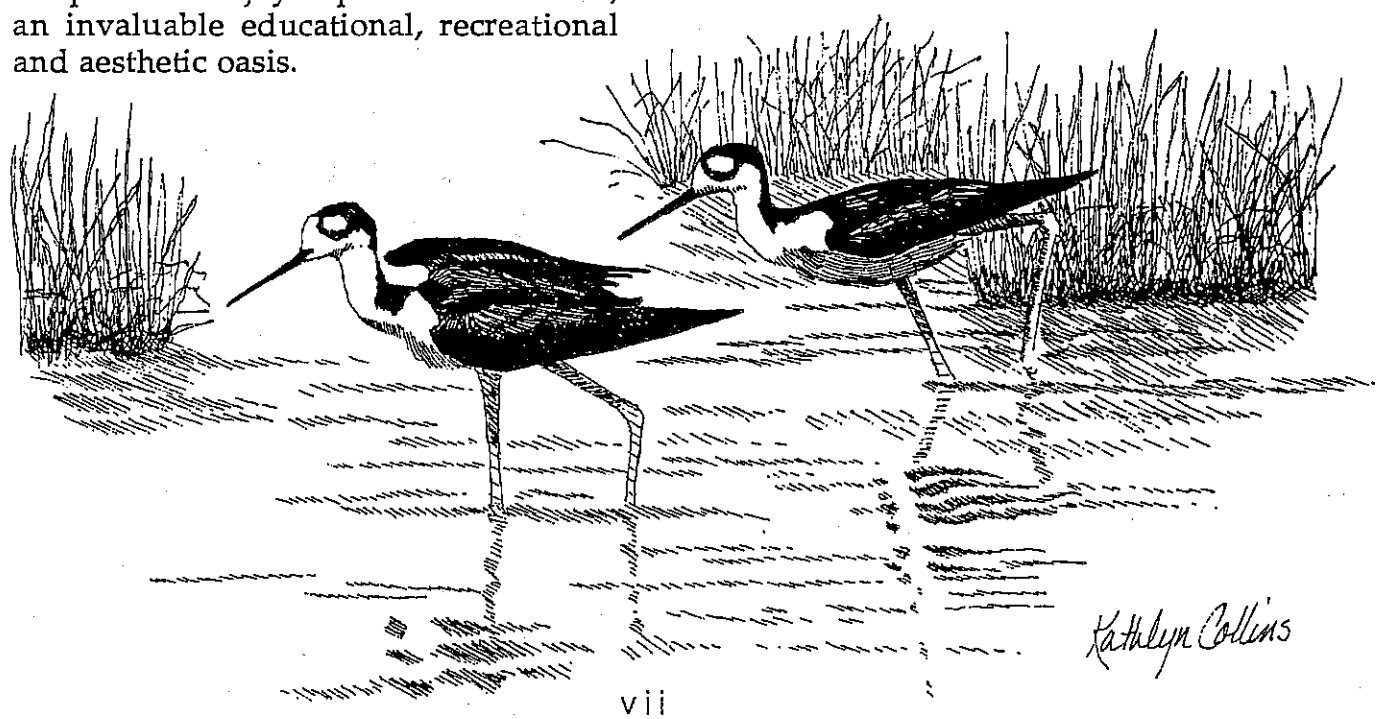
Conservation Alternative Concept Statement

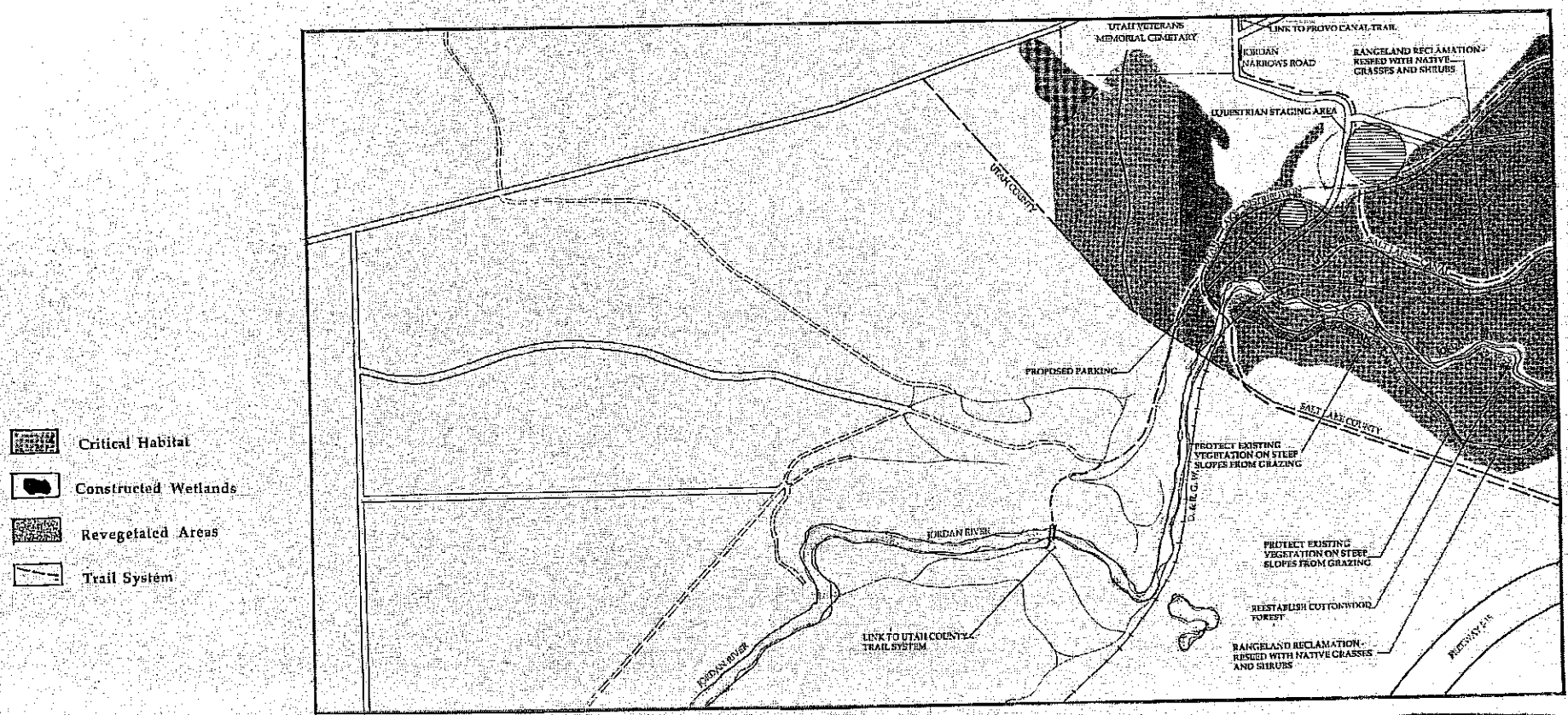
The Jordan River is an area of unique and essential habitat. A variety of wetlands, riparian zones, woodlands and grasslands are inter-mixed with residential and agricultural uses. Such a collection of environments is unusual in the midst of several urbanizing communities. It is the unique and unusual nature of the Jordan River which calls for its preservation, restoration and reclamation. The citizens of Draper, Bluffdale, and Riverton have a rare opportunity to enhance their community, regional water quality, and recreational opportunities through their recognition of this valuable habitat. An island oasis, the Jordan River Corridor is an invaluable resource whose preservation and restoration will have many long lasting and far reaching benefits.

The focus of this alternative suggests that the maximum benefit of the Jordan River may be obtained through a program of conservation and rehabilitation. The primary objective of this alternative would be to return the Jordan River to a natural state, enhancing wildlife habitat, wetlands and fisheries. Although the river corridor is isolated, several sections have been degraded by livestock and human use. The river has been channelized and invasive plants such as Russian Olive and Salt Cedar have taken over once rich and viable habitat. This alternative recommends rehabilitation of these zones and suggests altering some traditional land use practices. Agricultural methods and uses are suggested which will be compatible with the conservation of the corridor. The conservation alternative proposes the use of constructed wetland areas to treat urban runoff. We recommend that the river be allowed to return to its natural course, supporting the recommendations contained in the CH2M Hill (1992) report Jordan River Stability Study. Wetlands and increased vegetation will desychronize high river flows contributing to flood control. Cottonwoods and willows will help to

stabilize banks, trapping sediment, provide shade, and thus enhance fisheries. This alternative recommends the acquisition of all areas designated as primary wildlife habitat, as well as the meander corridor delineated in the CH2M Hill (1992) study, and that no development take place within these boundaries. In addition, this alternative considers all wetlands essential for the maintenance of the Jordan River ecosystem. Wetlands, many unfortunately degraded but classified as secondary wildlife habitat, would be protected by Section 404 of the Clean Water Act. Steep slopes and other sensitive areas would be regulated through zoning and/or performance standards.

The unique nature of The Jordan River Corridor Habitat is the key to its importance; to both humans and wildlife. By enhancing the ecological integrity of the Jordan Corridor the citizens of Riverton, Bluffdale, and Draper will enjoy a priceless resource, an invaluable educational, recreational and aesthetic oasis.





JORDAN RIVER CORRIDOR Conceptual Master Plan

CONSERVATION ALTERNATIVE

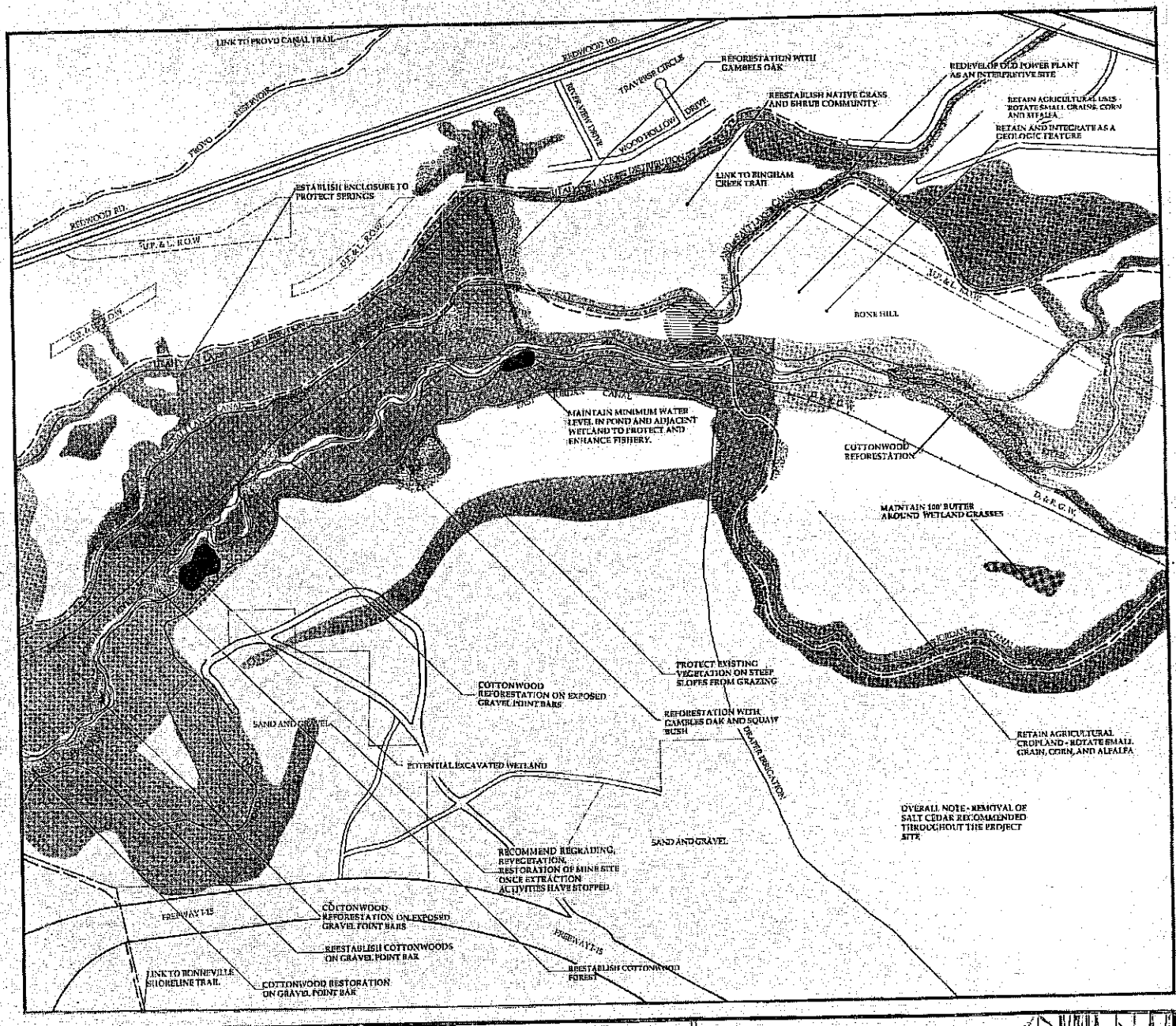
The Narrows to 11800 South

PREPARED BY THE DEPARTMENT OF LANDSCAPE ARCHITECTURE AND ENVIRONMENTAL PLANNING ENVIRONMENTAL FIELD SERVICE
UTAH STATE UNIVERSITY PROJECT DIRECTOR: CRAIG JOHNSON JUNE 1993

SCALE 1"= 400'

NORTH

Team Members: Jason Perich-Jarock Bess-Angie Brizendine-Greg Brown-Alan Buckingham-Jackie Cochran-Sarah Crutchfield-Jeff Gilbert-Troy Herold-Brock Hill-Dorian Howell-David Kuhn-Scott Mendenhall-Steve Siddoway-Rebecca Sobol-Andrea Sorensen-Robert Stevenson-Bergavan Utaweri-Paul Valcarce-Chris Warner-Alvin Yanwen-Burton Yates



Critical Habitat

Constructed Wetlands

Revegetated Areas

Trail System

JORDAN RIVER CORRIDOR Conceptual Master Plan

The Narrows to 11800 South

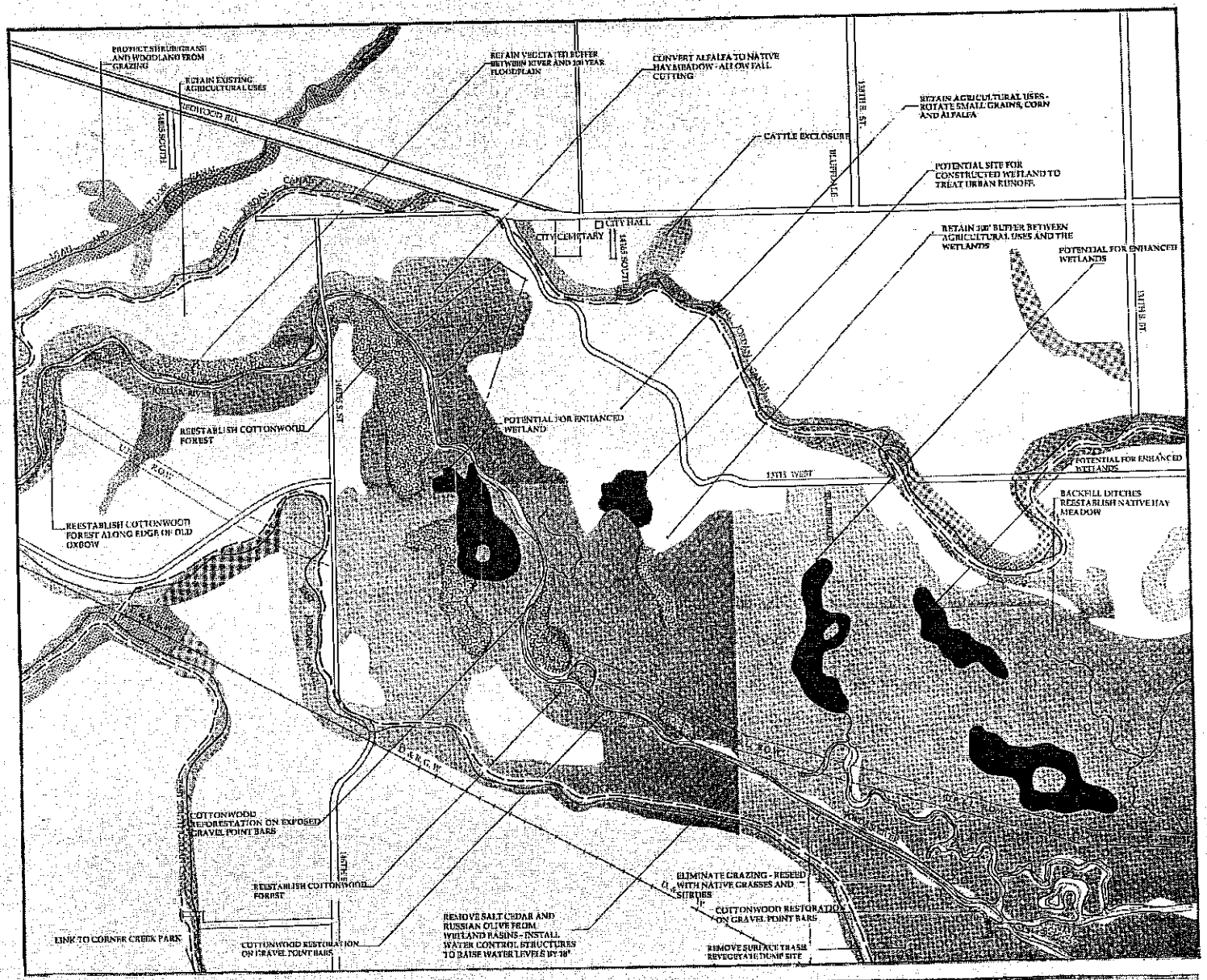
CONSERVATION ALTERNATIVE

PREPARED BY THE DEPARTMENT OF LANDSCAPE ARCHITECTURE AND ENVIRONMENTAL PLANNING ENVIRONMENTAL FIELD SERVICE
UTAH STATE UNIVERSITY PROJECT DIRECTOR: CRAIG JOHNSON JUNE 1993

SCALE 1"= 400'

NORTH

Team Members: Jason Beech–Jorech Bess–Angie Brinnelhow–Greg Brown–Alan Buckingham–Jackie Cochran–Sarah Crutchfield–Jeff Gilbert–Troy Herold–Brock Hill–Donna Howell–David Kurtz–Scott Mendenhall–Steve Siddoway–Rebecca Sobol–Andrea Sorensen–Robert Stevenson–Bengawan Utomo–Paul Valcarce–Chris Warner–Alvin Yarlwon–Burton Yeo–



JORDAN RIVER CORRIDOR

CONSERVATION ALTERNATIVE

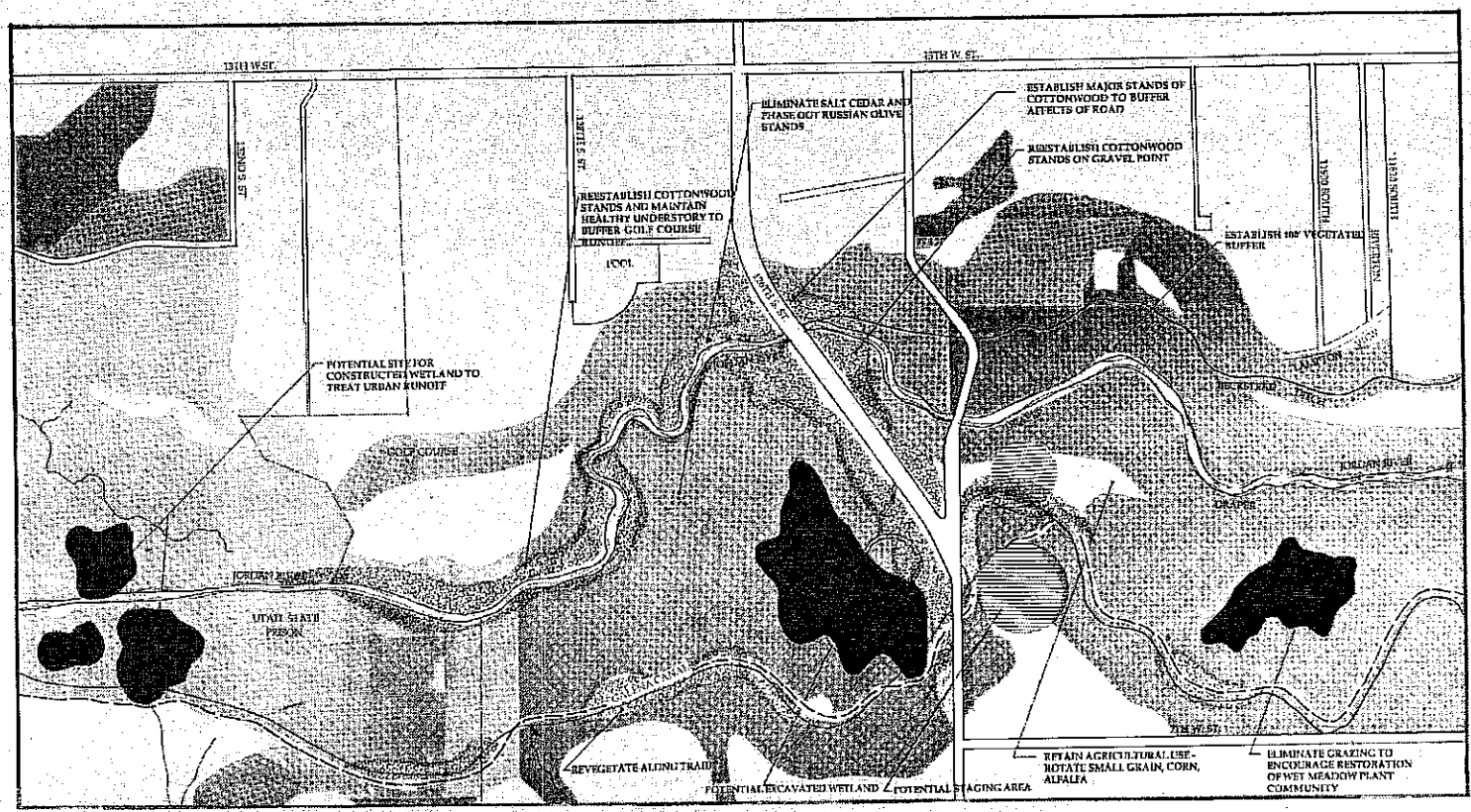
Conceptual Master Plan
The Narrows to 11800 South

PREPARED BY THE DEPARTMENT OF LANDSCAPE ARCHITECTURE AND ENVIRONMENTAL PLANNING ENVIRONMENTAL FIELD SERVICE
UTAH STATE UNIVERSITY PROJECT DIRECTOR: CRAIG JOHNSON JUNE 1993

SCALE 1"= 400'

NORTH

Team Members: Jason Bench-Jerock Bere-Angie Brownline-Craig Brown-Alan Buckingham-Jodie Cochran-Sarah Crutchfield-Jeff Gilbert-Troy Herold-Brock Hill-Dana Howell-David Kurtz-Scott Mendenhall-Steve Siddoway-Rebecca Sobol-Andrea Sorensen-Jeri Stevenson-Benjawan Tharat-Paul Velarde-Chris Warner-Alvin Yazzie-Burton Yost-



Critical Habitat

Constructed Wetlands

Revegetated Areas

Trail System

JORDAN RIVER CORRIDOR Conceptual Master Plan

CONSERVATION ALTERNATIVE

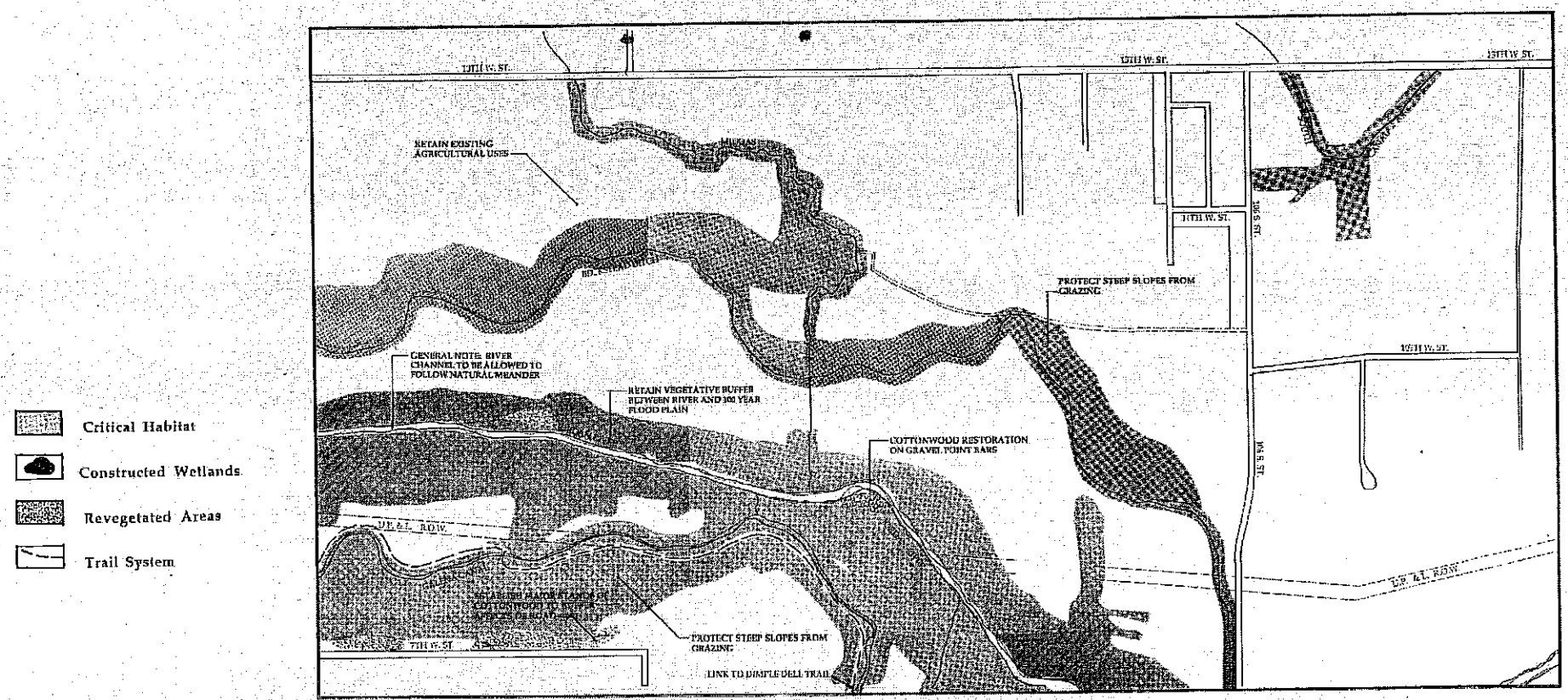
The Narrows to 11800 South

PREPARED BY THE DEPARTMENT OF LANDSCAPE ARCHITECTURE AND ENVIRONMENTAL PLANNING ENVIRONMENTAL FIELD SERVICE
UTAH STATE UNIVERSITY PROJECT DIRECTOR: CRAIG JOHNSON JUNE 1993

SCALE 1"= 400'

NORTH

Team Members-Jason Bench-Jerrick Bess-Angie Busenbark-Greg Brown-Alan Buckingham-Jackie Cochran-Sarah Creechbaum-Jeff Gilbert-Troy Herold-Brock Hill-Donna Howell-David Kurtz-Scott Mendenhall-Steve Siddoway-Rebecca Sobel-Andrea Sorensen-Robert Stevenson-Benjawan Uhorsri-Paul Valcarce-Chris Warner-Alvin Yanwon-Barlon Yoon-



JORDAN RIVER CORRIDOR

CONSERVATION ALTERNATIVE

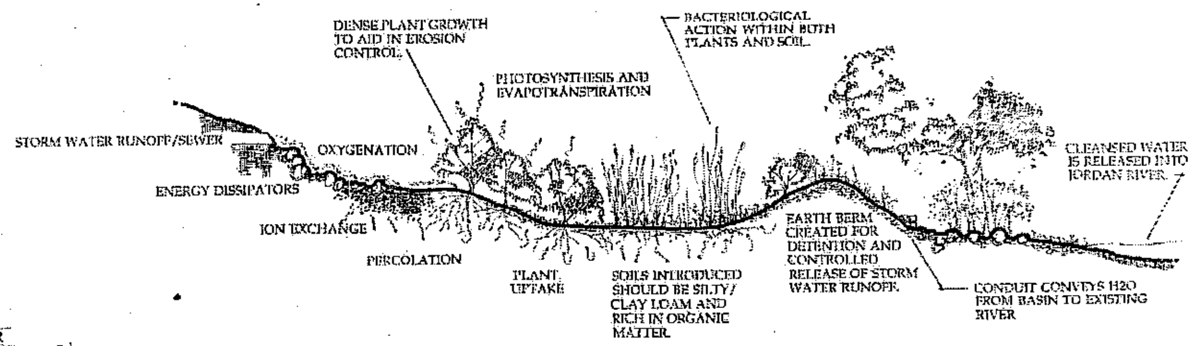
Conceptual Master Plan
The Narrows to 11800 South

PREPARED BY THE DEPARTMENT OF LANDSCAPE ARCHITECTURE AND ENVIRONMENTAL PLANNING ENVIRONMENTAL FIELD SERVICE
UTAH STATE UNIVERSITY PROJECT DIRECTOR: CRAIG JOHNSON JUNE 1993

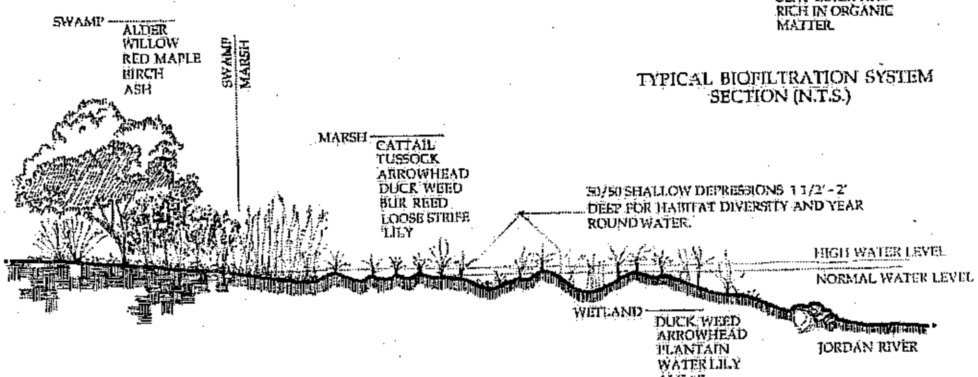
SCALE 1"= 400'

NORTH

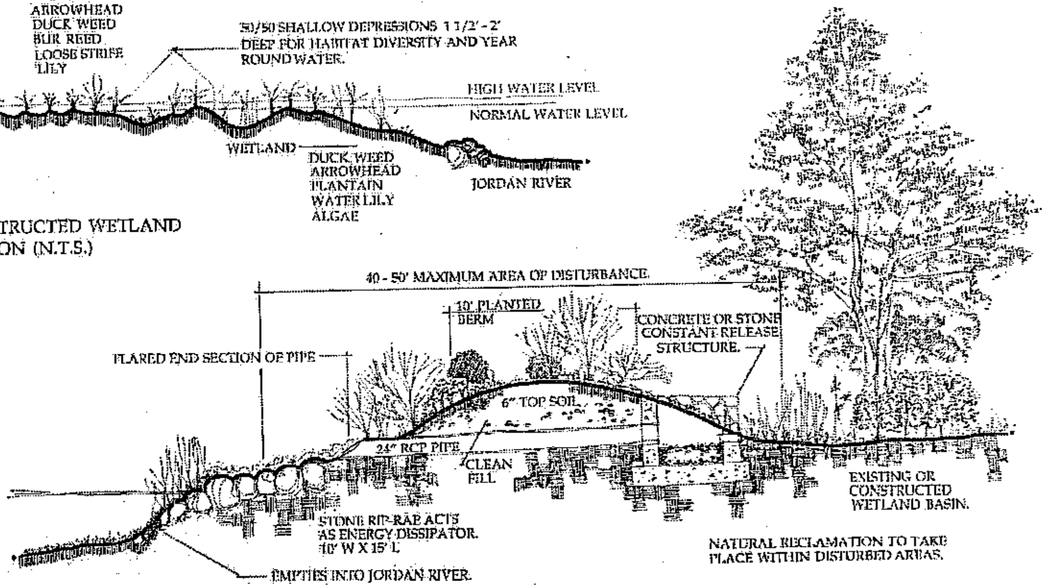
Team Members: Jason Beach-Jered Bice-Angie Brierton-Greg Bayes-Alan Buckingham-Jackie Cochran-Sarah Crenshaw-Jeff Gilbert-Troy Harold-Brock Hill-Darin Howell-David Kurtz-Scott Mendenhall-Steve Siddoway-Rebecca Sokol-Andrew Svenson-Kelton Stevenson-Benjamin Thorsen-Paul Valcarce-Chris Warner-Alvin Yarrow-Burton Yates



TYPICAL BIOFILTRATION SYSTEM SECTION (N.T.S.)



TYPICAL CONSTRUCTED WETLAND SECTION (N.T.S.)



TYPICAL WETLAND DETENTION BASIN SECTION (N.T.S.)

JORDAN RIVER CORRIDOR

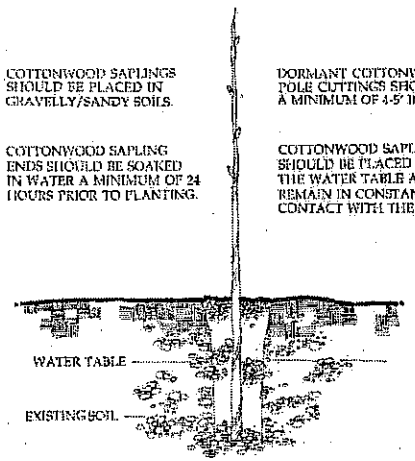
Conceptual Master Plan
The Narrows to 11800 South

CONSERVATION ALTERNATIVE SECTIONS & DETAILS

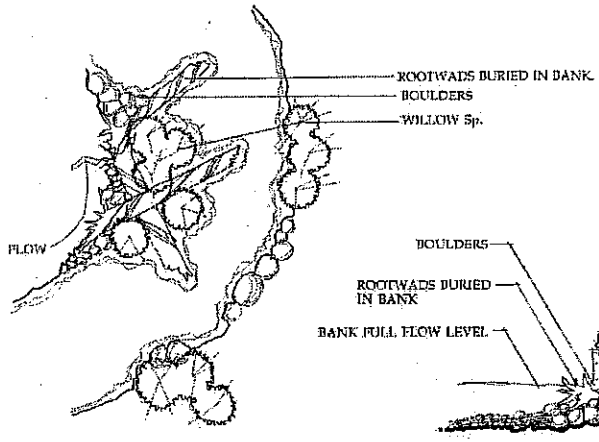
PREPARED BY THE DEPARTMENT OF LANDSCAPE ARCHITECTURE AND ENVIRONMENTAL PLANNING ENVIRONMENTAL FIELD SERVICE

UTAH STATE UNIVERSITY   PROJECT DIRECTOR: CRAIG JOHNSON   JUNE 1993

NORTH

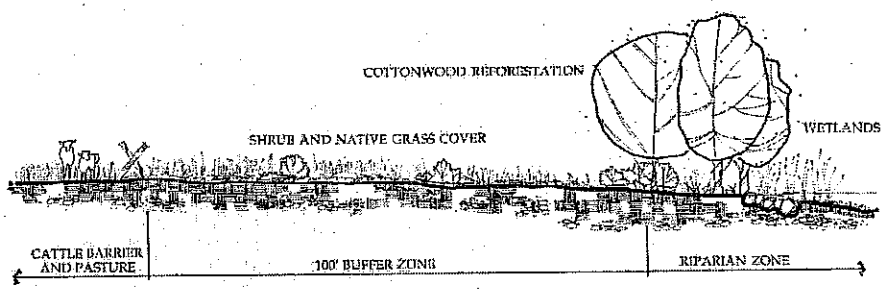


POLE PLANTING DETAIL FOR COTTONWOOD CUTTINGS (N.T.S.)

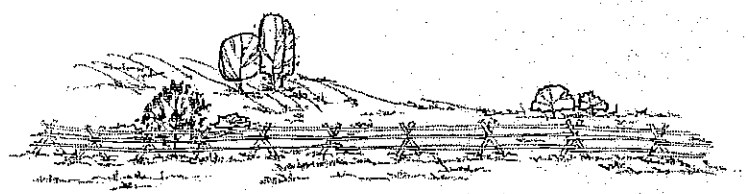


STREAM FLOW DIVERSION PLAN VIEW (N.T.S)

BANK STABILIZATION SECTION (N.T.S.)



TYPICAL CATTLE BARRIER & BUFFER ZONE (N.T.S.)



TYPICAL CATTLE BARRIER (N.T.S.)

Recreation Alternative Concept Statement

The Jordan River is a unique and beautiful area, containing a variety of wetlands, riparian zones, woodlands and grasslands inter-mixed with residential and agricultural uses. The area is still relatively undeveloped, compared to the urban areas to the north and east. The citizens of Draper, Bluffdale, and Riverton have a rare opportunity to preserve, restore and reclaim essential wildlife habitat, and provide themselves with an outstanding recreational resource. The restoration and preservation of the Jordan River corridor will provide incalculable long-term benefits to the community.

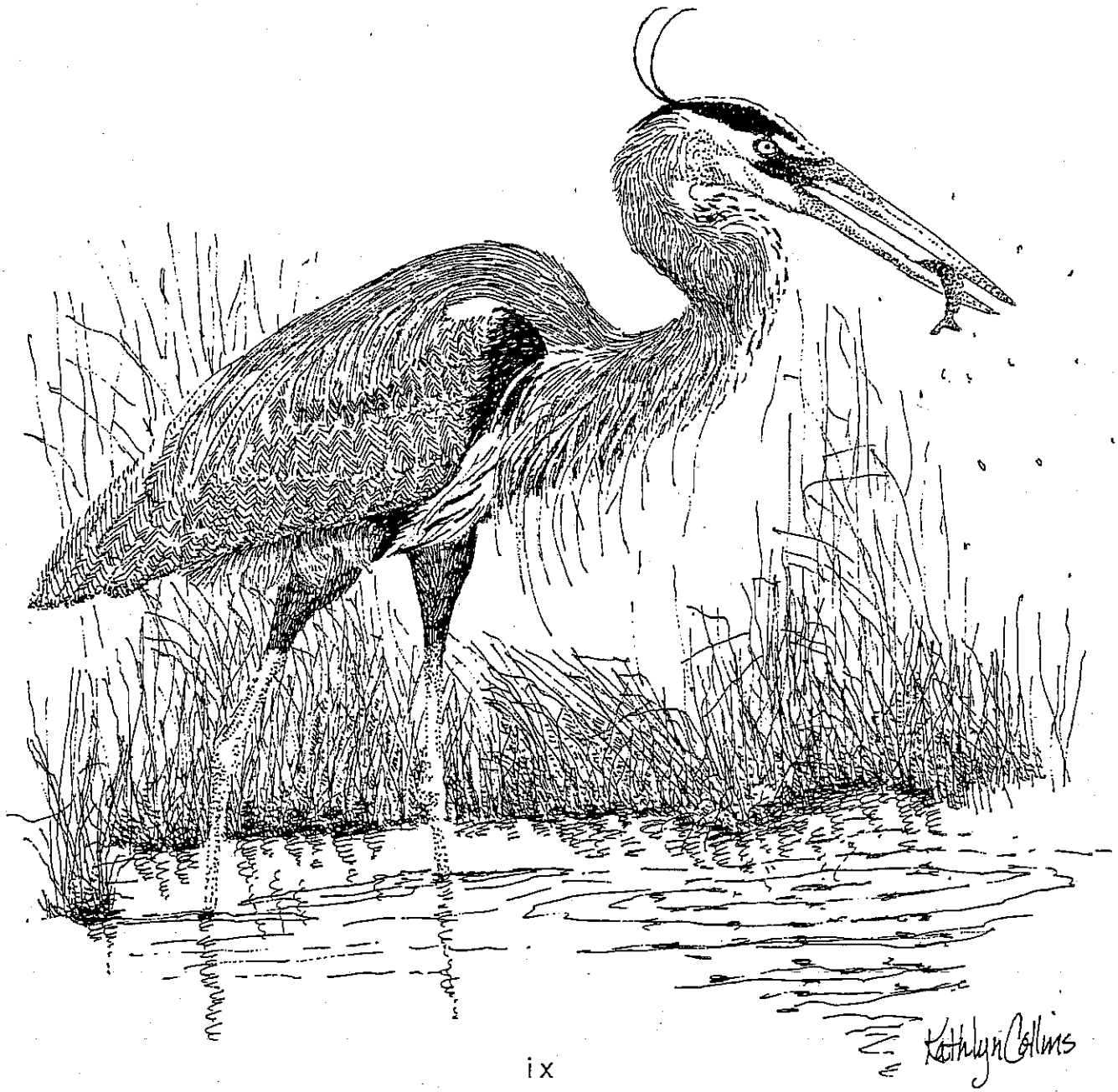
This alternative focuses on the recreational benefits of a restored and preserved river corridor. Like the conservation alternative, this alternative proposes that the river be returned to a natural state, enhancing wildlife habitat, wetlands and fisheries. The recreational opportunities of the restored corridor would then be capitalized on. Trails, particularly the horse trails, would be located along the edges of primary wildlife habitat to minimize disturbance. The trails connect existing development with proposed developments and link to trail systems outside the study area.

At the Narrows Staging Area at the south end of the site, two parking lots, a small one for foot traffic, and a larger one to accommodate horse trailers are recommended. Both horse and foot trails follow the existing roads to the proposed Indian Ford Park and on south into Utah County. The trails also head north to the next proposed development in the Bone Hill area.

Bluffdale is tied into the system with a proposed park, with ball fields, picnic areas, and an amphitheater and playground at Bone Hill. The park, located away from sensitive natural areas would be irrigated. A culvert carries water from the canal into the Grotto, which has additional picnic facilities and is accessible by both horse and foot traffic. The trails go by the old power plant which has been preserved as a historical site, and down to the Boy Scout camp. This connection will require a creative solution, as both horse and foot traffic must be able to safely cross both the river and the railroad tracks; an underpass is recommended. Trails on the east side of the river would link to other Draper trails.

There is a small parking lot for foot traffic proposed near the west end of 14600 South. An existing ranch has been proposed as the Basin 3 Nature Center just North of 14600 South. The trail also ties the Nature Center with Riverton at the existing county park and pool area adjacent to the golf course. At 12600 South there is another horse staging area combined with canoe/raft staging and picnic facilities. There is also a fitness loop just north of the parking lot. The trails go under the road at an underpass by the river. There is a small handicap accessible parking lot and a path to a fishing pond at the site of the old race track.

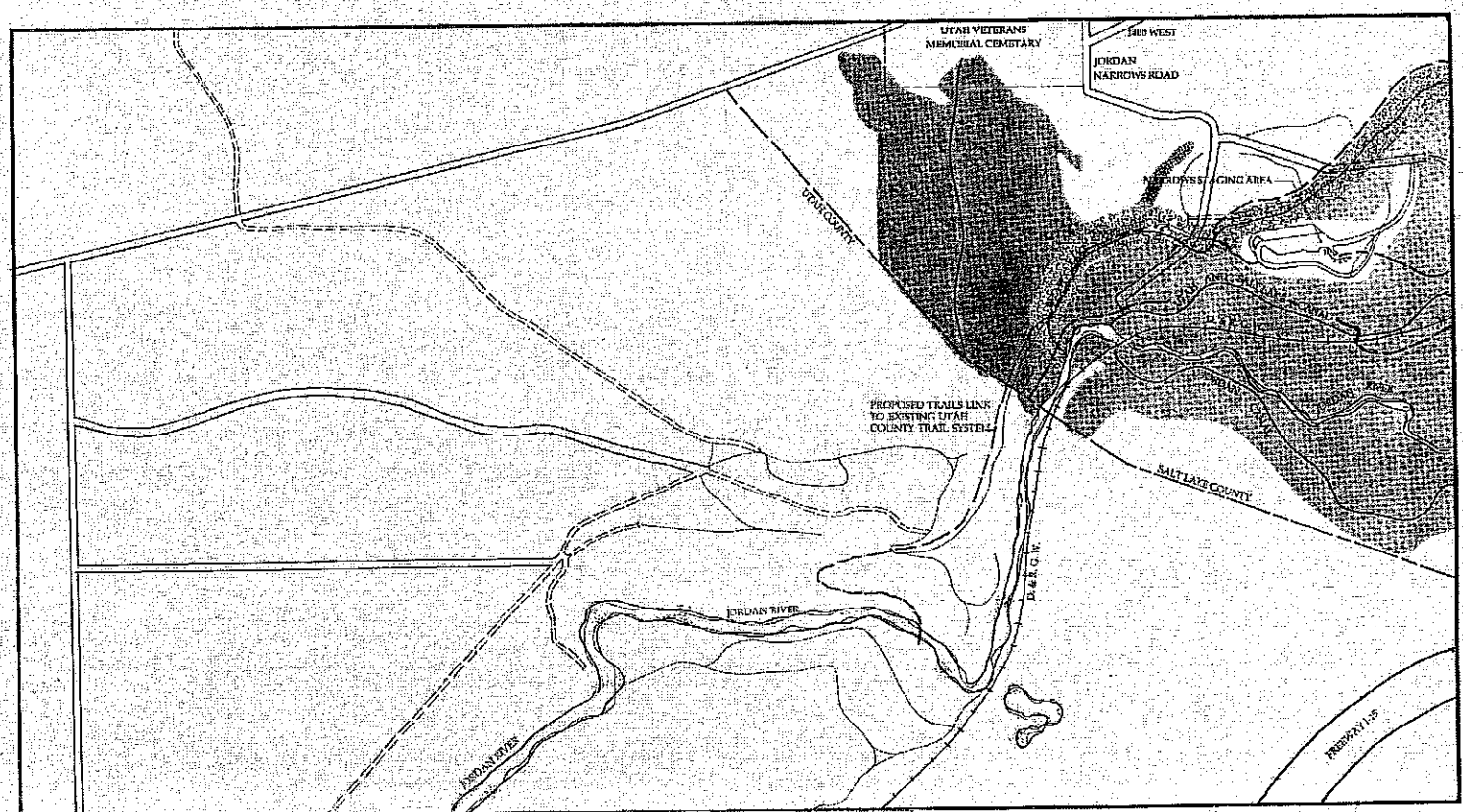
The trails and bridges shown crossing the river will have to be added. Trails have generally been kept to one side of the river to reduce disturbance of wildlife in the river corridor. Where possible, the trails have taken advantage of existing canal roads to minimize impacts on the landscape. It is assumed that small informal trails along the river will be formed by fisher persons.



Recreation Alternative Concept Statement

The Jordan River is a unique and beautiful area, containing a variety of wetlands, riparian zones, woodlands and grasslands inter-mixed with residential and agricultural uses. The area is still relatively undeveloped, compared to the urban areas to the north and east. The citizens of Draper, Bluffdale, and Riverton have a rare opportunity to preserve, restore and reclaim essential wildlife habitat, and provide themselves with an outstanding recreational resource. The reclamation and preservation of the Jordan River corridor will provide incalculable long-term benefits to the community.

This alternative focuses on the recreational benefits of a restored and preserved river corridor. Like the conservation alternative, this alternative proposes that the river be returned to a natural state, enhancing wildlife habitat, wetlands and fisheries. The recreational opportunities of the restored corridor would then be capitalized on by this alternative. Trails, particularly the horse trail, would be located along the edges of primary wildlife habitat to minimize disturbance. The trails connect existing development with proposed developments and link to trail systems outside the study area.



- Staging Area
- Equestrian Trail
- Bike / Pedestrian Trail
- Cottonwood Reforestation
- Existing Land Use
- Critical Habitat

JORDAN RIVER CORRIDOR

Conceptual Master Plan

The Narrows to 11800 South

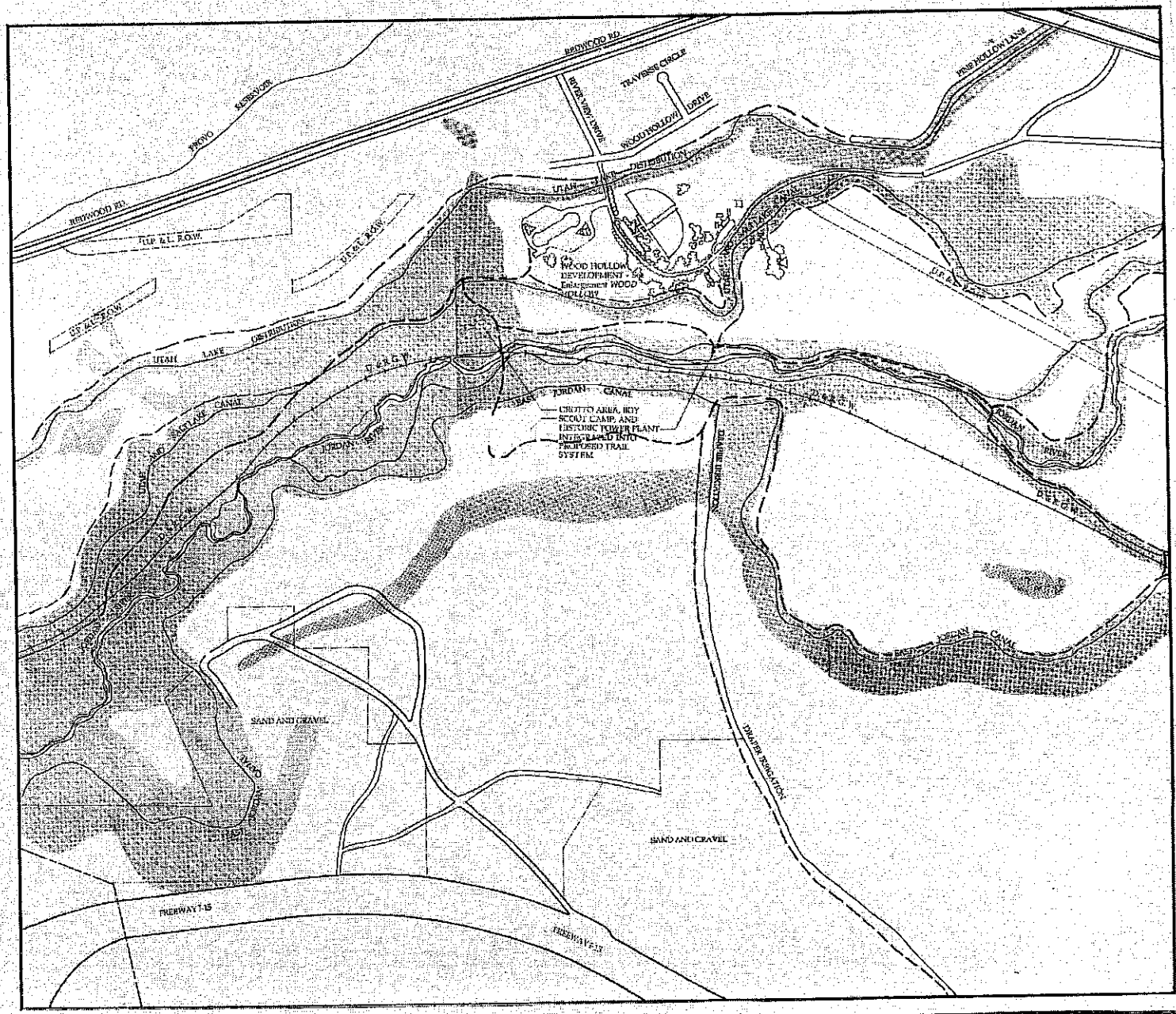
RECREATION ALTERNATIVE

PREPARED BY THE DEPARTMENT OF LANDSCAPE ARCHITECTURE AND ENVIRONMENTAL PLANNING ENVIRONMENTAL FIELD SERVICE
UTAH STATE UNIVERSITY PROJECT DIRECTOR: CRAIG JOHNSON JUNE 1993

Team Members: Jason Beach-Jerick Ross-Angie Brandsma-Greg Brown-Alan Buckingham-Jackie Cochran-Sarah Crandlemire-Jeff Gilbert-Troy Herold-Brock Hill-Donna Howell-David Kurtz-Scott Mendenhall-Steve Siddoway-Rebecca Sobol-Andrea Stevenson-Rodney Stevenson-Benjawan Thuneri-Paul Valcarce-Chris Warner-Alvin Yazawan-Burton Yuen-

SCALE 1"= 400'

NORTH



- Intensive Recreation
- Equestrian Trail
- Bike / Pedestrian Trail
- Cottonwood Reforestation
- Existing Land Use
- Critical Habitat

JORDAN RIVER CORRIDOR Conceptual Master Plan

The Narrows to 11800 South

RECREATION ALTERNATIVE

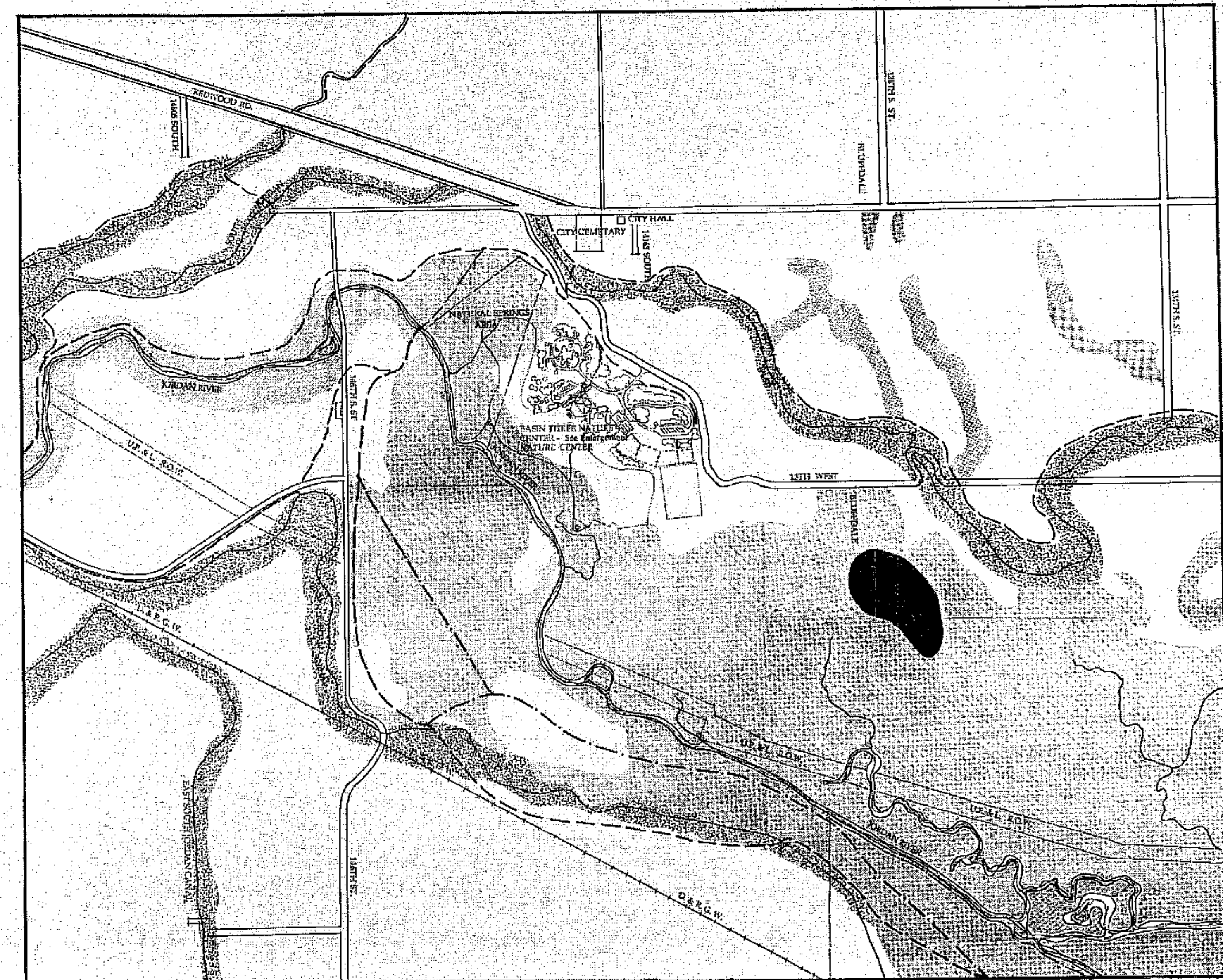
PREPARED BY THE DEPARTMENT OF LANDSCAPE ARCHITECTURE AND ENVIRONMENTAL PLANNING ENVIRONMENTAL FIELD SERVICE

UTAH STATE UNIVERSITY PROJECT DIRECTOR: CRAIG JOHNSON JUNE 1993

SCALE 1"= 400'

NORTH

Team Members- Jason Beach-Jereck Bess-Angie Brinkerhoff-Greg Brown-Alan Buckingham-Jackie Cochran-Sarah Crouchbaum-Jeff Gilbert-Troy Herald-Brock Hill-Dennis Howell-David Kurtz-Scott Mendenhall-Steve Sidaway-Rebecca Sokol-Andrea Sorensen-Robert Stevensen-Benjawan Ubonrat-Paul Valcarce-Chris Warner-Alvin Yanawon-Burton Yuen-



- Wetland
- Nature Reserve Park
- Staging Area
- Equestrian Trail
- Bike / Pedestrian Trail
- Cottonwood Reforestation
- Existing Land Use
- Critical Habitat

JORDAN RIVER CORRIDOR Conceptual Master Plan

The Narrows to 11800 South

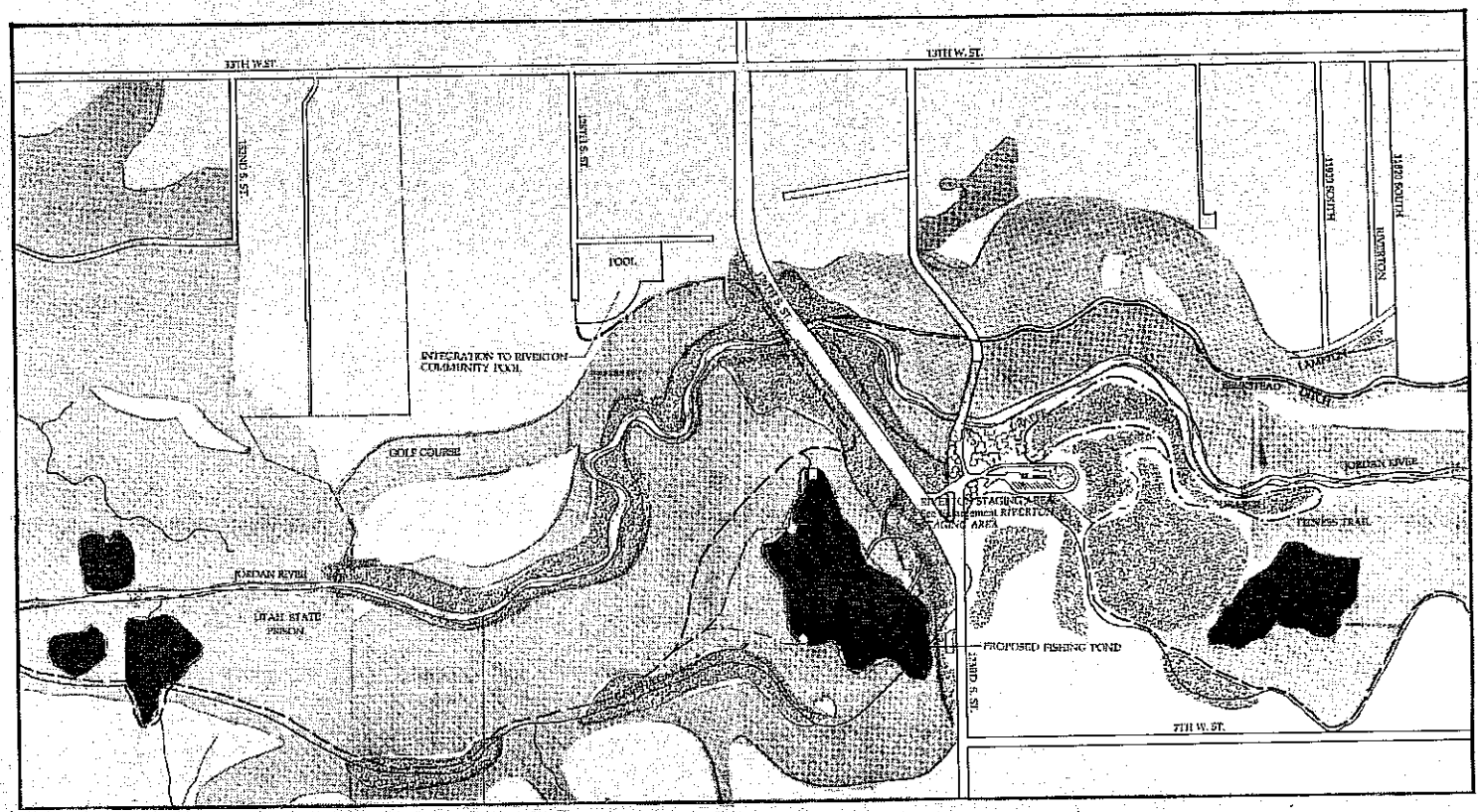
RECREATION ALTERNATIVE

PREPARED BY THE DEPARTMENT OF LANDSCAPE ARCHITECTURE AND ENVIRONMENTAL PLANNING ENVIRONMENTAL FIELD SERVICE

UTAH STATE UNIVERSITY PROJECT DIRECTOR: CRAIG JOHNSON JUNE 1993

SCALE 1" = 400'

3/5 NORTH



JORDAN RIVER CORRIDOR

Conceptual Master Plan
The Narrows to 11800 South

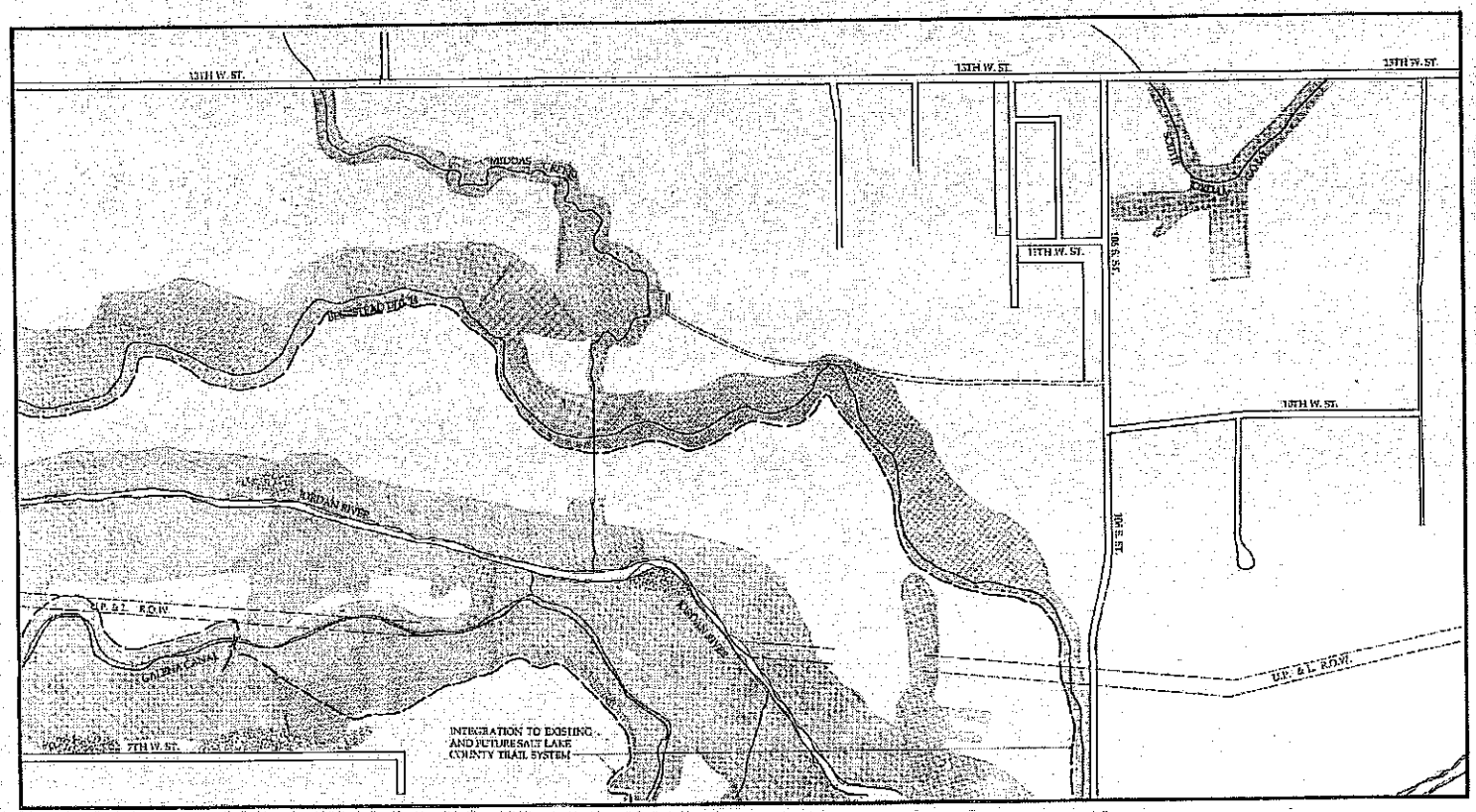
RECREATION ALTERNATIVE

PREPARED BY THE DEPARTMENT OF LANDSCAPE ARCHITECTURE AND ENVIRONMENTAL PLANNING ENVIRONMENTAL FIELD SERVICE
UTAH STATE UNIVERSITY PROJECT DIRECTOR: CRAIG JOHNSON JUNE 1993

SCALE 1"= 400'

NORTH

Team Members: Jason Bench-Jereck Bies-Angie Brisendine-Greg Brown-Alan Buckingham-Jackie Cochran-Sarah Cranchbaum-Jill Gilbert-Troy Herald-Brock Hill-Donna Howell-David Kurtz-Scott Mendenhall-Steve Siddoway-Rebecca Solsd-Andrea Sorenson-Robert Stevenson-Benjawan Ubonsri-Paul Valcarce-Chris Warner-Alvin Yarwon-Burton Yuen-



Equestrian Trail

Bike / Pedestrian Trail

Cottonwood Reforestation

Existing Land Use

Critical Habitat

JORDAN RIVER CORRIDOR

RECREATION ALTERNATIVE

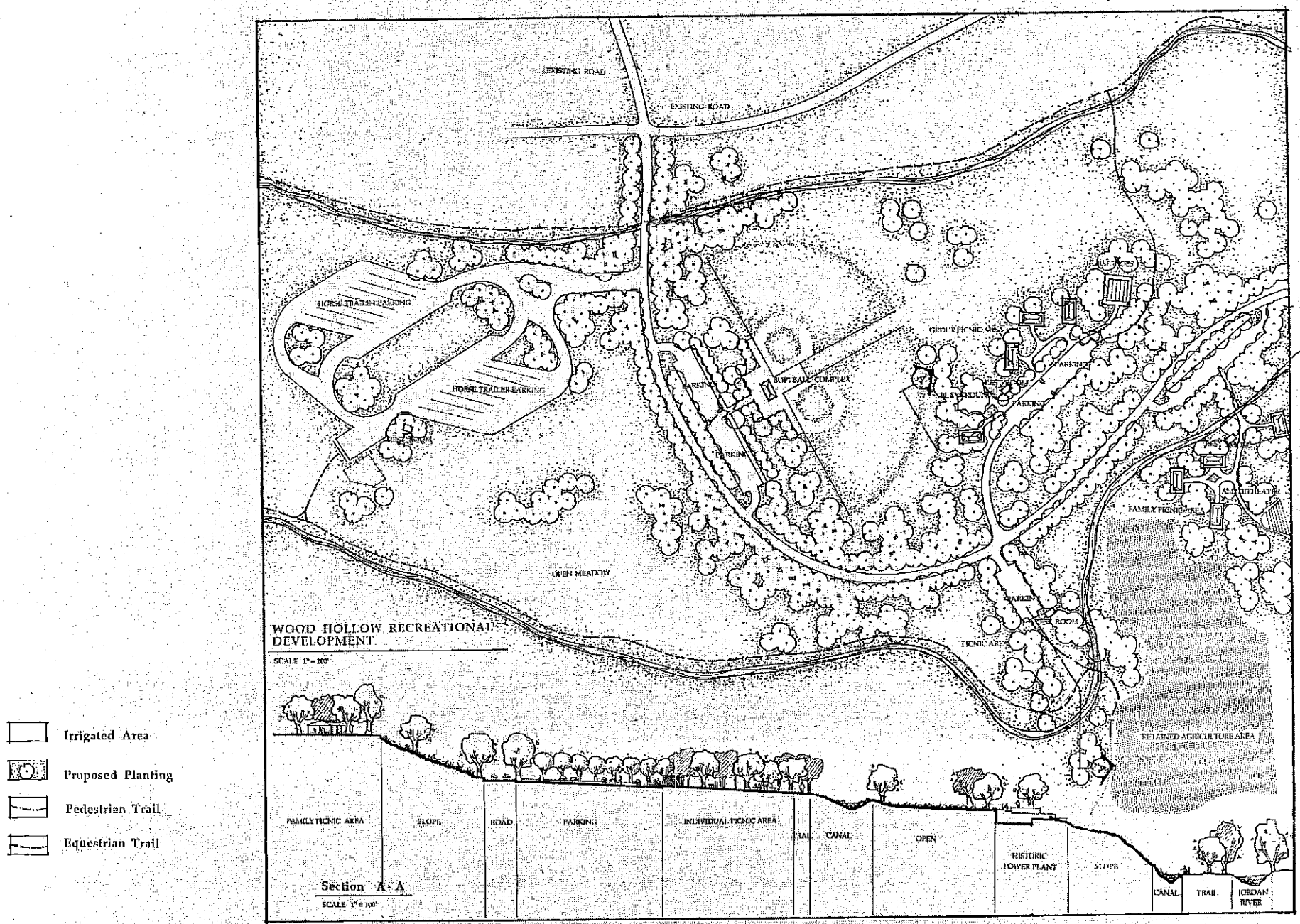
Conceptual Master Plan
The Narrows to 11800 South

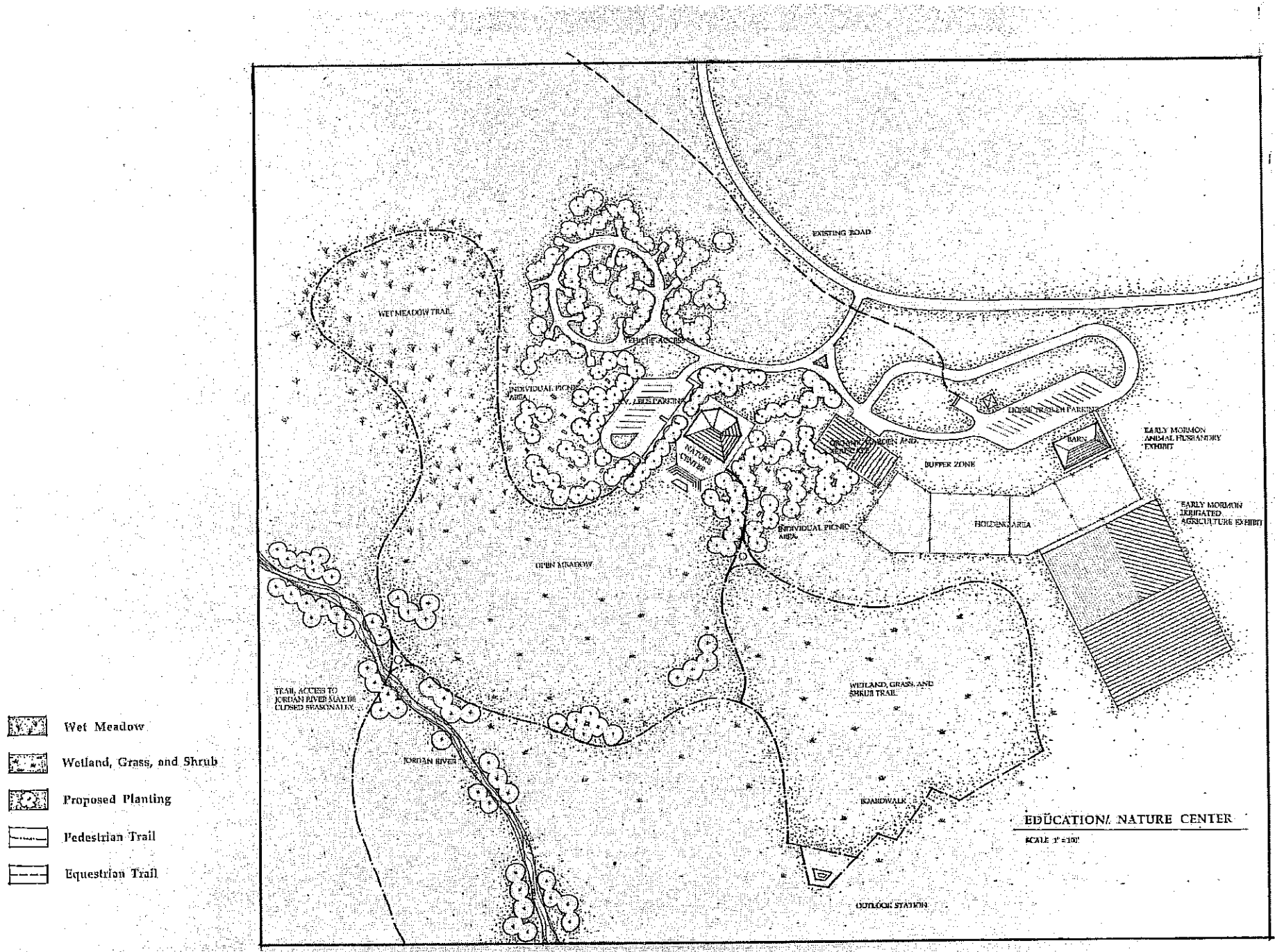
PREPARED BY THE DEPARTMENT OF LANDSCAPE ARCHITECTURE AND ENVIRONMENTAL PLANNING ENVIRONMENTAL FIELD SERVICE
UTAH STATE UNIVERSITY PROJECT DIRECTOR: CRAIG JOHNSON JUNE 1993

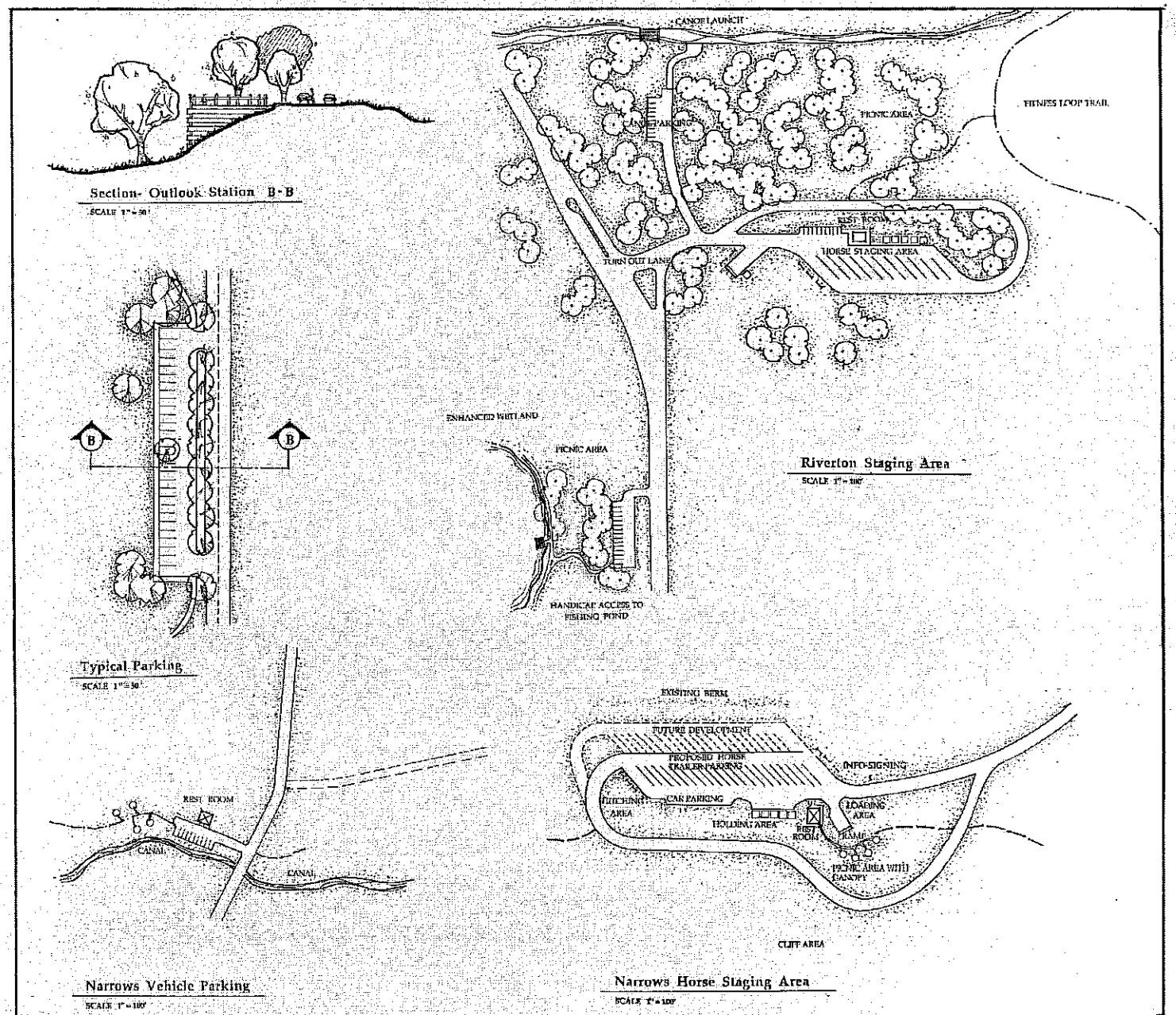
Team Members: Jason Bench-Jereck Bess-Angie Brisendine-Greg Brown-Alan Buckingham-Jackie Cochran-Sarah Cruchfield-Jeff Gilbert-Troy Herold-Brock Hill-Donna Howell-David Kurtz-Scott Manderfield-Steve Siddoway-Rebecca Sobol-Andrea Sorensen-Robert Stevenson-Benjawan Ukasri-Paul Valcarce-Chris Warner-Alvin Yarwon-Burton Yuen-

SCALE 1"= 400'

NORTH


EXISTING ROAD
EXISTING ROAD
HORSE TRAILER PARKING
HORSE TRAILER PARKING
SOFTBALL COMPLEX
PARKING
PARKING
PARKING
PARKING
PARKING
PARKING
PARKING
OPEN MEADOW
FAMILY PICNIC AREA
AMPHITHEATER
PICNIC AREA
ROOM
RESTORED AGRICULTURE AREA
WOOD HOLLOW RECREATIONAL DEVELOPMENT
SCALE 1"=100'
Irrigated Area
Proposed Planting
Pedestrian Trail
Equestrian Trail
FAMILY PICNIC AREA
SLOPE
ROAD
PARKING
INDIVIDUAL PICNIC AREA
TRAIL
CANAL
OPEN
HISTORIC POWER PLANT
SLOPE
CANAL
TRAIL
JORDAN RIVER
Section A-A'
SCALE 1" = 100'


EXISTING ROAD
WET MEADOW TRAIL
VEHICLE ACCESS
INDIVIDUAL PICNIC AREA
VEHICLE PARKING
NATURE CENTER
ORCHARD, GARDEN AND PASTURE
BUFFER ZONE
HORSE TRAILER PARKING
BARN
EARLY MORMON ANIMAL HUSBANDRY EXHIBIT
EARLY MORMON IRRIGATED AGRICULTURE EXHIBIT
HOLDING AREA
INDIVIDUAL PICNIC AREA
OPEN MEADOW
TRAIL ACCESS TO JORDAN RIVER MAY BE CLOSED SEASONALLY
JORDAN RIVER
WETLAND, GRASS, AND SHRUB TRAIL
BOARDWALK
OUTLOOK STATION
EDUCATIONAL NATURE CENTER
SCALE 1" = 100'
Wet Meadow
Wetland, Grass, and Shrub
Proposed Planting
Pedestrian Trail
Equestrian Trail



Proposed Planting

Pedestrian Trail

Equestrian Trail

Multi-Use Alternative Concept Statement

The goal of this alternative is to accommodate recreational and residential development uses while protecting the integrity of the Jordan River ecosystem. The plan is predicated in large measure on the assumption that all land development adjacent to the Jordan River benefits from the protection and enhancement of the corridor ecosystem. This plan with its diversity of uses has selected the best locations for each land use based on soils, topography, hydrology, and access to existing infrastructure. The plan explores alternatives to existing zoning such as overlay zoning and performance zoning as a means for implementing many of the concepts presented.

Overlay ordinances would establish performance standards for development activity on sensitive areas such as stream banks, floodplains, wetlands, and steep slopes. These overlays represent layers of constraints in addition to the requirements of the zoning map. Overlay ordinances are very problem-specific. As a result, they can be focused on areas where environmental damage would carry the highest public cost. Performance zoning provides landowners with a broad choice of uses in each area. The emphasis is on optimizing development opportunities, limiting expenditures on roads, and sewer and water uses, while protecting sensitive landscape features. This method would also promote awarding bonuses to developers for dedication of open space land to the community or for exceptional mitigation of environmental impacts. In the Jordan River setting, both of these land use management tools could provide development incentives or design standards to encourage desired development patterns and could have a place in shaping the growth of the communities along the river. The development alternatives shown optimize visual and physical links with the river.

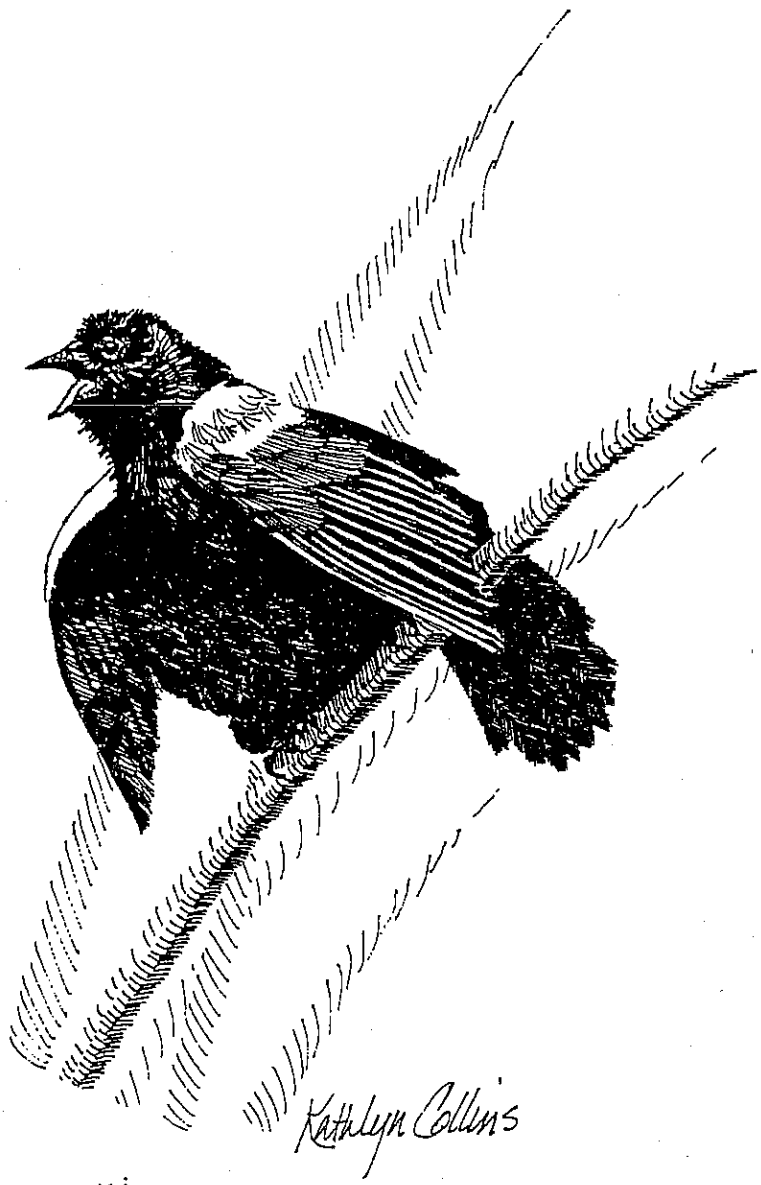
This alternative includes trails in an integrated system with public access. These trails become the link that integrates all three communities and the Jordan River corridor. In locations where practical trails for hiking and cycling are separated from equestrian trails.

The plan also preserves existing agricultural uses on soils of highest productivity where possible. In addition to maintaining productive soils, preservation of agricultural areas provides open space which reduces the perceived development density, while also serving as an effective buffer to and from adjacent properties. Best management practices are recommended for agricultural lands to ensure preservation of topsoil and protection of water quality.

This plan borrows from both the conservation alternative and the recreation/ education alternative. It recommends respecting the sensitive environments zone of the conservative alternative and incorporates most of the landscape restoration recommendations. It also integrates the staging areas, park,

and education center, proposals of the recreation/ education alternative.

The planning concepts presented, if implemented would accommodate the initial stages of development pressure while still protecting the character of the area. Considerably more detailed planning of residential development, particularly on the Draper side of the river, will be required once points of access and other issues become more clearly defined.



Multi-Use Alternative Concept Statement

The goal of this alternative is to accommodate recreational and residential development uses while protecting the integrity of the Jordan River ecosystem. The plan is predicated in large measure on the assumption that all land development adjacent to the Jordan River benefits from the protection and enhancement of the corridor ecosystem. The plan with its diversity of uses has selected the best locations for each land use based on soils, topography, hydrology, and access to existing infrastructure. The plan explores alternatives to existing zoning such as overlay zoning and performance zoning as a means for implementing many of the concepts presented.

Overlay ordinances would establish performance standard for development activity in sensitive areas such as stream banks, floodplains, wetlands, and steep slopes. These overlays represent layers of restrictions in addition to the requirements of the zoning map. Overlay ordinances are very problem-specific. As a result, they can be focused on areas where environmental damage would carry the highest public cost.

Performance zoning provides landowners with a broad choice of uses in each area. The emphasis is on optimizing development opportunities, blending responsibilities on roads, and sewer and water uses, while protecting sensitive landscape features. This method would also promote awarding bonuses to developers for dedication of open space land to the community or exceptional mitigation of environmental impacts. In the Jordan River setting, both of these land use management tools could provide development incentives or method design standards to encourage desired development patterns and could have a place in shaping the growth of the communities along the river. The development alternatives stressed optimize visual and physical links with the river.

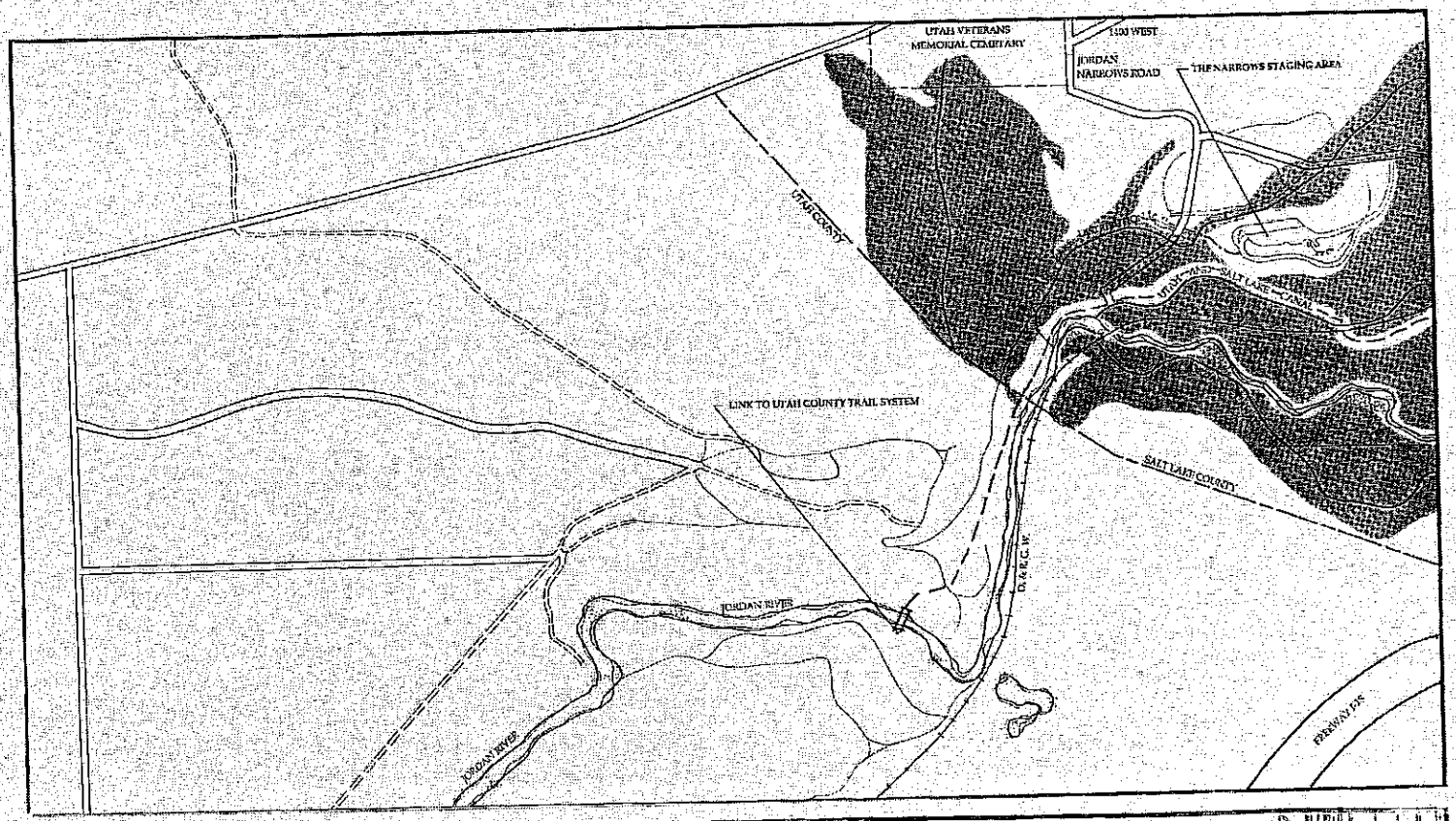
This alternative includes trails in an integrated system with public streets. These trails become the link that integrates all these communities and the Jordan River corridor in locations where practical trails for biking and cycling are separated from equestrian trails.

The plan also preserves existing agricultural uses on soils of highest productivity where possible. In addition to maintaining productive soils, preservation of agricultural uses provides open space which reduces the perceived development density, while also serving as an effective buffer to and from adjacent properties. Here, management practices are recommended for agricultural lands to ensure preservation of topsoil and protection of water quality.

This plan borrows from both the conservation alternative and the recreational/urban alternative. It recommends respecting the sensitive environments zone of the conservative alternative and incorporates most of the landscape composition recommendations. It also integrates the staging areas, park, and education center proposals of the recreation/ education alternative.

The planning concepts presented, if implemented would accommodate the initial stages of development pressure while still protecting the character of the area. Considerably more detailed planning of residential development, particularly on the Draper side of the river, will be required once points of access and other issues become more clear.

- Critical Habitats
- Residential
- Equestrian Trails
- Bike\Pedestrian Trails
- Agriculture
- Recreation
- Restored Vegetation
- Existing Land Uses



JORDAN RIVER CORRIDOR Conceptual Master Plan

The Narrows to 11800 South

MULTIPLE USE ALTERNATIVE

PREPARED BY THE DEPARTMENT OF LANDSCAPE ARCHITECTURE AND ENVIRONMENTAL PLANNING ENVIRONMENTAL FIELD SERVICE
UTAH STATE UNIVERSITY PROJECT DIRECTOR: CRAIG JOHNSON JUNE 1993
Team Members: Jason Bench–Jeneck Bess–Angie Brisendine–Greg Brown–Alan Buckingham–Jackie Cochran–Sarah Cruickshank–Jeff Gilbert–Troy Herold–Brock Hill–Donna Howell–David Kurtz–Scott Mendenhall–Steve Sidoway–Rebecca Sobol–Andrea Sorensen–Rachel Stevenson–Benjawan Utoomsit–Paul Valcarce–Chris Warner–Alvin Yamwon–Burton Yuen.

SCALE 1"= 400'

NORTH

JORDAN RIVER CORRIDOR Conceptual Master Plan

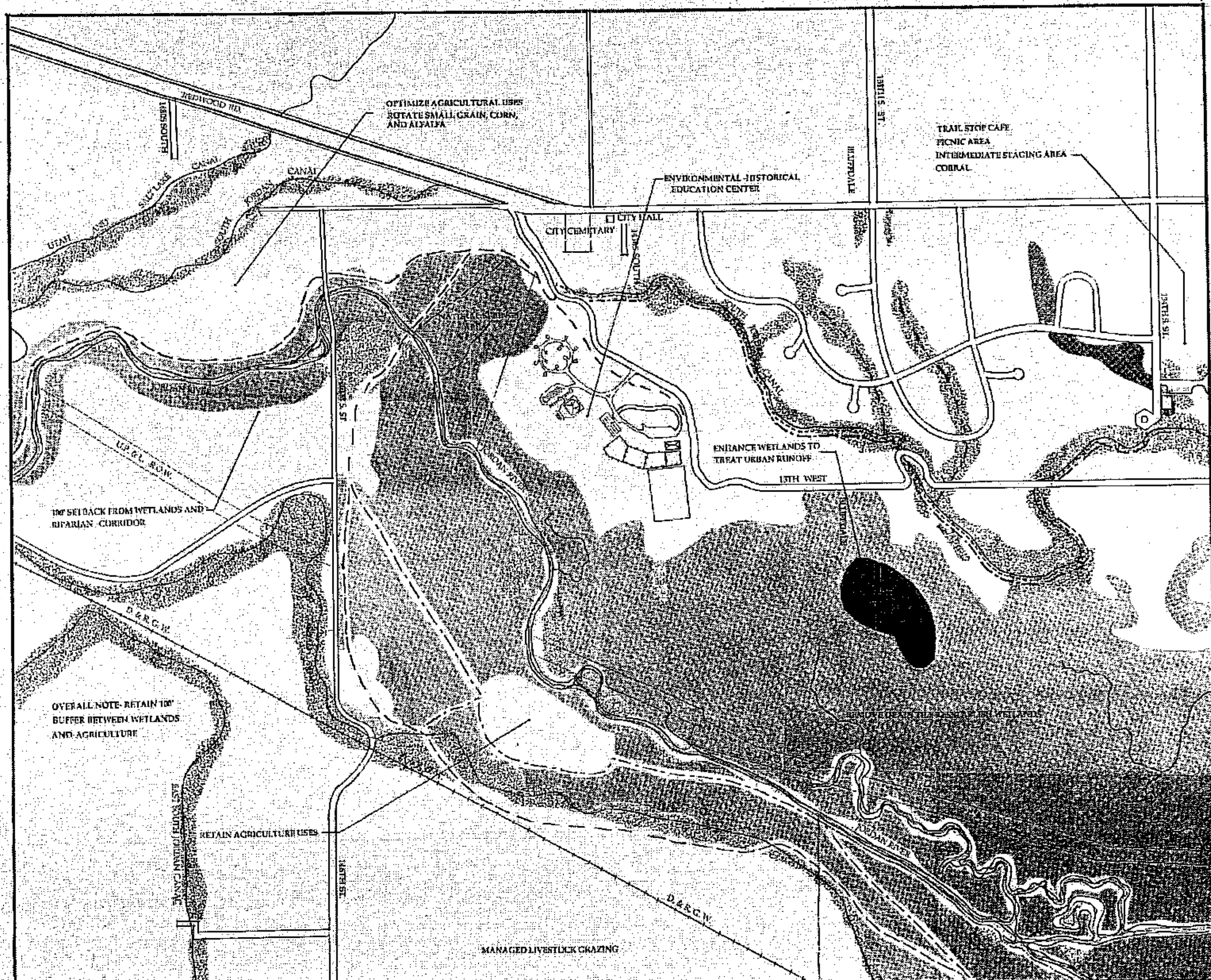
The Narrows to 11800 South

MULTIPLE USE ALTERNATIVE

PREPARED BY THE DEPARTMENT OF LANDSCAPE ARCHITECTURE AND ENVIRONMENTAL PLANNING ENVIRONMENTAL FIELD SERVICE

UTAH STATE UNIVERSITY PROJECT DIRECTOR: CRAIG JOHNSON JUNE 1993

SCALE 1" = 400' NORTH



- Critical Habitats
- Residential
- Equestrian Trails
- Bike\Pedestrian Trails
- Agriculture
- Recreation
- Restored Vegetation
- Existing Land Uses

JORDAN RIVER CORRIDOR Conceptual Master Plan

The Narrows to 11800 South

MULTIPLE USE ALTERNATIVE

PREPARED BY THE DEPARTMENT OF LANDSCAPE ARCHITECTURE AND ENVIRONMENTAL PLANNING ENVIRONMENTAL FIELD SERVICE

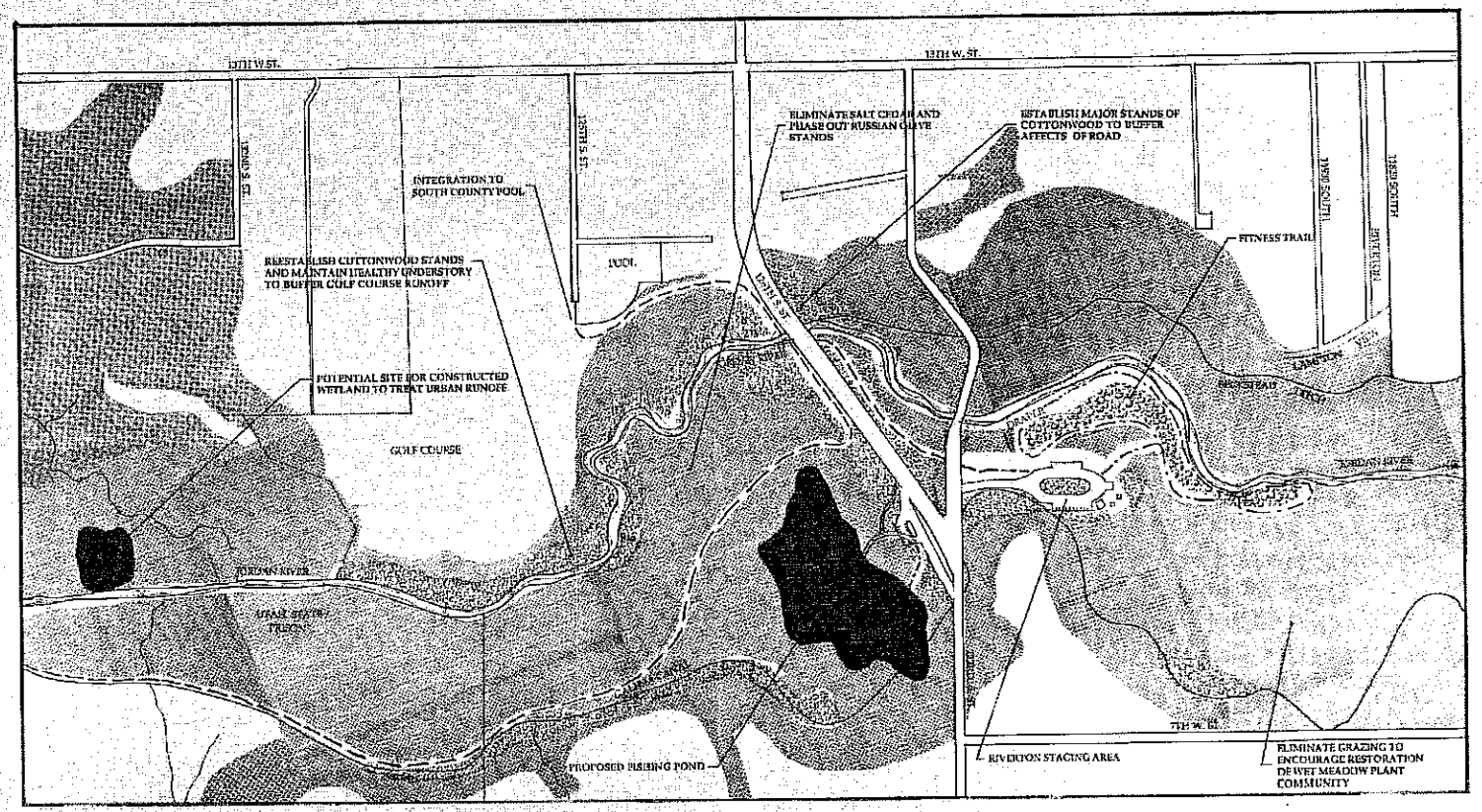
UTAH STATE UNIVERSITY PROJECT DIRECTOR: CRAIG JOHNSON JUNE 1993

SCALE 1" = 400'

3/5

NORTH

Team Members: Jaron Bench–Jereck Boss–Angie Dirrendine–Greg Brown–Alan Buckingham–Jackie Cochran–Sarah Creachbaum–Jeff Gilbert–Troy Herold–Brock Hill–Denna Howell–David Kurtz–Scott Mendenhall–Steve Siddoway–Rebecca Sobol–Andrea Sorenson–Robert Stevenson–Benjawan Ubonsri–Paul Valcarce–Chris Warner–Alvin Yarlwon–Burton Yuen



- Critical Habitats
- Residential
- Equestrian Trails
- Bike\Pedestrian Trails
- Agriculture
- Recreation
- Restored Vegetation
- Existing Land Uses

JORDAN RIVER CORRIDOR Conceptual Master Plan

MULTIPLE USE ALTERNATIVE

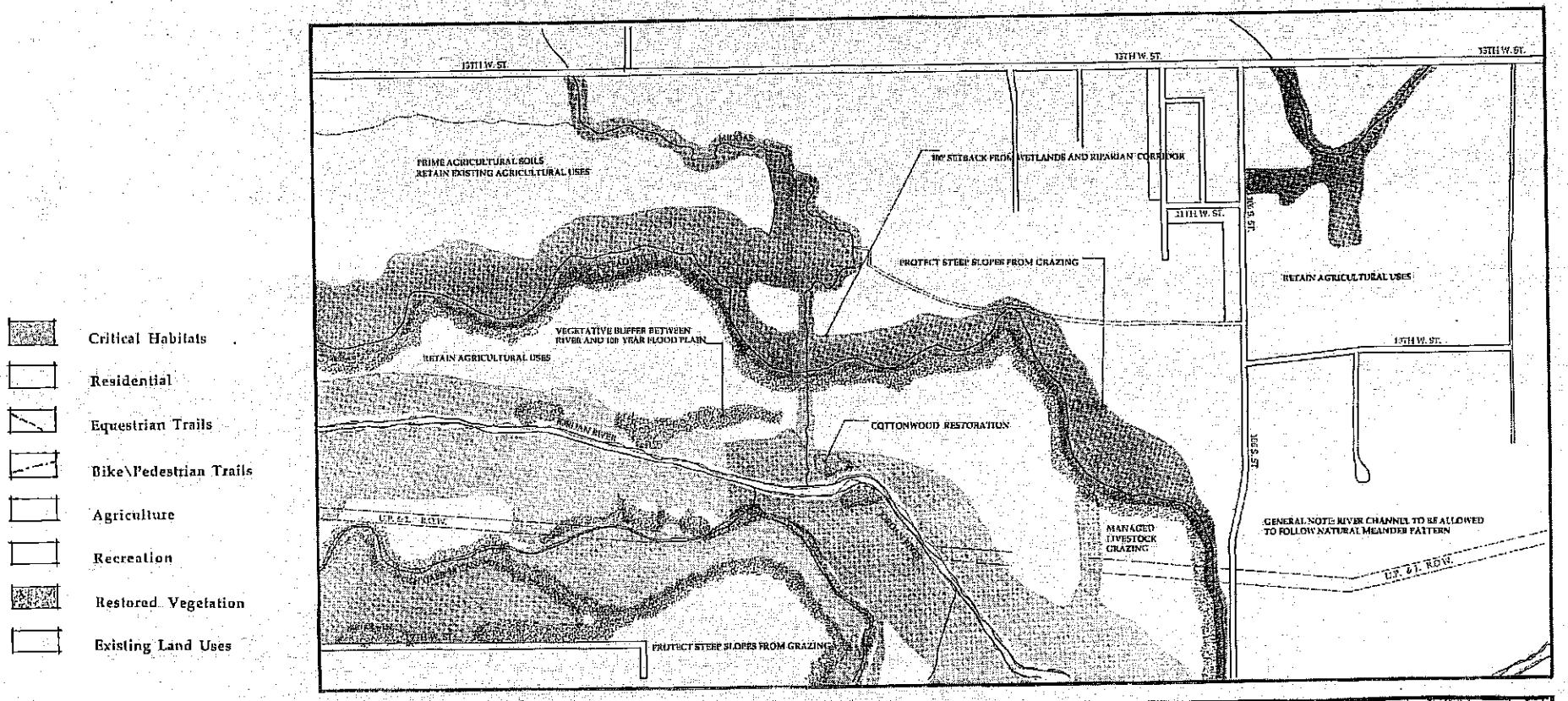
The Narrows to 11800 South

PREPARED BY THE DEPARTMENT OF LANDSCAPE ARCHITECTURE AND ENVIRONMENTAL PLANNING ENVIRONMENTAL FIELD SERVICE
UTAH STATE UNIVERSITY PROJECT DIRECTOR: CRAIG JOHNSON JUNE 1993

SCALE 1"= 400'

NORTH

Team Members: Jason Beach–Jerod Bess–Angie Dittemore–Greg Brown–Alan Buckingham–Jackie Cochran–Sarah Crutchfield–Jeff Gilbert–Troy Herald–Brock Hill–Donna Howell–David Kurtz–Scott Mendenhall–Steve Siddoway–Rebecca Schell–Andrea Sorensen–Robert Stevenson–Benjamin Thomas–Paul Valcarce–Chris Warner–Alvin Yarrow–Burton Yuen



JORDAN RIVER CORRIDOR

Conceptual Master Plan
The Narrows to 11800 South

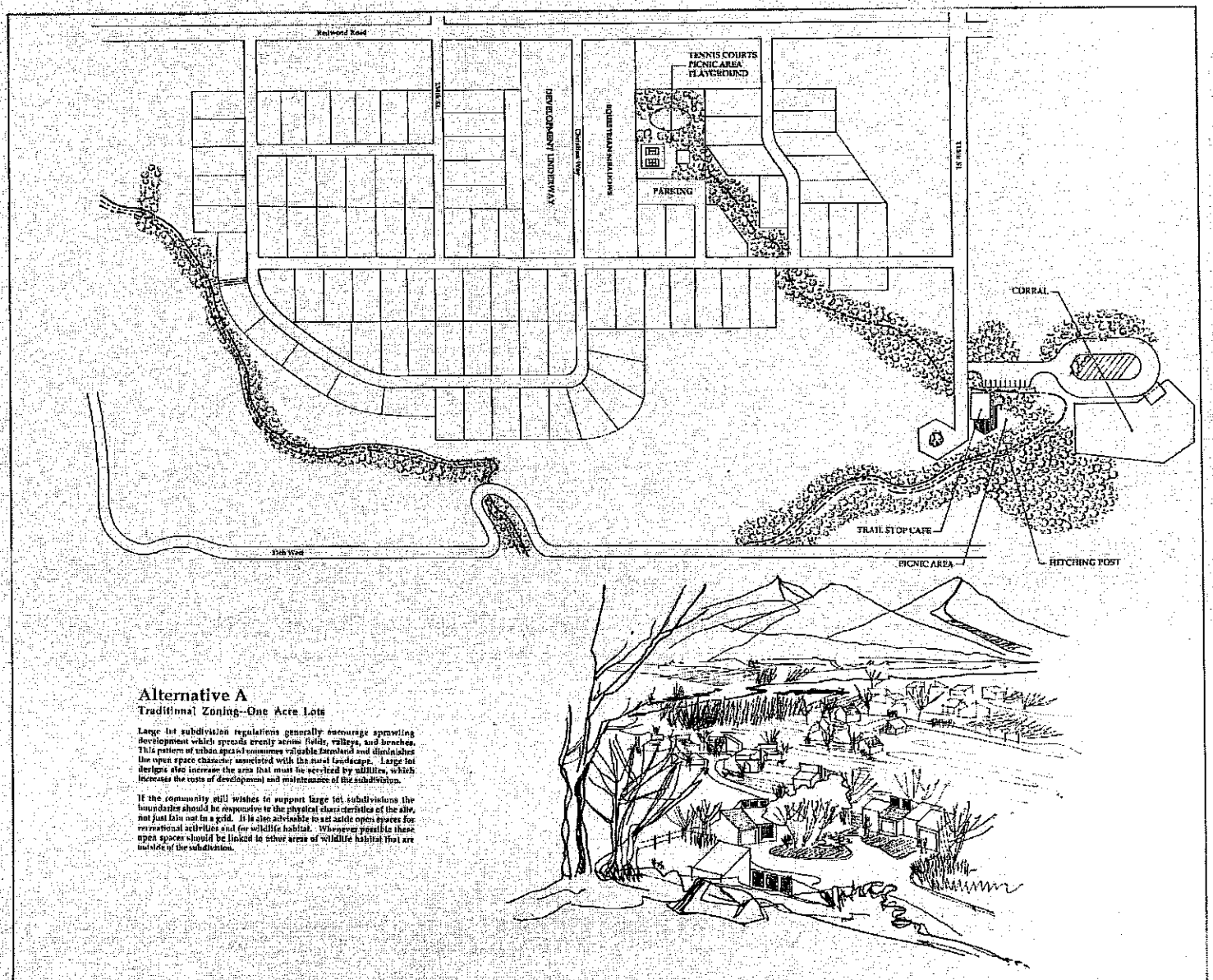
MULTIPLE USE ALTERNATIVE

PREPARED BY THE DEPARTMENT OF LANDSCAPE ARCHITECTURE AND ENVIRONMENTAL PLANNING ENVIRONMENTAL FIELD SERVICE
UTAH STATE UNIVERSITY PROJECT DIRECTOR: CRAIG JOHNSON JUNE 1993

SCALE 1"= 400'

NORTH

Team Members: Jason Bench-Jeneen Bess-Angie Bohemstine-Greg Brown-Alan Buckingham-Jackie Cochran-Sarah Crandelmann-Jeff Gilbert-Troy Harold-Brock Hill-Dennis Howell-David Kurtz-Scott Mendenhall-Steve Siddaway-Rebecca Schol-Andrea Sorensen-Robert Stevenson-Benjawan Usanee-Paul Valcarce-Chris Warner-Alvin Yarlowa-Burton Yuen-



Optimize Agricultural use - Prime Agricultural soils

New Development

Equestrian Trails

Hiking Trails

Existing Vegetation

Restored Native Vegetation

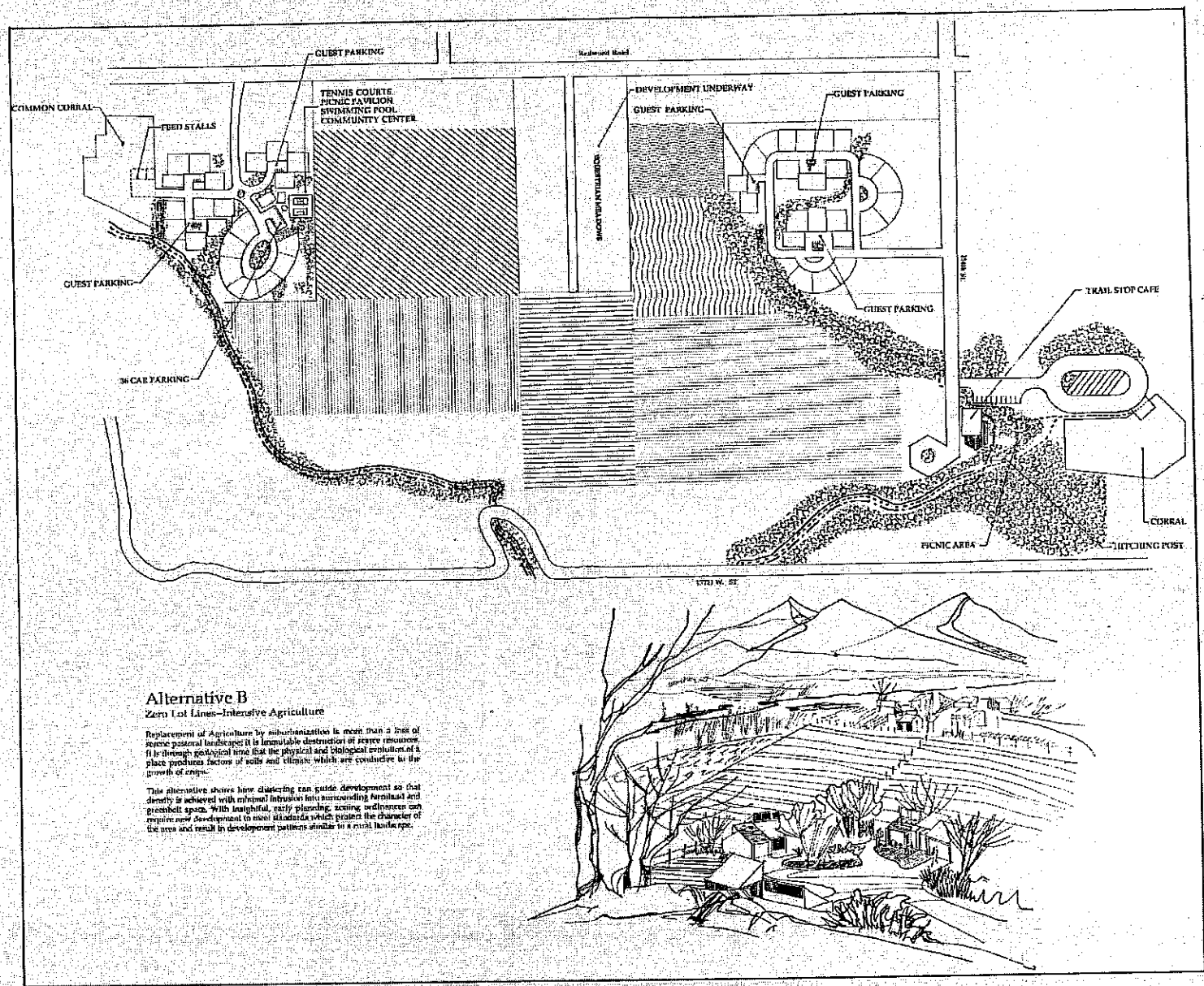
Retain Existing Use

Alternative A

Traditional Zoning--One Acre Lots

Large lot subdivision regulations generally encourage sprawling development which spreads evenly across fields, valleys, and beaches. This pattern of urban sprawl consumes valuable farmland and diminishes the open space character associated with the rural landscape. Large lot designs also increase the area that must be serviced by utilities, which increases the costs of development and maintenance of the subdivision.

If the community still wishes to support large lot subdivisions the boundaries should be responsive to the physical characteristics of the site, not just laid out in a grid. It is also advisable to set aside open spaces for recreational activities and for wildlife habitat. Wherever possible these open spaces should be linked to other areas of wildlife habitat that are outside of the subdivision.



Optimize Agricultural use
-Prime Agricultural soils

New Development

Equestrian Trails

Hiking Trails

Existing Vegetation

Restored Native Vegetation

Retain Existing Use

Alternative B

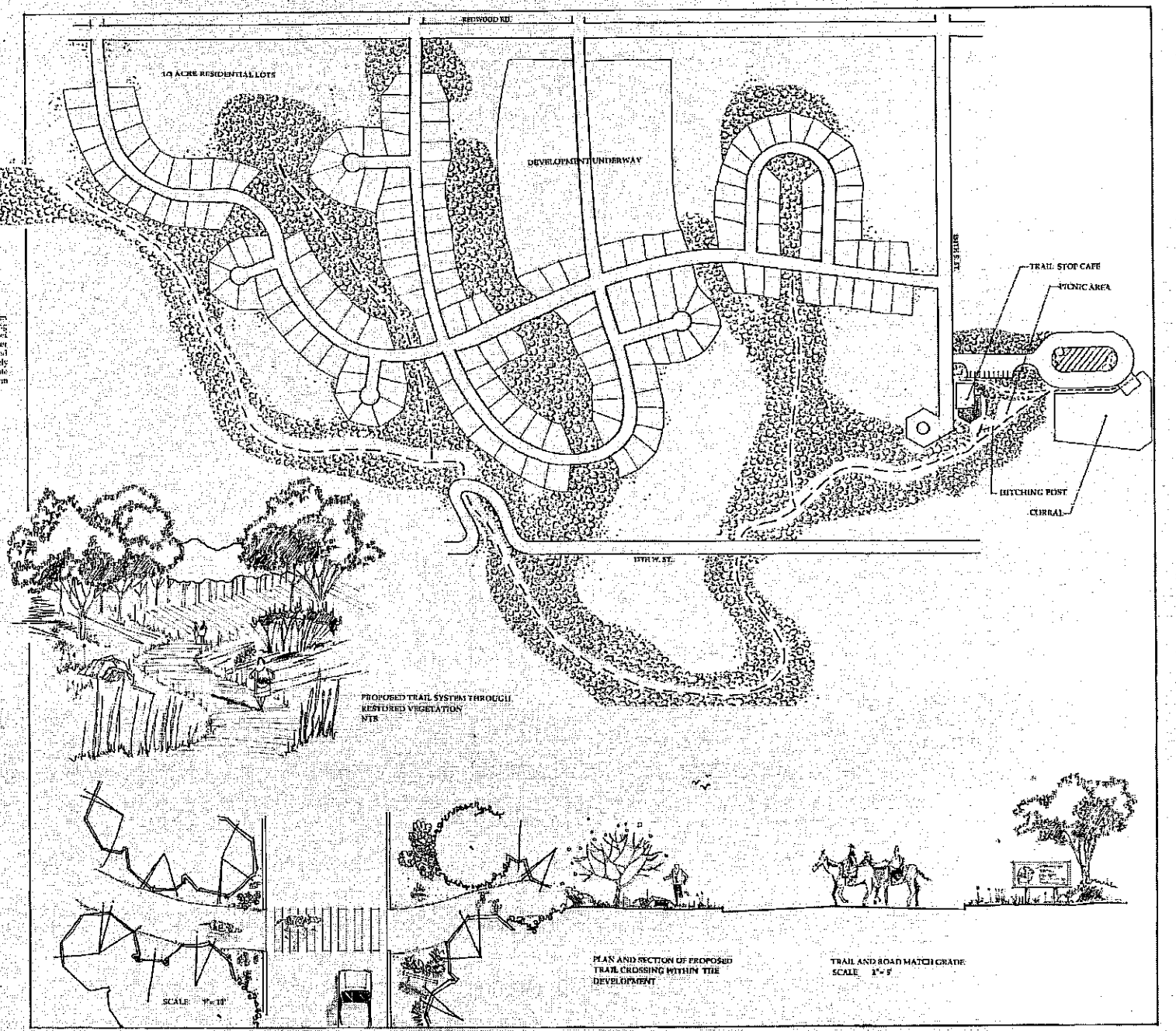
Zero Lot Lines–Intensive Agriculture

Replacement of Agriculture by suburbanization is more than a loss of scarce pastoral landscape; it is irrevocable destruction of scarce resources. It is through geological time that the physical and biological evolution of a place produces factors of soils and climate which are conducive to the growth of crops.

This alternative shows how clustering can guide development so that density is achieved with minimal intrusion into surrounding farmland and greenbelt space. With insightful, early planning, zoning ordinances can require new development to meet standards which protect the character of the area and result in development patterns similar to a rural landscape.

Alternative C
High Density Lotting

The high density lotting design attempts to create a higher density pattern leaving relatively large expanses of undeveloped open space. This lotting pattern provides a visual effect of mass and unity, with scenic relief created by open space, similar to the traditional Utah landscape. Higher density development can be more economical in terms of construction and public costs than large lot lower density development. With a relatively dense housing pattern in the developed areas, the land can accommodate as many families as large lot subdividing but preserve open space for all in the community to enjoy.



- Optimize Agricultural Use-Prime Agricultural Soils
- New Development
- Equestrian Trails
- Hiking Trails
- Existing Vegetation
- Restored Vegetation
- Retain Existing Use

TECHNICAL REPORTS INTRODUCTION

Introduction

The following technical resource reports were prepared by individual students. All reports were prepared from reviews of research, reports, computer programs, and technical documents authored by others. In some instances material was gathered from personal interviews. Where possible findings in the literature were verified by field observations. In some resource areas additional on-site research would greatly enhance the reliability of the data. Project time constraints and limited funding precluded field research. However, we believe that the data that has been compiled and mapped is sufficiently accurate for the preparation of a critical habitat plan and a conceptual level master plan.

Technical Reports Included are:

Regional Context
Program - User Surveys
Historical Vegetation
Historical and Cultural Resources
Land Use and Zoning
Soils and Topography
Hydrology
Vegetation
Wildlife
Fisheries
Visual Resource
Ownership
Summary

Appendices:

Appendix A - User survey
Appendix B - Soils
Appendix C - Vegetation
Appendix D - Vegetative summary of findings
Appendix E - Wildlife species list
Appendix F - Wildlife species/plant list
Appendix G - Preparing an Urban Wildlife Habitat Ordinance Amendment and Other Implementation Tools

Section 3

Cottonwood Reforestation
Weed Control
Economic Valuation Techniques to Evaluate Natural Resources
Alternative Zoning and Implementation
Beaver Habitat Model
Bullock's Oriole Habitat Model
Canadian Goose Habitat Model
Muskrat Habitat Model
Red-winged Blackbird Habitat Model

TECHNICAL REPORTS

REGIONAL CONTEXT

Introduction

Regional analysis beyond the boundaries of the project site identifies issues, proposals and land use changes that may affect the site or in turn be affected by development on the project site. The south end of Salt Lake County is in a rapid transition from rural/ agricultural to suburban/ urban land uses, development of the site will have important ramifications on the Jordan River Corridor.

The regional analysis considered the area from 9000 South to 12300 South and from the freeway to 3600 West. This area includes the cities of South Jordan, Sandy, Riverton, Draper, Bluffdale, and unincorporated areas of Utah County. Analysis of the area determined factors that may affect the Jordan River Narrows in the cities of Draper, Bluffdale , and Riverton.

The following factors could be an influence on the Jordan River Corridor:

- ten major roads with four freeway accesses
- three major canals and three minor canals
- two major drainages
- one high school, two middle schools, and six elementary schools
- five proposed trails
- five parks
- one existing freeway, and one proposed major highway

Methods

The method used to collect data included on-site visits, literature and map review and personal communications. The author of this section has been a long time resident of the area and has a general knowledge of what exists in the region.

Results

The communities of Bluffdale, Riverton, and Draper are small, have relatively low density and are rural in character. Historically, most urban development has remained on the uplands above the Jordan River floodplain. Development pressures in the community are increasing dramatically. In both Riverton and Bluffdale, new developments have either been constructed or are being proposed within the Jordan River Corridor.

The south Salt Lake County region is serviced by ten major roads. The roads that run East-West are 9000 South, 10600 South, 11400 South, 11800 South, 12600 South, 13400 South, and the Bluffdale exit. The roads that run North-South are 1300 West, 1700 West (Redwood Road), 2700 West, and 3600 West. Out of the regional area analyzed, 5600 West is important because it will be a major highway that will make a loop through the south-end of Salt Lake County. Freeway accesses to the west side of Salt Lake County are located at 9000 South, 10600 South, 12300 South (which turns into 12600 South), and approximately 14600 South (the Bluffdale exit). The freeway accesses cut across the corridor and crosses over the Jordan River fragmenting the corridor into several pieces.

A proposed highway would be located at approximately 13400 South and would cross the river further dissecting the corridor. The proposal is to build a

highway at 5600 West that will turn and follow 13400 South. There is also a proposal to link 11400 South on the west side of the freeway with the east side and an east-west link at 9400 South in South Jordan.

The Jordan River drains the region. It is a major source of water that when diverted irrigates much of the regions remaining farmland.

The region has three large canals: the Utah Lake Distributing Canal, Utah Salt Lake Canal, and the South Jordan Canal. The purpose of these canals is to provide water for irrigation. The canal service roads also function as undesignated trails that link the Jordan River Narrows with neighborhoods in the communities. The canals run in a north-south direction. There are also three minor canals that service the region; the Beckstead Ditch, Galena Canal, and the Jordan Canal. Butterfield Creek that runs through Riverton, empties into the Beckstead Ditch. Willow Creek and Dry Creek empty into the Galena Canal. The three minor canals run general north-south but they meander and follow the Jordan River. These canals greatly reduce instream flows in the Jordan River during the summer months.

The two major drainages in the region are Woods Hollow and Beef Hollow. These drainages carry the spring run-off from the Oquirrh Mountains to the Jordan River. They also provide corridors for wildlife to travel from the Jordan River Narrows to the nearby canyons. A number of small minor swales also drain into the Jordan River corridor. On the east side of the river Corner Creek and Willow Creek drain into the river. The city of Draper projects Corner Creek as a major conveyer of urban stormwater drainage in the future. Many of the drainages in the region run through horse pastures, feedlots, and other sources of potential nutrient loading. Although some drainages are intercepted by canals, many empty directly into wetlands.

The schools currently in the region include: Bingham High School, Oquirrh Hills Middle School, South Jordan Middle School, Southland Elementary, Riverton Elementary, Rosamond Elementary, Monte Vista Elementary, South Jordan Elementary, and Jordan Ridge Elementary. Some of the junior high students are bused outside of the region are to Bingham Middle School. None of these schools has a major area for outdoor environmental education.

The region has five parks which are Bluffdale City Park, Riverton City Park, South Jordan City Park, River Park, and a neighborhood park in South Jordan. There is the potential of linking these parks with pedestrian access to the Jordan River corridor.

There are five trails proposed for the area by Salt Lake County Parks and Recreation Department. They are Utah Lake Canal Trail, Utah and Salt Lake Canal Trail, Jordan River Parkway West Trail, Jordan River Parkway East Trail, and the West Jordan Bingham Creek Trail. Additional connecting trails to interior of each community are being considered.

Summary

The population of Salt Lake County is expanding. Growth is moving south into the South Salt Lake County Region. In preparing for anticipated growth, the Utah Department of Transportation has proposed expansions to the collector highway network.

Improved access to south Salt Lake County will accelerate growth rates. Increasing pressure to develop in close proximity to the Jordan River can be expected as growth continues. The six mile stretch of the Jordan River is one of the few remaining large tracts of riparian wetland openspace, remaining in the Salt Lake Valley. The Jordan River Corridor has the potential to provide many amenities if properly planned and managed, some of which are: flood control, recreation, agriculture, education, visual quality, storm water treatment, fisheries and wildlife habitat, and groundwater recharge.

Literature Cited

Transportation Improvements Program. 1992. Wasatch Front Regional Council.

PROGRAM - USER SURVEY

Introduction

The purpose of this report is to provide an analysis of user-needs relating to development along the Jordan River. This analysis is based on information gathered from the cities of Draper, Riverton, and Bluffdale, which are adjacent to the 6-mile portion of the Jordan River that this study considers.

All three communities support the following objectives:

1. Increase public access
2. Encourage low impact recreational uses such as hiking, biking, and nature study
3. Incorporate trails on both sides of the Jordan River
   a. Walking/bicycling/cross country skiing
   b. Equestrian
4. Enhance wildlife habitat and improve the quality of the fishery
5. Integrate stormwater management into plans for the Jordan River corridor
6. Preserve existing wetlands/ create new wetlands to treat city run-off
7. Provide a seamless transition between communities
8. Link trails from the river into the communities

All three cities favor preserving the integrity of the cottonwood/willow wetland system. Of the three cities, Bluffdale proposes the most development including an educational center, an interpretive center, and a more traditional community park. Draper favors mainly preservation and enhancement of the natural landscape, although they do not want to displace agricultural uses along the river at this time. Riverton favors preservation, enhancement, and reclamation of the existing resource with increased public access, but minimal development.

Methods

Data for this report has been collected by gathering written objectives from city planning offices, parks and recreation advisory boards, public hearing comments, and input from individual sources. An effort has been made to have the views of Bluffdale, Riverton, and Draper cities represented as accurately as possible since they are directly affected by this study.

Problem

An accelerating rate of urban development is occurring in the Salt Lake Valley. Recent growth has placed unprecedented pressure on the communities south of Salt Lake City, including Bluffdale, Draper, and Riverton. Development pressures are now being felt along and adjacent to the Jordan River. The six-mile portion of the Jordan River remains as one of the few large wetland research open spaces in the county. It is important that we understand the use related issues involved in this natural corridor, in order to make a proper recommendation for its future use. Many different people and organizations have expressed opinions about how (or if) this area should be developed.

Purpose

No project can be successful without understanding the needs of its users. The purpose of this study is to gather as

much information as possible from individuals and groups that have an interest in the Jordan River corridor.

Scope

This report will present information in a summary format. It will not make an attempt to place a value judgement on the ideas presented. In order to make that judgement, this information will have to be analyzed in relation to other research about wildlife, hydrology, vegetation, fisheries, and other natural and cultural resources.

Results

Bluffdale City

Bluffdale is projecting rapid growth over the next two decades and recognizes the need for additional park space to meet the needs of the community. They participate in the Salt Lake County Regional Parks and Recreation programs, including the Jordan River Parkway plan. In connection with this program, they plan to develop trails, nature parks and "other regional features" as part of the system (Bluffdale 1992).

A household survey of Bluffdale residents showed that 77 percent of the residents who responded to the survey want the City of Bluffdale to provide recreational services (Bluffdale 1992). The types of services they noted include:

*Playgrounds
*Horse trails
*Nature parks
*Bicycle trails

See Appendix A- Comprehensive Master Plan statistical tabulation.

The Bluffdale Comprehensive Plan (1992) notes that "the Jordan River Narrows and associated wetlands offer the greatest opportunity and the greatest challenge for developing major park and recreational facilities within its boundaries". The Provo-Jordan River Parkway concept calls for a series of parks and trails through the Narrows. One thing that may be an obstacle is the variety of pubic and private parties who control land in this area. Groups who control property include Camp Williams Military Reservation, Salt Lake County, Utah Division of Parks and Recreation, City of Bluffdale, and privately-owned parcels. The Great Salt Lake Council of the Boy Scouts of America uses an 80-acre undeveloped campground on the East side of the River. This area also houses the Veterans Memorial Cemetery. Developing this land to its full potential will require a great deal of cooperation from State, County, City, and private land-controllers (Bluffdale 1992).

Several irrigation canals originate within Bluffdale that have improved service roads along at least one side of them. Also, a power corridor runs through the City and several natural drainages exist on the surrounding foothills. All of these provide possible trailways and other recreational opportunities that link Bluffdale to the Provo-Jordan Parkway.

The Bluffdale Parks Committee has adopted several policies that tie in directly to the Jordan River Parkway system (Bluffdale 1992). The policies included directly effect or otherwise delineate uses in the Jordan River Parkway system. These policies include:

1. Preserving existing trails in the City.
2. Developing new trails for equestrian, bicycle, walking, and cross-country skiing uses.

3. Preserving and enhancing the Jordan River and associated wetland and wildlife environments.
4. Creating a recreational buffer zone between Camp Williams, existing residences and future residential development.
5. Requiring all subdivisions to provide a right-of-way for non-motorized access.
6. Developing a main City Park with athletic fields, picnic areas, and playgrounds on 2200 West and 14000 South. (Therefore, some of these uses may not be necessary within the Jordan River Parkway system).
7. Establishing an active program for the acquisition of property to accommodate future park needs.
8. Striving for the inclusion of Bluffdale's Jordan River Park and Trails Master Plan into the regional parks and recreation master plans.
9. Preserving existing open areas while the community is still rural
10. Linking the parks, trails, bicycle paths, and other facilities together.
11. Working together with neighboring cities and coordinating efforts with the Salt Lake Parks and Recreation Master plan and the Salt Lake Regional Trails Plan.

Bluffdale also proposes an educational use with the Jordan River Educational Center. This would be a multi-use learning center that emphasizes environmental and historical studies (Trickler 1993). Uses would include:

* Nature trails--identifying, flora, fauna, and geological features.
* Historical trails--interpreting Native American use,the Pony Express Trail, early Pioneer experiences, and historical water use in the valley.
* Observation stations--for wildlife viewing.
* Learning Center and Museum-for various laboratories and displays.
* Lecture Hall or Amphitheater.

Overall objectives of the Bluffdale Parks Committee, which are supported by the City of Riverton include (Bliss 1993):

1. Master plan the Jordan River from the Narrows to 11700 South.
2. Set aside and protect wetlands as open space areas; plan public access and use.
3. Reserve and restore wildlife habitat.
4. Landscape in native trees, plants, and grasses minimizing maintenance and weed control.
5. Plan bank contouring to control erosion.
6. Plan settling ponds for cleaning city runoff before it is returned to the river: Beef Hollow, Rock Hollow, Wood Hollow, and Rose Creek.
7. Plan trails on each side of the Jordan River. Separate equestrian from other non-motorized trails.

Site specific objective include (Bliss 1993):

1. Trails
   a. East side trail
   b. West side trail
   c. Canal access trail
   d. Draper canal is to be piped and buried-would make a good trail
   e. Separate equestrian from biking/hiking uses
   f. Fencing and limited-access gates
   g. Interpretive signs
2. Basin 3 Nature Reserve
   a. Staging area
   b. Interpretive center
   c. Overlook-nature trail
   d. Boardwalks
   e. Blinds

3. The Narrows
   a. Staging areas
   b. Picnic facilities at Williams Park which include picnic areas, canoe outage, restrooms, water
   c. Fishery
   d. Bridge connecting to Camp Williams Park
4. Wood Hollow Recreational Area which includes the following four areas:
   * upper 48 acres- Randy Parry
   * Leased UP&L property
   * Grotto
   * Actual drainage
   a. Staging area
   b. Amphitheater
   c. Baseball field
   d. Playground
   e. Picnic facilities
   f. Natural trail
   g. Link to Scouts property under railroad
5. Staging Areas
   a. Facilities:
      *Parking
      *Hitching posts
      *Limited access gates
      *Restrooms
      *Drinking fountains
      *Picnic areas
   b. Locations:
      * 14600 South--North side of road, East of River
      * 12600 South--North side of road, Both sides of River
      * Basin 3 Nature Reserve--Loumis's
      * The Narrows
      * Wood Hollow Recreation Area
   c. No night lighting
6. Reducing grazing in wetland areas

Draper City

A survey was recently conducted among citizens of Draper to gather public opinion about the city zoning and providing amenities (City of Draper 1992). 2000 surveys were mailed and 420 were returned, for a response rate of 21%. Most of the residents who responded own 1 to 4 acres of land (48%), and have lived in Draper for more that 15 years (45%).

The results of the survey shows that regarding amenities, people want:

1. Additional community parks--20 acre minimum (71%)
2. Linear parkways--along rivers, canals, and roadways (62%)
3. Bicycle trails (68%)
4. Equestrian trails (60%)

Regarding zoning, people want fairly large minimum lot sizes. 79% oppose minimum lot sizes of 1/4 acre and 65% oppose minimum lot sizes of 1/3 acre. 45% favored 1/2 acre minimum lots, and opinions were split regarding 1 acre lot sizes (37% for, 39% against).

Public opinion concerning planning issues favored:

1. Developing a zoning/master plan (82%)
2. Requiring park/green space per dwelling unit built (77%)
3. Assessing park impact fees on new development (86%)
4. Enforcing zoning ordinances (71%)
5. Protecting the environment in the bench area (89%)

However, 75% oppose raising taxes to increase the City Planning staff.

According to the chairman of the Draper Parks Committee, proposed uses within the Jordan River Parkway include (Riffkin 1993):

1. Low-impact recreation such as

"walking and riding"-- Baseball fields, tennis courts, picnic pavilions, etc. will be provided within the city.
2. Flood control - maintain connection with Willow and Corner Drainage/Parks.
3. Seamless transition within the Parkway between neighboring communities.
4. No night lighting
5. Maintain existing agricultural uses along the Jordan River including beef and dairy cattle, sheep, fruit orchards, and pleasure and draft horses.

At a Draper City council meeting on April 6, 1993, public input regarding uses along the Jordan River Parkway was gathered (Draper City Council Meeting 1993). Issues discussed include:

1. Increased public access
2. Trails were important--along the river and from upper bench into Draper
3. Equestrian trails
4. 2 dams--warm water fishery
5. Save the Wetlands

Riverton City

Riverton supports preservation and enhancement of the existing resource, with increased public access, but minimal development (Varley, 1993). Although no written objectives are available from Riverton, verbal communication with them has suggested a very close parallel to the objectives of Draper. As noted previously, they also support the objectives of the Bluffdale Parks Committee.

Summary

The cities of Bluffdale, Draper, and Riverton all want to preserve the Jordan River and associated wetlands for wildlife, flood control, and low impact recreation. Of the three cities, Bluffdale proposes the most development. Draper does not want to displace agricultural uses along the river at this time and Riverton favors preservation.

Now an analysis must be made to determine if site-specific goals discussed (such as trails on both sides of the river) conflict with these goals. If conflicting goals exist, then recommendations should be made on how to alter those goals, thus effectively responding to the user-needs that have been gathered in this report or mitigate for potential impacts.

References

Bliss, Rick. 1993. Personal communication regarding Bluffdale Parks Committee objectives

Bluffdale Comprehensive Plan--Draft. 1992.

City of Draper. 1992. Memorandum regarding survey results.

Draper City Council Meeting. 1993. Personal input from citizens on 6 April 1993.

Riffkin, Suellen. 1993. Personal memo dated 2 April 1993.

Trickler, Ellen. 1993. Jordan River Education Center (an outline of goals and objectives).

Varley, Jeff. 1993. Personal communication on 31 March 1993.

HISTORICAL VEGETATION

Introduction

The study of the historical vegetation of the Salt Lake Basin is important for determining the types of plant (and animal) communities that existed along the Jordan River Corridor prior to major development. Knowing about prior vegetation will allow designers insight for the reclamation or restoration of self sustaining communities of native plants.

Methods

Although no site specific information was available, historical plant community types along the Jordan River have been compiled by studying vegetation found and recorded in similar locations in the Salt Lake Basin (i.e. wetlands and marshes of the Great Salt Lake, riparian regions of the Weber River and Parley's creek). The plant lists found in this report were assembled by examining the journals of early expeditions into the area by Captain John C. Fremont, Howard Stansbury, and Father Escalante among others. These were the earliest records (pre 1840) of vegetation in the area and represent one source of information about pre-anglo vegetation along the Jordan River. As an additional source of information, the journals of the early Mormon pioneers were reviewed (1840-1860). The "Riparian Community Type Classification of Utah and Southern Idaho" was also consulted as a contemporary source of riparian vegetation.

Results

Pre 1850

Plants discovered as the Fremont expedition ventured from what is now Brigham City south to Utah Lake are as follows:

- Dietera
- Lynosiris gravetons
- Artemesia spp.
- Obione
- Purshia tridentata
- Salicornia
- Salix longifolia
- Betula spp.
- Malva rotundifolia
- Populus angustifolia
- Salicornia herbacia
- Salix spp.
- Eupatorium purpureum
- Alnus vicidis
- Glycyrriza lepidota
- Crataegus spp.
- Hackberry (celtis)
- Cerasus
- Sumach (Rhus)
- Equisetum hyemale
- Solidago
- Populus canadesi
- Helianthi
- Fremontia vermicularis
- Phaca spp.
- Valveriana edulis
- Leptotemia
- Prickly Pear
- Convollaria stellat
- Palhouse type bunch grass

(Tanner)

Post 1850

The favorable reaction of the Mormon pioneers to the Salt Lake Valley was modified through time as timber resources were used and lands were cleared for agriculture and grazing. Perceptions of the valley became less favorable as grasslands and forest were overtaken by desert shrub species (sage,

sedge etc.) and dwarf forest species such as rocky mountain juniper and scrub oak. Expeditions were requested to seek out new seed stock for the area, which began the establishment of introduced species and development of irrigation practices (Jackson).

Contemporary Riparian Vegetation

Species were studied and then classified into categories by the U.S. Forest Service and Department of Agriculture. The following categories were located in the southern Salt Lake and northern Utah counties.

Populus angustifolia / Betula Occidentalis Community type
Tree layer: Populus angustifolia, some Acer negundo
Low tree : Betula occidentalis, with Alnus incana, Acer grandidentatum
Shrub: Cornus sericea or Rosa spp.
Herbaceous: Poa pratensis, Osmorhiza chilensis or Equisetum arvense

Populus Angustifolia / Cornus Sericea c.t.
Tree layer: P. angustifolia, A. negundo
Low tree: C. sericea, Salix spp.
Shrub: P. pratensis, Silacina stellata, --- E. arvense, Argrostis stolonifera, Elymus glaucus, Taraxacum officinale

Acer Negundo / Cornus Sericea c.t.
Tree layer: A. negundo
Low tree: B. occidentalis, A. incana, A. grandidentatum, Fraxinus americanus
Shrub: C. sericea, Salix lutea, S. exigua --Rosa spp. Ribes inerme, Symphoricarpos oreophilus
Herbaceous: Smilacina stella, P. pratensis, Heracleaum lanatum, O. chilensis, Arctium lappa, T. officinale

Alnus Incana / Mesic forb c.t.
Tree layer: A. incana
forb layer: H. lanatum, Aconitum columbianum, Mertensia spp. Hydrophyllum fendleri, S. stellata, Geranium richardsonii, Actaea rubra, Urtica dioca

Betula Occidentalis / Cornus Sericea c.t.
Tree layer: B. occidentalis, A. incana
Low tree: C. sericea, Salix (lutea, exigua, lasiolepis), Rosa spp. Ribes lacustre
Shrub: Equisetum hyemale, E. laevigatum, E. arvense

Salix Boothii / Mesic forb c.t.
Overstory: S. boothii, S. drummondiana, S. geyeriana
Low tree: Lonicera involucrata, R. inerme
Undergrowth: H. lanatum, Mertensia, S. stellata, Hydrophyllum fendler, A. columbianum, Thalictrum fendler, Urtica dioicia, Redbeckia occidentalis

Salix Exigua /Barren c.t.
Tree layer: S. exigua, S. lasiandra or S. lutea
Low tree: C. sericea, R. inerme, Rosa spp.
No undergrowth

Cornus Sericea / Heracleum Lanatum c.t.
Tree layer: C. sericea , S. exigua, S. lutea --- R. aureum, R. hudsonianum, R. inerme, Rosa spp.
Low tree: H. lanatum, U. dioica, --- P. pratensis, Elymus glaucus,

Summary

It is clear that the plant communities along the Jordan River have changed over time. The riparian gallery forest, adjacent wetlands, wet meadows and grassland vegetation have been replaced by a more exotic desert shrub plant community. Numerous exotic species (Salt Cedar, Russian Olive) now

dominate most areas.

If a decision is made to reclaim or restore disturbed lands to previous ecosystems, there are several possibilities to consider.

1. Restore the aboriginal plant communities as described by Fremont and others.
2. Reclaim to the early settler plant communities
3. Reclaim to self sustaining plant communities utilizing both natural and exotic species.

Literature Cited

Annals of the Association of American Geographers, Vol: 68, Sept 1978 Number 3.

Fremont, John C., 1843 *Journal of Captain John C. Fremont.*

Jackson, Richard H., *Mormon Perception and Settlement.*

Padgett Wayne G., Winward Alma H., Youngblood Andrew P. *Riparian Community Classification of Utah and Southeastern Idaho,*

Tanner, Vasco M., *The Great Basin Naturalist.* Dept. of Zoology and Entomology, Brigham Young University, Provo Utah.

U.S. Dept. of Agriculture -- U.S. Forest Service, December 1989.

HISTORICAL RESOURCES

Introduction

The following categories were investigated in terms of historical and cultural perspectives to better understand the needs of the project and to discover what can be learned from past interactions with the Jordan River.

Public perceptions of the Jordan
Contextual treatment
Native American inhabitants
River pollution
Flood control
Fish, wildlife, and vegetation
Housing, farm, and industrial development
Recreation development

The Jordan River, although generally perceived in a negative way for much of its recent history, is much in need of recognition and better treatment. Significantly reduced from a time when the water was so contaminated it was unsafe to enter, pollutants continue to reflect ill affects of contaminants both past and present. This report attempts to place the stewardship responsibility now in the hands of planners into historical context, from the home range of Native Americans prior to first contact by Europeans, to the overwheming impacts of mid-twentieth century development.

Methods

The information for this report was gathered from interviews with archeologists and a review of newspaper articles concerning the Jordan River.

Public perceptions of the Jordan River

"Beauty or Beast" the title of a 1972 article introducing flood control plans to be effected on the river, sums up a rather broad array of differing opinions about the river. "...seeking relief from the sounds, smell and cement of the city, it is nearby. To the farmer who owns land along the stream it is a temptation to trespass. To the (city,county, and state) planners it is (a natural resource). To the municipalities it carries away sewage. To Salt Lake County flood control it is 623 cubic feet per second, and rising."

Settled in the middle 19th century by the Mormon pioneers, one of their first impressions of the Jordan River and the lakes from which it ran, (Utah Lake) and flowed into, (The Great Salt Lake) was its striking similarity to the Biblical River Jordan, hence the name. Despite the symbolic significance and high esteem early pioneers must have had for the river, consistent with the practices of most white settlers, any showing of respect appears to have been in the naming of it only. "All the filth in the city will be carried off to the River Jordan". (Journal entry from July 27, 1847) (D.N. 1964).

Since then, consideration for the natural aspects of the river, and value of it has been slow in becoming more complementary. As stated by columnist, Jerry Johnston of the Deseret News, (D.N.1986) "In the West, we have an image of what a river should be: sparkling, tumbling, clean, musical ... the Jordan hasn't been our style. You have to be from Hanibal, Mo. to understand the Jordan. Like the Mississippi ..." he then begins the telling of adventures that can only take place on a slow moving, winding, and silty river."

In an attempt to learn for himself what the Jordan River was all about, Jack Fenton embarked on a self sponsored, six hour cruise down the river. (S.L.T. '71) "There are sand bars and sunken logs and abandoned car hulks, but it doesn't stink, like many people say". Besides mention of "all the filth in the city" being carried to its banks, early descriptions of the river have also made mention of "transparency" and instead of Utah Lake's carp, "lake trout as big as your arm". (D.N. 1964)

Context

Given a broader view of the full extent of the Jordan, to include the southern tip of the Great Salt Lake and the northern border of Utah Lake and the Provo River, (Utah Lake's major tributary) it becomes possible to identify the incredible significance of a six mile portion that is the focus of this study, as shown on the map above. Both the Jordan river and Provo river have a concentration of recreation development at their lower ends near the population centers of Salt Lake City and Provo. Both rivers also have about a six mile segment beginning at their source that is relatively free of development. Because of their relative isolation, these upper stream segments have been able to maintain some level of ecological integrity. In the process of development around them, they have become yet another "feature" in and of themselves.

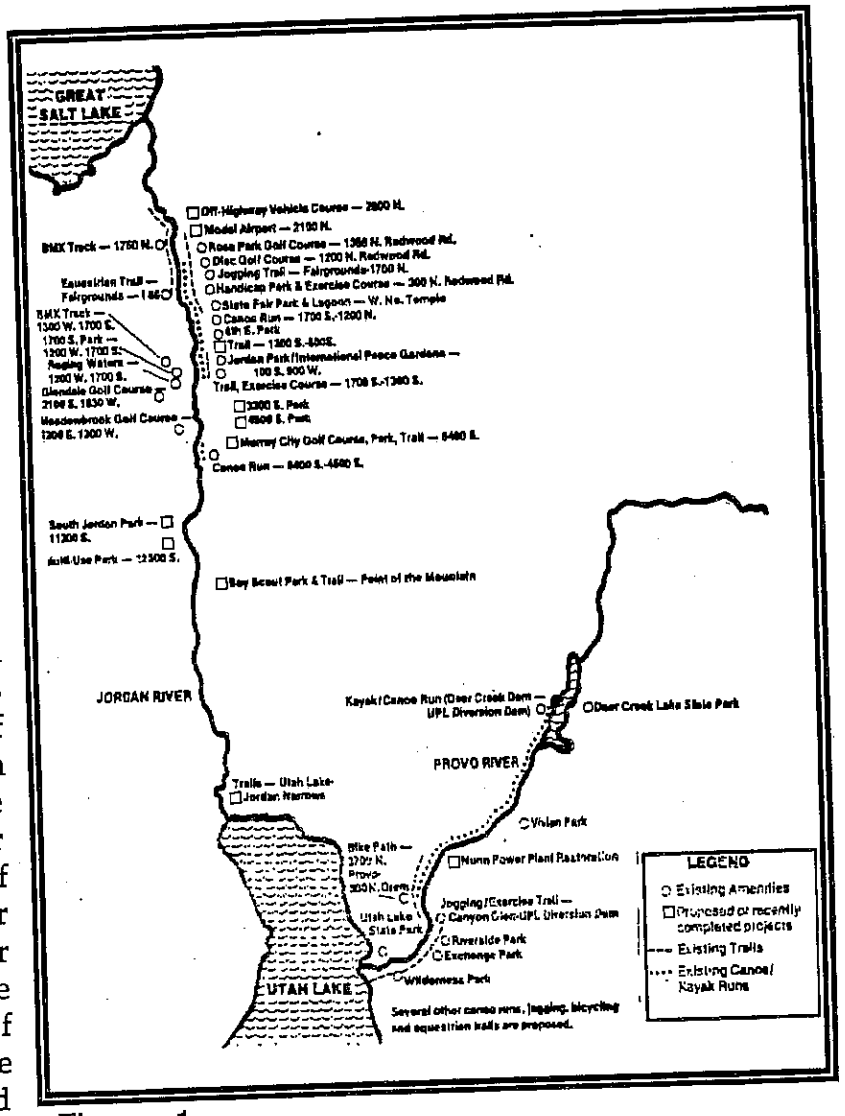


Figure 1

The Provo, "sparkling, tumbling, clean and musical" shares similar characteristics with other mountain fed, canyon streams in the Wasatch front. The Jordan however, is the only stream of its kind in Utah and in fact, has a comparable context with only one other place on Earth; the river plains between the fresh and saltwater "lakes" of Israel, the Dead Sea and the Sea of Galilee. This makes the six miles of preserved stream remaining a very unusual site, not only within Utah, but within this hemisphere as well.

Native American Inhabitants

The Ute tribes of the Utah valley are first documented in the explorer journals of the Spanish fathers,

Dominguez and Escalante who visited the valley in September, 1776. (Janetski 1991) Their range at the time of European contact was south of the Salt Lake valley, while the Western Shoshone occupied the northwestern territory as shown. (map; Janetski 1991) The valley of the Great Salt Lake could almost be described as a "no-mans-land" however, because both the Shoshone and Ute Indians laid claim to it at different times.

"None of these boundaries were static, rather they shifted with the events of history and climate ... 'We were now probably in the Country of the Utah Indians'", were the words of explorer John C. Fremont, traveling in the vicinity of present day Ogden, in 1843, suggesting a mixing of Ute and Shoshone Indians. He also records a mixing of the groups in the canyon above Ogden in 1846. (Janetski 1991)

The Timpanogots were the chief inhabitants about the Utah Lake, which they called "Timpanogas". They relied upon the lake for its abundant fish population, and had a method of drying fish for preserved use all throughout the year. (Janetski 1991) Without horses, these and other Ute groups were at times, afraid to hunt further north for fear of the horse mounted Shoshone, who were in turn, pressured by even better equipped Crow and Blackfoot tribes pushed from their normal ranges by European settlers. "These groups plagued the Shoshone in the Great Salt Lake area until the Shoshoni joined forces with the trappers against them in the 1820s ... The abundance of wild life in the GSL wetlands invoked this comment from the explorer John C. Fremont. 'The whole morass was animated with multitudes of waterfowl, which appeared to be very wild, rising for the space of a mile round about at the sound of a gun, with a noise like distant thunder. Several of the people waded out into the marshes, and we had tonight a delicious supper of ducks, geese and plover' ". (Simms 1991)

River pollution

Since the settlements of the middle 1800s, the water quality and life of the Jordan River has continued to deteriorate. Despite rescue attempts along the way and in the 1960s a century and a half later, water ratings did not reach an all time low until the middle/late 70s at which point real protection and restoration efforts began to make a change. In 1964, the pollution board first began work on the classification ratings of Utah streams. (D.N. '64) An "A" rating considers the water as fit for any use including drinking and regresses to B, C, and D as contaminates increase in concentration

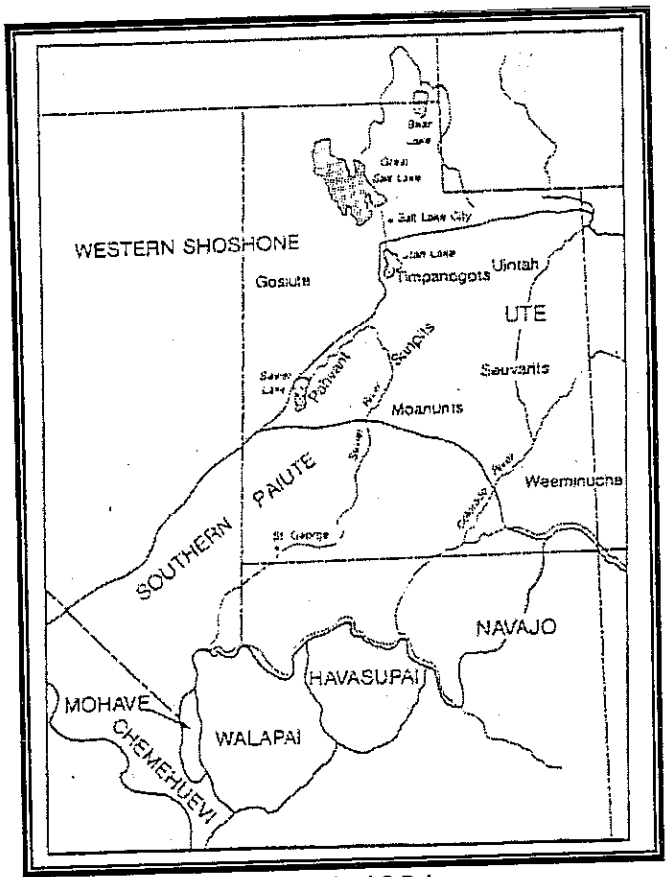


Figure 3 Janetski 1991

with "E" water being heavily contaminated and virtually useless.

"A far cry from the 'beautiful river' first seen by the pioneers when they arrived ... not only is it obnoxious in appearance and odor but it is also a health hazard." With this description, the river was proposed for a "C" rating. Still considered suitable for boating, fishing, and irrigation, a "C" stream cannot have a biochemical oxygen demand (BOD) count of more than five. Which means that for a liter of water taken from the river, it cannot have more than five milligrams of organic matter. "This type of pollution causes oxygen shortages and is deadly to fish life." (D.N. 64) Cleaning out critical areas, targeting dysfunctional irrigation dams, and identifying both point and non point specific sources for pollution, the Environmental Protection Agency outlined a study with the purpose of making the valley water swimmable by 1983. By 1976, according the Jordan Basin report, the Jordan River water had concentrations of D and E ratings as did portions of Utah Lake.

Flood control

Overflowing its banks periodically and flooding portions of Salt Lake City since 1862, the Jordan has undergone structural changes to control flooding. One of the main solutions has been to straighten out the bends, dredging and deepening the bottoms and stacking up fill along the banks. Side by side "before and after" photos appearing in the Salt Lake Tribune (Dec. 27, '53) congratulate the work, giving promise of similar proposals at other locations along the river to control flooding. Twenty years later, the same comparison photos are presented with accompanying articles and captions that refer to them as barren, ugly canals. "The federal EPA regional office in Denver is taking a more optimistic view of the stream which resembles the Palestinian Jordan. 'We have personally inspected Utah's Jordan and feel it has rich recreational potential in its metropolitan setting ... however additional funds are being sought for the Jordan ... under class C or multiple usage, not merely for a lifeless ditch to run off water."

Fish, Wildlife, and Vegetation

The slow moving, silt laden river now buries bottom plants that would feed fish, and suffocates valuable spawning habitat. Much of the silt is contributed by steep eroding banks that collapse into the river. " Sloping banks gently to the water and using some natural stone or logs along the banks would prevent most of this" says Albert Christianson, an architect working on Jordan River developments in 1971. "The banks on the river now range from water level to several feet high".

Weeping Willows, cottonwoods, Russian olive and wild grasses are types of vegetation most abundant today; many species are not native. On his "six hour cruise" down the Jordan, Jack Fenton reported "ducks and even a heron" taking off at the sound of an outboard motor, while "a muskrat seems to play tag with the boat." Beavers, which are "what you should be able to see as a citizen of Salt Lake City" weren't sighted. "There will be less and less of it (wildlife) as the county grows", says Christianson (S.L.T. '71) .

Housing, Farms, and Industrial Development

Housing, farm buildings and industrial development have so far kept a relative distance from the upper half of the Jordan River. However, agricultural

uses of the floodplain including grazing and cultivation for crops has gone on since the mid 1800's. But as population growth increases in the Salt Lake valley, the pressure for development increases. "Buy or let us develop" was the complaint of riverbank owners in Riverton, South Jordan, and Draper in April of 1979. This was because these cities had forbidden building permits or subdivision of land that would be flooded out by the proposed Lampton Reservoir. More than 70 land owners filed a claim to protest the restrictions put on their land. "Development Inevitable" was the resultant heading over mayor Lowell White's statements that there was no way to prevent development in the parkway. "The city does not have the funds to take options on private land or to battle lawsuits to protect public land". With funding unavailable to purchase land, for the reservoir for another ten to fifteen years, and support of the project diminished because of the success of the growing Jordan River Parkway to the north, the reservoir was never built (D.N.4-24-79; 6-19-79).

Recreation Development

One of the first ventures on the river was a boat called the Jordan River Queen. Now a restaurant, it reportedly traveled up and down the river carrying passengers and supplies between 1871 and 1874 (S.L.T. 5-1-79). Despite cost setbacks and the difficult task of cleaning up the river, one project that has continued to go forward in modern times is the Jordan River Parkway. Providing some "badly needed recreation along the ... Wasatch front," it also provided a relatively inexpensive way to keep developers and subdivisions out of the flood plains. "There was a time when the Provo-Jordan River Parkway seemed like a pipe dream ... two urban rivers impacted heavily by industry and scorned by many." (S.L.T. 8-8-85) Now a great variety of recreational activities are available along the river. Extending with an emphasis on ecological concerns from South Jordan to the Utah County line and south to Utah Lake would enrich the entire parkway.

Literature Cited

Salt Lake Deseret News: Jordan Parkway - Two Rivers In Search of a New Identity, Jan 22, 86; Ceremonies officially open Jordan River jogging course, Oct 5, '79; Buy or let us develop, riverbank owners say, Apr 24, '79; Jordan River tells pollution story, Oct 8, '76; News' co-sponsors paddle craft race, Apr 27, '73; Jordan Parkway Authority stunned by ballooning costs, Sept 26, 73; Land Deal Propels Parkway, Sep 15, '73; Plan Due For Jordan Horse Park, Jan 12, '72; Beauty of Beast? Jordan Plans Aired, Feb 9,'72; Termed "Health Hazard" Jordan River Cleanup Under Study, Feb 5, '64; S.L. Poses King-Size Answer to Jordan, Drainage Woes, Dec10, '64; Army Engineers Map Flood Control, Feb 8, '50.

Salt Lake Tribune; Parkway Is Reaching Maturity, Aug 8, '85; Parkway Growth clouds Hope For Jordan Dam, Jun 19, '79; 2-Year Analysis Marks Pollution, Solutions In Jordan River Basin, Oct 8, 76; Land Deal Propels Parkway, Sep 15, '73; 6-Hour Cruise Down the Jordan: Eye-Opening, Not Nose-Pinching, May 1 '71
S.L. Experts Winning Fight Against Floods, Dec 27, '53.

Janetski, Joel C. 1991. *Anthropological Papers; The Ute of Utah Lake* No.116: 4,18,19,22 .

Simms, Steven R., Carol J. Loveland and Mark E. Stuart. *Prehistoric Human Skeletal Remains and the Prehistory of the Great Salt Lake Wetlands. Utah State University, Dept of Sociology, Logan Ut. State Project No. 090UC090.*

LANDUSE AND ZONING

Introduction

The towns of Bluffdale, Draper and Riverton are, in general, more rural communities defined by large residential lots (generally one or more acres) and abundant agricultural land (five acre minimum lots). In all three communities accommodations to the increased demand for development are granted through variances to the existing zoning. All of the communities have been making periodic changes to their zoning maps and are in need of generating new maps. Draper is currently reworking its zoning and should have it finalized this year. Bluffdale will have new zoning in place by the end of June.

Methods

The zoning information for Bluffdale, Draper and Riverton was complied from their respective zoning maps. Phone calls were also made to city offices to clarify information.

Bluffdale

Bluffdale is, by far, the most rural of the three communities within the study area. More than 25% of the land within the city limits is zoned A-5 (minimum five acre agricultural lots). The majority of the residential land is zoned RR-43 (restricted residential, one acre minimum). There are several general commercial areas and large sand and gravel extraction areas, also within the city boundaries.

The Jordan River is encompassed by land that is zoned RR-43. Currently there are no ordinances protecting land adjacent to the river. Bluffdale hopes to include some sort of guidelines to minimize impact to the Jordan River in the new ordinances which will go into effect in June 1993.

Draper

Draper is undergoing a rapid transition from a rural to suburban community. In the last year more than 2000 new homes have been built in Draper. The impending zoning is aimed at controlling such runaway growth. Presently there is a proposed moratorium on subdivision construction until the zoning has been revised.

The area along the Jordan River is zoned A-5 (minimum five acre agricultural lots). Draper's master plan labels that area as sensitive, but no attempts have been made to protect it.

Riverton

The Riverton zoning map could be characterized as a patchwork of land uses. Within the city boundaries there is no land that is zoned agricultural, although farming is still allowed in many areas. The residentially zoned lots start at a minimum of 10,000 square feet (R-10), and go up to 1 acre minimum lots (RR-43)

The areas adjacent to the Jordan River have been rezoned A-1 (agricultural one acre minimum) for areas south of 12600 between the crest of hill and the meander corridor. The meander corridor is zoned A-5 (agricultural, five acre minimum). This was done to those areas below the "ridge" (the ridge is defined by the 4400 foot contour) to reduce the housing density. From 12600

North the area from the crest of hill to meandor corridor is zoned R-14. A Salt Lake County golf course that fronts on the Jordan River is currently under construction.

Summary

Due to the nature of the project, current and future zoning will play a crucial roll in any proposals for the area. How the land is utilized and developed will impact the river directly. Continuing development surrounding the river will increase pollutant runoff into the river such as fertilizer from lawns, and oil and salt from additional roads, increased water level fluctuations following storms, and reduced levels of ground water recharge. It will also decrease any buffer zone around existing designated wetlands and could impact migratory waterfowl and other wildlife species that inhabit the Jordan River corridor. If heavy grazing near the river were to persist many sensitive areas could be further damaged. Therefore, strong guidelines must be set in place to protect what is left of the Jordan River corridor.

Bluffdale, Draper and Riverton are currently undergoing changes in their zoning to try to accommodate for present and future growth. As urban development in the Salt Lake Valley expands south, these communities will need strong zoning to accommodate growth in a planned and orderly way as to protect the Jordan River. Currently these cities have no definite ordinances in place to protect the river corridor. Riverton has made an effort to minimize impacts to the river by rezoning the meander corridor A-5 and adjacent lands as A-1. Some land is zoned R-14 outside of the meander corridor. Draper's riverfront is zoned A-5. Bluffdale is planning to include some type of zoning to protect their portion of the river. Currently, none of the communities appear to be looking beyond agricultural zoning to protect the Jordan River corridor.

SOILS AND TOPOGRAPHY

Introduction

The inventory of the soils along the Jordan River Project is essential in determining what types of developments could be accommodated economically and in an environmentally sound way. Of particular importance are hydriodic (wetland) or potentially hydriodic soils, highly erodible soils, and soils with severe restrictions for development. It was also imperative to determine which areas were suitable for development.

Methods

The soils analysis was taken from the Soil Survey of Salt Lake Area, Utah, published by the United States Department of Agriculture Soil Conservation Service.

The soils in the study area were identified, mapped, researched, and then categorized into the following categories:

1. Developable - determined low and/or slight to moderate restrictions for footings, foundations, and roads.
2. Developable with some constraints - determined moderate and/or medium restrictions for footings, foundations and roads.
3. Developable with numerous constraints - determined moderate/ severe and/or medium/ high restrictions for footings, foundations and roads.
4. Undevelopable - includes those areas with severe restrictions, steep slopes, hydriodic and potential hydriodic soils, and the soils which were in direct proximity to the river.

Soils were placed into the four categories noted above. Approximately 20% were identified as developable, 10% developable with some constraints, 20% developable with numerous constraints, and 50% as undevelopable. The majority of the sites classified as undevelopable are adjacent to the Jordan River and include either wetlands or hydric soils.

Summary

In conclusion, it is important to protect all existing and potential hydriodic soils and to restrict development in areas in proximity to the Jordan River, particularly the areas within the meander corridor. These soils have limited potential for development and are important in the sites hydrology and may be important in future planning for the treatment of urban runoff. Other areas on the site with highly erodible soils, steep slopes and severe restrictions should also be protected. Land with high value for agricultural use should also be preserved for that purpose. A detailed description of soils in the study area is included in Appendix B.

LIterature Cited

Soil Survey of Salt Lake Area, Utah; United States Department of Agriculture Soil Conservation Service; 1974.

HYDROLOGY

Introduction

Over thousands of years, water has sculpted the Jordan River Corridor. The Jordan has historically meandered back and forth across a broad flood plain. Today it remains one of the most important aspects of the project site if not the most important. Nearly everything on the site is affected in one way or another by hydrology. The hydrology of the project site is made up of the Jordan River, several canals, wetlands, springs, perennial and intermittent streams.

Results

The Jordan River forms the spine of the site. Waterfowl depend on the marshy wetland areas for food, protection and as a breeding habitat. Wildlife depends on the surrounding vegetation for protection and feeding grounds. People depend on the water for both recreational and agricultural uses.

Because of diversion dams upstream, water levels in the river are kept relatively constant except during peak runoffs. Water levels during extremely wet years can cause extreme flooding. The most recent major flooding occurred in the spring of 1983. Vegetation was washed away and the stream channel shifted in many locations. "Since 1946 the area now occupied by the Riverton golf course has experienced bank erosion and channel movement of up to 460 feet. A bank erosion rate of 60 feet per year was experienced between 1986 and 1990 in this area.(CH2M Hill 1990). During dry years, low flows occur and water depths and stream widths are minimal.

The meander nature of the river has lead to attempts to control the river through channelization. This has lead to downcutting of the stream and a drop in the water table. Channelization has had serious adverse impacts on the adjacent riparian areas. Recent proposals suggest that the river be allowed to meander within its historic corridor which would promote a healthier riparian ecosystem. The engineering firm CH2M Hill was hired by Salt Lake County to delineate the historical meander corridor. "The meander corridor for the Jordan River identifies a zone within which the river channel may reasonably be expected to migrate during the next 100 years. The following conditions and assumptions were used in developing the corridor:

1. The corridor represents the valley width required for the channel to reestablish a stable, natural channel pattern in dynamic equilibrium given the sediment load, water discharge rate, and other independent variables.

2. The width of the corridor reflects the historic and predicted meander characteristics for each reach. The corridor width accounts for possible repetition of maximum historical single-event channel erosion distances.

3. The corridor has a minimum setback of 50 feet from the top of the existing channel bank to allow access, maintenance, and future parkway use. This minimum setback was applied even where engineered bank stabilization was assumed to be.

4. All existing structural channel stabilization was assumed to be permanent. It was also assumed no

additional measures would be implemented to stabilize the river. It was assumed that the river would be allowed to migrate freely within the corridor, to attain a state of dynamic equilibrium.

5. The corridor limits do not explicitly reflect riparian or other wetland objectives, although recovery of riparian environment is likely as channel stability increases.

6. Turner Dam, the Joint Diversion, the North Jordan Diversion, the 6400 South drop structure, and the Brighton Diversion Structures were assumed to be the only existing, permanent grade control structures.

7. The corridor generally was not narrowed significantly at bridge locations, although significant bank erosion immediately downstream of bridges is not likely" (Jordan Study).

Summary

Due to the instability and fragility of the Jordan River and surrounding wetlands, it is very important that development be minimal in these areas. The wetlands are an integral part of the ecosystem and vital to the wildlife along the Jordan River. Development could be devastating. Impacts have been felt along the river from spring runoff from natural drainages, springs, and runoff from urban areas entering the storm sewer inlets. Canals are also an important part of the wetlands in some isolated areas. Water is lost though infiltration into the soils in the canal bottoms and this may be a key element in charging some of the wetlands.

Water is a key element within the site, the many forms it takes as discussed earlier serve important functions along the river corridor. In preparing a masterplan hydrology must be considered in all aspects of the planning and design. Channelization efforts that have degraded the riparian and wetland environments must stop. The negative impacts that inputs from adjacent drainages including storm sewer discharge, agricultural and feedlot runoff have on water quality must be addressed. Settling basins, vegetative buffer zones, and biofilters should be investigated as possible mitigation measures. A plan to address hydrological issues could have positive impacts in the restoration of the riparian ecosystem and bringing life back to the river corridor.

Literature Cited

CH2M Hill. 1990. *Jordan River Stability Study.*

VEGETATION

Introduction

Vegetation provides many important functions. Some of these are: provide habitat for wildlife, provide feed for livestock, prevent erosion, alter microclimates, and aesthetics. Some plant species provide these functions better than others. Some are more sensitive to alterations than others. When making site design guidelines, it is important to know what vegetation is present and what changes might be desirable to enhance the site.

Methods

To determine what vegetation is present on the Jordan River project site, a map of existing vegetative communities was made. To create the map, trace paper was placed as an overlay on aerial photographs of the site. Nine vegetative communities were then drawn on the paper overlay. The nine communities used were barren land, aquatic, wetland, riparian, grassland, shrubland, woodland, managed open space, and agricultural land. Significant roads and buildings were also mapped as a tenth category . The aerial photos used were taken in 1989. The size of plant communities and the species within them are dynamic. Therefore the vegetation maps cannot be used as an exact mapping of what is currently on the site, but as an indicator of what was on the site and what might be there now. Some 1990 photos were available to update the maps where possible. General plant community distribution was verified in the field. However, to establish exact species, or exact locations of plants, more detailed field verification will be necessary.

The first community mapped , Barren, were disturbed areas that had little or no vegetation. The Aquatic community included the Jordan River and all of the canals in the area. The Wetlands that were mapped were only those that had visible standing water. Actual wetlands were determined by referring to soils maps and the wetland identification studies. The riparian community was not drawn on the map but was estimated to be the vegetation located 10 feet on each side of any of the waterways. The grasslands were those areas that appeared to be mostly grasses (over 50%), and the shrublands were those areas that seemed to be covered mostly by shrubs (over 50%). Any trees were mapped as being woodlands. Only the golf course which is currently being constructed was mapped as managed open space. Agricultural lands were those that currently show evidence of being farmed. Some buildings and roads were mapped to help establish location reference points, and to give more accurate estimates of the vegetative communities.

After the 9 communities were outlined on the overlay maps, estimates of the acreage for each community were made.

To obtain the estimate for the aquatic areas, the length of the combined waterways (266,500 feet) was multiplied by the estimated width of the waterways. The areas of riparian vegetation was estimated by multiplying the length of the waterways by an estimated 100 feet on each side of the waterways. The results of the acreage estimates are found in the result section below.

Results

1. Barren	275.5 ac
2. Aquatic	98.7 ac
3. Wetland (includes wetland soils)	1,067.4 ac
4. Riparian	91.8 ac
5. Grassland	2,417.4 ac
6. Shrubland	1,092.2 ac
7. Woodland	82.6 ac
8. Managed Open Space	229.6 ac
9. Agricultural	2,754.8 ac
10. Buildings	1,469.2 ac

Summary

There is relatively little woodland vegetation remains of the historical cottonwood forest. The patches of woodlands are small and most of them are exotic species that people have planted around their homes, orchards and as wind breaks around their fields. Many of the trees that were not planted by people are also non-native species such as Siberian elm (Ulmus pumila).

Many of the shrublands also seem to be undesirable non-native invasive species such as Russian olive (Eleagnus angustifolia) and tamarisk (Tamarix ramosissima).

Reestablishing native species in large patches should be a priority in this project. There is a real need to establish vegetation with multi-layers, especially upper canopy layers along the Jordan River.

WILDLIFE

Introduction

Populations of wildlife in urban environments add many benefits to human residents of the community. Resident and migratory wildlife have used the Jordan River Corridor for centuries, although the diversity of species in the corridor appears to be declining because of habitat loss. Habitat is defined as a place where an animal finds the resources necessary to support itself during its lifetime. Habitat needs involve the integration and availability of food, cover, space and water all of which help fulfill the demands on an animal such as; life maintenance, migration, and reproduction. This is why it is of great importance to know what settings and conditions best provide for individual wildlife species and wildlife populations. Before delineating habitats, it is necessary to know what wildlife species exist in the area; the purpose and focus of our research.

Methods

The research began with a site visit. This enabled us to become more familiar with the type of environmental conditions existing along the Jordan River. In addition a series of interviews with specialists at the Utah Division of Wildlife Resources, a literature review, and an updated G. I. S. wildlife species list were utilized (Appendix A, B, and C).

Findings

The G. I. S. species list includes all wildlife that previously or currently inhabit or utilize the Jordan River study site. A total of 191 species were listed. The majority of the species were birds, but mammals, reptiles and amphibians were also listed. No threatened or endangered species were on the list.

This list was further elaborated showing the relationship between species and plant community types; riparian, shrubland, agriculture, etc. By showing the relationship between wildlife species and vegetation it became possible to map important wildlife habitats based on plant community types (See Vegetation and Wildlife Map). The total percent of wildlife species use was calculated for each plant community type. The percentage was derived from the sum of percentages for all species based on A= Critical Values, B = High Values, and C= Substantial Values (Appendix D) of a species habitat needs in relationship to the availability of habitat that supports their life requests. The calculated percent total's help determine what plant community types were considered primary, secondary, or tertiary wildlife habitat value.

Primary habitat supports (or would support) a wide variety of wildlife species and would be diverse habitats of two or more layers of vegetation. Based on species use of plant communities, the primary habitats include aquatic, cottonwood/ willow riparian, shrubland and wetlands plant communities. Although most of the wetland acres were rated as somewhat lower in value, for reasons noted below they were rated as primary habitats because they are critical to migrating species, such as waterfowl. In the final habitat mapping only those plant communities that were relatively undisturbed, included a

diversity of plant species or were in immediate proximity to water were mapped as primary. Many wetland and riparian areas in the project area have been significantly altered by past and present land use practices and were thus not rated as primary. However, they clearly have potential to be of primary value if land use practices are modified and if landscape reclamation is undertaken.

Secondary habitats are less diverse than primary habitat but are also important because they often serve to link patches of primary habitat in a continuous corridor. Secondary habitats are often also important to the public for wildlife related recreation such as trails. Most of the plant community types noted above that were not rated as primary for the reasons noted were rated and mapped as secondary. Secondary habitats will be critical to the creation of an integrated wildlife plan for the Jordan River Corridor.

Tertiary habitats are the lowest rated habitat classification but they still supports some wildlife and may be important because of their location as segments of a corridor. Tertiary habitats are often on sites characterized by major disturbances - channelization for example. Rehabilitation of tertiary sites is often necessary before their potential can be realized.

Primary, secondary, and tertiary habitats were mapped directly on the vegetation map. The wildlife habitat map delineates what areas in the Jordan River corridor are most crucial and need protection or reclamation. The map visually represents areas of potential habitat development as well as areas to be safeguarded to ensure a heathy habitat for existing species and potential species.

Conclusion

Wildlife constitute one of the resources that make this 6 mile segment of the Jordan River special. An estimated 191 species previously or currently inhabit or utilize the site; including birds, mammals, reptiles, and amphibians. These species use the existing plant community types in varying proportion. Among the plant community types aquatic, cottonwood/willow, riparian and wetlands are of greatest value. However, remnant stands of oak shrubland, grassland, and shrub grassland are also important.

Many of the plant communities in the project site have been disturbed by a variety of natural and human induced causes. Consequently their value as habitat for wildlife has been reduced. To rate the habitat value of plant communities, percentage of wildlife use of each community type, structural integrity and level of disturbance were considered. Nine hundred acres of habitat were rated as primary, 800 acres were rated as secondary. The remainder of the study area was rated as tertiary. Many of the areas rated as secondary have excellent potential to be returned to primary status through either modification of present management practices or reclamation.

To benefit the greatest diversity of wildlife species possible, it will be important to retain all existing patches of habitat rated as primary to keep the entire corridor as continuous as possible by integrating key patches of habitat rated as secondary and to reintroduce structural diversity in plant communities that have been disturbed.

References

Halpin, M. A., *Jordan River Wetland Wildlife Evaluation,* 1987, 1-40.

Jensen, S. F., *Jordan River Wetlands Advance Identification Study,* 1987, 33 - 36.

Johnson, C. W., *A Wildlife Conservation Manual For Urbanizing Areas in Utah,* 1990, 6-1, 6-2, 9-5.

Johnson, C.W. Professor Utah State University. 1993. Personal interview.

Johnson, Wes. Intern UWIN/ G. I. S. program manager. 1993. Personal interview.

Liliquist, Nancy. Wildlife specialist, Utah Department of Wildlife Resources. 1993. Personal interview.

Locke, Patricia. Wetland specialist, Utah Department of Wildlife Resources. 1993. Personal interview.

FISHERIES

Introduction

The Jordan River lies in the heart of the most urbanized region in Utah. The project site begins at the Salt Lake/ Utah County line and continues approximately six miles north to 11800 south. The river flows north and empties into the Great Salt Lake. Due to the affects of pollution, erosion, inconsistent stream velocity and other impacts along the river, fisheries productivity varies among reaches. Water diversions, channelization, development, grazing and other human induced causes are primarily responsible for the fisheries decline.

The river enters the project site at the Utah County line. From the Utah County line north to 14600 south the quality is the highest. This segment has a greater diversity of fish species, a higher fishery classification, more structure and habitat for fish species, and has less impact from channelization, than the remaining lower portion of the river.

"Many areas of the river are 'habitat limited', meaning lack of habitat limits the number of fish produced, and that if habitat were improved, the number of fish produced could be increased" (Jordan River Fish and Riparian Habitat Restoration Task Group, 1993). Based on the current physical, biological, and hydrological condition of the project site segment, the development of fish habitat could increase existing fish populations.

Existing survey of fish species and individuals, conducted by Utah Division of Wildlife Resources, from the Salt Lake / Utah county line to 14600 south are as follows:

Common Name of Fish	# Retrieved
Carp	11
Brown Trout	Rare
Black Crappie	6
Black Bullhead	1
Fathead Minnow	10
Mountain Sucker	6
Rainbow Trout	15-20
Utah Sucker	92
Walleye	7
White Bass	20
Yellow Perch	1

(Jensen, S. 1987)

The project site segment of the Jordan River fishery has been rated as class 3. "Class 3 streams comprise about half of the total stream fisheries in Utah. These waters are important because they support the bulk of our stream fishing. Any water development project involving Class 3 waters should be planned to include fisheries as a primary use, and fishery losses should be prevented, or enhanced when possible. There are 3,864 miles of class 3 stream (out of 6,855 of measured stream) in Utah. Many Class 3 streams are on the quality stream list" (Holden, C. 1987).

If a game fishery were to be established in the Jordan River, the segment from the Salt Lake / Utah County line to 14600 south would provide the best opportunity for a "put and take" fishery to be successful. "The Jordan River is primarily a put and take fishery; it cannot support angling pressure through natural reproduction and must be stocked with catchable channel catfish and rainbow trout" (Jordan River Fish

and Riparian Habitat Restoration Task Group, 1993).

This segment from 14600 south to 9000 south, which extends north of the site, has been adversely impacted and is less productive fishery than that of the upper reaches of the site. Dredging, channelization, periodic low flows, and lack of habitat are the main reasons for the decline in fisheries quality. "Stream discharge, water velocities, and percent of channel covered by low flow were thought to be suitable to maintain a fishery. Channelization caused major adverse impacts to the fish habitat in this reach also. Substrate was described as fair and suitable for macroinvertebrate production; important fish food. Bank cover and stream shading were noted as poor. This reach was designated a Class 5 fishery, though it was thought to be of Class 3 quality had it not been impacted by channelization" (Wilson. M, 1987).

Class 5 streams, in their existing conditions, have a relatively low probability of being a productive and healthy fishery if left alone. Impacts to this segment of the river have greatly diminished the opportunity to introduce a game species fishery. "Class 5 streams in their present state are practically valueless as fisheries. Other water uses might take preference over fisheries use in planning water developments. However, many class 5 streams could provide valuable fisheries if additional water and physical habitat improvement were provided. Class 5 streams are generally not on the quality stream list" (Holden, C. 1987).

The fish species found in the section of the Jordan River from 9000 south to 14600 south by Utah Division of Wildlife Resources are as follows:

Common Name of Fish	# Retrieved
Carp	197
Bluegill Sunfish	8
Channel Catfish	3
Green Sunfish	7
Utah Sucker	204
White Bass	4

(Jensen, S. 1987)

Fish species and diversity are different in this section of the Jordan River from those found in the reaches to the south. Carp and the native Utah sucker are by far the most abundant and best adapted to this portion of the river. Game species are unable to compete with the nongame species due to the loss of habitat and cover caused by channelization and dredging. They are also unable to maintain population numbers due to impacts in this segment of stream. "All the fish sampling efforts on the Jordan River show that the nongame species are common in all of the fishery reaches and are the dominant group of species at all sampling sites, except at the Narrows. This is probably because members of this species group (e.g., carp) tend to be opportunistic feeders and can utilize a wider range on water quality and habitat conditions" (Wilson, M. 1987).

As this report has shown, the Jordan River has been adversely impacted, in some segments more dramatically then others. The upper portion from 14600 South to Salt Lake/ Utah County line has suffered less from impacts such as channelization and dredging, then the section north from 9000 South to 14600 South. It would appear that nongame fish species (carp and suckers) survive well in undisturbed areas as well as in channelized areas.

Game species populations seem to suffer worse when met with impacts such as loss of habitat, no cover, dredging, and low flow, conditions similar to the area of 14600 South to 9000 South.

Summary

The study of the fishery indicates that the segment of stream from 14600 south to the Salt Lake /Utah county line is more productive then the segment of the Jordan River from 9000 south to 14600 south. The lower segment has suffered from flood control methods such as dredging and channelization which have directly resulted in habitat loss.

Channelized sections are dominated by carp, and non-game native species. Species located in channelized sections of the stream are more tolerant of higher water temperatures, lower oxygen levels, turbidity, and lack of habitat than those species which are found in less disturbed areas (Bio/West, 1988). Those sections of the river which are less disturbed support game species desirable to anglers such as trout, walleye, perch, and bass.

Other factors that seem to be limiting all fish populations include:

- Fish habitat improvement opportunities are limited by the current flood management philosophy.
- Less desirable, non-native and non-game fishes currently dominate the fish community.
- Encroachment on river and floodplain by development.
- Summer flow is mostly return flow with potential water quality problems.
- Extreme low flow --no flow sometimes occurs in winter below Utah Lake to Bluffdale.

It is vital to the maintenance of the existing fishery that further channelization to the stream channel and disturbance of adjacent wetlands be terminated. "From a fishery resource standpoint, the maintenance of all existing wetlands along the Jordan River corridor is valuable to preserve what little habitat diversity the river now has" (Wilson, M. 1987). Enhancement of the fishery would require considerable habitat reclamation including such things as increased flows during the summer months, shade, increased stream structural diversity, control of bank erosion and improved water quality.

Literature Cited

Bio/West. 1988. Fish Tagged by Bio/West in the Jordan River and Associated canals.

Filbert, R. 1992. *Fisheries investigations of the lower Jordan River,Utah.* TR-291-1 Central Valley Water Reclamation Board.

Holden, C. 1987. *Electrofishing summary, Jordan River Utah State Department of Natural Resources.* Division of Wildlife Resources.

Division of Wildlife Resources. 1993. *Jordan River Fish and Riparian Habitat Restoration Task Group.*

Jensen S, 1987. *Jordan River wetland advance identification study. wetland functional assessment interpretive report.*

Liliquist, N. April, 1993. Interview, Species Diversity and Population Numbers.

Nabrotzky, F. 1987. *Macroinvertebrate analysis and water quality data for*

wetlands of the Jordan River in Salt Lake County. Salt Lake City - County Health Department.

Wilson, M. 1987. *Jordan River Fisheries Evaluation*.

VISUAL ASSESSMENT

Introduction

The Jordan River Corridor is clearly defined by enveloping topography in the Riverton, Bluffdale, and Draper area. Topographic definition is most pronounced in the narrows area. Riverton and Bluffdale are both elevated above the floodplain and views to the river are available from many locations within these communities. Most of the existing residential development in Draper is east of the interstate and does not have views to the river. However, future urban development may occur west of the interstate. Views of the river corridor would be available from these sites and these sites would be visible by those recreating in the corridor. The corridor can also be viewed from I-15, Redwood Road, and the major roads linking Riverton and Bluffdale to the interstate.

The Jordan River Corridor which is oriented in a basically north-south direction is really the dominant visual element. The river which meanders through the corridor can be seen occasionally from most elevated viewpoints but does not dominate. The fact that there are few buildings and bisecting roads in the corridor has helped the corridor retain its lineal quality. Within the corridor itself, there is however considerable evidence of human activities; canals, powerlines, fences, croplands, gravel extractions, roads and railroad. Several sections of land in the Narrows area have been drastically disturbed by gravel mining activities. The mining scars dominate the middle ground of many views, particularly from Bluffdale.

Views from within the corridor looking out feature dramatic mountain backgrounds. The view middle ground ranges from new urban development in the Riverton area to sagebrush and grasses on the Draper side. Over time the middle ground will be increasingly dominated by urban development.

Summary

It is clear from statements made in public hearings and questionnaire responses that residents from all three communities are very concerned about preserving the visual integrity of the Jordan River Corridor. Reclamation of disturbed areas, restoration of native plant communities, and plans to accommodate new users and activities must keep visual quality in mind.

OWNERSHIP

Introduction

By performing land ownership analysis, we can gain information as to what land is accessible to the public and what land is available for development, subject to local zoning.

Methods

Some of the land ownership information was supplied by Jeff Varley, Riverton City Planner (1), and from The U.S. Geological survey map (2). These sources are not fully up to date but are the most accurate that could be found.

The ownership map shows the location and boundaries of private and public owned land along the six miles of the Jordan River. Approximately 10% of the land along the corridor is open to public access. The rest belongs to private owners or is state owned land that is closed to the public.

Public lands include the county golf course, the county park and pool complex, and a Utah Power and Light corridor purchased by the State Parks Department.

Quasi public lands include Utah Power and Light corridors and railroad row owned by The Denver and Rio Grande Western Railroad. Although these lands are privately owned, there is some public access.

Land with restricted access includes The state prison and Camp Williams military reservation. The prison is willing to sell some land along the river for public use. A park area and a public access route in the vicinity of the narrows has been negotiated with Camp Williams.

Summary

Development of a publicly accessible system of land along the Jordan river may be difficult and expensive because of the amount of land that is in private ownership. Land that is located along the river and wetlands should be purchased from private owners and be part of a rehabilitation program. It may also be helpful to provide owners with incentives to sell or even to convert their land into part of an open space and education program.

References:

Varley, Jeff. 1993. Riverton City planner, Riverton, Utah. Personal Communication.

U.S. Geological Survey, Midvale Quadrangle Map, Revised 1975.

SUMMARY

The Jordan River has been a valued resource for centuries. Native Americans utilized it for hunting and fishing and as a movement corridor between Utah Lake and the Great Salt Lake. Trappers and traders plied the Jordan waters in search of beaver. Early Mormon settlers farmed pockets of rich floodplain soils, grazed cattle on wet meadows, and later diverted the Jordan's waters to irrigate upland areas.

Today, the Jordan River corridor and the adjacent uplands is a landscape in transition. We see a landscape that has been substantially disturbed over the past 100 years. Presettlement woody riparian vegetation has been removed or died out because of human induced environmental changes. This and other disturbances has resulted in a decline in biological diversity, animal and fish food chains have been altered and erosion and sedimentation has increased. Upstream water diversions have lowered summer water flows. Typically summer water temperatures are high with low oxygen levels causing adverse impacts on fish populations. Channelization has caused the downcutting of the river bed and the drying out of adjacent wetlands. Many of the functional values traditionally associated with these wetlands such as floodwater, detention, groundwater recharge, and habitat for wildlife have been either compromised or eliminated. The visual quality of the corridor has been degraded by gravel extractions, channelization and poorly planned developments. The trend line for the quality of both the physical and biological resources in the Jordan River corridor is downward.

Yet the project site remains an unfragmented patch of landscape utilized by a diverse array of wildlife species. The fishery still has potential. Substantial areas of high quality agricultural land remain. Some wetland functions could be reestablished and aspects of the riparian ecosystem reclaimed.

The increasing demands of urban development are putting new pressures on an already overtaxed landscape. Citizens in the communities of Riverton, Draper and Bluffdale have expressed their concern about the future of the Jordan River corridor. The vast majority of residents would like to see the corridor remain natural with improved access for hikers, cyclists and horseback riders and interpretive educational opportunities for all. Federal, State and County agencies continue to urge conservation of soil, water, wetland, wildlife, and recreation resources within the corridor.

Expressions of public and agency concern can be turned into action that initiates wise long term planning, economically and politically sound implementation programs, and the phased implementation of landscape restoration and reclamation procedures. The negative quality trend line that reflects the Jordan's recent past can be reversed. The Jordan River Corridor can once again return to its status as a valued resource in a new more urban context.

APPENDICES

APPENDIX A - Organizations Interested in Jordan River Development

Source: Bluffdale City, 1992

City of Bluffdale
City of Draper
City of Riverton
Utah Trails
Salt Lake Regional Trails Council
Utah State Parks Dept.
Jordan River State Park
Salt Lake County Water Conservancy District
USDA--Soil Conservation Service
Boy Scouts of America
US Army--Camp Williams
Utah State Parks and Recreation
Daughters of the Utah Pioneers
Sons of the Utah Pioneers
Utah State Historical Society
Utah State Board of Education
Jordan School District
Utah State Fish and Game
U.S. Wildlife Resources
Utah County
Salt Lake County
Salt Lake County Parks and Recreation
Central Utah Water Project
Utah Science Teachers Association
Utah Geology Alliance
Utah Nature Studies
The Audubon Society
Utah Environmental Educators Society
Pony Express Riders

APPENDIX B - SOILS OF THE JORDAN RIVER CORRIDOR

Source: U.S. Soil Conservation Service Soils Survey, Salt Lake County, 1974

Soil series: Bingham - BhA,BhB,BkC

USDA texture: Gravelly loam and cobbly clay loam

Shrink swell potential: Low

Soil features affecting:
- Foundations for low building: Features generally favorable
- Embankment: Gravelly; high stability; low compressibility; high permeability

Degree of limitations and dominant limitations for:
- septic tanks: slight to moderate: 0 to 10 % slopes
- paths and trails: slight

Soil series: Bluffdale - BnA,BnB

USDA texture: Silty clay loam

Shrink swell potential: Moderate

Soil features affecting:
- Foundations for low building: Medium compressibility; slow permeability; high shrink swell potential below 16 inches.
- Embankment: Cracks when dry; medium to low shear strength.

Degree of limitations and dominant limitations for:
- septic tanks: Severe: slow permeability
- paths and trails: Slight

Soil series: Bramwell - BsA,BsB

USDA texture: Silty clay loam
Potential hydriodic soil

Shrink swell potential: Moderate

Soil features affecting:
- Foundations for low building: Medium compressibility; slow permeability; water table at a depth of 20 to 40 inches; moderate to high shrink swell potential.
- Embankment: Cracks when dry; medium to low shear strength; medium compressibility.

Degree of limitations and dominant limitations for:
- septic tanks: Severe: slow permeability.
- paths and trails: moderate; silty clay loam surface layer; water table at 20 to 40 inches.

Soil series: Butterfield - BuE,BFF

USDA texture: Very cobbly clay loam.

Shrink swell potential: Moderate

Soil features affecting:
- Foundations for low building: Slow permeability
- Embankment: Medium Stability; high to medium shear strength; fair to good compressibility.

Degree of limitations and dominant limitations for:
- septic tanks: Severe -slow permeability; steep slopes
- paths and trails: Moderate to severe- 0 to 50 % slopes; gravelly; cobbly; stony surface.

Soil series: Chipman - Ch,Ck

USDA texture: Light silty clay loam.
CK- Potential hydriodic soil

Shrink swell potential: Moderate

Soil features affecting:
• Foundations for low building: Medium compressibility; water table at depth of 20 to 40 inches; moderately slow permeability.
• Embankment: Cracks when dry; low stability; medium to low shear strength; medium to high piping hazard.

Degree of limitations and
dominant limitations for:
• septic tanks: Severe - water table at a depth of 20 to 40 inches; moderately slow permeability.
• paths and trails: Moderate - silty clay loam surface layer; high water table.

Soil series: Chipman - Cl gravelly substratum

USDA texture: silty clay loam - Potential hydriodic soil

Shrink swell potential: Moderate

Soil features affecting:
• Foundations for low building: Water table at a depth of 20 to 40 inches.
• Embankment: Cracks when dry; low stability; medium to low shear strength.

Degree of limitations and
dominant limitations for:
• septic tanks: Severe - high water table
• paths and trails: Moderate -

Soil series: Clayey terrace escarpment - CA

USDA texture: Properties too variable to be estimated.

Shrink swell potential:

Soil features affecting:
• Foundations for low building:
• Embankment:

Degree of limitations and
dominant limitations for:
• septic tanks:
• paths and trails:

Soil series: Decker - De

USDA texture: Loam

Shrink swell potential: Low

Soil features affecting:
• Foundations for low building: Moderate - water table at a depth of 30 to 50 inches.
• Embankment: Medium permeability.

Degree of limitations and
dominant limitations for:
• septic tanks: Moderate - water table 30 to 50 inches.
• paths and trails: Moderate - somewhat poorly drained.

Soil series: Harrisville - HbA

USDA texture: Silt loam and silty clay loam

Shrink swell potential: Low to moderate

Soil features affecting:
• Foundations for low building: Medium compressibility; water table at a depth of 40 to 60 inches; slow permeability.
• Embankment: Medium to low shear strength.

Degree of limitations and
dominant limitations for:
• septic tanks: Severe - slow permeability.
• paths and trails: Moderate - silty clay loam surface layer.

Soil series: Henefer - HKF

USDA texture: Loam to cobbly clay

Shrink swell potential: Moderate to high

Soil features affecting:
• Foundations for low building: Medium compressibility ; slow permeability.
• Embankment: Medium to low shear strength.

Degree of limitations and dominant limitations for:
• septic tanks: Severe - slow permeability; steep slopes.
• paths and trails: Moderate to severe 10 to 40 % slopes.

Soil series: Hillfield - HlA,HlB,HlC

USDA texture: Stratified loam to sandy loam.

Shrink swell potential: Low

Soil features affecting:
• Foundations for low building: Medium compressibility
• Embankment: Medium to low shear strength

Degree of limitations and dominant limitations for:
• septic tanks: Moderate to severe- 0 to 30 % slopes.
• paths and trails: Slight to severe 0 to 30 % slopes.

Soil series: Hillfield - Taylorsville series - HtF2

USDA texture: Silty clay loam

Shrink swell potential: Moderate

Soil features affecting:
• Foundations for low building: Medium compressibility; slow permeability
• Embankment: Cracks when dry; medium to low shear strength.

Degree of limitations and dominant limitations for:
• septic tanks: Severe - slow permeability
• paths and trails: Moderate - silty clay loam surface layer.

Soil series: Horrocks - HWF

USDA texture: Very cobbly clay loam

Shrink swell potential: Moderate

Soil features affecting:
• Foundations for low building: Moderately slow permeability; 5 to 50 % slopes
• Embankment: Medium to low shear strength; high permeability below a depth of 30 inches.

Degree of limitations and dominant limitations for:
• septic tanks: Severe Moderately slow permeability 5 to 50 % slopes.
• paths and trails: Moderate to severe - 5 to 50 % slopes;stony and rocky.

Soil series: Iornton - Ir

USDA texture: Very fine sandy loam

Shrink swell potential: Low

Soil features affecting:
• Foundations for low building: Water table at a depth of 20 to 40 inches.
• Embankment: High piping hazard; medium to low shear strength.

Degree of limitations and dominant limitations for:

• septic tanks: Moderate - high water table
• paths and trails: Moderate - high water table.

Soil series: Kearns - KaB, KaC

USDA texture: Heavy silt loam or silty clay loam

Shrink swell potential: Low

Soil features affecting:
• Foundations for low building: Medium compressibility
• Embankment: Medium shear strength; medium to high piping hazard.

Degree of limitations and dominant limitations for:
• septic tanks: Slight
• paths and trails: Slight

Soil series: Kidman - KdA, kdB

USDA texture: Very fine sandy loam

Shrink swell potential: Low

Soil features affecting:
• Foundations for low building: Medium compressibility.
• Embankment: Medium shear strength; medium to high piping hazard.

Degree of limitations and dominant limitations for:
• septic tanks: Slight: 0 to 6 percent slopes.
• paths and trails: Slight

Soil series: Knutsen - KnA, KoB, KoC

USDA texture: 0-33": Gravelly coarse sandy loam; 33-60": Very gravelly sand.

Shrink swell potential: Low

Soil features affecting:
• Foundations for low building: Features generally favorable.
• Embankment: Medium shear strength; medium to high piping hazard; high permeabiity below a depth of 30 inches.

Degree of limitations and dominant limitations for:
• septic tanks: Slight to severe: 0 to 70 percent slopes.
• paths and trails: Slight to severe: 0 to 70 percent slopes.

Soil series: Lakewin - LaA, LaC, LbC

USDA texture: 0-25": gravelly heavy sandy loam; 25-64": Vary gravelly loamy coarse sand.

Shrink swell potential: Low

Soil features affecting:
• Foundations for low building: Features generally favorable.
• Embankment: High shear strength; medium to high permeability.

Degree of limitations and dominant limitations for:
• septic tanks: Slight
• paths and trails: Slight

Soil series: Lasil - LcA, LdB

USDA texture: 0-48": Silt loam or silty clay loam; 48-78": Fine sand.
Shrink swell potential: 0-48": Low or moderate; 48-78": Low.

Soil features affecting:
• Foundations for low building: Medium compressibility; water table at a depth of 30 to 50 inches; slow permeability.
• Embankment: Cracks when dry; medium to low shear strength;

moderately high piping hazard.

Degree of limitations and
dominant limitations for:
• septic tanks: Severe: slow permeability.
• paths and trails: Moderate: somewhat poorly drained; water table at depth of 30 to 50 inches.

Soil series: Magna - Mc, Mg

USDA texture: Silty clay or silty clay loam - Hydriodic soil

Shrink swell potential: High

Soil features affecting:
• Foundations for low building: Medium compressibility; water table at depth 0 to 20 inches; high shrink swell potential; very slow permeability.
• Embankment: Cracks when dry; medium to low shear strength.

Degree of limitations and
dominant limitations for:
• septic tanks: Severe - very low permeability; high water table.
• paths and trails: Severe - high water table

Soil series: Mixed alluvial land - Mu

Properties too variable to be estimated.
USDA texture:

Shrink swell potential:

Soil features affecting:
• Foundations for low building:
• Embankment: Degree of limitations and dominant limitations for:
• septic tanks:
• paths and trails:

Soil series: Parleys - PeA, PeB

USDA texture: Heavy silt loam or silty clay loam.

Shrink swell potential: Low

Soil features affecting:
• Foundations for low building: Medium compressibility.
• Embankment: Cracks when dry; medium to low shear strength; moderate to low piping hazard.

Degree of limitations and
dominant limitations for:
• septic tanks: Moderate: moderate permeability.
• paths and trails: Slight.

Soil series: Preston - PrD

USDA texture: Sand or loamy fine sand.

Shrink swell potential: Low.

Soil features affecting:
• Foundations for low building: Features generally favorable.
• Embankment: Medium to high shear strength; high permeability.

Degree of limitations and
dominant limitations for:
• septic tanks: Slight to severe: 1 to 30 percent slopes.
• paths and trails: Severe: 1 to 30 percent slopes; sand surface layer.

Soil series: Stony terrace escarpments - SP

Properties too variable to be estimated.

USDA texture:

Shrink swell potential:

Soil features affecting:
• Foundations for low building:
• Embankment:

Degree of limitations and
dominant limitations for:
• septic tanks:
• paths and trails:

Soil series: Stony alluvial land - St

Properties too variable to be estimated.

USDA texture:

Shrink swell potential:

Soil features affecting:
• Foundations for low building:
• Embankment:

Degree of limitations and
dominant limitations for:
• septic tanks:
• paths and trails:

Soil series: Taylorsville - TaA, TaB, TaC,TbB

USDA texture: Silty clay loam.

Shrink swell potential: Moderate

Soil features affecting:
• Foundations for low building: Medium compressibility; slow permeability.
• Embankment: Cracks when dry; medium to low shear strength.

Degree of limitations and
dominant limitations for:
• septic tanks: Severe: slow permeability.
• paths and trails: Moderate: silty clay loam surface layer.

Soil series: Wasatch - WgD, WgE

USDA texture: Loamy coarse sand.

Shrink swell potential: Low.

Soil features affecting:
• Foundations for low building: Features generally favorable.
• Embankment: Medium to high shear strength; medium to high piping hazard.

Degree of limitations and
dominant limitations for:
• septic tanks: Slight to severe: 1 to 25 percent slopes.
• paths and trails: Moderate to severe: sand or loamy sand surface layer.

Soil series: Welby - WmA, WmB

USDA texture: Silt loam

Shrink swell potential: Low

Soil features affecting:
• Foundations for low building: Medium compressibility.
• Embankment: Medium to low shear strength; high piping hazard.

Degree of limitations and
dominant limitations for:
• septic tanks: Moderate: moderate permeability.
• paths and trails: Slight.

APPENDIX C: VEGETATION

Source: Environmental Assessment Report, Riverton Golf Course
Ecotone, Environmental Consultants, Logan, Utah 1993

Table 1. Withers Property Vegetation - Riverton, Utah

Scientific Name	Common Name
Shrubs	
Chrysothamnus nauseosus	Rubber rabbitbrush
Eleagnus angustifolia	Russian olive
Rosa woodsii	Woods wildrose
Salix exigua	Sandbar willow
Tamarix ramosissima	Tamarisk
Ulmus pumila	Siberian elm
Forbs	
Argemone sp.	Prickly poppy
Artemisia biennis	Biennial wormwood
Artemisia ludoviciana	Cudweed sagewort
Asclepias incarnata	Swamp milkweed
Asclepias speciosa	Showy milkweed
Aster sp.	Aster
Astragalus utahensis	Utah milkvetch
Bassia hyssopifolia	Five-hook bassia
Capsella bursa-pastoris	Common shepherd's purse
Cardaria draba	Whitetop
Carduus nutans	Musk thistle
Chenopodium album	Lambsquarters
Chenopodium berlandieri	Netseed lambsquarters
Chichorium intybus	Chicory
Cirsium arvense	Canada thistle
Cirsium scariosum	Meadow thistle
Cirsium vulgare	Bull thistle
Conium maculatum	Poison hemlock
Convolvulus arvensis	Field bindweed
Conyza canadensis	Canadian horseweed
Cynoglossum officinale	Houndstongue
Descurainia sophia	Flixweed
Dipsacus sylvestris	Teasel
Scientific Name	Common Name
Epilobium ciliatum	Hairy willowherb
Erodium cicutarium	Alfileria
Equisetum arvense	Field horsetail
Equisetum hyemale	Western scouring rush
Grindelia squarrosa	Curlycup gumweed

Forbs continued:

Helianthus annuus	Common sunflower
Kochia scoparia	Mexican summer cypress
Lactuca ludoviciana	Western lettuce
Lactuca serriola	Prickly lettuce
Lepidium perfoliatum	Clasping pepperweed
Medicago lupulina	Low hop clover
Melilotus alba	White sweetclover
Melilotus officinalis	Yellow sweetclover
Plantago major	Broadleaf plantain
Polygonum aviculare	Prostate knotweed
Potentilla anserina	Common silverweed
Ranunculus cymbalaria	Rocky Mountain buttercup
Ranunculus sceratus	Blister buttercup
Ranunculus testiculatus	Bur buttercup
Rorippa nasturnum-aquatica	True watercress
Rumex crispus	Curly dock
Rumex obtusifolius	Bitter dock
Salsola iberica	Russian thistle
Senecio hydrophilus	Water groundsel
Sisymbrium altissimum	Tall tumblemustard
Solidago sp.	Goldenrod
Taraxacum officinale	Common dandelion
Tragopogon dubius	Yellow salsify
Trifolium pratense	Red clover
Typha latifolia	Broadleaf cattail
Urtica dioica	Stinging nettle
Verbascum thapsus	Flannel mullein
Veronica biloba	Speedwell
Xanthium strummarium	Rough cocklebur

Scientific Name	Common Name
Graminoids	
Agropyron elongatum	Tall wheatgrass
Agropyron repens	Quackgrass
Agropyron trachycaulum	Slender wheatgrass
Agrostis stolonifera	Redtop
Alopecurus pratensis	Meadow foxtail
Beckmannia syzigachne	American sloughgrass
Bromus tectorum	Cheatgrass
Carex aquatilis	Water sedge
Carex nebrascensis	Nebraska sedge
Carex praegracilis	Clustered field sedge
Carex rostrata	Beaked sedge
Distichlis spicata	Saltgrass

Eleocharis palustris	Creeping spikerush
Festuca pratensis	Meadow fescue
Glyceria grandis	American mannagrass
Hordeum jubatum	Foxtail barley
Hordeum murinum	Wall barley
Juncus balticus	Baltic rush
Juncus torreyi	Torrey rush
Muhlenbergia asperifolia	Alkali muhly
Phalaris arundinacea	Reed canarygrass
Phragmites australis	Common reed
Polypogon monspeliensis	Annual rabbits-foot grass
Scirpus acutus	Hardstem bulrush
Scirpus pungens	Three-square bulrush

Table 2. Riverton Golf Course Vegetation

Scientific Name	Common Name
Shrubs	
Artemisia tridentada	Big sagebrush
Atriplex gardneri	Gardner saltbush
Chrysothamnus nauseosus	Rubber rabbitbrush
Eleagnus angustifolia	Russian olive
Populus X acuminata	Lance-leafed cottonwood
Populus angustifolia	Narrowleaf cottonwood
Populus fremontii	Fremont cottonwood
Ribes aureum	Golden currant
Rosa woodsii	Woods wildrose
Salix exigua	Sandbar willow
Sarcobatus vermiculatus	Greasewood
Tamarix ramosissima	Tamarisk
Ulmus pumila	Siberian elm
Forbs	
Argemone sp.	Prickly poppy
Artemisia biennis	Biennial wormwood
Artemisia ludoviciana	Cudweed sagewort
Asclepias incarnata	Swamp milkweed
Asclepias speciosa	Showy milkweed
Aster sp.	Aster
Astragalus utahensis	Utah milkvetch
Capsella bursa-pastoris	Common shepherd's purse
Cardaria draba	Whitetop
Carduus nutans	Musk thistle
Castilleja sp.	Indian paintbrush
Chenopodium album	Lambsquarters

Forbs continued:

Chenopodium berlandieri	Netseed lambsquarters
Chichorium intybus	Chicory
Chorisopora tenella	Purplebloom
Cirsium arvense	Canada thistle
Cirsium scariosum	Meadow thistle
Cirsium vulgare	Bull thistle
Scientific Name	Common Name
Cleome serrulata	Bee spider-flower
Conium maculatum	Poison hemlock
Convolvulus arvensis	Field bindweed
Conyza canadensis	Canadian horseweed
Cynoglossum officinale	Houndstongue
Descurainia sophia	Flixweed
Dipsacus sylvestris	Teasel
Epilobium ciliatum	Hairy willowherb
Erodium cicutarium	Alfileria
Equisetum arvense	Field horsetail
Equisetum hyemale	Western scouring rush
Grindelia squarrosa	Curlycup gumweed
Glycyrrhiza lepidota	American licorice
Helianthus annuus	Common sunflower
Iva axillaris	Small-flower sumpweed
Kochia scoparia	Mexican summer cypress
Lactuca ludoviciana	Western lettuce
Lactuca serriola	Prickly lettuce
Lepidium perfoliatum	Clasping pepperweed
Marrubium vulgare	Common horehound
Medicago lupulina	Low-hop clover
Melilotus alba	White sweetclover
Melilotus officinalis	Yellow sweetclover
Plantago major	Broadleaf plantain
Polygonum aviculare	Prostate knotweed
Potentilla anserina	Common silverweed
Ranunculus cymbalaria	Rocky Mountain buttercup
Ranunculus sceratus	Blister buttercup
Ranunculus testiculatus	Bur buttercup
Rorippa nasturnum-aquatica	True watercress
Rumex crispus	Curly dock
Rumex obtusifolius	Bitter dock
Salsola iberica	Russian thistle
Senecio hydrophilus	Water groundsel
Sisymbrium altissimum	Tall tumblemustard
Taraxacum officinale	Common dandelion
Tragopogon dubius	Yellow salsify
Trifolium pratense	Red clover
Typha latifolia	Broadleaf cattail
Urtica dioica	Stinging nettle

Forbs continued:

Verbascum thapsus	Flannel mullein
Veronica biloba	Speedwell
Xanthium strummarium	Rough cocklebur

Graminoids

Aegilops	
Agropyron elongatum	Tall wheatgrass
Agropyron repens	Quackgrass
Agropyron trachycaulum	Slender wheatgrass
Agrostis stolonifera	Redtop
Alopecurus pratensis	Meadow foxtail
Bromus tectorum	Cheatgrass
Carex aquatilis	Water sedge
Carex nebrascensis	Nebraska sedge
Carex praegracilis	Clustered field sedge
Carex rostrata	Beaked sedge
Distichlis spicata	Saltgrass
Eleocharis palustris	Creeping spikerush
Festuca pratensis	Meadow fescue
Glyceria grandis	American mannagrass
Hordeum jubatum	Foxtail barley
Hordeum murinum	Wall barley
Juncus balticus	Baltic rush
Juncus torreyi	Torrey rush
Muhlenbergia asperifolia	Alkali muhly
Phalaris arundinacea	Reed canarygrass
Phragmites australis	Common reed
Polypogon monspeliensis	Annual rabbits-foot grass
Scirpus acutus	Hardstem bulrush
Scirpus pungens	Three-square bulrush
Sclerochloa dura	Hardgrass

APPENDIX D: VEGETATION SUMMARY OF FINDINGS

Source: Aerial photographic interpretation and on site verification

The aerial photos of the project site were mapped on a trace overlay according to the vegetation present. The following table shows the estimated acreage of each of the 10 categories mapped.

1. Barren . .	275.5 ac
2. Aquatic . .	98.7 ac
3. Wetland . .	59.7 ac
4. Riparian . .	91.8 ac
(not mapped on overlay)	
5. Grassland .	2,984.4 ac
6. Shrubland.	1,492.2 ac
7. Woodland .	82.6 ac
8. Managed Open Space	229.6 ac
9. Agricultural .	2,754.8 ac
10. Buildings .	1,469.2 ac
Total Area Mapped	9,412.0 ac

(estimated acreage is 34.7 acres or 0.4% over the actual acreage)

NOTE: the aquatic category includes the Jordan River and all of the canals in the area. These waterways totaled 266,599 feet in length. To obtain an acreage estimate, the length was multiplied by segment widths ranging from 20 to 30 feet. The wetland category only represents the wetlands that could be seen on the aerial photos. The actual wetland area should be much higher. The unmapped riparian category was also estimated using the waterway length. The length of the waterway was multiplied by an estimated 10 feet on both sides of each waterway. The specific species that appear in the grassland, shrubland, and woodland categories were indistinguishable from the aerial photos. The only area that was mapped as managed open space was the area that will become the new golf course. An attempt was not made to map all of the buildings and roads for the building category, only those that seemed like they would significantly influence the other categories, and those that aid in locating specific areas on the maps.

APPENDIX E: SPECIES LIST

Source: Utah Division of Wildlife Resouces G.I.S. Species List, 1990.

Aquatic:

Heron, Blue, Great
Swan, Tundra
Stork, Wood
Frog, Leopard, Northern
Frog, Spotted
Frog, Green
Frog, Chorus, Boreal
Heron, Blue, Little
Pelican, Cattle
Redhead
Coot, American
Yellowlegs, Greaper
Blackbirk, Rusty
Gull. Sabine
Shoveler, Northern
Teal, Blue - Winged
Duck, Wood
Gull, Glaucous
Egret, Great
Gull, Glaucous -Winged
Phalarope, Red - Necked
Ibis, White - Faced
Night-Heron,Crowned, Black
Merganser, Common
Grebe, Pied - Billed
Godwit, Marbled
Stilt, Black - Necked
Mallard
Blackbird, Yellow -Headed
Gull, Mew
Blackbird, Red - Winged
Tern, Black
Tern, Forster's
Goose, Canada
Loon, Common
Yellowlegs, Lesser
Kingfisher, Belted
Teal, Cinnamon
Pintail, Northern
Goldeneye, Barrow's
Goldeneye, Common
Egret, Snowy
Flycatcher, Olive -Sided
Gull, Herring
Phalarope, Wilsons
Heron, Green - Backed
Sandpiper, Baird's
Bittern, American
Cormorant, Double - Creasted
Heron, Tricolored
Swallow, Bank
Teal, Green - Winged
Scaup, Lesser
Eagle, Bald
Sandpiper, Semipalmated
Grebe, Horned
Swallow, Barm
Bittern, Least
Mink
Muskrat
Otter, River
Shrew, Water, Northern
Tern, Common
Osprey
Gull, Thayer's
Gull, Bonaparte's
Gull, Franklin
Goose, Snow
Avocet, American
Duck, Ring - Neck
Moorhen, Common
Canvasback
Sandpiper, Pectoral
Dunlin
Sandpiper, Stilt
Gull, California
Grebe, Western
Grebe, Eared
Sandpiper, Least
Gull, Ring - Billed
Gadwall
Wigeon, Eurasian
Wigeon, American

Cottonwood/ Willow:

Bunting, Indigo
Catbird, Gray
Chat, Yellow, Breasted
Crossbill, Red
Dove, Morning
Eagle, Golden
Finch, House
Flycatcher, Gray
Gnatchtcher, Blue, Gray
Grosbeak, Blue
Hawk, Broad - Winged
Hawk, Red - Shouldered
Hawk, Rough - Legged
Hawk, Swainsons
Hummingbird,Broad - Tailed
Kingbird, Eastern
Lizard, Tree, Northern
Magpie, Black-Billed
Mergamser, Hooded
Mockingbird, Northern
Mouse, Harvest, Western
Mouse, House
Oriole, Northern
Ovenbird
Pheasant, Ring - Necked
Placer, Yellowbelly, Western
Rat, Kangaroo
Shrike, Northern
Sparrow, Fox
Sparrow, Lincoln
Sparrow, Song
Squirrel, Flying, Northern
Squirrel, Rock
Thrasher, Brown
Toad, Woodhouse
Veery
Warbler, Black - and - White
Warbler, Black, Poll
Warbler, Connecticut
Warbler, Magnolia
Waxing, Cedar
Wren, Bewick's
Woodpecker, Red - Headed
Yellowthroat, Common

Agricultural:

Crane, Sandhill
Cuckoo, Yellow - Billed
Dove, Ground, Common
Ermine
Flycatcher, Scissor - Tailed
Grackle, Great- Tailed
Grosbeak, Rose - Breased
Killdeer
Longspur, Lapland
Meadowlark, Western
Owl, Long - Eared
Partridge, Gray
Quail, California
Rattlesnake, Faded, Midget
Rattlesnake, Great Basin
Sandpiper, Spotted
Sparrow, Lark
Sparrow, Lecnote's
Sparrow, Savannah
Sparrow, Swamp
Sparrow. Tree, American
Sparrow, White - Throated
Squirrel,Ground, Townsend's

Riparian:

Tattler, Wandering
Bat, Hoary
Bat, Red
Cuckoo, Black - Billed
Dipper, American
Fox, Red
Kingsnake, Mountain, Utah
Shrew, Merriam's
Shrew, Vagrant
Swift, Vaux
Tattler, Wandering
Weasel, Long - Tailed

Shrubland:

Lizard,Short- Horned,Mountain
Mouse, Brush
Snake, Night, Desert
Snake, Night, Spotted
Swallow, Cliff

Warbler, Gray, Black -Thorned
Warbler, Virginia's

Urban:

Blackbird, Brewers
Cowbird, Brown- Headed
Deer,Mule
Lark, Horned
Rat, Blace
Sparrow, Grasshopper
Sparrow,White- Crowned
Woodpecker, Downy

Wetland:

Gallinule, Purple
Rail, Sora
Snipe, Common

Grassland:

Longspur, Chestnut
Rat, Norway

Barren:

Plover, Snowy

Note:

Four species were removed from the speicies lists (Johnson 1993) and the Red Fox was added based on the observed presence of a fox on the class field trip.

APPENDIX F: PERCENTAGES OF WILDLIFE SPECIES USE OF PLANT COMMUNITY TYPES

Source: Calculated from Appendix E

To get the percentages one must add up the total number of species in a particular plant community on the G. I. S. species list and dividing that number by the total number of species. We then took the different plant communities and counted the A's (critical value),B's (high value), and C's (substantial value), to get the percentage of species use for each specific community. The percentage helps determine what plant community were classified as primary, secondary, and tertiary.

Defining the species categories A, B, and C are as follows (as defined by the Division of Wildlife Resources):

* Critical: Sensitive use areas that, because of limited abundance and/or unique qualities, constitute irreplaceable critical requirements for high interest wildlife. This category may also include highly sensitive habitats that have little of no reclamation potential.

* High Value: Intensive use areas important to wildlife. This category differs from the critical category in that the areas are of a wider distribution, High value habitat may also contain moderately sensitive habitats that have a low reclamation potential.

* Substantial: Existence areas used regularly by wildlife but at moderate levels with little or no concentration. Substantial habitat may contain areas with moderate reclamation potential.

Primary:

Aquatic = 46%
A = 43%
B = 3%
C = 0%
Cottonwood/Willow = 25%
A = 14%
B = 9%
C = 2%

Secondary:

Agricultural = 13%
A = 10%
B = 1%
C = 2%
Riparian = 5%
A = 5%
B = 0%
C = 0%

Tertiary:

Shrublands = 4%
A = 3%
B = 1%
C = 0%
Urban = 4%
A = 1%
B = 3%
C = 0%
Wetland = 2%
A = 2%
B = 0%
C = 0%
Grassland = 1%
A = .05%
B = .05%
C = 0%
Barren = 1%
A = 1%
B = 0%
C = 0%

Total number of species 191.

Note: these ratings were further modified based on vegetation vertical and horizontal structure and levels of disturbance as discussed in this report.

SECTION 3 REPORTS

COTTONWOOD REFORESTATION

Composition of the ecosystem

The Cottonwood-willow riparian ecosystem's overstory in the northern Utah area below 2440 m. is dominated by Cottonwood (*Populus angustifolia*). The undergrowth is characterized by Red-Osier Dogwood (*Cornus stolonifera*), Narrowleaf Willow (*Salix exigua*), and Water Birch (*Betula occidentalis*). Low shrubs include Black Twinberry (*Lonicera involucrata*), Black Currant (*Ribes hudsonianum*) and White Snowberry (*Symphoricarpos albus*). Herbaceous species include Kentucky Bluegrass (*Poa pratensis*) and minor amounts of Blue Wildrye (*Elymus glaucus*), Sweet-scented Bedstraw (*galium triflorum*), Western Sweet-cicely (*Osmorhiza chilensis*), and False Solomon-seal (*Smilacina stellata*) (Youngblood et. al 1985).

Factors Important to Viability of Riparian Ecosystems

As R.A. Schmidt (1983) points out, water is the key factor in establishing and maintaining the cottonwood-willow ecosystem association. According to him, two regulating factors essentially determine the ecosystem structure and composition: 1) the frequency, magnitude, duration and seasonal timing of stream flooding. 2) The subsurface moisture conditions during the growing season.

Fluvial processes

As pointed out, some of the factors that effect plant species are; flood magnitude, frequency, duration and seasonal timing. These factors influence the physical nature of the riparian environment that in turn effect plant species. Flooding influences such things as channel morphology, nutrient enrichment and transport, and groundwater recharge (Sands, 1978). In terms of plant community viability and sustainablity, one of the most crucial results of flooding is seed bed exposure. As Schmidt (1983) points out, that the moving water scours and erodes, producing areas of bare, moist, mineral soils important for seed germination.

Strahan (1984) established that both scour and fill processes, resulting from high water flow, determine vegetation patterns. According to her, a flood may eliminate a portion of a mature riparian stand through bank undercutting with the undercut material forming new depositional surfaces for seedling establishment further downstream.

These features are critical for the reproduction of most riparian plant species. Horton (1977) described the factors important to seed germination and seedling survival. According to him, cottonwood and willow seeds germinate quickly on water or on moist soils. Seeds of these species quickly lose viability and must germinate within 2-4 months. Annual spring floods expose soil and provide ideal conditions for seed germination and initial growth.

McBride and Strahan (1984), in their investigation of the factors influencing seedling establishment and survival for "gravel bar" species such as cottonwoods and willows, verify the reproductive relationship these species have with

flooding patterns. They found that in the Lower Dry Creek near Sonoma California, seedling establishment of Fremont Cottonwood (*Populus fremontii*) and willow (*Salix spp.*) was restricted almost entirely by the availability of gravel bars which in turn are related to the established patterns of flooding. They found that seeds from all species tend to germinate immediately after dispersal and that although seeds are dispersed over the entire surface of most bars, they only germinate in the moist zone at the edge of the stream. In addition, they found that the willows preferred areas where surface sediment size was less 0.2 cm (silt). Cottonwood established more densely on areas of intermediate and large-sized sediments. Only the areas of the bars with larger-sized gravels were exposed during the spring months when the cottonwood seeds were dispersed. Dispersal of Willow seeds occurred later when the water had receded and the smaller particle portions of the bars were exposed and moist. The result of these adaptations is a better survival rate and more diversity in the plant community.

In addition to flood occurrences, Strahan (1983) points out the importance of a "low-flow" regime to provide freshly exposed surfaces. According to her, both the low-flow regime and high flows influence distribution and a receding water level in the spring must coincide with cottonwood and willow seed dispersal.

Once established on gravelbars, according to Strahan, the young cottonwoods and willow stands do not form a continuous protective cover on the gravelbar. Providing floods do not alter the bar significantly, plant colonization will create additional deposits. Several inches of soil may be deposited by a single flood. As the bar builds higher, it is less frequently flooded. This deposition in combination with channel migration, results in a stabilized floodplain developing from a gravelbar.

Application to the Jordan River Study Area

The moderating effect on stream flows of upstream controls means less flood disturbance and potentials for "scour." As explained above, this factor is important for the successional dynamics of the ecosystem. Crouch (1979) linked the decline of cottonwood-willow ecosystems on the South Platte River to the reductions of seasonal stream flows and fluctuations. The diminished stream flows and lack of flooding also effect groundwater. Lack of flooding means that groundwater recharge is diminished. In addition, Schmidt (1983) points out that if the water level in the river is lower than the mean elevation of the water table, the river will act as a drain. The water table will slope toward the river. This has important implications to riparian species dependent on groundwater sources for water.

Other fluvial processes are at work in the Jordan river that could, in part, substitute for annual flooding. For example; the continual wide fluctuation of stream flows as the summer progresses could help in seedling establishment by providing exposed seed beds. Lateral stream migration is another fluvial process at work at the Jordan River. Campbell and Green (1968) link "perpetual succession" to rivers that actively meander over their floodplains. They found that frequent shifting of landforms and channels resulted in early successional stages occupying the majority of the floodplain.

Subsurface Water and the Riparian Ecosystem

Most riparian plants uptake water from the area in the soil that extends above the water table called the capillary fringe (Barbour et. al 1987). The water in this zone is continuously being reduced by evapotranspiration during the growing season and may be recharged by groundwater brought up through capillary action, flooding, or precipitation. According to Schmidt (1983), in arid or semi-arid summers this surface recharge is generally insufficient. The groundwater is depleted through capillary transfer to evapotranspiration and, eventually, the water table drops. Unless the species are capable of rapidly extending their roots downward into the new capillary fringe, they will suffer loss of vitality and growth due to moisture stress.

In order for a vigorous cottonwood-willow ecosystem to exist variations in depth to water table must be within the plants ability to cope. The change in groundwater recharge, if significant, will be reflected in the "vigor, extent and composition" of riparian growth. The optimum depth to ground water for cottonwood-willow ecosystems is less than 6 feet. Moisture stress tolerance for the cottonwood and willow is estimated at 2-4 weeks (Schmidt, 1983).

If the water table remains beyond the reach of plant's root systems longer than the critical time period, these species will give way to plants that are more drought tolerant and better able to cope. Such plants can be less desirable from a habitat and community diversity perspective.

Application to the Jordan River Study Area

Concerned individuals have little or no control over stream flow conditions and climatic variations in the Jordan River watershed. The best land managers can do is be aware of the conditions prevalent and determine the short or long-range problems with which they must cope. Schmidt (1983) suggests installation of standpipes regularly spaced on transects at right angles to the river to monitor groundwater levels and eliminate guesswork.

Restoration of the Cottonwood-Willow Ecosystem

Natural Restoration

Artificial revegetation is not the only means to reestablish a satisfactory riparian ecosystem. Natural recovery can often occur if areas are protected from livestock grazing or other destructive effects. Most riparian trees and shrubs are capable of resprouting and can recover from extensive use, and if a remnant composition of desirable plants exists, natural restoration may be most practical (Meehan and Platts,1978).

Artificial Restoration

Before any restoration/ revegetation efforts, site disturbances must be evaluated and analyzed relative to their effects on seedbed or planting conditions. Platts et al. (1987) proposes the following site preparations and alterations;

1. The erection of physical structures is often required to protect the seedbed or streambank from initial excessive erosion. Temporary structures, including logs, trees, or netting may be used during the period of plant establishment to divert or reduce stream impacts.

2. Steep banks may not be successfully planted unless the slope is reshaped. In addition, topsoiling is an effective and practical method of treating riparian sites and is important in improving the seedbed.

3. Neither seeded nor transplanted species can be established on sites supporting existing plant cover unless some means is provided to control the existing competition.

4. Proper seedbed and planting surfaces can be achieved by allowing time for loose soils to settle, or by mechanical compaction. Highly compact or hard surfaces can be loosened by ripping, plowing, or disking.

5. Herbicides can be applied to remove or control undesirable vegetation, leaving other desirable vegetation.

Recommended Species for the Jordan River

Plants recommended for restoration of riparian communities consists of native species prevalent in the area. Species recommended by Monsen (1982) for planting in riparian zones in sagebrush communities of the Intermountain region are listed in Table 1.

Seeding

Seeding of shrubs and trees is generally less successful than transplanting cuttings or seedlings (Swenson, 1988). The failure of seeding of riparian plants is most likely due to their adaptive reproductive strategies. As explained above, riparian plants produce large number of seeds throughout late spring and early summer to correspond with flooding events. These seeds quickly lose viability and must germinate soon after dispersal. The fact that many seeds lose viability is compensated by the number of seeds produced. However, artificial seeding efforts would find it difficult in timing and magnitude of seed dispersal to mimic this reproductive strategy. Direct seeding of other plants may prove successful due to the extended viability of their seeds. They employ a different strategy of fewer seeds that are able to remain viable for longer periods of time. This allows them to remain dormant until conditions are satisfactory for germination.

Monsen (1982) recommends planting in early spring so spring and summer precipitation could start germination and sustain new plants. Where flooding

Grasses	Trees & Shrubs
Tall Fescue	Currant
Red Top	Blueberry Elder
Squirreltail	Black Greasewood
Tall Wheatgrass	Hawthorn
Streambank Wheatgrass	Tatarian Honeysuckle
Creeping Wildrye	Desert Peachbrush
Great Basin Wildrye	Black Poplar
Russian Wildrye	Narrowleaf Poplar
Gardner Saltbush	Mountain Snowberry
	Western Snowberry
Forbs	Purpleosier Willow
Creeping Alfalfa	
Leafybract Aster	
Pacific Aster	
Fivehook Bassia	
Black Medick	
Chickpea Milkvetch	
Yarrow	

Table 1 Species recommended for planting (Monsen 1982)

occurs, planting should be done as soon as possible after the water recedes. He recommends drill seeding or planting using a cultipacker.

Transplanting of Understory Plants

Swenson (1988) found the best results have been obtained when using rhizomes or growing plants in container and putting them in the ground. According to him, the use of container stock planting machines has mechanized operation to where as many as 600 plants can be planted in one hour. As well, he suggests a "water harvesting" site preparation technique to optimize plant survival and growth. The technique consists of shaping and sealing the soil surface to collect rainfall and concentrate it at a plant. The site is prepared by shaping the surface into v-shaped ditches, applying a pre-emergent herbicide, and machine planting into the bottom of the small ditch. By covering the soil with a dark plastic film water is further concentrated as competing plants are suppressed.

Transplanting Cottonwoods

The following recommendations were given for planting based on the Anderson et. al. (1981) experience in reintroducing cottonwoods on disturbed sites;

1. Trees should be started from cuttings taken from local native stock. These cuttings should be allowed to take root and develop in a greenhouse for two or three months.

2. Planting should be done when the trees are small; the tallest shoot should not exceed 1 meter.

3. The soil should be analyzed prior to planting and planting should take place only in sandy, relatively salt-free soil.

4. The water table should be no more than 4.6 m. from the surface and the salt concentration in the ground water should not exceed 1200 ppm.

5. Deep tillage is of critical importance. Holes at least 20 cm. in diametershould be augured 3 m. deep or to the water table.

6. As a safeguard against salt damage to newly planted saplings, all holes should be leached 48 consecutive hours prior to planting.

7. Each tree should be supplied with 85 gm. of time-release fertilizer at planting.

8. Irrigation should extend for at least 150 consecutive days at about 114 liters per day.

9. Planting should not be done if significant growth of any other vegetation is present.

10. Trees should be weeded regularly throughout the first summer to keep competition from other vegetation to near zero and to keep salt cedar from becoming established.

Swenson (1988) claims that most efforts to reestablish native riparian vegetation by conventional techniques have been largely unsuccessful. He summarized what has been learned in unsuccessful efforts to reestablish native riparian trees. Some of his suggestions include;

1. Select sites with sand, gravel or small cobble soils above and in the water table. Avoid sites with continuous clay or silt soils, or where lenses of

clay or silt are thicker than one foot.

2. Prior to planting, measure monthly water table fluctuation for one year.

3. Cut poles from stands of open grown, young, rapidly growing trees, using only wood which is four years old or less. Remove side branches, leaving only the tip and next to lower side branches.

4. Cut poles when completely dormant.

5. Soak poles in water from the day of cutting for 10 to 14 days.

6. Auger holes to the depth of the lowest anticipated growing season water table.

7. Place the poles in the augured holes the same day they are removed from the soak. Set the butt at the lowest anticipated growing season groundwater depth. select poles of a length which provides 4 to 6 feet above the soil surface.

8. Back fill the holes carefully to avoid air pockets. The use of dry surface soil is recommended.

9. As buds begin to swell along the pole, wipe them off the lower two-thirds of the pole.

10. Plantings must be excluded from livestock grazing for two and possibly three growing seasons.

In his studies, Swenson (1988) particularly emphasized the importance of cutting distance to groundwater source. The findings of his study indicates that survival of cuttings decrease with distance
from groundwater source. Anderson et. al. (1984) as well found a relationship between depth of cutting and survival. They found that shallow depth (1.2 meters)
43% of the trees died. For trees with depth of 3 meters survival was 100%.

LaRosa (1988) suggests planting cottonwoods in both open and dense groupings with an installation rate of 100 trees per acre, with a minimum of three trees width and maximum of 40 trees width in total planting area. He suggests that twenty percent of the trees planted should be planted on 5 foot centers to allow crowns to grow into each other. Willows should be planted more adjacent to the surface water. As well, he recommends that other shrubs be mixed in among edges of tree area in odd, irregular groupings. Goldner (1984) points out that placing plants at high densities, in contrast to widely spaced, appears to be a good method of reducing weed competition and rapidly provides cover for wildlife.

Trees and shrubs should be grouped to provide optimum habitat by providing a mixture of irregular edges and random openings in proximity to a variety of community types (LaRosa, 1981). This could be accomplished by making an effort to create a mosaic of seral stages of communities with different combinations of species dominating each stage. Planting the cottonwood cuttings in staged 5 year intervals would also give a variety of cover types and age classes important to community viability.

Literature Cited

Anderson, Bertin W. et al. 1984. "Mortality and growth of cottonwood on dredge-spoil."*California Riparian Systems; ecology, conservation and*

productive management. ed. R.E. Warner and K.M. Hendrix. Los Angeles:U. of California P.

Barbour, Michael G., Jack H. Burk, and Wanna D. Pitts. 1987. *Terrestrial Plant Ecology*. Menlo Park: Benjamin/ Cummings,

Campbell, C.J. and Win Green. "perpetual succession of stream channel vegetation in a semiarid region." *J. Arizona Academy of Science*. 5(2)(1968):86-98.

Crouch, Glen L. 1979. "Changes in the vegetation complex of a cottonwood ecosytem on the South Platte River." *Riparian and Wetland Habitats of the Great Plains*. Conf. Proc. of 31st mgt. Great Plains Agricultural Council. Fort Collins,CO. Colorado State Univ.

Goldner, Bernard H. 1984. "Riparian Restoration efforts associated with structurally modified flood control channels." *California Riparian Systems; ecology, conservation, and productive management*. ed. R.E. Warner and K.M. Hendrix. Los Angeles:U. of California P.

Horton, J.S. 1977. "The development and perpetuation of the permanent tamarisk type in the phreotophyte zone of the Southwest." *Importance, preservation, and management of riparian habitat: A symposium*. USDA, USFS, GTR RM-43.

LaRosa, Ronald. 1984. "Environmental Resource Conservation: Riparian System Enhancement through Water Reclamation." *California Riparian Systems; Ecology, conservation, and productive management*. ed. R.W. Warner and K.M. Hendrix. Los Angeles: U. of California P.

McBride, Joe R. and Jan Strahan, "Establishment and Survival of woody riparian species on gravel bars of an intermittent stream." *Am. Midland Naturalist*.112(2) (1984):235-245.

Meehan, W.R. and W.S. Platts. "Livestock grazing and the aquatic environment." *J. of Soil and Water Conservation*. 33(6)(1978):274-278.

Monsen, Stephen B. 1983. "Plants for revegetation of riparian sites within the intermountain region." *Managing intermountain rangelands--improvement of range and wildlife habitats*. USDA, USFS, GTR INT-152.

Platts, William et al. 1987. *Methods for evaluating riparian habitats with applications to management*. USDA, USFS, GTR INT-221.

Sands, Anne. "Public Involvement in Riparian Habitat Protection A California Case History." *Strategies for the Protection and Management of Floodplain Wetlands and Other Riparian Ecosystems*. Proc. Symp. ed. R.R. Johnson and J.F. McCormick, USDA, USFS. GTR WO-12, 1978.

Schmidt, Ralph A. eds. 1983. *Management of cottonwood-willow riparian associations in Colorado*. The Wildlife Society: Colorado Chapter,

Strahan, Jan. 1984. "Regeneration of riparian forests of the central valley." *California riparian systems: ecology, conservation, and productive management*. ed. R.E. Warner and K.M. Hendrix, Los Angeles: U of California P.

Swenson, Edwin A. 1988. "Progress in the understanding of how to reestablish native riparian plants in New Mexico." *Restoration, Creation, and Management of Wetland and Riparian Ecosystems in the West.* Symp. proc. Denver, CO.

Youngblood, Andrew P., Wayne G. Padgett, and Alma H. Winward. 1985. *Riparian Community Type Classification of Eastern Idaho-Western Wyoming.* USDA, USFS, Intermountain Region; Ogden UT.

ECONOMIC VALUATION TECHNIQUES TO EVALUATE NATURAL RESOURCES

Introduction

Freshwater wetlands are areas of political and economic conflict. Wetland loss and impairment are significant public policy concern in the United States. Wetlands have been filled, drained, and altered for many types of developments. U. S. Fish and Wildlife Service has estimated that 215 millon wetland acres existed in the U.S. when European settlement began. By the mid-1970's only 99 million acres remained. U.S. Fish and Wildlife Service data indicates that from the mid-1950 to 1974, the United States lost approximately 9 million acres of wetland or approximately 450,000 acres per year. Agricultural development was estimated to be responsible for about 87 percent of these losses, urban development for 8 percent, and other activities for the remaining 5 percent. Thibodeau and Ostre (1979) reported that wetlands; swamps, marshes, flats, sloughs were drained and filled to make the land suitable for development. Losses include: three-quarters of wet bottom land in the Mississippi Delta region, 30 percent of Utah's overall wetlands, one-half of California's original wetlands and roughly 99 percent of Iowa's prairie wetlands have been drained for farming. Wetlands in their natural state provide a wealth of values to the society as show in figure 1.

Figure 1 outlines wetland values which can be divided to three categories; fish and wildlife values, environmental quality values, and socio-economic values. Fish and wildlife inhabit wetlands across county. Some animals spend their whole lives in wetlands. At the same time, some species use wetlands for reproduction and nursery grounds. Numerous fish and wildlife species frequent marshes and swamps to feed on organisms produced in wetland as well as sustain aquatic life. Wetlands also are important for survival of endangered species. Besides providing habitats for fish and wildlife, wetlands are also important for maintaining environmental quality. Wetlands are important for purifying water by

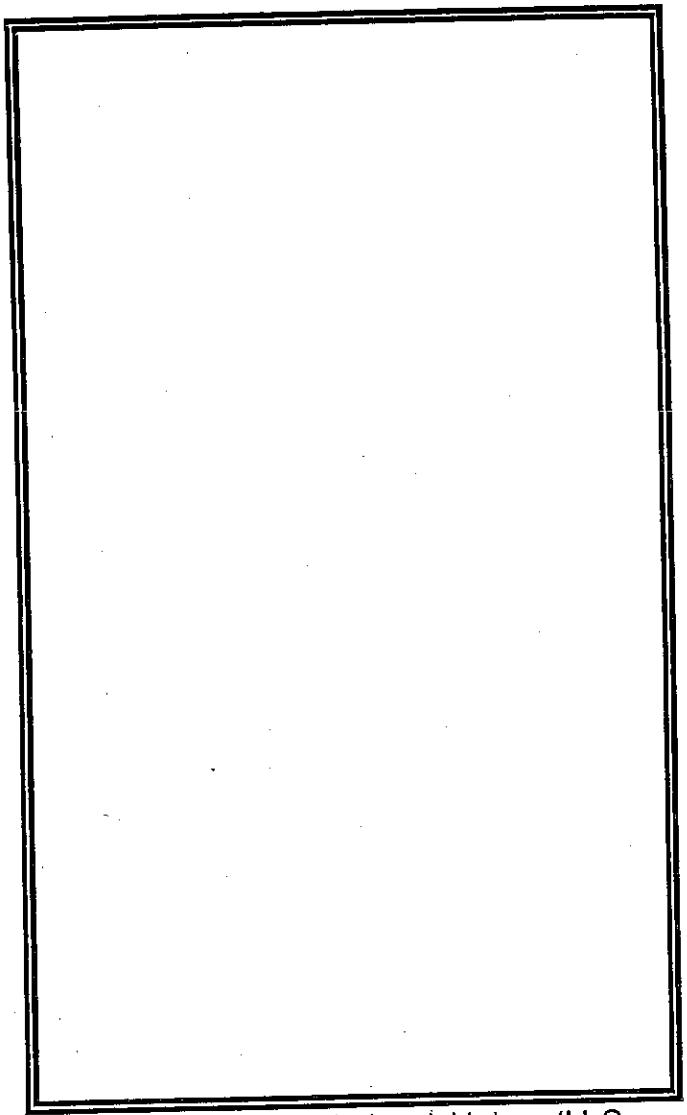


Figure 1. List of Wetland Value (U.S. Department of Interior, 1990.

ECONOMIC VALUATION TECHNIQUES TO EVALUATE NATURAL RESOURCES

Introduction

Freshwater wetlands are areas of political and economic conflict. Wetland loss and impairment are significant public policy concern in the United States. Wetlands have been filled, drained, and altered for many types of developments. Fish and Wildlife service has estimated that 215 millon wetland acres existed in the U.S. when European settlement began. By the mid-1970's only 99 million acres remained. U.S. Fish and Wildlife Service data indicates that from the mid-1950 to 1974, the United States lost approximately 9 million acres of wetland or approximately 450,000 acres per year. Agricultural development was estimated to be responsible for about 87 percent of these losses, urban development for 8 percent, and other activities for the remaining 5 percent. Thibodeau and Ostre (1979) reported that wetlands; swamps, marshes, flats, sloughs were drained and filled to make the land suitable for development. Losses include: three-quarters of wet bottom land in the Mississippi Delta region, 30 percent of Utah's overall wetlands, one-half of California's original wetlands and roughly 99 percent of Iowa's prairie wetlands have been drained for farming. Wetlands in their natural state provide a wealth of values to the society as show in figure 1.

Figure 1 outlines wetland values which can be divided to three categories; fish and wildlife values, environmental quality values, and socio-economic values. Fish and wildlife inhabit wetlands across county. Some animals spend their whole lives in wetlands. At the same time, some species use wetlands for reproduction and nursery grounds. Numerous fish and wildlife species frequent marshes and swamps to feed on organisms produced in wetland as well as sustain aquatic life. Wetlands also are important for survival of endangered species. Besides providing habitats for fish and wildlife, wetlands are also important for maintaining environmental quality. Wetlands are important for purifying water by

FISH AND WILDLIFE VALUES
-Fish and Shellfish habitat
-Waterfowl and other bird habitat
-Furbearer and other wildlife habitat

ENVIRONMENTAL QUALITY VALUES
- Water qualtiy maintenance
  -pollution filter
  -sediment removal
  -oxygen production
  -nutrient recycling
  -chemical and nutrient absorbtion
-Aquatic productivity
-Microclimate regulation
-World climate (ozone layer)

SOCIO-ECONOMIC VALUES
-Flood control
-Wave damage protection
-Erosion and control
-Groundwater recharge and water supply
-Timber and other natural products
-Energy source (Peat)
-Livestock grazing
-Fishing and shellfish
-Hunting and trapping
-Recreation
-Aestetics
-Education and scientific researc

Figure 1. List of Wetland Value (U.S. Department of Interior, 1990.

removing nutrients, chemical and organic pollutants, and sediment. The other importance is to providing food to support aquatic life.

The socio-economic values of wetlands include flood and storm damage protection, water supply and groundwater recharge, harvest of natural products and so on.

Wetlands were converted to agriculture or urban areas because the market value of wetlands is relatively low. Many wetland outputs are called public goods because an increase in one's person consumption does not reduce its availability to others. For example, if privately owned wetlands stop flooding in adjacent communities, the owner can not charge community members for this service because he can not withhold it from those who do not pay.

Kerry Turner (1992) suggested a three step process which would provide a measurement of the economic benefits from wetland goods and services and also responds to wetland alternation. "First, the analysis must identify the good and how the wetland produces it. This requires identifying and estimating the level of the wetland functions that give rise to the good, and estimating how those functions relate to the ecological characteristic that the proposed project may effect. Next, the analyst must determine the nature and supply of goods. This involves estimating how various wetland contribute to the type and number of game animals supported. Finally, the analyst must determine the use and economic value of the good, and how those relate to its nature and supply. For a final wetland good, this requires estimating the demand for the good".
As shown in Figure 1, wetlands have many values and benefits. To preserve these wetlands, economists have suggested several techniques or methods to evaluate wetland values. To determine the value, incetives for the consumer's "willingness to pay (WTP)" is an important suggested factor. This paper focuses on the economic method of evaluating natural resources by emphasizing wetlands.

Economic Techniques for Evaluating Wetlands

The following discussion briefly reviews the willingness to pay-based methodologies that could be used to determine the economic value of different type of wetlands goods. Determining the net benefit of goods provided by wetlands is very difficult because these goods do not have observable market prices. Valuation methodologies using this approach include the factor income, travel cost, and hedonic pricing techniques. In contrast, contingent valuation method may be used to approximate the economic value of non-market wetland goods. The detail for all of these valuation methods are described as follows.

Net Factor Income Method (NFI)

The net factor income method uses the measurement of appropriate income for natural resource as a factor for production in commercial activities. This method is based on an understanding of the production process for the market good and would involve development of a formal model of this process. This model relates to the variable production inputs, including the wetland goods, to production of the market good. For example, the contribution of groundwater to the production of domestic water supply could be valued using an

economic/engineering model of that production.

The application of NFI method attempts to model physical production and economic linkages. For example, to estimate the value of wetlands in production of blue crabs on Florida Gulf Coast and Oyster in Virginia by use of bioeconomic modeling to relate wetland service to the production of specific commercial goods.

Traveling Cost Method (TC)

Traveling cost method is used for estimating the value of recreational benefits. It is built on the hypothesis that public demand for recreational use of natural resources is indirectly linked to travel and its related expenditure incurred. For example, if a user incurs the cost to travel to and from a wetland, the user values the wetland at least greater that the costs of traveling to the site. The single site model determines consumer demand for the recreational uses of a site by plotting the role of site visitation against the cost of that visitation. The model produces a demand relationship for recreational trips to a site as a function of simulated price, represented by travel costs and the value of the resource users' time. From this demand relationship, one can estimate consumers' net willingness to pay to use the study site.

Application of the traveling cost method which is suggested by Scodari (1990) and Freeman (1978) involves several steps.

1. The area surrounding the study site (wetland) is divided into concentric zones, and the travel costs from each zone are estimated. The proposal is to measure the travel cost from each zone to the site and return.
2. Site visitors are surveyed to find their zones of origin, and a visitation rate (typical in visitor days per capita) for each zone is calculated using the survey data.
3. A travel cost measure is constructed to indicate cost of travel and return.
4. Visitor rates (in each zone) are calculated controlling for demographic variables and travel cost.
5. The observed total visitation from the site for all travel zone represents the point on the demand curve for the site - the intersection of the entry fee and the true (unknown) demand curve.
6. Other points on the demand curve are found by assuming that visitors would respond to a $ 1 increase in the price of site use just as they would to a $ 1 increase in travel cost, and using the visitation equation parameters to assess use at higher and higher travel cost.

The travel cost requires site-specific data on the number of trips made from each zone, travel times, users socioeconomic characteristic, and site entry fees. However, this type of valuation method requires; biological assessment of the effect of site alteration on site attributes. It also requires knowledge of the relationship between site attributes and recreational quality indices, and knowledge of the effects of recreational quality changes on visitation rates.

Hedonic pricing - Property value Method (PV)

The objective of property value method is to measure demand by related changes in adjacent property values to changes in wetland characteristics. For example, if housing become more expensive as property is situated closer to a wetland, that wetland has an intrinsic value that people are

willingness to pay for on demand. The most common property value depend on variations in property value to reveal implicit prices for environmental amenities; it uses these implicit prices to construct demand functions for the amenities.

The PV approach takes two steps to estimate the value of a resource good such as clean air. First step, a regression is constructed with property values as the dependent variable. The independent variables are quality and quantity indices of different property characteristics (e.g.,number of rooms, proximity to school, index of air quality), as well as household socioeconomic characteristics. It also require three assumptions to use property values differences as measure of willingness to pay for a wetland. First, there must be population mobility around a wetland site. Next, a typical household's utility and related demand function must be specified economically. Finally, property owners must have perfect information about all wetland uses and functions at the site. The important functions of the PV method are aesthetics, fishery and waterfowl benefits, water quality and supply, fertility for agriculture and other non market functions.

Contingent Valuation Method (CV)

Contingent valuation method estimates net benefits by questioning consumers directly about their valuation of non-market goods. Wetlands users are asked to state their marginal and total willingness to pay for specific non-market wetland functions. The method assumes that people understand the good in question and reveal their preferences in the contingent market just as they would in the real market. This method relies on mail surveys or personal interviews that use direct questions. The common questions usually asked are the amount they would pay to have a wetland (or wetland functions) versus not having it. The other question is to ask users what they are willingness to pay to have another unit of wetland function. The last technique usually used is to ask for their preferred quantities of wetland use at different places.

Scodari (1957) pointed out that CV method is the most straightforward method and has three advantages. "First, contingent valuation is flexible in that questions can be tested on a variety of wetland situations, both real and hypothetical. This implies the CV method is dutiable for valuing irreversible options, such as dredging, channelizing, or draining a wetland. Second, CV can always be used to check other valuation procedures. Although this method has several advantages, it also has a few disadvantages. Because CV is a survey method so they usually have the biases from the surveys. They are behavioral, hypothetical, and starting point biases. A behavioral bias results from incentives of survey respondents to not be truthful about their willing to pay. A hypothetically bias results when respondents do not take the survey seriously. A starting point bias is because of a questionnaires' desire to affects respondents' answers. To minimize these three biases, the CV method should be used in conjunction with other valuation methods."

Valuation Transfers: The Activity Day method (AD)

There are two types of valuation transfers. A simple transfer might use an activity day value (e.g., the value of a user day of duck hunting) previously

developed at another site to value this activity at the study site. For example, an estimate of net willingness to pay for a user day of trout fishing might be derived from a TC study at another site and applied to value trout fishing at the study site. Another way might apply a valuation model derived from a previous TC study to the resource goods and user characteristics of the study site. Recreation activity day values represent values accruing to actual users of recreational goods at a particular site. They are based on a myriad of site-specific factors including:

- site, quality factors for recreational activities (e.g., water quality, type of game fish available)
- lactational factors (e.g. distance from user populations, number of close substitutes in the regions), and
- user populations socioeconomic and other characteristics.

Post applications of the TC and CV methods to particular recreation sites have produced numerous activity day value estimates. These estimates are available for many different day values for particular types of recreational activities in specific areas. Activity day value estimates representing the average net willingness to pay of individual users may be also used to forecast the recreational value change that will result from significant site alterations. Nevertheless, these predictions require estimates of activity day values both before and after site alteration, as well as the effects of the alteration on participation in the activity at the site.

Replacement Cost Method (RC)

The replacement cost method used to estimate the value of non-market environmental service relies on the cost of providing it through an alternative supply mechanism, typically a technological substitute. For example, to value the waste assimilation service provided by a wetland area, one might ascertain the cost of building and operating a tertiary waste treatment system that could provide the same service.

The RC method has three important steps: 1) Estimate the level of the environmental service provided. For flood control service this might mean conducting an ecological assessment. for domestic water supply, it might deal with investigating use level directly, 2) Identify the least cost alternative supply mechanism that could provide the same benefit level, and 3) Gathering evidence that the public would demand the identified least cost supply mechanism, at its price.

Damage Cost Method (DC)

Damage cost method is based on the damage that might result from wetland service loss. For example, the wetland service of erosion prevention may be valued based on the cost of removing sediment from a navigable waterway. Gupta and Foster (1975) valued the flood control benefits provided by Massachusetts wetlands based on estimates of property damage expected to occur without them.

There are several steps in estimating property damage that might result from elimination of a wetland service. First, an ecological assessment of the service level is necessary to determine the physical impact of eliminating it. Second, the potential physical damage to property either annually or over some discrete time period, must be estimated. Third, this damage must be translated into dollar terms. Forth, an RC-type

investigation of alternative supplies must be conducted.

Analysis/Biological Productivity Method (EA)

Energy analysis or biological productivity method is based on the energy content of the natural environment and assumes that values of wetland goods are determined by the amount of available energy. The EA method is based on the assumption that the value and goods is reflected in the amount of energy required to produce it. If energy is the basic input into all production, wetlands may be valued by their biomass energy. Wetland value can also be calculated by multiplying a wetland's total units of energy by some energy price.

Factors	NFI	TC	CV	PV	RC	DC
Commercial	X					
Water Supply	X				X	
Flood Control					X	X
Storm Protection						X
Waste Treatment	X				X	
Erosion Control						X
Recreation		X	X			
Amenities			X	X		
Nonuse Benefit			X			

Figure 2. Valuation approach by wetlands goods (Scodari, 1990)

Scodari(1990) reviewed the first major application of the EA method which was of coastal wetlands on the Southeastern united States. This study used the annual net production of salt marshes to represent the energy flow of wetlands that carry out various function. It used a conversion factor of 1985 kilocalories/pound of biomass to estimate kilocalories per acre, then applied an equivalence factor of 104 kilocalories/dollar. The total life support value per acre was found to be $4,100 annually.

For all of these valuation technique can be summarize and applied to work with wetlands goods as shown in Figure 2.

Summary

All of these techniques are suitable for non-market goods from wetlands. To apply all of these methods to the six miles south of Jordan river, we have to decided which wetlands goods are the most important. Then use table 2 above to determine that what evaluation method that should use. Also we can combine two methods or more than two to get the best output.

The more important techniques are the application of the TC and CV methods. The applications of the TC and CV methods to particular recreation sites have produced numerous activity day value estimates that might be cross-applied to wetland areas. These estimates are available for many different recreation activities in many different locations. The examples are two recent federal government publications review activity day values for particular sites of recreational activities in specific areas. The values represent estimate of the average consumer surplus accruing to an

individual user for a day of an activity of a site. These estimates provide enough data on recreational values to allow application activities in many parts of the county.

Literature Cited

Farber, S and Costanza, R. *The Economic Value of Wetlands Systems*. Department of Economics, and Center for Wetland Resources, Louisiana State University. 1986.

Freeman, R.T., *Approaches to Measuring Public Goods Demands*. American Journal of Agricultural Economic, Vol. 61. Dec 1979.

Gupta, T.R., Foster, J.H., *Economic Criteria for freshwater Wetland Policy in Massachusetts*. American journal of Agricultural Economics, Vol. 57, 1975.

Johnson, R.L.and Johnson,G.V. *Economic Valuation of Natural Resources. San Francisco*. Social Behavior and Natural Resources Series, Western Press. 1990.

Scodari, P.F. *Wetlands Protection: The Role of Economics*. Washington:Environmental Law Institute,1990.

Thibodeau, F,R., Ostro, B.D. *An Economic Analysis of Wetland Protection*. The journal of Environmental Management. Vol 12, 1981.

Tiner, R. U.S. Department of The Interior Fish and Wildlife Service. *Wetlands of The United States:Current Status and Recent Trends National wetlands Inventory*. 1984.

WEED CONTROL

Throughout the project site there are areas where noxious weeds have invaded and displaced more desirable native plant species. Three such weeds are Canadian thistle (*Cirsium arvense*), Russian olive (*Elaeagnus angustifolia*), and tamarisk (*Tamarix pentandra*). Getting rid of these weeds should be one of the goals of this project.

Integrated pest management is the combining of weed control techniques into the most effective and environmentally sensitive weed control program. Some of the weed control methods which are commonly used are mechanical, cultural, biological, and chemical. Mechanical weed control employs such techniques as mowing, plowing, hoeing, chaining, burning, mulching, or hand pulling. Cultural weed control uses cultural practices to control weeds. Some of these practices are crop rotation, planting a smother crop in areas that are already infested, or planting a cover crop to prevent the establishment of weed species. Biological control uses organisms or animals which eat or disrupt the life cycle of the weeds. Care must be taken in selecting the biological agents used so that they will be able to survive in the area, and at the same time not change the established ecosystem. Chemical control uses herbicides to eliminate weeds. Some considerations of using herbicides are the selectivity of the chemical, the effect on the target specie, the effects on animals and insects, drift and runoff onto nontarget areas, and residual contamination of soil or ground water. By proper selection of the herbicide used, and by strictly following the application rates and procedures, chemical use can be a safe and effective means of weed control.

Many of the areas on the project site present limitations on the control methods that can be used. Due to steep slopes, inaccessibility, and vast acreage covered by weeds, mechanical control is of limited value. Many of the problem areas are not cultivated so cultural methods of control do not provide a long term solution to the problem. For the three weed species that are being focused on there are no biological agents that have proven successful. There are many herbicides that would work well on the target species, but because the site is a wetland or is adjacent to wetlands, the herbicides that can legally be used are limited. Some of the herbicides that might be used are: 2,4-D an effective broadleaf herbicide; glyphosate, which is marketed as Roundup or Rodeo, and is a nonselective herbicide; and picloram, which is marketed as Tordon, and is also a nonselective herbicide. Picloram is highly mobile and is highly persistent so should not be used where it could get into or leach into ground water.

Canadian thistle, *Cirsium arvense*, is a member of the composite family. It reproduces by seed and by an extensive system of horizontal and vertical creeping roots (Lembi, Ross 1985). Mowing is a successful way to prevent the formation of new seeds, but old seeds have been known to remain viable in the soil for over 20 years. Also, a healthy plant can spread 10 to 20 feet per year by its creeping roots. It has been shown that grazing eliminates plant cover that can help eliminate Canadian thistle. If grazing could be cut back or stopped altogether, that would help control the thistle. Both glyphosate and 2,4-D are effective on thistle. Glyphosate should be applied at 2 to 3 quarts per acre once in the spring and

once in the fall. Because glyphosate is nonselective, the treated area should be reseeded with a vigorous perennial grass or other cover crop. 2,4-D should be applied multiple times each season (three or more times) for two to three seasons at a rate of 1 to 2 pounds per acre. Treatments should be applied each time the thistle reaches bud stage or approximately 12 inches in height.

Tamarisk, *Tamarix pentandra*, is a shrubby weed. It is the most difficult of the three target weeds to control. Roundup is not very successful on tamarisk. Picloram works well on tamarisk, but can't be used in wetland areas. The foliar sprays Arsenal, and Rodeo (applied every two months or less) are the best options for controlling tamarisk. Mechanical control can be used in easily accessible areas, but is not feasible in remote or unaccessible areas (Gangstad 1989).

Russian olive, *Elaeagnus angustifolia*, is a woody tree that is often considered to be a weed. Herbicides are the most successful method of eliminating Russian olive. 2,4-D as a foliar spray is not very successful on larger trees, but is quite successful on 5 to 6 foot tall saplings. Similarly, glyphosate provides fair results when sprayed on mature trees, and excellent results when sprayed on saplings. The preferred method of control is trunk injections of glyphosate. In the late summer or early fall a hatchet can be used to chop into the tree. 2cc of Roundup for each inch of trunk diameter, can then be injected with a syringe into the wound. The herbicide is then translocated throughout the tree which provides excellent results. If the cut and spray method (cut the tree down then spray the stump with herbicide) is used, then Picloram, which is more powerful, might be permissible in a wetland area. But, if it is not sprayed on while the cut is still fresh, then it will not be very effective.

Even though the target species are considered to be weeds, they do provide habitat requirements for many animals. By removing only sections of weeds at a time, some habitat will be left for the animals to use. At the same time the value of maintaining these habitat areas must be weighed against the negative aspects of having a continuing source of the weeds propagules. One possibility that can be considered is to eradicate the Canadian thistle all at once, but only work on half of the tamarisk and Russian olive at one time. After the weed species have been replaced with desirable species, the rest of the weedy areas can be removed. When delineating which ares will be treated at the same time, thought should be given to preserving corridors between habitat areas.

When making a weed control program, it is very important to contact the county weed supervisor for suggestions and permission. The weed supervisor for Salt Lake County is Hugh Bringhurst and his phone number is 562-6400. It is also very important for those carrying out the program to follow proper safety rules, and use proper weed control techniques. By doing so, weed control can be safe for those doing the work, for the surrounding community, and for the environment.

Literature Cited

Dewey, Steve 1993. USU Extension weed specialist. Personal contact.

Gangstad, Edward O. 1988. *Woody Brush Control*. CRC Press, Boca Raton, Florida.

Jeffery, Larry S. and Lorenzi, Harri J. 1987. *Weeds of the United States and Their Control.* Van Nostrand Reinhold Company, New York.

Lembi, C.A. and Ross, M.A. 1985. *Applied Weed Science.* Macmillan Publishing Company, New York.

ALTERNATIVE ZONING AND IMPLEMENTATION

This section provides a brief examination of legal methods used to enforce planned growth under State statutes. Topics include the importance of a community general plan, conventional zoning, tiered zoning, planned unit developments, performance zoning and permit systems, and concurrency zoning.

A community general plan provides a guide to development that allows the community to create and maintain an environment that reflects the aims and goals of it's citizens. The general plan provides the legal backbone for additional ordinances that promote the plan objectives. The Utah Municipal Planning Enabling Act, Title 10, Utah Code provides the legal standing for this and the other issues covered in this section.

Conventional zoning is an accepted method of implementing a general plan, but it has often proved inadequate to withstand the pressures of development. Zoning maps are rarely detailed enough to reflect the physical characteristics of potential development sites. Variances to zoning are granted for humane or political reasons that have little to do with environmental concerns. The density requirements of conventional zoning often do little to preserve contiguous open space. Without some additional ordinances or controls the developer has no incentive to develop in an ecologically sensitive manner.

Conventional zoning can be tiered with additional ordinances that specify performance requirements for environmentally sensitive areas such as steep slopes, stream corridors, and wetlands. When these ordinances are well written and rigorously administered they can be very effective in protecting environmentally sensitive areas. These can be difficult to administer though as administrators need to wade through specific ordinances for each proposed development site.

A planned unit development (PUD) can provide an ecologically sensitive alternative to the typical sprawling suburban grid. Also referred to as cluster or density zoning, the PUD may be allowed in an amendment to the zoning ordinance, or as part of performance zoning or permit system. The PUD allows for flexibility and creativity in planning and developing large scale and mixed use projects. While a conventional zoning ordinance will specify rigid setbacks or sideyards on each lot in a development, the PUD amendment allows these and other density requirements to be waived. Clustered development provides openings and corridors for wildlife and allows open space to be integrated with development.

Some people think of PUDs as only clusters of multiple family housing, but they may also be single family residential areas, mixed residential with both single family and multiple family dwellings, commercial or industrial, or may even mix compatible commercial, industrial, and residential development. The typical PUD takes the characteristics of the site into account, then clusters the development in the buildable area, leaving larger patches of open space in the environmentally sensitive areas.

Consider a 50 acre development site in a traditionally zoned, one house per acre area. The site could be carved into 50 one acre parcels, chopping up the entire area, allowing no room for trails or wildlife corridors, or a PUD could cluster 56 single family homes on 14 acres, leaving 36 acres as open space to be maintained either by a homeowner's association, or by the municipality, or in some combination. These can be less expensive to develop as utilities and roads are also clustered, and because environmentally sensitive areas are more expensive to develop. The open space amenity adds to the value of the units and the increased number of units gives the developer additional profits. If developers are still not convinced of the benefits of the PUD, tax incentives are often included with the PUD.

Performance zoning typically replaces conventional zoning. Specific standards are established for all types of development that the municipality allows. The standards will address issues such as steep slopes and wetland areas as well as open space requirements. Then developers negotiate with administrators and development is allowed only if it generates a positive or neutral impact on the natural environment and the community. As in tiered zoning, these systems require more administration than conventional zoning. When properly administered though, this can be one of the most effective ways of achieving planning goals. Often an overlay zone will be employed which requires that specific standards be met before the base zoned lands use will be permitted.

There is also another type of performance zoning which is probably the easiest for a small planning staff to administer. No districts are created. Any and all low density used are allowed, but any more incentive developments are examined closely. No intensive development is allowed unless it is accessible by zoning. The proposed development must also be compatible with existing uses. Even low density development can fragment open space, however, and this type of zoning doesn't really address environmental concerns as well as some of the other methods. A system like this that encourages PUD type development in low density areas can solve the fragmentation problems of this system.

Permit systems are simple and flexible. This ordinance consists of clearly written policy objectives and standards that take into account the physical, social, fiscal, and environmental impacts on the community. The developer may chose how best to meet the stated objectives. Some requirements will be mandatory, but there may be an equal number that the developer may choose. Bonus points and incentives are given for items of choice. This encourages developers to incorporate community objectives into their plans. When the developer applies for a permit they will be given a form that lists the mandatory and optional items. The developer then checks those items that will be accommodated. All the mandatory items must be checked, and additional points are given for other items checked. The permit can be denied if the proposed development does not have enough points. There may be added incentives given for developers who accumulate greater numbers of points. This is easy to administer as the planning staff need only count the points from the form. Care must be taken, however, to enforce and developments should be checked for compliance.

Another plan that allows a community to keep control of development is concurrency zoning. In this plan the municipality decides where development should occur. Then when they have any money to spend on roads, sewers, or other improvements, they spend it in that area. Development is not allowed unless services are there to accommodate it, so development is steered into the areas targeted by the municipality. This is very similar to the second type of performance zoning discussed earlier, only in the previous system low density developments are allowed while this system prohibits development in some areas.

The fifth amendment to the U.S. Constitution provides in part that "private property shall not be taken for public use without just compensation." While development can be controlled, it cannot be completely denied without some compensation. Many communities use municipal bonds to fund open space programs. This requires community support as bond issues must be voted on. In a receptive community can be used to acquire many acres of land that can be add to an open space system. Land may also sometimes be acquired through donations, or with the help of groups like the Nature Conservancy. If a community is committed to a plan, open space and wildlife habitat can be preserved, even on limited resources.

References

Gold, Julia. 1989. *Performance-Oriented Land Use Controls to Address Environmental Impacts of Development.* Master's Thesis, University of Pennsylvania.

Johnson, C.W. 1993. *A wildlife Conservation Manual for Urbanizing Areas in Utah.* Utah State University.

Moser, Gene. 1993. From a lecture given at Utah State University April 30, 1993. Mr. Moser is a County Commissioner in Summit County, Ut.

BEAVER HABITAT MODEL

General Information

Castor canadensis are found throughout North America with the exception of the Arctic, sections of the Florida peninsula, and parts of the southwestern deserts (Rue 1964). Beavers weigh from 30 to 60 lbs (*that's some beaver!*) and obtain lengths averaging from 3 to 3.5 ft. The most common coloring is reddish brown although black beavers are not unusual(Morgan 1868). The species is found in aquatic environments, generally occupying the margins of streams, lakes and ponds. Beavers construct dams and burrows which they occupy year round. If specific habitat requirements are met beavers can exist quite comfortably in close proximity to man (Rue 1964).

Food

Beavers are herbivorous, feeding on a variety of woody and herbaceous vegetation (Allen 1982). Although beavers show a strong preference for aspen (Populus tremuloides), willow (Salix spp.) cottonwood, (Populus fremontii), and alder (Alnus spp.) they have been known to subsist on coniferous species when more palatable species are unavailable (Allen 1982). Beier and Barrett (1985) found that on the Truckee River beaver utilized tree species in the following order: Aspen, cottonwood, willow, and alder. Trees and vegetation located nearest riparian areas are generally used first. Hall (1970) reported in his study of a California beaver colony that 90% of all tree harvesting by beavers was within 30 m of the stream (Hall 1970). Tree species located more than 200 m from the stream channel are believed to have little importance as a food source (Allen 1982).

Beavers prefer herbaceous vegetation to woody vegetation. A variety of species are utilized such as duckweed (Lenna spp.) pondweed (Potamogeton spp.) water weed (Elodea spp.) and water lilies (Nymphaea spp.) Forbs, grasses and the roots of stream side vegetation are important food sources in the spring and summer (Morgan 1868, Allen 1982). Beavers harvest different food sources at different times of the year with the highest rate of tree harvesting activity occurring in the fall when beavers store food for winter consumption (Morgan 1868, Ryden 1989).

A direct correlation exists between the diameter of woody vegetation harvested by beavers and the distance of that vegetation from the stream. Trees of larger diameter are felled when they exist closer to the stream. Woody species harvested by beavers are generally less than 10.1 cm dbh (Allen 1982).

Water

Of all habitat requirements a stable and permanent supply of water is most important to beaver (Slough and Sadleir 1976, Beier and Barrett 1987). Streams with steep gradients have swifter flows. The high velocity of larger channels would, obviously, make dam building quite impossible. Waterways with a gradient exceeding 15% are believed to be unacceptable for beaver occupancy and gradients less than 6% are optimum (Allen 1982). Stream channels which are both deep and wide and of manageable volume offer beavers optimum escape cover, secure food cache sites and a

more reliable water source (Howard and Larson 1985). Lakes, marshes and ponds offer suitable habitat for beavers (Allen 1982).

Cover

Cover for beavers is provided by constructed burrows and lodges. Beaver lodges are constructed of woody vegetation, herbaceous vegetation, and mud. Lodges and burrows provide for nearly all beaver cover requirements: security, thermal, and reproductive (Rue 1964). Beavers use their lodges to store food for winter consumption. The water surrounding the lodge provides excellent protection from predators (Allen 1982).

Reproduction

Beavers form monogamous pairs. They generally produce 2 young yearly. Kits remain in the colony for two years before emigrating (Slough and Sadleir 1976). Habitat requirements for reproduction are provided by beaver burrows and lodges (Allen 1982).

Interspersion

Successful colonization of an area by beavers depends upon three primary factors. The water supply must be stable, water velocity must be controllable, and an adequate food supply must be present. Beier and Barrett (1987) point out that stream morphology is by far the most important factor in beaver habitat selection. Stream reaches which had gentle gradients, deeper and wider channels, and low banks characterized 91% of occupied habitat on the Truckee River in California (Beier and Barrett 1987). Howard and Larson (1985) found that due to the beavers opportunistic feeding habits food variability had little impact on habitat choice (Howard and Larson 1985).

Beavers occupy habitat which may be classified as deciduous shrub and tree communities. These communities may be in state of climax or sub-climax. Beaver habitat is generally exploited through the migration of the young. Migratory young often emigrate to transient habitats which form after fire, logging or outbreaks of insects. (Allen 1982). The young may also inhabit abandoned lodges and burrows if a sufficient food source exists (Slough and Sadlier 1976). This rapid colonization of the area by sub-adult beavers is the key to the species wide spread success.

Beaver densities are a product of available suitable habitat. Allen (1982) defines the minimum habitat area required for beaver as .5 sq miles (Allen 1982).

Management Applications

Beavers have long been the focus of management conflicts. Beaver can have a significant impact on large stands of aspen and cottonwood species (Beier and Barrett 1987). Damming activities alter stream morphology. Beavers also are known to dam culverts and irrigation intakes in an effort to stabilize water supplies. Beaver ponds may cover gravel bars and stream riffles used for trout spawning and food production (USDA Forest Service 1988).

Beavers have an amazing capacity to colonize. The species had been nearly eliminated in Alabama by 1940. From a remnant population of 500, the species increased to 3500 individuals in two years time (Spencer 1965) .

Efforts to control beavers by landowners are often frustrated. The destruction of lodges and dams by dynamite is a

common technique used to control the species. This method is rarely successful. If beavers are left in the area they will quickly repair the damage and reestablish the colony (Spencer 1965). Trapping and removal of beavers can be successful in controlling populations. The labor and time required for trapping can make it quite an expensive proposition. If trapping is discontinued beavers quickly reestablish dams and lodges. Trapping appears to work best when population control rather than eradication is the management objective (Spencer 1985).

In areas where beaver damage is moderate, mitigating structures may be helpful. The National Forest Service has successfully used log drains for lowering the water level behind beaver dams (fig 1). Beavers will immediately clog any drain or break in their dams. The key to the success of this method lies in the fine openings on the intake side of the piping which allow it to go undetected by the beaver colony (USDA Forest Service 1988).

Several systems for eliminating the damming of culverts have been devised. The "beaver baffler" is a long tube extended through the culvert which makes the clogging of the culvert impossible (fig 2) (Ryden 1989).

As previously stated, the physical structure of beaver habitat (stream channel gradient, width and depth) is far more important than forage resources. Beavers have preferred food species, but will make do with many different types of vegetation. It should be noted that some plant species are far more resilient to beaver use than others. In a study in Southeastern Oregon, Kindschy discovered that beavers made substantial use of willow. After several years of intensive use the willow maintained high growth rates. The ability of willows for natural crown renewal makes them especially tolerant of top removal by beavers (Kindschy 1985).

Many land managers are using beavers to their benefit. In southeastern Wyoming the Bureau of Land Management used beavers in their restoration efforts on 80 miles of stream side habitat. Accelerated erosion and a subsequent dropping of the water table had heavily degraded the stream side zone. As introduced beavers constructed dams stream flow slowed, reducing erosion and stabilizing stream banks. Water trapped behind dams formed pools enhancing trout habitat, trapping nutrients, drastically reducing silt loading (from 8 to 4 tons per day) and supporting stream side vegetation. Where channelization created stream flows too swift for beavers to build dams, the BLM lent a helping hand. Old truck tires were placed in the stream channel offering the beavers a more stable construction material (Spencer 1985).

Maret, Parker and Fanin (1985) studied the effect of beaver dams on non-point source water quality. They discovered that beaver dams significantly reduced concentrations of suspended solids, phosphorous, and nitrogen. Beaver dams can significantly contribute to nutrient conversion or retention.

Beaver impoundments create valuable wildlife habitat. Mammals, fish, amphibians and birds all use wetlands created by beaver dams. The comeback of the beaver population may be directly connected to the resurgence of the wood duck and the river otter in the southeast (Spencer 1985).

Summary

The Jordan River meets all the habitat requirements for beaver. Beaver activity has been observed in several areas along the Jordan River (Collins 1990). The cutting of cottonwood plantings by beaver would be of primary concern to any rehabilitation effort along the Jordan river corridor. Beaver harvesting of cottonwood seedlings could have a negative impact on revegetation efforts, especially where the natural regeneration of native species is rare. (Collins 1990). Offering alternative food sources such as willow and herbaceous vegetation may be effective.

Beavers can do a great deal to benefit the rehabilitation of the Jordan River. Damming activities can naturally help to control erosion , contribute to groundwater recharge, improve water quality, enhance fisheries and wildlife habitat. The impact of beaver on revegetation efforts should be closely monitored. Only after protective measures have proved ineffective should a beaver management program be implemented.

Literature cited

Allen, A.W. 1982. *Habitat suitability index models: Beaver.* U.S. Dept. Int., Fish Wildlife. Serv. FWS/OBS-82/10.30. 20 pp.

Beier, Paul, Reginald H. Barrett. 1987. *Beaver habitat use and impact in the Truckee River basin, California.* J. Wildlife. Manage. 51(4)794-799.

Collins, Kathlyn J. 1990. *Wildlife habitat enhancement and vegetation plan, implementation, specifications, and management guidelines: Recommendations for the Jordan River Parkway, Murray, Utah.* Masters Thesis. Dept. of Landscape Architecture and Environmental Planning, Utah State University. Logan, Utah. 99 pp.

Hall, J. G. 1970. *Willow and aspen in the ecology of beaver in Sagehen Creek, California.* Ecology 41 (3) : 484-494.

Howard, R.J. and J. S. Larson. 1985. *A stream habitat classification system for beaver.* J. Wildlife. Manage. 49:19-25.

Kindschy, R.R. 1985. *Response of red willow to beaver use in southeastern Oregon.* J. Wildlife. Manage. 49(1): 26-28.

Maret, Timothy J., Michael Parker, and Timothy E. Fanin. 1987. *The effect of beaver ponds on the non-point source water quality of a stream in southwestern Wyoming.* Wat. Res. Vol. 21, No. 3. 263-268.

Morgan, Lewis H. 1868. *The American Beaver: A classic of natural history and ecology.* Dover Publications Inc. New York. 330 pp.

Rue, L.E., III. 1964. *The world of the beaver.* J.B. Lippincott Co., Philadelphia and New York. 155pp.

Ryden, Hope. 1989. *Lily pond: Four years with a family of beavers.* William Morrow and Co., New York. 250 pp.

Spencer, Jim. 1985. *A plague of Beavers.* American Forests. May 1985. 22- 27.

Slough, Brian and G. R.M.F.S. Sadlier. 1976. *A land capability classification system for beaver (Castor canadensis*

Kuhl). Can. J. Zool. Vol. 55, 1977.

U.S.D.A. Forest Service. 1988. *Wildlife and fisheries habitat improvement handbook*. Dept. of Agri. Forest Service. wild. and Fish. Admin. Rept. (unnumbered) 131 pp

BULLOCK'S ORIOLE HABITAT MODEL

The Bullock's oriole, *Icterus galbula bullockii*, is a subspecies of *Icterus galbula* the Northern oriole. The Baltimore oriole is another subspecies of the Northern oriole. Bullock's orioles are found from Canada to Mexico, and from the western edge of the great plains to the Pacific coast.

Adult male Bullock's orioles have bright orange bodies with black tails, backs, and wings. Their heads are also black but their throats and their eye lines are orange. The Bullock's has a single white wing bar. The female is olive green above and buff white below. It has two white wing bars. Both are about 7 to 8 inches long.

Bullock's orioles weave bag-like hanging nests. "The nests are usually placed in low situations, from 6 to 15 feet from the ground, but occasionally one is found fully 50 feet up" (Bent 1965). Typically the nests are 8 inches deep, with an outside diameter of 7 inches, and an inside diameter of 4 inches. Bullock's orioles lay between 3 and 6 eggs. The eggs average size is about 0.94 by 0.63 inch. Bendire (1895) states: "Only one brood is raised in a season, and the duties of incubation, which are performed almost exclusively by the female, last about 14 days." The male usually stays close by to guard the nest from intruders. According to Wheelock (1904) "When newly hatched, the young orioles are naked, pink babies with little tufts of thin white down on head and back."

F.E.L. Beal examined the stomachs of 162 Bullock's orioles. He determined that 79 percent of the stomach contents was animal matter, and 21 percent was vegetable. "The animal food consisted of insects, with a few spiders, a lizard, a mollusk shell, and eggshells" (Beal 1910). Some of the insects that they like to eat are beetles, ants, ladybugs, stinkbugs, leafhoppers, tree hoppers, aphids, caterpillars, weevils, and moths. Codling moth pupa and larvae were found in many of the stomachs. Almost all of the vegetable food was fruit such as cherries, figs, blackberries, raspberries, and elderberries. Although they eat fruit which may make gardeners unhappy, they do an extremely valuable service by also eating many damaging insects.

Natural enemies of the Bullock's oriole are the same as those for most small birds. Typically, larger birds, squirrels, weasels etc., try to prey on the oriole eggs, or young birds. Generally the parents are quite successful at driving the intruders away.

Most of the necessities of life for the Bullock's oriole are found in large upper canopy trees. Increasing the number of cottonwoods, willows, sycamores, etc., would increase the area of preferred habitat for the Bullock's oriole, and would hopefully attract more of these beautiful birds.

Literature Cited

Beal, F.E.L. 1910. *Birds of California in Relation To The Fruit Industry, pt* 2. U.S. Dep. Agric. Biol. Surv. Bull. 34.

Bendire, C.E. 1895. *Life Histories of North American Birds.* U.S. Nat. Mus. Spec. Bull. 3.

Bent, A.C. 1965. *Life Histories of North American Blackbirds, Orioles, Tanagers, and Allies.* Dover Publications, Inc., New York.

Bruun, B., C.S. Robbins, and H.S. Zim 1983. *Birds of North America: a guide to field identification.* Golden Press, New York.

Lyttle, R.B. 1983. *Birds of North America.* Gallery Books, New York.

Wheelock, I.G. 1904. *Birds of California.* A.C . McClurg & co., Chicago.

CANADA GOOSE HABITAT MODEL

General

Canada geese are subdivided into numerous subspecies having widely divergent ecological adaptations and habitat needs. The Canada goose inhabits in extensive agricultural area near open, shallow expanses of fresh or slightly brackish-water. Their breeding habitat is nearly all the nonmountainous ares of continental Canada and Alaska. In addition they are also widely spread over the Great Plains and Great Basin of the United States; for example, Aleutian Islands, Newfoundland, and South to Northern America. In the summer, they inhabit marshes, prairies, woodlands, wet and dry tundra, and coastal regions. Wintering areas range from coastal estuaries to impoundments and lakes in the continental interior and also in open county, feeding in fields or at the edge of ponds, or woods. Dzubin (1963) added detail on the distribution of large canada goose in Saskatchewan " large type canada geese are found breeding into the grasslands-parklands ecozone from Manito Lake West of Battleford along the north Saskatchewan River to a point North of Saskatoon.

Food

Mainly vegetable, various grasses, sedges, and aquatic plants. In the extensive agriculture areas, the primary important food for canada geese is waste corn. Other important foods include the leaves, stems, and rootstalks of submerged plants. In areas that food is rather insufficient like in winter areas, shoots of cultivated crops and grain, insects, molluscs and crustaceans are also their food.

Water

Perhaps the only common denominators requisite in all of these habitat types are that they are available in large blocks and include bodies of water of moderate to large size, with a depth of at least 30 inches, and preferably containing islands.

Nest Sites

Nest-building is normally done by the female. Nests are usually well dispersed over the available habitat, but in some situations where favored nest sites are highly limited such as on islands or in relatively safe situations nests are concentrated. One of the more important factors determining areas that are suitable to nesting for Canada goose is the presence of muskrat houses. Everywhere in the prairie sector of its range, nesting on muskrat house has been characteristic of past as well as present-day populations. The muskrat houses, therefore, offer the ecological equivalent of islets or islands which are so abundant in lakes used by nesting geese in Arctic and Subarctic areas (Hanson,1965). Moreover, John (1968) also added that at Bear River Migratory Bird refuge in Utah, 39 percent of 95 nests were on top of muskrat houses, as were 58 percent in Ogden Bay. Paul (1979) reported that Canada geese prefer to nest in locations that allow good visibility, a firm and fairly dry nest foundation, close proximity to water, and nearness to suitable foraging and brood rearing habitats. He also added that the elevated sites are preferred over lower ones, and sand seems to be preferred over cobblestone as a substrate.

Breeding Areas

John (1968) suggested that good breeding areas should have:

1. A browsing area available to nesting birds and to paired breeders prior to the nesting season.
2. Nesting sites with firm foundations that afford excellent visibility and are isolated.
3. A brooding area of open water and low banks with an aquatic feeding area.
4. A cover of emergent plants for use during molting.
5. A browsing area for broods after they have learned to fly.

Nest Size

William and Nelson (1943) found the average nest in the Bear River marshes, Utah, to be 25 inches in diameter at its widest point. Kossack (1950) also found the average size of the nests of Canada geese near Barington, Illinois, was 27 inches by 31 inches.

Cover Types Utilized for Nesting

Descriptions of cover types use for nesting were based upon the material providing concealment and/or support to the nest. Dimmick (1968) found that cover types most often selected for nesting were shrub and driftwood. A number of other types, ranging from dense woods to bare gravel, were utilized for nesting. Nevertheless, several nests were observed in rather unusual situations. For example, nests in the south park Elk Feedgrounds, Jackson Hole, Wyoming were observed on an haystack and in tubs placed in trees. One nest was constructed in a cavity in a large, hollow cottonwood tree. However, Williams and Marshall (1937) stated that vegetation was a major factor influencing the placement of nests located on Bear River Migration Waterfowl Refuge, and found that 30 percent of all nests were located in hardstem bulrush (Scirpus acutus) and 21 percent were located in cattails (Typha spp.) which, respectively, occupied only 3 and 6 percent of the area.

Factors Affecting Nesting Success

The factors that determine the outcome of the nesting cycle may be divided into external or environmental and internal or behavioral and genetic (Hanson,1965).

Environmental factors are ecology factors which have pressures on Canada goose reproduction. In general these factors tend to be density-independent rather than density-dependent. The followings are example of external factors: Flooding is an important external factor to goose nests on most river systems. Flooding destroyed five nests (3.7 percent) in Jackson Hole during the period 1962-1964 (Dimmick,1964). At Honey Lake, California, Dow (1943) found that flooding destroyed 8.9 per cent of the Canada goose nests under observation.

Late Spring storms may be a critical factor in a climatically marginal area. Hanson (1965) reported that at Blackfoot Reservoir the heaviest rainfall comes later in the breeding season during May and produces maximum effects on breeding geese because the storms come during the critical incubation period. Furthermore, they can and usually do come as hail and snow. Deserted nests which have been matted down by excessive moisture are often observed (Jensen and Nelson, 1948).

Predators are also an important external

factor for Canada geese nests. In the far west and on the Great Plains, the coyote (Canis latrans) may be the chief mammalian predator; in the east and northeast portion the red fox (Vulpes fulva) supplants the coyote in important (Hanson,1965). The other predators are crows, ravens, and magpies.

Fire is also a main external factor for Canada geese nests such as on the Great Plains but it would be of little consequence now.

Behavioral and genetic factors. Hanson (1965) pointed out that a population containing a relatively high percentage of 2-year-old females nesting for the first time may have a higher rate of nest loss due to desertion than population composed largely old, experienced, and fully developed sexually mature females Geis (1959) has pointed that nests with large clutches of eggs were usually better hidden and were less frequently deserted or destroyed than nests with four eggs or less.

Migration

Bellrose (1976) said the biological reason for waterfowl migration is for survival. He added that numerous population are prone to leave breeding areas in late summer or early fall,long before weather conditions would seen to dictate. These populations return to their Subarctic or Arctic breeding grounds while snow covers the ground and the first open water is just opening. Most waterfowl would not survive if they did not migrate, for water areas where the bulk of them breed, freezes over, making food unattainable. On the other hand, space and food supplies are insufficient to accommodate them on the winter grounds.

Winter period

The winter period is defined as that time between the autumn migration (late November) and Spring migration (late March). Wintering areas utilized by Canada geese are characterized by the presence of some open water and available food even during the coldest weather (Dimmick,1968). Large rivers and streams fed by warm springs provide the essential component of the wintering habitat. William and Elwood point out that the wintering regions for these Canada geese are Southern California, Southeastern Idaho, and central California. Inventories of these Canada geese concentrations which are restricted to the northern wintering ground are not reliable indications of the trend in the total population or of individual breeding components of this population. Mortality and natality are believed less important factors involved in migration, such as weather, availability of food, and hunting pressure. Fleming (1959) observed that the numbers of Canada geese on Roosevelt Lake, Arizona, during winter were influence by:

- the severity of weather in the Great Basin States.
- breeding success of the various components that make up this composite wintering flock and
- hunting regulations.

Spring period

Canada geese move northward as rapidly as melting snow unearths food and melting ice provides drinking water. Bellrose (1916) said the Canada geese begin to leave their winter grounds in mild temperature zones as early as mid-January.

Summary

Canada geese are the waterfowl habitat and need water and marshes lands that exist along the Jordan River. Several pairs of nesting geese have been observed on the project site. If these wetlands are disturbed, geese will be displaced. Restored wetland and riparian areas together with protected agricultural lands would support a much larger goose (and other waterfowl) population.

Literature Cited

Fant, W.M. *Behavior and Survival of Canada Geese in Utah.* M.S. Theses, Utah State University. 1963.

Frank, C.B. *Ducks, Geese, Swans of North America.* A Wildlife Management Institute Book Sponsored Jointly With The Illinois Natural History Survey. 1976.

Dimmick, R.W. *Canada Geese of Jackson Hole.* Wyoming Game and Fish Commission Cheyenne. Bulletin no. 11. 1968.

Hanson, H.C. *The Giant Canada Goose.* Southern Illinois University Press. 1965.

Hine, L.R and Schoenfeld, C. *Canada Goose Management.* Dember Educational Services. Wisconsin. 1968.

Soothill, E. *Wildfowl of The World.* Blemdford Press and Peter Whitehead. 1978.

U.S. Department of the Interior. Fish and Wildlife Service Bureau of Sport Fisheries and wildlife, Special Scientific Report. Wildlife no. 65. Washington. 1962.

U.S Department of The interior. Fish and Wildlife Service Bureau of Sport Fisheries and Wildlife, Special Scientific Report no. 229. *The Rocky Mountain population of the Western Canada Goose; Its Distribution, Habitats, and Management.* 1990.

Vaught, R.W. and Kirsch, L.M. *Canada Geese of The Eastern Prairie Population, with Special Reference to The Swan Lake Flock.* Missouri Department of Conservation. 1966.

Wormer, J.V. *The World of The Canada Goose.* J.B. Lippincott Company. Philadelphia. New York. 1968.

MUSKRAT HABITAT MODEL

Introduction

The muskrat lives in a variety of habitats, from typical valley marshes and streams to beaver pools at 10,000 feet, beaches along the Pacific Ocean, desert springs, irrigation ditches and reservoirs, and in almost every thinkable combination of food and water furnishing living requirements for muskrats. In going about living muskrats are industrious and crafty, and have a strong will to live and a way of keeping at their job of staying alive. "If they do not actually inherit the earth, it is not because they are unwilling to try (Errington, 1978)." What follows is a description of the habitat factors important to muskrat management.

Food Requirements

Muskrats are mostly herbivorous although animal matter is sometimes consumed during the winter when vegetation is scarce (Errington, 1978). Muskrats are able to utilize a variety of plant species as food and diet will vary with type of habitat. Neal (1968) found that the basal portions of aquatic vegetation are eaten most often followed by the rhizomes and leaves. According to Sather (1958) cattail (*Typha spp.*) is the most preferred food of muskrats. Errington (1948) found that the broad-leaved cattail (*Typha latifolia*) was highly preferred and, according to him, would support muskrat populations nearly twice that of other vegetation. He found in Iowa the highest density recorded for bulrush marshes was 15-20 muskrats per acre compared with a maxima of 35 per acre for cattail marshes. Other important food plants include sweetflag (*Acorus calamus*), waterlily (*Nymphaea spp.*), arrowhead (*Sagittaria spp.*), sedge (*Carex spp.*), and wild rice (*Zizania aquatica*) (Sather, 1958). Errington (1978) points out that stream and canal-dwelling muskrats tend to have a more diverse diet and that agricultural crops will meet the dietary needs of stream-dwelling muskrats. Submergent vegetation appears to be of little dietary value to muskrats.

In constructing a habitat model for identifying favorable muskrat habitat, Brooks and Dodge (1981) found that open or agricultural land had a positive influence on burrow location and density. It is unclear from this analysis if this is food related or related to some other factor.

The density of emergent vegetation is a critical factor in evaluating muskrat populations. Neal (1968) found that increasing populations were associated with more dense vegetation. Errington (1978) rated marsh conditions as excellent when two-thirds of the marsh was covered with emergent vegetation, but gave a poor rating to a marsh with only 17% coverage. It is difficult to separate the importance of vegetation in providing cover from its role as a food source.

Muskrat feeding and house construction can have a detrimental effect on aquatic vegetation. Danell (1978) reported that stands of horsetail (*Equisetum fluviatile*) decreased as muskrat population density increased. Errington (1978) found that high muskrat population density may result in elimination of preferred plants and eventually result in a decline in muskrat populations.

Water Requirements

Suitable muskrat habitat requires a consistent supply of still or slow moving water. According to Brooks and Dodge, stream discharge and gradient was a very important factor in predicting quality of streams for muskrat habitat. They found that rapids were avoided by muskrats while backwater areas and coves provided the best conditions.

Both low and high water conditions have a detrimental effect on muskrat populations. Errington (1978) stated that muskrat population density was more affected by changes in water levels than by the types of emergent vegetation present. According to him low water levels result in reduced food and cover availability while high water also results in habitat deprivation by altering vegetative composition and forcing muskrats out of refuge.

Cover Requirements

High quality muskrat habitat along streams generally has an abundance of retreats. According to Errington (1937), these include downfall, lodged debris, deep pools, backwaters, undercut banks and areas bordered by dense herbaceous vegetation.

Muskrats construct conical lodges from plant material or in its absence may dig burrows in the banks adjacent to aquatic habitats (Errington, 1978). The ability to build either type of shelter is probably one of the reasons it is so successful and wide ranging.

In river environments the main channel may serve as a travel avenue, large streams and rivers are generally unsuitable habitat if they are subject to fluctuating water levels, or are highly turbid (Errington, 1963). In these conditions, muskrats may be common in oxbows, tributary streams and canals, or wetlands adjacent to the main channel (Brooks and Dodge, 1981).

Range Requirements

Neal (1968) believed that habitat quality was more important in determining muskrat density than were intraspecific interactions. Danell (1978) found that the mean distance between muskrat lodges was 110 m (360.8 ft) and no houses were closer together than approximately 40 m (131.2 ft). In a New Bunswick study they recorded that most muskrats remained in the same habitat type, within a relatively confined area. With captured and marked muskrats they found that no recoveries were greater than several hundred meters from the site of tagging and all were within the expected cruising distance (Parker and Maxwell, 1980).

Management as a pest

According to Errington (1978), when it is desirable to keep muskrat populations as much reduced as possible, trapping has proved to be as effective as any method in common use. Systematic destruction of burrows should be carried out in places where no muskrats are wanted. As well, areas needing protection could be guarded by galvanized wire mesh or rocks along a heavily used migration route of muskrats.

Literature Cited

Brooks, R.P., and W.E. Dodge. 1981. *Identification of muskrat habitat in riverine environments.* Proc. Worldwide Furbearer Conf. I:113-127.

Danell, K. 1978. "Intra- and

interannual changes in habitat selection by muskrat." *J. of Wildlife Management* 42(3):540-549.

Errington, P. L. 1937. "Habitat requirements of stream-dwelling muskrats." *Trans. of N. America Wildlife Conf.* 2:411-416.

----------. 1948. "Environmental control for increasing muskrat production." *Trans. of N. America Wildlife Conf.* 13:596-607.

----------. 1978. *Muskrats and marsh management.* U. of Nebraska Press, Lincon, NE.

Neal, T. J. 1968. "A comparison of two muskrat populations." *Iowa State Journal of Science* 43(2):193-210.

Parker, G.R., and J.W. Maxwell. 1980. "Characteristics of a population of muskrats (*Ondatra zebethicus*) in New Brunswick." *Canadian Field-Naturalist.* 94(1):1-8.

Sather, J.H. 1958 "Biology of the Great Plains muskrat in Nebraska." *Wildlife Monographs* 2.

HABITAT MODEL FOR THE RED-WINGED BLACKBIRD

The Red-winged blackbird, (Agelaius phoeniceus), or Redwing, is a very common North American migratory song bird. Their summer breeding range extends from east-central Alaska and the Yukon south to northern Costa Rica, and from the Atlantic to the Pacific. Although they are migratory, some winter as far north as southern Canada. There are also a few flocks that are year-round residents of California. They can be found in almost any marshy, wet area in Utah in the summer, except at the highest altitudes.

The male Redwing is a distinctive black bird with bright red shoulder patches on the wings, weighing about 65-80 grams. The females are about two-thirds the size of the males. They have a black and white striped breast with a brown back. Older females will have reddish shoulder patches on their wings. The subspecies found in UTah is noted for having exceptionally bright red wing patches.

Flocks of male Redwings arrive in Utah early in the spring, often while there is still snow on the ground. They stake out their territories, flashing their red wings at each other and singing loudly. First year, those born the previous summer, males do not breed, and there may be other males who do not manage to stake out a territory and so will not breed that year. The females arrive a few weeks later and start looking for places to nest. The males renew their displays, not only letting the other males know where the boundaries are, but also trying to entice the females. The females check out the territories, looking for the best place to nest. Since the first year females will mate, there are more females than males, so several may mate with one male. Generally the male will only try and court with one female at a time. This means females will be nesting at different times. Although the males do not take an active role in patenting, they may help to feed the nestlings. This results in the earlier nesting females performing their own territorial songs and displays, as they attempt to drive other females away from their mates. This makes the Redwing one of the few species of song birds where the females sing. Territories may change throughout the breeding season, but mostly they remain constant once they are established. The average territory is about 60′ square.

The males need to have tall shrub or tree that he can perch on within the territory. They are very bold and have been known to attack small hawks and even people that venture into their territory. Although the female Redwing prefers a cattail marsh with lots of edge where she can hide her nest and approach from the side, they can be found nesting deeper in the cattails, or even in an upland meadow. If the area also has Yellow-headed blackbirds, the Yellowheads will claim territories nearest open water and the Redwings will claim territories around the periphery. The females build nest by weaving wet strips of cattails, bulrushes, or wet blades of grass which dry into a hard pouch firmly attached to dry cattail stalks, or possibly a shrub. They line the pouches with softer materials before laying anywhere from 2 to 7 pale bluish-green eggs. She will incubate the eggs for 11 or 12 days before they hatch. Sometimes the female will mate twice in a season, having two separate broods.

The female is almost entirely

responsible for raising the young. She builds the nest, incubates the eggs, and cares for the hatchlings. The males occasionally feed the nestlings. Early in the spring the birds eat mostly insects and spiders. Males seen pecking at cattails are probably eating cattail moth larvae. The young are fed on emerging aquatic insects and other invertebrates. The Redwings can often be seen foraging in upland areas on spring and summer afternoons. They do not find all their food on their territory. In the fall the diet changes to include more seeds and sprouts. A flock of Redwings that are getting ready to migrate can descend on a corn field and destroy it. But even when their diet includes corn and other crops, they are also eating insect pests and weed seeds.

Coyotes, foxes, raccoons, skunks, hawks and weasels will all prey on the Redwings. In addition, carp and other birds will compete for the same food supply. But these and human hunters have made little impact in the population of the Redwings. Winter flocks of the birds often number in the tens of thousands.

Literature Cited

Nero, Robert W. 1984. *Redwings.* Smithsonian Institution Press, Washington, D.C.

Orians, Gordon H. 1980. *Some Adaptations of Marsh-nesting Blackbirds.* Princeton University Press, Princeton, New Jersey.

CHAPTER 11: PREPARING AN URBAN WILDLIFE HABITAT ORDINANCE AMENDMENT AND OTHER IMPLEMENTATION TOOLS

Introduction

At this stage in the Urban Wildlife Conservation and Management Planning Process the community has already taken a number of important steps. It has recognized the need for action to preserve and enhance wildlife habitat and it has conducted an inventory of habitat resources, set goals and objectives, and developed an Urban Wildlife Conservation and Management Plan. The next step is to develop a strategy for implementing the Plan.

The strategy is a technique to get the community from Point A, where it is now, to Point B, where it would like to be. Point A is determined by the status of conservation in the community and by natural resources. Point B is the goals from the program planning. Developing a successful strategy will involve the entire Advisory Board and will require the cooperation of a number of other participants.

Each community operates under different policies and values. The implementation tools must reflect these values if there is to be public support. A variety of implementation tools is available. These tools can be adopted to community-specific situations. There are four broad approaches to implementation: acquisition, voluntary action, special strategies, and regulation by ordinance. In addition, it is often possible to approach and convince developers of the benefits of the Plan.

Acquisition

Acquisition of privately owned land has traditionally been the technique to add land to parks and open space systems. It is the best means of protecting habitats that are central to an Urban Wildlife Conservation and Management Plan. However, decreased government funding has made it necessary for communities to find new means of financing land acquisitions. Murray, Utah, showed what can be accomplished through innovative funding. The city used federal and state matching funds, Jordan River Parkway funds, capital improvement funds and a percentage of golf course revenues to purchase 70% of the available land along the Jordan River for public open space. Much of this land is or could be high quality wildlife habitat. Murray City passed a 1.5 million dollar bond to acquire the remaining 30% over the next several years. Communities may acquire valuable wildlife habitat through donation. Perry, Utah, has a 15 acre wetland park that supports a number of breeding waterfowl thanks to a land donation by a former resident. Other forms of acquisition include acquisition of development rights for conservation easements and transfer of development rights and easements. (See Table 1.)

Volunteer Action

Volunteer action is an effective way to implement the Plan on both private and public property. Neighbors working together to coordinate the planting and management of backyard landscapes can create patches of habitat large enough to attract and retain species that would not normally be found in suburban landscapes. There are numerous examples of volunteer groups improving the quality of habitat in public parks and open spaces. Each year volunteers and personnel from city, county, and state agencies enhance the habitat diversity of the Ogden Nature Center in Ogden, Utah. Three years ago over two miles of shelterbelt were planted by volunteers with assistance from the Division of Wildlife Resources. Last year two wetlands were dug by the county and planted by volunteers. Volunteer groups such as the Audubon Society offer public outreach and education programs.

Special Strategies

Other special strategies can be used to implement the Plan. They all revolve around one common concept integrating the Wildlife Conservation and Management Plan into city or county open space plans and other environmental programs. Some of these plans and programs include:

- City and county comprehensive plans
- City and county open space or recreation master plans
- Storm water and flood control programs
- City and county trail plans
- City forestry programs
- Outdoor education programs
- State comprehensive outdoor recreation plans (SCORP)
- Soil Conservation Service programs

The Urban Wildlife Conservation and Management Plan can benefit from any program that aims to preserve, enhance or rehabilitate the environment. Salt Lake City and Murray, Utah, are using previously abused wetlands as part of their storm and waste treatment system. Waterfowl, shorebirds, many passerine species, small mammals, amphibians and reptiles all benefit from these progressive programs. The cooperation of City departments, DWR, State Parks and Recreation and Utah State University has been the key to these success stories.

However, certain aspects of some community programs can hurt wildlife habitat. Negotiation and compromise are necessary to resolve conflicts in program objectives. Recently a master plan was completed for eight miles of open space adjacent to the Snake River in Idaho Falls, Idaho. Funding for the project came from the city, State of Idaho, a local foundation, and a private donor. The funds were originally for improvements to undeveloped open spaces. "Improvement" was generally assumed to mean thinning of trees, removal of native shrubs and grasses and planting blue grass and shade trees. After several planning meetings, wildlife planners persuaded city officials and representatives from other funding sources that many existing stands of vegetation did not need to be "improved." The excellent habitat value of the native vegetation was preserved and integrated into the open space system. The funds for improvements could then be applied to landscaping a few sites within the eight-mile corridor. These had limited wildlife value but were excellent locations for more active kinds of parks. Murray City, Utah, is following similar procedures for developing four miles of the Jordan River.

Through cooperation with other programs, wildlife can benefit from money spent for other community and environmental goals. Whenever possible the Advisory Board should seek out cooperative arrangements. This chapter is on how to use existing federal, state and local statutes, prepare an ordinance, and develop a set of implementation tools.

Most communities will need to develop some type of land use regulation (a zoning ordinance amendment) that is specific to wildlife habitat conservation. Regulation is necessary for two reasons. First, much of the land that will be included in the Plan is privately owned. Its use is controlled by zoning ordinances which generally do not protect wildlife habitat. Second, there is seldom enough funding for a community to acquire all lands included in the Plan. Even if there were, it would not be feasible for the community to administer such a large land area. Regulation ensures that the community's goals and values are expressed and can be implemented.

Drafting an Ordinance Amendment

An ordinance amendment establishes the urban wildlife program within city or county government and addresses the issues of wildlife habitat not covered under federal, state, and local statutes. An Urban Wildlife Habitat Ordinance as an amendment to zoning and subdivision ordinances gives the urban wildlife program legal standing. With the statement of goals the ordinance defines the legal responsibilities for the program. The ordinance makes the Urban Wildlife Advisory Board responsible for program direction and specifies the number of Advisory Board members, duties and terms, as discussed in Chapter 5. It may also recommend a position for an Urban Wildlife Specialist and specify the duties of that position.

In addition the ordinance amendment should specify a Wildlife Habitat Overlay Zone with specific land management and site development regulations. This zone would apply only to those lands included in the Urban Wildlife Conservation and Management Plan. The overlay zone protects special community resources such as historical districts, agricultural lands, and environmentally sensitive areas. Salt Lake City has set the precedent for the use of the overlay zones in Utah. Its Foothills Ordinance protects the fragile foothills landscape. Cities and counties in other states have used overlay zones to protect irreplacable natural resources.

The Urban Wildlife Habitat Ordinance and overlay zone must extend police powers through an enabling act stated in the Utah Code. Title 17 Chapter 27 of the Utah Code sets forth the powers of the counties to engage in zoning. Cities and towns find their authority to zone in Chapter 9 of Title 10 of the Utah Code, sections 1 through 30 under the heading "Municipal Planning Enabling Act." This means that local governments need not pay private property owners, subject to the restric-

tions in the Urban Wildlife Ordinance. The Plan, incorporated into the Comprehensive Master Plan, promotes the health, safety, morals, and general welfare of the community. The restrictions for the overlay zone would regulate land use activities within the zone in the same way that restrictions do for other land uses.

The most legally defensible land use regulations—and this would apply to a Wildlife Habitat Overlay Zone—address well-documented public concerns. They are clear, resulting in minimum administration, and easy to understand. They are flexible, to let developers comply in creative ways. The purpose of land use regulation is to encourage the beneficial impacts of development and to do away with the undesirable ones. (Wickersham, 1981).

Some caution is necessary because litigation can set back an Urban Wildlife Conservation and Management Program. The courts have regularly upheld reasonable regulations, and a community should not be intimidated from developing an ordinance.

Laying the Groundwork

To ensure that the Urban Wildlife Habitat Ordinance works in coordination with the existing community structure, participants in the ordinance preparation should represent diverse interests. These include:

Urban Wildlife Advisory Board Members:
Role - To ensure that the goals and objectives of the Plan can be accomplished.

Representative of the development industry:
Role - To represent the building industry's point of view and to ensure that the ordinance and implementation tools are technically and economically feasible.

City or County planning staff member:
Role - To ensure that the ordinance and all proposed implementation tools are in harmony with the comprehensive plan and that existing incentive programs and regulations are used where possible.

City or County Parks and Recreation staff member:
Role - To represent those who will administer and manage public open space.

Planning Commission Representatives:
Role - To represent the concerns of the general public.

City or County Attorney:
Role - To ensure that the ordinance and all implementation tools comply with federal, state and local statutes and to draft the final ordinance and incentive programs which will be forwarded to the elected officials for a vote.

The committee should begin preparing an ordinance by reviewing the goals and objectives in the Urban Wildlife Conservation and Management Plan Report. This will allow all members to become familiar with the intent of the program. Next, the committee should identify which incentive programs and regulations already in place can be used to advance the Plan. Existing federal, state, and local statutes may help accomplish many of the goals outlined in the plan. If additional regulations or incentives are required, examples from other communities may suggest options that, when modified, could be applied. To make the committee's search and review procedures as efficient as possible, the following process is suggested:

1. Review federal and state agency programs and regulations that may apply to lands in the Plan.
2. Review local regulations and programs that may apply to the lands in the Plan.
3. Review ordinances from other communities for strategies that may apply to the local situation.
4. Develop an Urban Wildlife Habitat Ordinance that fills the voids in federal, state, and local statutes.
5. Select other tools to complement the ordinance that will be in harmony with the community's political climate, financial situation, and legal statutes.

1. REVIEW FEDERAL AND STATE AGENCY PROGRAMS AND REGULATIONS:

Federal and state environmental regulations and programs provide a base upon which to construct local implementation strategies. Federal and state regulations can be used if local regulations are adapted to them. Funding may be obtained through many federal programs that depend on environmental regulation, compliance or grants-in-kind. Such funding can be applied to land acquisition or site enhancement. In addition, by complying with federal and state regulations, the community may be able to affect state and federal agencies concerning permit issuance and the

accompanying constraints. This may include such permits as the Army Corps of Engineers' 404 Permit required for wetlands dredging and filling and the 100 Year Floodplain Identification as part of the National Flood Insurance Program.

For example, several wetlands along the Jordan River will be acquired or enhanced with money acquired under the 404 Permit for the loss of wetlands from the construction of the Jordanelle Dam. The upcoming Federal 319 Water Quality Program will require communities to meet strict standards for urban runoff into streams or rivers. Looking ahead, Murray City may use wetlands along the Jordan River to "treat" some of its urban runoff as a relatively inexpensive way to comply with 319 standards. Many Utah communities will already protect some floodplains and riparian and wetland resources because of restrictions in the National Flood Insurance Program.

The committee should list all federal and state regulations and programs that apply to the Plan. As illustrated in Tables 1-2, they should assess the value of each program by its spatial application, type of habitat influenced, effect on habitat, benefits, and cost to the community. This assessment will help identify potential conflicts and opportunities.

Table 2 is a reference of programs in Utah that may apply to a community's Urban Wildlife Management and Conservation Plan. Some programs are more active than others and funding varies according to appropriations from federal and state legislation. Although one agency is listed for each program, often more than one will be involved. Most of these programs are not specifically designed for protection of wildlife habitat. However, they provide opportunities for land acquisition and habitat regulation and management. These aspects of the program are emphasized in Table 3.

2. REVIEW LOCAL REGULATIONS AND PROGRAMS:

Federal and state regulations will not cover every local situation. Often program funding and enforcement are uncertain. Many programs are subject to the whims of politics. Therefore, the committee needs to identify those situations that would not be covered by federal and state programs. Examples could include preservation of locally significant migration corridors or the fact that threatened sage/grassland, barren areas, woodland and other habitat types are not expressly addressed by federal or state statutes.

Local city or county statutes, land use regulations, policies, and standards may start filling the gaps in federal and state statutes. Often enforcing existing ordinances is all that is needed. For instance, the Salt Lake City Foothills Ordinance provides some protection for wildlife by reducing soil erosion and conserving vegetative cover. Strict enforcement of the Foothills Ordinance would benefit many species along the Wasatch Front. Similarly, strict enforcement of "no dumping" regulations along creeks, streams, and rivers would preserve valuable riparian habitat.

Some ordinances may need only slight additions to apply towards protection or enhancement of wildlife habitat. For instance, additions to subdivision regulations could limit development to areas least used by wildlife, regulate the removal of trees and understory vegetation from stream corridors, and protect all existing trees not designated for removal. This would enhance habitat values.

Avoid adding new regulations when changes to existing ones will do. However, the many unique habitats and the species they support may not be sufficiently protected under zoning ordinances and subdivision regulations, even if they are modified. The committee should make one list of statutes that could be applied to wildlife habitat and a second list of incentives and regulations that might be needed. The representative of the planning staff will be an important resource here. The assessment should be similar to the one described for the review of federal and state programs. It should also look at positive and negative effects that the regulation or incentive has on habitat. The committee should assess the value of each regulation and incentive by its spatial application, type of habitat influenced, potential positive and negative effects on wildlife habitat, and ways to improve wildlife habitat (Table 3). This assessment will help identify regulatory gaps, conflicting regulations, and harmful policies.

Tables 1-3 are a reference of regulations and incentives that can be used within the community structure. The committee should determine how well a particular incentive or regulation fits into the economic and political fabric of the community. Knowledge of the community and sound legal advice are important.

3. REVIEW ORDINANCES FROM OTHER COMMUNITIES:

A review of programs used in other communities will show typical issues plus regulations and incentives that are politically feasible. Examples of western cities and counties with wildlife habitat provisions included in their planning and zoning ordinances are Aspen, Boulder and Fort Collins, Colorado; Boise, Idaho: Portland, Oregon; and Lincoln and Teton Counties in Wyoming. These programs can be studied for general

concepts and technical content. However, modify them to meet your community's circumstances. Ordinances from other communities should not be copied verbatim. List general concepts and technical content which can be used when preparing the ordinance.

4. DEVELOP AN URBAN WILDLIFE HABITAT ORDINANCE THAT SUPPLEMENTS FEDERAL, STATE AND LOCAL STATUTES:

Keeping in mind the guidelines discussed earlier in this chapter, begin drafting the ordinance. First, determine what goals and objectives must be achieved by ordinance. These are goals that are not achieved by existing federal, state, and local statutes. Draft one list of provisions for the ordinance and another of incentive programs that are needed. Discuss these provisions and incentives thoroughly. Be patient; it will take time to reach a consensus. Ask the city or county attorney to review the draft document. It may require several revisions before all committee members agree.

Determine the complexity of the ordinance by the available technical and administrative expertise. A small community may not be able to afford the technical and administrative staff to oversee the program. Administration would become the responsibility of an existing staff person; a zoning administrator for example.

Since in most cases the Wildlife Habitat Ordinance will be an amendment to existing zoning and subdivision ordinances, it is important that the language is compatible and that it does not conflict with existing statutes. Keep the administration as simple and direct as possible. Larger communities may be able to hire an Urban Wildlife Specialist to administer the program.

5. SELECT OTHER TOOLS TO COMPLEMENT THE ORDINANCE AND HARMONIZE WITH THE COMMUNITY'S POLITICAL CLIMATE, FINANCIAL SITUATION, AND LEGAL STATUS:

Ordinance Components

The following description of an ordinance has been taken from A Community Forestry Manual for the Cities and Towns of Utah and Southern Idaho (Johnson et al., 1982). Wording has been modified to apply to the wildlife habitat resource. Examples of existing ordinances are included in Appendix E. An effective ordinance will include most of the following section. Those marked with an asterisk are absolutely necessary.

* **Purpose and findings.** This section should include a short description of why the municipality has written the ordinance and what "public good" will be promoted. This section may include findings of the Advisory Board or of the Board recommending the ordinance.

* **Definitions.** These should be very specific and are necessary to reduce challenges.

* **Authority.** A provision necessary to establish legal authority for an Urban Wildlife Advisory Board. It can delegate authority to the city employer, such as the Urban Wildlife Specialist or Director of Parks, upon commission approval, allowing him/her to enforce the ordinance. The term of office, the compensation, rules and duties of the board may be included here.

* **Requirements.** Depending on the level of jurisdiction, the Urban Wildlife Habitat Ordinance must establish whatever requirements are deemed appropriate by the Advisory Board. These requirements may include any or all of the following categories:

Urban Wildlife Habitat Zone: The ordinance can specify that an overlay zone which places additional requirements on the base zone be applied to all private land included within the Urban Wildlife Conservation and Management Plan. The overlay zone is not intended to change the base zone (the zone delineated on the comprehensive plan) but rather to provide adequate protection of wildlife habitat in case of development. For example, the overlay could specify setbacks, prescribe vegetation management practices, require land rehabilitation of disturbed areas, and regulate other land management practices both during and after construction.

Incentives: Because an overlay zone restricts development in certain ways, the ordinance may include incentives. This will help developers to comply with the ordinance and to carry

opers to comply with the ordinance and to carry the spirit of the overlay zone into developments outside of land areas regulated by the Plan. Incentives include density bonuses scaled to acreage either preserved or enhanced; counting acres of preserved wildlife habitat toward required open space dedication acreage; permitting the transfer of development rights from land preserved as wildlife habitat to lands more suited for development elsewhere in the community; providing plant materials for habitat enhancement from the city, county or state nursery; and providing habitat planning and design assistance.

Site Plan Review: As a condition for development of private lands, the ordinance may require additional wildlife-related site information. It can also require special review procedures to ensure that the development complies with the Wildlife Habitat Overlay Zone. Additional review procedures should be coordinated with the plan review so as not to delay the project approval.

Management Requirements: This includes specifications for activities such as planting, weed control, vegetation manipulation, water level maintenance, wildlife pest species control, treatment of plant diseases, etc. on public land. This material should be supplemental to the ordinance.

Management Responsibilities: This is a critical element of the ordinance and must clearly define what the city or county must do to manage urban wildlife habitat on public land. In general, the city or county must maintain a healthy and safe habitat.

Permits: The ordinance may require that the Advisory Board issue a permit before a landowner or utility can make any major modification to vegetation on land in the Plan–removal of large trees for example.

Plant Species Lists: The ordinance may specify plant species recommended for planting within each type for all land in the Plan or may recommend these species to adjacent land owners on either a voluntary or incentive basis.

- **Interference/Enforcement**: The ordinance should also state that non-compliance is illegal and subject to prosecution. An ordinance is effective only if it is enforced. A city or county must be willing to back up the ordinance with whatever it takes to enforce it. An appeals procedure must be available. In most cases an enforcement clause will already be a part of the zoning ordinance.

Ordinance Environmental Requirements

The performance standard requirements below are based upon information in the literature, ordinances from several western cities and counties, and the opinions of biologists, landscape architects and planners. The requirements prescribe buffer and corridor widths and landscape management activities to be met within the overlay zone. The ordinance for Aspen, Colorado, is a good example of a prescriptive ordinance. The requirements have been tailored to the intermountain desert landscape. A prescriptive ordinance cannot protect all habitat functions for a species or even a group of wildlife species. The complex nature of ecosystems makes such precision impossible. Ecologists and biologists, however, agree that even minimal widths of protected habitat can help maintain healthy populations of some wildlife species.

For communities with a professional planning staff, a performance-based ordinance–one which specifies outcomes and leaves the means to the developer–is a good alternative. Ordinances of this type afford developers flexibility in achieving habitat protection. The ordinance for the city of Fort Collins, Colorado, (Appendix E) is a good example of the performance-based approach. However, the expertise of a planning staff is often required to adequately review plans and ensure that the proposed development will protect the habitat.

Each community must draft an ordinance that fits its specific resources and politics. Listed below are requirements that should be part of the ordinance and recommendations that should be provided in printed materials given to home owners and developers.

Recommended Performance Standards For Wildlife Habitat Overlay Zone

Physionomic Type	Performance Standards
Aquatic areas	● Modification of vegetation is prohibited except to provide access from a property to open water for recreation or to improve habitat for wildlife.
Wetlands	● Regulations for aquatic areas apply to wetlands. ● Draining, filling, or development of wetlands as defined in section 404 of the Federal Water Pollution Control Act shall be subject to regulation under section 404. ● A 100 foot transition zone shall be maintained free of development from the edge of the wetland (as delineated by the Army Corps of Engineers) to the adjacent upland. ● Management practices to minimize soil erosion in all properties immediately adjacent to wetlands shall be required such as drainage detention basins, grassed water ways, silt barriers, etc. ● Wetland edges devoid of vegetation due to human disturbance or to livestock shall be revegetated. A list of suggested plant species is included in Appendix D. Revegetation plans shall be approved by a representative of the DWR. ● Sediment basins for all major ditches or canals flowing into a wetland shall be required. ❖ The use of herbicides, pesticides and fertilizers within the setback zone is prohibited (except to remove designated noxious weeds) and shall be minimized on land outside the setback to reduce water pollution.
Riparian Areas	● No building, hard-surface paving (other than trails) or fencing shall be permitted within 100 feet of the mean high water level of rivers, streams, canals, lakes, or reservoirs. ● Removal of vegetation in riparian and shoreline areas within the setback zone shall be prohibited except to protect public safety. ● No channel modifications shall be permitted unless it would improve habitat for fish populations or would protect public health and safety. Any proposed modification would be subject to approval by the city or county engineer, DWR personnel, and the Army Corps of Engineers as required under the 404 permitting process. ● Adequate erosion control measures shall be incorporated in any site plans, including documents that illustrate how erosion will be controlled on all land abutting riparian areas during construction. ● Bridges shall be used instead of culverts when a stream or river crossed by a road or trail supports a fish population or is a movement corridor for wildlife. ● Clearing and grading in all developments outside but immediately adjacent to the setback shall be revegetated during the first suitable planting season. All sediments shall be retained on site during construction.
● Requirements ❖ Recommendations	● Modification of existing river or stream oxbows (even outside the setback) shall be prohibited, except to improve their quality as habitat for wildlife.

Physionomic Type	Performance Standards
Riparian Areas (Cont.)	● Any proposed stream bank stabilization shall be approved by the city or county engineer, a representative of the DWR, and the Army Corps of Engineers under the 404 permitting process. ● All areas within the 100 foot setback zone that are devoid of vegetation shall be revegetated. A list of suggested plant species is included in Appendix D. Revegetation plans shall be approved by a representative of the DWR. ❖ The use of herbicides, pesticides and fertilizers within the setback zone is prohibited (except to remove designated noxious weeds) and shall be minimized on land outside the setback to reduce water pollution. ❖ On-site retention of all surface runoff is recommended for all development within the riparian zone. ❖ The riparian setback zone shall be fenced if cattle are grazed and gaps in the fencing provided if the river, stream or canal is to be used for watering. Water gaps shall be sufficiently armored with rock or other suitable material to reduce turbidity caused by wallowing cattle. ❖ Tall mature trees and standing dead trees shall be retained as resting sites or for cavity nesting species unless public safety would be threatened. ❖ Road and trail crossings over perennial streams shall be minimized. ❖ Removal of trees beyond the 50/100 foot setback lines shall be limited to those necessary for road access and building construction. ❖ Keep patch sizes as large and contiguous as possible.
Grasslands/Shrubland	● Development shall be limited to those portions of the site with the least value to wildlife. ❖ Keep patch sizes as large and contiguous as possible.
Woodland	● Development shall be limited to those portions of the site with the least value to wildlife. ● Development in drainage ways shall be prohibited. ● Removal of vegetation on slopes over 35 percent shall be limited. ● Removal of trees and understory vegetation shall be only what is necessary for the construction of roads, buildings, parking, and utilities. ❖ Keep patch sizes as large and contiguous as possible.
Barren Land Areas	● The impact of development on naturally occurring barren land areas has not been studied. Many of the wildlife species that use mudflats, playas, and similar barren areas require large open spaces. Because there are no precedents, it is recommended that setback requirements be negotiated, with final approval by a representative of the DWR.

Special Situations Across Types

Migration and Movement Corridors	● Migration corridors may cross any or all of the types listed above. Developments that block migration corridors shall be prohibited.

Physionomic Type	Performance Standards
Threatened , endangered and Locally Rare Species	● No development shall be permitted inside the overlay zone on lands within the setbacks that the DWR has determined are critical to the survival of an endangered, threatened, or locally rare species.
Managed Open Space	● Aquatic areas, wetland, and riparian areas within or bordering on managed open space shall be managed under performance standards above. ● Parks, playgrounds, golf courses, cemeteries, and other managed open spaces should be planned and managed as recommended in Chapter 14.
Agriculture Lands	● Agricultural lands shall be managed under the Best Management Practices specified for the type of soil as prescribed by the Soil Conservation Service. ● Aquatic areas, wetlands and riparian areas contained within or bordering on agriculture land shall be managed under performance standards above.

Mitigation

The best way to mitigate damages to wildlife habitat is to avoid or minimize disturbance. Preservation of wildlife habitat may reduce overall construction costs, increase property value or provide functional benefits such as storm water management or sites for recreation. Harm can be mitigated through regrading and revegetation. However, development impacts often cannot be avoided nor can they be mitigated effectively. In such cases replacement of the habitat lost, purchase of equivalent habitat, or enhancement and payment in lieu of replacement may be required.

Mitigation is required for unavoidable harm to wetlands under the Section 404 of the Water Pollution Control Act. The committee should consider preparing a section of the ordinance that specifies reasonable mitigation requirements for impacts caused by development to the other physionomic types in the Plan. All mitigation proposals would be subject to review by the Urban Wildlife Advisory Board and representatives of the DWR.

Summary

The final step toward achieving the community's goals as outlined in the Urban Wildlife Conservation and Management Plan is implementation: Doing it. Four broad approaches can be used: 1) acquisition; 2) volunteerism; 3) a mix of other strategies; and 4) regulation. Although much can be accomplished with the first three, regulation will probably be needed because privately owned land often comprises a major portion of the habitat identified in the Plan. Protection of wildlife habitat in these areas is typically not covered in existing ordinances. The Urban Wildlife Ordinance must be reasonable in content and fair in application. It must be simple and compatible with other regulations. Legal challenges will be minimized if the provisions in the ordinance are supported by an inventory of the type described in Chapter 9. Scheduled evaluations and enforcement are necessary for compliance. Biological, regulatory, and socio-economic impacts of the implementation strategy should be monitored. The community then has a reference base for fine-tuning the program and for changes when they are needed. If it becomes apparent that implementation is ineffective, then it must be modified so that public confidence is restored, developers believe they are being treated fairly, and wildlife habitat is not lost.

Table 1. Local Regulations (R) and Incentives (I) for Implementation

Regulation or Incentive	R	I	Legal Framework	Objective	Advantages	Disadvantages
Community Master Plan			Utah Municipal Planning Enable Act for cities; and Zoning and Planning Act for counties, Title 10, Utah Code. Not a Regulation per se but a necessary prerequisite for effective regulation.	1. Guide to future community development in order to create and maintain a desirable environment and promote health, safety, welfare and convenience. 2. Reflect the aims, goals and ambitions of the citizens of the community.	1. Land is identified in advance of development as habitat. 2. Coordinates and sets sound policies for development from the Master Plan. 3. A sound plan is the prerequisite forum of the following implementation tools.	1. Sometimes lacks implementation via zoning or other means.
Conventional Zoning	✓		Utah Municipal Planning Enabling Act for cities and Zoning; and Planning Act for counties, Title10, Utah Code.	1. Plan for orderly growth of a community through land use regulation according to the master plan.	1. Prescribes density according to the Master Plan. 2. Generally an accepted method of land use control.	1. Limited development constraints. 2. Variances often abused.
Subdivision Ordinance	✓		Utah Municipal Planning Enabling Act for cities and Zoning; and Planning Act for counties, Title 10, Utah Code.	Review of subdivision plans that include regulations, improvements required and design standards.	Regulation relating to improvements and lot layout.	1. A very limited tool except when used in association with zoning.
Subdivision Regulations: Mandatory Dedication, Off-Site Facilities, and Density Restrictions	✓	✓	Amendment to subdivision ordinance.	1. Provide open space and habitat in new development. 2. Distribute open space and habitat throughout the community.	1. Requires that developer set aside open space which may be sensitive lands of wildlife habitat. 2. Sometimes the developer may be allowed to pay fees in-lieu of land. Wildlife habitat can be purchased elsewhere with these funds.	1. Parcel designation is piecemeal. Parcels must be connected for viable habitat. 2. Must set standards for quality of land set aside. 3. Cannot always be used by itself to effectively protect habitat. 4. Requires sophisticated legal advise.
Acquisition: Fee simple or easements through gift or purchase *		✓	Legal agreement between land owner and the purchaser.	1. Protect habitat permanently from private development. 2. Reduce flood losses in riparian corridors. 3. Can permit educational and scientific use. 4. Can permit recreational use.	1. No constitutional problem of uncompensated "taking." 2. Permanent protection.	1. Costly 2. Political opposition may arise to large scale acquisition. 3. Creates public land management requirements.

Regulation or Incentive	R	I	Legal Framework	Objective	Advantages	Disadvantages
Performance Zoning and Permit System **	✓	✓	A new ordinance (preferable) or amendment to zoning ordinance adding performance standards.	1. Establish acceptable environmental effects of land use by setting minimum standards and maximum allowed degradation. 2. Reflects goals of community for habitat.	1. Leads to objective review of impacts of a proposed development. 2. Encourages innovative site plans which reduce negative impacts.	1. May be difficult to develop quantified, objective standards. 2. Local officials may back away from using objective, technical standards in the site plan review process. 3. Administrative time and work is increased.
Transfer of Development Rights **	✓	✓	Amendments to zoning ordinance establishing transfer districts. This avenue has not been used and challenged in Utah courts. Qualified legal advice is recommended.	1. Remove critical wildlife habitat from development pressures.	1. May compensate owners of environmentally sensitive lands with public values. 2. Public does not purchase land. 3. May allow for preservation of large tracts of land. 4. Compromise between a ban on development and full development.	1. Development rights only marketable if development pressure is high or land availability is limited. 2. May not be acceptable in Utah courts. 3. Incentive nonfunctional without zoning in place to set densities for transfer.
Planned Unit Development **	✓	✓	Amendments to zoning ordinance to allow cluster development as an option.	1. Provide openings and corridors for wildlife. 2. Integrate open space and development.	1. Increases open space. 2. Encourages creative site plans that take natural resources into account.	1. Developers may not be attracted to incentives for higher density in a rural community.
Special Districts or Overlay Zones **	✓		Special districts included in zoning ordinances or special purpose ordinances.	1. Protect wildlife habitat with specific land management and site development regulations. 2. Protect an area of environmental concern that may cross property boundaries and occasionally jurisdictional boundaries.	1. Special consideration for habitat during development review.	1. When parcels are predominantly wetlands or floodplain, may not be possible to comply with regulations and still accommodate reasonable use.

Regnlation or Incentive	R	I	Legal Framework	Objective	Advantages	Disadvantages
Mitigation: Habitat Enhancement, Restoration and Creation	✓		Amendments to zoning, subdivision ordinance or site plan review.	1. Soften the impacts on the environment from use and development.	1. Provide alternatives for addressing severity of impacts and environmental quality.	1. It is difficult to mitigate by creation of fragile habitats such as wetlands. 2. Developers may see habitat creation as an easy alternative. 3. Can be ineffective if not thought out carefully and implemented appropriately. 4. Probably beyond the ability of most communities to implement properly.
Local Environmental Impact Statement *	✓		Amendment to zoning ordinance, subdivision ordinance or site plan review.	1. Require consideration of short-term and long-term costs and benefits in decision making.	1. Requires a careful balancing of factors by decision makers. 2. Expose projects to public review.	1. Impact review does not protect habitat unless impact requirements are combined with regulation. 2. May be costly and time consuming. 3. May be beyond the ability of community to implement.
Deed Restrictions *		✓	Agreement between the land owner and the government or another party.	1. Prohibit private development while permitting continued private ownership of lands.	1. Low cost to government . 2. Provides basis for reduction in property tax. 3. Voluntary, may be politically acceptable.	1. Does not generally permit public use of land.
Site Plan Review	✓		Amendment to zoning ordinance.	1. Evaluate development proposals on a case by case basis. 2. Determine impacts and compliance with statutory and ordinance standards, and environmental concerns.	1. Accumulative and immediate environmental impacts are assessed.	1. Time consuming. 2. Small communities may not have adequate planning and engineering staff. 3. Does not ensure habitat protection.

Regulation or Incentive	R	I	Legal Framework	Objective	Advantages	Disadvantages
Building Codes	✓		Enabled through planning and zoning acts, Title 10, Utah Code.	1. Set standards for design that reduces nuisance wildlife or reduces impacts on habitat.	1. Typically already in place, requiring minimal changes. 2. Code must be met in order to pass inspection.	
Capital Improvement Programming **	✓			1. Control growth on sensitive lands. 2. Minimize impacts with proper facilities.	1. Control of types and locations of facilities such as roads, sewers and water mains. 2. Can help to temporarily protect resources without the necessity of land purchase or regulation.	1. Control of certain types of capital improvement (state roads and drains) is not within local government powers. 2. Cost of financing major public improvements may be prohibitive.
Education of Landowners *			None	1. Encourage private protection of habitat. 2. Encourage private balancing of benefits and costs.	1. Appeals to private land ethics. 2. Politically attractive. 3. Maximizes landowners options.	1. Some landowners are not responsive. 2. Time consuming.
Eminent Domain	✓		The general provision in Title 78 of the Utah Code allows for acquiring land in this manner only in cases for the highest public good.	1. Obtain land of special public value by due compensation from an unwilling seller.	1. Critical wildlife habitat can be obtained when all other means of protection have failed.	1. Politically, this method may be a very poor choice. It should be used carefully and with knowledgeable legal counsel.

KEY: R = Regulation; I = Incentive

Table 2. Federal, State and Private Programs

Programs	F	R	I	P	Administrator	Opportunities
STATE OF UTAH						
Land and Water Conservation Fund (LWCF)	✓				Division of Parks and Recreation	Federal matching funds provided to promote planning, acquisition and development of land and waters for recreation. Current acquisition of wetlands are high priority for funding.
Utah River Enhancement Program	✓				Division of Parks and Recreation	State matching funds provided for projects related to recreation, water conservation, flood control and wildlife conservation.
Wetland Water Treatment Works	✓	✓	✓		Division of Health, Bureau of Water Pollution Control	State Permit Discharge Elimination System Program requires individual permits of stormwater discharge not meeting standards, to utilize "Best Management Practices." A revolving fund is available to support publicly owned water treatment works for communities that meet project eligibility requirements. Utilizing created wetlands for water treatment is encouraged as an alternative technology.
319 Program of the Clean Water Act	✓			✓	Division of Health, Bureau of Water Pollution Control	Assessment and prioritization of impaired streams to plan mitigation projects. Funding available for projects.
Posted Hunting Units			✓		Division of Wildlife Resources	Cooperative agreement to charge hunters on private land where habitat has been developed. The program began 50 years ago as a program for pheasant but has been recently updated to include waterfowl and other upland game species.

Programs	F	R	I	P	Administrator	Opportunities
Acquisition of Critical Habitat	✓				Division of Wildlife Resources	Acquisition of wildlife habitat managed for game species through license fees, hunting eqoipment tax and state general fund. Habitats are also considered that involve a biological resource of statewide interest or the Federal Endangered Species List.
Sovereign Land Policy		✓			Division of State Lands and Forestry	Sovereign Lands are lands lying under or below the ordinary high water mark of navigable waters at the time of statehood. These lands are held in trust for the people of the State of Utah. These lands cannot be sold, leased or exchanged except in quantities and for the purposes as serve the public interest and do not interfere with the public trust. The Division coordinates any wetland habitat development on these lands with the Army Corps of Engineers.
State Lands		✓			Division of State Lands and Forestry	The state lands that contain high quality wetland or riparian habitat may be obtained by the community through a special use lease, land exchange or sale. The community may also work with the Division of Wildlife Resources to acquire the land as a conservation easement.
Urban Forestry Program	✓			✓	Division of State Lands and Forestry	Provides technical assistance for local urban forestry programs. Funding is available for tree inventories and to get programs started. Matching funds may be provided for projects.
Community Development Block Grant Program	✓				Division of Community Development	Grants and low cost loans may be available for planning and projects meeting one of the following criteria: At least 51% of grantee's CDBG expenditures must be devoted to activities benefitting low and moderate income households; or elimination of slums or blighted areas; or urgent health and welfare need. Projects my include parks.

Programs	F	R	I	P	Administrator	Opportunities
Permanent Community Impact Fund	✓				Division of Community Development	Funds, matching monies and loans are available for planning, construction and maintenance of projects within counties affected by mineral leasing activity. Any government entity is eligible to apply including special districts. Projects may include wildlife habitats as a park.
Stream Alteration Act		✓			Division of Water Rights - permitted through State Engineer	Requires a permit for any change in the course, current or cross-section of a stream channel. Construction guidelines are provided for riparian habitat.
Mineral Extraction Regulations		✓			Division of Oil, Gas and Mining	Specific regulations for coal mining concerning stream buffer zones, and fish and wildlife habitat related values. Non-coal mine regulation requires reclamation but there are no specific provisions for wetland and riparian habitat.

FEDERAL

Food Securities Act 1985	✓	✓	✓		Agricultural Stabilization and Conservation Service	Wetland protection and soil conservation planning for highly erodible soils to be eligible for U.S. Department of Agriculture farm program benefits.
'404' Permit Program		✓			U.S. Army Corps of Engineers	Requires a permit which plays a major role in any dredge or fill activity affecting wetlands and other waters of the U.S. The permit has an opportunity for interagency and public review.
National Flood Insurance		✓	✓	✓	Federal Emergency Management Agency	Federal flood insurance is available if communities implement programs to reduce flood risk including development setback requirements along floodways. Regulation is based on the mapping of the 100 year flood zone.

Programs	F	R	I	P	Administrator	Opportunities
USF&W Habitat Acquisition					U.S. Fish and Wildlife Service	The USFWS can acquire wetlands and some endangered species habitat through purchase of easement. Acquisition is prioritized according to value and degree of threat. Another protection action may stem from a project that requires mitigation.
Resource Conservation Plan	✓				Soil Conservation Service	Cooperative agreement between citizens and SCS to participate in projects for erosion control funded by the SCS. Wildlife habitat could become an integral part of a project.
COUNTY						
Water Quality Regulations		✓			County Department of Health	A violator of either ground and surface water regulation or solid waste ordinance, must comply with cleanup and restoration regulations.
Local Water Quality Management Program	✓			✓	County Department of Health	Authorized by Section 208 of the Clean Water Act, this is an area wide program to protect water quality for recreation, agriculture, and wildlife habitat. The planning process can involved a variety of participants including: resource management agencies, health and pollution control agencies, municipalities, citizens groups and university research units. Funding is available but may be limited.
Local Flood Control, Bank Stabilization and Detention Program				✓	City/County Engineer	Community can enter into a contract with the city/county engineer for habitat management project within a flood plain. Priority use (such as wildlife habitat) management is employed rather than traditional flood control techniques in riparian areas.

Programs	F	R	I	P	Administrator	Opportunities
Utah Greenbelt Law			✓		County Assessor	Tax incentive to preserve wildlife habitats associated with agricultural lands.

OTHER PROGRAMS

Urban Trails System				✓	Regional Trails Council (Salt Lake County area only)	A non-political, coordinating body for trails development concerned with urban and mountain trails and environmental conservation along those corridors including wildlife habitat. They can review a community's plan for trail corridors and recommend measures for development and habitat protection.
Land Trust Organizations	✓				Example, Nature Conservancy	Protection of areas of ecological significance through acquisition of fee-simple title and conservation easements. The program is very active in Utah. They work with Federal and State agencies, communities, and concerned individuals.
Utility Companies					Railroad and Power Companies	Contract with Utility companies to manage right-or-ways for wildlife habitat. In the case of powerlines, this may include a linear park-trail system. Certain restrictions on use and vegetation height exist in the contract.

KEY: F = Funding I = Incentive
R = Regulation P = Planning

Table 3. Step 1–Committee review of current and potential local regulations and incentives that can apply towards the implementation of the Urban Wildlife Conservation and Management Plan.

Program	Spatial Application (mapped)	Type of Habitat Influenced	Effect on Habitat	Benefit to the Community	Costs to the Community
Wetland water treatment works	Where storm water is discharged	Wetland and riparian habitat	Creates or restores wetland habitat with available water for treatment	Helps to meet water quality regulations but may degradate wetlands	Cost is greater than the community can afford with available funding
Posted Hunting Units	Private agricultnral lands	Upland habitat	Allows for habitat improvement	Landowners become willing partners in community goals	Little, habitat improvement by landowner paid for by hunters or users
404 Permit	Wetlands on both public and private land	Wetlands	Prevents wetland destruction or requires mitigation	Oversees habitat through regulation. Community may have some opportunity for input on the decision.	None

Table 3. Step 2–Committee review of current and potential local regulations and incentives that may apply towards the implementation of the Urban Wildlife Conservation and Management Plan.

Regulation or Incentive	Spatial Application (mapped)	Type of Habitat Influenced	Potential Positive Effects on Habitat	Potential Negative Effects on Habitat	Ways to Improve Effects on Wildlife Habitat
Foothills Ordinance	Land at higher elevations	Oak brush winter range for deer and elk	Reduces development pressures	None	Greater enforcement of ordinance
Street Tree Ordinance	Throughout community	The urban forest	Promotes planting and discourages nonessential tree removal among other things	Limits type and location of trees	Expand conditions of tree planting and maintenance that promotes habitat
Landscape Ordinance as Part of the Subdivision Ordinance	Subdivisions	Yards, vacant lots and public spaces	Provides a public standard to control noxious weeds and insects and reduce hazards such as fire	Cannot use native plants and required to mow vacant lots regardless of species	Examine regulation of permitted use of plant types and maintenance requirements to consider wildlife values.

Literature Cited

Kusler, J. A. 1983. Our National Wetland Heritage - a Protection Guidebook. Washington, D.C.: Environmental Law Institute.

Wickersham, Jr., K. 1981. The Permit System. Boulder, CO: Indian Peaks.

Johnson, C., G. McPherson and S. Gutting. 1982. Community Forestry Manual for the Cities and Towns of Utah and Southern Idaho. Logan, Utah: Cooperative Extension Service, Utah State University.

References

Boise River Plan. 1985. Boise, Idaho.

Brower, D. J, Candace Carraway, T. Pollard, and C. L. Prospst. 1984. Managing Development in Small Towns. Washington, D.C.: Planners Press, Amer. Planning Assoc.

City of Portland Environmental Regulations; Ammendments to the Comprehensive Plan and City Code Title 33. 1988. Portland, Oregon.

Diekelmann, J., and C. Bruner, 1979, revised 1988. An Introduction to Naturalized Landscapes: A Guide to Madison's Natural Lawn Ordinance. City of Madison, Wisconsin.

Elfring, C. 1989. "Preserving Land Through Local Land Trusts: How Small Groups Have Saved More Than 2 Million Acres of Open Space." BioScience 39(2): 71-74.

Farmington Foothill Ordinance, 1980. Farmington, Utah.

U.S. Forest Service and Environmental Protection Agency. 1978. Streamside Management Zone: Statutes and Ordinances. Washington, D.C.: U.S. Goverment Printing Office.

Garrett, Jr., M. A. 1987. Land Use Regulation: The Impacts of Alternative Land Use Rights. New York: Praeger, NY.

Hester, H. G. 1977. Planning and Zoning Administration in Utah. Salt Lake City: Paragon Press.

Holden, P. and M. Albee. 1983. Wildlife Values of South Park - Can They be Preserved? Jackson, Wyoming: Teton County Planning Office.

Jones, B. E. 1984. "A State Mandate for Riparian Wetland System Preservation." Pages 826-832 in Proceedings Calif. Riparian Systems, Berkeley: U. of Calif. Press.

Kaiser, R. A., J.D. and J. D. Mertes, Ph.D. 1986. Acquiring Parks and Recreation Facilities Through Mandatory Dedication: A Comprehensive Guide. State College, Pa.: Venture Publishing,.

Lincoln County Comprehensive Land Use Plan. 1987. Kemmerer, Wyoming.

Lincoln County Permit System Appendices. 1987. Kemmerer, Wyoming.

Lincoln County Permit System. 1987. Kemmerer, Lincoln County, Wyoming.

Office of Technology Assessment, U.S. Congress. 1984. Wetlands: Their Use and Regulation. Washington, D.C., OTA-O-206.

New York State Dept. of Environmental Conservation. 1985. Stream Corridor Management: A Basic Reference Manual. Albany, New York.

Pima County Site Analysis Requirements for Rezoning. 1985. Tucson, Arizona.

Pitkin County Code, 1985. Aspen, Colorado.

Pollock, P., and D. Cooper. 1988. "Scientific and Policy Outcomes of the Advanced Identification of Wetlands in the Boulder Valley, Boulder, Colorado." Presented at Wetlands '88: Urban Wetlands and Riparian Habitat. Association of State Wetland Managers; Oakland, California, June 26, 1988.

Salt Lake County. 1988. Reservation of Easement and Restrictive Covenants. Salt Lake County, Utah.

Teton County Comprehensive Plan, 1978. Jackson, Wyoming.

Wilkinson, R. 1988. "Protection of Wetlands and Riparian Habitats in an Urbanizing Environment, a Comprehensive Planning Approach." Presented at Wetlands '88: Urban Wetlands and Riparian Habitat. Association of State Wetland Managers; Oakland, California, June 26, 1988.

Wilkinson, R. 1987. Draft Wildlife Habitat and Management Plan for the City of Fort Collins. Fort Collins, Colorado: Department of Natural Resources.