# Machine Lake Area
# Final Mitigation Banking Instrument
## Brigham City, Utah – R & P Wetlands & Waterfront LLC

May 11, 2006

Prepared by
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RAY QUINNEY & NEBEKER

May 11, 2006

Amy Defreese, Project Manager
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Re: Machine Lake Area Mitigation Banking Instrument

Dear Ms. Defreese:

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I am please to submit the Machine Lake Mitigation Banking Instrument to you. As you know, this document represents a tremendous amount of work by the consultants for R&P Wetlands and Waterfowl, LLC. It is a culmination of a process that began with the submission of the Prospectus in the Spring of 2003, the Draft Banking Instrument in August of 2005 and many meetings between my clients, their consultants, the MBRT Members and the USACE. We appreciate the input we have received from each of the MBRT members and from your office and I truly believe that input has resulted in the creation of a fine Banking Instrument, that will form the basis for a successful Mitigation Banking effort.

The Mitigation Banking Instrument and successful implementation of the plans set forth therein represents an incredible ecological opportunity to add nearly 2800 acres of highly functioning wetlands to the ongoing wetland preservation efforts around the Great Salt Lake. As you know, the property encompassed by the Bank was once one of the most highly productive waterfowl and wildlife areas around the Great Salt Lake, as well as one of the more valuable resources on the entire Pacific Flyway. Restoration of the resource will not happen without the approval of this Bank. As such, approval of this Bank will allow the restoration of a complex and highly functional wetland resource that was lost due to the rising waters of the Great Salt Lake and the less than ideal management by the previous owners. We are also pleased to be able to add the vehicle we have referred to as the Catastrophic Loss Fund to ensure any damage caused by a rising Great Salt Lake in the future will be swiftly remedied.

We have compared this effort to the other mitigation banking efforts around the Great Salt Lake and have concluded this effort is superior to any and all of them for many reasons, but here are several of them. First, it allows the restoration goal of the Mitigation Banking Program to function as designed - - to restore this very important wetland resource complex. Second, the service area was selected based upon very refined criteria provided by your office, that will allow effective and efficient mitigation of wetland

impacts in like, kind and type, with little or no risk or an unfavorable outcome. Finally, the Maintenance and Operation Fund, together with the Catastrophic Loss Fund will operate to ensure the continued survivability of this Bank and its attributes in accordance with the goals of the Mitigation Banking Program.

After reviewing some of your recent correspondence, there seems to be some confusion regarding where we are in the approval process. This is the submittal of the Banking Instrument as a final product. We believe all tasks preparatory to that submittal have been completed, with the exception of the public comment process. I do not know why your office failed to notify the public of the existence of the Prospectus, nor why that oversight was not corrected at the time the Draft Banking Instrument was submitted. In my view, the public should comment on this document, so please immediately take the necessary steps to ensure public comment is gathered per the operative Federal Guidelines for the establishment, use and operation of Mitigation Banks.

Again, we appreciate your involvement and the involvement of the MBRT in the process. In accordance with the operative guidelines and guidance, we look forward to a swift review and approval of the Machine Lake Area Mitigation Banking Instrument.

Very truly yours,

RAY QUINNEY & NEBEKER P.C.

Jeffrey W. Appel

Jeffrey W. Appel

w/o Instrument

cc: Shawn Zinszer
Andrew J. Rosenau
Col. Ronald N. Light
Robert E. Roberts
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Dave Ruiter

**Machine Lake Area**
**Final Mitigation Banking Instrument**
Brigham City, Utah - R & P Wetlands and Waterfowl LLC

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**Machine Lake Area**
**Final Mitigation Banking Instrument**
**Brigham City, Utah - R & P Wetlands and Waterfowl LLC**

## 1. Preamble

The purpose of this Banking Instrument is to establish guidelines and responsibilities for the establishment, use, operation, and maintenance of the Machine Lake Area Mitigation Bank ("MLA"). The MLA will be used for compensatory mitigation of unavoidable impacts to waters of the United States including wetlands that result from activities authorized under Section 401 and 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act, provided that such activities have met all applicable requirements and are authorized by the appropriate authority. The Banking Instrument shall constitute a binding agreement by and between the signatories hereto as to the terms and conditions set forth herein.

## 2. Background and Introduction

In accordance with the terms and conditions of this Banking Instrument, R & P Wetlands & Waterfowl, LLC ("Bank Sponsor") proposes to create the MLA on a parcel of property consisting of approximately 2796 acres (the "Property"), located west of Brigham City and north of the Bear River National Bird Refuge (the "Refuge") in Box Elder County, Utah. The Bank Sponsor purchased this property with the intent of establishing a Mitigation Bank that will be used for compensatory mitigation for impacts to waters of the United States including wetlands that result from activities authorized under Section 401 and 404 of the Clean Water Act. The Mitigation Bank will, in turn, facilitate the restoration of the rich wetland complex that has historically existed on the property, thereby meeting one of the primary goals of the Mitigation Banking Program authorized under the Clean Water Act.

The goals of the MLA are to restore, enhance, preserve and create the wetland functions and habitat within the Property and, as portions of the Property are restored, enhanced, preserved and created, to secure and protect that condition of those lands under conservation easements or other like land use restrictions. In addition, the Banking Instrument will provide a long-term management and funding plan to maintain the wetland complex in its restored, enhanced, preserved and created state. The MLA site has been detrimentally affected by natural and human impacts over the years that have resulted in a significant decline in the quality of waterfowl and other species habitat, water quality and wetland function. The MLA will provide significant opportunities for mitigation of diverse classes of wetlands that are currently and will in the future be under pressure from development around the Great Salt Lake.

In the course of restoring, enhancing, preserving and creating wetlands on the Property and operating the MLA, the Bank Sponsor is committed to providing a sustainable economic plan to ensure that each of these goals are reached and will continue to be met into the future. This plan will also provide a mechanism to allow the project to remain financially viable and self-sustaining.

In the early stages of the development of this Banking Instrument, the MBRT felt the area in the initial banking proposal was too large. To allay this concern, the Bank

Sponsor is proposing to create the Bank in two phases. In this document, Phase 1 of the Bank is proposed. Phase Two will be submitted for consideration and approval after Phase 1 has been accepted and the release of credits has begun. However, with the exception of specific issues related to Phasing, all aspects of the MLA are presented for approval in this document.

The Bank Sponsor has previously completed the following activities on the Property that will operate to restore hydrology and specific habitats on that Property:

1. Reconstruction of two critical water control structures, so the MLA may be inundated and properly managed from a hydrologic perspective;
2. Reconstruction of berms and dikes to ensure comprehensive and controlled inundation of the Property by fresh water;
3. Control and removal of invasive species;
4. Control of human access and impacts to the site; and
5. Planting of areas that were previously vegetated, but upon which vegetation was destroyed or inhibited and provision of a water supply for growth of those plants.

The repair of the Machine Lake Dike was accomplished with United States Army Corp of Engineers ("USACE") approval under Nationwide Permit #3, which was issued on May 8, 2003. Work on the Machine Lake Dike began in 2003 and was completed in August of 2004. The Gooseneck Dike repair was authorized under Nationwide Permit #3, which was issued on September 5, 2005. This work is expected to be completed in September of 2006. Weed control has been on going since 2002 and rodent control has been initiated and has continued in coordination with the USFWS Bear River Bird Refuge.

One of the reasons this Property is ideally suited to become a highly successful mitigation bank is due to its proximity to the Bear River Refuge, as well as its historic condition as a high quality wetland complex and resource. Other attributes that support this conclusion are the consistent availability of sufficient water owned or controlled by the Bank Sponsor, together with the long-term financial commitment of the ownership team, as well as the creation of funding mechanisms to ensure adequate funding for ongoing maintenance and operation. The Bank will present a high quality mitigation option for projects impacting wetlands throughout the Great Salt Lake Watershed and the lower Bear River Watershed.

Phase 1 of the MLA was presented to the MBRT in the August 2005 Draft Banking Instrument and consists of six areas within the entire parcel:

1. LA 1 consisting of 223 acres of open water / marsh, which will yield 103 credits;
2. EM 7 consisting of 250 acres of wet meadow & emergent marsh, which will yield 117 credits;
3. MF 4 consisting of 147 acres of mudflat / playa, which will yield 73 credits; and
4. MF 5,6 & 13 consisting of 227 acres of mudflat / playa, which will yield 27 credits.

Phase 1 will include 847 acres of ground and provide approximately 320 credits. Advance credits at a rate of 25% are requested, which will allow 79 of these credits to become available for sale immediately upon approval of the Banking Instrument.

## 2.1 Mitigation Banking Review Team

The Mitigation Banking Review Team (MBRT) for this Bank has consisted of:

- Amy Defreese, US Army Corps of Engineers
  - Formerly Jim Thomas, US Army Corps of Engineers
  - Formerly Dennis Blinkhorn, US Army Corps of Engineers
- Shawn Zinser, US Army Corps of Engineers
  - Formerly Nancy Kang, US Army Corps of Engineers
- Betsy Herrmann, US Fish & Wildlife
  - Formerly Al Trout, US Fish & Wildlife, Bear River Bird Refuge
  - Formerly Chris Witt, US Fish & Wildlife
  - Formerly Lucy Jordan, US Fish & Wildlife
- Pam Kramer, Utah Division of Wildlife Resources
- Dave Ruiter, EPA Region VIII

## 2.2 2003 Meeting Summary

As mentioned above, efforts regarding implementation of the MLA began in early 2003. The first effort pertained to acquisition of approval of Nationwide Permit #3 for the repair of the Machine Lake Dike. This dike had fallen into disrepair in the 1970's and was damaged by the rising waters of the Great Salt Lake in the mid-1980's. The application for this permit was submitted prior to the submittal of the Prospectus in the spring of 2003. Maintenance Permit #3 was approved on May 8, 2003. The initial MBRT meeting was held on June 30th, 2003 at the USACE office in Bountiful, Utah. A summary of topics, concerns, issues and observations discussed by the MBRT in response to the 2003 Prospectus is presented below:

1. Need for a watershed/regional approach to the determination of the Service Area and approaches to mitigation in general;
2. For unspecified reasons, the size of the initially proposed Bank (approximately 2800 acres) was considered too large to be manageable by a majority of MBRT members;
3. Concern about the location of the Bank below the USACE designated Great Salt Lake 100-yr floodplain, described as the 4217 MSL contour. The MBRT believed this assumed flooding elevation may be cause for concern as the property could be flooded with rising Great Salt Lake waters;
4. Concerns regarding allowance of preservation credits for the MLA;
5. The need to provide documentation that demonstrates the Bank Sponsor possessed clear title and sufficient water rights for the activities of the MLA;
6. The need for additional evidence of the historic high value of the property as wildlife habitat and the admittedly favorable potential of a having a

highly functioning wetland area of this size adjacent to the Bear River National Wildlife Refuge;

7. Documentation of the presence of invasive species (cattails and phragmites) and their detrimental affect on wildlife;
8. Concerns regarding demand by the public for the number of credits the MLA will make available;
9. Concerns regarding the size and aerial extent of the Service Area;
10. Concerns regarding the availability of water and its impact on the success of restoration efforts;
11. The need to ensure ecological diversity of habitat type within the MLA (i.e. concern the entire area would be converted to a single habitat type);
12. Concerns regarding the ability of the MLA to compensate for loss of wetland functions throughout the region/watershed.

The Bank Sponsor has carefully considered the concerns and suggestions of the MBRT and incorporated the comments, responses and additional information into this Final Banking Instrument. The responses to the concerns, issues and observations of the MBRT are summarized below:

1. The Bank Sponsor agrees that a watershed approach is appropriate;
2. The Bank Sponsor will phase the project. This proposal is for Phase 1 of the Bank, which is 847 acres and represents a 70% reduction in size of the initially proposed Bank. This Banking Instrument will be amended in the future to provide for inclusion of additional land areas, restoration, enhancement, preservation and creation activities and credits in the next Phase.
3. After further review, the Bank Sponsor has ascertained that the 100-yr floodplain level of 4217 ft MSL suggested by the MBRT is not correct for this area. The 1997 USACE report indicates that wave and wind set up may reach an elevation of 4215 in Box Elder County. This issue is further discussed in Section 5. (The USACE Report and AGRC Map are provided in Appendix F.);
4. Preservation is a valid mitigation purpose for this Bank. Urban growth in Box Elder and Weber Counties is increasing, with projections indicating favorable upward commercial and residential development potential. This property was annexed into Brigham City and rezoned in 2003. The current zoning allows for recreational, residential and agricultural uses. Concept plans have been created which evaluate an ATV park or a destination resort for the Property. Additional information in this regard is provided in Section 4 and supporting documentation is provided in Appendix E;
5. The applicant has clear title to the property and more than sufficient water rights to support the proposed activities. Please refer to Section 5.2 and Appendix D;
6. R & P agrees with comments made by members of the MBRT regarding the historic high quality of wetlands and associated resources on the site. The evidence overwhelmingly supports this historic status. A desire to see this area returned to this historic condition is a major motivation for the Bank Sponsor in presenting this Banking Instrument;

7. The Bank Sponsor also agrees with members of the MBRT that the extensive presence of invasive species of vegetation has had a detrimental effect on habitat quality at the area. The Bank Sponsor believes there is an opportunity to remove this invasive vegetation and restore the area with native species that are more beneficial to wildlife through the creation of the Bank. In fact, those efforts have already begun.
8. The need for mitigation credits in the Brigham City, Box Elder County and around the Great Salt Lake is present and growing. Approximately 227 acres of the Bank Sponsor's property has already been sold to allow mitigation of wetlands for the Brigham City airport project. Other residential, commercial and industrial projects in progress or planned in the near future will require mitigation within the Service Area and the Bank Sponsor believes significant development pressure on wetlands now exists and will continue to exist well into the future;
9. The Bank Sponsor has extensive water rights for the property (see Section 5.2 and Appendix D) and has constructed and repaired numerous berms and water control structures at key locations on the Property. As a result, they will be able to successfully control and manage water levels in a manner that will ensure high quality and function of all wetland resources on the Property. The Bank Sponsor applied for and received a nationwide permit to reconstruct the Machine Lake Dike and have also applied for and received a permit to reconstruct the berm and outlet structure on the Gooseneck Dike.;
10. There will be many different land use types and wetland types on the Property, ranging from upland, playa, emergent wetlands and open water. The Bank Sponsor agrees that a diversity of land type is beneficial to wildlife habitat. The Bank will not be constructed or managed as a monotypic habitat with a geographic area;
11. The Bank will more than adequately allow compensation for loss for wetland function within the Service Area once it is completed. The extremely high quality wetlands that will exist on of the Property when banking is completed, coupled with it's proximity to the Wildlife Refuge, make it an ideal location for a mitigation bank that will provide for extensive and necessary wildlife habitat.

## 2.3 Agency Comments on 2005 Draft Banking Instrument

Based on the 2003 comments, the Draft Mitigation Banking Instrument ("Draft Instrument") was submitted in August 2005. The Draft Instrument contained revisions based upon the prior MBRT comments. Since a number of the MBRT members had changed over the two-year period, the MBRT requested a site visit prior to responding with formal comments. The Bank Sponsor acceded to this request and the site visit took place on September 14, 2005.

The written comments submitted by the MBRT with respect to the Draft Instrument are attached at Appendix B and included:

1. Concerns regarding flooding of the Bank by a rising Great Salt Lake;
2. How possible damage to the mitigation bank due to flooding would be repaired and restoration ensured;
3. Potential for loss of species habitat during flooding;
4. Lack of existence of wetlands similar to those found in the MLA above 4217 ft elevation
5. The size and aerial extent of the Service Area;
6. How credit ratios and accounting would be handled;
7. The demand for mitigation within the Service Area;
8. The potential development pressure near the Bank;
9. The basis for advance credit allocation;
10. Issues regarding water right availability and ownership;
11. Issues regarding potential future changes in points of diversion inside the Bank that may affect the Wildlife Refuge;
12. Issues relating to long-term ownership and management of the Bank once credits have been sold;
13. Availability of and support for credits for preservation of existing wetlands/uplands;
14. Issues relation to conversion of wetland types;
15. Issues relating to conversion of uplands to wetlands;
16. Existence and availability of buffer zones;
17. Issues regarding existence of Threatened and Endangered Species in the area;
18. The prospects for invasive species control; and
19. Financial controls that will be in place and accountability with respect to debiting of mitigation credits.

The responses to these questions, some of which were previously answered in the Draft Instrument and Prospectus, are as follows. The Bank Sponsor acknowledges there is a potential risk of flooding of the MLA due to rising Great Salt Lake levels in the future. However, this issue fairly appears to be one of risk management. First, the Bank Sponsor believes that hydrologic conditions in the Great Salt Lake Watershed have been significantly altered and the risk of flooding has noticeably diminished since the last flooding episode in the mid 1980's. That said, it is expected that if prolonged inundation of the Property were to occur, damage would occur to the Bank area during inundation and during the rise and fall of the lake levels. The cost to restore, repair, and revegetate the Bank from any such event will be held in a Catastrophic Loss Fund, which will be funded by a percentage of the sale of each wetland credit from the Bank (See Section 11). This amounts to complete insurance against the risk of degradation of the bank due to flooding or other catastrophic occurrences resulting in catastrophic loss of wetland habitat and/or the water control structures on the MLA.

It is important to note the wildlife functions (habitat) subject to discussion here primarily relate to waterfowl and their supporting species. The Bank Sponsor acknowledges that an inundation of habitat may begin to occur should lake levels rise above approximately 4208 feet in elevation in the northeast quadrant of the Great Salt Lake floodplain. The habitat change, however, will only be temporary due to the fact that the waters will recede and due to the existence of the Catastrophic Loss Fund. It should also be noted that flooding is not an annual event or even a regular occurrence. It is a remote and

infrequent occurrence. According to the Utah State Geological Society (USGS), flood elevations of the Great Salt Lake would rarely inundate the property (See Figure 9). The USGS records indicate the highest elevation the Great Salt Lake reached was in 1986, at a level of 4211.85 feet and the previous record elevation of 4211.6 feet was last reached in 1873.

According to the records compiled by the USGS, water elevations have only exceeded 4208 feet elevation during a total of 32 years within the 161 years records have been kept. This level has only been reached or exceeded in 7 years (1984-1990) in the last 100-years. It is important to remember that flooding of the site by the Great Salt Lake will require a multiple year wet cycle, which results in gradually rising Lake levels. Typically, these wet cycles are 4 to 6 years in length and are marked by above average runoff during the spring snowmelt. Moderate runoff, or a slow release of water from the melting snowpack does not have as great an affect on Lake levels as runoff from a rapidly diminishing snowpack.

However, as water levels rise, it is reasonable to conclude that waterfowl habitat would be enhanced and even created in the region. Importantly, specific habitat present at the Bank will not be permanently lost and temporal losses may be offset by increased function of wetland habitats located at a higher elevation within the watershed. These respective enhancements would occur as areas that were previously not available as new habitat becomes available due to the increased precipitation and rising water levels.

The hydrogeomorphic setting of the lake suggests that the north and west sides of the lake will have greatly increased waterfowl habitat during the events of high water levels. Additionally, the Catastrophic Loss Fund will be available to quickly fund any necessary repair of the dikes and restoration of the habitat should a flood event occur. This Fund is further described in Section 11. Importantly, the Bank Sponsor believes the risk of flooding has been substantially lessened by manmade alterations to the Great Salt Lake Watershed, such as construction of the Jordanelle Dam storage facility on the Provo River, the Utah Lake Drainage Management Plan and the construction of the Great Salt Lake pumping plant. Also, the ability of wildlife to adapt to changing conditions is well documented. It should also be noted that wildlife has returned to the restored areas of both the Refuge and the Property as restoration efforts have proceeded in each area.

Concerns were raised by the most recently constituted MBRT with respect to the size of the Service Area. Initial guidance from Mr. Jim Thomas and Mr. Dennis Blinkhorn from the USACE indicated a preference toward defining a Service Area based on political boundaries (i.e., counties). The Service Area originally outlined in response to that request included Box Elder County and the portion of Weber County north of the Weber River. Areas south of the Weber River were not considered because of the existence of the Inland Sea Shorebird Reserve (ISSR) mitigation bank owned and managed by Kennecott Utah Copper in Salt Lake County and another possible mitigation bank in the Weber–Davis County area. The Weber-Davis bank was never approved and Kennecott has halted sales of mitigation credits from the ISSR, so no Bank currently exists to serve those areas.

The political boundary approach elicited numerous comments from the later incarnations of the MBRT and they requested several changes in approach over time. In discussions

with the USACE following the comments on the Draft Instrument, efforts were made by the Bank Sponsor to define a new Service Area based upon a watershed approach. To create this new Service Area, the 8-digit HUC codes defined by the U.S. Geological Service were reviewed for the Bear River Watershed and were presented in conjunction with an area surrounding the Great Salt Lake that represented the low-lying area located between the Stansbury Shoreline and the historic Great Salt Lake shoreline. The Stansbury Shoreline is located between 4420 ft elevation and 4520 ft in elevation in the Great Salt Lake Basin. The variation in elevation is attributed to differential isostatic rebound since the shoreline features were formed (Currey, Donald R., 1980).

Areas on the northwest and west side of the lake within this shoreline were not included in the new Service Area due to a perceived lack of development pressure, comments from the State of Utah regarding the existence desert springs and unique hydrology in that area. This new Service Area was presented to the MBRT on Dec. 16, 2005. Subsequent comments from the MBRT provided in February of 2006 revealed a further change in approach by the MBRT. They requested use of the Gilbert shoreline rather than the Stansbury shoreline as a boundary and sought to limit mitigation of wetlands at the MLA by stating that where wetland impacts occur below 4220 ft asl, there will be no size limits for mitigation at the bank, but where wetland impacts occur above 4220 ft asl, wetland impacts eligible for mitigation at the bank would be limited to less than 2 acres in size (the elevations were subsequently changed to 4218 when the MBRT was made aware that the MLA does not own property higher in elevation than 4218).

The latter limitation was based on a position advocated by the MBRT that 90% of the permits allowed in the area were for less than 2 acres. Analysis of the USACE permitting history based on information provided by the USACE for the period between January 1991 to July 2004 actually demonstrated a rising trend in the total acreage of wetland impacts permitted in the area. This makes sense based on a growing population in Utah over that time period and increasing development pressure along the Wasatch Front. Agricultural land is converting into developments as the demand for homes, business and related infrastructure continue. Further analysis revealed that projects identified as less than ½ acre and/or completed under a Nationwide Permit accounted for only 65.6% of permitted wetland impacts. So, in reality, 34.4% of all permitted impacts would exceed the limitations the MBRT suggested and would thus be excluded from the MLA, including all permitted impacts larger than 2 acres. (See Appendix H). Based upon the Bank Sponsor's review of the relevant permitting history, acreage limits of any magnitude appear unreasonable. It is important to note that large wetland impacts have already been permitted from the immediate area (Brigham City Airport) on the Bank Sponsor's property. Other large transportation, commercial and public works projects are expected and planned as Box Elder County and other locales within the Service Area continue to grow in population. In summary, there appears to be no rational basis for any size limitation as suggested by the MBRT.

The MBRT also added further requirements to the Service Area delineation process. They described the need to identify similar wetlands using "factors such as climate, drainage, salt and alkali content, and water table levels particularly influence the development of soils, vegetation composition, abundance, and diversity, and wildlife use." In response to that set of MBRT requests, similar wetland types to those present in the MLA were identified using the NWI map digital data and identifying all wetlands

within the Salt Lake Valley that had the same Cowardin classifications. These were consolidated for the purpose of mapping the NWI wetland types. Similarly, based upon a further request by USACE, soil and geographic similarities were identified by using the criteria provided by the USACE from the Soil Survey of Box Elder County – Eastern Part and comparing the attributes described by the MBRT above (See Section 3 and Appendix I).

Concerns were expressed by UDWR and USFWS regarding available water rights. They focused on availability and use of water on the MLA site. The available water rights are described and presented in Section 5.2 and in Appendix D. They are more than adequate to serve the uses contemplated on the Property. Title for these water rights is currently in the process of being updated into the ownership of the Bank Sponsor and it does not present an issue or problem.

Advance credit allocation was a concern of the EPA. Such an approach is described in 1995 "Federal Guidance for Establishment, Use and Operation of Mitigation Banks" as being "generally appropriate, where there is adequate financial assurance and where the likelihood of success of the bank is high, to allow limited debiting of a percentage of the total credits project for the bank at maturity." The MLA is largely intend to be a restoration project, designed to bring back the highly functioning historical wetlands observed at the site prior to the flooding in the 1980's. The work Bank Sponsor has begun, as noted in Section 1 above, has demonstrated the viability of the restoration plans. Credit ratios and the rationale for advance credits are discussed in more detail in Section 12. Restoration of historic wetland types, conversion of uplands to wetlands and upland buffers are also discussed in Sections 6 & 12.

MBRT concerns regarding funding of operations, financial controls, debiting of credits and long-term maintenance/ownership are discussed in Sections 12 & 13.

## 3. Ownership and Management

The MLA is owned and operated by the Bank Sponsor. The Bank Sponsor's principal contact is:

Kim Rolfe
426 East 6865 South
Midvale, UT 84047
(801) 244-8453

The Property was purchased in 2002 and is wholly owned by the Bank Sponsor. The Bank Sponsor intends to continue to oversee management of the MLA during the completion of the restoration, enhancement, preservation and creation efforts. The entire Property will be utilized to provide mitigation credits for impacted wetlands. The MLA is privately owned and will not be accessible to the general public. It is anticipated that only the landowner and its invitees will have access to the MLA. The Property ownership documents are attached in Appendix A. The Bank Sponsor may elect to acquire additional lands adjacent to the Machine Lake Mitigation Bank area. In that event, it intends to propose a plan for each new parcel as an amendment to this Banking Instrument.

## 4. Geographical Boundaries & Service Area

### 4.1 Machine Lake Area Mitigation Bank Property

The MLA Property consists of approximately 2796 acres west of Brigham City and north of the Bear River National Bird Refuge (see Figure 1) in Box Elder County, UT. It includes Sections 19, 20, 21, 29, 30, 31 & 32 of Township 9 North, Range 2 West, Salt Lake Base & Meridian. The legal description is presented in Appendix A. Phase 1 consists of 847 acres. The MLA has been annexed into Brigham City (Spring 2003). Please refer to Figure 2 for the subject property boundary and Phase 1 boundary.

### 4.2 Service Area

The following issues have been raised at one time or another by the MBRT concerning the Service Area for the Bank:

1. Low elevation of the MLA and potential flooding of the Property by the Great Salt Lake, with resulting damage or degradation of the wetlands within the MLA;
2. Loss of habitat in the Service Area if impacts to higher elevation wetlands are mitigated at the MLA;
3. Resource needs in the watershed (or Service Area);
4. Ability of the bank to replace habitat types that are impacted or are foreseen to be impacted by flooding; and
5. Identification of similar wetland types to those that exist in the MLA within the proposed Service Area.

As a result of these concerns and in response to the latest requests from the USACE, the Bank Sponsor has determined that the Service Area should be selected by identification of similar wetlands within the Great Salt Lake Watershed that arise in areas possessing similar climate, drainage, salt and alkali content, and water table levels, which influence the development of soils, vegetation composition, abundance, and diversity and wildlife use.

Based upon a review full of these factors permitted impacts to wetlands within the following geographic area (i.e. Service Area) are eligible to be mitigated at the Machine Lake Mitigation Bank:

1. A portion of the Great Salt Lake Watershed, as defined in Figure 3a, which presents defining areas of similar wetland types and soil types. All areas of similar wetland types within the outer perimeter shown by the boundary line on the map will be eligible for mitigation at the Bank. Impacts to acreage of any size will be eligible to be mitigated at the Bank; and
2. Wetland impacts in areas of Tooele and Salt Lake Counties that have a Special Area Management Plan (SAMP) pending will be eligible to mitigate at the MLA until the SAMPs are adopted and the General Permit is in place. Once the General Permit is issued, it will be up to the individual SAMP to determine appropriate mitigation for projects within its

boundary. Mitigation at the Machine Lake Mitigation Bank for projects located within the SAMP boundaries after SAMP approval may be approved by the USACE on a case-by-case basis.

Rationale for this Service Area is as follows:

The MLA is located where the Bear River meets the Great Salt Lake. The types of wetlands found in the Bank and the types that will be restored, created, enhanced and preserved are typical of those surrounding the entire Great Salt Lake below the Stansbury Shoreline. Specifically, playa and mudflats, open water marsh, emergent marsh and wet meadow wetlands are found both in the Bank and throughout the Service Area.

The National Wetland Inventory (NWI) maps were used to identify wetland types based on availability of published data for the Great Salt Lake Area. An analysis of the MLA resulted in the existence of approximately 20 Cowardin wetland classifications being identified at the MLA. These were consolidated into 6 general categories of wetland types on the maps produced for the meeting with the USACE on March 31, 2006. The creation of these general categories allowed for a more readable map, but the map was still able to display the diverse wetland types present in the MLA. The breakpoint for this consolidation was determined to be the class level in the Cowardin classification system. Thus, all of the Palustrine Emergent Marsh (PEM) subclasses were consolidated and included all of the subclasses, types, water regimes and any special modifiers within that class.

As mentioned above, the USACE recently requested a map outlining soil classifications within the proposed Service Area. Using the information provided by the USACE in an email on February 16$^{th}$, the soil associations were identified and shown on the map presented at the meeting with the USACE on March 31, 2006. However, the information in the Feb. 16$^{th}$ email from the USACE only discussed the Soil Conservation Service's Soil Survey of Box Elder County – Eastern Part and did not reference the remaining areas around the Great Salt Lake located within the proposed Service Area. By using the information in the listed soil associations in the February 16$^{th}$ email, similar soil association were identified around the remaining portions of the Great Salt Lake and presented on the Service Area Soil Map.

Figure 6 shows the National Wetlands Inventory Map for the MLA Service Area. The Service Area was developed by identifying the areas around the Great Salt Lake that had similar wetland types on similar landforms. Figure 3C shows the extent and amount of similar wetland types found at the Bank within the Service Area. Figure 3B shows the soil types found at the Bank and within the Service Area. Please see Section 4 and Section 5.5 for further discussion of soil types and Section 5 for wetland classes found at the Bank. Figure 3A shows a composite map that overlays similar wetland types over similar soil types and provides the Service Area boundary in black.

Wetlands located within this Service Area that are of a significant functional difference from those available at the Bank may be mitigated at the Bank in the discretion of the USACE under their Out-of-Kind Mitigation Guidelines. All impacts mitigated at the MLA are subject to USACE approval on a case-by-case basis. In-kind or out-of-kind mitigation

for these impacts may be provided at the MLA based on USACE approval. Finally, in-kind or out-of-kind mitigation of impacts located outside of the boundaries of the Service Area may also be mitigated at the Bank in the discretion of the USACE.

Figure 3A shows the number of similar wetland classes present at the Bank that are also present within the Service Area. Phase 1 of the Bank will mitigate for impacts up to a maximum of 320 acres of wetlands within the Service Area. As this amount is only 0.05% of all similar wetland types located within the Service Area and 0.23% of all similar wetland types located within the Service Area above 4212 ft asl, the overall risk that temporary flooding at the Bank poses to the water quality and wildlife functions of any wetland that are mitigated at the Bank is minimized, as large quantities of high functioning wetland habitat will remain available outside of the Bank and above the historic high water levels. As a result, sufficient habitat should be available to wildlife for relocation purposes during any temporary inundation of the Bank, in such a manner that overall wildlife populations in the watershed will not be negatively impacted. It is important to note that any future inundation that may affect the Bank has historically occurred very sporadically over time and does not last more than a few years (See Figure 9).

In addition, the Bank will have the Catastrophic Event Fund in place, as set forth in the Section 11 herein, to ensure replacement of any attribute of the Bank that is damaged by such temporary flooding. This Fund is being provided despite the fact that the Bank Sponsor believes the risk of flooding is much lower than it has been in past, due to upstream storage on the Provo River, a major tributary of the Great Salt Lake, the emplacement of pumps on the Great Salt Lake and other hydrologic changes within the watersheds that flow into the Great Salt Lake.

In summary, it is the opinion of the Bank Sponsor that the restoration of the Property and the protection of the site as a mitigation bank will benefit the wildlife habitat and the overall environment within the Service Area with little or no risk. Protecting the Property for the 95 or so years that it is not flooded would be a significant achievement and the Catastrophic Loss Fund would provide for the restoration of any lost function that may occur from flooding at any time in the future.

The MLA will contain 2796 acres of uplands and wetlands in its entirety. Wetland creation, restoration, enhancement and preservation activities will dramatically improve the overall wetland functional values at the MLA. The following is a summary of the types of wetland restoration and changes proposed for the entire bank:

1. Wet meadow wetlands will be created from uplands;
2. Existing playa areas that were mapped as emergent marsh wetlands by the existing 1981 NWI map will be restored;
3. Existing playa areas that were mapped as lacustrine wetlands will be restored;
4. Emergent marsh wetlands will be enhanced by increased water availability and active weed control;
5. Lacustrine wetlands will be enhanced by increased water availability and active weed control; and

6. Mud flat/salt flat/playa wetlands will be preserved in appropriate areas based on elevation, water availability and historic conditions;

## 5. Baseline Conditions and Environmental Setting

The Machine Lake Area Bank property contains mostly wetland areas with some uplands in the northern section of the property. Significant changes have occurred on the subject property in the 25 or so years since the NWI map was produced. Flooding of the Great Salt Lake in the mid-1980's kept the lake water elevation above 4208 ASL for over 6 years, with peak lake water elevation reaching 4211.85 in 1986. This catastrophic event drastically altered the hydrologic regime at the MLA by inundating most of the area with water high in salinity (see Figure 5a) and damaging water control structures. The results of that inundation caused mudflats to form where emergent marsh and wet meadow wetlands had previously occurred. Other vegetation changes have occurred resulting in the establishment of invasive species (Phragmites, etc.) in large areas.

Other changes to the property consist of migrating river and stream channels, some due to natural causes and some due to breaches in earth berms that were constructed in the early 1900's and used for decades to control water levels on the Property and to maintain the highly functioning wetlands. These breaches have resulted in lower water levels in large areas of the MLA, as the water is no longer impounded, which in turn has led to a significant degradation of wetland functional values (compared to their historical values) across much of the site. These changes to the hydrologic regime and ecosystems on the Property have resulted in changes to the wetland classes mapped at the property site in 1981.

The combination of re-establishing historical native plant species in conjunction with steps taken to permanently maintain an appropriate water level for each class of wetlands, will provide the basis for the restoration and other Banking efforts at the MLA. Some areas that were recorded as Palustrine Emergent wetlands on the NWI map have been historically been used to grow upland grass species as feed for horses and cattle. A large portion of the existing uplands will be restored to wet meadow wetlands in this area. Large areas of Emergent Marsh and Lacustrine wetlands mapped by the NWI are eligible for enhancement. Controlling invasive non-native species (Phragmites), re-establishing native species such as alkali bulrush (Scirpus maritimus) and pickleweed (salicornia spp.), and establishing and maintaining beneficial water levels will all provide for the enhancement. These are described in Section 12.

### 5.1 Hydrologic Setting

The Bank is in the Bear River watershed. Three main water sources enter the property from the north (see Figure 2). Going west to east, the Reeder Overflow flows along the western edge of the property, but does not contribute much water to the Phase 1 portion of the Property. Water from the Hammond Canal is located roughly in the center (east-west) of the property. It flows south past agricultural uplands, and eventually terminates in marshland in the upper central portion of the property. The Hammond Canal is kept out of the Machine Lake Dike area. The Black Slough meanders into the property from the northeast and is the primary water source for the central marshlands. Water from the

Black Slough currently flows into Machine Lake and is released in a controlled manner through water control structures in the berm along the south end of Machine Lake. Water levels in Machine Lake will be maintained at appropriate levels to maximize wetland function and mimic natural conditions for this wetland system.

## 5.2 Water Rights

Bank Sponsor owns significant and substantial water rights that are available for diversion and use on the property (see Table 1). Currently the water rights are approved and utilized for a variety of purposes, as set forth in Table 1.

**TABLE 1**
**R & P Owned Wetlands Water Rights**

| **Water Right Number:** | **Annual Amount:** | **Source:** | **Description:** |
|---|---|---|---|
| 29-1912 36.666% | Approximately 120 acre-feet | Bear River | Overflow right limited to use of flood waters of the Bear River. |
| 29-2633 a16757 | Approximately 40 acre-feet | Bear River | Kimball Decree #336 right for irrigation and stock watering. |
| 29-3084 | 20.96 acre-feet | Black Slough | Civil decree right (#4473) for irrigation and waterfowl and wildlife propagation. |
| 29-3085 | 84.2 acre-feet | Black Slough | Civil decree right (#4473) for irrigation and waterfowl and wildlife propagation. |
| 29-3086 | 2757.92 acre-feet | Black Slough | Civil decree right (#4473) for irrigation and waterfowl and wildlife propagation. |
| 29-3495 | Approximately 400 acre-feet | Bear River and unnamed stream | Water user's claim recognized during times of high water flow from May 1 to June 15th and from September 15th to November 30th. |
| 29-3609 | Approximately 120 acre-feet | Bear River | Fixed time application and water user's claim right for water above 1000 cfs if it is available from the source. |
| 29-3848 | 2000.0 acre-feet | End of Hammond Canal | Application to appropriate surplus water not currently used by upstream water of the Hammond Canal. |

Figure 4 shows the points of diversion and places of use for each of these water rights on the Property. The availability of these water rights ensures the Bank Sponsor's ability to effectively control and manage water levels as needed and desired to maintain maximum wetland function for each wetland type. Appendix D contains a detailed listing of the water rights from the database of the Utah State Engineer. In total, 5543.08 acre-feet are owned, under the control of Bank Sponsor and available for diversion and use on the Property.

Necessary water volume was calculated for the Phase 1 portion of the MLA by using data from a USU remote sensing project that calculated water losses through evapotranspirative processes for open water, bulrush and cattail cover classes. The wet meadow areas were evaluated using NRCS calculations for irrigated pasture. Climate information based on precipitation and temperature records obtained from the WETS station at the Brigham City Waste Plant. The calculated water needs are listed in Table 2 below.

**TABLE 2**
**Annual Water Needs for Phase 1 of MLA**

**USU Remote Sensing Data Analysis**

| Cover | Average Water Use (mm/day) | Average Water Use (ft/day) | Annual Water Use* (ft/yr) |
|---|---|---|---|
| Bulrush | 6.1 | 0.02 | 4.260 |
| Cattail | 6.2 | 0.0203 | 4.324 |
| Open Water | 7.1 | 0.0233 | 4.963 |

| Wetland Type | Annual Water Needs* (ac-ft) | Phase 1 Irrigated Acreage | Annual Water Use* (ft/yr) |
|---|---|---|---|
| Open Water | 860 | 173 | 4.971 |
| Emergent Marsh | 275 | 61 | 4.508 |
| Wet Meadow | 815 | 437 | 1.865 |
| **Total** | 1950 | 671 | 2.906 |

**USDA Crop Cover Analysis**

| Cover | Annual Water Use* Per Acre |
|---|---|
| Pasture | 1.9 |

* water calculated for growing season between March 31 and Oct. 30

A portion of these rights is available during high flow periods to mimic flooding events under the natural hydrograph. The remainder will operate to ensure the availability of water on the Property during the remainder of the year. If the rights need to be modified or moved to facilitate the efforts of the MLA, that may be accomplished through the Utah State Engineer's office. These water rights are uniquely situated to meet the needs of the Bank.

Questions were raised by the MBRT regarding loss of water rights upon the sale of the Brigham City Airport mitigation property. These rights were reserved to the Bank Sponsor through negotiation and remain available. To the extent any MBRT member

has concerns about future modifications of points of diversion or places of use, none are currently contemplated, but those issues are most properly dealt with through the State Engineer.

## 5.3 Land Use and Development Pressure

The Bank Property is accessed from the Bear River Refuge road that borders the Property on the north and west. The Refuge is located to the west and south of the MLA. Some private lands exist between the MLA and the Refuge. Private lands exist to the east and north that are used mainly for agricultural and grazing activities. Existing land uses for the MLA include open water, agriculture and grazing.

There is development pressure on the site from the north. The Property was re-zoned following annexation into Brigham City in 2003. Current zoning of the Bank area allows for residential (P/RR-1-planned/rural residential), agricultural (P/A-5) and multiple use (P-M-U-160) areas (see Appendix E). Concept plans have been created to evaluate an All-Terrain Vehicle (ATV) park or destination resort for the parcel. One purpose of the MLA is to facilitate preservation and conservation of the land in its ultimate restored state, rather than allowing the development pressures to convert it to such development oriented uses.

The Refuge is planning to expand its facilities to accommodate current and future demand for wildlife viewing, fishing and hunting activities. These demands and needs are documented in the Bear River Migratory Bird Refuge Environmental Assessment, Economic Study in Appendix E. Approval of the MLA will result in the restoration of a resource that will be quite complimentary to the goals and aims of the adjacent Refuge.

Information provided by the Bear River Association of Governments indicate that Box Elder's population is projected to grow from 43,000 in 2000 to 70,755 in 2030, with a similar growth rate for Weber County. Reference Appendix E. The approach contemplated by the MLA will ensure the Property is fully insulated from these development pressures.

Brigham City has developed and adopted an Economic Development Strategic Plan in 2001 that outlines a plan to attract public and private investments. Portions of the strategic plan are included in Appendix E.

## 5.4 Topography & Climate

Elevations on the site range from 4218 ft MSL at the north boundary to approximately 4205 ft MSL at the south end. The topography of the property is very flat, with gradients in waterways less than 0.1%. As a result, annual high flows in the streams often cover much of the site during part of the year. This has been especially true since the structural improvements were emplaced by the Bank Sponsor. Cold snowy winters and hot dry summers characterize the climate in the area. The following data is for Brigham City, approximately 5 miles east of the project location and 100' higher in elevation. Precipitation averages 19.3 inches per year, with approximately 33% (6.39 inches) occurring as snowfall. The growing season is May to September, and average temperatures range from 27$^{o}$F in January to 77$^{o}$F in July.

## 5.5 Soils

Soil types include the Lasil-Fridlo association (somewhat poorly drained and moderately well drained, nearly level and gently sloping silt loams, on broad low lake terraces and lake plains) in the north to the Playas –Saltair association (playas and poorly drained, nearly level silty clay loams, on lake beds and broad plains) in the south (Box Elder County Soil Survey – Eastern Part, 1975). See Figure 3B for soil types found both at the bank and in the Service Area. The soil associations used were defined by landscape position, soil formation, elevation, climate, soil drainage and water regime. The February 16th email from USACE outlining the MBRT's position stated that soils similar to the Lasil-Fridlo Association and the Playa-Saltair Association would be suitable to demonstrate compatibility with the Mitigation Bank. These descriptions were reviewed in detail along with pages 200-205 of the Soil Survey of Box Elder County – Eastern Part, also provided in the email. The emphasized portions of that document included statements that the soils left by the receding Lake Bonneville may have variation in texture (pg 200). The Climate section refers to the semiarid conditions on the lake plains, low lake plains, low lake terraces and recent alluvial fans can range from 4225 to 4500 ft elevation (pg 202). The Relief section categorizes landforms differently, using elevations of 4200 to 4375 ft to describe lake plains, low lake terraces, valley bottoms and flood plains (pg 203). This section goes on to describe the Logan, Roshe Springs, Magna, Placeritos, Kirkham and Sunset soils as being "in stream drainageways, floodplains and along valley bottoms" within this landform classification (pg 204).

Based on the information provided, similar soil associations were determined for the remaining areas around the Great Salt Lake. These areas were identified based on their descriptions in the General Soil Map section at the front of each Soil Survey. The USACE's more recent concerns regarding the specific soil associations are addressed below.

Box Elder County – Soil Associations 11 (Honeyville-Greenson-Collett), 12 (Lasil-Fridlo), and 13 (Playa-Saltair) were chosen to be included in the map presented at the March 31, 2006 meeting. This was appropriate because the published Soil Conservation Service Soil Survey had grouped them as similar types. In addition, the descriptions of the associations revealed some interesting details when compared with the current Natural Resource Conservation Service (NRCS) hydric soils list posted on their website. The Honeyville-Greenson-Collett Association has a slightly higher percentage of hydric soils than the Lasil-Fridlo Association. Also, the elevations described in the Honeyville-Greenson-Collett range from 4250-4355 ft while the Lasil-Fridlo range from 4220-4600. Finally, excluding the Honeyville-Greenson-Collett would eliminate areas closely tied to the MLA via the Reeder Overflow. The Reeder Overflow carries water from the Bear River and it did not make sense to exclude areas on the Bear River and the lower Malad River mapped as the Honeyville-Greenson-Collett Association, despite a request by USACE to do so. This is especially apparent since the Lasil-Fridlo Association would include portions of the Malad River near Plymouth and the area near Howell along Blue Creek that are higher elevation than the Honeyville-Greenson-Collett association that the USACE requested be removed.

Using the Soil Survey of Davis-Weber Area, soil associations numbered from 6-10 were chosen. This again was based on the descriptions of the soil associations in the front of soil survey. On the map, soil associations 6 (Sunset-Kirkham-Martini) and 7 (Ironton-Logan-Draper) are described as being found on flood plains and terraces. But further review of the description in the text shows these soil associations to be closely tied to associations 8-10 shown on the map. Both associations in question begin on the low lake plains and range in elevation from 4220 to 4600 ft elevation.

The Sunset-Kirkham-Martini is described as being located "in a single irregularly shaped area on the nearly level floodplains of the Weber and Ogden River." Two of the major soil series in this association were listed in the pages of the Soil Survey of Box Elder County – Eastern Part as being "wet because of position" in the "in stream drainageways, floodplains and along valley bottoms (pg 204)." Excluding this association, as the USACE requested, does not make sense when viewed with the similar conditions found along the Reeder Overflow and Black Slough inside the MLA. Mitigation of riverine wetlands is often difficult due to lack of suitable habitat available near the impact area. The MLA has riverine habitat that can be enhanced and protected that will provide mitigation for potential impacts in the Sunset-Kirkham-Martini Association.

40% of the soil series within the association known as the Ironton-Logan-Draper Association is listed as hydric soils. The Logan series comprises 20% of the area within this type, while the minor component soils cover an additional 20%. These minor component soils include Roshe Springs, Woods Cross and Cudahy soils. All are listed by the NRCS as hydric soil series. This soil association begins within 0.5 miles of the Great Salt Lake from Wood Cross to Farmington and exclusion of this soil type per the request of USACE would exclude unreasonably areas of similar wetlands from the MLA Service Area. Other areas where this soil association is located include an area 'about 1 mile west of Kaysville, and two areas in Weber County. Again, this soil association begins at 4220 feet elevation, meets the described criteria of a high proportion of hydric soils in this soil association and is suitable for inclusion in the MLA Service Area.

In Salt Lake County, the USACE stated that the soil associations 1 and 2 were suitable because they exist on lake plains, but that soil association 3 (Chipman-Magna-Ironton) was not, because it was described as existing on flood plains. The description of the soil association describes this type as existing from 4200-4500 ft elevation. The concept that floodplains should not be mitigated at the bank is not correct, since the MLA has significant riverine wetlands along the Reeder Overflow and the Black Slough. As stated above, similar floodplains exist on the MLA site and they maybe be mitigated effectively at the MLA.

The removal of Chipman-Magna-Ironton per the request of the USACE does not make sense because this is the soil type mapped along the Jordan River beginning at the Great Salt Lake. Removal of this soil association would leave a Service Area that would allow impacts on the east bank of the Jordan River in Davis County to be mitigated in the MLA, but foreclose mitigation for impacts to areas on the west bank. In summary, the USACE has suggested that riverine and floodplain soil associations be removed. In view of the fact that the floodplain soils exist in the MLA adjacent to the Reeder Overflow

and Black Slough and elsewhere, it is the position of the Bank Sponsor that this is not a position based upon any scientific methodology.

In conclusion, we feel that the outside perimeter of the soil associations as mapped represent an acceptable compromise for defining the boundary of the Service Area. The soil associations shown on the map presented at the March 31, 2006 meeting are representative of both soil type and landform position that exist at the bank.

## 5.6 Wildlife

The area (including the Bird Refuge) demonstrates activity for a variety of bird species. The Refuge supports a large migratory population of shorebirds, waterfowl, raptors, and other wetland and upland species of birds. The refuge is actively managed with imported water, dikes and structures, aggressive vegetation control procedures and human access control to maintain a vibrant habitat. The close proximity of the MLA to the Bird Refuge would suggest similar wildlife activity, given comparable controls and management. As the MLA is restored and managed, increased usage by waterfowl and shorebirds is expected. Despite the damage caused by the flooding in the mid-1980's, initial work completed by the Bank Sponsor has demonstrated increases in habitat and wildlife use on the MLA. This parallels reported wildlife use of the Refuge since they began restoration of their dikes and berms that were damaged by the floodwaters in the mid 1980's.

The Bear River Bay of the Great Salt Lake has been declared a Globally Important Bird Area (IBA). IBA's are international, national and statewide efforts to identify, monitor and conserve essential bird habitats. Four other bays along the Great Salt Lake have been named as IBA's as well. These include Gunnison Bay, Gilbert Bay, Farmington Bay and Ogden Bay. Based upon conversations with Mr. Wayne Martinson, the Utah Important Bird Areas Coordinator for the National Audubon Society, the Bear River Bay has the highest wildlife counts and most diverse use of any of these Bays. Protection of this site will help raise and maintain quality wildlife habitat in this vital ecosystem. Its proximity to the Refuge will enhance efforts made by public agencies to protect these resources.

## 5.7 Wetland Delineation

The Bank Sponsor participated in the Brigham & Perry City Special Area Management Plan (SAMP) that was performed by Frontier Corporation of Logan, UT in 2003. The Bank property was flown as part of the SAMP project and his imagery was collected in mid-May of 2003. Field verification was conducted by Mr. Chris Browne of Stantec, Mr. Dennis Wenger with Frontier Corporation and others from Frontier Corporation in the summer and fall of 2003. This analysis occurred at approximately the same time that the Bank received its first Nationwide Permit to begin restoration the Machine Lake Dike. The verification process for the initial baseline conditions at the MLA was completed prior to completion of repairs and the installation of the new water control structure on the Machine Lake Dike in August of 2004.

A portion of the initial study area, approximately 227 acres analyzed by Frontier Corporation was later sold to Brigham City as mitigation for impacts at the Brigham City Airport. The analysis conducted on the MLA was used to determine the credit ratios for

the mitigation ratio of 3.43:1 for the Brigham City Airport wetland impacts. The portion of the property sold to Brigham City could not have the hydrology restored, because of its location in relation to the Machine Lake Dike. As such, this portion of the property has not benefited in the same manner as the proposed Phase 1 area has by the repair of the Machine Lake Dike.

The classification of different wetland types within the Phase 1 area of the MLA is presented in Figure 5. The basis for the wetland resource map for the MLA property is presented in Appendix C.

## 6. Existing Wetland Classes

There are four main land classes currently present at the MLA:

1. Upland (U);
2. Palustrine Emergent Wetlands (PEM, PUS, PUB);
3. Lacustrine Littoral Wetlands (L2); and
4. Riverine (R2, R4).

These categories are based on the Cowardin Wetland Classification system and are used by US Fish and Wildlife National Wetland Inventory (NWI) Maps. Please refer to Figure 6 for the 1981 NWI map of the site.

The Palustrine Emergent class is very broad and encompasses the majority of wetlands on the subject property. This class can be further subdivided into the following categories:

1. Emergent marsh;
2. Emergent wet meadow; and
3. Mud flat/salt flat/playa.

### 6.1 Recent History and Great Salt Lake Flooding

In 1981, NWI Maps for the subject property were published based on a analysis of vegetation using aerial photographs. Significant changes have occurred on the subject property in the 25 plus years since the NWI map was produced. Flooding of the Great Salt Lake (GSL) in the mid-1980's appears to have altered the hydrologic regime at the MLA by further damaging established dikes, water conveyance ditches and water management outlet structures, as well as introducing saline flood waters and eradicating existing vegetation (see Figure 7a). As the GSL waters receded, portions of the Bank have returned to fresh water system functions, but some areas that previously supported significant freshwater marsh vegetation were dewatered by the damage to the water control structures. Lack of available water, inundation and evaporation of saline lake water and reduced time of soil saturation have left certain areas in an alkaline / saline state. They will not return to the original fresh water systems that they once were without active restoration activities. Vegetation changes and lack of water management have also allowed invasive species (phragmites, etc.) to become established in large areas.

The south arm of the GSL reached a modern historic high of 4211.85 feet MSL in 1987 and has maintained an elevation of approximately 4200 feet during the 1990's. The August 2005 GSL elevation for the south arm is reported by the USGS as 4196.4 MSL, and the northern arm surface elevation at 4195.7 MSL.

The U.S. Army Corps of Engineers (USACE) studied the floodplain, ponding areas and transition zones of the GSL for Box Elder County in 1995 (see Appendix F). This study investigated lake elevation and the potential for flooding from wave height and wind run-up. The study concluded that this section of the GSL would experience an increase of three feet to 4215. This is due to prevailing winds, relatively short reaches of open water and man-made dikes, berms, railroad structures and other wind/wave/fetch elements.

Other changes on the property consist of meandering river and stream channels, with some waterway relocation due to natural causes and some due to breaches of earth berms that were constructed in the 1930's and before to control water on the property (Figures 7b & 7c). These breaches have resulted in lower water levels in large areas of the Bank as the water is no longer contained, which in turn has led to a significant degradation of wetland functional value (compared to their historical value) across much of the site. These changes to the hydrologic regime and ecosystems on the subject property have resulted in changes to the wetland classes mapped at the property site in 1981.

### 6.2 Assessment of Baseline Wetland Conditions

The wetland classes as present on the entire subject property in 2003 are listed below (see Figure 8).

1. Uplands;
2. Mud Flat/Salt Flat/Playa (comprising both palustrine emergent and lacustrine littoral areas from the NWI map);
3. Emergent Marsh (also comprising both palustrine emergent and lacustrine littoral areas from the NWI map);
4. Lacustrine (open water); and
5. Riverine (rivers, streams, canals and sloughs).

These classes and respective acreages are estimated from aerial photography taken in 2003, as part of the Brigham City/Perry SAMP study. The Bank Sponsor participated in the Brigham & Perry City Special Area Management Plan (SAMP) that was performed by Frontier Corporation of Logan, UT in 2003. This imagery was collected in mid-May of 2003. Field verification was conducted by Mr. Chris Browne of Stantec, Mr. Dennis Wenger with Frontier Corporation and others from Frontier Corporation in the summer and fall of 2003. This information is also shown in Figures 5 and 8.

## 7. Wetland Classes to be Created, Restored, Enhanced and Preserved

There is significant opportunity to restore, enhance, preserve and create wetlands with higher wetland functional values at the MLA than those that are currently present.

Presented below is a summary of the proposed wetland classes that could be included in the Machine Lake Mitigation Bank:

1. Wet Meadow (enhancement, restoration from mudflats, and creation from uplands);
2. Emergent Marsh (enhancement, restoration and preservation);
3. Lacustrine / Open Water Marsh (enhancement and restoration from mudflats);
4. Riverine (enhancement and creation on the Hammond Canal); and
5. Mudflat / Playa (enhancement and preservation).

The size and diversity of the site allows for a wide variety of wetland types and functions to be created, restored, enhanced and preserved as part of the Bank.

## 8. Endangered Species

The U.S. Fish and Wildlife Service (USFWS) have listed the following species on the Threatened and Endangered Species List in Box Elder County. It is not expected that the Bank will have any significant negative affect on any of the listed species.

| BOX ELDER COUNTY<br>THREATENED AND ENDANGERED SPECIES LIST | | |
|---|---|---|
| Bald Eagle ► | Haliaeetus leucocephalus | T |
| Fat-whorled Pondsnail | Stagnicola bonnevillensis | C |
| June Sucker # | Chasmistes liorus | E |
| Lahontan Cutthroat Trout | Oncorhynchus (=Salmo) clarki hensawi | T |
| Yellow-billed Cuckoo Ж | Coccyzus americanus | C |

## 9. Cultural and Archeological Artifacts

The Utah State Historical Preservation Office was asked to review the site location for the presence of cultural or archeological artifacts on the subject property. They did not have any specific information available regarding the site, but stated there is a high probability for the existence of cultural resources in the general area. It is not expected that the proposed bank will significantly impact such resources. Limited earthmoving for the dikes has been completed under the NWP restrictions requiring notification and cessation of construction if such resources are found.

## 10. Context of Parcel within the Watershed

The Bear River watershed, encompassing over 1.7 million acres, is a major source of water to the Great Salt Lake. Although the Bear River does not flow directly through the MLA, a natural overflow channel, the Reeder Overflow, does flow through the property. As a result the MLA is a major component of the lower Bear River ecosystem. The Hammond Canal, which also has its source from the Bear River and the Black Slough, flow through the MLA. Enhancing the stream corridors and restoring the degraded

wetlands within MLA will increase the usable wetland habitat and functional values in the lower Bear River watershed.

The MLA location is ideally suited for a mitigation bank. The site is located north of the Bear River Bird Refuge and south of Forest Street in Brigham City, UT. Brigham City is rapidly growing with an estimated 1,983 acres of unincorporated Box Elder County expected to be annexed into the city along the I-15 corridor in the next 1-5 years. Dennis Wenger of Frontier Corporation and Mark Teuscher, the Brigham City Planner, presented this information to the SAMP Steering Committee on December 13, 2005 as part of a proposed expansion of the SAMP area study. Protection of the MLA site as a mitigation bank will provide an upland buffer on the north side of the MLA to protect the mitigation area wetlands from future development and human impacts. Furthermore, protection and active management of this site will enhance neighboring efforts by the Bear River Bird Refuge in providing quality wildlife habitat for waterfowl. The Bank will also provide a buffer to wetlands on privately owned ground to areas south and west of the bank. The Bank Sponsor is also working with the Refuge and The Nature Conservancy to protect additional wetland areas on private property between Forest Street and the Refuge to the south from encroaching development.

## 11. Provisions for Property Protection

The Bank Sponsor agrees that none of the development allowed under the operative Brigham City Ordinances shall be allowed in the Phase 1 Bank Area while the area is being restored and wetlands are being enhanced, created and preserved. Activities necessary to meet restoration, enhancement, preservation and creation efforts shall be ongoing.

After all mitigation credits in the Phase 1 area have been sold and all restoration and other efforts have been completed, a conservation easement for the Phase 1 area will be granted to a non-profit or public agency under the following conditions:

1. The restored, enhanced, created and preserved condition of the Bank shall be maintained in perpetuity in accordance with the terms and provisions of the long-term maintenance plan described below. This plan will be further described in a Phase 1 Bank Closure Plan, to be prepared by the Bank Sponsor and submitted to the USACE. In no event, however, will the Bank Sponsor be permitted to close the Bank, prior to submission to and approval by the USACE with respect to the Bank Closure Plan.
2. The Bank Sponsor, or other approved entity entitled to monitor the closed Bank, shall maintain the Bank in accordance with the long-term maintenance plan.
3. Sufficient funds from the Maintenance and Operations Fund shall be made available to the Sponsor, or its successor, to implement the long-term maintenance and operation plan.

## 12. Provisions to Resolve Current or Potential Land-Use Conflicts

The Bank Sponsor has discussed the project with adjacent property owners and municipal jurisdictions and will continue to work toward resolving issues regarding access or rights of way as necessary in the future.

## 13. Phase 1 of the Wetland Mitigation Bank

The MLA will be managed as a wetland mitigation bank. However, due to concerns from regulatory agencies along with extensive restoration and enhancement requirements, the Bank Sponsor has proposed a phased approach, whereby portions of the property will be placed into the bank and utilized for credits. As Phase 1 is banked and credits are utilized, and as other areas of the MLA are restored, the subsequent phase will be added to the bank.

Phase 1 of the Machine Lake Area Wetland Mitigation Bank comprises 847 acres. These areas were chosen based upon type of wetland, restoration activities, availability of water rights and the conveyance and control systems needed to control and manage the water. Invasive plant species such as Phragmites will be controlled by a combination of spraying, dewatering, burning and disking. Efforts by the Bank Sponsor since 2003 to control Phragmites have substantially reduced these plants in many areas of Phase 1. Rodent control will continue to be conducted in coordination with the Bear River Bird Refuge as well.

### 13.1 Existing Wetland Classes

Phase 1 is currently comprised of the following areas (See Figure 8):

1. Mudflat Area 4 (MF4) - consisting of 147 acres of mudflat / playa;
2. Emergent Marsh Area 7 (EM7) - consisting of 250 acres of emergent marsh;
3. Lacustrine Area 1 (LA1) - consisting of 223 acres of open water/marsh; and
4. Mudflat Area 5,6 & 13 (MF5, 6, 13) - consisting of 227 acres of mudflat / playa.

### 13.2 Restoration/Enhancement Activities

There is significant opportunity to restore, enhance, preserve and create wetlands with higher wetland functional values in the MLA than are currently present. Presented below is a summary of the proposed wetland classes and estimated acreage that are planned for Phase 1 of the MLA:

1. 149 acres of Wet Meadow (restored from mudflats);
2. 257 acres of Emergent Wet Meadow and Marsh; and
3. 223 acres of Lacustrine / Open Water Marsh.

The following sections describe in detail the changes to wetland class and function that will occur. Please refer to Figures 8 and 9.

### 13.3 Mudflat Area 4

This area is currently considered as mud flat/salt flat/playa and emergent wet meadow (see Appendix A and Figure 5) and has been targeted for restoration activities. The area

consists of approximately 149 acres that will be restored to Wet Meadow conditions. A combination of re-establishing historical native plant species in conjunction with permanently maintaining an appropriate water level for each season will provide for the restoration.

Water control will be provided by a control structure along a berm at the southeast edge of the area. A nationwide permit has been submitted to allow for the replacement of the existing control structure with a new structure to better manage the water surface level. Bank Sponsor expects to be able to periodically inundate this area to maintain wetland vegetation and function. The wetlands, once restored, will consist of small depressions with fluctuating surface water surrounded by wet meadow dominated by Scirpus maritimus (alkali bulrush). Activities are scheduled as follows:

1. Repair of the Gooseneck Berm and installation of water control structure in the Summer of 2005;
2. Water has been retained behind berm in MF 4 since the berm repair was completed, with great success in having the area inundated in the Fall of 2005. ;
3. The Bank Sponsor has 500 lbs of seed mix available for revegetation of the area as soon as possible, scheduled for the Fall of 2006;
4. The Bank Sponsor expects to periodically inundate this area as needed, depending on the season and weather conditions; and
5. Additional revegetation of Alkali Bulrush and Sago Pondweed was completed in the Fall of 2005.

## 13.4 Lacustrine Area 1

LA 1 is the area historically known as Machine Lake. Restoration activities have already been conducted in this area, as outlined below:

1. Large stands of phragmites were burned in the Summer of 2002;
2. The Machine Lake Berm restoration was initiated in the Winter of 2002 and was completed in the Summer of 2003 under Nationwide Permit 3, #200350080;
3. The outlet structure for water control was installed successfully in the Spring of 2003;
4. Spraying of herbicide for phragmite control was done on test plots in LA 1 and EM 6 in the Summer of 2004. These tests have allowed The Bank Sponsor to determine the correct amount of herbicide to use, as well as an effective delivery method. These activities were conducted again in 2005 by means of a snowcat mobile platform to allow vehicle access on-site;
5. In February of 2005, the water control structure was fully opened to allow drainage of the area, due to higher than normal water levels. The intent was to draw down the water level so phragmite control could again be conducted during the Summer of 2005.
6. In August of 2005, Phragmite control consisted of cutting the vegetation down, spraying the remaining stems with herbicide, and then flooding the area in winter to prevent re-growth

7. It is anticipated that after this vegetation control phase the LA 1 area will be inundated permanently. The Bank Sponsor has determined, through, experimentation that 18 inches of board depth at the water control structure is the correct level to keep water in the marsh at an optimal depth to provide for open water habitat;
8. Revegetation efforts began in the Fall of 2005 and will continue through the Spring of 2006; and
9. A second water control structure (a pond gate) was installed in summer 2005 (west of the Machine Lake Berm to be better able to control drainage from low areas) while the area is dry.

## 13.5 Emergent Marsh Area 7

250 acres of Emergent Wet Meadow and Marsh area will be enhanced to provide higher functional values than are currently present. Controlling invasive non-native species, re-establishing native species such as alkali bulrush (Scirpus maritimus), hardstem bulrush (Scirpus acutus) and pickleweed (Salicornia spp.), and establishing and maintaining beneficial water levels will provide for the enhancement.

The following mitigation activities are planned for this area:

1. The area is currently extensively dominated by invasive phragmites. Access to the area is limited as a result of this effort, and spraying will not be conducted again until 2006. It will be done from a snow-cat mobile platform, as this is the only machine available to Bank Sponsor that is capable of gaining access to the area; and
2. Once phragmite control has been successful, revegetation efforts will begin, in the Fall of 2006 or in the Spring of 2007.

## 13.6 Mudflat Areas 5, 6 & 13

Development pressure associated with Brigham City on the north and eastern edges of the MLA highlights the need to preserve this area as wetlands. These areas (MF 5, MF 6 and MF 13) consist of approximately 227 acres of playa, wet meadow and uplands. They will be preserved in their current state as part of the MLA and offer a range of wetland and upland classes. Institutional controls will be available to preserve these areas from development upon approval of the banking instrument.

## 13.7 Summary of Proposed Wetland Restoration/Enhancement Activities

Wetland restoration, enhancement and preservation activities will improve wetland functional values in Phase 1 of the MLA. The following is a summary of the wetland classes that will be present after all mitigation activities are complete:

1. Approximately 173 acres of lacustrine wetlands, 20.4% of Phase 1;
2. Approximately 61 acres of emergent marsh wetlands, 7.2% of Phase 1;
3. Approximately 437 acres of emergent wet meadow, 51.6% of Phase 1;
4. Approximately 112 acres of mud flat/salt flat/playa wetlands, 13.2% of Phase 1; and

5. Approximately 65 acres of upland and bare soil, 7.7% of Phase 1.

These areas total 847 acres for the Phase 1 area.

## 13.8 Success Criteria for Phase 1 of Machine Lake Mitigation Bank

The final success criteria for the mitigation activities are to return the functions and values and hydrologic regime to that of the previously documented wetland systems. Vegetation cover is planned to be native species that historically occurred in the area. Final success criteria will be met when replanting, water management and rodent control activities have met proposed restoration, enhancement, creation and preservation goals for two consecutive growing seasons. Credit release, however, will take place as soon as it can be demonstrated that the success criteria has been met. It should be noted that the contemplated ongoing water management and invasive species controls will continue to ensure the successful establishment and survival of habitat and vegetation.

## 13.9 Performance Criteria

The presence of healthy native wetland vegetation (mainly alkali bulrush in most areas) together with surface hydrology will indicate that the wetland restoration is performing as intended. The presence of invasive species, and/or upland species together with dry conditions in the spring as well as the remainder of the year will indicate that the wetland has not met the performance criteria for the restoration.

The restoration will be considered successful for the mitigation area when the following criteria have been met:

1. When at least 80% of the existing vegetation is comprised of planted native plant species along with desirable existing on-site species. A total target percent groundcover of 50% is appropriate due to the types of wetlands involved and the fact that open water is a desired feature of the restoration at certain times of the year, especially in LA 1;
2. Adequate hydrology is present at levels appropriate for the relevant time of year;
3. Hydric soils are present; and
4. For preservation credits to be released, land use restrictions for development will be recorded upon approval of the Banking Instrument.

If these criteria are not met in any given year, replanting or other appropriate measures will be conducted and monitoring will continue.

Data will be collected using visual observation and basic statistical methods. If it is determined that the success criteria are not being met, additional vegetation will be planted and seeded as necessary. Invasive species will be controlled if they constitute a significant portion (> 20%) of the total vegetation, or otherwise dominate areas of the mitigation site. Controlling invasive species and other maintenance activities will be continued as necessary.

If sufficient hydrology or hydric soils fail to be present in the mitigation area, appropriate steps will be taken to restore the required conditions or to find an otherwise appropriate solution.

13.10 Mitigation Credits Available from Phase 1

Once all mitigation activities are completed and the wetlands are functioning properly (including regular maintenance activities, water management and invasive species control), the Machine Lake Area will provide the following credits:

1. Approximately 18.6 credits from mud flat/ playa (mostly preservation at a 6:1 ratio. The uplands areas will be included as non-debiting uplands. Ratios for the playa areas in these areas were reduced from 10:1 to 6:1 because of the benefits derived from approximately 65 acres of non-debiting uplands that will be included as integral habitat within Phase 1.);
2. Approximately 55.3 credits from lacustrine wetlands (mostly enhancement at a 3:1 ratio & restoration at a 2:1 ratio);
3. Approximately 19.9 credits from emergent marsh (mostly enhancement at a 3:1 ratio & restoration at a 2:1 ratio);
4. Approximately 141.3 credits from emergent wet meadow (mostly enhancement at a 3:1 ratio & restoration at a 2:1 ratio); and
5. 65 acres of Upland areas are included within Phase 1 but will act as upland buffers and provide habitat diversity. These will be non-debiting uplands and are the basis of reducing the ratios for the mud flat/playa areas.

Restoration credit was assessed to 2:1 ratios and enhancement at 3:1 ratios. It is understood that the USACE typically assesses higher mitigation ratios for enhancement and restoration. However, the selected ratios are justified by the average success rate of such mitigation efforts, together with the finely tuned criteria imposed by the USACE regarding existing soil and wetland types extant in both the Service Area and the MLA. In this case the lower ratios are also justified by the initial efforts and success the Bank Sponsor has already achieved at the MLA and the success at the Refuge using similar approaches. In addition, the availability of the management regime for water diversions on the MLA further support the proposed credit ratios. The overall credit ratio for the MLA is 3.7:1 based on the 320 credits requested for the MLA for the 847 acres in Phase 1. This is slightly higher than the 3.43:1 ratio assessed for the Brigham City Airport mitigation. That mitigation recently approved on the Bank Sponsors property by the USACE. The full credit analysis is presented in Table 3 – Phase 1 Wetland Class Summary and Mitigation Credit Analysis.

A total of 320 credits will be made available from Phase 1 of the Machine Lake Area Wetland Mitigation Bank.

TABLE 3
Phase One Wetland Class Summary and Mitigation Credit Analysis

| PHASE 1 TOTALS | EM7 (Ac) | LA1 (Ac) | MF4 (Ac) | MF5 (Ac) | MF6 (Ac) | MF13 (Ac) | TOTAL (Ac) |
|---|---|---|---|---|---|---|---|
| MFP | 64.1 | 108.0 | 85.5 | 32.8 | 49.4 | 29.5 | **369.3** |
| LOW | 10.9 | 51.4 | 0.8 | 0.6 | 0.4 | 0.4 | **64.5** |
| EM | 25.8 | 29.8 | 0.3 | 0.5 | 0.2 | 0.8 | **57.5** |
| EWM | 126.4 | 30.2 | 43.7 | 15.2 | 28.2 | 4.2 | **247.9** |
| U | 17.7 | 2.9 | 16.5 | 13.1 | 47.2 | 3.1 | **100.4** |
| S | 5.4 | 0.2 | 0.3 | 0.9 | 0.4 | 0.0 | **7.1** |
| Total | **250.3** | **222.5** | **147.0** | **63.1** | **125.8** | **38.0** | **846.7** |

| Total Final Acreage | Acres | Credits | Ratio |
|---|---|---|---|
| MFP | **112** | **18.6** | 6.0 |
| LOW | **173** | **55.3** | 3.1 |
| EM | **61** | **19.9** | 3.0 |
| EWM | **437** | **137.9** | 3.2 |
| U | **63** | **0.0** | Non-debiting |
| S | **1** | **0.0** | Non-debiting |
| Total | **846.7** | **231.8** | 3.7 |

**Wetland Types**
**MFP = Mud Flat / Playa**
**LOW = Lacustrine Open Water**
**EM = Emergent Marsh**
**EWM = Emergent Wet Meadow**
**U = Upland Range**
**S = Bare Soil**

| Credit Analysis | EM7 (Ac) | Target Wetland Type | Ratio | Credits | Action |
|---|---|---|---|---|---|
| MFP | 64.1 | EWM | 3 | 21.4 | Restoration |
| LOW | 10.9 | LOW | 6 | 1.8 | Preservation |
| EM | 25.8 | EM | 3 | 8.6 | Enhanced |
| EWM | 126.4 | EWM | 3 | 42.1 | Restoration |
| U | 17.7 | EWM | 3 | 5.9 | Creation |
| S | 5.4 | EWM | 3 | 1.8 | Creation |
| Total | **250.3** | | | **81.6** | 3.1 |

| Credit Analysis | LA1 (Ac) | Target Wetland Type | Ratio | Credits | Action |
|---|---|---|---|---|---|
| MFP | 108.0 | LOW | 3 | 36.0 | Restoration |
| LOW | 51.4 | LOW | 3 | 17.1 | Enhanced |
| EM | 29.8 | EM | 3 | 9.9 | Restoration |
| EWM | 30.2 | EWM | 3 | 10.1 | Restoration |
| U | 2.9 | EM | 3 | 1.0 | Creation |
| S | 0.2 | EM | 3 | 0.1 | Creation |
| Total | **222.5** | | | **74.2** | 3.0 |

| Credit Analysis | MF4 (Ac) | Target Wetland Type | Ratio | Credits | Action |
|---|---|---|---|---|---|
| MFP | 85.5 | EWM | 3 | 28.5 | Restoration |
| LOW | 0.8 | LOW | 6 | 0.1 | Preservation |
| EM | 0.3 | EM | 3 | 0.1 | Restoration |
| EWM | 43.7 | EWM | 3 | 14.6 | Restoration |
| U | 16.5 | EWM | 3 | 5.5 | Creation |
| S | 0.3 | EWM | 2 | 0.1 | Creation |
| Total | **147.0** | | | **48.9** | 3.0 |

| Credit Analysis | MF5 (Ac) | Target Wetland Type | Ratio | Credits | Action |
|---|---|---|---|---|---|
| MFP | 32.8 | MFP | 6 | 5.5 | Preservation |
| LOW | 0.6 | LOW | 6 | 0.1 | Preservation |
| EM | 0.5 | EM | 6 | 0.1 | Preservation |
| EWM | 15.2 | EWM | 6 | 2.5 | Preservation |
| U | 13.1 | U | Non-debiting | 0.0 | Preservation |
| S | 0.9 | S | Non-debiting | 0.0 | Preservation |
| Total | **63.1** | | | **8.2** | 7.7 |

| Credit Analysis | MF6 (Ac) | Target Wetland Type | Ratio | Credits | Action |
|---|---|---|---|---|---|
| MFP | 49.4 | MFP | 6 | 8.2 | Preservation |
| LOW | 0.4 | LOW | 6 | 0.1 | Preservation |
| EM | 0.2 | EM | 6 | 0.0 | Preservation |
| EWM | 28.2 | EWM | 6 | 4.7 | Preservation |
| U | 47.2 | U | Non-debiting | 0.0 | Preservation |
| S | 0.4 | S | Non-debiting | 0.0 | Preservation |
| Total | **125.8** | | | **13.0** | 9.6 |

| Credit Analysis | MF13 (Ac) | Target Wetland Type | Ratio | Credits | Action |
|---|---|---|---|---|---|
| MFP | 29.5 | MFP | 6 | 4.9 | Preservation |
| LOW | 0.4 | LOW | 6 | 0.1 | Preservation |
| EM | 0.8 | EM | 6 | 0.1 | Preservation |
| EWM | 4.2 | EWM | 6 | 0.7 | Preservation |
| U | 3.1 | U | Non-debiting | 0.0 | Preservation |
| S | 0.0 | S | Non-debiting | 0.0 | Preservation |
| Total | **38.0** | | | **5.8** | 6.5 |

## 13.11 Advance Credits for Mitigation

Bank Sponsor requests 79 advance credits be released immediately upon the approval of this banking instrument. This request is based on page 58606 of the Federal Register, November 28, 1995, Volume 60, Number 228, which states "… it is our intent to ensure that decisions to allow credits to be withdrawn from a mitigation bank in advance of bank maturity be made on a case-by-case basis to best reflect the particular ecological and economic circumstances of each bank. The percentage of advance credits permitted for a particular bank may be higher or lower than the 15% example included in the proposed guidance."

By comparison, four mitigation banks were authorized in Utah by the USACE between 1996 and 2000. These banks received between 50 and 100% of the total credits in advance upon acceptance of the banking instrument, recording of the conservation easements and deed restrictions and completion of the construction detailed in their design plan. Bank Sponsor believes an advance release of 25% of the total available credits in Phase 1 is both valid and fair. The Bank Sponsor has already completed extensive work to restore LA 1 and the preliminary work on EM 7 and MF 4 & 5 has also begun. The benefit of these improvements to the wetland function of these wetlands has begun, and a temporal gain of function has been realized by these improvements. While conservation easements will not be granted until the wetland functions have been completed, due to the need for accurate baseline monitoring for the conservation easement process, no development may or will occur on Phase 1 pursuant to the terms and conditions of this Banking Instrument. Accordingly, it is requested that the USACE authorize the release of 79 advance credits upon approval of the Banking Instrument.

## 13.12 Credit Release Criteria

Phase 1 is comprised of 6 separate areas, LA 1, EM 7, MF 4, MF 5, MF 6 and MF 13. Each area is at a different stage of mitigation activity as of the time of this submittal. As a result, it is likely that certain areas will meet the success and performance criteria before others. Credits will be requested and released in portions or for each area as they become available. The entire Phase 1 will not be required to meet the success and performance criteria before any credits are released for certain areas therein.

Although this schedule may change, here is a rough outline of when each area of Phase 1 is expected to meet the success criteria so as to allow release of credits:

1. Advance of 25 % of total credits when Banking Instrument is approved and signed.

    - 79 credits in the Spring of 2006.

2. MF 5, 6 & 13 credits will also be released at this time as the preservation activities will be in place and conservation easements recorded (These areas total 27 credits).

- Remaining 21 credits released in the Spring of 2006. (6 credits were previously accounted for in the 25% advance credit release.)

3. LA 1 will meet the success criteria when water is impounded in the Spring of 2006, as extensive mitigation work has been performed over the last two years. As a result, Bank Sponsor proposes that 50% of the credits be released for this area as soon as the success criteria can be demonstrated, and 50% when the area has been managed at the level required by the success criteria for two consecutive years.

    - 38 credits in the Spring of 2007, and 39 credits in the Spring of 2008.

4. MF 4 will likely require two years before the success and performance criteria have been met. 50% of the credits may be released in 2008 and 50% the subsequent year.

    - 27 credits in the Spring of 2008 and 28 credits in the Spring of 2009; and

5. EM 7 will also likely require at least two years before success and performance criteria may be met. 50% of the credits may be released as performance criteria and success are achieved and 50% the subsequent year.

    - 44 credits in the Spring of 2008, and 44 credits in the Spring of 2009.

The following table is an example of the ledger that will be used to track credit releases. It will be filled out and re-submitted with each subsequent release of credits (credit) and withdrawal of credits (debit), or as part of each yearly Monitoring Report submitted.

**LEDGER**

| Transaction Information | | | Debit Amount Acres (HU's) | | | | Ending Balance | | | | Total Acres |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Deposit Received | Entity | Permit Number | Open Water | Upland Buffer | Emergent Marsh | Wet Meadow | Open Water | Upland Buffer | Emergent Marsh | Wet Meadow | |
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## 14. Operation of the Wetland Mitigation Bank

### 14.1 Access to the Site

Bank Sponsor will allow or otherwise provide or access to the site by members of the MBRT, upon request and as reasonably necessary, for the purpose of inspection and monitoring consistent with this Banking Instrument throughout the period of Bank establishment, monitoring and operation.

### 14.2 Projects Eligible to Use the Bank

The following types of projects may be eligible to use the Machine Bank Wetland Bank:

1. All activities regulated under Section 404 of the Clean Water Act located within the Service Area of this Mitigation Bank may be eligible to use the bank as compensatory Mitigation for unavoidable impacts;
2. Use of credits may be authorized when impacts are unavoidable and when onsite mitigation is not practicable;
3. Credits may be used to compensate for environmental impacts under other programs (civil works, Superfund removal and remedial, supplemental environmental projects for State and Federal enforcement actions, etc.)
4. For projects in the Service Area of this Mitigation Bank that require authorization with a Nationwide Permit (NWP) under Section 404 of the Clean Water Act and if permits require compensatory Mitigation. Credits from this bank may be used to satisfy these compensatory Mitigation requirements if Bank Sponsor and the third party permittee reach a mutually acceptable financial agreement and such use is subject to regulatory approval on a case-by-case basis.
5. For projects in the Service Area of this Mitigation Bank that require authorization with an Individual Permit (IP) under Section 404 of the Clean Water Act, subject to regulatory approval on a case-by-case basis. Once the USACE has determined that the mitigation in this Bank is ecologically preferable to any on-site alternatives or that there are no practicable on-site alternatives, mitigation may be provided by the use of mitigation credits from the Bank, if Bank Sponsor and the third party permittee reach a mutually acceptable financial agreement.

### 14.3 Monitoring Methodology

Yearly monitoring of the restoration will be comprised of the following:

1. A visual inspection of hydrology in the Spring (April-May), including depth of surface water (if present); and
2. A visual inspection of the plant community in the summer (June-August), including percent cover of native vs. invasive species as well as percent cover of planted species vs. non-planted species.

Photos will be taken from pre-determined locations for each yearly monitoring inspection.

## 14.4 Annual Reports

An annual report containing all monitoring observations (hydrology, vegetation, etc.) and photographs will be prepared and submitted each to the USACE year. Performance and success criteria targets and progress will be discussed along with any actions taken to improve performance, such as replanting or re-grading.

## 14.5 Schedule

The first monitoring report will be due upon completion of restoration construction and subsequent annual reports shall be due each year 365 days after the date of acceptance of the restoration plan.

**MONITORING SCHEDULE**

| Dates | Task |
|---|---|
| 1st Spring after bank approval | Year 1 – first monitoring event (hydrology) |
| 1st Summer after bank approval | Year 1 – second monitoring event (veg), submit report to the USACE |
| 2nd Year after bank approval | Year 2 – monitoring events (hydrology & veg), submit report to USACE |
| 3rd Year after bank approval | Year 3 – monitoring events (hydrology & veg), submit report to USACE |
| 4th Year after bank approval | Year 4 – monitoring events (hydrology & veg), submit report to USACE |
| 5th Year after bank approval | Year 5 – monitoring events (hydrology & veg) & obtain sign off (Letter of Completion from the USACE) |

## 14.6 Contingency Measures

If the bank consistently fails to meet the performance criteria and no progress towards the success criteria is being made, a re-evaluation of the restoration activities will be conducted. If additional planting and/or re-grading are required in order to meet the performance and success criteria, then an appropriate plan will be prepared and implemented by Bank Sponsor. Natural conditions (drought, climate change) and their impact on the viability of natural wetlands at this site will be considered when measuring the success or failure of the restoration. Funding for all mitigation activities required for creation of the bank is the sole responsibility of the Bank Sponsor.

## 14.7 Provisions for uses of the Mitigation Bank Area

The Bank Sponsor shall not use or authorize the use of areas within Phase 1 of the Machine Lake Bank Area for any purpose that interferes with the purposes set forth in this Banking Instrument other than those specified below:

1. Monitoring of vegetation, soils and water;
2. Maintenance of wetlands, access roads and bridges, berms, dams, outlet and spillway structures and other appurtenant facilities;
3. Recreational uses such as hunting, hiking and bird watching;
4. Cattle Grazing utilized as vegetation control tool;
5. Ecological education; and
6. Compliance with federal regulations and conditions specified in the Mitigation Banking Instrument

## 14.8 Financial Assurances

**The Bank Sponsor** shall use an escrow account to satisfy financial assurance requirements.

*Advance Credit Release.* The Bank Sponsor understands that the release of advance credits normally requires financial assurance to ensure the wetland acreage will be restored on site. However, The Bank Sponsor believes they have met this financial requirement by completion of site activities to date. These activities include:

1. Application, design and approval of a Nationwide Permit #3 to reconstruct Machine Lake berm and outlet structure;
2. Reconstruction of the Machine Lake berm and new outlet structure;
3. Design Application and approval of Nationwide Permit #3 to reconstruct the Gooseneck Dike and outlet structure;
4. On-going invasive species control in Machine Lake; and
5. Identification and verification of water rights.

These activities have been completed or are ongoing and the costs to complete each of these activities is tantamount to the financial assurance for the release of the advance credits.

*Maintenance and Monitoring and Catastrophic Funds*. Six percent (6%) of all cash proceeds from credit sales shall be placed into two separate interest bearing escrow accounts entitled the Maintenance and Monitoring Fund and the Catastrophic Loss Fund with 50 % earmarked for each Fund. The total amount that will be generated by the Phase 1 area for these two funds is estimated at $576,000.00. If the required monitoring or maintenance is not conducted as specified in this Instrument, the USACE shall request release of funds to cover the necessary monitoring and/or maintenance activities.

One-tenth of this fund (or 0.5% of the total cash proceeds) shall be released to Bank Sponsor 30 days after the USACE reviews and approves the annual monitoring report that documents restoration and enhancement activities. At such time in the future that these funds appear excessive for the purposes for which they were devised, Bank Sponsor may request the USACE to release of that portion of the funds deemed to be in excess.

## 15. Other Provisions

### 15.1 Obligations of the Parties

1. Bank Sponsor: The Bank Sponsor is responsible for implementation, maintenance and remediation of the mitigation site plan as detailed in this Instrument, including but not limited to ensuring the success of the wetland restoration and creation work, reporting the results of monitoring of the mitigation site, managing and reporting credit sales and balances, complying with the requirements of local zoning ordinances and land use plans, obtaining any required water rights and meeting all other requirements in the Banking Instrument.

2. Responsibility of the MBRT and the USACE:

   A. MBRT Oversight: The agencies represented on the MBRT agree to provide appropriate oversight in carrying out provisions of this Agreement.

   B. MBRT Review: The agencies represented on the MBRT agree to review and provide comments on all project plans, monitoring reports, contingency and remediation plans, and necessary permits for the Bank, as identified or incorporated by reference into this Agreement, in a timely manner. Comments on the annual reports, contingency and remediation plans, will be provided to the Bank Sponsor within 30 calendar days from the date of submittal, except for good cause. Members of the MBRT shall notify the Bank Sponsor by telephone or by email, with subsequent written confirmation, within 10 working days from the date of receipt of a complete submission of a document to be reviewed, if they will not be able to review it within the specified period. Reasonable extensions for review and approval shall be granted by the Sponsor and/or the USACE, as appropriate, based upon demonstration of good cause, but in no event shall the review period be longer than 60 calendar days from the date of submittal.

   C. Evaluation of Bank Progress: The agencies represented on the MBRT agree to review and confirm reports on evaluation of the Success Criteria prior to certifying credits in the Bank, within the same timelines provided above.

   D. Site Visits: The agencies represented on the MBRT shall conduct site visits when necessary, as determined by the USACE in coordination with the Bank Sponsor, in order to:

      1. Verify the credits then currently available in the Bank;
      2. Review progress of site development and management; and/or

3. Recommend cooperative measures as needed.

These visits shall continue until the effort to restore and enhance the Bank site, as described in the Plan, has been determined to be completely successful or until all credits have been sold, whichever is later.

E. USACE Obligations: The USACE will review the Bank Sponsor's annual Credit balance sheet. In addition, upon receipt of a Bank application from a potential customer, the USACE will:

1. Determine if an applicant's project qualifies to purchase bank credits and if the applicant has adequately considered other potential compensatory mitigation sites;
2. Ensure that the operative regulations and guidance are used by the applicant to make credit determinations for projects that qualify to use the Bank and validate the accuracy of the credit determination;
3. Determine the accuracy of the wetland delineation and the impact site evaluation, including functional assessments;
4. Review the most recent Bank balance sheet to determine if by wetland type, are available for sale, and approve the deduction from the Bank of such for use by the applicant; and
5. Provide to the Bank Sponsor complete documentation of USACE approval of applicant's use of Credit from the Bank, including number and wetland type of Credit required of the applicant by the USACE.

## 15.2 Execution, Validity, Modification and Termination of the Banking Instrument

1. The Bank Sponsor must sign this Agreement prior to the signature and execution of this Agreement by the USACE and other members of the MBRT. Subsequently, this Agreement may be executed in counterpart by each agency that chooses to become signatory to said document. This Agreement will become valid and enforceable as between each signatory agency and the Sponsor on the date of that agency's signature.

2. This Agreement may be amended or modified with the written approval of the USACE and the Bank Sponsor, in consultation with the other members of the MBRT.

3. Terms and provisions of this Agreement will be valid until:

A. As regards individual signatories to this Agreement, termination of this Agreement may only happen if consistent with the following terms:

1. Any of the MBRT members, with the exception of the USACE, may terminate their participation upon sixty (60) calendar days by written notification to all signatory parties.

2. The USACE may only terminate their participation on the MBRT upon substantial failure of the Bank Sponsor to perform per the terms of this Agreement. Such termination shall occur only after written notice of deficiency and opportunity to correct by the Bank Sponsor, under the terms of this Agreement, have failed to produce necessary corrective action on the part of the Bank Sponsor. Subject to the above, the USACE may terminate their participation upon sixty (60) calendar days upon written notification to all signatory parties.

3. If requested, the member(s) of the MBRT proposing to terminate participation in the MBRT agree to meet with the other MBRT members and the Bank Sponsor to discuss the reason(s) for such termination, prior to the termination taking effect. Notice of a request for such meeting shall be made by the requesting MBRT member(s) not later than thirty (30) calendar days from receipt of the notice of termination.

B. Termination by one member of the MBRT of its involvement in this Agreement shall not terminate or affect the relationship between the remaining members of the MBRT toward each other or the Bank Sponsor, under this Agreement.

C. As regards the termination of this Agreement in its entirety, the terms and provisions of this Agreement will be valid until all credits are debited, and the USACE provides notice, in writing, to the Bank Sponsor that this Agreement may be terminated.

### 15.3 Force Majeure

Nothing herein shall be construed to authorize proceedings against the Bank Sponsor for any damages to the Bank Property caused by acts of God such as earthquake, drought, disease, regional pest infestation, fire, flood, storm, war, civil disturbance, strike, or similar causes. In the event of a force majeure event, the Bank Sponsor will notify the members of the MBRT and work with the MBRT to resolve the damages, if any, caused by the event. However, if the acts of God do not preclude the Bank

Sponsor from resuming bank operations without unreasonable expense, then it shall not be relieved of its obligations under this document. Any impact to future credit releases or numbers of credits available for sale shall be discussed and determined by the MBRT at that time.

15.4 Dispute Resolution

Resolution of disputes of this Banking Instrument shall be in accordance with those stated in the Federal Guidance for the Establishment, Use and Operation of Mitigation banks (60 F.R. 58605, et. seq., November 28 1995).

15.5 Validity, Modification, and Termination of the Banking Instrument

In addition to the provisions set forth above, this Banking Instrument will become valid on the date of the last signatory's signature. This Banking Instrument may be amended or modified with the written approval of all signatory parties.

15.6 Specific Language of Banking Instrument Shall Be Controlling

To the extent that specific language in this document changes, modifies, or deletes terms and conditions contained in those documents that are incorporated into the Banking Instrument by reference, and that are not legally binding, the specific language within the Banking Instrument shall be controlling.

15.7 Transfer

1. USACE Direction to Sponsor to Transfer Responsibility of Bank Operation: If the USACE, deems it necessary that a replacement Bank Operator be designated, the USACE must notify the Bank Sponsor of such direction in writing, setting forth the reasons requiring such a replacement. The Bank Sponsor may designate a replacement Bank Operator within 180 days of Bank Sponsor's receipt of such written notice from the USACE. The replacement Bank Operator shall agree to assume Bank Sponsor's obligations under this Agreement. Absent such designation within 180 days, this Agreement will be terminated. So long as the designated replacement Bank Operator is able to demonstrate an ability to satisfy the obligations created by this Agreement, this Agreement shall not terminate and the Bank Sponsor shall be without further liability or obligation hereunder, provided that the replacement Bank Operator shall be substituted for the Bank Sponsor. The replacement Bank Operator shall become solely responsible for Bank Sponsor's obligations under this Agreement.

   If the Bank Sponsor does not designate a replacement Bank Operator, then a right of entry onto the Bank Property shall be granted to the USACE, consistent with the guarantees established in this Instrument, to such public or private land or resource management organization acceptable to and as directed by the USACE; provided that no such right of entry shall be granted so long as the Bank Sponsor is acting in good

faith to pursue its rights and remedies under this Instrument. The right of entry shall be used to fulfill the purposes of the Bank, as described in this Agreement and the legal guarantees established at herein. Subsequent owners shall be subject to the same land use constraints involving the Bank property as the Bank Sponsor.

2. Bank Sponsor's Transfer of Bank Operation Responsibility: The Bank Sponsor may elect to designate a replacement Bank Operator, provided that the replacement is able to assume the obligations stipulated under this Agreement. The replacement Bank Operator must be reasonably acceptable to the USACE, who shall consult with the MBRT. So long as the designated replacement Bank Operator is able to demonstrate an ability to satisfy the obligations created by this Agreement. this Agreement shall not terminate, and the replacement Bank Operator shall become solely responsible for Bank Sponsor's obligations under this Agreement. Subsequent owners shall be subject to the same land use constraints involving the Bank property as the Bank Sponsor.

15.8 Bank Closure

The Bank shall be deemed closed upon the date that both:

1. Mature aquatic habitats have been established consistent with the performance objectives in the Plan; and

2. Either:

   A. The last authorized Bank credit has been transferred; or

   B. The Bank Sponsor sends the USACE written notice stating that Bank Sponsor is closing the Bank.

15.9 Withdrawal of the Bank Site

The Bank Sponsor may withdraw the entire Bank Site and terminate this Agreement at any time provided that:

1. No mitigation credits developed in the Bank have been transferred in order to compensate for the loss of aquatic habitat;

2. The wetland acreage and habitat values of any wetland habitat existing on the Bank site prior to the initiation of efforts to restore and enhance the site shall be preserved in a condition at least equal to that prior to initiation of Bank establishment efforts; and

3. Bank termination and any subsequent non-Bank use are consistent with then applicable local, state and federal laws and regulations.

15.10 Notice

Any notice required or permitted hereunder shall be deemed to have been given either (i) when delivered by hand, or (ii) three (3) days following the date deposited in the United States mail, postage prepaid.

**Supervisory and Signatory Personnel**

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**MBRT Representatives**

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Region VIII, Wetlands Section
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Denver, CO 80202 2466
Phone: 303-312-6794
Fax: 303-312-6897
Ruiter.David@epamail.epa.gov

15.11 Invalid Provisions

In the event any one or more of the provisions contained in this Instrument are held to be invalid, illegal or unenforceable in any respect, such invalidity, illegality or unenforceability will not affect any other provisions hereof, and this Agreement shall be construed as if such invalid, illegal or unenforceable provision had not been contained herein.

15.12 Captions

The captions of sections and subsections of this Agreement are for convenience only and have no effect on the interpretation of the provisions of this Agreement.

15.13 Word Usage

Unless the context clearly requires other-wise:

1. The plural and singular numbers shall each he considered to include the other.

2. The masculine, feminine and neuter genders shall each be considered to include the others,

3. “Shall,” “will,” “must,” “agrees” and “covenants” is each mandatory; “may” is permissive.

4. "Includes" and "including" are not limiting.

15.14 Counting Days

Days shall be counted by excluding the first day and including the last day. If the last day is a Saturday, Sunday or legal holiday of the federal or state government, it shall he

excluded. If the day for performance of any obligation under this Agreement is a Saturday, Sunday or legal holiday, the time for performance of that obligation shall be extended to 5:00 p.m., local time for the Bank, on the first following date that is not a Saturday, Sunday, or legal holiday.

15.15 Entire Agreement

This Agreement, and all attachments, addenda, schedules and agreements referred to in this Agreement, in addition to any other elements of a Agreement required under the Federal Guidelines not heretofore provided by the Bank Sponsor, constitute the final, complete and exclusive statement of the terms of the agreement between the USACE of the MBRT and the Bank Sponsor pertaining to the Bank and supersedes all prior and contemporaneous understandings or agreements of the parties, except as specified herein.

15.16 Reasonableness and Good Faith

Except as limited elsewhere in this Agreement, whenever this Agreement requires the Bank Sponsor, the USACE, and/or members of the MBRT to give consent or approval to any action on the part of the other(s), such consent or approval shall not be unreasonably withheld or delayed. If either the Bank Sponsor or the USACE of the MBRT disagrees with any determination covered by this provision and reasonably requests the reasons

15.17 Partial Invalidity

If a court of competent jurisdiction holds any clause of this Agreement to be invalid or unenforceable, in whole or in part, for any reason, the validity and enforceability of the remaining clauses, or portions of them, shall not be affected unless an essential purpose of this Agreement would be defeated by loss of the invalid or unenforceable provision.

## 16. Authorities

The establishment, use, operation and maintenance of the Bank is carried out in accordance with the following authorities:

1. Clean Water Act Section 404 (33 U.S.C. 1344);

2. Rivers and Harbors Act of 1899, Section 10 (33 U.S.C. 403);

3. Environmental Protection Agency, Section 401(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material;

4. Department of the Army, Section 404 Permit Regulations (33 C.F.R. Parts 320-330);

5. Memorandum of Agreement between the Environmental Protection Agency and the Department of the Army Concerning the Determination of

Mitigation under the Clean Water Act Section 404 (b)(1) Guidelines (February 6, 1990);

6. Fish and Wildlife Coordination Act (16 U.S.C. 661, et. seq.); and

7. Federal Guidance for the Establishment, Use, Operation of Mitigation Banks (60 F.R. 58605 et. seq. November 28, 1995).

## 17. Signatures

The parties to this Mitigation Banking Instrument have participated in the development of the (Instrument) for the Machine Lake Area Mitigation Bank. The Instrument, contains details for the mitigation site plan, goals, objectives, performance standards, monitoring and contingency plans, and reference site. By signing this document, the parties are deemed to have approved the Instrument and the mitigation plan described within it. The following four pages are signatory sheets for this Instrument, with a joint page for the Bank Sponsor and the U.S. Army Corps of Engineers (page 40) and single page for the U.S. Fish and Wildlife Service (page 41), U.S. Environmental Protection Agency (Page 42) and the Utah Division of Wildlife Resources (page 43). The signatories representing these agencies are:

Kim Rolfe – Bank Sponsor
R & P Wetlands and Waterfowl, LLC

Colonel Ronald N. Light, District Engineer, Sacramento District
U.S. Army Corps of Engineers

Mitch King, Regional Director, Region 6
U.S. Fish and Wildlife Service

Robert E. Roberts, Regional Administrator, Region VIII
U.S. Environmental Protection Agency

James F. Karpowitz, Director
Utah Division of Wildlife Resources

The Machine Lake Area Mitigation Banking Instrument (dated May 11, 2006) shall become effective between the Sponsor and each signatory upon its execution by the Sponsor and said individual signatory agency.

Kim Rolfe – Bank Sponsor
R & P Wetlands and Waterfowl, LLC

_____ _____
Signature Date

The Machine Lake Area Mitigation Banking Instrument (dated May 11, 2006) shall become effective between the Sponsor and each signatory upon its execution by the Sponsor and said individual signatory agency.

Colonel Ronald N. Light, District Engineer, Sacramento District
U.S. Army Corps of Engineers

_____ _____
Signature Date

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Mitch King, Regional Director, Region 6
U.S. Fish and Wildlife Service

_____ _____
Signature Date

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Robert E. Roberts, Regional Administrator, Region VIII
U.S. Environmental Protection Agency

_____ _____
Signature Date

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James F. Karpowitz, Director
Utah Division of Wildlife Resources

_____ _____
Signature Date

## 18. Literature Cited

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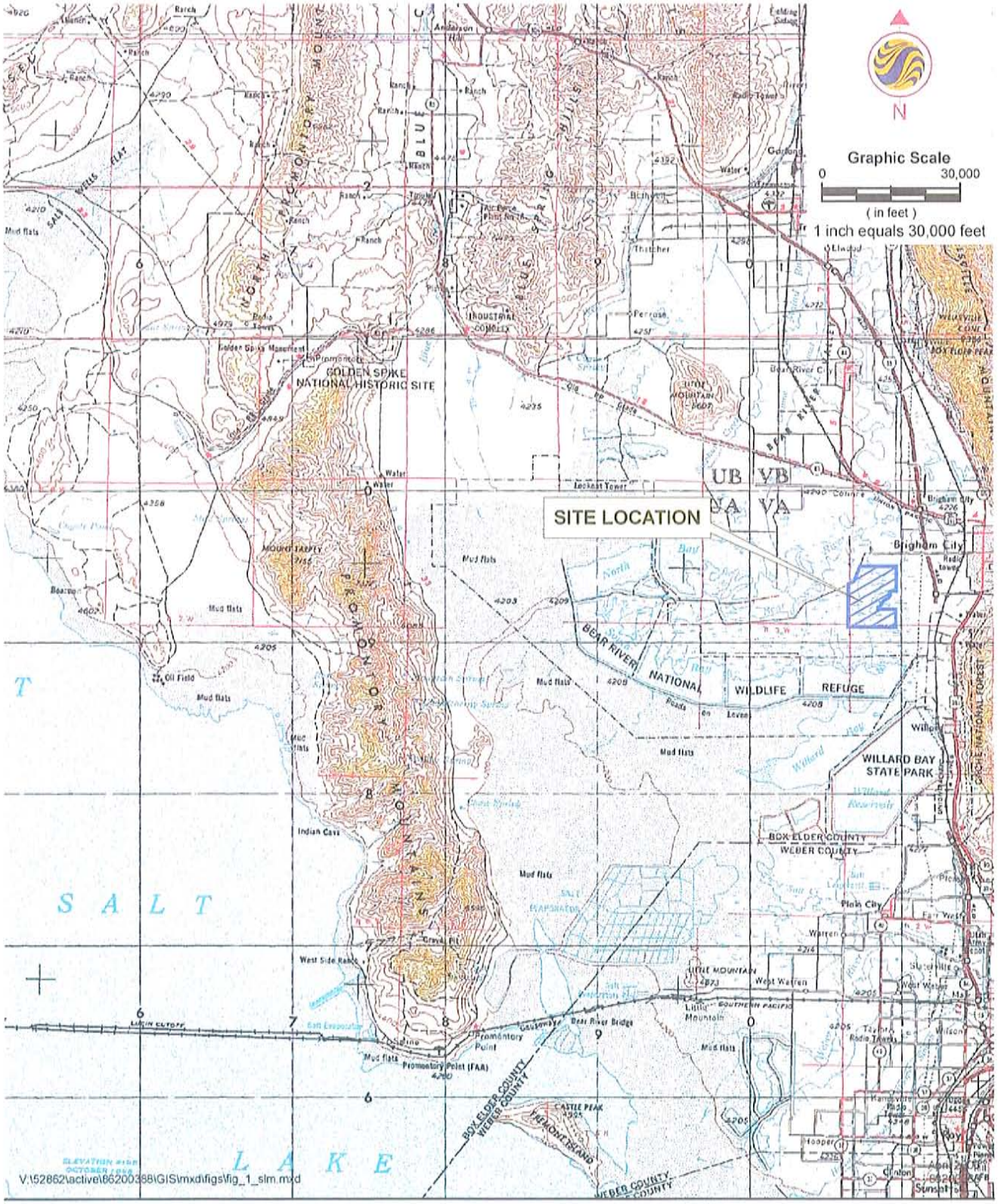
# Figures 1-9





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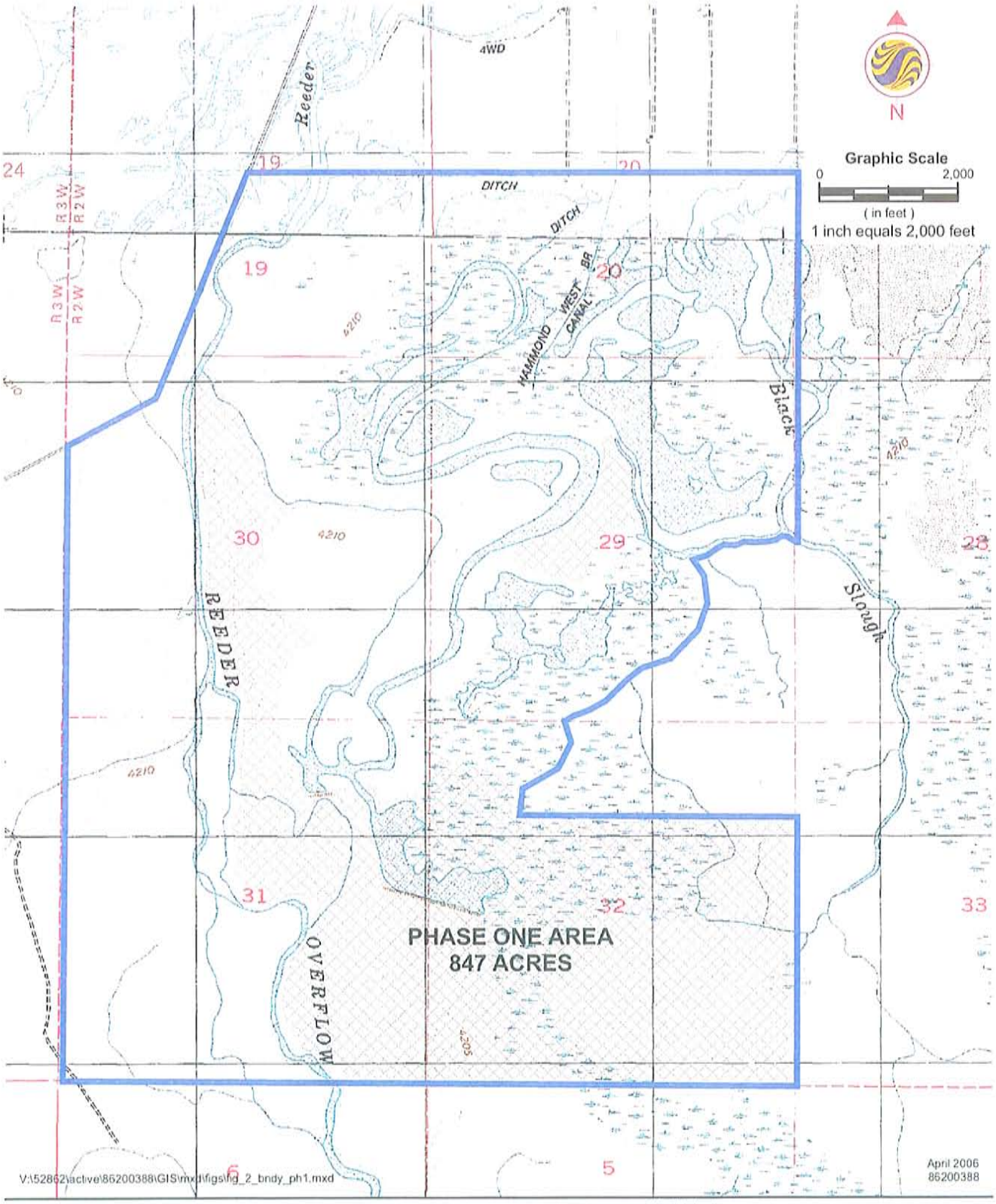
Client/Project
R&P WETLANDS AND WATERFOWL
MACHINE LAKE AREA
MITIGATION BANKING INSTRUMENT

Figure No.
1

Title
**SITE LOCATION MAP**

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April 2006
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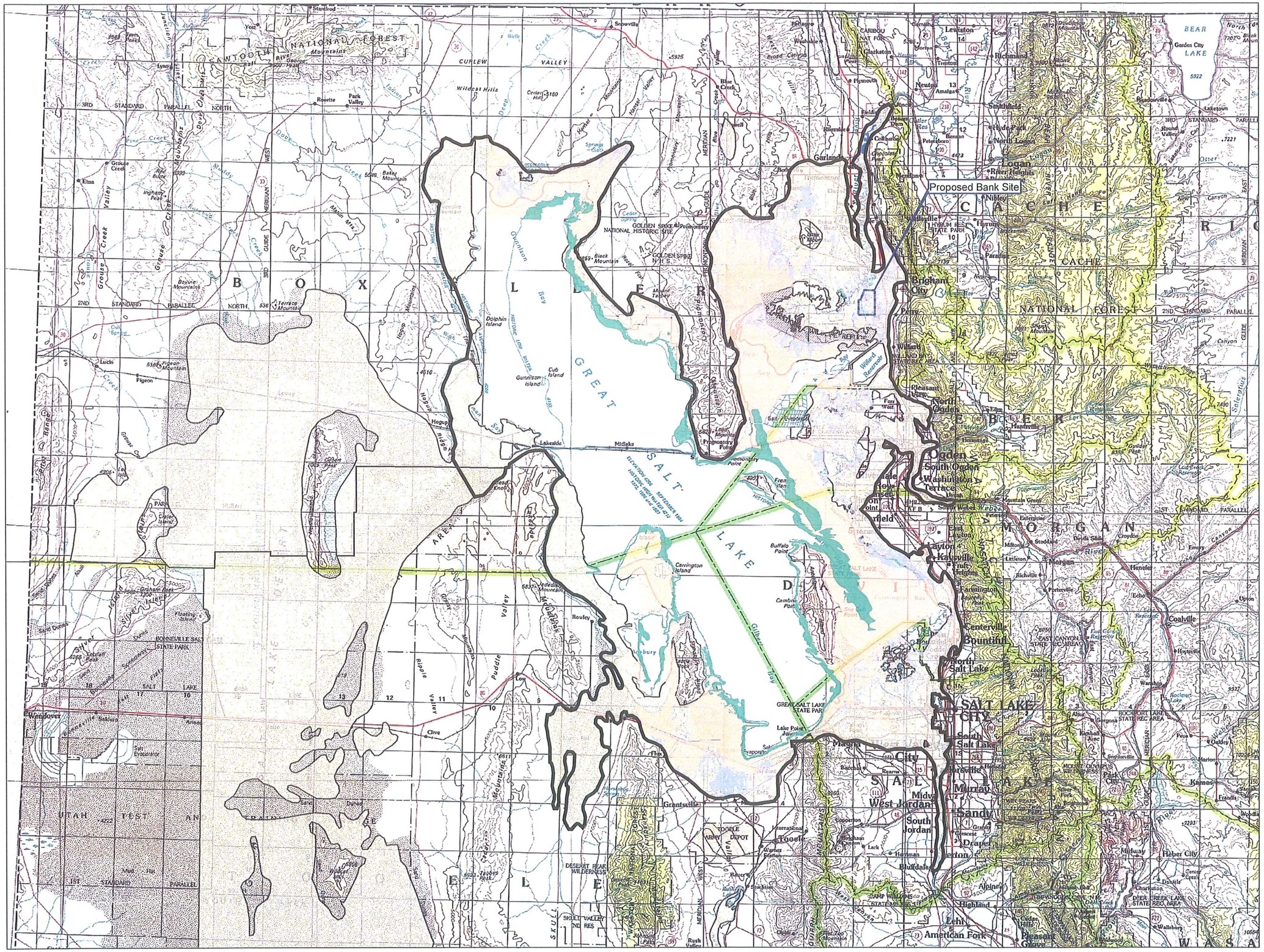
Client/Project
R&P WETLANDS AND WATERFOWL
MACHINE LAKE AREA
MITIGATION BANKING INSTRUMENT

Figure No.
2

Title
**SITE LOCATION MAP WITH PHASE 1 BOUNDARY**





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**Legend**

- SERVICE AREA BOUNDARY
- SOILS FOUND ON OLD LAKEPLAINS, LOW TERRACES, AND FLOODPLAINS
- WETLAND PEM: 90,334 acres
- WETLAND PUB: 608 acres
- WETLAND L2US: 390,746 acres
- WETLAND L2UB: 90,892 acres
- WETLAND PUS: 4,030 acres
- WETLAND R: 4,927 acres

**TOTAL = 581,537 acres**

N

Graphic Scale

5 0 5
Miles

1 inch equals 5 miles

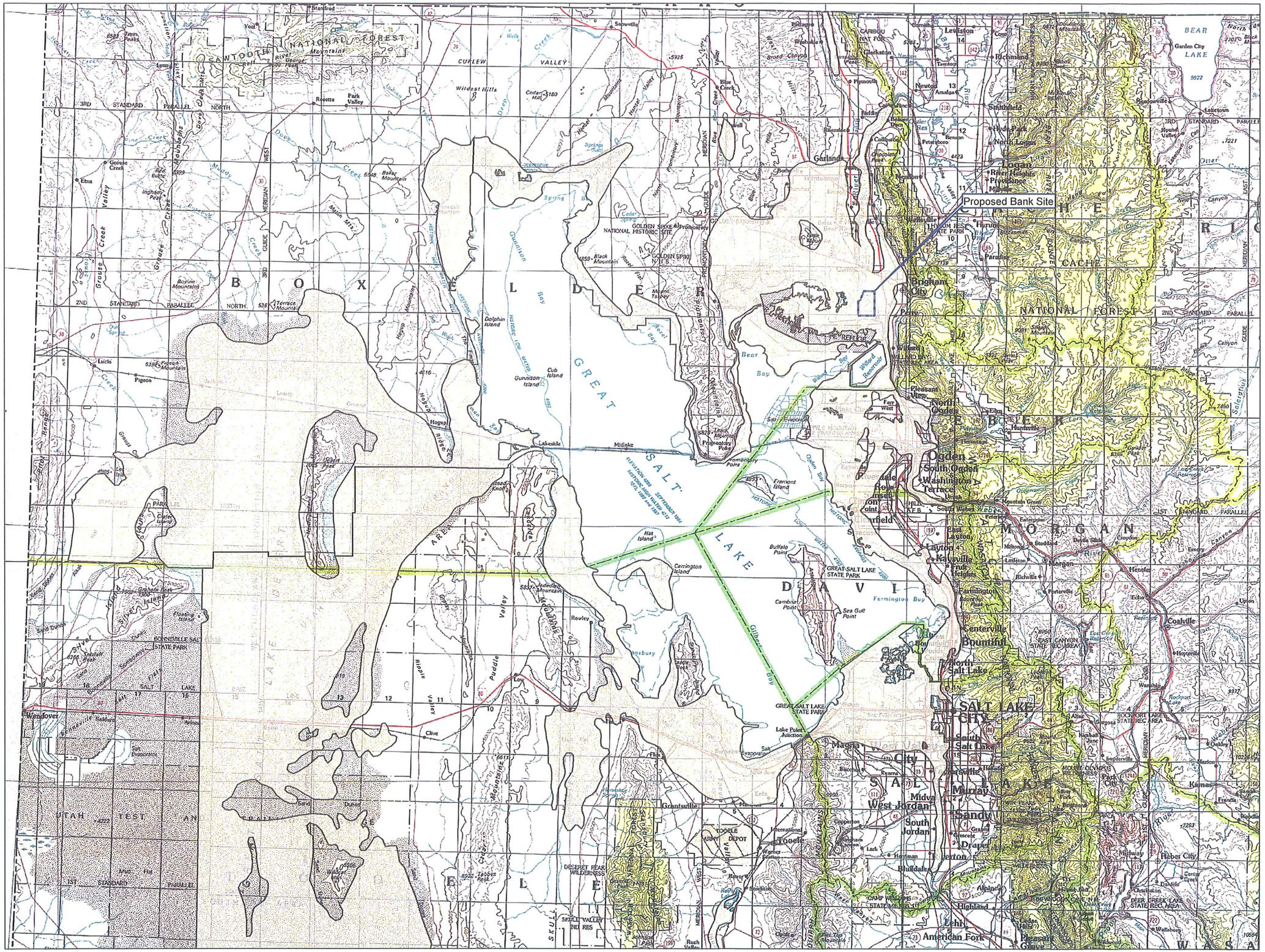
Notes

Client/Project
R&P WETLANDS

UTAH

Title
**SERVICE AREA SOIL MAP & SERVICE AREA NWI MAP**

| Project No. | Scale | |
|---|---|---|
| 86200388 | 1 inch equals 5 miles | |
| Drawing No. | Sheet | Revision |
| 3A | | 0 |





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**Legend**

SOILS FOUND ON OLD LAKEPLAINS, LOW TERRACES, AND FLOODPLAINS

N

Graphic Scale

5 0 5

Miles

1 inch equals 5 miles

Notes

Client/Project

R&P WETLANDS

UTAH

Title

**SERVICE AREA SOIL MAP**

| Project No. | Scale | |
|---|---|---|
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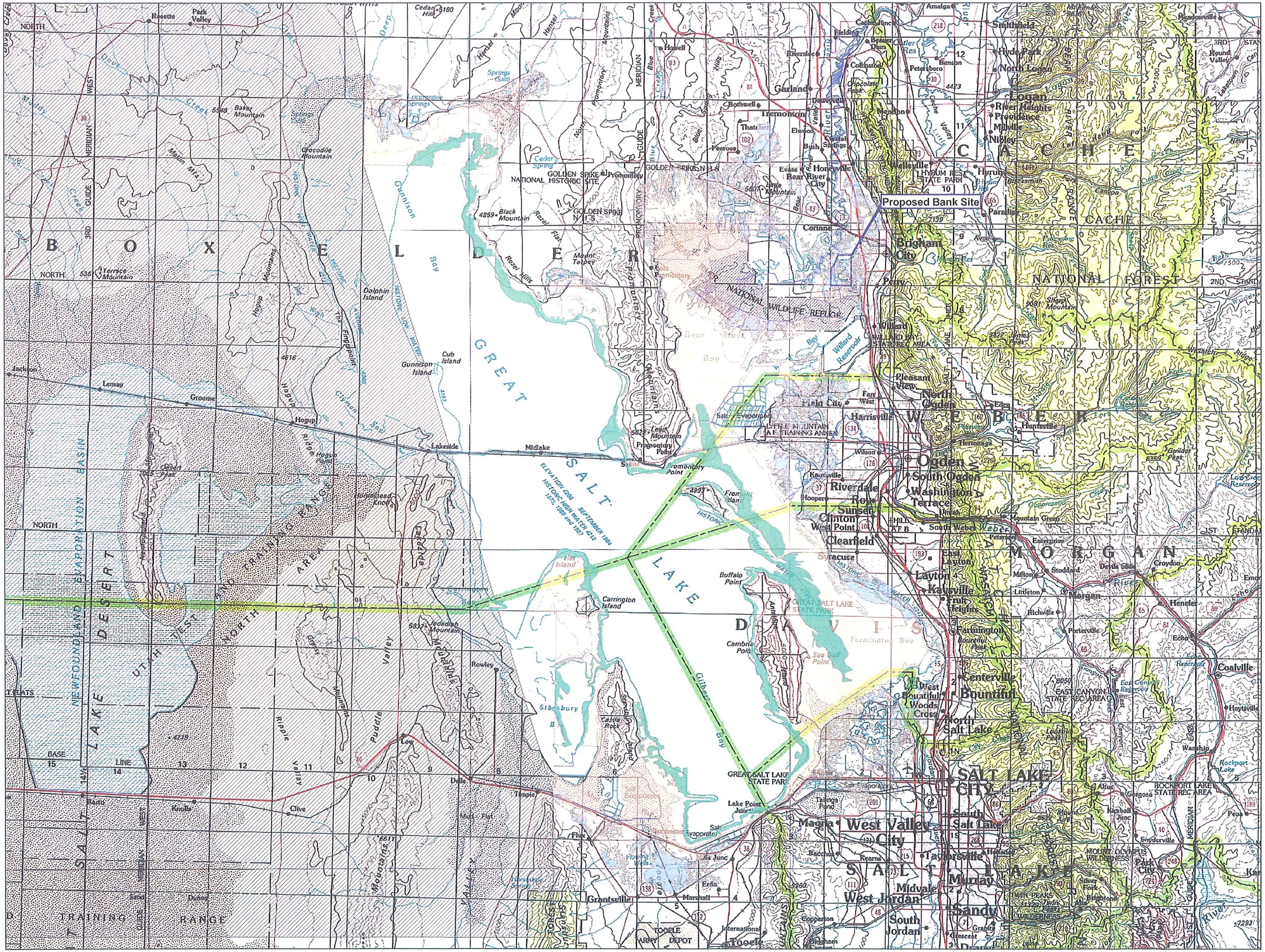
| **Drawing No.** | **Sheet** | **Revision** |
| 3B | | 0 |

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## Legend

NWI mapped wetlands matching bank wetland types below the Stansbury Shoreline

- WETLAND PEM: 95,601 acres
- WETLAND PUB: 614 acres
- WETLAND L2US: 395,057 acres
- WETLAND L2UB: 91,019 acres
- WETLAND PUS: 4,177 acres
- WETLAND R: 5,218 acres

**TOTAL = 591,684 acres**

N

Graphic Scale

4 0 4

Miles

1 inch equals 4 miles

Notes

Digital NWI maps are unavailable for West Box Elder and Tooele Counties

Client/Project

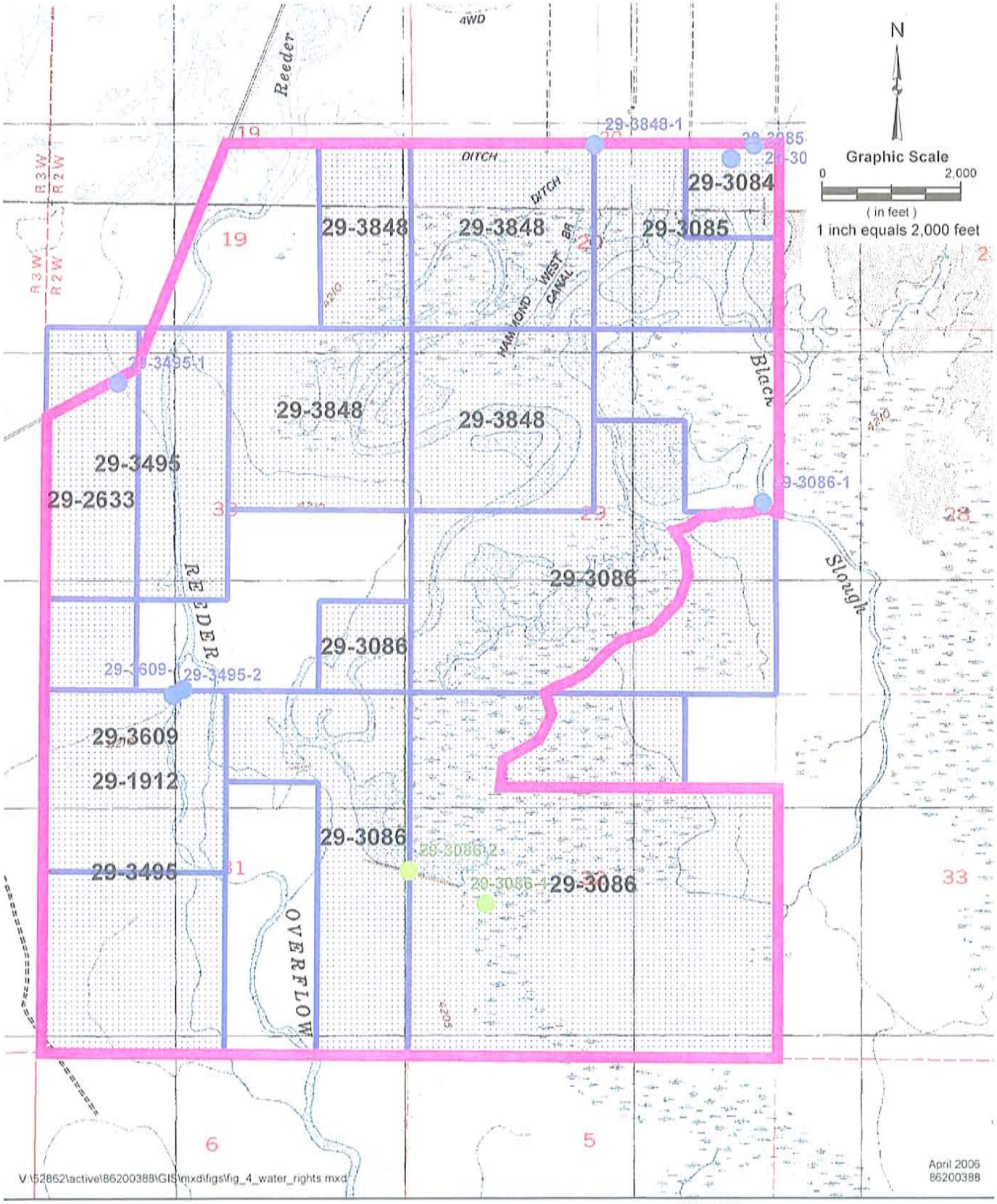
R&P WETLANDS

UTAH

Title

SERVICE AREA NWI MAP

| Project No. | Scale | |
|---|---|---|
| 86200388 | 1 inch equals 4 miles | |
| Drawing No. | Sheet | Revision |
| 3C | | 0 |





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**Legend**

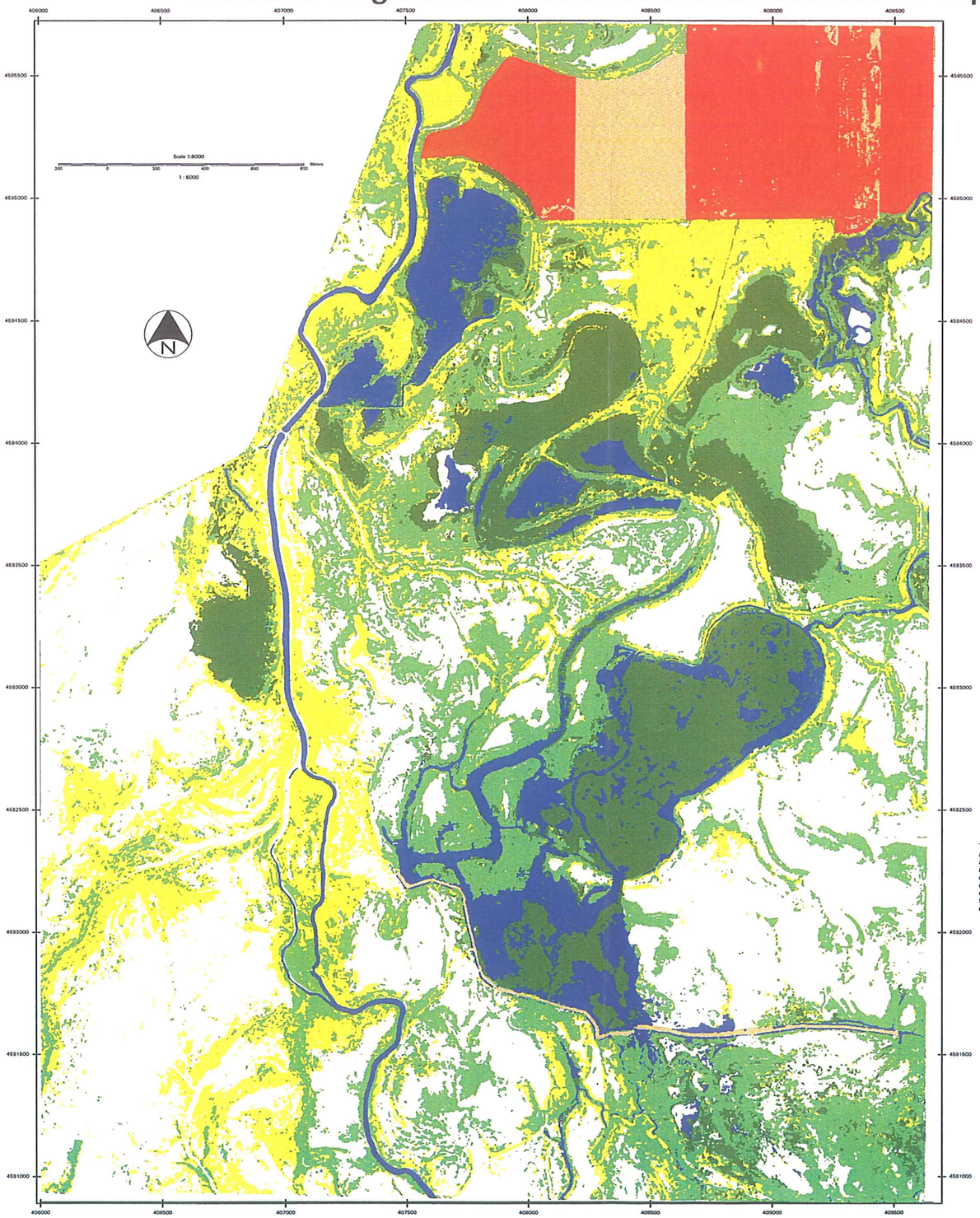
- Point of Diversion
- Point of Rediversion
- Point of Use
- Site Boundary

Client/Project
R&P WETLANDS AND WATERFOWL
MACHINE LAKE AREA
MITIGATION BANKING INSTRUMENT

Figure No
4

Title
**WATER RIGHTS MAP**

# Brigham City - Perry SAMP
# Wetland Vegetation Classification of the Rolfe Property




**Legend**

| Surface Class Names | Area (acres) |
|---|---|
| Mud Flat / Playa | 1252.4 |
| Open Water | 282.6 |
| Emergent Marsh | 491.2 |
| Emergent Wet Meadow | 779.9 |
| Upland Range | 614.5 |
| Crops | 250.1 |
| Bare Soil | 71.1 |

This wetland resource map was produced by supervised classification of airborne multispectral digital imagery. The imagery was acquired in mid-May 2003 at 1-meter pixel resolution. The individual spectral images in the green, red and near-infrared bands were corrected for geometric lens radial distortions, vignetting effects and registered into 3-band images. The images were rectified to 1:24000 digital orthophotoquads and stitched together to form a large mosaic covering the entire study area. The images were calibrated to a reflectance standard prior to the supervised classification. Field verification of spectral classes was conducted during the summer and fall of 2003.

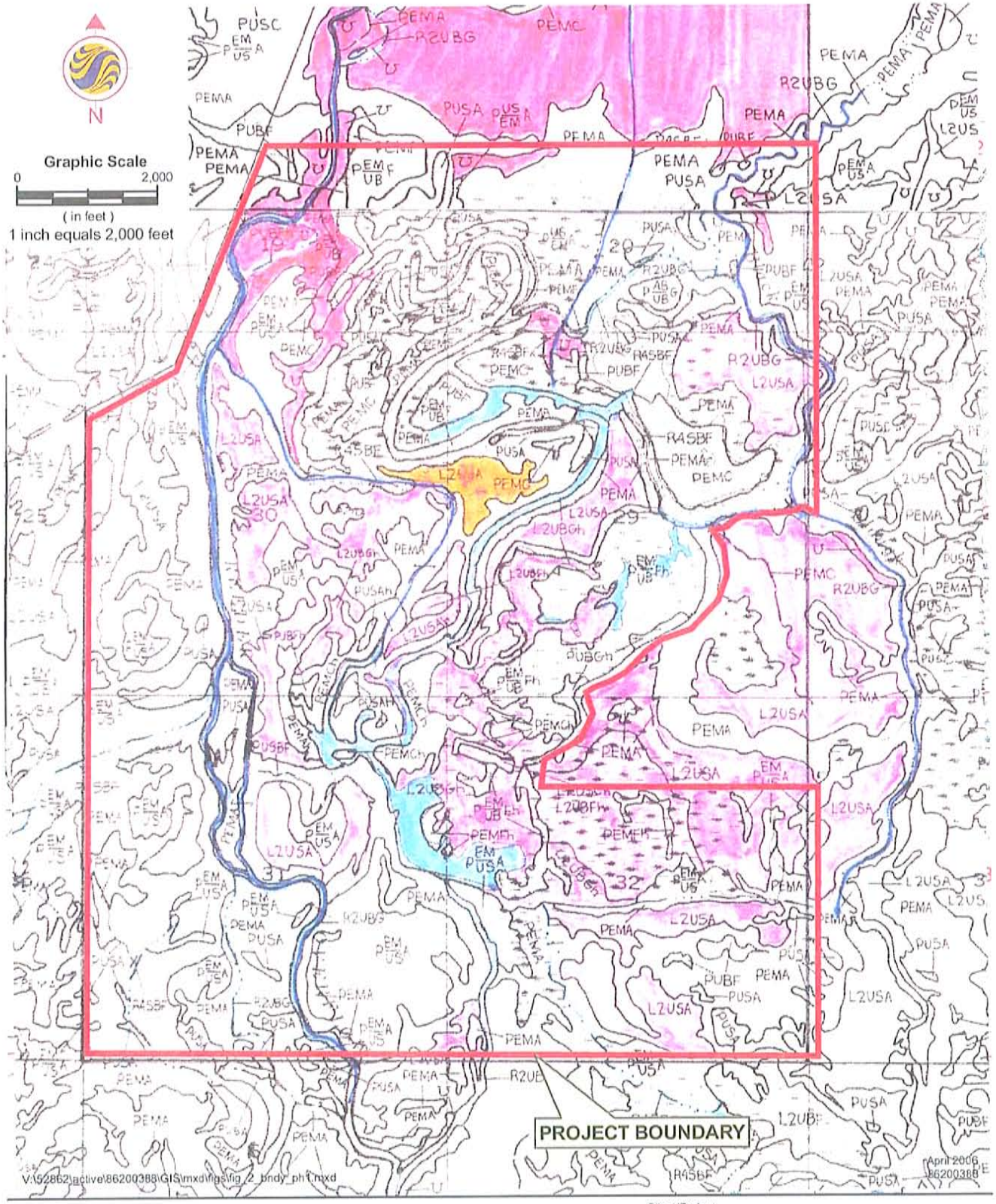
Minimum mapping unit: 25 square meters

Map Projection: UTM Zone 12
Spheroid: WGS 84
Datum: WGS 84

Classification map produced by:


*EMARS Inc.*
*Environmental Mapping and Remote Sensing*
1672 N. 1770 E.
Logan, Utah 84341


under contract from
Frontier Corporation, Providence, Utah




**Stantec Consulting Inc.**
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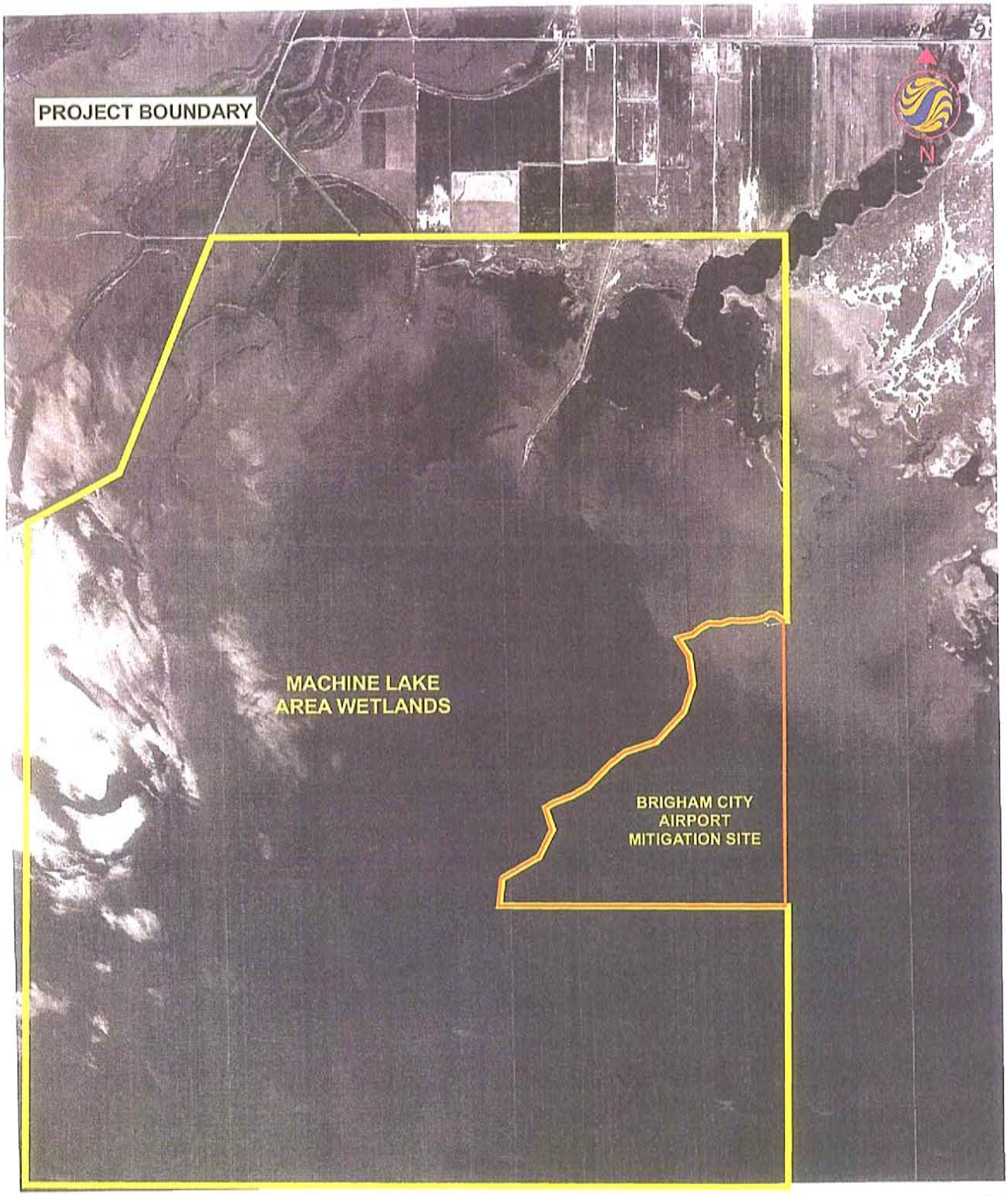
84107-2540
Tel. 801.261.0090
Fax 801.266.1671
www.stantec.com

Client/Project
R&P WETLANDS AND WATERFOWL
MACHINE LAKE AREA
MITIGATION BANKING INSTRUMENT

Figure No.
6

Title
**NATIONAL WETLAND INVENTORY MAP**

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April 2006
86200388

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Graphic Scale
0 2,000
( in feet )
1 inch equals 2,000 feet

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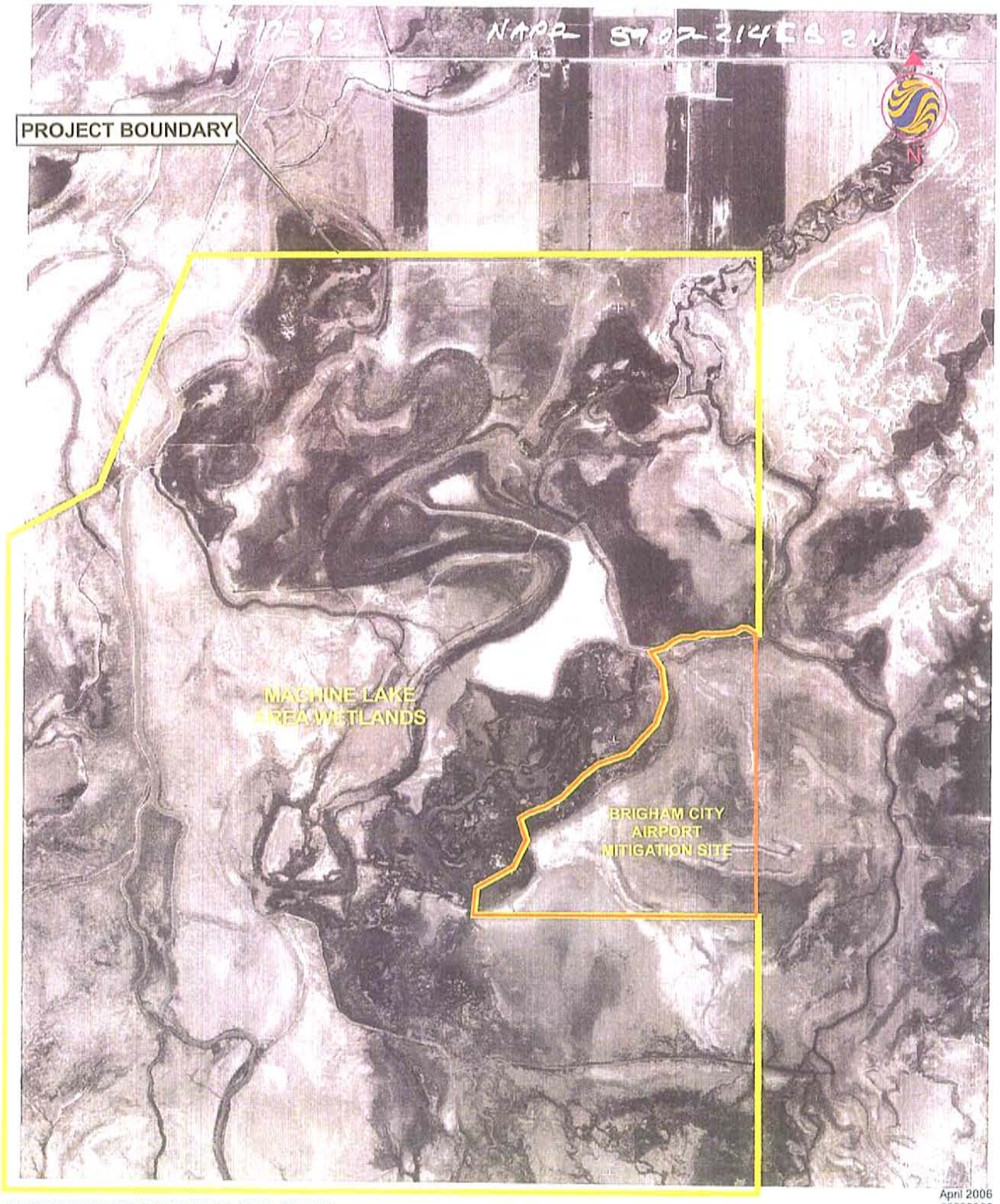
MACHINE LAKE AREA
MITIGATION BANKING INSTRUMENT

Figure No.
7A

Title
**AERIAL PHOTOGRAPH 1989**




V:\52862\active\86200388\GIS\mxd\figs\fig_7a_ap_1993.mxd

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**Graphic Scale**
0 2,000
( in feet )
1 inch equals 2,000 feet

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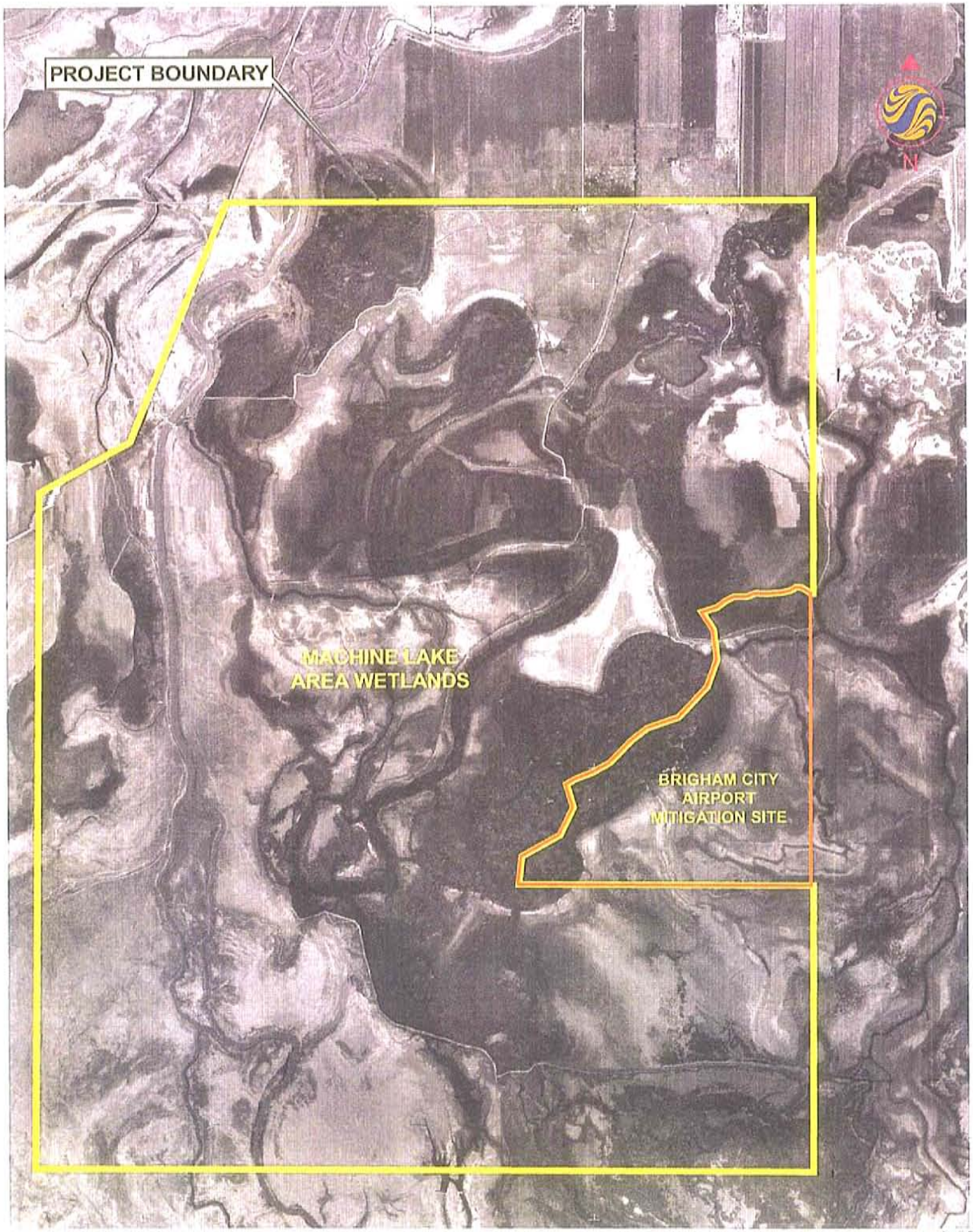
MACHINE LAKE AREA
MITIGATION BANKING INSTRUMENT

Figure No.
**7B**

Title
**AERIAL PHOTOGRAPH**
**1993**




V:\52862\active\86200388\GIS\mxd\figs\fig_7c_ap_1997.mxd

April 2006
86200388

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**Graphic Scale**
0 2,000
( in feet )
1 inch equals 2,000 feet

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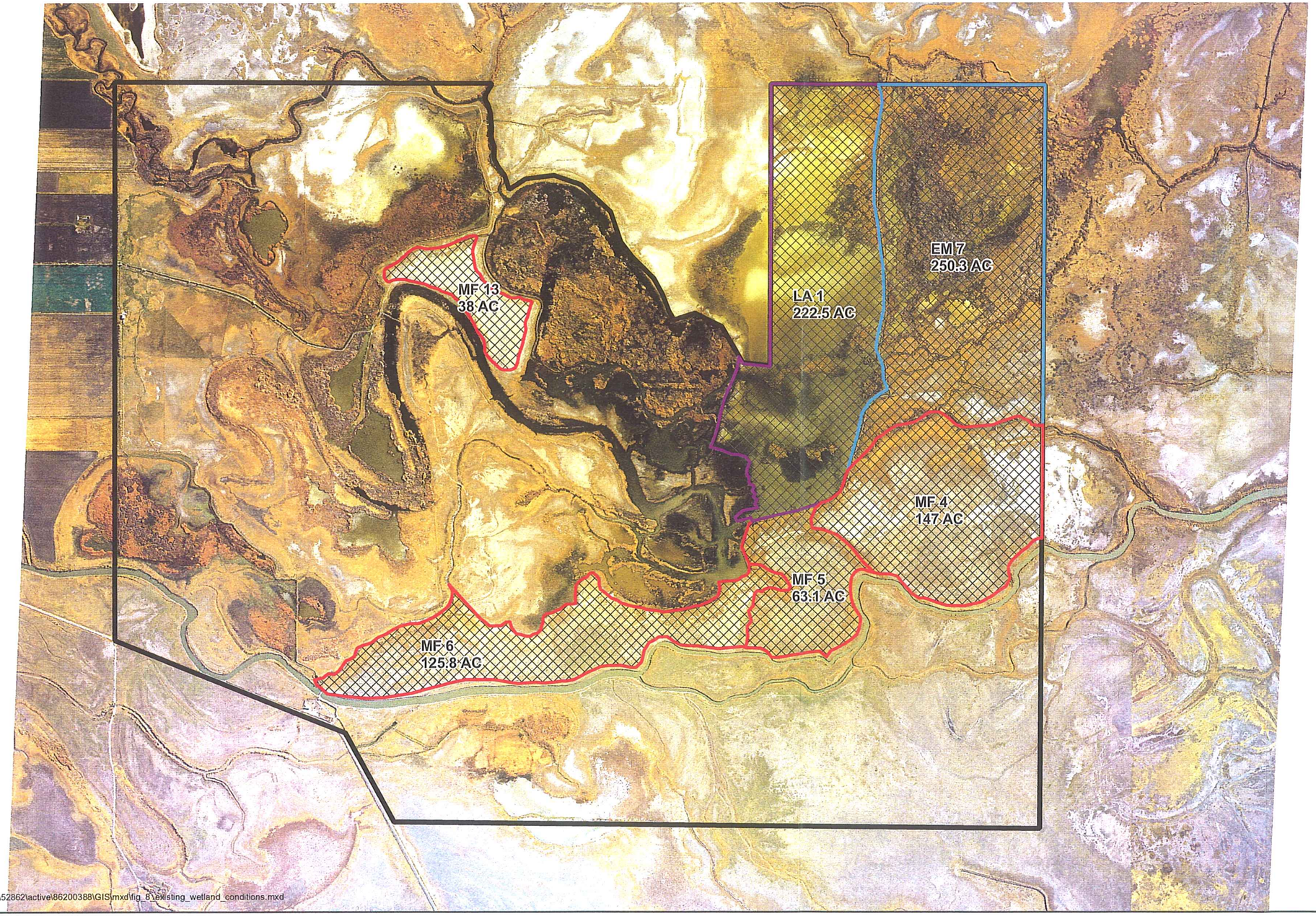
R&P WETLANDS AND WATERFOWL
MACHINE LAKE AREA
MITIGATION BANKING INSTRUMENT

Figure No.
**7C**

Title
**AERIAL PHOTOGRAPH 1997**




N

Graphic Scale

1,500 0 1,500

Feet

1 inch equals 1,500.000000 feet

## Legend

- Site Boundary
- Phase 1

Wetland Boundaries

- Mudflat
- Emergent Marsh
- Lacustrine
- Upland

V:\52862\active\86200388\GIS\mxd\fig_8_existing_wetland_conditions.mxd

APRIL 2006
86200388

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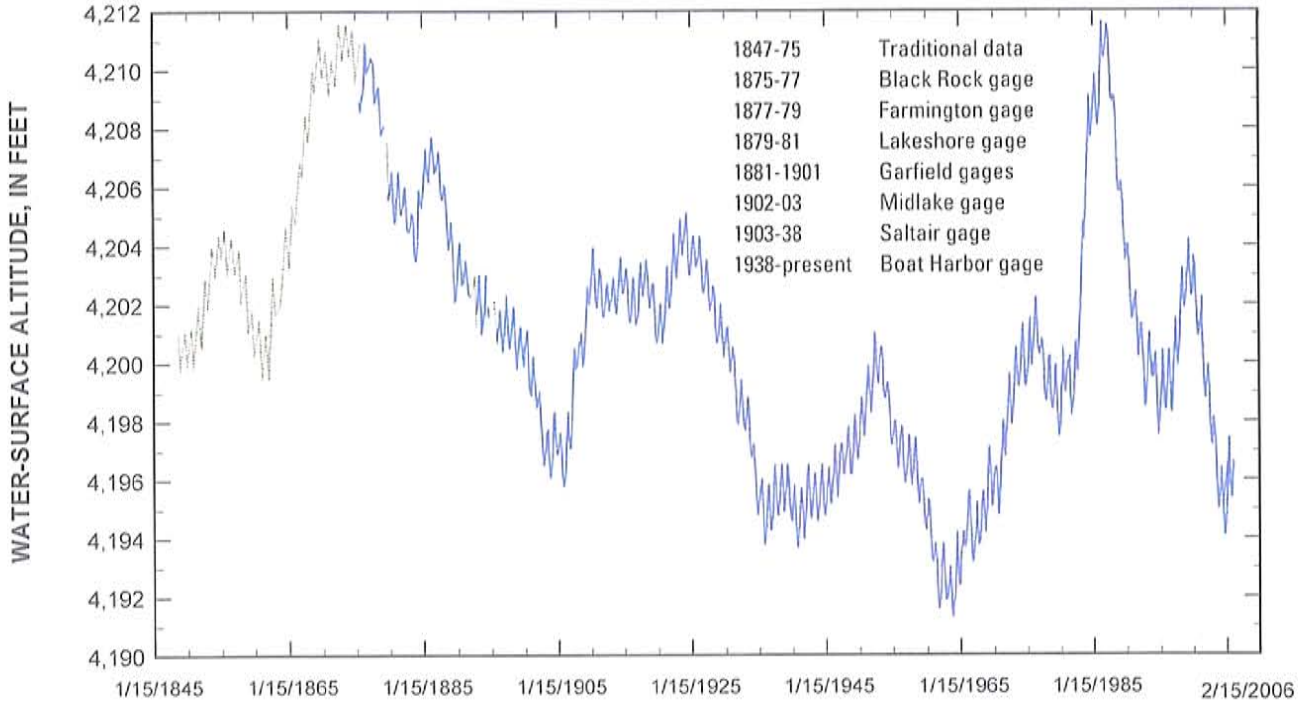
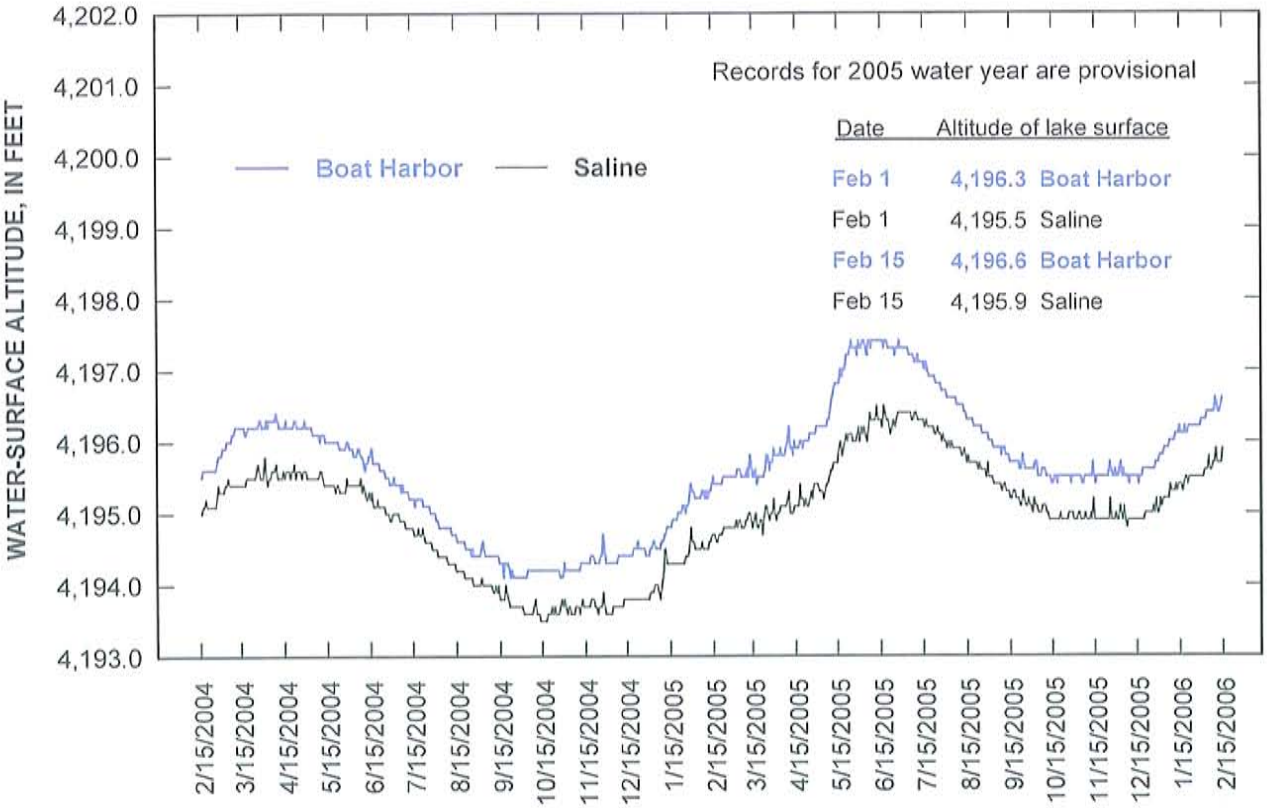
R&P WETLANDS AND WATERFOWL
MACHINE LAKE AREA
MITIGATION BANKING INSTRUMENT

Figure No.
**8**

Title
**EXISTING WETLAND CONDITIONS AND WETLAND MANAGEMENT AREA BOUNDARIES**




Fluctuation in water-surface altitude of Gilbert Bay (south part), Great Salt Lake, 1847 to present




Fluctuation in water-surface altitude of both parts of Great Salt Lake during last 2 years

# Appendix A

Property Ownership Documentation for Machine Lake Area

CTB-9359
Mail documents & tax notices to:
BRIGHAM CITY CORPORATION
20 NORTH MAIN
BRIGHAM CITY, UT 84302

03-003-0017 / 03-003-0020

# WARRANTY DEED

R&P WETLANDS AND WATER FOWL, LLC

grantor(s) hereby Convey(s) and Warrant(s) to

BRIGHAM CITY CORPORATION

grantee(s) for the sum of TEN DOLLARS AND OTHER GOOD AND VALUABLE CONSIDERATION, the following described tract of land in BOX ELDER County, State of Utah:

See Attached Exhibit "A"

SUBJECT TO SPECIAL EXCEPTIONS WHICH HAVE BEEN ACKNOWLEDGED BY THE GRANTEES(S) HEREIN.

WITNESS, the hand(s) of said grantor(s), this 22ND day of DECEMBER, 2004.

R&P Wetlands and Water fowl L.L.C.
R&P WETLANDS AND WATER FOWL, LLC
Manager/Member
BY KIM V ROLFE, MANAGER/MEMBER

State of UTAH }
County of BOX ELDER } ss:

On the 22ND day of DECEMBER, 2004, personally appeared before me

BY KIM V ROLFE, MANAGER/MEMBER OF
R&P WETLANDS AND WATER FOWL, LLC

who duly acknowledged to me that HE executed the same.

LARRY VAUGHN Notary Public

LARRY VAUGHN
NOTARY PUBLIC - STATE OF UTAH
535 SOUTH MAIN STREET
BRIGHAM CITY, UT 84302

Expires: AUGUST 28, 2006
Residing at: BRIGHAM CITY, UTAH

EXHIBIT A

A PART OF SECTIONS 29 AND 32, TOWNSHIP 9 NORTH, RANGE 2 WEST, OF THE SALT LAKE BASE AND MERIDIAN.

BEGINNING AT THE NORTHEAST CORNER OF SAID SECTION 32 BEING A UNITED STATES DEPARTMENT OF INTERIOR ALUMINUM CAP MONUMENT; RUNNING THENCE SOUTH 00°11'15" WEST 1362.11 FEET ALONG THE EAST LINE OF SAID SECTION; THENCE NORTH 89°35'43" WEST 3969.10 FEET TO THE EASTERLY EDGE OF A SLOUGH; THENCE NORTHEASTERLY ALONG SAID EASTERLY EDGE 7532 FEET, MORE OR LESS, TO THE EAST LINE OF SAID SECTION 29 BEING A POINT NORTH 00°04'22" EAST 2600.43 FEET FROM THE POINT OF BEGINNING; THENCE SOUTH 00°04'22" WEST 2600.43 FEET ALONG THE EAST LINE OF SAID SECTION 29 TO THE POINT OF BEGINNING. HAI SURVEY DATED APRIL 4, 2004

EXCEPT, "FROM ALL OF THE ABOVE-DESCRIBED PROPERTY, ONE-HALF OF ALL MINERALS IN OR UNDER SAID LAND INCLUDING, BUT NOT LIMITED TO, METALS, OIL, GAS, COAL, OTHER HYDROCARBONS, GRAVEL, STONE, SHALE, ANY AND ALL SALTS, SAND, CLAY, AGGREGAGE, AND MINERALS OF EVERY KIND OR CHARACTER IN, UPON, OR UNDERLYING ALL OF THE DESCRIBED PROPERTY, TOGETHER WITH THE RIGHT TO PROSPECT FOR, MINE AND REMOVE THE SAME, MINING RIGHTS AND EASEMENT RIGHTS OR OTHER MATTERS RELATING THERETO, WHETHER EXPRESSED OR IMPLIED."

TOGETHER WITH AN EASEMENT FOR INGRESS AND EGRESS DESCRIBED AS FOLLOWS:

AN EASEMENT BEING 16.50 FEET WIDE, 8.25 FEET RIGHT AND LEFT OF THE FOLLOWING DESCRIBED CENTERLINE:

BEGINNING AT A POINT LOCATED SOUTH 89°52'06" EAST 1941.25 FEET ALONG THE NORTH LINE OF SAID SECTION 20 FROM THE NORTHWEST CORNER OF SAID SECTION 20 BEING A BOX ELDER COUNTY SURVEYOR RAILROAD SPIKE; RUNNING THENCE ALONG THE CENTERLINE OF AN EXISTING GRAVEL LANE THE FOLLOWING EIGHTYTHREE COURSES (83) COURSES: SOUTH 0°01'59" WEST 2598.15 FEET; THENCE SOUTH 20°25'11" EAST 50.68 FEET; THENCE NORTH 57°33'41" EAST 50.24 FEET; THENCE NORTH 67°57'38" EAST 50.44 FEET; THENCE NORTH 81°12'59" EAST 50.09 FEET; THENCE NORTH 87°01'22" EAST 50.04 FEET; THENCE NORTH 89°48'01" EAST 406.35 FEET; THENCE SOUTH 81°48'18" EAST 50.93 FEET; THENCE SOUTH 15°29'32" EAST 50.24 FEET; THENCE SOUTH 20°21'40" WEST 50.14 FEET; THENCE SOUTH 13°20'18" WEST 151.97 FEET; THENCE SOUTH 15°56'26" WEST 304.71 FEET; THENCE SOUTH 14°50'27" WEST 302.36 FEET; THENCE SOUTH 13°07'02" WEST 354.91 FEET; THENCE SOUTH 15°21'35" WEST 202.00 FEET; THENCE SOUTH 16°24'48" WEST 251.24 FEET; THENCE SOUTH 20°32'15" WEST 102.08 FEET; THENCE SOUTH 28°30'42" WEST 151.82 FEET; THENCE SOUTH 34°23'52" WEST 405.16 FEET; THENCE SOUTH 34°41'57" WEST 201.76 FEET; THENCE SOUTH 33°53'44" WEST 50.29 FEET; THENCE SOUTH 42°33'50" WEST 101.05 FEET; THENCE SOUTH 38°53'50" WEST 100.80 FEET; THENCE SOUTH 31°07'04" WEST 100.62 FEET; THENCE SOUTH 19°06'15" WEST 101.03 FEET; THENCE SOUTH 10°10'39" WEST 360.79 FEET; THENCE SOUTH 02°58'43" EAST 50.71 FEET; THENCE SOUTH 38°47'18" EAST 50.47 FEET; THENCE SOUTH 56°18'46" EAST 101.45 FEET; THENCE SOUTH 59°17'03" EAST 101.09 FEET; THENCE SOUTH 49°37'45" EAST 50.66 FEET; THENCE SOUTH 20°19'46" EAST 50.10 FEET; THENCE SOUTH 15°28'16" EAST 50.24 FEET; THENCE SOUTH 05°31'21" EAST 132.83 FEET; THENCE SOUTH 64°54'41" EAST 150.60 FEET; THENCE SOUTH 55°15'48" EAST 100.92 FEET; THENCE SOUTH 59°25'10" EAST 50.63 FEET; THENCE SOUTH 69°44'14" EAST

EXHIBIT A (Continued)

100.54 FEET; THENCE SOUTH 76°02'58" EAST 101.30 FEET; THENCE SOUTH 76°01'07" EAST 50.07 FEET; THENCE SOUTH 67°19'43" EAST 150.87 FEET; THENCE SOUTH 68°04'36" EAST 100.87 FEET; THENCE SOUTH 62°38'04" EAST 101.08 FEET; THENCE SOUTH 58°37'53" EAST 100.81 FEET; THENCE SOUTH 47°03'42" EAST 101.04 FEET; THENCE SOUTH 39°18'54" EAST 101.65 FEET; THENCE SOUTH 42°11'27" EAST 50.47 FEET; THENCE SOUTH 29°10'51" EAST 50.86 FEET; THENCE SOUTH 11°41'49" EAST 50.65 FEET; THENCE SOUTH 01°40'30" EAST 207.40 FEET; THENCE SOUTH 05°55'26" EAST 151.03 FEET; THENCE SOUTH 15°50'23" EAST 151.13 FEET; THENCE SOUTH 19°22'12" EAST 50.38 FEET; THENCE SOUTH 26°52'53" EAST 50.71 FEET; THENCE SOUTH 75°02'03" EAST 50.43 FEET; THENCE NORTH 82°42'27" EAST 50.29 FEET; THENCE SOUTH 65°28'03" EAST 50.09 FEET; THENCE SOUTH 31°43'50" EAST 50.35 FEET; THENCE SOUTH 19°55'47" EAST 50.11 FEET; THENCE SOUTH 14°56'30" EAST 51.00 FEET; THENCE SOUTH 13°10'44" EAST 50.58 FEET; THENCE SOUTH 12°51'06" EAST 101.41 FEET; THENCE SOUTH 15°16'20" EAST 50.22 FEET; THENCE SOUTH 39°17'34" EAST 50.55 FEET; THENCE SOUTH 72°17'06" EAST 50.38 FEET; THENCE SOUTH 85°09'37" EAST 50.12 FEET; THENCE SOUTH 79°37'59" EAST 50.63 FEET; THENCE SOUTH 77°07'24" EAST 50.92 FEET; THENCE SOUTH 85°28'54" EAST 50.20 FEET; THENCE SOUTH 89°37'55" EAST 50.75 FEET; THENCE SOUTH 89°34'23" EAST 100.77 FEET; THENCE NORTH 82°59'16" EAST 50.21 FEET; THENCE NORTH 75°37'21" EAST 50.42 FEET; THENCE NORTH 77°28'42" EAST 100.64 FEET; THENCE NORTH 81°29'24" EAST 100.91 FEET; THENCE NORTH 71°57'52" EAST 101.24 FEET; THENCE NORTH 66°24'23" EAST 101.13 FEET; THENCE NORTH 78°56'00" EAST 452.69 FEET; THENCE SOUTH 87°24'14" EAST 52.45 FEET; THENCE SOUTH 68°23'39" EAST 50.09 FEET; THENCE SOUTH 60°44'09" EAST 50.44 FEET; THENCE SOUTH 14°23'10" WEST 56.05 FEET; THENCE SOUTH 03°14'49" WEST 114.67 FEET TO THE END OF SAID EASMENT AND A POINT ON THE NORTH LINE OF A 227 ACRE MITIGATION SITE LOCATED IN SECTIONS 29 AND 32, TOWNSHIP 9 NORTH, RANGE 2 WEST, OF THE SALT LAKE BASE AND MERIDIAN BEING LOCATED SOUTH 00°04'22" WEST 2616.22 FEET AND WEST 572.50 FEET FROM THE NORTHEAST CORNER OF SAID SECTION 29.

# Appendix B

Agency Correspondence

State of Utah

MICHAEL O. LEAVITT
*Governor*

LENE S. WALKER
*Lieutenant Governor*

Department of Community and Economic Development
DAVID HARMER
*Executive Director*

Division of State History / Utah State Historical Society
PHILIP F. NOTARIANNI
*Division Director*

RECEIVED
MAY 13 2003
Stantec Consulting Inc.

May 6, 2003

Chris L. Browne, M.Sc.
Project Hydrogeologist and Wetland Consultant
Stantec Consulting, Inc.
3995 South 700 East, Suite 300
Salt Lake City UT 84107

RE: Machine Lake Wetland Complex Mitigation Bank

In Reply Please Refer to Case No. 03-0916

Dear M. Browne:

The Utah State Historic Preservation Office received the referenced information on April 29, 2003. After consideration of the consultation request, the Utah Preservation Office provides the following comments per §36CFR800.

No location USGS map was provided with the location of the 3500-acre project, therefore our office cannot comment on the project.

This information is provided to assist with Section 106 responsibilities as per §36CFR800. My email address is: jdykman@utah.gov

As ever,

James L. Dykmann
Deputy State Historic
Preservation Officer - Archaeology

JLD:03-0916 OR

**State of Utah**

JON M. HUNTSMAN, JR.
*Governor*

GARY R. HERBERT
*Lieutenant Governor*

**Department of Community and Culture**

YVETTE DONOSSO DIAZ
*Executive Director*

Division of State History / Utah State Historical Society

PHILIP F. NOTARIANNI
*Division Director*

RECEIVED
MAY 01 2006
Stantec Consulting Inc.

April 26, 2006

Matthew Betts
Ecologist
Stantec Consulting, Inc.
3995 South 700 East, Suite 300
Salt Lake City UT 84107

RE: Machine Lake Complex Mitigation Bank

In reply, please refer to Case No. 03-0916

Dear Mr. Betts:

The Utah State Historic Preservation Office received your request for comment on the above referenced project on April 25, 2006. We understand that the Corps of Engineers has required that you get a letter from our office regarding cultural resources. You have provided a site location map for the project area. We understand that this requirement stems from the obligations of the Corps of Engineers to comply with the National Historic Preservation Act (16 U.S.C. 470) and its implementing regulations (36CFR800).

Based on the location of the project we can state that there is a high probability for cultural resources in the project area. If the Corps of Engineers determines that the project has the potential to cause effects to cultural resources (per 36CFR800.3(a)), and requests our comments (per 36CFR800.4-800.6) we will provide formal comment on the Corps determinations regarding identified cultural resources and project effects.

We are happy to provide additional advice regarding the federal process stipulated by the NHPA. If you have any additional questions, please feel free to contact me at the above number or via email at mseddon@utah.gov.

Sincerely,

Matthew T. Seddon, Ph.D., RPA
Deputy State Historic Preservation Officer-Archaeology

EPA Comments on Draft Banking Instrument for Proposed Machine Lake Area Mitigation Bank
September 28, 2005

1) Service Area: The proposed service area (figure 3) is not supported by the wetland habitat types proposed to be provided by the bank.

> The proposed bank is located low within the Great Salt Lake fringe and supports wetland habitat types typical of the Salt Lake margins. While the banking instrument purports to follow a watershed approach, there is no evidence that the instrument actually followed such an approach. Agency guidance for a model mitigation plan should be revisited [http://www.mitigationactionplan.gov/checklist.pdf] as well as the mitigation banking guidance [http://www.epa.gov/owow/wetlands/guidance/mitbankn.html] for recommendations on how to incorporate watershed plans and concerns within the mitigation banking instrument. Two major questions need to be answered: 1) what are the wetland resource needs of the watershed? 2) How does the bank meet those needs?

2) Potential Inundation of Bank: Portions of the proposed bank may be inundated by Great Salt Lake during highwater periods.

> During the site visit the FWS indicated that the wildlife refuge levees would not protect the proposed bank from potential inundation to the degree envisioned by the banking instrument. This issue will need to be resolved to develop an appropriate credit allocation for the bank.

3) Preservation Credits: Preservation credits are to be authorized only in exceptional circumstances for important resources in the water that are under demonstrable threat of loss.

> The applicant should review requirements for preservation credits outlined in the mitigation banking guidance.

4) Success Criteria: The success criteria need to be rewritten to clearly list the criteria used to measure success.

> As currently written it is difficult to understand which parameter is to be used to quatify success, and credit authorization. For example, as written on page 12, it is not necessary to have actual vegetation at the site to meet the final "success criteria."

5) Land Use Restrictions: The final land use restrictions need to be developed and agreed to prior to signature of the banking instrument.

> The Banking instrument needs to document <u>all</u> agreements, restrictions, conevants, etc. prior to signature.

6) Advanced Credits: Previous permits, and resulting activities, do not qualify as financial assurance.

> During discussions for the previously permitted activities EPA opposed issuance of the

permit without development of the banking instrument if the dike was to be any part of the bank. It was made clear by the Corps that ".....the dike and the bank are two separate issues. the (sic) permit for repair of the dike will not authorize a bank." [Corps email to FWS, 26 Mar 2003].

EPA is also opposed to any allocation of advanced credits. The Interagency Mitigation Banking Guidance (60 F.R. 228, Nov. 28, 1995) discussion on credit withdrawal contains language suggesting limited debiting of a percentage of the total expected credits in cases where a bank is financially constrained during construction. The guidance goes on to envision the need for this pre-success credit allocation to assure the bank is viable long term by acquiring the land prior to bank initiation. The Corps seems to follow a policy that all bankers should receive pre-success allocation of credits, no matter if there is a financial need or not. EPA believes this Corps approach conflicts both with the interagency banking guidance and with the basic banking concept that deposits should be made to a bank before credits can be withdrawn. The basic ecological deposit/credit of a mitigation bank is the presence of a fully functioning aquatic system. Without fully functioning aquatic systems, successful mitigation does not occur.

EPA also believes the Corps approach of authorizing pre-success credits results in mitigation banks actually providing less mitigation potential for off-setting impacts, than the non-bank, project specific, approaches to mitigation. Normally, project specific approaches require the applicant to provide mitigation either prior to, or concurrent with, the impact. If project specific mitigation must occur after project impacts have occurred the mitigation ratios are increased to offset the temporal functional losses. However, the Corps banking pre-success credit approach does not offset the temporal losses. Instead, this pre-success credit approach financially rewards the independent banker, often significantly. The banker receives credits to "sell" before mitigation efforts at the bank have even been initiated. The banker also does not have to offset the temporal losses for the period of time that it takes for the wetland bank functions to develop. Such an inequity is directly opposite the goals of the wetland mitigation banking process.

7) Credit Allocation: Double Counting of Credits is not allowed.

From information provided in pages 15-16 it appears the applicant is requesting advanced credits for 15% of the total credits and then again requesting complete credit for the total credits, as they meet the success criteria. This would result in the applicant receiving 115% of total credits.

8) Financial Assurance: O&M account needs to be sufficient for an outside entity to maintain the bank in perpetuity.

As written the there is no indication of how much money will be available for long term O&M (there is no indication of $/credit), and it appears that the applicant can draw down the fund, possibly to zero in the long term. There is also no indication of who would operate the bank should the applicant default on the bank. Both of these need to be clearly and adequately addressed prior to bank approval.

Corps Comments – Machine Lake Mitigation Banking Instrument
September 30, 2005
Amy Defreese, Utah Regulatory Office

---

The Corps has reviewed the Machine Lake Mitigation Banking Instrument and has the following comments:

**Goal of the Bank**

"...to improve and restore the wetland function and habitat that the property once provided, before mismanagement of the land over the years resulted in a significant drop in quality of waterfowl habitat, water quality, and wetland function."

According to Federal Guidance for the Establishment, Use and Operation of Mitigation Banks, the overall goal of a mitigation bank is to provide economically efficient and flexible mitigation opportunities, while fully compensating for wetland and other aquatic resource losses in a manner that contributes to the long-term ecological functioning of the watershed within which the bank is to be located. The goal will include the need to replace essential aquatic functions which are anticipated to be lost through authorized activities within the bank's service area. It is desirable to set the particular objectives for a mitigation bank (i.e., the type and character of wetlands and/or aquatic resources to be established) in advance of site selection. The goal and objectives should be driven by the anticipated mitigation need; the site selected should support achieving the goal and objectives.

*Corps comment: The current goal of the bank is specific to restoration of the landowner's property. This is an admirable goal for the land owner, however it should not be the goal of a mitigation bank. It is imperative to determine the wetland resource deficiencies in the watershed in order to decide first whether the bank can provide the type of habitat that is needed. Once resource needs have been identified, one can articulate the goals of the mitigation bank. Further guidance on this subject can be found in the attached document entitled Key Questions Regarding Establishing and Operating Mitigation Banks, section I.*

**Service Area**

*Corps comment: The development of a mitigation bank normally proceeds in the following manner: 1)determination of need within a watershed, 2) selection of goals, and 3) selection of a mitigation banking site. Because the bank proponent is invested in one mitigation bank site, it is necessary to work backwards to determine the service area. However, it is imperative to demonstrate watershed needs and how the bank will address those needs.*

*The proposed bank (phase one) exists within the Bear River watershed and at elevations lower than 4215', the Corps determined maximum flood elevation. Therefore it supports*

*wetland types specific to those immediately adjacent to the Great Salt Lake. Phase one of the mitigation bank proposes a service area that extends beyond the Bear River watershed and includes properties at elevations up to 7500'. Because the goal of mitigation banking is to address resource needs within a particular watershed as well as replace habitat types impacted within the watershed, the Corps does not believe that the existing service area is appropriate. The service area for phase one should be determined based upon the watershed in which the bank exists, the Bear River watershed. It is also imperative to consider the types of wetlands that would be impacted at elevations higher than 4215' in order to determine whether the bank can compensate for those types of wetlands.*

*If the service area is redrawn to more appropriately address the location of the mitigation bank, it will be necessary to determine the resource deficiencies in the service area (i.e. poor water quality, wildlife habitat, etc.) and what kind of demand there is for 404 permits and/or other activities that result in the destruction of wetlands. One could easily determine historical demand for permits within the service area by accessing the Corps database in Bountiful. Zoning maps of the chosen service area will also assist in the determination of need.*

**Proposed Mitigation Bank Site**

*Corps comment: It is unclear whether the proposed site can compensate for wetland impacts within an appropriate service area. In order to make this determination, it is necessary to understand watershed needs and wetland permit demands, at a minimum. The wetland classes that exist may have inherent value. Therefore, it is necessary to understand whether the conversion of mudflat to wet meadow addresses a watershed need, or whether it eliminates a valuable wetland type.*

*There appears to be an inconsistency in the acreage of habitat types on the property. The proponent, on Page 1 of the document, describes the mitigation bank parcel as 2802 acres. The proponent describes 2902 acres of different habitat types within the bank on page 8.*

**General**

Corps comment:

*The proponent states on page 8 that there exists T&ES, and sensitive species documentation from the FWS and DWR within Appendix B. This information may have been left out of the Corps copy of the banking instrument.*

*In general, the Corps does not have enough information to provide comment on mitigation credits, success criteria, land use restrictions, etc. until the proponent can demonstrate that the bank meets watershed needs and demand within a reasonable service area as outlined in the previous comments.*

# United States Department of the Interior

FISH AND WILDLIFE SERVICE

UTAH FIELD OFFICE
2369 WEST ORTON CIRCLE, SUITE 50
WEST VALLEY CITY, UTAH 84119


In Reply Refer To
FWS/R6
ES/UT
05-1278

October 7, 2005

Karen K. Nichols, P.E.
Principal
Stantec Consulting Inc.
3995 South 700 East Suite 300
Salt Lake City, Utah 84107

RE: Draft Banking Instrument for the Machine Lake Area Bank

Dear Ms. Nichols:

The United States Fish and Wildlife Service (Service) has received the notice of August 16, 2005 requesting comments on the subject project. The applicant proposes to restore and preserve 847 acres of wetland/upland complex in order to create a mitigation bank containing 198 credits of playa, mudflat, wet meadow, and emergent marsh habitats. This bank would serve portions of northern Weber County and all of Box Elder County, Utah. The Machine Lake Area (MLA) would be the first phase in a larger banking instrument roughly 2800 acres in size. We are providing the following comments for your consideration.

We believe that the proposed service area (Box Elder County and those portions of Weber County north of the City of Ogden) is too large and includes wetland types and locales that should not be mitigated in the geographical area of MLA. These include wetlands located at higher elevations (Huntsville and other areas of the Upper Ogden River Watershed) and areas in different watersheds (Ogden River, Western Box Elder County). We believe the MLA should only serve those areas within the Bear River Watershed that share wetland type at similar elevations.

As far as we can ascertain, the entire MLA lies below the 4217 elevation line. We have consistently objected to allowing impacts above this elevation to be mitigated in areas below it. The reasons for this are threefold:

- First, wetlands above this line rarely share the same water chemistry. Consequently, they function differently and accommodate different plant and animal communities. This would amount to out-of kind mitigation.

- Second, the lake dynamic below the 4217 elevation dictates wetland type and duration regardless of intervening human activities. The Bear River National Migratory Bird Refuge (Refuge) does not afford the protection claimed in the document, as their dikes reach 4208 feet, at best. Therefore, there is currently no way for the proponents to insulate their property from the lake inundation. It is for these reasons that we recommend that only those impacts incurred below 4217 feet be mitigated below 4217 feet.

- Third, if wetlands above the floodplain are mitigated below it, there will be no substitute habitat available when lake levels rise and inundate all habitats below the floodplain, including the mitigation sites. Therefore, this type of mitigation would not function during times when it is most critical to wildlife.

If there are wetlands above 4217 in the MLA, we recommend they be available to mitigate impacts at or below the Gilbert Shoreline, or 4250 feet above sea level, provided they are of the same wetland type and within the Bear River Watershed.

It appears that "wetland acres" is the currency by which the proponent is basing the number of credits available for purchase. The Service agrees that this works well for preservation credits, and we have no objection to the exchange ratio proposed in the document (10:1 acre to credit ratio). However, we do not believe that this method works well for creation, restoration and/or enhancement. For the areas proposed for these types of activities, there needs to be an assessment of how the wetlands are currently functioning and how much improvement is gained by the proposed activities. The difference between baseline conditions and post-"improvement" should then be used to base credit availability for these wetlands. This is the only way to confirm that restoration/creation/enhancement efforts actually accomplished what they were meant to and are deserving of a lower ratio. This type of crediting can provide an additional degree of flexibility to the bank by allowing the maintenance of a certain number of credits for each wetland type somewhere on the MLA, but not necessarily in the same place throughout the life of the bank. This will allow the bank managers to better accommodate demand for credits of a certain wetland type while taking ever-changing wildlife needs under consideration at the same time. It could also conceivably allow restoration efforts to move away from impacts that occur through time along the perimeter of the MLA, thus avoiding functional loss (and thus credits) of wetlands being impacted by development/disturbance on neighboring lands.

The Service is concerned with intentions to convert mudflat and/or playa wetlands into wet meadow or emergent marsh wetlands in the name of restoration. Mudflats and playas are under increasing threat in the general area, provide their own unique and important wildlife benefits, and some are critically important to migratory birds in times of high lake levels. They are also impossible to create, which adds to their intrinsic value. Therefore, we recommend that mudflats and playas within the MLA be preserved or their wildlife functions restored (weed management, trash removal, livestock removal, etc.). Since there appear to be many opportunities for restoration of wet meadows and emergent marsh currently in existence within the MLA, we see no good reason to convert currently functioning mudflats and playas into other wetland types. In addition, we believe playas will continue to be frequent targets of developers within the recommended service area. As such, playa habitats should be as valuable as wet meadow types and more valuable than open water or emergent marsh, in terms of credit demand.

The Service believes that mitigation banks best serve the resource by providing credits for projects that are incurring small wetland impacts, typically those of a size and type authorized by nationwide permits. We believe that larger impacts are best mitigated outside of mitigation banks because larger wetland tracts are generally more available and valuable than smaller ones. Small mitigation sites are difficult to find and acquire, nearly impossible to manage, and if they are isolated, they are not very valuable to wildlife. The Federal Guidance for the Establishment, Use , And Operation of Mitigation Banks (Federal Register Vol.60, No. 228) recognizes this by stating:

"Mitigation banking...typically the consolidation of small, fragmented wetland mitigation projects into one large contiguous site..."

And...

"In general, use of a mitigation bank to compensate for minor aquatic resource impacts (e.g. numerous, small impacts associated with linear projects, impacts authorized under nationwide permits) is preferable to onsite mitigation."

By consolidating small impacts into one large area, wildlife is better served and the 404 process runs more efficiently. To this end, the Service recommends a cap be placed on the size of impact or number of credits that can be purchased for mitigating a single impact. This will prevent the bank being filled by only a few large projects, thereby compromising the utility of the bank and its purpose of serving as an option for projects that are difficult to mitigate for (e.g., small impacts). This cap should be based on an analysis of future mitigation needs within the recommended service area of the bank.

The Service is concerned that changes in point of diversion and changes in places of use could have profound impacts on surrounding wetlands and upland habitats, including those found within the borders of the Refuge. We do not believe that it is beneficial to reduce the function of quality wildlife habitats in order to create quality wildlife habitats somewhere else. We recommend that a thorough analysis of the consequences of the proposed changes in water diversion and distribution be conducted in order to better assess the consequences of such actions.

The document does not provide sufficient detail on how water will be distributed in order to achieve some of the restoration goals identified. There needs to be an accurate and detailed accounting of how much water there will be available (at a bare minimum) to the proposed bank, where that water will go, for how long, on how many acres, and what the presumed results will be. There is a concern that there is not enough water available to meet the goals outlined in the document. There is also the concern that other habitats, such as those on bordering Refuge lands, would be compromised if water distribution were changed from its current place of use.

The proponents contend that development pressure in and around the MLA warrants preservation credit within the bank. If this development occurs, it will likely have negative impacts to the wetland functions in the MLA. This will alter the value of any areas near or contiguous with development and should be accounted for when assigning available credits for the bank. If this land is protected via incorporation into the bank, conservation easement, or other means (regardless of R & P Wetlands and Waterfowl's participation of management or ownership of said lands), the value of the MLA would increase and credits could be adjusted accordingly.

We understand that R&P Wetlands and Waterfowl will retain ownership and access to the bank and be responsible for long term management of the property. We recommend a more detailed narrative of the long term use of the land once credits have been exhausted. The integrity of the site as wildlife habitat can be compromised by vehicle access, livestock grazing, and human disturbance, among other activities. We would need to know the foreseeable activities in and around the MLA before we can fully appreciate the utility of the area as a mitigation bank. The banking agreement should be accompanied by a comprehensive long term management plan, approved by the resource agencies, that addresses all future use and management including predator control, weeds and mosquito control.

In summary, the Service has concerns with the extent of the service area, the type and size of impacts that would be accommodated at the MLA, the change of diversion and area of use of water on the MLA, and the conversion of one functioning wetland type to another type. We also recommend that a functional assessment be applied to the wetlands before and after "restoration" and to those wetlands to be preserved as well. This will establish a currency that will drive the amount of credit available at the bank. We also suggest that an accurate and detailed plan be submitted for the distribution of water on the site and what is to be accomplished by such distribution. This will allow the Corps to confirm that enough water is available to implement the plans for the MLA. Finally ,we would like to see a more detailed plan for long term management and use of the property once the bank is fully debited.

We appreciate the MLA owners' desire to create and maintain quality habitat for Utah's wildlife. We believe that the site is currently providing good habitat for a wide diversity of bird and mammal species, but there is certainly room for improvement in terms of water control, invasive weeds management, and access control. The concerns identified above will need to be addressed during development of the MLA mitigation bank plan and permit. However, we are willing to assist in any way we can.

Thank you for the opportunity to review and comment on this project. If you have any questions or need further information please Chris Witt, Ecologist, at (801) 975-3330 ext. 133.

Sincerely,

Henry R. Maddux
Utah Field Supervisor

cc: EPA-Denver
UDWR-Ogden
COE-Bountiful
Bear River NWR-Al Trout

State of Utah

JON M. HUNTSMAN, JR.
*Governor*

GARY R. HERBERT
*Lieutenant Governor*

Office of The Governor
PUBLIC LANDS POLICY COORDINATION

LYNN STEVENS
*Public Lands Policy Coordinator*

OCT 24 2005
BY: AD

October 21, 2005

Ms. Amy Defreese
U.S. Army Corps of Engineers
Utah Regulatory Office
533 West 2600 South, Suite 150
Bountiful, UT 84010

Subject: Machine Lake Area Mitigation Banking Instrument

Dear Ms. Defreese:

The Public Lands Policy Coordination Office of the State of Utah has reviewed the proposal to create a wetlands mitigation bank in the Machine Lake area of Box Elder County, Utah. The state's Division of Wildlife Resources (UDWR) participated in an on-site visit on September 14, 2005 with the applicant, the U.S. Army Corps of Engineers (Corps), the U.S. Fish and Wildlife Service (USFWS), and the Environmental Protection Agency. The Division has generated a number of comments on the proposal, which are set out below for your consideration. We would also simply note for your information that the State of Utah and the Fish and Wildlife Service are engaged in negotiations to resolve ownership issues within the Bear River Migratory Bird Refuge; negotiations which involve, among other things, the ordinary high water mark of the Great Salt Lake.

**Comments of the Division of Wildlife Resources**

Page 3:

- The USFWS indicated during the on-site meeting that the dikes and berms rebuilt on the Bear River Migratory Bird Refuge (BRMBR) since the high water events of the 1980s will not be sufficient to prevent flooding of the Refuge nor prevent flooding on the Machine Lake Wetland Mitigation Bank (MLWMB). Potential flooding of the mitigation bank should be addressed in the document, as high water events would appear to render a large portion of the mitigation bank



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unavailable as mitigation for wetlands above the high water mark of the Great Salt Lake.

- The project proponent states that approximately 2000 acre-feet of water are available to support the proposed mitigation and restoration activities. The UDWR is unclear as to whether or not this amount of water is sufficient to restore and enhance the 620 acres of wetlands currently targeted for mitigation activities ((Mudflat Area 4, Emergent marsh Area 7, Lacustrine Area 1). According to the 1970 UDWR publication "Water Requirements of Waterfowl Marshlands in Northern Utah" (69-12), 2000 acre-feet of water would only be able to adequately flood 286 acres of wetlands on a year-round basis (based on the use of 7af/acre). If four af/acre were used for only seasonally irrigating the wetlands, approximately 500 acres of wetlands could be irrigated. The Division recommends clarifying the amount of wetlands that could undergo mitigation with the 2000 acre-feet of water and include documentation to justify the amount of water needed to accomplish the mitigation.

- Appendix D contains numerous water rights that the project proponent claims to have available, with many of these rights listed as lapsed, unapproved, or having a "bad status." The UDWR is unclear as to why these rights were included if they are unavailable for use at the MLWMB. Some of these rights also list water rights associated with the Brigham City Airport Wetland Mitigation site that is adjacent to the proposed MLWMB. It does not appear prudent to use the same water rights for two mitigation areas, as there will be some consumptive loss of water between the first site and the second site. Table One lists all the water rights and shows WR#29-3848 as having 2000 af available. However, the priority date for this water right appears to be 1996. Given the late priority of this water right (a junior right), we are unclear as to whether or not this water would be available for wetland mitigation activities during drought years. In addition, none of the water rights are in the name of the project proponent, R&P Wetlands & Waterfowl, LLC.

- Appendix E includes documentation that Brigham City has annexed this property into the city limits and has zoned the area for recreational, residential and agricultural uses. However, the supporting documentation also indicates that the City would not support building within floodplains. Also, there is no guarantee that the Corps would issue permits to build within these wetlands. Since the majority of this property is within the Great Salt Lake floodplain and the rebuilt dikes at the BRMBR would not protect the property from flooding, it is unclear whether or not this property is in imminent threat of loss due to development. As such, we are not sure that preservation credits are warranted at this time.

Page 8:

- Appendix B only includes a letter from the State Historic Preservation Office. There are no letters from either the USFWS or UDWR regarding the presence of threatened, endangered, candidate or state sensitive wildlife species that may be found on the property.

Page 9

- Item number 10. No information is provided as to what the "restrictive covenant" will cover. We assume that this means that a deed restriction would be placed on the property that would restrict development and that the property will be managed as a wetland mitigation site in perpetuity. This issue should be clarified.

- Item number 11. What are the current or potential land-use conflicts and can they be resolved? Are there access or rights-of-way issues that are currently a problem in the development of this bank? Are there unresolved issues that could keep the bank from being completed?

Pages 10, 11, 12 and 13

- The document indicates that there is a significant opportunity to restore, enhance, preserve and create wetlands with higher wetland functional values in the area than are currently present. While we do not disagree that the addition of water will create different wetland habitats that will enhance areas for wildlife, much of Phase 1 will be converting one currently functioning wetland habitat to another wetland habitat. The Mitigation Bank Review Team (MBRT) has previously been concerned with the conversion of wetland habitat types within a bank because the original wetland habitat is still functioning, albeit perhaps at a lower functional level. The UDWR believes that the MBRT should continue this discussion so that the various agencies are comfortable with the conversion of wetland types.

- In LA1 and EM6, restoration activities included burning and spraying of phragmites stands. There was no supporting documentation regarding the number of acres treated, the number of acres eliminated, or the results from these activities. If these treatments were completed in 2002 and 2004, respectively, results from these treatments should be known and published so that the MBRT can evaluate the effectiveness of the restoration activity.

- Under "wetland class changes," upland and bare soil is listed for the first time in the document. Is this a change from current conditions? Will there be any restoration effort applied to restoring uplands to a native or more healthy condition?

- During the on-site tour, it was mentioned that the Machine Lake area had previously been a highly productive waterfowl area. The mitigation banking instrument document also refers to this information, yet there is no supporting

information regarding what year(s) this area was of high functional value, nor the types and amounts of wetland habitats that were present on the site at that time. We would be interested in reviewing this information and/or comparing any historical aerial photos with the existing site conditions.

- The UDWR is unclear as to what the difference is between the "success criteria" and "performance criteria" and why two separate criteria lists are needed for this project. It is not clear why credits can be released once replanting, water management, and rodent control activities have taken place for two growing seasons (success criteria), yet restoration or performance criteria are based on 80% of the existing vegetation being comprised of native plant species along with desirable existing on-site species. The UDWR is more concerned that the vegetation component be restored than just having the "activities" completed with little or minimal restoration of the wetland habitats. The UDWR recommends that these two criteria measurements be merged into one set of clear success criteria, and that more than two growing seasons be considered to assure vegetation criteria are achieved. Another recommendation would be to consider having different criteria for different areas, especially considering that each habitat type may respond differently to vegetation and water level manipulation.

- The document indicates that invasive species will be controlled if they constitute a significant portion (>20%) of the total vegetation or otherwise dominate areas of the mitigation site. Visual observation and basic statistical methods will be used to determine the success criteria. Is this 20% for each individual species, or for all invasive species combined? We suggest that all invasive species be combined to contribute to the 20%, as this will allow more native or desirable species to be found on site. The UDWR does have some concerns with using "visual observation and basic statistical methods" as the methodology that will be used to quantify and qualify the vegetation data, and suggests the project proponent include more specific information regarding the methods to be used on the bank property. Any of the following methods could be used to quantify and qualify vegetation data: density of plants, total cover, frequency, nested frequency, basic cover transects, and so on. These methods would provide the MBRT members more assurance as to the success of the mitigation activities. In UDWR's experience, phragmites must be continually controlled even if it is less than 20% of the total plant community. If it is not aggressively controlled and is not treated for more than a few years, it will expand and dominate plant communities. A long-term commitment and plan should be in place to annually undertake control efforts for phragmites and other invasive plant species. In addition to phragmites, UDWR noticed a new free floating aquatic plant (similar to duckweed) on the property that may be of concern, as it had created an algae-like mat completely covering the water surface. This plant will most likely shade out submerged vegetation, thereby reducing food for waterfowl and other wildlife. We suggest

this plant be evaluated for removal. The document should also include plans to control noxious weeds that are found on the property.

- A visual inspection of the plant community and photo points will be utilized during yearly monitoring efforts. We would also encourage the use of several vegetation transects within each of the habitat types to verify that restoration is occurring as anticipated.

- We are unclear as to what "re-grading" activities would be on the property.

Page 14 and Table 2

- In our review of Table 2, we are not clear as to how the credit analysis was completed. For example, if the entire Phase 1 site has 369.3 acres of mud flat/playa habitat, why were only 112 acres used in the total final acreage analysis? It also appears that general ratios were utilized in the credit decision process (restoration = 3:1, enhancement = 2:1, etc.) with no consideration to the fact that in some cases, the original functional wetland is being converted to a different wetland type. If the wetland type is being changed, do the same ratios apply? It also seems that a lot of credit is being given for vegetation control. The UDWR believes that vegetation control is part of any typical wetland management program and, while we believe some credit should be given, the credit ratio should be less than the restoration or enhancement amounts.

- We also noticed that some uplands are targeted for creation into emergent wet meadow or emergent marsh habitats. The presence of uplands is critically important to the wildlife function and value of wetlands because many birds nest or feed in uplands adjacent to wetlands. Given the functional value of uplands, UDWR would support mitigation credit for restoring these areas to a more native upland plant community, instead of conversion to wetland habitat types.

Page 16

- Typically, the MBRT has only authorized the use of wetland mitigation banks for small wetland impacts where the quality of the wetlands was of low value. Wetlands with higher acreages and/or of higher quality were considered for mitigation outside of a bank. The current document does not address the acreage, the quality, or the type of wetlands to be mitigated at the bank. This issue should be clarified in the banking instrument.

- Under #3, credits are proposed to be utilized for compensation for environmental impacts under other programs. We are not aware of credits being used in this manner in the past, and we ask that this issue be clarified. For example, how can a Superfund site removal and remediation be mitigated at a bank?

Page 17

- Items #4 and #5 discuss the "service area" proposed for this bank (Figure 3). The UDWR is concerned with the current service area proposal as it includes a large area with wetlands that are very dissimilar to the wetlands within the proposed bank boundary. For example, Ogden Valley (eastern portion of Weber County) is included within the service area. Wetlands found within this area are higher elevation wetlands that are not hydrologically connected to the Bear River system. In another example, wetland springs in the west desert are not only much different in size and hydrology than wetlands in the bank, but they also provide a valuable wildlife function that needs to be kept on-site and not moved 50-100 miles away. The UDWR does not believe the current service area should be permitted for this project and we suggest the MBRT and the project proponent discuss the proposed service area in more detail.

- Item #5 seems to indicate that if no on-site mitigation options are available, then mitigation must occur at the bank. However, UDWR would like to include the option that, depending upon the circumstances surrounding the wetlands to be impacted, another off-site mitigation option may be preferable to mitigation at the MLWMB.

Page 18

- The UDWR is unclear as to how money will be managed within the "Maintenance and Monitoring Fund" to manage the property in perpetuity (30-50 years). The property manager should anticipate annual management costs for the wetlands to be similar to the costs that government agencies incur to annually monitor, manage, and maintain wetlands. We suggest contacting the Bear River Migratory Bird Refuge for information regarding their management costs.

Thank you for the opportunity for a coordinated state response to this proposal. Please feel free to contact myself at 801-537-9275 with any questions, or contact Pam Kramer (801-476-2775) or Randy Berger (435-854-3610) with the Division of Wildlife Resources with any questions about the detailed comments.

Sincerely,

John Harja
Assistant Director
Planning and Policy

# Appendix C

Brigham / Perry City Special Area Management Plan (SAMP) Wetland Characterization for the Machine Lake Area

## ROLFE PROPERTY EXISTING HABITAT TYPES

The habitats described below are made up of vegetative communities that are a mixture of several species in varying proportions. Many species occur in more than one habitat type. Thus some species are listed more than once, under several habitat types.

Bare Soil

Most of the unvegetated patches on the property are in areas disturbed by human activities, such as excavations and RV use.

Crops

The crops grown in and around this property are mostly irrigated row crops, such as alfalfa and wheat.

Upland Range

These areas are the driest of vegetated areas on the property, and are generally higher in elevation. They are rarely inundated because they receive less run-off and/or precipitation, and have a deeper groundwater surface. In some cases they are disturbed areas, such as roadsides, that have been colonized by noxious weeds. The plant community is primarily composed of invasive weeds, and grasses. The plant species observed in these areas include:
little barley (*Hordeum pusillum*), foxtail barley (*Hordeum jubatum*), cheatgrass (*Bromus tectorum*), curly cup gumweed (*Grindelia squarrosa*), and prickly lettuce (*Lactuca serriola*).

Mudflat Playa

Sparsely vegetated mudflat/playas are depressional wetlands that are supported by the accumulation of runoff and seasonally high groundwater. Unvegetated mudflats occur within the portions of these depressional wetlands that have the greatest frequency and duration of flooding. Soil salinity is typically high and crusty layers of salt deposits were observed on many mudflat surfaces, which limits the type and amount of vegetation present. Most of the mudflat/playas in the Project Area are sparsely vegetated with salt tolerant (i.e., halophytic) plants. The plant community include the following species:
pickleweed (*Salicornia spp.*), seepweed (*Suaeda sp.*), clasping pepperweed (*Lepidium perfoliatum*), Saltgrass (*Distichlis spicata*), Iodine bush (*Allenrolfea occidentalis*), tamarisk (*Tamarix sp.*), foxtail barley (*Hordeum jubatum*), little barley (*Hordeum pusillum*), and Rabbit's foot (*Polypogon monspeliensis*).

Emergent Marsh

An emergent marsh is a semi-permanently flooded wetland. These wetlands are usually in slough areas that are saturated for extended periods due to seasonal flooding during spring runoff. Water levels in these areas are usually maintained by flood irrigation used for agricultural practices. Common plant species include:
common cattail (*Typha latifolia*), sedges (*Carex* spp.), rushes (Juncus spp.), spikerushes (*Eleocharis spp.*), curly dock (*Rumex crispus*), common reed (*Phragmites australis*), and bullrushes (*Scirpus spp.*).

Emergent Wet Meadow

Wet meadows are seasonally flooded wetlands that are supported by irrigation water, seasonal runoff, and /or seasonally high groundwater. Plant species composition is highly variable and appears to be influenced by historic land uses. In general, wet meadows in the Project Area are well vegetated. Plants species include: salt grass (*Distichlis spicata*), foxtail barley (*Hordeum jubatum*), Rabbit's foot (*Polypogon monspeliensis*), spikerushes (*Eleocharis spp.*), bullrushes (*Scirpus spp.*), tamarisk (*Tamarix sp.*), Seepweed (*Suaeda sp.*), rushes (*Juncus spp.*), and curly dock (*Rumex crispus*).

Open Water

Open water habitats are generally man-made conveyances used to distribute irrigation water, and ponded areas too deep for the establishment of emergent plants. Areas of open water are often associated with agricultural areas and residences. Open water habitats are frequently fringed with marsh plants, listed above. These areas are often maintained by irrigation water and would likely revert to wetlands in the absence of this water source.

**BRIGHAM CITY/PERRY CITY SAMP PROJECT**
**Rolfe Property**
Wetland Inventory & Mapping Accuracy Assessment

3/23/2004

| | | GROUNDTRUTH/ACCURACY OBSERVATION | | | | | | | Comm. Error | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | UPR | MF* | EWM* | EM* | CRP | BS | W* | total | % correct |
| MAP CLASS-IFICATION | UPR | 95 | 1 | 9 | 4 | | | | 109 | 87 |
| | MF* | 1 | 116 | 3 | 2 | | | | 122 | 95 |
| | EWM* | 5 | | 121 | 5 | | | | 131 | 92 |
| | EM* | 6 | | 5 | 78 | | | | 89 | 88 |
| | CRP | | | | | 10 | | | 10 | 100 |
| | BS | | | | | | 12 | | 12 | 100 |
| | W* | | | | 1 | | | 49 | 50 | 98 |
| Omm. Error | total | 107 | 117 | 138 | 90 | 10 | 12 | 49 | 523 | |
| | % correct | 89 | 99 | 88 | 87 | 100 | 100 | 100 | | 481 |

**Total observations**
**Total correct**
**91.97% Overall accuracy**

| Class | Abbrev. |
|---|---|
| Upland Rangeland | UPR |
| Mudflat/Playa* | MF* |
| Emergent Wet Meadow* | EWM* |
| Emergent Marsh* | EM* |
| Crops | CRP |
| Bare Soil | BS |
| Open Water | W* |

*Wetland Classes
391 Total observations
364 Total Correct
93.09% Wetland accurarcy

The Rolfe Property is approximately 3,750 acres in size and is located on the low lakeplain of the Great Salt Lake shorelands, west of Interstate Highway 15 and south-east of Forest Street (aka Bear River Access Road).

This is an accuracy table combining field checking results and automated techniques to assess the accuracy of RS classifications.

| | | TRUTH: OBSERVATION | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | UP | MF | EWM | EM | CRP | BS | W | Com. Error | % correct |
| RS CLASS-IFICATION | UP | 90 | 1. | 9 | 6 | 0 | 0 | 0 | 106 | 84.9 |
| | MF | 1 | 103 | 3 | 4 | 0 | 15 | 2 | 128 | 80.5 |
| | EWM | 8 | 0 | 119 | 10 | 0 | 0 | 0 | 137 | 86.9 |
| | EM | 8 | 0 | 7 | 74 | 0 | 0 | 0 | 89 | 83.1 |
| | CRP | 2 | 0 | 0 | 0 | 10 | 0 | 0 | 12 | 83.3 |
| | BS | 0 | 4 | 0 | 0 | 0 | 7 | 0 | 11 | 63.6 |
| | W | 0 | 0 | 0 | 1 | 0 | 0 | 47 | 48 | 97.9 |
| | Om. Er. | 109 | 108 | 138 | 95 | 10 | 22 | 49 | 531 | |
| | % correct | 82.6 | 95.4 | 86.2 | 77.9 | 100.0 | 31.8 | 95.9 | | 450 total correct |
| | | | | | | | | | | 84.7 overall accuracy |

Wetland classes:

492 total
433 total correct
88 percent correct

| Class | Abbrev. |
|---|---|
| Upland Range | UP |
| Mudflat/Playa | MF |
| Emergent Wet Meadow | EWM |
| Emergent Marsh | EM |
| Crops | CRP |
| Dirt Track/Bare Soil | BS |
| Structures and Roads | SR |
| Open Water | W |

**Table 1. Common Plant Species Observed in the Low Lake Plain Habitat Zone.**

| Plant Species | Scientific Name | USFWS Region 8 Indicator Status |
|---|---|---|
| **Mudflat/Playa** | | |
| pickleweed | *Salicornia spp.* | OBL |
| saltgrass | *Distichlis spicata* | FAC+ |
| seepweed | *Suaeda sp.* | FAC |
| Iodine bush | *Allenrolfea occidentalis* | FACW |
| **Emergent Marsh** | | |
| common cattail | *Typha latifolia* | OBL |
| sedges | *Carex spp.* | FAC |
| rushes | *Juncus spp.* | FAC |
| spikerushes | *Eleocharis spp.* | FACW |
| bullrushes | *Scirpus spp.* | OBL |
| common reed | *Phragmitis australis* | FACW+ |
| **Emergent Wet Meadow** | | |
| saltgrass | *Distichlis spicata* | FAC+ |
| foxtail barley | *Hordeum jubatum* | FAC |
| rabbitfoot grass | *Polypogon monspeliensis* | FACW+ |
| spikerushes | *Eleocharis spp.* | FACW |
| bullrushes | *Scirpus spp.* | OBL |
| seepweed | *Suaeda sp.* | FAC |
| sedges | *Carex spp.* | OBL |
| rushes | *Juncus spp.* | FAC |
| curly dock | *Rumex crispus* | FACW |
| **Upland Rangeland** | | |
| cheatgrass | *Bromus tectorum* | UPL |
| foxtail barley | *Hordeum jubatum* | FAC |
| clasping pepperweed | *Lepidium perfoliatum* | FACU- |
| little barley | *Hordeum pusillum* | FAC |
| prickly lettuce | *Lactuca serriola* | FACU |
| curly cup gumweed | *Grindelia squarrosa* | FACU |
| **Pasture/Turf/Crop** | | |
| meadow fescue | *Festuca pratensis* | FACU |
| Kentucky bluegrass | *Poa pratensis* | FACU |
| red clover | *Trifolium pratense* | FACU |

**Table 2. Common Plant Species Observed in the High Lake Plain Habitat Zone.**

| Plant Species | Scientific Name | USFWS Region 8 Indicator Status |
|---|---|---|
| **Riparian Forest/Shrub** | | |
| narrowleaf cottonwood | *Populus angustifolia* | FACW |
| Fremont cottonwood | *Populus fremontii* | FACW |
| willows | *Salix spp.* | FACW |
| Russian olive | *Elaeagnus angustifolia* | FACW |
| tamarisk | *Tamarix sp.* | FACW |
| **Mudflat/Playa** | | |
| pickleweed | *Salicornia spp.* | OBL |
| saltgrass | *Distichlis spicata* | FAC+ |
| seepweed | *Suaeda sp.* | FAC |
| iodine bush | *Allenrolfea occidentalis* | FACW |
| little barley | *Hordeum pusillum* | FAC |
| foxtail barley | *Hordeum jubatum* | FAC |
| clasping pepperweed | *Lepidium perfoliatum* | FACU- |
| **Emergent Marsh** | | |
| common cattail | *Typha latifolia* | OBL |
| spikerushes | *Eleocharis spp.* | FACW |
| bullrushes | *Scirpus spp.* | OBL |
| common reed | *Phragmitis australis* | FACW+ |
| curly dock | *Rumex crispus* | FACW |
| **Emergent Wet Meadow** | | |
| saltgrass | *Distichlis spicata* | FAC+ |
| foxtail barley | *Hordeum jubatum* | FAC |
| rabbitfoot grass | *Polypogon monspeliensis* | FACW+ |
| spikerushes | *Eleocharis spp.* | FACW |
| bullrushes | *Scirpus spp.* | OBL |
| seepweed | *Suaeda sp.* | FAC |
| sedges | *Carex spp.* | FAC |
| rushes | *Juncus spp.* | FAC |

**Table 2 (continued). Common Plant Species Observed in the High Lake Plain Habitat Zone.**

| Plant Species | Scientific Name | USFWS Region 8 Indicator Status |
|---|---|---|
| **Pasture/Turf/Crop** | | |
| meadow fescue | *Festuca pratensis* | FACU |
| Kentucky bluegrass | *Poa pratensis* | FACU |
| red clover | *Trifolium pratense* | FACU |
| **Upland Rangeland** | | |
| cheatgrass | *Bromus tectorum* | UPL |
| little barley | *Hordeum pusillum* | FAC |
| cheat | *Bromus secalinus* | UPL |
| western wheatgrass | *Agropyron smithii* | FACU |
| common rye | *Secale cereale* | UPL |
| oatgrass | *Danthonia sp.* | FACU |
| crabgrass | *Digitaria sanguinalis* | FACU |
| prickly lettuce | *Lactuca serriola* | FACU |
| curly cup gumweed | *Grindelia squarrosa* | FACU |

# Appendix D

Water Rights Ownership Documentation for Machine Lake Area

# STATE OF UTAH -- DIVISION OF WATER RIGHTS -- DATA PRINT OUT for 29-1912(D2983)

(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 04/17/2006 Page 1

WATER RIGHT: 29-1912 APPLICATION/CLAIM NO.: D2983 CERT. NO.:

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OWNERSHIP**********

---

NAME: First Commercial Trust
ADDR: c/o Richard Knudson etal Trustees
2200 Panorama Way
Salt Lake City UT 84105
INTEREST: 36.666% REMARKS: 11cfs

NAME: USA Fish & Wildlife Service
ADDR: c/o Regional Director, Region Six
P.O. Box 25486, Denver Federal Center
Denver, CO 80225
INTEREST: 50% REMARKS: 15 cfs

NAME: Wetlands Management Company L.L.C.
ADDR: c/o Bob Evans
P.O. Box 3765
Ogden UT 84409
INTEREST: 13.333% REMARKS: 4 cfs

---

DATES, ETC.**********

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LAND OWNED BY APPLICANT?
FILED: 09/23/1974|PRIORITY: / /1890|PUB BEGAN: |PUB ENDED: |NEWSPAPER:
ProtestEnd: |PROTESTED: [No ]|HEARNG HLD: |SE ACTION: [ ]|ActionDate: |PROOF DUE:
EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF: |CERT/WUC: |LAP, ETC: |PROV LETTER:
RENOVATE: |RECON REQ: |TYPE: [ ]

PD Book No. 4 Map:

Type of Right: Diligence Claim Source of Info: Proposed Determination Status: Pro. Determination Protested

---

LOCATION OF WATER RIGHT**********

---

FLOW: 30.0 cfs SOURCE: Bear River

COUNTY: Box Elder COMMON DESCRIPTION:

POINT OF DIVERSION -- POINT TO POINT:
( 1)Irrigation from a stream from a point at N843 ft. W833 ft. from SE corner, Sec 26, T9N, R3W, SLBM,
to a point at N573 ft. E0 ft. from SW corner, Sec 30, T9N, R3W, SLBM.
SOURCE: Bear River

POINTS OF REDIVERSION:
(1) N 343 ft E 269 ft from SW cor, Sec 02, T 8N, R 3W, SLBM
Diverting Works: Culvert from Whistler Canal Source: Whistler Canal
(2) N 748 ft E 273 ft from SW cor, Sec 02, T 8N, R 3W, SLBM
Diverting Works: Culvert from Whistler Canal Source: Whistler Canal

---

USES OF WATER RIGHT**********

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SUPPLEMENTAL GROUP NO. 26436.
29-1912

.....

###IRRIGATION: 3817.32 acres Diversion Limit: 6564.36 acft. PERIOD OF USE: 04/01 TO 10/31
See Explanatory for `diversion limit`.

###OTHER: Incidental creation and maintanence of vegetation for waterfowl habitat. PERIOD OF USE: 01/01 TO 12/31
Acre Feet Allowed by this Right for this Use:

| ###PLACE OF USE: | NORTH WEST QUARTER | | | | NORTH EAST QUARTER | | | | SOUTH WEST QUARTER | | | | SOUTH EAST QUARTER | | | | Section |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NW | NE | SW | SE | NW | NE | SW | SE | NW | NE | SW | SE | NW | NE | SW | SE | Totals |
| Sec 05 T 8N R 2W SLBM | | | | | | | | | X | X | X | X | X | X | X | X | 0.0000 |
| Sec 06 T 8N R 2W SLBM | | | | | | | | | X | X | X | X | X | X | X | X | 0.0000 |
| Sec 07 T 8N R 2W SLBM | X | X | X | X | X | X | X | X | X | X | | | | | | | 0.0000 |
| Sec 08 T 8N R 2W SLBM | X | X | X | X | X | X | X | X | | | | | | | | | 0.0000 |
| Sec 01 T 8N R 3W SLBM | | | | | | | | | X | X | X | X | X | X | X | X | 0.0000 |
| Sec 02 T 8N R 3W SLBM | | | | | | | | | X | X | X | X | X | X | X | X | 0.0000 |
| Sec 03 T 8N R 3W SLBM | | | | | | | | | X | X | X | X | X | X | X | X | 0.0000 |
| Sec 04 T 8N R 3W SLBM | | | | | | | | | X | X | X | X | X | X | X | X | 0.0000 |
| Sec 05 T 8N R 3W SLBM | | | | | | | | | X | X | X | X | X | X | X | X | 0.0000 |
| Sec 06 T 8N R 3W SLBM | | | | | | | | | X | X | X | X | X | X | X | X | 0.0000 |
| Sec 07 T 8N R 3W SLBM | X | X | | | X | X | | | | | | | | | | | 0.0000 |
| Sec 08 T 8N R 3W SLBM | X | X | | | X | X | | | | | | | | | | | 0.0000 |
| Sec 09 T 8N R 3W SLBM | X | X | | | X | X | | | | | | | | | | | 0.0000 |
| Sec 10 T 8N R 3W SLBM | X | X | | | X | X | | | | | | | | | | | 0.0000 |
| Sec 11 T 8N R 3W SLBM | X | X | X | X | X | X | X | X | | | | | | | | | 0.0000 |
| Sec 12 T 8N R 3W SLBM | X | X | X | X | X | X | X | X | X | X | | | | | | | 0.0000 |
| Sec 26 T 9N R 3W SLBM | | | | | | | | | | | | | | | | X | 0.0000 |
| Sec 30 T 9N R 3W SLBM | | | | | | | | | | | X | | | | | | 0.0000 |
| Sec 31 T 9N R 3W SLBM | X | X | X | X | | | | | X | X | X | X | | | | | 0.0000 |

SUPPLEMENTAL GROUP NO. 28242. Water Rights Appurtenant to the following use(s):
29-1912,3609

###IRRIGATION: 0.0 acres of the Group Total: 933.0 acres Diversion Limit: 0.0 acft. PERIOD OF USE: 01/01 TO 12/31
***Sole Supply for Irrigation for 29-1912 in this Group has NOT YET been evaluated***

| ###PLACE OF USE: | NORTH WEST QUARTER | | | | NORTH EAST QUARTER | | | | SOUTH WEST QUARTER | | | | SOUTH EAST QUARTER | | | | Section |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NW | NE | SW | SE | NW | NE | SW | SE | NW | NE | SW | SE | NW | NE | SW | SE | Totals |
| Sec 06 T 8N R 2W SLBM | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | 0.0000 |
| Sec 30 T 8N R 2W SLBM | X | X | X | X | | | | | | | | | | | | | 0.0000 |
| Sec 01 T 8N R 3W SLBM | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | 0.0000 |
| Sec 02 T 8N R 3W SLBM | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | 0.0000 |
| Sec 03 T 8N R 3W SLBM | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | 0.0000 |
| Sec 04 T 8N R 3W SLBM | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | 0.0000 |
| Sec 05 T 8N R 3W SLBM | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | 0.0000 |
| Sec 06 T 8N R 3W SLBM | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | 0.0000 |
| Sec 31 T 9N R 2W SLBM | X | X | X | X | | | | | | | | | | | | | 0.0000 |
| Sec 25 T 9N R 3W SLBM | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | 0.0000 |
| Sec 35 T 9N R 3W SLBM | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | 0.0000 |
| Sec 36 T 9N R 3W SLBM | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | 0.0000 |

This Right has a total irrigated acreage for all claims of 0.00 acres.

OTHER COMMENTS

Water is to be used for irrigation on unspecified acreage described in place of use. Canals were constructed in the early 1900's and several miles of dikes have been constructed to cause ponding and spreading of water.

Bear River Silt Lands Company and Dyna-Flex Corp. merged March 19, 1970. Point of diversion #4 as filed: North 5498 feet and East 1073 feet from the SW corner, Sec. 35, T9N, R3E, SLBM.

This is an overflow right limited to the use of Bear River flood waters on the above described lands during flood stage of the river as the waters naturally flood the banks of the river between the points listed above generally from May 1st to June 15th, and September 15 to October 30th. Flood waters may also be diverted through the Whistler Canal when flows are greater than 1000 cfs. When the river is not flooding it's banks, high water diverted through the Whistler Canal under this right is limited to the irrigation of 705.46 acres west of the canal currently owned by Wetlands Management Company. Because the historic period of use is generally limited to that when the river is at flood stage the annual diversion limitation is 92/214 days x 3,817.32 x 4.0 AF/acre/year = 6,564.36 AF/yr.

**********END OF DATA**********

# STATE OF UTAH -- DIVISION OF WATER RIGHTS -- DATA PRINT OUT for a16752(29-2633)

(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 04/18/2006 Page 1

CHANGE: a16752 WATER RIGHT: 29-2633 CERT. NO.: AMENDATORY? No

BASE WATER RIGHTS: 29-2633

RIGHT EVIDENCED BY: 29-2633(Kimball Decree 336); Bear Lake Storage by contract; 29-2752(A56809),2754(56811),2755(56812)

CHANGES: Point of Diversion [ ], Place of Use [X], Nature of Use [X], Reservoir Storage [ ].

NAME: Bear River Canal Company
ADDR: 275 N. 1600 West
Tremonton UT 84337
REMARKS:

FILED: 05/12/1992 | PRIORITY: 05/12/1992 | ADV BEGAN: 06/10/1992 | ADV ENDED: | NEWSPAPER: Box Elder Journal
ProtestEnd: 07/24/1992 | PROTESTED: [No ] | HEARNG HLD: | SE ACTION: [Approved] | ActionDate: 09/04/1992 | PROOF DUE: 09/30/2001
EXTENSION: | ELEC/PROOF: [Proof ] | ELEC/PROOF: 05/29/2001 | CERT/WUC: | LAP, ETC: | PROV LETTER:
RENOVATE: | RECON REQ: | TYPE: [ ]

Status: Approved

**********H E R E T O F O R E**********

FLOW: 100.0 acre-feet

SOURCE: Bear River, Springs and Drains

COUNTY: Box Elder

Water from Bear Lake Storage (Kimball Decree 1 Page 10) by contract with Utah Power & Light is diverted in th NE1/4, section 34, T13S, R44E, B.B.M. (Rainbow Canal) and in the NW1/4, section 17, T14S, R45E, B.B.M. (Dingle Canal) in Bear Lake County, Idaho. Storage water rediverted at Cutler Dam (S 640 ft E 120 ft from W1/4 corner of section 26, T13N, R2W, SLB&M).
Quantity of water is for 24.86 acres at 1 cfs/80 acres.

POINT(S) OF DIVERSION ------>

Point Surface:
(1) 0 ft E 480 ft from NW cor, Sec 20, T 12N, R 2W, SLBM
Dvrting Wks:
Source: Overflow Pack and Barnard Springs
(2) S 2100 ft E 220 ft from NW cor, Sec 20, T 12N, R 2W, SLBM
Dvrting Wks:
Source: Overflow Pack and Barnard Springs
(3) S 640 ft E 120 ft from W4 cor, Sec 26, T 13N, R 2W, SLBM
Dvrting Wks: Cutler Dam
Source: Bear River

Point Underground:

**********H E R E A F T E R**********

FLOW: 100.0 acre-feet

SOURCE: Bear River, Springs and Drains

COUNTY: Box Elder COM DESC: No. of Bear River Bird Refuge

Water previously used for pasture and row crops is being partially relocated to an area west of the Reeder Overflow via improvements authorized by the Army Corps of Engineers, Permit #198900089, valid to 12/31/92. Land where water was originally used is being put into a feed lot.
Other: Some wetland will be created by irrigating pasture land. Even the wet-lands will produce more forage than at present. Run off may cause ponds in low area.

SAME AS HERETOFORE

(1) N 720 ft E 1920 ft from SW cor, Sec 05, T 11N, R 2W, SLBM
Diameter: ins. Depth: to ft.
COMMENT:
(2) N 2080 ft E 2270 ft from SW cor, Sec 08, T 11N, R 2W, SLBM
Diameter: ins. Depth: to ft.
COMMENT:
(3) S 20 ft E 1320 ft from NW cor, Sec 32, T 11N, R 2W, SLBM
Diameter: ins. Depth: to ft.
COMMENT:
(4) S 20 ft E 1300 ft from NW cor, Sec 32, T 11N, R 2W, SLBM
Diameter: ins. Depth: to ft.
COMMENT:

PLACE OF USE ------>

| | NW¼ | | NE¼ | | SW¼ | | SE¼ | |
|---|---|---|---|---|---|---|---|---|
| | N N S S | N N S S | N N S S | N N S S | N N S S | N N S S | N N S S | N N S S |
| | W E W E | W E W E | W E W E | W E W E | W E W E | W E W E | W E W E | W E W E |
| Sec 02 T 9N R 2W SLBM | * : : : | ** : : | :X:X** | : : : | ** : : | : : | : | * |
| Sec 19 T 9N R 2W SLBM | * : : : | ** : : | : : ** | :X: : | ** : : | : : | : | * |
| Sec 20 T 9N R 2W SLBM | * : : : | ** : : | : : **X: | : : | ** : : | : : | : | * |

CHANGED as follows:

| | NW¼ | | NE¼ | | SW¼ | | SE¼ | |
|---|---|---|---|---|---|---|---|---|
| | N N S S | N N S S | N N S S | N N S S | N N S S | N N S S | N N S S | N N S S |
| | W E W E | W E W E | W E W E | W E W E | W E W E | W E W E | W E W E | W E W E |
| Sec 30 T 9N R 2W SLBM | *X: | :X: ** | : : : | **X: | :X: ** | : : : | : | * |
| Sec 25 T 9N R 3W SLBM | * : | : : ** | : :X: | ** : | : : ** | X:X:X:X | | * |

NATURE OF USE ------>

SUPPLEMENTAL to Other Water Rights: No

IRR: 24.8600 acs Sol/Sup: acs USED 04/01 - 11/01

STK: 1270 Cattle or Equivalent USED 04/01 - 11/01

SAME AS HERETOFORE, AND IN ADDITION TO:

SUPPLEMENTAL to Other Water Rights: No

OTH: OTHER: Marshland, wetland. USED 01/01 - 12/31

EXTENSIONS OF TIME WITHIN WHICH TO FILE PROOF

FILED: 08/27/1996 | PUB BEGAN: | PUB ENDED: | NEWSPAPER:
ProtestEnd: | PROTESTED: [No | HEARNG HLD: | SE ACTION: [Approved] | ActionDate:09/20/1996 | PROOF DUE: 08/31/2000

FILED: 08/30/2000 | PUB BEGAN: | PUB ENDED: | NEWSPAPER:
ProtestEnd: | PROTESTED: [No | HEARNG HLD: | SE ACTION: [Approved] | ActionDate:10/19/2000 | PROOF DUE: 09/30/2001

END OF DATA

# STATE OF UTAH -- DIVISION OF WATER RIGHTS -- DATA PRINT OUT for 29-3084

(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 04/17/2006 

WATER RIGHT: 29-3084 APPLICATION/CLAIM NO.: CERT. NO.:

OWNERSHIP**********

NAME: Bonnie L. Knundson (Trustee)
ADDR: First Commercial Trust
2200 Panorama Way
Salt Lake Cit UT 84124

NAME: Diane K. Edminster (Trustee)
ADDR: First Commercial Trust
2200 Panorama Way
Salt Lake City UT 84124

NAME: Richard C. Knudson (Trustee)
ADDR: First Commercial Trust
2200 Panorama Way
Salt Lake City UT 84124

DATES, ETC.**********

LAND OWNED BY APPLICANT?

| | | | | |
|---|---|---|---|---|
| FILED: | \|PRIORITY: / /1896 | \|PUB BEGAN: | \|PUB ENDED: | \|NEWSPAPER: |
| ProtestEnd: | \|PROTESTED: [No ] | \|HEARNG HLD: | \|SE ACTION: [ ] | \|ActionDate: \|PROOF DUE: |
| EXTENSION: | \|ELEC/PROOF:[ ] | \|ELEC/PROOF: | \|CERT/WUC: | \|LAP, ETC: \|PROV LETTER: |
| RENOVATE: | \|RECON REQ: | \|TYPE: [ ] | | |

PD Book No. 4 Map:

Type of Right: Decree Source of Info: Proposed Determination Status: Pro. Determination Protested

LOCATION OF WATER RIGHT**********

FLOW: 45.0 cfs SOURCE: Black Slough

COUNTY: Box Elder COMMON DESCRIPTION: 4 mi. W. Brigham City

POINT OF DIVERSION -- SURFACE:
(1) S 2627 ft W 369 ft from NE cor, Sec 20, T 9N, R 2W, SLBM
Diverting Works: Source: Black Slough

Stream Alt Required?: No

USES OF WATER RIGHT**********

SUPPLEMENTAL GROUP NO. 27705.
29-3084

###IRRIGATION: 5.24 acres Diversion Limit: 20.96 acft. PERIOD OF USE: 04/01 TO 10/31

###OTHER: Incidental waterfowl & wildlife propagation. PERIOD OF USE: 01/01 TO 12/31
Acre Feet Allowed by this Right for this Use:

| ###PLACE OF USE: | NORTH WEST QUARTER | | | | NORTH EAST QUARTER | | | | SOUTH WEST QUARTER | | | | SOUTH EAST QUARTER | | | | Section |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NW | NE | SW | SE | NW | NE | SW | SE | NW | NE | SW | SE | NW | NE | SW | SE | Totals |
| Sec 20 T 9N R 2W SLBM | | | | | | | | | | | | | X | | | | 0.0000 |

SUPPLEMENTAL GROUP NO. 27706. Water Rights Appurtenant to the following use(s):
29-3084,3085,3086

###STOCKWATER: 0 Stock Units of the Group Total of 200 Diversion Limit: 1.848 acft. PERIOD OF USE: 01/01 TO 12/31
***Sole Supply for Stockwatering for 29-3084 in this Group has NOT YET been evaluated***
Stockwatering under this right is limited to 66 ELUs.

OTHER COMMENTS

The point of diversion as described on this claim is the point at which stream enters claimants property.

Flow: Civil Decree #4473 establishes flow at 45.00 cfs shared by Water User Claims 3079/3086, 3412.

END OF DATA

# STATE OF UTAH -- DIVISION OF WATER RIGHTS -- DATA PRINT OUT for 29-3085

(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 04/17/2006 

WATER RIGHT: 29-3085 APPLICATION/CLAIM NO.: CERT. NO.:

OWNERSHIP**********

NAME: Richard C. & Bonnie L. Knudson
ADDR: 2200 Panorama Way
Salt Lake City UT 84124

DATES, ETC.**********

LAND OWNED BY APPLICANT?

| | | | | | |
|---|---|---|---|---|---|
| FILED: | \|PRIORITY: / /1896 | \|PUB BEGAN: | \|PUB ENDED: | \|NEWSPAPER: | |
| ProtestEnd: | \|PROTESTED: [No ] | \|HEARNG HLD: | \|SE ACTION: [ ] | \|ActionDate: | \|PROOF DUE: |
| EXTENSION: | \|ELEC/PROOF:[ ] | \|ELEC/PROOF: | \|CERT/WUC: | \|LAP, ETC: | \|PROV LETTER: |
| RENOVATE: | \|RECON REQ: | \|TYPE: [ ] | | | |

PD Book No. 4 Map:

Type of Right: Decree Source of Info: Proposed Determination Status: Pro. Determination Protested

LOCATION OF WATER RIGHT**********

FLOW: 45.0 cfs SOURCE: Black Slough

COUNTY: Box Elder COMMON DESCRIPTION: 4 mi. W. Brigham City

POINT OF DIVERSION -- SURFACE:
(1) N 2460 ft W 630 ft from SE cor, Sec 20, T 9N, R 2W, SLBM
Diverting Works: Source: Black Slough

Stream Alt Required?: No

USES OF WATER RIGHT**********

SUPPLEMENTAL GROUP NO. 27706. Water Rights Appurtenant to the following use(s):
29-3084,3085,3086

###STOCKWATER: 0 Stock Units of the Group Total of 200 Diversion Limit: 1.848 acft. PERIOD OF USE: 01/01 TO 12/31
***Sole Supply for Stockwatering for 29-3085 in this Group has NOT YET been evaluated***
Stockwatering under this right is limited to 66 ELUs.

SUPPLEMENTAL GROUP NO. 27707.
29-3085 .

###IRRIGATION: 21.05 acres Diversion Limit: 84.2 acft. PERIOD OF USE: 04/01 TO 10/31

###WILDLIFE: Incidental waterfowl & wildlife propagation. PERIOD OF USE: 01/01 TO 12/31
Acre Feet Allowed by this Right for this Use:

###PLACE OF USE:

| | NORTH WEST QUARTER | | | | NORTH EAST QUARTER | | | | SOUTH WEST QUARTER | | | | SOUTH EAST QUARTER | | | | Section |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NW | NE | SW | SE | NW | NE | SW | SE | NW | NE | SW | SE | NW | NE | SW | SE | Totals |
| Sec 20 T 9N R 2W SLBM | | | | | | | | | | | | X | | X | X | | 0.0000 |

PLACE OF USE for STOCKWATERING**********

| | NORTH-WEST¼ | NORTH-EAST¼ | SOUTH-WEST¼ | SOUTH-EAST¼ |
|---|---|---|---|---|
| | NW NE SW SE | NW NE SW SE | NW NE SW SE | NW NE SW SE |
| Sec 20 T 9N R 2W SLBM | : : : : | : : : : | : : : : | X: X: X: X |

OTHER COMMENTS**********

The point of diversion as described on this claim is point at which stream enters claimants property.

Civil Decree #4473 establishes the flow at 45.0 cfs shared by Water User Claims 3079/3085, 3412.

**********E N D O F D A T A**********

# STATE OF UTAH -- DIVISION OF WATER RIGHTS -- DATA PRINT OUT for 29-3086

(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 04/17/2006 

WATER RIGHT: 29-3086 APPLICATION/CLAIM NO.: CERT. NO.:

---

OWNERSHIP**********

---

NAME: First Commercial Trust
ADDR: Richard C. Knudson Trustee
2200 Panorama Way
Salt Lake City UT 84124

---

DATES, ETC.**********

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LAND OWNED BY APPLICANT?
FILED: |PRIORITY: / /1896|PUB BEGAN: |PUB ENDED: |NEWSPAPER:
ProtestEnd: |PROTESTED: [No ]|HEARNG HLD: |SE ACTION: [ ]|ActionDate: |PROOF DUE:
EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF: |CERT/WUC: |LAP, ETC: |PROV LETTER:
RENOVATE: |RECON REQ: |TYPE: [ ]

PD Book No. 4 Map:

Type of Right: Decree Source of Info: Proposed Determination Status: Pro. Determination Protested

---

LOCATION OF WATER RIGHT**********

---

FLOW: 45.0 cfs SOURCE: Black Slough

COUNTY: Box Elder COMMON DESCRIPTION: 4 mi. W. Brigham City

POINT OF DIVERSION -- SURFACE:
(1) S 2485 ft W 186 ft from NE cor, Sec 29, T 9N, R 2W, SLBM
Diverting Works: Earth Canal Source: Black Slough

Stream Alt Required?: No

POINTS OF REDIVERSION:
(1) N 2187 ft E 1125 ft from SW cor, Sec 32, T 9N, R 2W, SLBM
Diverting Works: Earthen dike and culvert Source: Black Slough
(2) N 2667 ft E 15 ft from SW cor, Sec 32, T 9N, R 2W, SLBM
Diverting Works: Earthen dike and culvert Source: Black Slough

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USES OF WATER RIGHT**********

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SUPPLEMENTAL GROUP NO. 27706. Water Rights Appurtenant to the following use(s):
29-3084,3085,3086

.....

###STOCKWATER: 0 Stock Units of the Group Total of 200 Diversion Limit: 1.848 acft. PERIOD OF USE: 01/01 TO 12/31
***Sole Supply for Stockwatering for 29-3086 in this Group has NOT YET been evaluated***
Stockwatering under this right is limited to 66 ELUs.

*==========

SUPPLEMENTAL GROUP NO. 27708.
29-3086

.....

###IRRIGATION: 689.48 acres Diversion Limit: 2757.92 acft. PERIOD OF USE: 04/01 TO 10/31

.....

###WILDLIFE: Incidental waterfowl & wildlife propagation. PERIOD OF USE: 01/01 TO 12/31
Acre Feet Allowed by this Right for this Use:

| ###PLACE OF USE: | NORTH WEST QUARTER | | | | NORTH EAST QUARTER | | | | SOUTH WEST QUARTER | | | | SOUTH EAST QUARTER | | | | Section |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NW | NE | SW | SE | NW | NE | SW | SE | NW | NE | SW | SE | NW | NE | SW | SE | Totals |
| Sec 29 T 9N R 2W SLBM | | | | | | | X | | X | X | X | X | X | X | X | | 0.0000 |
| Sec 30 T 9N R 2W SLBM | | | | | | | | | | | | | | | X | | 0.0000 |
| Sec 31 T 9N R 2W SLBM | | | | | X | X | | X | | | | | | X | X | | 0.0000 |
| Sec 32 T 9N R 2W SLBM | X | X | X | X | X | | X | X | X | X | X | X | X | X | X | | 0.0000 |

PLACE OF USE for STOCKWATERING

| | NORTH-WEST¼ | | | | NORTH-EAST¼ | | | | SOUTH-WEST¼ | | | | SOUTH-EAST¼ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NW | NE | SW | SE | NW | NE | SW | SE | NW | NE | SW | SE | NW | NE | SW | SE |
| Sec 29 T 9N R 2W SLBM | | | | | | | X | | X | X | X | X | X | X | X | X |
| Sec 30 T 9N R 2W SLBM | | | | | | | | | | | | | | | | X |
| Sec 31 T 9N R 2W SLBM | | | | | X | X | | X | | | | | | X | | X |
| Sec 32 T 9N R 2W SLBM | X | X | X | X | X | | X | X | X | X | X | X | X | X | X | X |

OTHER COMMENTS

Flow: Civil Decree #4473 establishes flow at 45.0 cfs shared by Water User Claims 3079/3086, 3412.

END OF DATA

# STATE OF UTAH -- DIVISION OF WATER RIGHTS -- DATA PRINT OUT for 29-3495

(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 04/17/2006 

WATER RIGHT: 29-3495 APPLICATION/CLAIM NO.: CERT. NO.:

OWNERSHIP**********

NAME: First Commercial Trust
ADDR: Richard C. Knudson, Trustee
2200 Panorama Way
Salt Lake City UT 84124-2818

DATES, ETC.**********

LAND OWNED BY APPLICANT?

| | | | | | |
|---|---|---|---|---|---|
| FILED: | \|PRIORITY: / /1890 | \|PUB BEGAN: | \|PUB ENDED: | \|NEWSPAPER: | |
| ProtestEnd: | \|PROTESTED: [No ] | \|HEARNG HLD: | \|SE ACTION: [ ] | \|ActionDate: | \|PROOF DUE: |
| EXTENSION: | \|ELEC/PROOF: [ ] | \|ELEC/PROOF: | \|CERT/WUC: | \|LAP, ETC: | \|PROV LETTER: |
| RENOVATE: | \|RECON REQ: | \|TYPE: [ ] | | | |

PD Book No. 4 Map:

Type of Right: Diligence Claim Source of Info: Proposed Determination Status: Pro. Determination Protested

LOCATION OF WATER RIGHT**********

FLOW: 17.0 cfs SOURCE: Bear River and unnamed streams

COUNTY: Box Elder COMMON DESCRIPTION: 10 mi. W. Brigham City

POINTS OF DIVERSION -- SURFACE:

(1) S 805 ft E 1005 ft from NW cor, Sec 30, T 9N, R 2W, SLBM
Diverting Works: Source: Unnamed stream
(2) S 83 ft E 1851 ft from NW cor, Sec 31, T 9N, R 2W, SLBM
Diverting Works: Source: Unnamed stream
(3) N 550 ft W 2000 ft from SE cor, Sec 26, T 9N, R 3W, SLBM
Diverting Works: Natural channels Source: Bear River overflow channel

Stream Alt Required?: No

USES OF WATER RIGHT**********

SUPPLEMENTAL GROUP NO. 28114.

###IRRIGATION: 1703.59 acres Diversion Limit: 0.0 acft. PERIOD OF USE: 04/01 TO 10/31

| ###PLACE OF USE: | NORTH WEST QUARTER | | | | NORTH EAST QUARTER | | | | SOUTH WEST QUARTER | | | | SOUTH EAST QUARTER | | | | Section |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NW | NE | SW | SE | NW | NE | SW | SE | NW | NE | SW | SE | NW | NE | SW | SE | Totals |
| Sec 06 T 8N R 2W SLBM | X | | | | | | | | | | | | | | | | 0.0000 |
| Sec 01 T 8N R 3W SLBM | X | X | | | X | X | | | | | | | | | | | 0.0000 |
| Sec 02 T 8N R 3W SLBM | | X | | | X | X | | | | | | | | | | | 0.0000 |
| Sec 30 T 9N R 2W SLBM | X | X | X | X | | | | | X | X | | | | | | | 0.0000 |
| Sec 31 T 9N R 2W SLBM | X | X | X | X | | | | | X | X | X | X | | | | | 0.0000 |
| Sec 25 T 9N R 3W SLBM | | | | | | | | | X | X | X | X | X | X | X | | 0.0000 |
| Sec 26 T 9N R 3W SLBM | | | | | | | | | | | | | | | | X | 0.0000 |
| Sec 35 T 9N R 3W SLBM | | | | | X | X | X | X | | X | X | | | | | | 0.0000 |
| Sec 36 T 9N R 3W SLBM | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | 0.0000 |

OTHER COMMENTS**********

The State Engineer believes that these waters were historically used during high flows of the Bear River. Therefore, WUC 3495 will be included in the priority list of the Lower Bear River distribution system and will be recog-nized during periods of high water flow generally from May 1st to June 15th and September 15th to November 30th. Therefore, the diversion limitation

is limited to 92/214 days x 1703.59 acres x 4.0 af/ac/yr = 2,930.17 af/yr.

WUC 3495 is evidenced by `Evidence of Pre-Statutory Water Use`.

**********
**********E N D  O F  D A T A**********
**********

# STATE OF UTAH -- DIVISION OF WATER RIGHTS -- DATA PRINT OUT for 29-3609(F37412a)

(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 04/17/2006 

WATER RIGHT: 29-3609 APPLICATION/CLAIM NO.: F37412a CERT. NO.:

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OWNERSHIP**********

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NAME: Bear River Silt Lands Company
ADDR: c/o Richard C. Knudson
2200 Panorama Way
Salt Lake City UT 84124

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DATES, ETC.**********

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LAND OWNED BY APPLICANT?
FILED: 10/17/1990|PRIORITY: 01/11/1966|PUB BEGAN: |PUB ENDED: |NEWSPAPER:
ProtestEnd: |PROTESTED: [No ]|HEARNG HLD: |SE ACTION: [Approved]|ActionDate:11/08/1991|PROOF DUE: 11/30/2006
EXTENSION: |ELEC/PROOF:[Proof ]|ELEC/PROOF:09/20/1995|CERT/WUC: |LAP, ETC: |PROV LETTER:
RENOVATE: |RECON REQ: |TYPE: [ ]

PD Book No. Map:

Type of Right: Fixed-Time Application Source of Info: Water User's Claim Status: Approved

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LOCATION OF WATER RIGHT**********

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FLOW: 10.0 cfs SOURCE: Bear River

COUNTY: Box Elder COMMON DESCRIPTION:

POINTS OF DIVERSION -- SURFACE:
(1) S 0 ft E 2000 ft from NW cor, Sec 31, T 9N, R 2W, SLBM
Diverting Works: Source:
(2) N 1100 ft E 900 ft from SW cor, Sec 24, T 9N, R 3W, SLBM
Diverting Works: Source:
(3) N 2400 ft E 700 ft from SW cor, Sec 34, T 9N, R 3W, SLBM
Diverting Works: Source:
(4) N 4700 ft E 1200 ft from SW cor, Sec 35, T 9N, R 3W, SLBM
Diverting Works: Pumps, pipelines, ditches Source:

Stream Alt Required?: No

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USES OF WATER RIGHT**********

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SUPPLEMENTAL GROUP NO. 28242. Water Rights Appurtenant to the following use(s):
29-1912,3609

.....

###IRRIGATION: 0.0 acres of the Group Total: 933.0 acres Diversion Limit: 0.0 acft. PERIOD OF USE: 01/01 TO 12/31
***Sole Supply for Irrigation for 29-3609 in this Group has NOT YET been evaluated***

.....

| ###PLACE OF USE: | NORTH WEST QUARTER | | | | NORTH EAST QUARTER | | | | SOUTH WEST QUARTER | | | | SOUTH EAST QUARTER | | | | Section |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NW | NE | SW | SE | NW | NE | SW | SE | NW | NE | SW | SE | NW | NE | SW | SE | Totals |
| Sec 06 T 8N R 2W SLBM | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | 0.0000 |
| Sec 30 T 8N R 2W SLBM | X | X | X | X | | | | | | | | | | | | | 0.0000 |
| Sec 01 T 8N R 3W SLBM | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | 0.0000 |
| Sec 02 T 8N R 3W SLBM | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | 0.0000 |
| Sec 03 T 8N R 3W SLBM | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | 0.0000 |
| Sec 04 T 8N R 3W SLBM | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | 0.0000 |
| Sec 05 T 8N R 3W SLBM | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | 0.0000 |
| Sec 06 T 8N R 3W SLBM | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | 0.0000 |
| Sec 31 T 9N R 2W SLBM | X | X | X | | | | | | | | | | | | | | 0.0000 |
| Sec 25 T 9N R 3W SLBM | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | 0.0000 |
| Sec 35 T 9N R 3W SLBM | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | 0.0000 |
| Sec 36 T 9N R 3W SLBM | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | 0.0000 |

OTHER COMMENTS**********

The applicant wishes to flood irrigate and create pasture for a cattle operation. Because of flooding some ponding will occur. Any excess water will flow naturally into the Bird Refuge Units 4&5. The applicant does not include the priority as part of this right and will only take water above 1000 cfs if it is available. No distribution of other rights is required for this right.
This Water Right was protested to the Proposed Determination, Area 29, Book 4 by R&P Wetlands on October 27, 2005.

SEGREGATION HISTORY**********

This Right was Segregated from 29-1473, with Appl#: A37412, Approval Date: / / under which Proof is to be submitted.

This Right as originally filed:

| FLOW IN CFS | QUANTITY IN ACRE-FEET | WATER USES: IRRIGATED ACREAGE | STOCK (ELUs) | DOMESTIC (FAM - PER) | MUNICIPAL | MINING | POWER | OTHER |
|---|---|---|---|---|---|---|---|---|
| 10.0 | | 933.0000 | | | | | | |

APPLICATIONS FOR EXTENSIONS OF TIME WITHIN WHICH TO SUBMIT PROOF**********

FILED: 08/31/1995|PUB BEGAN: |PUB ENDED: |NEWSPAPER:
ProtestEnd: |PROTESTED: [No ]|HEARNG HLD: |SE ACTION: [Approved]|ActionDate:10/17/1995|PROOF DUE: 11/30/1996

FILED: 05/28/1996|PUB BEGAN: |PUB ENDED: |NEWSPAPER:
ProtestEnd: |PROTESTED: [No ]|HEARNG HLD: |SE ACTION: [Approved]|ActionDate:08/17/1998|PROOF DUE: 11/30/2006

**********E N D O F D A T A**********

# STATE OF UTAH -- DIVISION OF WATER RIGHTS -- DATA PRINT OUT for 29-3848(A70370)

(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 04/17/2006 

WATER RIGHT: 29-3848 APPLICATION/CLAIM NO.: A70370 CERT. NO.:

OWNERSHIP**********

NAME: Richard C. & Bonnie L. Knudson
ADDR: Joint tenants, WROS
2200 Panorama Way
Salt Lake City UT 84124-2818

DATES, ETC.**********

LAND OWNED BY APPLICANT? Yes
FILED: 09/12/1996|PRIORITY: 09/12/1996|PUB BEGAN: 09/25/1996|PUB ENDED: 10/02/1996|NEWSPAPER: Box Elder Journal
ProtestEnd:10/22/1996|PROTESTED: [HearHeld]|HEARNG HLD: |SE ACTION: [Approved]|ActionDate:05/07/1997|PROOF DUE: 08/31/2000
EXTENSION: |ELEC/PROOF:[Proof ]|ELEC/PROOF:08/24/2000|CERT/WUC: |LAP, ETC: |PROV LETTER:
RENOVATE: |RECON REQ: |TYPE: [ ]

PD Book No. Map:

Type of Right: Application to Appropriate Source of Info: Application to Appropriate Status: Pro. Determination Protested

LOCATION OF WATER RIGHT**********

FLOW: 2000.0 acre-feet SOURCE: End of Hammond Canal

COUNTY: Box Elder COMMON DESCRIPTION: 4 miles W of Brigham City

POINT OF DIVERSION -- SURFACE:
(1) S 2640 ft E 0 ft from N4 cor, Sec 20, T 9N, R 2W, SLBM
Diverting Works: Concrete sided headgate Source:

Stream Alt Required?: No

USES OF WATER RIGHT**********

SUPPLEMENTAL GROUP NO. 28505. Water Rights Appurtenant to the following use(s):
29-2549,2633,2725,2751,2752,2753,2754,2755,2856,3321,3848

###IRRIGATION: 0.0 acres of the Group Total: 500.0 acres Diversion Limit: 0.0 acft. PERIOD OF USE: 04/15 TO 10/15
***Sole Supply for Irrigation for 29-3848 in this Group has NOT YET been evaluated***

###STOCKWATER: 0 Stock Units of the Group Total of 300 Diversion Limit: PERIOD OF USE: 04/15 TO 10/15
***Sole Supply for Stockwatering for 29-3848 in this Group has NOT YET been evaluated***

| ###PLACE OF USE: | NORTH WEST QUARTER | | | | NORTH EAST QUARTER | | | | SOUTH WEST QUARTER | | | | SOUTH EAST QUARTER | | | | Section |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NW | NE | SW | SE | NW | NE | SW | SE | NW | NE | SW | SE | NW | NE | SW | SE | Totals |
| Sec 19 T 9N R 2W SLBM | | | | | | | | | | | | | | X | | X | 0.0000 |
| Sec 20 T 9N R 2W SLBM | | | | | | | | | X | X | X | X | | | | | 0.0000 |
| Sec 29 T 9N R 2W SLBM | X | X | X | X | | | | | | | | | | | | | 0.0000 |
| Sec 30 T 9N R 2W SLBM | | | | | X | X | X | X | | | | | | | | | 0.0000 |

PLACE OF USE for STOCKWATERING**********

| | NORTH-WEST¼ | | | | NORTH-EAST¼ | | | | SOUTH-WEST¼ | | | | SOUTH-EAST¼ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NW | NE | SW | SE | NW | NE | SW | SE | NW | NE | SW | SE | NW | NE | SW | SE |
| Sec 19 T 9N R 2W SLBM | | | | | | | | | | | | | | X | | X |
| Sec 20 T 9N R 2W SLBM | | | | | | | | | X | X | X | X | | | | |
| Sec 29 T 9N R 2W SLBM | X | X | X | X | | | | | | | | | | | | |
| Sec 30 T 9N R 2W SLBM | | | | | X | X | X | X | | | | | | | | |

OTHER COMMENTS**********

We are the tailend user of water flowing through the Hammond canal arm of the Bear River Canal Company, and any surplus of excess water not being currently used by upstream water owners of necessity dumps onto our property at Point A of map. The south half of Section 20 was acquired in 1954 and during the ensuing 42 years the property owners have put to beneficial use any and all such surplus which, on occasion dumped onto applicant's land. Via this application, we are seeking the legal right to continue using said surplus water, as, if & when it may be available.

PROTESTANTS**********

NAME: Bear River Canal Company
ADDR: c/o D. Brent Rose
One Utah Center, Suite 1000 201 South Main Street
Salt Lake City UT 84111-2208

NAME: Ron & Sheila Rathbone
ADDR: P. O. Box 101
1550 North 3000 West
Corrine UT 84307

NAME: State of Utah
ADDR: Division of Wildlife Resources
1594 West North Temple
Salt Lake City UT 84114

NAME: US Department of the Interior
ADDR: Fish and Wildlife Service
P. O. Box 25486 Denver Federal Center
Denver CO 80225-0486

**********E N D O F D A T A**********

# Appendix E

Economic Development in Brigham City and Box Elder County

**ORDINANCE # 03-39**

**AN ORDINANCE ESTABLISHING THE NORTH SHORE DEVELOPMENT PLANNED DISTRICT PURSUANT TO CHAPTER 29.17 OF THE BRIGHAM CITY ZONING ORDINANCE.**

**WHEREAS,** Chapter 29.17 of the Brigham City Zoning Ordinance allows the establishment of Planned Districts in Brigham City; and

**WHEREAS,** procedures for establishing such a Planned District are outlined in Chapter 29.17 of the Brigham City Zoning Ordinance; and

**WHEREAS,** a petition for establishment of a Planned District has been received by Brigham City; and

**WHEREAS,** the Planning Commission and City Council have previously given approval in principal to the proposed Planned District; and

**WHEREAS,** following appropriate procedures, the Planning Commission has held a public hearing to consider the proposed North Shore Development Planned District; and

**WHEREAS,** following appropriate notice a public hearing, the Planning Commission has recommended approval of the North Shore Planned District; and

**WHRERAS,** following appropriate notice and a public hearing, the City Council of Brigham City finds that establishment of the North Shore Planned District is desirable and in the best interests of the citizens of Brigham City and will protect the health, safety, and welfare of the citizens of Brigham City.

**NOW THEREFORE BE IT AND IT IS HEREBY ORDAINED by the City Council of Brigham City:**

**Section 1.**

A Planned District is hereby created to be known as the North Shore Development Planned District covering and limited to the property described in Exhibits A, B, and C attached hereto and made a part hereof.

**Section 2.**

The North Shore Planned District shall consist of a P/RR-1 (Planned/Rural Residential, 1 Unit Per Acre Density) area, a P/A-5 (Planned/Agricultural, 5 Acre Minimum) area, and a P/M-U-160 (Planned/Multiple Use, 1 Unit Per 160 Acre Density) area.

**Section 3.**

The Brigham City Zoning Ordinance is hereby amended to include Chapter 29.27. North Shore Development Planned District which shall read as follows:

## Chapter 29.27. North Shore Development Planned District

### 29.27.010. Establishment of the North Shore Development Planned District.

A. Definitions:
The definitions contained in Chapter 29.01 shall apply to this Chapter, except as otherwise provided herein. The following definitions are specific to this Chapter. In the event that a definition herein imposes a stricter requirement than a definition contained elsewhere in this Title, the stricter requirement shall apply.

1. General Development Plan. A plan pursuant to Section 29.17.050 consisting of documents and supporting evidence prepared and endorsed by a qualified professional team, as required by the Planning Commission. The General Development Plan for the North Shore Development Planned District provides general guidance as to the approximate location and proposed density of dwelling units, non-residential building uses and intensities, open space, and land use considered suitable for adjacent properties.
2. Household Pet. Animals ordinarily permitted in Utah residences and kept for the company or pleasure of Utah residents. Household Pets also includes tropical fish, amphibians, reptiles, or invertebrates of a number that do not constitute a health hazard or nuisance, and can be safely and humanely kept in aquariums, cages, or enclosures, the cumulative size of which shall not exceed fifty (50) cubic feet per household. Household pets shall not include animals such as dogs, cats, or others that have the potential to escape or become feral and act as predators on the Bear River Migratory Bird Refuge or within the boundary of the North Shore Development Planned District. Household pets shall not include the keeping of "Dangerous Animals", "Vicious Animals", "Wild Animals", or "Livestock", as defined in Title 4 of the Brigham City Code. Furthermore, household pets shall not include exotic, pygmy, or dwarf variations of animals defined as either "Wild Animals" or "Livestock" in Title 4 of the Brigham City Code, including but not limited to miniature horses, pygmy goats, and Vietnamese pot-bellied pigs, notwithstanding that such animals may be kept as household pets by residents of other communities.
3. The North Shore Development. A development located in Brigham City containing a mixture of residential, recreational, and open space land uses that will be governed by the provisions of this Chapter and the General Development Plan adopted in conjunction with this Chapter and the Brigham City General Plan to provide guidance for the development of the project.
4. The Property. The private property that is the subject of the North Shore Development Planned District and general development plan.

B. Purposes. The purposes of the North Shore Development Planned District are:

1. To allow the orderly and beneficial development of the North Shore Development, a primarily residential community in a rural setting;
2. To promote the economic benefit of Brigham City and Box Elder County;
3. To protect the general health, safety, and welfare of the citizens of Brigham City;
4. To consider the interests of the Bear River Migratory Bird Refuge insomuch as such interests may be impacted by development of the North Shore Development;
5. To implement the Brigham City General Plan by controlling the type, location, density, intensity, and other characteristics of development within the North Shore development area as defined and described in the North Shore Development General Development Plan;
6. To ensure that appropriate infrastructure and services are available to support the development of the North Shore Development;
7. To provide a structure for the review and approval of the design and infrastructure feature of permitted and conditional uses within the North Shore Development Planned District.

C. All development permits within the North Shore Development Planned District shall comply with the provisions of this Chapter, the standards contained herein and the policies of the Brigham City General Plan and the North Shore Development General Development Plan.

D. No development in the North Shore Development shall be approved by Brigham City unless there are available and adequate public facilities and services as evidenced by meeting the following standards:

1. The public facilities are currently in place or will be in place when the development permit is issued and the development permit is conditioned on the availability of public facilities prior to approval of a final subdivision plat or final site plan approval for a permitted or conditional use; or
2. The provision of the public facilities are a condition of the development permit and are guaranteed to be provided at or before the issuance of a building permit for proposed development in the North Shore Development Planned District development; or
3. The public facilities are under construction; or
4. There is an enforceable development agreement guaranteeing that the facilities will be in place at the time that the impacts of the development will occur; or
5. The Brigham City Planning Commission determines that there are significant overriding public policy considerations or public health, safety, and welfare concerns which warrant the approval of the application in the absence of evidence that all public facilities and services are adequate and available.

E. Adequacy of Public Facilities. The available capacity for public facilities and services shall be determined in accordance with the following calculation methodology:

1. Adding together the total capacity of existing and planned capital improvements for a public facility;
2. Calculate available capacity by subtracting from the total capacity of Subsection (a) herein the sum of:

   a. The demand for each public facility created by existing development; and
   b. The demand for each public facility created by the anticipated completion of committed development; and
   c. The demand for each public facility created by the anticipated completion of the proposed development under consideration for concurrency determination.

F. Zoning Districts Established. The following Zoning Districts are hereby created within the North Shore Development Planned District: P/RR-1 (Planned/Rural Residential, 1 Unit Per Acre Density), P/A-5 (Planned/Agricultural, 5 Acre Minimum) and P/M-U-160 (Planned/Multiple Use, 1 Unit Per 160 Acre Density).

G. Codes and Symbols. In following Sections of this Chapter, uses of land or buildings which are allowed in the various districts are shown as "permitted uses," indicated by a "P" in the appropriate column, or as "conditional uses," indicated by a "C" in the appropriate column. If a use is not allowed in a given district, it is either not named in the use list or it is indicated in the appropriate column by a dash, "_." If a regulation applies in a given district, it is indicated in the appropriate column by a numeral to show the linear or square feet, or acres required, or by the letter "A." If the regulation does not apply, it is indicated in the appropriate column by a dash, "_."

H. Uses. No building, structure or land shall be used and no building or structure shall be hereafter erected, structurally altered, enlarged or maintained in the multiple use, agricultural, or rural residential districts except as provided in this ordinance.

| | P/RR-1 | P/A-5 | P/M-U-160 |
|---|---|---|---|
| (1) Accessory buildings and uses customarily incidental to permitted and conditional uses | P | P | P |
| (2) Agriculture<br>a. Agriculture, except grazing and pasturing of animals | P | P | P |
| b. Agriculture, including grazing and pasturing of animals | - | P | C |
| c. Agriculture, Business or Industry | C | C | C |
| d. Animals and fowl for recreation or for family food production for the primary use of persons residing on the premises | - | C | - |
| e. Nursery or green house, whole-sale or retail | C | P | - |

| | P/RR-1 | P/A-5 | P/M-U-160 |
|---|---|---|---|
| f. The tilling of the soil, the raising of crops, horticulture and gardening..... | P | P | P |
| (3) Apiary (bee keeping)..... | C | P | C |
| (4) Aviary..... | P | P | C |
| (5) Bed and Breakfast Facility subject to the conditions outlined in 29.03.210 | P | P | - |
| (6) Cluster subdivision of single-family dwellings.<br>a. Provided that the residential density is not increased by more than ten (10) per cent for the district | P | P | - |
| b. Provided that the area, in acres, of the subdivision is not less than | 5 | 640 | - |
| (7) Dude Ranch: family vacation ranch..... | - | P | C |
| (8) Educational Institution..... | C | C | C |
| (9) Educational Institution with lodging: | C | C | C |
| (10) Home occupation..... | P | P | - |
| (11) Household pets as defined above ..... | P | P | - |
| (12) Licensed Family Child Care ..... | C | C | - |
| (13) Private park or recreational grounds ..... | P | C | C |
| (14) Private recreational camp or resort, including accessory or supporting dwellings or dwelling complexes and commercial service uses which are owned or managed by the recreational facility to which it is accessory (private recreational camps or resorts shall not be subject to the residential density restrictions of this Section). ..... | - | P | C |
| (15) Private Stables. horses for private use. ... | P | P | C |
| a) Private stables or the keeping of horses for the private use of persons residing on the premises and providing that not more than two (2) horses shall be kept for each one acre in the lot ..... | P | P | C |
| (16) Public use, quasi-public use, essential services, including but not limited to parks, schools, churches, dams and reservoirs | C | C | C |
| (17) Recreation: | | | |
| a) Archery Shop/Range..... | - | P | C |
| b) Campground..... | - | C | C |
| c) Golf Course ..... | C | C | C |
| (18) Residential facility for elderly persons ..... | P | P | - |
| (19) Residential facility for persons with a disability | P | P | - |
| (20) Signs:<br>The type, size, height, location and other standards and requirements for signs shall be in accordance with the regulations set forth in Chapter 20. | A | A | A |

| | P/RR-1 | P/A-5 | P/M-U-160 |
|---|---|---|---|
| (21) Single family dwellings ..... | P | P | - |
| (22) Temporary buildings for uses incidental to construction work, including living quarters for a guard or night watchman, which building must be removed upon completion or abandonment of the construction work | P | P | P |
| (23) Wetland Mitigation Bank | C | P | P |
| **29.27.040. Area Regulations.** No minimum lot area requirement is established, however maximum density expressed as the number of residential dwelling units per gross acre shall not exceed:..... | 1 unit per 1acre | 1 unit per 5 acres | 0 |
| **29.27.050. Width Regulations.** The minimum width in feet for any lot in the districts regulated by this chapter, except as modified by planned unit- developments or cluster subdivisions shall be. ..... | 100 | 200 | 1320 |
| **29.27.060. Frontage Regulations.** The minimum frontage in feet for any lot in the districts regulated by this chapter on a public street or a private street approved by the governing body shall be:..... | 25 | 50 | 60 |
| **29.27.070. Front Yard Regulations.** The minimum depth in feet for the front yard for main buildings in districts regulated by this chapter shall be: | 30 | 30 | 60 |
| Accessory buildings may have the same minimum front yard depth as main buildings if they have the same side yard required for main buildings, otherwise they shall be set back at least six (6) feet in the rear of the main building | A | A | A |
| **29.27.080. Rear Yard Regulations.** The minimum depth in feet for the rear yard in the districts regulated by this chapter shall be: for main buildings ..... | 30 | 50 | 60 |
| for accessory buildings..... | 20 | 20 | 20 |
| **29.27.090. Side Yard Regulations.** The minimum side yard in feet for any dwelling or main or buildings shall be: | 15 | 20 | 60 |
| Except on corner lots the side yard in feet which faces on a street for both main and accessory buildings, shall not be less than: | 30 | 30 | 60 |
| The minimum side yard in feet for any accessory building shall be: | 20 | 20 | 20 |
| **29.27.100. Height Regulations.** The maximum height for all buildings and structures in districts regulated by this chapter shall be: in feet..... | 35 | 35 | 35 |
| in number of stories..... | 2½ | 2½ | 2½ |
| **29.27.110. Animal Regulations.** Any barn, coop, pen, stable, corral, enclosure for the confinement of large animals, shall be set back from a public street at least the following distance ..... | 100 | 100 | - |

## 29.27.020. Environmental Criteria.

A. Air Quality. Any land use in the North Shore development that produces emissions to the air shall, at a minimum demonstrate compliance with all State air quality standards, as evidenced by the issuance of any permits required for their emissions by the State of Utah.

B. Water Quality and Watershed Protection. Land uses in the North Shore Development Planned District shall be subject to any applicable requirements of Brigham City source protection zones.

C. Sewage Disposal.

1. Connection to Brigham City sewer is required for all land uses, except as otherwise permitted by the Brigham City Waste Treatment Department under applicable provisions of the Brigham City Code.
2. If permitted by the Brigham City Waste Treatment Department and Brigham City Culinary Water Department, alternative sewage disposal systems shall be sited and constructed in accordance with applicable health regulations and standards of Brigham City, Box Elder County, and the State of Utah.

D. Revegetation/Erosion Protection/Runoff Control. To the extent possible, plans for the development of the North Shore Development and actual construction of infrastructure and land uses shall provide for the preservation of existing vegetation; shall provide for appropriate, prompt revegetation or erosion protection measures; and shall provide for surface water runoff control in accordance with the Brigham City Public Works Standards and Technical Specifications or modifications thereto granted pursuant to the procedure for such modifications.

1. Storm water created by the development shall be detained on the Property and released according to standard engineering calculations and practices, except as such practices may be modified for the North Shore Development. Existing natural storm water drainage shall be allowed to follow the current natural drainage patterns. Due to the unique setting and rural environment of the Property, storm water management may be accomplished through the use of roadside swales and permeable basins allowing storm water to infiltrate into the ground. Design and construction of such storm water management features shall be subject to restrictions of the Brigham City Source Protection Zones if applicable.
2. All developments shall minimize the area disturbed by construction activities at any given time.
3. Buildings shall not be located on soils with severe limitations for any of the proposed uses, unless fully mitigated by appropriate design and construction techniques. Limitations on development may be due to any of a number of factors including the depth to bedrock or a water table, soil permeability, the soil's propensity to shrink and swell and other factors.

## 29.27.030. Critical Areas

Development within Critical Areas, as defined in Subsections (A) through (C) below, is prohibited.

A. Geologic Hazards. The development layout and design shall avoid areas which may be adversely affected by geologic hazards. This prohibition may be waived in cases where the developer demonstrates to the Planning Commission that the geologic hazard is fully mitigated by appropriate design and construction techniques. Geologic hazards include ground subsidence that may result from natural or man-made conditions and also any kind of seismic activity.

B. Floodplains. All areas within a 100-year floodplain as mapped for the Federal Flood Insurance program, or as calculated by a qualified engineer, or where the prevailing or potential natural vegetation is riparian in nature, are declared to be critical to the maintenance of the North Shore Development's hydrologic systems, fisheries, and wildlife habitat. Development of floodplain areas has a significant potential to adversely affect wildlife, water quality, and if it modifies the floodway, adjoining, upstream and downstream properties, roads and other public facilities. Development in floodplain areas may also be constrained by a high water table which raises the cost of installing and maintaining utilities. Finally, floodplain development adversely affects all taxpayers through public expenditures to prevent or clean up flood damages.

1. Development, other than open use recreation, shall be prohibited in areas that include 100-year floodplains. Structures shall not be permitted in a 100-year floodplain.
2. Road and driveway crossings shall bridge over all 100-year floodplains. The installation of culverts for such purposes shall be minimized and is generally not appropriate.
3. Where 100-year floodplain areas are modified any action that may increase flood hazards or adversely affect water quality or fisheries shall be avoided. Such actions may include, but are not limited to, stream channel modifications, the storage of floatable or potentially polluting materials, and the construction of stream crossings.
4. Plantings or natural areas (as opposed to scrap metal, junked vehicles, or concrete slabs) shall be used where stream channels are required to be stabilized. Riprap may be utilized if approved in advance through the development review process, and integrated with a planting plan.

## 29.27.040. Water and Water Supply.

A. For individual subdivisions and development proposals, the developer shall submit a site plan prepared by a professional engineer showing the property boundary with topography, proposed building envelopes, and proposed public and

private roads and streets. The submittal shall show infrastructure necessary to serve the proposed development with a water system designed in compliance with the Brigham City Public Works Standards and Technical Specifications, or applicable modifications thereto, to be dedicated to Brigham City, serving all building lots. A publicly dedicated water system is necessary for the following purposes:

1. To protect existing and future Brigham City water rights and water sources;
2. To provide an efficient and reliable water source for fire prevention and suppression;
3. To provide development sites with an efficient and reliable source of water for culinary and other uses.

B. Source Protection. All development shall be designed, constructed, and maintained in compliance with applicable Brigham City source protection zones. Source protection restrictions must be binding on all heirs, successors, and assigns. Any land use restrictions required to insure compliance with source protection restrictions must be recorded with the property description in the Box Elder County Recorder's Office. Copies of this recording must be submitted to the Brigham City Culinary Water Department for review.

**29.27.050. Sanitary Sewer.**

A. For individual subdivisions and development proposals, the developer shall submit a site plan prepared by a professional engineer showing the property boundary with topography, proposed building envelopes, and proposed public and private roads and streets. The submittal shall show infrastructure necessary to serve the proposed development with a sanitary sewer system serving all building lots. A sanitary sewer system is necessary for the following purposes:

1. To protect existing and future Brigham City water sources from contamination;
2. To provide development sites with an efficient and reliable system for the treatment of sewage and waste water;
3. To protect water bodies on and adjacent to the property subject to this Planned District from contamination.

The system shall be designed in compliance with the Brigham City Public Works Standards and Technical Specifications, or applicable modifications thereto.

B. Easements or rights-of-way required for sewer service by the Brigham City Waste Treatment Department shall be provided by all developments proposing public sewer systems prior to final subdivision plat or final development plan approval.

C. Where the Brigham City Sanitary Sewer Capital Facilities Plan calls for sewer main sizes through a development that are larger than necessary to serve the

development, the larger main shall be installed in accordance with Brigham City policy.

**29.27.060. Fire Protection.**

A. Water infrastructure and water supply shall be in place and serviceable prior to any combustible construction.

B. Brigham City Fire Department Level of Service Standards

1. The Brigham City Fire Department has established the acceptable emergency response time as ten (10) minutes or less within the District. An acceptable response time to larger scale development may actually be less, as determined by the Brigham City Fire Department. (It must be realized that prevailing weather conditions, general topography, geographical diversities, and unusual traffic conditions may inhibit Fire Department response times at any time of year.)
2. In order to comply with an acceptable level of service standard, a developer may be required to provide appropriate fire protection infrastructure, including facilities, apparatus, and equipment for the Brigham City Fire Department to comply with the appropriate level of service standard. In addition, approved fire sprinkler and suppression systems may be required by the Fire Marshall in conjunction with other appropriate mitigation measures, which must be approved by the Fire Marshall, to comply with the required level of service standard.
3. If the Brigham City Fire Marshall determines that a desired level of service cannot be provided to a proposed development, the developer shall prepare and submit a Fire Protection Mitigation Plan to the Fire Marshall for review and approval. This plan shall address the measures that will be used to comply with the intent of the level of service standard, and the timing/phasing in which such measures will be provided. An acceptable mitigation plan shall be approved by the Brigham City Fire Marshall before a final subdivision plan, or final site plan approval is granted. Failure of a developer to provide an acceptable plan may be cause for denial of a development application by Brigham City.

C. Development in Wildfire Hazard Areas

1. All proposed new subdivisions or developments will be analyzed and rated for wildfire risk using the Fire Hazard Severity Scale developed by the State of Utah, Division of State Lands and Forestry. All of these factors can vary from development to development. The composite score will categorize the hazard level of the proposed development. Once a proposed subdivision or development has been classified as to its hazard level, development standards for each level can be used by the Brigham City Fire Marshall to guide fire protection and wildfire prevention measures. This rating shall be submitted to Brigham City at the initial stage of a subdivision application, as required by

the Fire Marshall, or as otherwise required in the processing of development permits for any proposed development. The Rating Scale is based on five separate factors:

a. Slope – This factor is displayed as a percentage. It is calculated by measuring the vertical distance and horizontal distance for a given area, and dividing the vertical by the horizontal.
b. Aspect – This factor is the cardinal direction in which the surface of the ground faces.
c. Response Time of Fire Agency – This factor is measured in minutes it takes the nearest responsible fire agency to respond to a fire in a given area.
d. Type of Vegetation – This factor is categorized by fuel types. Rates of spread, resistance to control, and potential to cause structural damage are the criteria for rating severity.
e. Vegetation Density – This factor is considered the total combustible vegetation that may be available as a fuel for wildfire.

2. Fuel Breaks/Vegetation Manipulation

a. Hazardous fuels in the form of native vegetation will be cleared around structures and around the perimeter of the development to assist in wildfire prevention measures. This fuel break is not intended as a complete vegetation clearing fire break. Fuel breaks must be in place prior to occupancy of the structure.
b. The definition of a fuel break by the Utah State Division of Lands and Forestry is, "a change in fuel continuity, type of fuel, or degree of flammability of fuel in a strategically located parcel or strip of land to reduce or hinder the rate of fire spread".
c. Fuel breaks shall consist of the following:

i. Grasses within 30 feet of structures shall be mowed to 4 inches or less.
ii. Ground litter shall be removed annually.
iii. Over mature, dead, and dying trees shall be evaluated as to their potential to ignite and to carry fire and possibly will be removed.
iv. Fuel breaks may contain individual tree specimens, ornamental plants, or other similar vegetation used as ground cover, provided they will not provide a means of transmitting wildfire from native vegetation to structures.
v. Fire resistive vegetation shall be planted in the fuel breaks to prevent undue soil erosion.

d. A maintained fuel break easement around the perimeter of any development shall be dedicated in favor of Brigham City and shall be shown on the final recorded subdivision plat of a subdivision or the final approved site plan of a development not requiring subdivision. The

easement shall be recorded by separate deed for development plans not requiring subdivision of land. Fuel breaks must be maintained by the landowners and a requirement for such maintenance shall be included as a stipulation in private covenants recorded as part of any subdivision plat approval. In subdivisions, planned unit developments, or other developments where a Homeowners' or other Association of property owners is created, such Association shall be responsible for monitoring of the fuel break easement. Private covenants for the subdivision, planned unit development, or other development shall include language enabling the Homeowner's or other property owners' Association to budget for and provide fuel break maintenance services around the perimeter of the development boundary.

e. The following chart identifies fuel break clearing limits around structures and development perimeters based on the wildfire hazard rating:

| Type | Moderate | High | Extreme |
|---|---|---|---|
| Structures | 30 feet | 50 feet | 100 feet |
| Development Perimeters | None | 75 feet | 100 feet |

D. Certification of compliance with adopted service levels and standards of the Brigham City Fire Department, shall occur prior to Final Site Plan approval, or in the case of a single-family dwelling unit or any use approved as a Conditional Use or a Permitted Use, before a building permit is issued for such development.

E. Fire hydrants, water line sizes, water storage for fire protection, and minimum flow for fire protection shall be determined by using the standards of the Insurance Services Office, which are known as the Fire System Grading Standards and the Brigham City Public Works Standards and Technical Specifications. In no case shall minimum fire flow be less than one thousand gallons per minute for a period of two (2) hours, unless otherwise permitted herein, or as approved by the Fire Marshall.

F. Plat Note Required. All recorded subdivision plats for the North Shore Development shall include the following note. In developments not requiring subdivision of land, an affidavit containing the following note shall be recorded against the subject property in the Box Elder County Recorder's Office.

> The property owner acknowledges that he/she is building in a rural environment adjacent to lands managed primarily for natural values including wildlife habitat and agriculture. As such, the property owner is on notice that public services in the area are subject to the constraints inherent to such environments. Emergency response time may be longer than it is in more accessible areas, and access by emergency vehicles may be impeded at times due to weather and road conditions. The owner understands and acknowledges that wildfire risks are higher in the North Shore Development than in other areas of Brigham City. By this notice, the property owner assumes the risk of occupancy as outlined above.

**29.27.070. Transportation Infrastructure and Access Design.**

A. Access.

1. Access to Existing Roads. All points of access to existing Brigham City roads or streets shall meet the standards set forth in the Brigham City Public Works Standards and Technical Specifications, or applicable modifications thereto. The design and construction of turn lanes, merging lanes, traffic signs or signals and other improvements required to make access points conform to Brigham City standards shall be the responsibility of the developer.
2. Development plans shall provide for the dedication of any rights-of-way which are within but will not serve a development, and which are determined by the Planning Commission or City Council to be necessary to effectively link the proposed development with future major roads or future developments or to prevent the "landlocking" of adjoining properties or to provide the best possible long-term circulation pattern.

B. Road Infrastructure Design

1. The design and construction of all roads in the North Shore development shall be in accordance with the Brigham City Public Works Standards and Technical Specifications as modified for the North Shore development.
2. Roads on soils having low bearing strengths, high shrink-swell potentials or high frost heave hazards may be required, upon recommendation of the City Engineer, to be constructed to specifications more demanding than those required on other sites.

C. Cul-de-Sacs

1. Cul-de-sacs are discouraged and shall only be permitted where they are identified on the General Development Plan or subsequent development plans.
2. The maximum length of a cul-de-sac on any non-rural designated road, as designated on the General Development Plan or subsequent development plans shall be 600 feet.
3. The maximum length of a cul-de-sac on a rural designated road, as designated on the General Development Plan or subsequent development plans shall be as follows, unless the Fire Marshall agrees to other lengths. The length of these cul-de-sacs shall be based on the wildfire hazard rating of the surrounding area.

| Wildfire Hazard Rating | Maximum Length |
|---|---|
| Moderate | 1,200 feet |
| High | 900 feet |
| Extreme | 500 feet |

4. The cul-de-sac shall not be less than 60 feet in diameter, or as required by the Fire Marshall and City Engineer.
5. A hammerhead cul-de-sac design may be allowed at the discretion of the Fire Marshall.
6. All cul-de-sacs must include signage indicating that the road is a dead end road within 50 feet of the outlet.

D. Bridges and Culverts: Bridges and culverts shall be constructed to support a gross vehicle weight of 40,000 pounds and shall have vehicle load limits posted. Permanent culverts shall be installed at all intermittent and perennial stream crossings. Specifications for bridges, culverts, and other stream crossing devices shall take into account at least the 25-year frequency storm and upstream debris hazard. If the development is within a 100-year flood plain, then 100-year frequency storm shall be used in drainage design.

E. Traffic Control and Street Signage

1. All roads will be designated with road names and signs will be installed at each major road intersection. All lots and/or home sites will be visibly signed with street addresses and numbered as such. Emergency access roads shall be clearly identified.
2. All roads shall be named or numbered in accordance with the City's addressing system and road identification signs in accordance with City standards and specifications. All permitted occupied structures shall post addresses prior to occupancy.
3. The developer shall be responsible for the expense of constructing and placing traffic control signs, as follows:

    a. Stop signs shall be placed at all intersections of arterials; of collectors and arterials; and when appropriate as determined by the City Engineer, local streets/roads and collectors.
    b. Yield signs shall be required at the intersection of all other streets and roads when determined by the Streets Department.

F. Snow Removal and Road Maintenance on Private Roads: Snow removal and road maintenance on private roads will be the responsibility of the respective property owner or Homeowners' Association and will be noted as such on the recorded plat of any subdivision which includes private streets. The CC&R's for the development shall include enforcement language for mandatory budgeting by the Association to provide snow removal and road maintenance services. When no Homeowners' Association exists, snow removal shall be the responsibility of the owner of the private street.

G. Pedestrian Access

1. Sidewalks, pedestrian walkways, or non-motorized trails shall be provided for internal pedestrian, bicycle, and/or equestrian circulation within developed portions of the North Shore Development.
2. Sidewalks, walkways, and trails shall be designed and constructed in accordance with the Brigham City Public Works Standards and Technical Specifications as modified for the North Shore Development.

H. Public Utilities

1. All utilities shall be placed underground unless the Brigham City Planning Commission, with input from the affected utility, determines that special conditions exist, other than cost, which should permit the utility to be installed above ground.
2. Natural gas service may be installed at the developer's option. Propane use must conform to all applicable provisions of the Uniform Fire Code.
3. Rights-of-way or easements shall be provided as required by the utilities serving the proposed development.
4. Underground utility services shall be installed extending into private property to a distance fifteen feet (15') from the property line of each lot before roads are surfaced.

I. Coordination With Box Elder School District: All developments proposing residential uses shall coordinate such development proposals with the Box Elder School District. All residential developments where public maintenance is anticipated shall provide adequate school bus loading and turn-around areas, as evidenced by a written statement from the Box Elder School District.

**29.27.080. Special Site Design Requirements.**

These criteria serve the public interest by requiring that the design of developments in the North Shore Development are compatible with the natural, rural environment and characteristics of their setting and with the image of the area which Brigham City seeks to promote; helping to reduce the potential for land use conflicts by encouraging the protection of privacy and scenic views; and protecting the integrity of the Bear River Migratory Bird Refuge.

A. Clustering of homes is encouraged to allow for reduced infrastructure costs for roads, driveways and water and sanitary sewer systems when compared with conventional design, and promote the visual integrity of development as viewed from within the development.

B. Development in the North Shore Development planned district shall be integrated in a manner that is consistent with the Brigham City General Plan and the General Development Plan for the North Shore Development. Integration shall be accomplished through, among other things, pedestrian and vehicular circulation, visual, open space, and other linkages and design techniques. A piecemeal

approach to planning and development, where individual development parcels are designed and constructed without adequate integration opportunities with surrounding areas, will not be permitted.

C. Outbuildings, Barns, and Associated Corrals: Outbuildings, barns, and associated corrals intended for the keeping and use of horses shall be located in the rear yard not closer than 60 (sixty) feet from the rear plane of the house.

**29.27.090. Lighting Regulations.**

A. Purpose. The general purpose of this Section is to protect and promote the public health, safety and welfare, the quality of life, and the ability to view the night sky, by establishing regulations and a process of review for exterior lighting. This Section establishes standards for exterior lighting in order to accomplish the following:

1. To protect against direct glare and excessive lighting;
2. To provide safe roadways for motorists, cyclists, pedestrians, and equestrians.
3. To provide for adequate lighting to protect public safety and security of residents of the North Shore Development planned district;
4. To protect and reclaim the ability to view the night sky, and help preserve the quality of life of the North Shore Development planned district residents;
5. To preserve the quality of the experience of tourists visiting the Bear River Migratory Bird Refuge and other adjacent wildlife areas;
6. To protect the integrity of wildlife habitat at the Bear River Migratory Bird Refuge and other adjacent wildlife areas;
7. To prevent light trespass in all areas of the North Shore Development planned district;
8. To promote efficient and cost effective lighting;
9. To allow for flexibility in the style of lighting fixtures;
10. To provide lighting guidelines;
11. To provide assistance to property owners and occupants in bringing non-conforming lighting into conformance with this Section;
12. To work with Box Elder County to promote the purposes of this chapter.

B. Definitions

1. Cut-off Angle (of a luminaire) – the angle, measured up from the nadir, between the vertical axis and the first line of sight at which the bare source is not visible.
2. Foot-candle – a unit of illuminance amounting to on lumen per square foot.
3. Fully Shielded – outdoor light fixtures shielded or constructed so that no light rays are emitted by the installed fixtures at angles above the

horizontal plane. This means that the shield is not flush or parallel with the light source or bulb. This is referred to in this document as a cut-off-fixture.

4. Glare – the sensation produced by luminance within the visual field that is sufficiently greater than the luminance to which the eyes are adapted to cause annoyance, discomfort, or loss in visual performance and visibility.
5. Illuminance – the quantity of light, or luminous flux, arriving at a surface divided by the area of the illuminated surface, measured in lux or foot-candles.
6. Installed – the initial installation of outdoor light fixtures defined herein, following the effective date of this ordinance but shall not apply to those outdoor light fixtures installed prior to such date.
7. Light trespass – light emitted by a lighting installation that falls outside the boundaries of the property on which the installation is sited (also called spill light).
8. Lumen – a unit of measurement.
9. Luminance – the physical quantity corresponding to the brightness of a surface (e.g. a lamp, luminaries, sky, or reflecting material) in a specified direction. It is the luminous intensity of an area of the surface divided by that area.
10. Luminaire – a complete lighting unit consisting of a lamp or lamps together with the parts designed to distribute the light, to position and protect the lamps and to connect the lamps to the power supply.
11. Lux (lx) – the SI unit of illuminance. One lux is one lumen per square meter.
12. Obtrusive light – spill light which, because of quantitative, directional, or spectral context, gives rise to annoyance, discomfort, distraction, or a reduction in the ability to see essential information.
13. Outdoor Light Fixtures – outdoor artificial illuminating devices, outdoor fixtures, lamps, and other devices, permanent or portable, used for illumination or advertisement. Such devices shall include, but are not limited to search, spot, or flood lights for:

    a) buildings and structures, including canopies and overhangs
    b) recreational areas
    c) parking lot lighting
    d) landscape lighting
    e) signs
    f) street lighting
    g) display and service areas

14. Spill light – light emitted by a lighting installation that falls outside the boundaries of the property on which the installation is sited (also called light trespass).

C. Approved Materials and Methods of Installation

The provisions of this Section are not intended to prevent the use of any material or method of installation not specifically prescribed by this Section provided any such alternate has been approved. The Planning Commission may approve any such alternate provided that the proposed design, material, or method provides approximate equivalence to the specific requirements of this Section, or is otherwise satisfactory and complies with the intent of this Section.

1. Shielding. All outdoor light fixtures except those exempted by Section 29.27.090(F) and those regulated by Section 29.27.090(C)(2) shall be fully shielded as required in Section 29.27.090(C)(2).
2. Requirements for Shielding. The requirements for shielding light emissions from outdoor light fixtures shall be as set forth in table 1. Shielding of sign, landscape, or building façade lighting shall be set forth in sections 29.27.090(D)(1) and 29.27.090(E)(6). Vegetation shall not be considered as a shield.

| Fixture Lamp Type | Shielded |
|---|---|
| Low Pressure Sodium [1] | Fully |
| High Pressure Sodium | Fully |
| Metal Halide [2] | Fully |
| Fluorescent [3] | Fully |
| Quartz [4] | Fully |
| Incandescent Greater than 100W | Fully |
| Mercury Vapor | Not permitted |
| Fossil Fuel | None |
| Glass tubes filled with Neon, Argon, Krypton [5] | None |

Table 1. Requirements for Shielding

Footnotes:

1) This light source is monochromatic and is the most energy efficient of all. It is a possible choice when used with a quality fixture that controls the light output. LPS lighting should be mixed with another light source for color rendering.
2) Metal halide lamps shall be in enclosed luminaires.
3) Warm white natural lamps are preferred to minimize detrimental effects.
4) For the purposes of this Section, quartz lamps shall not be considered an incandescent light source.
5) Outdoor advertising signs of the type constructed of translucent materials and wholly illuminated from within do not require shielding.

D. On-Site Lighting

1. Building/wall mounted and freestanding exterior area lighting shall be directed down and fully screened away from adjacent properties. Sign, landscape, and building façade luminaires that are non-cutoff shall be equipped with glare shields, visors, barn doors, or similar shielding accessories that restrict direct illumination to within the perimeter of the object being illuminated.

    a. Building Mounted Lighting, Plaza Lighting, Open Space Lighting, Parking Lot Lighting and Landscape Lighting: the top of such fixtures shall not exceed thirty (30) feet in height from grade (including the pole base).
    b. Recreational Field Lighting: shall be exempt from the height requirement.

2. Details of all commercial exterior lighting installations require approval by the Brigham City Planning Commission prior to intallation.
3. Other lighting alternatives that meet the intent of items above may be used with prior written approval from the Brigham City Planning Commission.

E. Prohibitions

1. Recreational Facility. No public outdoor recreational facility shall be illuminated after 11 p.m. except to conclude any recreational or sporting event or other activity conducted at a ball park, outdoor amphitheater, arena, or similar facility in progress prior to 10:30 p.m. No private outdoor recreation facility shall be illuminated after 10:00 p.m.
2. Outdoor Building, Landscaping, and Signs. The unshielded (per section (E)(6)) outdoor illumination of any building or landscaping is prohibited except with incandescent fixtures with lamps of 100 watts or less. Free standing advertisement signs with internal lighting are permitted. All illuminated outdoor advertising signs shall be equipped with an automatic time controller that prevents the operation of the lighting fixtures between the hours of 11 p.m. and sunrise. Businesses open 24 hours a day are exempt from this curfew.
3. Mercury Vapor. The installation of mercury vapor fixtures is prohibited.
4. Searchlights. Searchlights used for advertising or entertainment purposes are prohibited past 10:00 p.m.
5. Light trespass, deemed nuisance. Outside lighting such as lamps, bulbs, lights, and all other devices for producing artificial light which shine or reflect light onto or into a neighboring residence or property so as to annoy or disturb the persons inhabiting or using such property is hereby declared to be a nuisance and is unlawful and prohibited. Investigation and enforcement by the City of violations of this Section shall be only upon written complaint signed and submitted by the aggrieved

complaining party. The maximum maintained illuminance levels permitted at property lines is set forth in table 2.

| Application | Horizontal Footcandles Measured At Grade |
|---|---|
| Property Line Adjoins a Public Roadway or Public Right-of-Way | 0.5 footcandles |
| Property Line Adjoins a Non-Residential Property | 0.3 footcandles |
| Property Line Adjoins a Residential Property | 0.1 footcandles |

Table 2: Maximum Footcandles at Property Lines

6. All upward-directed sign building or landscaping lighting is prohibited, unless equipped with glare shields, visors, barn doors, or similar shielding accessories that restrict direct illumination to within the perimeter of the object being illuminated.
7. Any unshielded (per section (E)(6)) flood light or spot light must be aimed no higher than 45 degrees above straight down.
8. Non cut-off wall packs are prohibited.
9. Drop lenses that change a luminaire from cutoff to non-cutoff are prohibited.
10. Tilting of existing or new fixtures that change a cutoff fixture to non-cutoff is prohibited.

F. Exemptions

1. Nonconforming Fixtures. Outdoor light fixtures installed prior to the effective date of this Section are exempt from the provisions of this ordinance, provided, however, that no change in use, replacement, structural alteration, or restoration of outdoor light fixtures shall be made unless it thereafter conforms to the provisions of this ordinance. Routine maintenance activities shall be allowed and include the following: replacement of lamps, replacement/repair of damaged or inoperative luminaire components such as ballasts, igniters, lenses, reflectors, refractors, sockets, or photo cell controls.
2. Fossil Fuel Light. Fossil fuel light produced directly or indirectly by the combustion of natural gas or other utility-type fossil fuels is exempt from the provisions of this Section.
3. Special Conditions. For street lighting in a right-of-way, the Brigham City Council may grant an exemption to the requirements of this Section.
4. Construction Lighting. Lighting necessary for construction is exempt from the provisions of this Section provided said lighting is temporary and is discontinued immediately upon completion of the construction work.
5. Emergency lighting by police, fire, and rescue authorities is exempt from this Section.
6. Holiday lighting is exempt from this Section.

H. Applications (Commercial Uses Only)

Any person applying for a building, electrical or sign permit to install outdoor lighting fixtures shall, as a part of said application submit evidence that the proposed work will comply with this ordinance.

The application shall contain but shall not be limited to the following:

1. Plans indicating the location of the premises, and the type of illuminating devices, fixtures, lamps, supports, other devices.
2. Descriptions of the illuminating devices, fixtures, lamps, supports, and other devices. This description shall include but is not limited to manufacturer's catalog cuts, footcandle plots (in tenths, example: 0.3), and drawings including sections where required. Footcandle plots shall include listings of average, maximum, minimum, maximum/minimum, average/minimum values, as well as plots.
3. The above required plans and descriptions shall be sufficiently complete to enable the City Engineer to readily determine whether compliance with the requirements of this ordinance will be secured. If such plans and descriptions cannot enable this ready determination, by reason of the nature or configuration of the devices, fixtures or lamps proposed, the applicant shall submit evidence of compliance by certified test reports as performed by a recognized testing lab.

I. Issuance of Permit for Lighting on Private Property

The requirements of this Section shall be incorporated into any design review, conditional use review, building permit review, or other such land use approvals granted by the Brigham City Council, Brigham City Redevelopment Agency, Planning Commission, or Community Development Department.

J. Maximum Lighting Levels

All installations are allowed to meet the Illumination Engineering Society of North America minimum standards, plus 30%, maximum.

**29.27.010. Conflicts and Severability.**

A. Conflict. Whenever regulations in this Chapter conflict with other provision of the Brigham City Code, the provisions of this Chapter shall govern. Whenever regulations of other provisions of the Brigham City Code address matters that are not addressed by this Chapter, then said other provisions shall govern.

B. Severability. This Chapter and the various parts, sections, and clauses are hereby declared to be severable. If any part, section, paragraph, sentence, clause or phrase is adjudged to be unconstitutional or invalid, it is hereby declared that the remainder of the

Chapter shall not be affected thereby. The City Council of Brigham City, Utah, hereby declares that it would have passed this Chapter on each part, section, paragraph, sentence, clause, or phrase thereof, irrespective of the fact that any one or more portions thereof be declared invalid.

**Section 4.**

This Ordinance shall become effective upon its adoption, recordation, and first publication.

**PASSED AND ADOPTED BY THE CITY COUNCIL OF BRIGHAM CITY, STATE OF UTAH, ON THIS 25th DAY OF October, 2003.**

**By:**

**LOU ANN CHRISTENSEN, MAYOR**

**ATTEST:**

Mary Kate Christensen

**MARY KATE CHRISTENSEN, CITY RECORDER**

**Exhibit A**

P/RR-1 (Planned/Rural Residential) Area

Parcels:

03-111-0002
03-111-0014
03-111-0015
03-111-0023
03-111-0025

Legal descriptions for these parcels follow this page.

# Legal Description

For 03-111-0002

Owner : **KNUDSON, RICHARD C** Effective : **11/26/1994**

TG 455 FT E OF SW COR OF NW/4 OF SEC 20 TWP 9N R 2W, SLM, E ALG 1/4 SEC LINE 1492 FT TO A LANE BELONG- ING B.R.S.L. CO., N 0*7'E 2583.7 FT IN A SLY DIREC ALG S LINE OF HWY TO A PT 1915 FT DUE N OF BEG, S 1915 FT TO BEG. ALSO BEG AT NW COR OF SD SEC, E ALG N LINE OF SD SEC 1923 FT, S 0*7'W 51.5 FT TO N LINE OF HWY IN A SWLY DIRC ALG N LINE OF SD HWY TO A PT DUE S OF BEG. N 508.5 FT TO BEG. EXC BEG AT NW COR OF SD SEC, E 1980 FT, S 33 FT, W 1980 FT, N 33 FT TO BEG. CONTG 91.42 ACS.

# Legal Description

For 03-111-0014

Owner : **ROLFE, KIM V ETAL** Effective : **11/26/1994**

REMAINDER DESCRIPTION: BEG AT A PT 33 FT S & 1278.75 FT W OF NE COR OF SEC 20 T9N R2W SLM, S 400 FT, W 193.25 FT, N 400 FT, E 193.25 FT TO POB. CONT 1.77 ACRES M/L

# Legal Description

For 03-111-0015

Owner : **KNUDSON, RICHARD C ETUX JT ETAL** Effective : **11/26/1994**

BEG 43 RDS W OF NE COR OF SEC 20, TWP 9N, R 2W, S.L.M. S 160 RDS, W 15 RDS, N 160 RDS, E 15 RDS TO BEG.

# Legal Description

For 03-111-0023

Owner : **KNUDSON, RICHARD C** Effective : **11/26/1994**

G AT A PT LOC 1950.4 FT N 89*56`E FROM SW COR OF NW/4 OF SEC 20 T9N R2W SLM, N 0*07`E 2538.7 FT, TH TO THE HT ALG THE ARC OF A CURVE WHOSE RADIUS IS 1477.5 FT A DIST OF 60.42 FT, LONG CHORD BEARS S 33*13` 18W 42 FT, S 0*07`W 2488.19 FT, N 89*56`E 33 FT TO POB. CONT 1.90 ACRES

# Legal Description

For 03-111-0025

Owner : **KNUDSON, RICHARD ETUX ETAL** Effective : **11/26/1994**

'G AT A PT 433 FT S & 957 FT W OF NE COR OF SEC 20 T9N R2W SLM, S 2207 FT, W 660 FT, N 2207 FT, E 660 FT TO POB.
H CERTAIN RESERVATIONS CONT 33.43 ACRES M/L

**Exhibit B**

P/A-5 (Planned/Agricultural, 5 Acre Minimum) Area

Parcels:

03-111-0019
03-111-0020
03-111-0021
03-111-0024
03-189-0009

Legal descriptions for these parcels follow this page.

# Legal Description

For 03-111-0019

Owner : **R&P WETLANDS & WATERFOWL LLC** Effective : **8/23/2001**

L THAT PORTION OF SW/4 OF SEC 20 T09N R02W SLM LYING WESTERLY OF THE HAMMOND CANAL. 147 AC M/L

# Legal Description

For 03-111-0020

Owner : **KNUDSON, RICHARD C TRUSTEE ETAL** Effective : **2/13/2001**

MAINDER DESC: ALL OF FOL LYING ELY OF HAMMOND CANAL BEG AT A PT 140 RDS W OF SE COR OF SEC 20 T9N SLM. N 160 RDS, W 100 RDS, S 160 RDS, E 100 RDS TO POB. SUBJECT TO EASEMENTS ETC OF RECORD. LESS: E/2 OF /4 OF SW/4 OF SEC 20 CONT 29 ACRES M/L

# Legal Description

For 03-111-0021

Owner : **KNUDSON, RICHARD C TRUSTEE ETAL** Effective : **11/26/1994**

"G AT A PT 40 RDS W OF SE COR OF SEC 20 T9N R2W SLM. N 160 RDS, W 100 RDS, S 160 RDS, E 100 RDS TO POB.
JECT TO EASEMENTS ETC OF RECORD. LESS: W/2 OF NW/4 OF SE/4 OF SEC 20 CONT 80 ACRES M/L

# Legal Description

For 03-111-0022

Owner : **KNUDSON, RICHARD C TTEE ETAL** Effective : **11/26/1994**

MAINDER DESCRIPTION: BEG AT SE COR OF SEC 20 T9N R2W SLM W 40 RDS, N 160 RDS, E 40 RDS, S 160 RDS TO BEG. IT 39.88 ACRES

# Legal Description

For 03-111-0024

Owner : **KNUDSON, RICHARD C TRUSTEE ETAL** Effective : **2/5/2001**

MAINDER DESC: ALL OF FOL ELY OF HAMMOND CANAL. E/2 OF NE/4 OF SW/4 & W/2 OF NW/4 OF SE/4 OF SEC 20 T9N . RESERVING ACCESS EASMENTS OVER N 4 RDS & 2 RDS ON EACH SIDE OF CANAL TOGETHER WITH A HICULAR ACCESS EASEMENT OVER THE FOLLOWING: BEG AT NW COR OF E/2 OF NE/4 OF SW/4 OF SEC 20, W 33 FT, S 82.5 FT, E 33 FT, N 82.5 FT TO BEG. CONT 24 AC M/L

# Legal Description

For 03-189-0009

Owner : **R&P WETLANDS & WATERFOWL LLC** Effective : **7/22/1996**

'G AT SE COR OF SEC 19 T9N R2W SLM N 160 RDS, W 20 RDS, S 160 RDS, E 20 RDS, TO POB. TOGETHER WITH MINERAL RIGHTS, EASEMENTS R/W'S ETC OF RECORD. CONT 20 ACRES M/L

## Exhibit C

P/M-U-160 (Planned/Multiple Use, 1 Unit per 160 Acre Density) Area

Parcels:

03-003-0017
03-003-0020
03-003-0043
03-003-0044
03-003-0045
03-003-0046
03-189-0002
03-189-0010

Legal descriptions for these parcels follow this page.

# Legal Description

For 03-003-0017

Owner : **R&P WETLANDS & WATERFOWL LLC** Effective : **11/26/1994**

L OF SEC 29, TWP 9N, R 2W, SLM

# Legal Description

For 03-003-0020

Owner : **R&P WETLANDS & WATERFOWL LLC** Effective : **11/26/1994**

L OF SEC 32, TWP 9N, R 2W, SLM, CONT 640 ACS

# Legal Description

For 03-003-0043

Owner : **R&P WETLANDS & WATERFOWL LLC** Effective : **3/28/2002**

L OF SEC 30 T09N R02W SLM LYING ELY OF C/L OF REEDER OVERFLOW. 412 AC M/L

# Legal Description

For 03-003-0044

Owner : **KNUDSON, RICHARD C TTEE ETAL** Effective : **3/28/2002**

MAINDER DESC: ALL OF SEC 30 T09N R02W SLM LYING WLY OF C/L OF REEDER OVERFLOW, LESS: THAT PART OF 4 OF SEC 30 LYING W OF CO (REFUGE) RD. 208 AC M/L

# Legal Description

For 03-003-0045

Owner : **R&P WETLANDS & WATERFOWL LLC** Effective : **3/28/2002**

L OF SEC 31 T09N R02W SLM LYING ELY OF C/L OF REEDER OVERFLOW. 388 AC M/L

# Legal Description

For 03-003-0046

Owner : **KNUDSON, RICHARD C TTEE ETAL** Effective : **3/28/2002**

MAINDER DESC: ALL OF SEC 31 T09N R02W SLM LYING WLY OF C/L OF REEDER OVERFLOW. 252 AC M/L

# Legal Description

For 03-189-0002

Owner : **R&P WETLANDS & WATERFOWL LLC** Effective : **11/26/1994**

` OF SEC 19, TWP 9N, R 2W, SLM LESS: THAT PART OF W/2 OF S/2 LYING W OF CO (REFUGE RD). LESS: BEG AT SE COR ·EC 19, N 160 RDS, W 20 RDS, S 160 RDS, E 20 RDS TO PT OF BEG. CONT 169.49 ACRES

# Legal Description

For 03-189-0010

Owner : **KNUDSON, RICHARD C TTEE ETAL** Effective : **3/14/1995**

'G AT SE COR OF NE/4 OF SEC 19 T9N R2W SLM, N 244 FT, N 79*15`W 1690 FT, N 2*52`W 283 FT, N 13*15`E 264 FT M/L TO .NK OF BEAR RIVER- REEDER OVERFLOW, SLY ALG SD E BANK TO S/L OF NE/4 OF SEC 19, E ALG SD S/L TO BEG. CONT 17.28 ACRES M/L

File cy EIA

BEAR RIVER MIGRATORY BIRD REFUGE
ENVIRONMENTAL ASSESSMENT, ECONOMIC STUDY

by Steve Piper
303-236-3818

## Background

In the early 1900's the State of Utah with federal and private aid began to develop several thousand acres of wetlands throughout the state. In 1928, 65,000 acres of land near Brigham City, Utah were set aside and established as the Bear River Migratory Bird Refuge (Refuge). The Refuge is a well known wildlife viewing area where waterfowl populations often reach 500,000 birds. The Refuge is managed by the Fish and Wildlife Service.

In 1983 the rising waters of the Great Salt Lake flooded the Refuge area and destroyed the visitor facilities. [redacted]

The Fish and Wildlife Service is considering building new facilities and expanding the Refuge by approximately 40,000 acres to attract recreationists to the area. The new facilities would be located further from the Great Salt Lake and closer to Interstate 15 to avoid a recurrence of the flood problems in 1983 and to attract more visitors passing by on Interstate 15. As part of the planning process, information is needed regarding the number of visitors that could be expected at the new visitor facilities and the monetary benefits that could result from those facilities.

This study presents some estimates of the possible number of visitors the Refuge facilities could attract, the monetary value of the Refuge to recreationists, and the potential economic impacts of the new visitor center and expanded refuge on the economy. Although these estimates are not precise, they do indicate the potential magnitude of benefits that could be generated by re-opening the Refuge.

## Need for the Facilities Proposed at the Refuge

The need for new facilites and an expanded refuge depends on two factors, the demand for wildlife viewing and the supply of facilities similar to those proposed at the Refuge which already exist in the state. The demand for wildlife viewing facilities originates primarily from the area extending from Brigham City south to Provo. About 85 percent of the total state population resides in this region. The supply of wildlife viewing facilities under consideration in this analysis includes the entire state of Utah.

### Demand

Future demand for wildlife viewing, fishing, and hunting activities provided by wildlife refuge facilities is a function of future population levels and preferences for wildlife refuge recreation activities.

Utah population projections provided by the Utah Office of Planning and Budget, Demographic and Economic analysis indicate an annual average population growth rate of 1.6 percent for the entire state (Utah Office of Planning and Budget, 1989). Demand for bird refuge facilities would also be likely to grow as the population grows, although not necessarily at the same rate.
Changing recreational preferences can also affect future demand for bird refuge facilities. Several documents were obtained from the Utah Department of Natural Resources to determine possible future recreational preferences in Utah. The 1985 Utah Statewide Comprehensive Outdoor Recreation Plan (SCORP) was reviewed to determine overall recreational needs in the state (Utah Department of Natural Resources, 1985). The 1985 SCORP was the latest available.

A recreation survey reported in the 1985 SCORP indicated that on a statewide basis, nature study, which is the category closest to wildlife viewing included in the survey, was the 20th most participated in recreational activity in the

state. In 1985 the number of nature study visits was about 6.6 percent of the number of fishing and hunting visits and 24 percent of the number of camping vists. The 1985 SCORP estimated an annual growth rate of 7.1 percent for all recreation between 1985 and 2000 assuming the 1975 to 1980 rate of growth in real income continues, that state population projections are accurate, and that recreationists are able to increase participation as miles of roadway and airline traffic increase.

A 1988 Utah Department of Natural Resources publication indicated a belief that interest in wetlands and the value of wetlands is increasing (Utah Department of Natural Resources, 1988). In addition, preliminary results of a 1990 survey conducted for an updated SCORP indicate that wildlife-nature study is the 10th most frequently participated in activity amoung the top recreational activites. This compares to the 20th most participated in activity in 1985. In a 1990 survey of Utah recreationists, 48 percent of the respondents strongly favored increasing the number of fish and wildlife habitats and 34 percent somewhat favored increasing the habitats. Therefore, 82 percent of those surveyed indicated some support for increasing fish and wildlife habitats, which could be an indication of high demand for wildlife viewing resources.

[redacted]

Supply

Although the 1985 SCORP did not specifically address the supply of nature study facilities, the recreational survey reported in the 1985 SCORP did include questions pertaining to recreational users' perceptions of the adequacy of recreational facilities. The survey indicated nature facilities were adaquate. However, results from the 1990 survey indicate recreational users would like to see more designated fish and wildlife habitats. In addition, The Utah SCORP Action Plan, 1989-1991 indicates outdoor recreation development in the urbanized areas of the state, mostly near Salt Lake City, is a major objective for the Utah Department of Natural Resources (Utah Department of Natural Resources, 1989). This is a major objective due to increasing urban population needs.
There are several bird refuges located in Utah. Table 1 presents a list of major bird refuges in Utah and their general location.

Table 1--Major bird refuges in Utah

| Bird Refuge Area | General Location |
|---|---|
| Locomotive Springs Waterfowl | Northwest corner of Utah |
| Timpie Springs Waterfowl | South edge of Great Salt Lake (1440 acres) |
| Fish Springs Nat. Wildlife Refuge | West-central Utah (17,992 acres) |
| Topaz Marsh | West-Central Utah |
| Clear Lake Waterfowl | West-South-Central Utah (6,150 acres) |
| Cutler Marsh | North-Central, Utah (4,800 acres) |
| Salt Creek Waterfowl | North-Central Utah (6,900 acres) |
| Bear River Migratory Bird Refuge | North-Central Utah (currently 65,000 acres) |
| Harold S. Crane Waterfowl | North-Central Utah (12,500 acres) |
| Ogden Bay Waterfowl | Near Ogden, Utah (20,000 acres) |
| Bicknell Bottoms Waterfowl | South-Central, Utah |
| Desert Lake Waterfowl | East-Central, Utah (3,000 acres) |
| Ouray Nat'l Wildlife Refuge | North-East, Utah (11,483 acres) |

Although there are a substantial number of other bird refuges in the state, the Bear River Migratory Bird Refuge is considerably larger than the others and is located near the most populated region of Utah. The area stretching from Brigham City south to Provo (about 110 miles) accounts for about 85 percent of the total Utah population. The Refuge represents a large and accessible wildlife resource that could not be easily replaced by other bird refuges in the state.

The information provided by the Utah Department of Natural Resources combined with the number and location of bird refuges in Utah indicate the supply of wildlife habitat provided by the Bear River Migratory Bird Refuge is likely to be necessary to provide the wildlife viewing facilities needed to meet future demand.

**Past Resident Use of the Bear River Migratory Bird Refuge Facilities**

Visitation records for the Refuge before the facilities were flooded are useful in determining potential use of the Refuge when it is re-opened. Visitation records were available for each year from 1950 to 1983 from the Bear River Migratory Bird Refuge Staff in Brigham City (Hansen, 1990). Table 2 shows the number of users for selected years from 1950 to 1983 and average visitation from 1950 to 1983. Generally, wildlife viewing numbers increased during this period while non-wildlife viewing activities, hunting and fishing, remained approximately the same or decreased.

Table 2-- The number of Bear River Migratory Bird Refuge users

| YEAR | Wildlife Viewing | Non-Wildlife Viewing | Total |
|---|---|---|---|
| 1950 | 13,430 | 7,830 | 21,260 |
| 1955 | 10,875 | 5,325 | 16,200 |
| 1960 | 12,830 | 4,950 | 17,780 |
| 1965 | 15,235 | 5,260 | 20,495 |
| 1970 | 20,435 | 4,980 | 25,520 |
| 1975 | 15,995 | 5,980 | 21,975 |
| 1980 | 15,335 | 4,575 | 19,910 |
| 1983 | 21,190 | 5,240 | [redacted] |
| Average (1950-1983) | 16,587 | 5,548 | 22,135 |

Two different groups of users were identified from Refuge visitation records for the years 1981 to 1983: Utah residents and non-Utah residents. This information was obtained from a visitors log at the Refuge which was signed by each visitor before they entered the Refuge. Better future use and recreational value estimates can be made by separating the two user groups. The number of visitors to the new facilities attributable to each group would probably change at differing rates and the monetary visitor day values for each group would not be expected to be the same. The percentage of Utah resident users ranged from 59 percent to 79 percent between 1981 and 1983, with an average of 68 percent (Hansen, 1990).

Resident users and non-resident users in nearby cities such as Pocatello, Idaho are likely to represent the majority of planned bird watching use. Based on data from the 1983 visitor log, the trip origination point for about 95 percent of all resident users was 75 miles or less, indicating the Refuge is probably the main

destination. These visitors would not likely be influenced by the location of a new visitor center close to Interstate 15 compared to the old visitor center several miles off of the highway. The resident visitors would probably want to tour the Refuge irrespective of the location of the visitor center, negating the location advantage from the visitor center being near the Interstate. Therefore, using pre-flood visitor data as a basis for estimating Utah resident use of the new facilities seems appropriate.

Non-resident visitors stopping at the Refuge on their way to other destinations would probably be affected by the location of the visitor center near Interstate 15. Therefore, previous non-resident visitation records based on the old visitor center several miles from the highway cannot be used to estimate potential non-resident use with the new facilities. Other secondary data are used to roughly approximate potential non-resident use. Non-resident visitors who come from great distances to specifically see the refuge are not included in the visitation estimates because they are likely to be a very small percentage of total use.

## The relationship between resident Refuge visitation and population growth

The large majority of resident visitors come from the high population counties near the Refuge, such as Salt Lake, Utah, Davis, and Weber Counties. The growth rate for the area including the ten nearest counties from 1950 to 1985 was estimated using published data from the Utah Office of Planning and Budget (Utah Office of Planning and Budget, 1989). The projected growth rates for the years 1985 to 1995 and 1995 to 2005 were also estimated. The population growth estimates are presented in table 3. The estimated annual rate of population growth from 1950 to 1985 for the 10 counties is 2.74 percent, but is projected to be less in future years.

Table 3-- Population growth rate in the ten counties nearest the Refuge

| County | 1950-1985 | Projected 1985-1995 | Projected 1995-2005 |
|---|---|---|---|
| | (percentage average growth rate per year) | | |
| Box Elder | +1.78 | +0.89 | +0.63 |
| Cache | +1.98 | +1.23 | +1.04 |
| Davis | +5.00 | +2.25 | +1.85 |
| Morgan | +2.23 | +1.13 | +2.09 |
| Rich | +0.65 | +0.47 | +1.29 |
| Salt Lake | +2.66 | +0.99 | +1.41 |
| Summit | +1.75 | +2.06 | +1.82 |
| Toole | +1.90 | +0.72 | +1.42 |
| Utah | +3.24 | +1.32 | +1.28 |
| Weber | +1.79 | +0.95 | +1.04 |
| Average | +2.74 | +1.22 | +1.38 |

Estimating Refuge user growth is not as simple as estimating population growth because other factors can influence short-term use in any one year, creating a non-uniform growth pattern. For example, total visitation for the Refuge in 1983 was equal to 26,430 user days while use in 1978 was 32,505 user days even though population was greater in 1983 than in 1978. In order to avoid arbitrarily chosing a level of base use from which to estimate user growth, a simple linear

regression was performed using estimated Utah resident visitors as the dependent variable and time as the independent variable. The regression results are shown in figure 1.

The regression equation was statistically significant at the 1 percent level. Using this technique the estimated growth trend in Utah resident visitors from 1950 to 1983 was an additional 210 users per year for wildlife viewing.

Figure 1-- Regression results for growth in Utah resident Refuge use

Resident Visits = 7603.2 + 210.0(year)
{t-statistic}: (6.754)*
Adjusted R Squared = .575
F Statistic = 45.61*

Resident Visits = the number of visitors from Utah
year = year of visitor data

*statistically significant at the 1% level

Based on annual growth of wildlife viewing of 210 users and a 1950 base level of use, the estimated annual growth of resident wildlife viewing at the Refuge from 1950 is 1.71 percent. This rate of growth is lower than the 2.74 percent average rate of population growth in Utah over roughly the same time period. Based on the pre-flood resident visitation growth rate and the population growth rate, resident wildlife viewing use at the Refuge is estimated to grow at approximately 62.4 percent of the population growth rate in the 10 nearest counties (1.71 percent divided by 2.74 percent equals 0.624).

## Projected Future Resident Use

To project the potential resident use of the proposed Bear River Migratory Bird Refuge facilities, population growth estimates were used along with the population growth-visitor growth relationship hypothesized above. As a sensitivity analysis, a range of visitation estimates are presented based on three different assumptions of base visitation.

### Base year visitation

The low estimate of visitation is based on a "normalized" average visitation rate from 1979 to 1983. The "normalized" average is the average number of resident wildlife viewing users from 1979 to 1983 after eliminating the two years that vary most from the five year average. The "normalized" average is 13,410 users per year. The medium estimate of visitation is based on the estimated 1983 level of resident visitation, or 14,410 users per year. This is the last year visitation data is available. The high estimate is based on visitation during 1978, the highest use year on record. There were approximately 17,760 resident wildlife viewing users at the Refuge during 1978.

### Estimated resident visitation in 1993

It is assumed that the Refuge facilities would be completed and open to the public by 1993. Since population and, therefore, demand for wildlife viewing

activities would have increased from 1983 to 1993, the average annual population growth rate for this period is used to project the number of resident visitors for 1993. The projected 1983 to 1993 growth rate for the ten nearby counties in Utah is 1.22 percent. The projected annual rate of resident wildlife viewing visitor growth at the Refuge from 1983 to 1993 is about 0.76 percent (1.22 percent multiplied by 0.624).

Using the "normalized" average as a base, the projected number of wildlife viewing visitors in 1993 would be approximately 14,470. Using the 1983 number of wildlife viewing visitors as a base, the projected number of resident wildlife viewing visitors in 1993 would be about 15,540. Using the highest annual number of wildlife viewing visitors as a base, the projected number of visitors in 1993 would be about 19,160.

Estimated resident visitation for the years 1993 to 2005

The projected 1995 to 2005 annual population growth rate for the ten nearby counties in Utah is 1.38 percent. The estimated rate of resident wildlife viewing visitor growth at the Refuge is 0.86 percent (1.38 percent multiplied by 0.624. The projected number of resident wildlife viewing visitors for the years 1993 to 2005 are shown in table 4. The 1995 to 2005 growth rate is applied to the entire period.

Table 4--Projected number of resident wildlife viewing visitors at the Bear River Migratory Bird Refuge for the years 1993 to 2005

| | Projection Based On: | | |
|---|---|---|---|
| Year | Normalized level of use | 1983 level of use | Highest visitation year level of use |
| 1993 | 14,470 | 15,540 | 19,160 |
| 1994 | 14,590 | 15,680 | 19,320 |
| 1995 | 14,710 | 15,810 | 19,480 |
| 1996 | 14,840 | 15,940 | 19,650 |
| 1997 | 14,960 | 16,080 | 19,820 |
| 1998 | 15,090 | 16,210 | 19,980 |
| 1999 | 15,220 | 16,350 | 20,150 |
| 2000 | 15,350 | 16,490 | 20,320 |
| 2001 | 15,480 | 16,630 | 20,500 |
| 2002 | 15,610 | 16,770 | 20,670 |
| 2003 | 15,740 | 16,910 | 20,840 |
| 2004 | 15,870 | 17,060 | 21,020 |
| 2005 | 16,010 | 17,200 | 21,200 |

The projection based on the "normalized" average represents an average number of wildlife viewing visitors that could be expected over several years. The projection based on the 1983 number of visitors represents an estimate based on the latest year of data available. The projection based on the high use year represents the maximum number of visitors that could be reasonably expected in any particular year. The first year the visitor center opens could be a high visitation year if people visit out of curiosity to see the new facilities.

This analysis implicitly assumes that underlying factors that affect recreation at the Refuge will not change significantly. Some of these factors include income, the amount of leisure time available, ease of access to the Refuge, and preferences for different types of recreation. Since preferences for wildlife viewing activities appear to be increasing, the low estimates of use are likely

to underestimate future resident use.

### Projected Future Non-Resident Use

Future non-resident use of the Refuge is likely to be boosted considerably by the location of the proposed visitor center near Interstate 15. The visitor center would be within eyesight of the highway, while the old visitor center was several miles off of the highway. An exit off of the Interstate that would provide easy access to the visitor center is also under consideration.

Due to the easy access from the highway, a large number of visits from travelers passing by to other recreation areas would be expected. The non-resident visits would probably be shorter in duration than the Utah resident visits. The non-resident visitors would probably stop by to view the exhibits, rest, and possibly eat and make some retail purchases. Since past non-resident visitation records are of no value in estimating non-resident visits to the new visitor center, less precise secondary data must be used to roughly approximate the potential number of non-residential visitors.

The Utah Department of Natural Resources, Division of Parks and Recreation provided valuable information related to annual use at planned and current recreation areas that could be comparable to the Bear River Migratory Bird Refuge visitor facilities (Utah Department of Natural Resources, 1990).

Visitation to a planned facility at Antelope Island north of Salt Lake City off of Interstate 15 is officially projected by the Division of Parks and Recreation to be 325,000 when first opened and 500,000 when all facilities are completed (Utah Department of Natural Resources, 1990). It is also estimated that 32 percent of the visitation would be from non-residents, coincidentally the same percentage of non-resident visitation found from the 1981 to 1983 Refuge visitation records. Therefore, 104,000 to 160,000 non-residents who are passing through could visit Antelope Island.

There is currently a Kennecott Copper pull-off rest area along Interstate 15 which had approximately 80,000 visitors during 1990 as of the beginning of November 1990 (Salt Lake Convention and Visitors Bureau, 1990). Use of this facility would likely be primarily by non-residents passing through.

Based on the above information, a rough estimate of potential passing-by non-residential use could be 80,000 to 160,000 visitors. This level of visitation represents about [redacted] percent and [redacted] percent of the current total annual traffic that passes through the Brigham City area on Interstate 15. Due to the international recognition of the Refuge and increasing interest in wildlife viewing activities, the level of use could be on the higher end of the estimated range.

Assuming that the level of non-resident use is a function of traffic along the highway, projections provided by the Utah Department of Transportation for the annual use of Interstate 15 near the Refuge were used to project future potential non-residential visits to the Refuge. Table 5 presents these estimates.

Table 5-- Estimates of future non-resident use based on Interstate 15 traffic projections

| Year | Projected Traffic volume | Estimates of Passing by Use | | |
|---|---|---|---|---|
| | | Low | Medium | High |
| [redacted] | [redacted] | 86,000 | 129,000 | [redacted] |

1.8 million generated in local economy

313 km²/yr

| | | | | |
|---|---|---|---|---|
| 1994 | 5,509,849 | 87,500 | 131,300 | 175,100 |
| 1995 | 5,604,601 | 89,000 | 133,500 | 178,100 |
| 1996 | 5,699,353 | 90,500 | 135,800 | 181,100 |
| 1997 | 5,794,106 | 92,000 | 138,100 | 184,100 |
| 1998 | 5,888,858 | 93,500 | 140,300 | 187,100 |
| 1999 | 5,983,610 | 95,100 | 142,600 | 190,100 |
| 2000 | 6,078,362 | 96,600 | 144,800 | 193,100 |
| 2001 | 6,173,115 | 98,100 | 147,100 | 196,100 |
| 2002 | 6,267,867 | 99,600 | 149,400 | 199,100 |
| 2003 | 6,362,619 | 101,100 | 151,600 | 202,100 |
| 2004 | 6,457,371 | 102,600 | 153,900 | 205,200 |
| 2005 | 6,552,124 | 104,100 | 156,100 | 208,200 |
| | | | | 272,171 |
| | | | | 216,784 |
| | | | | 221,208 |
| | | | | 225,723 |
| | | | | 230,330 |

95-48

211,156
214,154
217,195
220,278
223,8

9855

## Projected Future Hunting and Fishing Use

While wildlife viewing numbers increased from 1950 to 1983, hunting and fishing activity remained the same or even decreased. This follows the pattern of increased preferences toward nature study and wildlife viewing activities and away from the hunting and fishing activities found by Division of Parks and Recreation surveys. As a result, the level of non-viewing use at the Refuge is assumed to remain the same as the level during 1983, totaling about 3,200 hunting users and 2,100 fishing users. This category of use is low compared to the resident and non-resident viewing categories.

## Total Projected Visitation

Table 6 shows the estimated total visitation to the Refuge for all three recreation user categories listed above. Total visitation is projected to range from about 105,800 to 196,500 in 1993, from 113,900 to 212,400 visitors in 1998, and from 122,100 to 228,200 visitors in 2003.

Table 6-- Estimated total visitation at the Bear River Migratory Bird Refuge

| | Visitation Projections by Category | | | | |
|---|---|---|---|---|---|
| Year | Resident | Non-Resident | Hunting & Fishing | Total | CARS |
| 1993 | 14,500-19,200 | 86,000-172,000 | 5,300 | 105,800-196,500 | |
| 1998 | 15,100-20,000 | 93,500-187,100 | 5,300 | 113,900-212,400 | |
| 2003 | 15,700-20,800 | 101,100-202,100 | 5,300 | 122,100-228,200 | |
| 2005 | 16,000-21,200 | 104,100-208,200 | 5,300 | 125,400-234,700 | 39,250 |
| 2010 | | | | 135,549-253,690 | 42,425 |

## Type of Use That Could be Expected From Resident and Non-Resident Users

The resident use estimates presented above represent users who are likely to tour the Refuge to view the waterfowl and habitat. Therefore, the resident visitor estimates represent more intensive use of the Refuge. Resident users may plan their trips according to nesting and migration patterns to maximize their viewing success. The more intensive use would probably occur between March and October, when the peak abundance of waterfowl generally occur.

Many species peak in March and April or in August and September (United States Department of the Interior, 1979). The fall migration is generally in September and October. The peaking abundance of most waterfowl in the Refuge area appears to be in the Spring and Fall with some fairly high numbers during the Summer. Therefore, the most intensive use of the Refuge wetlands from resident users would probably occur in the Spring and Fall with moderately high use during the



visitors per car = 3.195 (per telecom 5/15/91 w/ steve piper)

summer.

The estimated level of non-resident use is several times greater than the estimated level of resident use. It could be expected that the visitor center would get extensive use from visitors passing through to other destinations. These visits would probably be fairly short compared to the resident visits described above. Non-resident use would likely be highest during the late Spring, Summer, and early Fall, when the level of vacation traffic is high.

**The Economic Impacts From Reopening The Bear River Migratory Bird Refuge**

Reopening the Bear River Migratory Bird Refuge will have several impacts on the regional economy. First, the visitors who stop at the refuge may purchase goods and services during their stay. These purchases could include souvenirs, food, gasoline, and lodging. Increased purchases from visitors effect the economy by increasing demand for final output, increasing earnings in the region, and increasing employment.

visitors

A second impact would be from increased economic activity created by construction of the visitor center, dikes, and other refuge structures. Construction of these facilities will create increased demand for labor and materials which will create increased demand for other goods and services in the economy. The economic impact from construction of refuge facilities is short term compared to the impacts from new visitors, since construction activities would last only a few years and increased tourism would last as long as the facilities are in place.

construction

Finally, operation, maintenance, and repair of the facilities will affect the economy. These impacts would be long term and are the result of labor and materials needed to continue operation of the facilities.

O&M

<u>The impacts of non-resident visitation on the state economy</u>

Increased expenditures by tourists in the Brigham City, Utah area would be an important economic impact from re-opening the Bird Refuge and opening a new visitor center. Using regional economic multipliers provided by the U.S. Department of Commerce, Bureau of Economic Analysis, the impacts of increased tourism can be estimated (Bureau of Economic Analysis, 1986 and Beemiller,1990).

The impact of tourist expenditures on the economy was estimated using only the non-resident visitation estimates. Visitation by residents was assumed to have only a redistribution effect on income within the regional economy. Resident visitation is not likely to represent new expenditures within the regional economy because a large majority of resident visitors come from relatively short distances. Based on information obtained from the 1983 refuge visitor log, 63 percent of resident visitors traveled less than 30 miles one-way to visit the Refuge, 88 percent traveled 60 miles or less, and 96 percent traveled 75 miles or less. Upwards of 90 percent of all resident visitors are likely to originate their trip from a point that would be within 75 miles of the Bear River Migratory Bird Refuge.

not used residents at all

Since only non-resident visitors are included in estimating the regional economic impacts of refuge visitation, state level economic multipliers are used. These multipliers represent the impact of increased non-resident visitation on output, earnings, and employment in Utah. An example of the potential annual impacts from non-resident visitation are presented in table 7.

The example in table 7 assumes the level of non-resident visitation is the medium estimate of 1993 visitation (129,000 users) and each visitor spends an average of $10. It is also assumed that 55 percent of the amount is spent on eating and drinking, 35 percent is spent on retail goods, and 10 percent is spent on hotels

and amusements. Based on the levels of visitation and spending assumed above, the economic impacts from re-opening the Refuge, which include direct visitor spending and the associated multiplier effects, would total about $1.8 million in 1993. The estimated change in output presented in table 7 includes the change in final demand and the change in earnings.

For every dollar increase in visitor spending, output increases by $1.42 and earnings increase by $0.41. For every $24,800 spent by tourists, one job is created. If the assumed percentages of spending for different goods and services were varied from those assumed above, the level of economic impacts would also change.

Table 7-- Economic impacts of non-resident visitation to the Bear River Migratory Bird Refuge (At 1993 level of 129,000 users, w/ new U/C)

1993 visitation is

| | TOURIST RELATED INDUSTRY | CHANGE IN FINAL DEMAND (PER YEAR) | MULTIPLIERS OUTPUT (DOLLARS) | EARNINGS (DOLLARS) | EMPLOYMENT PER $MILLION | IMPACTS OUTPUT | EARNINGS | EMPLOYMENT |
|---|---|---|---|---|---|---|---|---|
| 44 | Eating and Drinking | $709,500 | 2.1400 | 0.6100 | 62.1 | $1,518,000 | $433,000 | |
| 7 | Hotels, Lodging, Amusements | $129,000 | 2.0300 | 0.6300 | 54.2 | $262,000 | $81,000 | |
| 1 | Retail | $21,672 | 1.9600 | 0.7700 | 58.6 | $42,000 | $17,000 | |
| 0 | Wholesale | $2,709 | 1.9300 | 0.6700 | 33.1 | $5,000 | $2,000 | |
| 52 | Totals | $862,881 | - | - | - | $1,827,000 | $533,000 | |

The estimates in table 7 include a less than 35 percent level of change in final demand for retail and a small change in final demand for wholesale because not all of the amount spent on retail represents a change in final demand in Utah and some wholesale activity is needed to provide retail goods.

The output and earnings estimates illustrated in table 7 are annual estimates. The annual impacts must be discounted to a present value and then summed to estimate the total of these impacts over time. Table 8 shows estimates of the 1993 present value of the economic impacts from non-resident visitation to the refuge. It is assumed that from the year 2006 on, non-resident visitation growth trends continue as before. Based on the assumptions used, the total present value of impacts on output is about $19 million over 20 years, $22.2 million over 30 years, and $23.9 million over 40 years.

Table 8--Present value of non-resident visitation economic impacts on output discounted at 8.75 percent

| Tourist Related Industry | 20 years | 30 years ($1,000's) | 40 years |
|---|---|---|---|
| Eating and Drinking | 15,788 | 18,478 | 19,841 |
| Hotels, Lodging, Amusements | 2,723 | 3,187 | 3,422 |
| Retail | 442 | 517 | 555 |
| Wholesale | 54 | 64 | 68 |
| Total | 19,007,000 | 22,246,000 | 23,886,000 |

millions

The present value of the economic impacts on output from one dollar spent every year by tourists is $13.17 in output over 20 years, $14.89 over 30 years, and $15.63 over 40 years discounted at 8.75 percent.

The impacts from construction of new facilities on the state economy

Construction of new facilities will affect the economy through the need for materials and labor. Table 9 shows the impact on the Utah economy from construction of facilities that cost $27 million. The $27 million figure is an appraisal-level cost estimate prepared by the Bureau of Reclamation Engineering Division in Denver. The economic impacts from construction would be one-time rather than recurring as with the visitation impacts. New construction costs of $27 million will result in a $61 million increase in final output.

1-2.3

Table 9-- Economic impacts from construction of new refuge facilities

| INDUSTRY | CHANGE IN FINAL DEMAND (TOTAL) | MULTIPLIERS OUTPUT (DOLLARS) | EARNINGS (DOLLARS) | EMPLOYMENT PER $MILLION | IMPACTS OUTPUT | EARNINGS | EMPLOYMENT |
|---|---|---|---|---|---|---|---|
| New Construction | $27,000,000 | 2.2600 | 0.7300 | 37.2 | $61,020,000 | $19,710,000 | 1004 |

what is Output + Earnings

For every dollar spent on new construction, output increases by approximately $2.26 and earnings increase by about $0.73. For every $26,900 spent on new construction, approximately one new job is created.

The impacts from operation, maintenance, and repair on the state economy

Once the facilities are in place, normal maintenance and repairs will be necessary. These costs will also affect the economy as long as the Refuge is in operation. Table 10 presents these impacts assuming an annual cost of $175,000 per year, which was the annual operation and maintenance costs estimated by the Bureau of Reclamation Engineering Division. The estimated increase in output from operation, maintenance, and repair expenditures is $380,000 annually.

For every dollar increase in operation, maintenance, and repair costs, output increases by $2.17 and earnings increase by $0.81. For every $25,000 spent by tourists, one job is created.

Table 10-- Economic impacts from operation, maintenance, and repair of new refuge facilities

| INDUSTRY | CHANGE IN FINAL DEMAND (PER YEAR) | MULTIPLIERS | | | IMPACTS | | |
|---|---|---|---|---|---|---|---|
| | | OUTPUT (DOLLARS) | EARNINGS (DOLLARS) | EMPLOYMENT PER $MILLION | OUTPUT | EARNINGS | EMPLOYMENT |
| Maintenance and Repair Construction | $175,000 | 2.1700 | 0.8100 | 40.3 | $380,000 | $142,000 | |

The operation, maintenance, and repair impacts will occur every year the Refuge is in operation. Therefore, the present value of these impacts are equal to the sum of the annual impacts discounted to the present. Table 11 presents a range of present value estimates for operation, maintenance, and repair impacts.

Table 11-- Present value of operation, maintenance, and repair impacts on output discounted at 8.75 percent

| Industry | 20 years | 30 years ($1,000's) | 40 years |
|---|---|---|---|
| Maintenance and Repair Construction | 3,529 | 3,990 | 4,189 |

For every dollar in annual operation, maintenance, and repair costs, the impact on output is $20.17 over 20 years, $22.80 over 30 years, and $23.93 over 40 years discounted at 8.75 percent.

### The Value of Recreation at the Bear River Migratory Bird Refuge

Economic benefits will be realized by visitors attracted to the re-opened and expanded Refuge. These benefits are derived from the recreational value of visiting the Refuge above the actual cost incurred in visiting the Refuge.

The value of wildlife viewing, fishing, and hunting activities to potential future recreationists can be estimated using several different methods. The methods used include unit day values, the travel-cost method, and contingent valuation (Clawson and Knetsch, 1978; Forster, 1989; and Walsh, 1986).

Contingent valuation relies on information provided by detailed questionnaires from users and nonusers. This method was not practical for this study because of time limitations and budget considerations. The unit day method depends on expert judgement on the average willingness to pay of the resource users. The values depend on the type of activity supported by the site and the characteristics of the site. This method is often used when no visitation records are available and surveys are not possible. The travel-cost method uses the out-of-pocket costs associated with travel, the opportunity cost of time, and entrance fees as the price of obtaining the recreational experience. Greater travel distances represent greater costs of obtaining recreation, resulting in the typical downward sloping demand curve.

## The Value of Wildlife Viewing Use When the Refuge is the Final Destination

In this report, the value of wildlife viewing use when the Refuge is the final destination is based on a very simplified zonal travel cost model using 1983 visitor data from the Bear River Migratory Bird Refuge. Consumer surplus estimates from previous studies are also used to estimate a range of wildlife viewing values for the refuge.

### The travel cost model

The travel cost model estimated in this study is based on a sample from the 1983 visitors log. Information provided by the log included number of people in the party and origin of travel. Other information typically used in the travel cost methodology includes socio-economic variables such as income, education, and information related to tastes and preferences. Information pertaining to substitute sites is also typically included.

The variables included in this simple travel cost model include per capita visits to the refuge from each zone, distance to the refuge from place of origin, income, and distance to substitute sites. The per capita number of visits was estimated by dividing the estimated number of visitors from each zone by the population of the zone. The number of visits must be expressed in per capita terms in order to make the number of visits from each zone comparable. Distance traveled to the refuge was estimated using a Utah state map. Income by county was obtained from Bureau of the Census data for 1979 (U.S. Department of Commerce, 1983). Distance to substitute sites was obtained from a listing of bird refuges in the state (Cole, 1990) and a Utah state map. Table 12 presents a summary of the travel-cost data.

Table 12--Data used as input for the travel-cost model

| Zone | 1980 Population | Visits | 1979 income per capita | Mean distance to site | Miles to substitute site |
|---|---|---|---|---|---|
| 1 | 18,433 | 2,094 | $6,233 | 5.0 | 15 |
| 2 | 15,293 | 1,087 | $6,003 | 17.5 | 5 |
| 3 | 2,856 | 52 | $6,073 | 20.0 | 8 |
| 4 | 31,862 | 997 | $5,542 | 27.5 | 25 |
| 5 | 152,731 | 4,357 | $6,462 | 30.0 | 5 |
| 6 | 42,763 | 402 | $5,863 | 35.0 | 15 |
| 7 | 2,524 | 47 | $5,577 | 40.0 | 30 |
| 8 | 51,796 | 255 | $6,809 | 47.5 | 30 |
| 9 | 1,438 | 3 | $5,401 | 55.0 | 35 |
| 10 | 236,043 | 2,598 | $7,012 | 57.5 | 35 |
| 11 | 14,335 | 10 | $6,787 | 90.0 | 25 |
| 12 | 141,266 | 1,092 | $8,608 | 75.0 | 50 |

| | | | | | |
|---|---|---|---|---|---|
| 13 | 157,941 | 493 | $4,987 | 97.5 | 75 |
| 14 | 1,194 | 8 | $5,466 | 95.0 | 60 |
| 15 | 500 | 5 | $6,458 | 120.0 | 38 |
| 16 | 1,636 | 16 | $5,111 | 145.0 | 110 |
| 17 | 9,086 | 13 | $7,056 | 175.0 | 100 |
| 18 | 7,449 | 16 | $5,980 | 230.0 | 80 |
| 19 | 10,972 | 16 | $5,601 | 290.0 | 145 |

Data for only Utah residents and non-Utah residents who lived less than 300 one-way miles from the Refuge were included in estimating the model because it was assumed visitors who began their journey from more than 300 miles were likely to be stopping at the Refuge on their way to another destination. It is necessary to exclude those passing through to other destinations from the data because the time and money spent on travel, which represents the willingness-to-pay for the recreational experience, is not entirely attributable to the Refuge.

In order to estimate the model, travel distance must be converted to travel cost. The opportunity cost of travel was estimated assuming an average travel speed of 50 miles per hour and a cost equal to one-half of the average wage. The variable cost of operating an automobile in 1983 was approximately $0.13 per mile.

The model was estimated using the Recreation Market Model (RMM) developed by the U.S. Forest Service Rocky Mountain Forest and Range Experiment Station (Arnold, et. al., 1989). The RMM was developed to provide a means for quickly estimating travel cost models and consumer surplus values with a minimum of data.

A double-log functional form was used because it produced the best results and has many desirable econometric properties. The double-log functional form has been used in several other travel cost studies. The regression results are presented in table 13.

Table 13--Travel cost regression results

ln(trips/cap) = 4.428 - 1.093[ln(cost)] - .029[ln(sub)] - .819[ln(inc)]
{t-statistics}: (3.088)* (0.081) (0.524)

Adjusted R Squared = .593
F Statistic = 9.99*

trips/cap = trips to refuge per capita
cost = travel cost to refuge
sub = travel cost to substitute
inc = income per capita

*statistically significant at the 1% level

The substitute site and income variables were statistically insignificant at the 10 percent level or better. This could be due to the use of secondary data for substitutes or due to the fact that the Bear River Refuge is very unique and well known and has no real substitutes. The income variable may be insignificant due to the relatively low cost of visiting the refuge. However, the travel cost variable and the equation are statistically significant.

This is the first step in estimating consumer surplus. The next step is to estimate the demand curve, total visits at different travel costs, for recreation at the site. Total consumer surplus is equal to the area under the demand curve, representing total trips per year at incrementally greater costs or distances. Using the RMM, the average consumer surplus per trip was estimated to be about $11.95. It was assumed that at a distance of 300 miles or more a recreationist would not make the trip solely to see the refuge. The cost associated with a 300 mile trip was used as a cut off point in estimating consumer surplus.

~~[illegible] paper by McCollum, et. al.,~~ the average consumer surplus per day for wildlife observation in the region that includes Utah was ~~$8.68~~. In a 1978 study of the value of wilderness in Utah the average consumer surplus was estimated to be $12 per day (Loomis and Sorg, 1982). The value estimated by the simple travel-cost model presented above appears to be within the range of some previous estimates for the area. The estimate could be somewhat high, but this could be due to the fact that the Bear River Migratory Bird Refuge is a unique nationally known bird refuge.

## The Value of Hunting and Fishing Use

Recreationists also participate in hunting and fishing activities at the refuge. It is assumed that the Refuge is the final destination for all hunting and fishing visits. The consumer surplus for cold water fishing in the intermountain region that includes Utah has been estimated by McCollum, et. al. to be $7.47 per day. Consumer surplus has been estimated to be about $20 per day in the intermountain region for waterfowl hunting (Loomis and Sorg, 1982). These values are used in this report to estimate the total value of recreation at the Bear River Migratory Bird Refuge.

## The Value of Wildlife Viewing Use When the Refuge is Not the Final Destination

The value of the Refuge to those who are passing through to other final destinations would likely be much less than the value to those who travel specifically to see the refuge. Those passing through are likely to make relatively short visits and the visit is probably more a result of convenience rather than a planned stop. Therefore, the consumer surplus estimates listed above are not applicable to passing through visitation.

A search of the literature did not reveal any previous studies from which benefit estimates of passing through use could be derived. Therefore, unit day values from the Bureau of Reclamation Principles and Guidelines for 1989 are used to roughly approximate possible recreational values for passing through use of the Refuge. The unit day values for all levels of quality range from $2.07 to $6.21 in 1989 dollars for general recreation. The unit day value for the average level of recreation quality for general recreation is $4.52. This value is used to estimate the value of use when the Refuge is not the final destination.

## Estimated Total Recreational Use Value

Ranges of recreational use values by user group are presented in table 14. The estimated ranges are based on the high and low visitation estimates and the use value estimates presented above. Total benefits are estimated to be from $642,000 to $1,086,000 in 1993, the first year of use.

Table 14--Estimated total recreational use value at the Bear River Migratory Bird Refuge

| Year | Wildlife Viewing: Utah Residents ($11.95/visit) | Wildlife Viewing: Non-Utah Residents ($4.52/visit) | Hunting ($20.00/visit) | Fishing ($7.47/visit) | Total |
|---|---|---|---|---|---|
| | | | ($1,000's) | | |
| 1993 | 173-229 | 389-777 | 64 | 16 | 642-1,086 |
| 1998 | 180-239 | 423-846 | 64 | 16 | 683-1,165 |
| 2003 | 188-249 | 457-913 | 64 | 16 | 725-1,242 |
| 2005 | 191-253 | 470-941 | 64 | 16 | 741-1,274 |

## Costs Associated With Expansion of the Refuge

There are also costs associated with re-opening the Refuge. The costs would include lost production from cropland in the area of the proposed expansion and reduced waterfowl hunting by clubs in the expansion area.

Farm income & not total economic benefit

Approximately 200 acres of land that currently produces primarily corn and alfalfa would be taken out of production if the refuge is expanded. Based on previous farm budget studies, a reasonable net farm income from corn and alfalfa acreage would be about $100 per acre. Therefore, lost farm income from expansion of the Refuge is estimated to be $20,000 per year. The present value of these losses discounted at 8.75 percent would be $186,000 over 20 years, $210,000 over 30 years, and $221,000 over 40 years.

There are several clubs in the expansion area which provide waterfowl hunting recreational opportunities. Based on estimates from the Bear River Migratory Bird Refuge Staff, 261 people belong to these clubs and each person hunts about 5 days per year on average. The participation estimate could be somewhat low because of local members who hunt more frequently. Therefore, the average rate of participation was estimated to be 10 days per year per person. The total number of waterfowl hunting days are estimated to be 2,610 days. If hunting were allowed in the expanded area, the cost in terms of reduced hunting activities would be near zero. However, if hunting is not allowed in the expaned area, up to 2,610 hunting days could be lost. Based on a hunting value of $20 per day, the costs of lost hunting opportunities could be as high as $52,200 annually. The present value of these losses discounted at 8.75 percent would be $485,000 over 20 years, $548,000 over 30 years, and $576,000 over 40 years.

Not applicable to be allowed hunting

## Summary

This report has indicated that the Bear River Migratory Bird Refuge near Brigham City, Utah represents a unique recreational opportunity that is not available elsewhere in Utah. Reconstruction of visitor facilities at the Refuge could serve a potentially large number of visitors. The following conclusions and projections were presented in this report.

1. Demand for wildlife viewing facilities are expected to increase as a result of population growth, the likelihood of increasing participation rates, and increasing out-of-state traffic along Interstate 15.

2. Because of the large urban population in the Salt Lake City area and traffic along Interstate 15, the Bear River Refuge is necessary to provide an adequate supply of wildlife viewing facilities.

3. Resident visitation, which represents more intensive viewing use of the Refuge, is projected to be 16,000 to 21,000 visits by the year 2003.

4. Non-resident visitation, which represents short visits to the visitor center and other convenient facilities, is projected to be 101,000 to 202,000 visits by the year 2003.

5. The economic impacts from increased visitation, construction of the visitor center and other structures, and normal operating expenses could be substantial. The impacts depend on the visitation estimate used, the assumed dollars spent by visitors, construction costs, and operating costs.

6. The monetary value of recreation at the Refuge was estimated to be $11.75 per visit for those whose final destination is the Refuge. The value for those on their way to other destinations was estimated to be $4.52 per visit. The passing-by value is based on an average quality general recreation site.

7. There are some costs associated with the expansion of the Refuge, such as lost agricultural production and possibly lost hunting facilities.

1.8 m from visitors
Revenue sharing (income over transit)
500,000 O+M Increase (250,000 Exh)
1.6 m " " (800,000 Exp)
9.2 Const (Exh 4.0 m)
21 " (Exp 9. m)

-29,000 in Farm Profits

?? ??
9.7 9
20.7

Full Expansion – 1.8 m visitors
1.6 m O+m
21. m Const.
≈25 million
24.4 m. w/o land purchase dollars and Revenue sharing up

Exh .2 million visitors
.5 O+m
@ 10 m 9.2 Const
9.9 w/o Land Acq & R

3.4 m annual

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5/24/91 Telecom w/ Steve

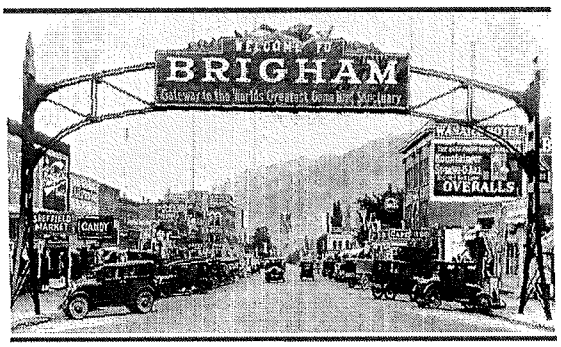
(1) Total Visitation Impact to Economy 1,827,000
52 jobs created
each dollar provides $1.42 into economy

(2) Construction
27 million (CBR estimate of cost) = 61,020,000
1,004 Jobs
each dollar = 2.26 into Economy
Each 26,400 provides 1 new job
For 10,000,000 cost = 2,260,000 impact
And 384 Jobs

(3) O+M
800,000 O+M = 1,736,000 Benefit
32 jobs created
each 25,000 = 1 job

(4) value to recipient
1993 642,000 – 1,086,000
2005 741,000 – 1,274,000

# Brigham City Economic Development Strategic Plan




**Executive Summary**

**Adopted**
**Brigham City Council**
**May 31, 2001**

## SECTION 1: INTRODUCTION

"Says T.J. Rodgers, founder of Cypress Semiconductor: 'The winners and losers in the information age will be differentiated by brainpower. It takes 2 percent of Americans to feed us all, and 5 percent to make everything we need. Everything else will be service and information technology, and in that world humans and brains will be the key variable.'"

"Our geo-architect certainly would have designed a country that still had a lot of environmentally attractive, wide-open spaces and small towns, to attract knowledge workers. Because today, thanks to the Internet, fax machines and overnight package delivery, high-tech firms and knowledge workers can escape from urban centers and settle virtually anywhere they want. So having lots of lush green valleys not far from oceans or mountains can be a real asset."

-The Lexus and the Olive Tree, Thomas L. Friedman

"For the emerging workforce of the digital electronic era, 'the best benefit will be the quality of life in the community in which the worker lives,' and ... many cities will compete not for firms, but for talented and skilled workers. ...The real role for local government will be to 'increase the livability of communities as an attractor of talent," and to be 'entrepreneurial in devising products and services that can sustain social capital within the community.'"

-Where I'm @, William J. Mitchell, quoting Edward J. Blakely, Journal of the American Planning Association, Spring 2001

### Purpose of the Strategic Plan

The purpose of this economic development strategic plan is to develop strategies the City can employ in its economic development efforts. These strategies should accomplish the following:

1. Trigger public and private investment in Brigham City.
2. Enhance the quality of life enjoyed by current and future Brigham City residents.
3. Increase revenues to the City without disproportionately increasing demand for public services or tax rates.
4. Increase the median income of Brigham City residents.
5. Accomplish the goals of the Brigham City General Plan.

### Stakeholders

The Strategic Plan was developed by a group of stakeholders chosen to represent the broadest cross-section of the political, economic, and social life of Brigham City. Stakeholders were divided into two broad categories, internal and external. Internal stakeholders are stakeholders who are elected or appointed officials of Brigham City. They are "internal" to the organization developing the strategic plan. External stakeholders are elected or appointed officials of governmental bodies other than Brigham City, as well as representatives of businesses, utilities, and community groups. These stakeholders are "external" to Brigham City as a governmental body, although they may or may not live or do business in Brigham City.

### Issue Identification

A Community Situation Analysis, developed by David R. Kolzow, Ph.D. and described in "Strategic Planning for Economic Development" (Kolzow 1998) was utilized to poll internal and external stakeholders about their perception of Brigham City's strengths and weaknesses in a variety of areas. These results were combined with information gathered in the first stakeholders' meeting to describe the stakeholders' perception of Brigham City's strengths, weaknesses, opportunities, and threats, or SWOT.

SWOT information was combined and compared with issue identification discussion in the second stakeholders' meeting, as well as comments from the Brigham City General Plan, and an analysis of current projects, proposals, and initiatives to identify the strategic issues to be addressed by the plan.

Issues were organized into groups of related issues, referred to in the plan as "Issue Sets". These issue sets included geographic setting, quality of life, infrastructure and services, and economic development program. These issue sets included a total of 17 issues.

### Goal Identification

Using the information gathered through the issue identification process, the stakeholders identified goals specific to each issue set. These goals were developed during the third stakeholders' meeting and were refined by staff using the input gained during that meeting and taking into account other planning efforts, current and ongoing projects, and literature searches. The Brigham City General Plan was also consulted to insure coordination with its goals. Goals were established addressing each of the 17 issues identified in the four issue sets.

## SECTION 2: VISION STATEMENT

Brigham City envisions becoming a community that preserves a small-town atmosphere of tree-lined streets surrounding homes, parks, and Main Street with its specialty businesses, crafts, arts, and cultural life, while accommodating growth in the new economy and the new century. It will solve the challenges of its geographic setting – isolation and limited land availability – while building on its advantages – easy access to the Salt Lake City and Ogden metropolitan areas, history, natural beauty, and a clean environment.

Brigham City, the County Seat, reflecting the County's changing pattern from trails, rails, and the new technologies of outer space, will improve its already considerable quality of life, becoming the location of choice for knowledge workers seeking a place to live and do business in a desirable setting, and providing the same opportunity for our children if they choose to stay. Brigham City will become a regional center for arts and culture, capitalizing on the history, quality, and potential of its downtown business district, parks, and tourism destinations. It will recruit businesses and entrepreneurs to provide the amenities its residents now seek in other markets. And it will ensure the safety and security of its residents through continuing commitments to its public safety services.

Brigham City will insure that its citizens have the services and infrastructure they need to maintain their quality of life and do business in the new economy. This will include state-of-the-art, redundant telecommunications infrastructure. It will include basic infrastructure – clean water, wastewater treatment, and reliable electricity – as well as safe, efficient highways, freeways, rail, mass transit, and air transportation connecting Brigham City to the region, the nation, and the world. It will include quality housing at all income levels.

Brigham City will have a reputation as a desirable place to start and grow a business. This will be accomplished by having high but realistic standards, clearly articulating those standards, and making the development or licensing approval process as simple and user-friendly as possible.

## SECTION 3: STRATEGIC ISSUES

**ISSUE SET 1** – Geographic Setting: Brigham City's geographic setting creates advantages upon which the City should capitalize, and disadvantages that need to be mitigated. Brigham City is located on the far northern fringe of what is commonly considered the "Wasatch Front". It is close enough to be within the sphere of influence of the Salt Lake City and Ogden metropolitan areas, but far enough away to retain its status as a discrete city and not a suburb of either. Brigham City is located on an alluvial fan that provides a stable building surface and a stock of aggregate that will provide building materials for the foreseeable future. However, this same feature has resulted in an unsightly backdrop of open gravel pits to the east. The Wasatch and Wellsville Mountains above this alluvial fan present a steep slope that is difficult to build on but is very scenic. To the west, at the edge of the alluvial fan, is the valley floor and floodplains of the Bear River and Great Salt Lake. Wetlands are common and present a challenge to balancing economic development and environmental responsibility.

**ISSUE 1-1 - Land Availability:** Brigham City has limited land available for development, both for residential and business growth. Much of the available land within the current corporate boundary of the City is either too steep for development, is unsuitable for development due to aesthetic considerations, or is too wet. There is a perceived lack of suitable buildings and sites with adequate infrastructure for industrial and business park development.

**ISSUE 1-2 - Regional Competition and Cooperation**: Economic development is a regional issue that crosses jurisdictional boundaries. The solution to economic development issues can seldom be found by looking only within one city's boundary. There is a need for multi-governmental cooperation and integration of economic development efforts and plans where common interests can be identified. Brigham City has a relatively small population when compared to the Wasatch Front as a whole. There is a need to reposition Brigham City on the economic map so that location decisions are not made solely on the basis of population. There is regional competition for economic development. Brigham City needs to balance the need to be competitive within and outside the region, with reaping the benefits of regional cooperation on economic development that will accrue from participating in such efforts. The Wasatch Front attracts attention nationally and internationally with the 2002 Winter Olympics and with its economic and quality-of-life successes of the last decade. Brigham City needs to position itself to take advantage of these benefits. At the same time, there are examples along the Wasatch Front from which Brigham City can learn and mistakes we need not repeat.

**ISSUE SET 2** – Quality of Life: Brigham City has a unique character and identity, derived from a number of elements, which makes it an attractive community in which to live. Brigham City is recognized statewide and nationally as a desirable place to live. This creates opportunities to retain, expand, and attract business, and develop a tourism industry based on community assets and heritage products. At the same time, there are weaknesses and threats to the integrity of Brigham City's character and identity, and a lack of certain basic amenities that would further enhance Brigham City's quality of life, for both current and prospective residents and businesses. This quality of life can be lost, but through proper planning it can be maintained and enhanced. Attention to quality of life

factors is critical to the ability of Brigham City to compete for "knowledge workers" – and thus for business and industry retention, expansion, and recruitment – in the new economy. These workers are increasingly able to locate anywhere, and show preference for locations with high quality of life and amenities.

**ISSUE 2-1 – Arts and Cultural Activity**: Arts and culture are components that contribute to quality of life. The retention and recruitment of a quality workforce and employers is enhanced by a healthy cultural life in the community. There are cultural and artistic events, activities, and opportunities in the community, which need to be enhanced and expanded. There are world-class artists and artisans in Brigham City. Brigham City has a City owned and operated museum and gallery. However, other cultural amenities could be added to improve the cultural life of Brigham City residents. Cultural activity can also provide a significant "anchor", particularly in a downtown setting when linked with other entertainment options.

**ISSUE 2-2 - Main Street/Central Business District**: The Brigham City Main Street district, between 100 N. and 200 S. has gained recognition as an example of late 19th and early 20th century architecture. "Downtown" is central not only to the physical City but also to the character and image commonly associated with the City. With the establishment of RDA Project Area #1, the Main Street streetscape project, the adoption of design guidelines, and the establishment of grants and loans for downtown businesses, Brigham City has demonstrated its commitment to making downtown a viable, attractive place to visit and do business. However, more needs to be done to establish downtown as the economic, cultural, and social heart of the City.

**ISSUE 2-3 – Parks, Recreation, and Open Space**: Brigham City has an excellent parks and recreation program which provides services for Brigham City residents as well as residents of surrounding communities. These facilities also attract visitors from more distant areas along the Wasatch Front. These facilities should be integrated into economic development efforts by virtue of their effect on quality of life and tourism potential. There is a need to insure that recreational facilities keep pace with an expanding population. There is also a need to protect and maintain open spaces. Open space, including the undeveloped hillsides, the countryside to the north and west, and the undeveloped Bear River Migratory Bird Refuge reinforce the "small town atmosphere" mentioned elsewhere that is so important to Brigham City's character and image. There is also a need for additional outdoor recreational activities and facilities in the Brigham City area.

**ISSUE 2-4 - Entertainment/Retail**: Brigham City has limited opportunities for entertainment and limited retail outlets. There is currently one movie theater in Brigham City with another nearby in Perry. There is a stage theater in Perry as well. There is one destination restaurant, Maddox, also located in Perry. There is considerable entertainment and retail leakage from the Brigham City market to other communities, particularly the Ogden area and Cache Valley. While the existing opportunities are limited, there are many possibilities for increasing the number of opportunities in Brigham City. There are a number of local restaurants that have good quality and reputation. There is the possibility of a town center in downtown Brigham City that would bring together entertainment, shopping, and other services along with artistic and cultural activities and government services. Many communities have successfully transformed their downtowns into such centers. There are many elements that will need to be incorporated, and there will need to be commitment from the City and the private sector in order to make such a center successful.

**ISSUE 2-5 - Tourism Resources**: Brigham City is located in an area that has natural and man-made attractions for tourism. The Bear River Migratory Bird Refuge, the Golden Spike National Historical Site, Willard Bay State Park, Crystal Hot Springs, Thiokol Rocket Display, Peach Days, the Fruitway and other sites and attractions bring visitors from the region and beyond. Brigham City has the potential to become a hub for these visitors and capitalize on

much of the economic activity generated by tourism. Brigham City is also located on major tourism corridors to Yellowstone, Jackson Hole, and Sun Valley to the north, and Utah ski resorts and national parks to the south. The 2002 Winter Olympics in Salt Lake City will bring unprecedented exposure to the Wasatch Front. Brigham City can use this exposure to increase its visibility and desirability as a tourist destination. In order to take advantage of tourism potential, additional services and amenities are needed. Restaurants, hotels, shopping, etc. are amenities demanded by tourists. Brigham City has many historic sites and resources and has the potential to capitalize on heritage tourism, the number one sector of the traveling public.

**ISSUE 2-6 - Public Safety**: Brigham City enjoys a small town atmosphere. This atmosphere is one of the most commonly mentioned responses when residents are asked what they like about the City. A sense of security and the perception of freedom from crime are part of this small town atmosphere. Although Brigham City, and Utah in general, enjoys a relatively low crime rate, crime is increasing and the City needs to insure that it stays on top of the issue.

**ISSUE SET 3** – Infrastructure and Services: Brigham City needs to develop and maintain adequate infrastructure to accommodate the new economy. This infrastructure includes long-recognized city services such as culinary water, wastewater, storm water, and electricity. It includes non-municipal public utilities such as natural gas. It includes transportation infrastructure such as highways, local streets, rail, public transit, and the airport. It also includes the infrastructure of the new economy – high speed, high capacity ground based and wireless telecommunications that are adequately protected and redundant.

**ISSUE 3-1 - Telecommunications**: Businesses and individuals increasingly rely on high speed, high capacity telecommunications. Fiber optics has replaced copper wiring as the state-of-the-art transmission medium. It is likely that over time, satellite transmission will carry more of the information that is currently sent over land-based lines. With telecommunications access and infrastructure controlled by private companies, it is difficult to determine the capacity and speed of the telecommunications infrastructure Brigham City currently has. Telecommunications companies consider this information proprietary. What is known is that there is a single trunk line running from Brigham City to North Ogden and when that line is broken, Brigham City is isolated. Anecdotal information also indicates that capacity and speed are insufficient for many of the most important needs.

**ISSUE 3-2 - Basic Infrastructure (Culinary Water, Wastewater, Storm Water, Electricity, Natural Gas and Streets)**: Basic infrastructure is the backbone upon which the City is built. Residents and visitors judge the success and responsiveness of the City based in large measure upon the quality of these services. In order to protect the City's investment, this infrastructure must be maintained. Possible deregulation of electric utilities could have a major impact on the City's budget since utility fund transfers from the electric utility supplement the general fund. The City's capital improvement plans for infrastructure specify anticipated investments in infrastructure to meet existing and anticipated needs. Since infrastructure availability can influence location decisions, the City should bring economic development planning and infrastructure planning into harmony. Brigham City provides all essential basic infrastructure with the exception of natural gas, which is provided in Brigham City by Questar Gas. Infrastructure planning should take into account the needs of natural gas provision.

**ISSUE 3-3 - Transportation**: Transportation is the movement of people and goods from one location to another. Ease of movement and options in the choice of transportation modes are important both for commerce and quality of life. Brigham City is located in a zone characterized by the convergence of transportation routes and modes including I 15, I 80, I-

84, US 89, US 91, SR 13, and SR 38. The Union Pacific Railroad has a rail corridor that bisects Brigham City and provides freight service as well as the potential for commuter service. The Brigham City airport is evolving into a regional facility. Utah Transit Authority currently provides transit service to Brigham City. Two routes provide service within Brigham City and to Ogden. The route servicing the City could be improved by the addition of another bus so that two busses travel in opposite directions. The convergence of these routes and modes creates opportunities for economic development that should be recognized and exploited.

**ISSUE 3-4 - Public and Community Services**: Cities exist in part to facilitate the provision of essential services and amenities to their citizens. Either the public or private sector may provide these services. A well-rounded community will have a good mix of these services and amenities. To the degree that Brigham City is able to do so, it will be perceived as a desirable place to live and do business. Certain services, such as parks and recreation, infrastructure, etc., are discussed elsewhere in this document.

**ISSUE 3-5 - Housing**: Housing is a basic necessity of life. Without adequate housing, no community can hope to expand its economic opportunity in a meaningful way. Housing should be available for the executive as well as the mid-level and line worker. In each category, housing should be attractive, well planned, and consistent with the character and identity of the community.

**ISSUE SET 4** – Economic Development: Brigham City needs to develop an economic development program that works within the constraints of limited resources and personnel. In the past there has been no organized economic development program at the City level. The City has participated with the Box Elder County Economic Development office. At times the efforts of Box Elder County have been consistent with Brigham City goals and interests, and at times they have not. In order to have a greater level of control over guiding its economic future, Brigham City needs to cooperate and participate with the County and other jurisdictions where cooperation is mutually advantageous, but also needs to have the ability to protect its interests when necessary. In order to do this, an economic development program internal to the City needs to be developed.

**ISSUE 4-1 - Workforce Development**: Anecdotal and statistical evidence indicates that Utah in general and Box Elder County in particular have a highly educated workforce. In order to participate in the new economy, this workforce needs to have the necessary technological skills. Workers need to be prepared to adapt to new industries and occupations with a high degree of entrepreneurism, participate in a global marketplace, and maintain state of the art information technology skills.

**ISSUE 4-2 - Marketing and Promotion**: In a sense, the City is a product that is in competition with other areas for economic activity. Just as consumers make decisions based in part on the marketing of a product, businesses will make locational decisions based in part on the information provided and portrayed by the City and its competitors. Marketing and promotion in the private sector involves increasing the sales of a product by better positioning of the product in the marketplace through advertising and presentation or packaging. This involves understanding who the customer is, and what motivates the customer to buy. In order to be successful in the economic development marketplace, Brigham City needs to have an understanding of what it has to offer, and get this information to the "customer." In this

context, the customer can include site selection consultants, desired industries, and knowledge workers.

**ISSUE 4-3 - Expansion and Retention**: The majority of new jobs in an economy are generally created by expansion of existing businesses. This is often forgotten when communities assume that economic development means attracting new businesses. Many of the same factors that new businesses take into account in making a locational decision are considered in decisions by businesses to remain at an existing location or to expand. This is because these decisions, whether by a new business or an existing one, are related to the ability of the business to be profitable.

**ISSUE 4-4 - Recruitment**: Although existing businesses will create the majority of jobs in a local economy, recruitment of targeted businesses is an important component of an economic development program. The lack of certain services and amenities in Brigham City which could be provided through recruitment have been described elsewhere. There is also a sense that more high technology businesses are needed. Certain targeted types of recruitment may also help in expansion or retention efforts, for example recruitment of suppliers to resident industries. Many of the factors involved in recruitment are inseparable from the factors involved in expansion and retention efforts. In fact all of the items listed in issue sets 1 through 3 apply equally well to both since they relate in part to the reasons why businesses and knowledge employees choose to locate and remain where they do. Brigham City needs to determine which types of businesses and industries would be most conducive to accomplishing its economic development goals and concentrate on recruiting them.

# SECTION 3: STRATEGIC ISSUES

**ISSUE SET 1** – Geographic Setting: Brigham City's geographic setting creates advantages upon which the City should capitalize, and disadvantages that need to be mitigated. Brigham City is located on the far northern fringe of what is commonly considered the "Wasatch Front". It is close enough to be within the sphere of influence of the Salt Lake City and Ogden metropolitan areas, but far enough away to retain its status as a discrete city and not a suburb of either. Brigham City is located on an alluvial fan that provides a stable building surface and a stock of aggregate that will provide building materials for the foreseeable future. However, this same feature has resulted in an unsightly backdrop of open gravel pits to the east. The Wasatch and Wellsville Mountains above this alluvial fan present a steep slope that is difficult to build on but is very scenic. To the west, at the edge of the alluvial fan, is the valley floor and floodplains of the Bear River and Great Salt Lake. Wetlands are common and present a challenge to balancing economic development and environmental responsibility.

**ISSUE 1-1 - Land Availability:** Brigham City has limited land available for development, both for residential and business growth. Much of the available land within the current corporate boundary of the City is either too steep for development, is unsuitable for development due to aesthetic considerations, or is too wet. There is a perceived lack of suitable buildings and sites with adequate infrastructure for industrial and business park development.

### S.W.O.T. results supporting Issue 1-1:

Community Situation Analysis:

| ACCESS TO SPACE | STAKE-HOLDER GROUP | WEAKNESS | NORMAL | STRENGTH | DON'T KNOW OR |
|---|---|---|---|---|---|
| 1. Availability of fully served and attractive industrial sites | Internal | 9 | 4 | 0 | 0 |
| | External | 11 | 7 | 6 | 6 |
| 2. Availability of fully served and attractive office sites | Internal | 8 | 5 | 0 | 0 |
| | External | 14 | 8 | 1 | 7 |
| 3. Reasonably priced sites | Internal | 4 | 6 | 2 | 1 |
| | External | 5 | 14 | 3 | 8 |
| 4. Availability of suitable industrial space | Internal | 9 | 4 | 0 | 0 |
| | External | 14 | 4 | 6 | 6 |
| 5. Availability of suitable office space | Internal | 7 | 5 | 1 | 0 |
| | External | 14 | 9 | 2 | 5 |

S.W.O.T. discussion results supporting Issue 1-1:

Weaknesses:

<u>Land Availability</u>

- Current land availability in Brigham City is somewhat limited for expansion of residential and commercial areas.
- There is a lack of commercial sites in Brigham City.
- There is a lack of industrial development in Brigham City.

Opportunities:

**Potential for Annexations**

- There is potential for annexation of land to meet the growth needs of Brigham City.
- There is the potential to encourage "complimentary growth" that enhances Brigham City's situation.

Threats:

Job/Land Area Ratio

- While Brigham City is well positioned to attract distribution centers, these uses occupy large tracts of land, create relatively few jobs for the amount of land they occupy, and pay low wages.

**Wetlands**

- The presence of wetlands, and the need for mitigation and wetland permitting creates difficulties for businesses locating in Brigham City. [2 groups]

**Issue identification comments supporting Issue 1-1:**

- Land or area to grow (7 dots)
- Land Availability – wetlands mitigation (6 dots)
- Wetland planning and conservation balanced with economic development – open lands for development (6 dots)
- Lack of industrial park development sites (1 dot)
- Wetland mitigation and comprehensive planning (1 dot)
- Access to raw material – no lumber/coal (1 dot)
- Area for residential growth

**General Plan comments supporting Issue 1-1:**

What issues should the City consider in its general plan?

- Annexation to the north

As a business person, what are the most important factors influencing the location of your business? (Chamber of Commerce, Main Street Merchants)

- Sufficient population to draw upon
- Population

**Current projects, proposals, and initiatives involving Issue 1-1**:

- **Envision Utah**: Envision Utah is a public-private partnership that has been analyzing growth-related issues in the Wasatch Front area, including Brigham City, since January of 1997. As a result of this process, two publications have been produced entitled Urban Planning Tools for Quality Growth and Model Codes and Analysis Tools for Quality Growth. These publications include information that could help Brigham City create codes and policies that make more efficient and productive use of limited land.
- **Box Elder County Comprehensive Wetland Management Plan** and **Special Area Management Plan**: Box Elder County with the cooperation and involvement of Brigham City has adopted a plan for the management of wetlands. This plan is intended to protect the environment while allowing for reasonable economic and community development. One of the initiatives of this planning process has been the establishment of a Special Area Management Plan or SAMP which would combine wetland permitting and mitigation within a defined area to streamline the wetland permitting process.
- **Brigham City Annexation Policy Declaration**: Adopted in 1996, the annexation policy declaration stated Brigham City's willingness and readiness to annex property within a defined boundary. In general, this boundary extends west to the Bear River, north to Honeyville City's boundary, South to Perry City's boundary, and east to the Box Elder County line, Highway 89, and the Mantua City boundary. By annexing these areas, Brigham City would add to its stock of developable land.

**ISSUE 1-2 - Regional Competition and Cooperation**: Economic development is a regional issue that crosses jurisdictional boundaries. The solution to economic development issues can seldom be found by looking only within one city's boundary. There is a need for multi-governmental cooperation and integration of economic development efforts and plans where common interests can be identified. Brigham City has a relatively small population when compared to the Wasatch Front as a whole. There is a need to reposition Brigham City on the economic map so that location decisions are not made solely on the basis of population. There is regional competition for economic development. Brigham City needs to balance the need to be competitive within and outside the region, with reaping the benefits of regional cooperation on economic development that will accrue from participating in such efforts. The

Wasatch Front attracts attention nationally and internationally with the 2002 Winter Olympics and with its economic and quality-of-life successes of the last decade. Brigham City needs to position itself to take advantage of these benefits. At the same time, there are examples along the Wasatch Front from which Brigham City can learn and mistakes we need not repeat.

## S.W.O.T. results supporting Issue 1-2:

### Community Situation Analysis:

| ACCESS TO MARKETS | STAKE-HOLDER GROUP | WEAKNESS | NORMAL | STRENGTH | DON'T KNOW OR N/A |
|---|---|---|---|---|---|
| 1. Centrally located for major regional market | Internal | 3 | 6 | 4 | 1 |
| | External | 6 | 14 | 9 | 1 |
| 9. Within 1 hour of commercial air passenger service (non-commuter) | Internal | 0 | 8 | 4 | 1 |
| | External | 4 | 18 | 8 | 0 |

| ACCESS TO LABOR | STAKE-HOLDER GROUP | WEAKNESS | NORMAL | STRENGTH | DON'T KNOW OR N/A |
|---|---|---|---|---|---|
| 10. Within ½ hour of major university/college | Internal | 0 | 1 | 11 | 1 |
| | External | 0 | 8 | 22 | 0 |
| 12. Cooperation of local state employment office in recruiting and screening applicants | Internal | 0 | 5 | 5 | 3 |
| | External | 0 | 18 | 7 | 5 |

| LOCAL ECONOMIC DEVELOPMENT PROGRAM | STAKE-HOLDER GROUP | WEAKNESS | NORMAL | STRENGTH | DON'T KNOW OR N/A |
|---|---|---|---|---|---|
| 5. Level of cooperation between various organizations involved in economic development activity | Internal | 10 | 1 | 2 | 0 |
| | External | 6 | 9 | 6 | 9 |

| QUALITY OF LIFE | STAKE-HOLDER GROUP | WEAKNESS | NORMAL | STRENGTH | DON'T KNOW OR N/A |
|---|---|---|---|---|---|
| 7. Availability of recreational opportunities | Internal | 0 | 4 | 9 | 0 |
| | External | 5 | 12 | 12 | 1 |
| 8. Presence of major sporting events | Internal | 4 | 8 | 1 | 0 |
| | External | 24 | 4 | 1 | 1 |
| 13. Availability of major shopping facilities | Internal | 10 | 3 | 0 | 0 |
| | External | 17 | 11 | 2 | 0 |

## S.W.O.T. discussion results supporting Issue 1-2:

Strengths:

Community Services

- Brigham City enjoys good interlocal relations with its neighbors. These relations are improving.

**Issue identification comments supporting Issue 1-2:**

- Multi-governmental cooperation (3 dots)
- Intergovernmental cooperation – integrate plans (2 dots)
- **P opulation base – need to increase (1 dot)**
- **L ack of customers (1 dot)**
- Regional competition
- Brigham City's location and appearance
- **A lign ourselves with the Wasatch Front**
- Intergovernmental relations
- Overall growth of Wasatch Front – How will Brigham City fit in?
- Demographics of the Wasatch Front
- Look south (Layton) to avoid mistakes

**General Plan comments supporting Issue 1-2:**

Favorite things about Brigham City

- Cooperation between agencies

What issues should the City consider in its general plan?

- Competition with Ogden for businesses

**Current projects, proposals, and initiatives involving Issue 1-2:**

- **Envision Utah**: Brigham City has actively participated in the Envision Utah process. This process has brought together hundreds of people from all along the Wasatch Front to cooperate in a planning exercise. This has also created networking opportunities for Brigham City.
- **Brigham City/Perry Interlocal Agreement**: Brigham City and Perry have negotiated an interlocal agreement for the area along the boundary between the two cities. This agreement will facilitate the orderly development of the project area with input from both cities.
- **Northern Utah Coalition**: An informal association of economic development practitioners from Davis, Morgan, Weber, Box Elder, and Cache Counties has been cooperating since June 2000 on an economic development strategy for

northern Utah. This group will be working toward a cooperative strategy to take to officials in the northern Utah area for implementation.

- **Utah Alliance**: Brigham City participates with the Utah Alliance, an association of economic development professionals statewide.

**ISSUE SET 2** – Quality of Life: Brigham City has a unique character and identity, derived from a number of elements, which makes it an attractive community in which to live. Brigham City is recognized statewide and nationally as a desirable place to live. This creates opportunities to retain, expand, and attract business, and develop a tourism industry based on community assets and heritage products. At the same time, there are weaknesses and threats to the integrity of Brigham City's character and identity, and a lack of certain basic amenities that would further enhance Brigham City's quality of life, for both current and prospective residents and businesses. This quality of life can be lost, but through proper planning it can be maintained and enhanced. Attention to quality of life factors is critical to the ability of Brigham City to compete for "knowledge workers" – and thus for business and industry retention, expansion, and recruitment – in the new economy. These workers are increasingly able to locate anywhere, and show preference for locations with high quality of life and amenities.

**ISSUE 2-1 – Arts and Cultural Activity**: Arts and culture are components that contribute to quality of life. The retention and recruitment of a quality workforce and employers is enhanced by a healthy cultural life in the community. There are cultural and artistic events, activities, and opportunities in the community, which need to be enhanced and expanded. There are world-class artists and artisans in Brigham City. Brigham City has a City owned and operated museum and gallery. However, other cultural amenities could be added to improve the cultural life of Brigham City residents. Cultural activity can also provide a significant "anchor", particularly in a downtown setting when linked with other entertainment options.

**S.W.O.T. results supporting Issue 2-1**:

Community Situation Analysis:

| QUALITY OF LIFE | STAKE-HOLDER GROUP | WEAKNESS | NORMAL | STRENGTH | DON'T KNOW OR N/A |
|---|---|---|---|---|---|
| 6. Level of cultural activity | Internal | 2 | 9 | 2 | 0 |
| | External | 11 | 8 | 8 | 3 |

S.W.O.T. discussion results supporting Issue 2-1:

Strengths:

<u>Community Character and Livability:</u>

- There is good cultural arts participation

**Issue identification comments supporting Issue 2-1**:

- Capitalize on cultural activity – arts (3 dots)

- Lack of cultural activity

**General Plan comments supporting Issue 2-1:**

Favorite things about Brigham City

- Museum/Gallery
- Capitol Theatre

Least favorite things about Brigham City

- Lack of entertainment (4 responses)
- No activities/entertainment for teens/young adults (7 responses)
- Not too much for adults to do or see!
- Lack of cultural activities
- Lack of activities for teens

What is unique about Brigham City, and worth preserving or continuing, that distinguishes it from other towns or suburban areas?

- Peach Days (12 responses)
- Museum/Gallery (2 responses)
- The old time theatre - downtown
- Summer concert series (2 responses)
- Community celebrations

What issues should the City consider in its general plan?

- Increased retail opportunities/restaurants/entertainment (9 responses)
- Refurbish old theatre
- Downtown summer concerts
- Consider needs of children and teenagers - more recreational areas and activities (3 responses)
- Don't put new movie theatre in (2 responses)

**Current projects, proposals, and initiatives involving Issue 2-1:**

- **Cultural Plan**: Brigham City has acquired a copy of the cultural plan conducted by Salt Lake City and intends to conduct a similar planning process. This process will help define the needed infrastructure and support necessary for culture and the arts in Brigham City.

- **Academy of Music and Dance**: The Academy of Music and Dance, an historic building on Main Street was acquired by Brigham City. The City has been exploring the potential to rehabilitate the structure and dedicate it for a performing arts center. The Lincoln Youth Symphony, in particular, has expressed interest in the potential for this use. The Academy building would help anchor downtown Brigham City as a cultural and arts center for the county, helping to revitalize downtown.

**ISSUE 2-2 - Main Street/Central Business District**: The Brigham City Main Street district, between 100 N. and 200 S. has gained recognition as an example of late 19th and early 20th century architecture. "Downtown" is central not only to the physical City but also to the character and image commonly associated with the City. With the establishment of RDA Project Area #1, the Main Street streetscape project, the adoption of design guidelines, and the establishment of grants and loans for downtown businesses, Brigham City has demonstrated its commitment to making downtown a viable, attractive place to visit and do business. However, more needs to be done to establish downtown as the economic, cultural, and social heart of the City.

**S.W.O.T. results supporting Issue 2-2**:

Community Situation Analysis:

| QUALITY OF LIFE | STAKE-HOLDER GROUP | WEAKNESS | NORMAL | STRENGTH | DON'T KNOW OR N/A |
|---|---|---|---|---|---|
| 12. General appearance of the community | Internal | 0 | 2 | 11 | 0 |
| | External | 2 | 5 | 22 | 1 |
| 16. Quality of local restaurants | Internal | 8 | 5 | 0 | 0 |
| | External | 12 | 14 | 4 | 0 |
| 17. Appearance of the Central Business District | Internal | 6 | 6 | 1 | 0 |
| | External | 5 | 12 | 13 | 0 |

S.W.O.T. discussion results supporting Issue 2-2:

Strengths:

<u>Community Character and Livability:</u>

- Brigham City enjoys a small town atmosphere. [2 groups]
- Brigham City enjoys a rural character. This may be considered to be related to the "small town atmosphere" mentioned above.

## SECTION 4: GOALS

### Issue Set 1: Geographic Setting

#### Issue 1-1: Land Availability

- **Goal: Solve uncertainty of wetland/upland environment in future development areas.**

  Strategies and Objectives:

  - Support and participate in the Box Elder County Comprehensive Wetland Management Plan (WMP) activities and efforts.
    - Continue current involvement with WMP Steering Committee.
  - Support establishment of a Special Area Management Plan (SAMP) for wetlands in east Box Elder County.
    - Continue current involvement with SAMP committee.
    - Fund fair share portion of study to delineate wetlands in SAMP area in budget years 2000/2001 and 2001/2002.
  - Acquire mitigation areas, encourage mitigation banking.
  - Educate public and officials about wetlands.
    - Assist SAMP committee with newsletter for property owners, officials, and interested public. Funding from USU, input from SAMP committee.

- **Goal: Expand boundaries of Brigham City to provide additional developable land where suitable and to provide protection for open space amenities critical to maintenance of quality of life and small town environment.**

  Strategies and Objectives:

  - Encourage annexations north to Honeyville, east to Mantua and Cache County, and west into the Bear River Migratory Bird Refuge (BRMBR).
    - Proceed with proposed annexation of BRMBR properties.
    - Discourage use of interlocal agreements for provision of infrastructure to unincorporated areas.

- **Goal: Provide suitable sites for industrial and business growth. These sites should have adequate available infrastructure, particularly state of the art telecommunications infrastructure, to become attractive sites for industries and businesses that provide high salaries and high ratios of jobs per unit area of land, or provide services and amenities currently lacking in Brigham City.**

  Strategies and Objectives:

  - Develop high quality industrial parks on West Forest Street and at the airport with infrastructure to eventually accommodate high jobs/acre ratios.

    - Seek agreements with property owners detailing architectural and design standards, appropriate uses, funding.
    - Establish RDA/EDA project area. Use tax increment financing to relocate power lines, provide infrastructure. Other uses as per adopted plan.
    - Incorporate a mixture of uses that will foster a desirable work environment for knowledge workers and high technology firms.
    - Provide a high quality street environment on Forest Street.
    - Discourage distributions centers, other uses that devote excessive area to storage and warehousing.

  - Develop spec buildings in the West Forest Street industrial park for marketing to targeted businesses.

    - Establish relationship with property owners.
    - Identify developer for partnership.
    - Identify financing options.

  - Encourage use of upper stories of buildings in Central Business District for professional offices.

    - Promote "smart sites" on Main Street.
    - Take advantage of the proximity of the Brigham City central office.
    - Address parking needs.

- **Goal: Inventory redevelopment opportunities and vacant developable land.**

  Strategies and Objectives:

  - Utilize interns from USU, WSU geography, planning, and landscape architecture programs to update land use map identifying vacant lots and areas. Correlate with general plan.

- **Goal: Redevelop underused and blighted areas.**

  Strategies and Objectives:

  - Conduct blight studies.
  - Establish project areas on West Forest Street and North Main Street.
  - Explore options for other areas inventoried.

**Issue 1-2: Regional Competition and Cooperation**

- **Goal: Establish partnerships with local, regional, state, and national entities involved in compatible economic development activities.**

  Strategies and Objectives:

  - Establish a stronger presence on Box Elder County boards involved in economic development activities.

    - Box Elder County Economic Development Board
    - Box Elder County Tourism Board
    - Box Elder County Housing Board

  - Establish a working group of Box Elder County mayors independent from the Box Elder County Council of Governments (GOG).

  - Where appropriate, feasible, and asked for, share expertise with smaller communities who have no staff.

  - Participate with regional and state entities involved in economic development in order to elevate Brigham City's visibility and standing with economic decision makers.

    - Salt Lake Olympic Organizing Committee
    - Northern Utah Coalition
    - Utah Alliance of Economic Development Professionals
    - Bear River Heritage Area
    - Bear River Association of Governments
    - Economic Development Corporation of Utah
    - Community Development Corporation of Utah
    - Utah Department of Community and Economic Development
    - Utah Division of Business and Economic Development
    - American Economic Development Council
    - Council for Urban Economic Development
    - National Association of Manufacturers Site Selection Network

## SECTION 4: GOALS

### Issue Set 1: Geographic Setting

#### Issue 1-1: Land Availability

- Goal: Solve uncertainty of wetland/upland environment in future development areas.
- Goal: Expand boundaries of Brigham City to provide additional developable land where suitable and to provide protection for open space amenities critical to maintenance of quality of life and small town environment.
- Goal: Provide suitable sites for industrial and business growth. These sites should have adequate available infrastructure, particularly state of the art telecommunications infrastructure, to become attractive sites for industries and businesses that provide high salaries and high ratios of jobs per unit area of land, or provide services and amenities currently lacking in Brigham City.
- Goal: Inventory redevelopment opportunities and vacant developable land.
- Goal: Redevelop underused and blighted areas.

#### Issue 1-2: Regional Competition and Cooperation

- Goal: Establish partnerships with local, regional, state, and national entities involved in compatible economic development activities.

### Issue Set 2: Quality of Life

#### Issue 2-1: Arts and Cultural Activity

- Goal: Establish and promote Brigham City as a center of arts and culture to enhance quality of life for current residents and to help attract and retain knowledge workers and businesses.

#### Issue 2-2: Main Street/Central Business District

- Goal: Establish downtown as the economic, cultural, and social heart of the City.
- Goal: Address parking problems
- Goal: Identify and integrate a diverse mixture of uses into downtown to provide constant activity and presence of people

Issue 2-3: Parks, Recreation, and Open Space

- Goal: Maintain acre/1000 population ratio of parkland as population grows.
- Goal: Provide a diverse package of services in a park system.
- Goal: Provide a diverse package of recreation programs.

Issue 2-4: Entertainment/Retail

- Goal: Promote recruitment and expansion of amenities that are currently lacking and creating leakage to other markets.
- Goal: Strengthen downtown as a retail/entertainment destination.
- Goal: Promote a convention center or meeting center for Brigham City and Box Elder County.
- Goal: Insure compatibility of new development on 1100 S. corridor and Eagle Point with Brigham City's character and identity.

Issue 2-5: Tourism Resources

- Goal: Maintain "small town atmosphere"
- Goal: Establish Brigham City as a tourism destination.
- Goal: Cooperate in tourism development with other tourism destinations near Brigham City.

Issue 2-6: Public Safety

- Goal: Coordinate public safety and economic development/planning functions

Issue Set 3: Infrastructure and Services

Issue 3-1: Telecommunications

- Goal: Establish state of the art business and personal telecommunications capabilities in Brigham City

Issue 3-2: Basic Infrastructure (Culinary Water, Wastewater, Storm Water, Electricity, Natural Gas and Streets)

- Goal: Deploy infrastructure in a way that supports economic development goals
- Goal: Prepare for possible electrical deregulation

Issue 3-3: Transportation

- Goal: Maintain and improve transportation ties to the Salt Lake and Ogden metropolitan areas and the region
- Goal: Establish the Brigham City Airport as a regional facility
- Goal: Improve public transportation in Brigham City
- Goal: Address master planning for internal collector route system for the Brigham City area.
- Goal: Resolve 1100 S. corridor issues

Issue 3-4: Public and Community Services

- Goal: Establish a "business friendly" reputation for Brigham City
- Goal: Increase proactiveness of planning process

Issue 3-5: Housing

- Goal: Encourage well-planned, diverse communities of housing types

Issue Set 4: Economic Development

Issue 4-1: Workforce development

- Goal: Promote the development of a highly educated, technologically skilled workforce

Issue 4-2: Marketing and Promotion

- Goal: Increase awareness about Brigham City among economic decision makers

Issue 4-3: Expansion and Retention

- Goal: Create a desirable climate in Brigham City for business expansions and retention

Issue 4-4: Recruitment

- Goal: Recruit desired and missing industries and amenities to Brigham City

# Population Projections for Utah Cities

Bear River Association of Governments
Contact: Jeff Gilbert
Voice: (435) 752-7242
Fax: (435) 752-6962
Email: jeffg@brag.dst.ut.us
May 2000

| AREA | Populations 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2010 | 2020 | 2030 | AARC |
|---|---|---|---|---|---|---|---|---|---|---|
| **BOX ELDER COUNTY** | 43,083 | 43,964 | 44,857 | 45,819 | 46,829 | 47,896 | 53,855 | 63,209 | 70,755 | 1.7% |
| Bear River City town | 832 | 838 | 844 | 850 | 871 | 879 | 971 | 1,068 | 1,165 | 1.1% |
| Brigham City city | 17,215 | 17,439 | 17,666 | 17,893 | 18,140 | 18,387 | 19,987 | 22,387 | 24,509 | 1.2% |
| Corinne city | 691 | 744 | 769 | 825 | 910 | 961 | 1,086 | 1,266 | 1,338 | 2.2% |
| Deweyville town | 351 | 359 | 367 | 375 | 383 | 391 | 431 | 513 | 595 | 1.8% |
| Elwood town | 684 | 684 | 688 | 700 | 704 | 708 | 728 | 768 | 808 | 0.6% |
| Fielding town | 472 | 476 | 480 | 495 | 497 | 499 | 509 | 529 | 549 | 0.5% |
| Garland city | 1,938 | 2,004 | 2,071 | 2,138 | 2,213 | 2,288 | 2,811 | 3,798 | 4,552 | 2.9% |
| Honeyville city | 1,326 | 1,358 | 1,390 | 1,422 | 1,454 | 1,486 | 1,646 | 1,987 | 2,328 | 1.9% |
| Howell town | 270 | 272 | 274 | 276 | 291 | 306 | 381 | 443 | 505 | 2.1% |
| Mantua town | 724 | 740 | 758 | 776 | 798 | 820 | 930 | 1,150 | 1,370 | 2.1% |
| Perry city | 2,239 | 2,391 | 2,513 | 2,635 | 2,732 | 2,863 | 3,665 | 5,085 | 6,006 | 3.3% |
| Plymouth town | 291 | 291 | 291 | 299 | 301 | 303 | 313 | 333 | 353 | 0.6% |
| Portage town | 218 | 221 | 224 | 227 | 236 | 245 | 290 | 330 | 370 | 1.8% |
| Snowville town | 277 | 281 | 285 | 289 | 293 | 297 | 317 | 407 | 497 | 2.0% |
| Tremonton city | 5,309 | 5,452 | 5,597 | 5,742 | 5,912 | 6,152 | 7,604 | 9,329 | 10,852 | 2.4% |
| Willard city | 1,563 | 1,591 | 1,619 | 1,658 | 1,697 | 1,736 | 1,931 | 2,321 | 2,741 | 1.9% |
| Balance of Box Elder County | 8,683 | 8,823 | 9,021 | 9,219 | 9,397 | 9,575 | 10,255 | 11,495 | 12,217 | 1.1% |

Notes:

1) All populations are July 1
2) County totals for 2000 through 2030 are the Provisional 2000 Baseline.
3) Subcounty projections are based on the 1998 estimates from the Census Bureau
4) 2000 through 2030 subcounty numbers have been produced by BRAG analysts controlling to GOPB county totals
5) Initial projections of subcounty populations maintained a constant share based on the distribution in the 1998 Census Estimates.
6) AARC = Annual Average Rate of Change, 2000-2030

# Box Elder County, Utah

## Community and Labor Demographic Information Summary

| | |
|---|---|
| Total MSA Population* | 318,390 (Box Elder, Cache, Weber) |
| MSA area | *Box Elder is not in an MSA, but including Cache (east) and Weber (south) Counties there is 318,390 population in the area. |
| MSA annual population growth rate | 1.7% |
| Total labor force | 18,449 (Box Elder) 101,276 (Weber) 45,128 (Cache) |
| Unemployment rate | 4.2% |
| Median age in years | 28 |
| Median household income | $42,500 |
| Education Level<br>High school degree or higher | 83% |
| Equivalent of Bachelor's degree or higher | 31% |
| Nearby colleges/name/type | Utah State University Branch Campus, Brigham City<br>Weber State University, Ogden (25 miles)<br>Utah State University, Logan (25 miles) |
| Nearby vocational schools | Bridgerland Applied Technology Center Branch Campus, Brigham City<br>Ogden Applied Technology Center, Ogden |

**Population Projections by County**
2000-2030

| County | 2000 | 2005 | 2010 | 2020 | 2030 | 1.7% 2000-2030 |
|---|---|---|---|---|---|---|
| **Box Elder** | **43,083** | **47,896** | **53,855** | **63,209** | **70,755** | **1.7%** |
| Cache | 88,320 | 96,904 | 108,150 | 127,896 | 143,040 | 1.6% |
| Weber | 186,987 | 201,8950 | 227,032 | 271,369 | 307,350 | 1.7 % |

*Average Annual Rate of Change

**Source: U.S. Department of Commerce, Bureau of the Census and Governor's Office of Planning and Budget, UPED model. Totals may *not add due to rounding*.**

| EXISTING MANUFACTURING INFORMATION | |
|---|---|
| Total number of manufacturing businesses | 46 |
| Total number of manufacturing employees | 10,150 |
| Average starting wage per hour | $8.50/hr. (Please see 1999 Box Elder/Cache Counties Occupational Wages brochure) |
| Time Zone | Mountain Standard |
| Airline Service | One hour to Salt Lake International |

| TAX INCENTIVE PROGRAMS | |
|---|---|
| Corporate income tax rate | 5% |
| Corporate franchise tax rate | Pass through franchise tax |
| Total sales tax rate | 6.25% |
| Unemployment tax rate | Minimum of 0.03% and Maximum of 8% |
| Economic incentive programs | Enterprise Zone - State Income Tax Credits<br>Recyling Zone - State Income Tax Credits<br>EDA/RDA Designation |
| Employee development programs | The State and Bridgerland Applied Technology Center through their Custom Fit Training Programs offer training that can be specified by your company. |
| Important alternative data/comments | Box Elder County's ACCRA Standard of Living is 96.6% of the National Average. In spring 2000, WalMart had 4,000 applications for 200 jobs at an average starting wage of $9.50/hr. |

# Appendix F

Army Corps of Engineers Flood Plain Management Services Study – Box Elder County

# FLOOD PLAIN MANAGEMENT SERVICES STUDY

PREPARED AT THE REQUEST OF

## BOX ELDER COUNTY, UTAH

JULY 1997

U.S. ARMY CORPS OF ENGINEERS, SACRAMENTO DISTRICT
PLANNING DIVISION
REGIONAL PLANNING BRANCH

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A Hydrology Report
B 100-Year Flooded Area Maps

**Flood Plain Management Services Study**
**100-Year Flood for the Great Salt Lake**
**Box Elder County, Utah**
**June 1997**

# INTRODUCTION

## Background

Box Elder County, Utah, can guide its future growth with an accurate assessment of the flood conditions expected from the Great Salt Lake. Previous flood insurance studies prepared by the Federal Emergency Management Agency (FEMA) and other flood plain studies have been outdated by more current hydrologic data and by various flood control projects that have been built subsequent to completion of FEMA's mapping efforts. By a letter of request dated October 18, 1996, Box Elder County requested a Flood Plain Management Services (FPMS) study for reassessing the 100-year flood for the Great Salt Lake in Box Elder County. This request was endorsed and fully supported by the State of Utah, by letter dated October 22, 1996.

## Authority

This study was conducted under Section 206 of the Flood Control Act of 1960, as amended (Public Law 86-645). Upon request and without charge, the Corps of Engineers is authorized to furnish flood plain information and technical assistance to state, regional, and local governments. Study priorities are assigned based on need and degree of assistance provided by the requestor.

## Scope of Study

This study was limited to the general area along the northeastern shore of the Great Salt Lake in Box Elder County. Only the 100-year flood elevation including wind and wave action for the Great Salt Lake was evaluated in this study. No stream or other drainages were included in this study for analysis or delineation.

## Coordination

After receipt of the study request from Box Elder County, discussions with county personnel were held confirming available data usable for this study. Study funding was then requested from Headquarters, Corps of Engineers; and approval and funding was provided in October 1996. A letter of initiation dated December 30, 1996, was sent to Box Elder County (Mr. Denton Beecher, County Surveyer, Box Elder County) indicating that funding and approval had been obtained.

An office hydrology report was completed in November, 1996. Subsequently, a field assessment of the lake stages was performed during April 1997. Based on the results of these efforts and office analyses, the final lake elevations were determined and subsequently delineated on the mapping. The final report was submitted to Box Elder County in July 1997.

## STUDY AREA

### Community Description

Box Elder County is located north of Salt Lake City in the north-central area of Utah. The topography for the county changes dramatically from mountainous terrain to gently sloped plains adjacent to the Great Salt Lake, and shallow lake/mudflats. The county rings the north half of the Great Salt Lake. There are many industries located along the north-south transportation corridor in eastern Box Elder County. This corridor is bounded by the Great Salt Lake to the west and the Wasatch Mountains on the east. Major economic activities within the county are agriculture, aerospace, and defense. Because of close proximity to the Great Salt Lake, flooding is obviously of major concern.

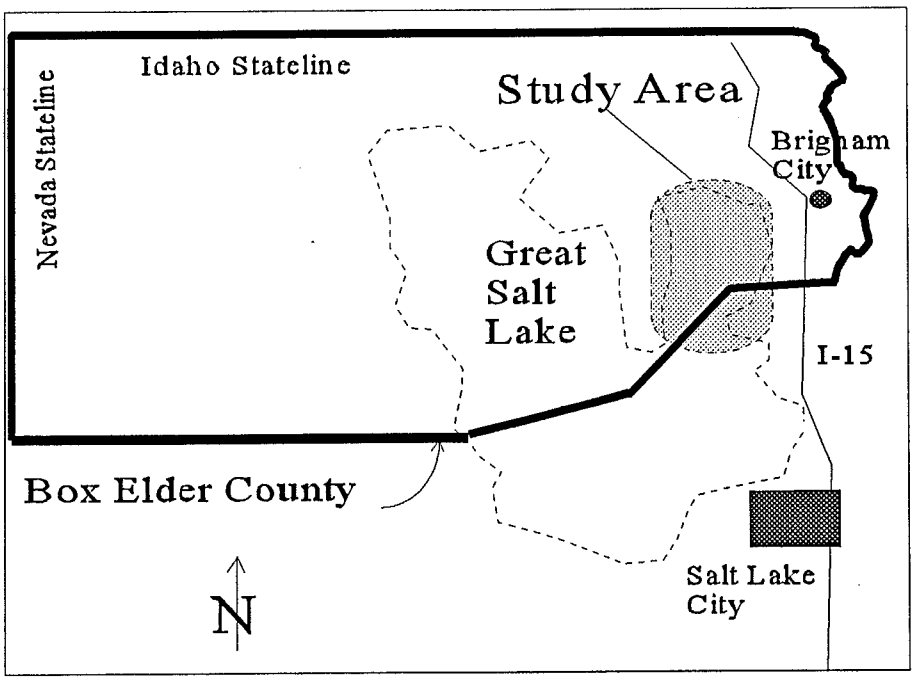


Figure 1, County Map

### Flood History

The Great Salt Lake is a remnant of Lake Bonneville which covered a large portion of western Utah and segments of Nevada and Idaho. With land form changes resulting in the loss of containment of Lake Bonneville and the climatological changes for the region, the lake level changed resulting in the present day Great Salt Lake.

The Great Salt Lake is a terminal body of water, meaning that it has no outlet. The major contributing stream systems to the lake are the Bear, Weber, and Jordan River Systems flowing from the Wasatch Mountains to the east. They contribute over 2,000,000 acre-feet of water each year on the average. The lake level is dependent upon the flows from these systems, the available lake storage, and the corresponding surface area and resultant evaporation losses.

Archeological evidence dating from the 1600's indicates that the lake has overflowed into the West Desert area 50 miles west of Salt Lake City, when lake levels would reach an elevation of about 4215 feet. Since the settlement of the Salt Lake Valley in the mid-1800's, the record high lake elevation of 4211.85 feet occurred in June 1986. The previously documented high of 4211.6 feet occurred in 1873. During this same historic period the record low elevation was 4191.35 feet in 1963.

**Study Limits**

This study is limited to flooding from high lake stages. Box Elder County representatives requested the study be limited to the northeast arm, east of Promontory Point. Specifically, the shoreline reach studied extended from the county boundary with Weber County at the southern edge of Box Elder County near Willard, north past Brigham City and west around Willard Bay and then south to Promontory Point. The flood boundaries delineated and elevations determined were based on lake flooding only without incorporating any stream flood plains.

## AVAILABLE DATA

### Other Studies

Flood insurance studies for the communities in Box Elder County were initiated in the 1970's and were revised in the 1980's and the 1990's. However, in all of these studies the Great Salt Lake flooding was identified only as an approximate Zone A establishing the area flooded only in a general concept relative to the lake.

The State of Utah completed a Great Salt Lake Contingency Plan report in January 1983 because of rising lake levels. This study provided preliminary assessments for alternatives to control flooding due to future high lake stages.

In December 1986 the Sacramento District, Corps of Engineers, completed a Reconnaissance Report for the Great Salt Lake. Since the 1983 Contingency Plan report the lake had risen substantially, resulting in the initiation of several emergency procedures to control damages from high lake stages. The reconnaissance study analyzed the impact of these measures on five additional alternative plans for prevention of flood damages. None of these alternatives proved to be economical in light of the procedures already enacted or damages already sustained. However, this report provides a technical basis for evaluating the lake stages.

### Aerial/Topographic Mapping

Box Elder County had no additional detailed mapping available for the total shore line. The 100-year lake elevations have been delineated on 12 USGS quadrangle maps, 7.5 minute, 1 inch = 2000 feet.

## FLOOD PLAIN ANALYSIS

### Hydrology

A study analysis was conducted to determine the magnitude of wind-induced wave action for the 100-year lake elevation for several locations along the eastern shore of the Great Salt Lake within Box Elder County. The 100-year stillwater lake elevation used is 4212.0 feet, National Geodetic Vertical Datum of 1929. For technical details see appendix A. Data for four locations, based on maximum individual site exposure, is summarized in table 1 on the following page. The selection of the individual site control data is based on the conditions that create the maximum wave runup possible at that site and not necessarily the worst conditions for the system as a whole. The four locations are shown on the following map (figure 2).

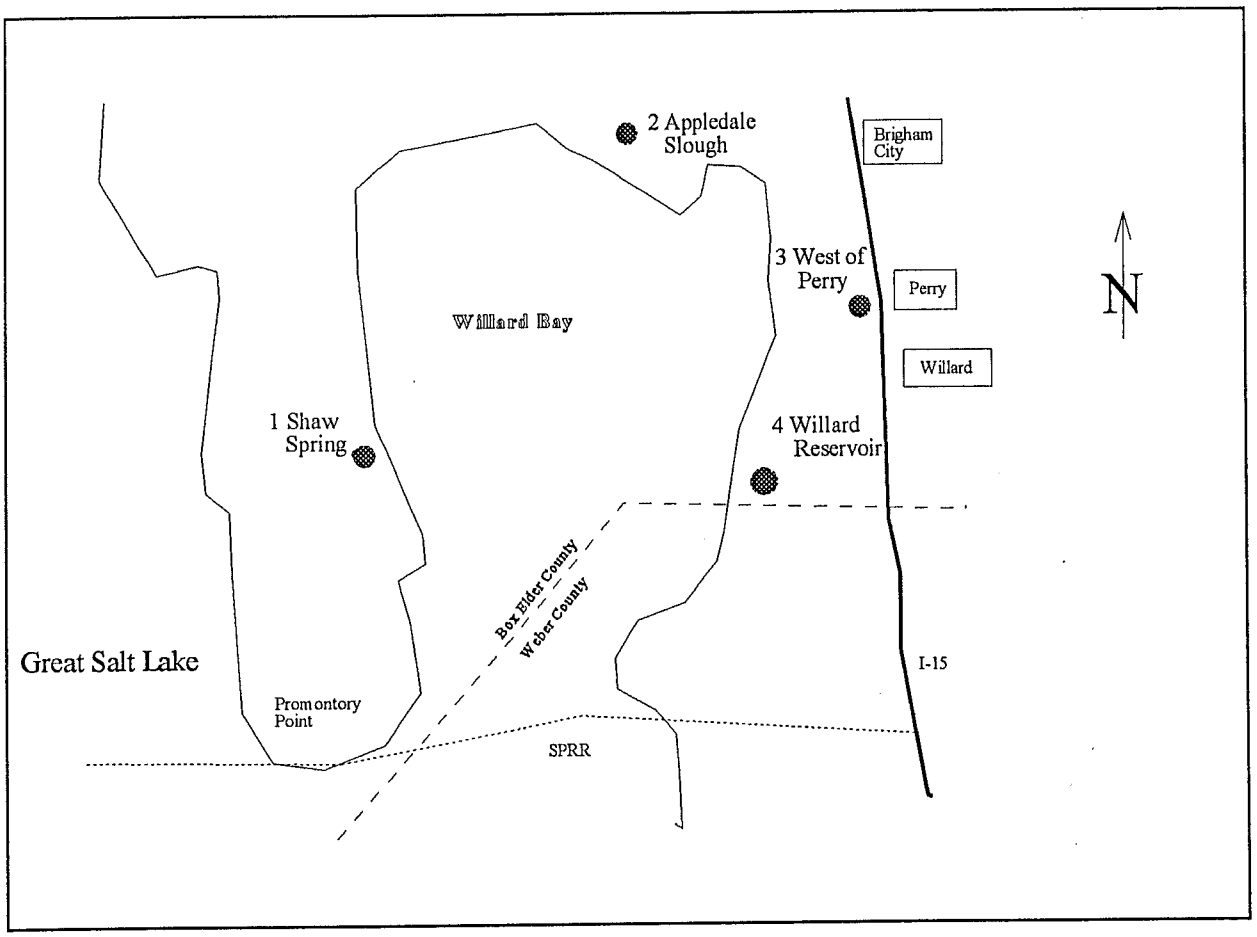


Figure 2, Location of Elevation Sites

# Table 1
# Maximum Individual Site Exposure in Feet

| Feature/Identification Number | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| **Location** | **Shaw Spring** | **Appledale Slough** | **West Perry** | **Willard Reservoir** |
| **100-Year Lake Elevation** | **4212.0** | **4212.0** | **4212.0** | **4212.0** |
| **Wind Set** | **1.1** | **2.1** | **2.3** | **2.5** |
| **Wave Runup** | **1.4** | **0.5** | **0.5** | **0.6** |
| **Maximum Shoreline Elevation** | **4214.5** | **4214.6** | **4214.8** | **4215.1** |
| **Wave Height (Off Shore)** | **2.7** | **2.1** | **2.3** | **2.8** |
| **Maximum Offshore Elevation** | **4214.5** | **4215.2** | **4215.5** | **4215.8** |

System exposure is based on maximum stillwater lake elevation and wave action for the entire area. There is less wave runup at some sites because the system wind exposure angle at those sites may be reduced. This data provides the basis for establishing the shoreline intersect between lake and ground line for normally open exposed shallow sloped shorelines.

Ponded areas are areas that are flooded but are protected by levees or other features. The flood elevations expected are the results of maximum stillwater lake elevation and wind set but do not include any wave action. These areas were evaluated and established by the engineers performing the study during the field assessment.

The offshore lake elevation is the summation of the 100-year stillwater lake elevation, wind set, and half of the wave height (no runup potential). Because of the variable character and factors impacting off shore flooding, rounding the resultant elevation to the nearest foot provided reasonable results for determining off shore flood elevations. This resulted in an elevation of about 4216 feet as the controlling elevation for off shore elevations considering all factors.

**Field Assessment**

All shoreline flood boundaries, ponded areas, and transitions zones were verified in the field by engineers with extensive experience in flood plain hydraulics. Landfill and development were noted and adjustments to the flood zones were made. This was completed during April 1997. Minor adjustments to the field work were performed in the office before completion of the final 100-year flooded area maps.

## Map Zoning Criteria

The 100-year elevation along the shoreline for Box Elder County gradually changes by about one half foot along the entire study reach. The elevation of this boundary is noted in tenths of a foot on each map. For the ponded areas, the shoreline elevation will be different. Ponded area elevations (including shoreline boundary elevations) are based on the sum of the stillwater elevation plus the wind set, excluding wave height and wave runup. Otherwise the specified boundary elevations control. For steep embankments, much higher wave heights may be expected (because of the larger runup potential) but are limited to a narrow zone and have been delineated as a wave runup zone without any elevation provided. The area between offshore elevations and the shoreline boundary is the transition zone. This area accounts for the attenuation in offshore lake wave heights and the potential shoreline runup. Figure 3 is an illustration demonstrating these features.

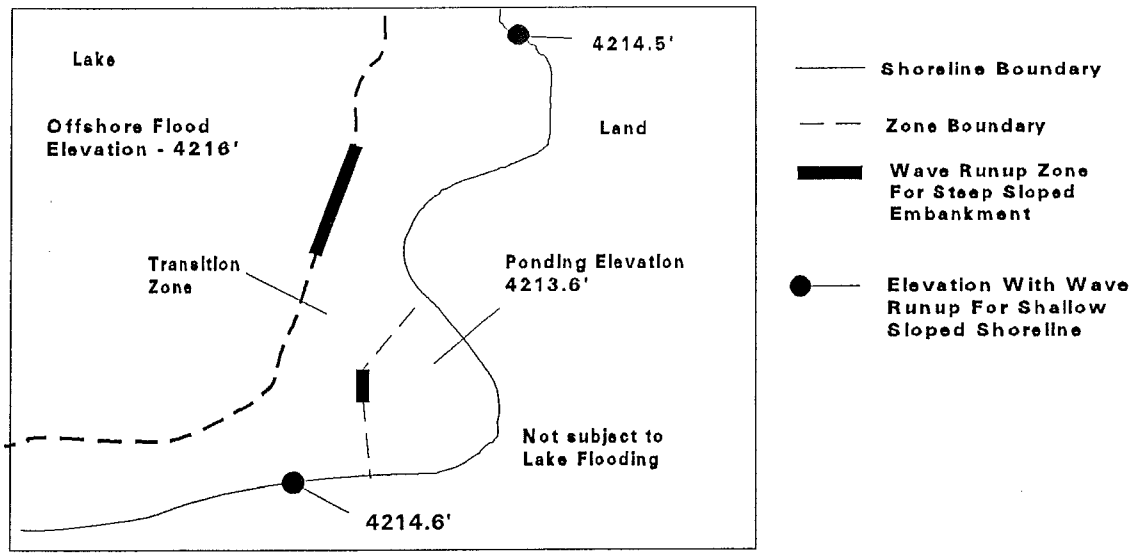


Figure 3, Typical Flood Map Data

## Flood Plain Mapping

The flood plains for the Great Salt Lake have been delineated on the 12 quadrangle maps. These maps make up Appendix B for this study. Reproducible copies of these maps for distribution will not be retained by the Corps of Engineers. Box Elder County is the repository for this information.

## SUMMARY

### Applications

This study attempted to incorporate the most current information concerning lake stages, wind impact analyses, and physical constraints present in the study area. Changes to these features could result in changes to the data presented on the flooded area mapping. However, prudent use of this information with any proposed future needs should result in a consistent coordinated land use application functional to the specific requirements of the communities involved.

### Conclusions

This study is intended for the specific area of Box Elder County and its communities. It was not prepared for application for areas beyond its study limits.

JULY 1997

# FLOOD PLAIN MANAGEMENT SERVICES STUDY

FOR

# BOX ELDER COUNTY, UTAH

## APPENDIX A
## (HYDROLOGY REPORT)

**US Army Corps**
**of Engineers**
Sacramento District
South Pacific Division

BOX ELDER COUNTY, UTAH
100-YEAR STAGE, GREAT SALT LAKE
LAKE SHORE DELINEATION
NOVEMBER 1996


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1. General Map
2. Definition Sketch of Wave Runup
3. Definition of Angle from Shore Normal and Angle Reduction from Shore Normal

BOX ELDER COUNTY, UTAH
100-YEAR STAGE, GREAT SALT LAKE
LAKE SHORE DELINEATION
NOVEMBER 1996

1. Scope. - This write-up presents hydrologic data needed to delineate the 100-year flood elevation along the shore line of Great Salt Lake in Box Elder County, Utah. The hydrologic data includes the water level increase along the Box Elder County shore line as a result of: (1) the 100-year stillwater lake stage, (2) wind set, and (3) wave runup.

2. Wave Runup Estimates. - An analysis was conducted to determine the magnitude of wind-induced wave action on the Great Salt Lake against several locations along the Box Elder County shore line. The water surface elevation considered is for the 100-year lake elevation, 4212 feet N.G.V.D. (National Geodetic Vertical Datum or 1929). The locations chosen were: around Shaw Spring/Boothe Valley east of the Promontory Mountains, the location where Appledale Slough enters North Bay, the westside levee of Willard Reservoir, and a location south of Brigham City and west of Perry. A map with the four locations is shown on Chart 1.

a. Wind Data - The records for observed wind data at the Salt Lake City International Airport were checked for the wind directions that can act against the Box Elder County shore line. The years of record used were between 1964 and 1994. The maximum 1-minute windspeeds used are based on the observed data. The 60-minute windspeeds were estimated by dividing the 1-minute windspeeds by 1.24. This value was derived from a study of wind data at the Sacramento Airport. The 1- and 60-minute windspeeds for the wind directions used for Box Elder County shore line are tabulated below.

Table 1
Wind Data for Box Elder County shore line

| Direction | 1-Minute Wind (mph) | 60-Minute Wind (mph) |
|---|---|---|
| Northwest | 59 | 48 |
| West | 45 | 36 |
| Southwest | 54 | 44 |
| South | 49 | 40 |
| Southeast | 40 | 32 |
| East | 40 | 32 |
| Northeast | 40 | 32 |

The wind direction is the direction from which the wind is blowing. The windspeeds were measured at an elevation 20 feet above the ground. They needed to be adjusted to a standard elevation of 33 feet, using the following approximation:

$$Us = [(33/Z)^{(1/7)}] * Uz,$$

where Us is the windspeed at the 33-foot level, and Uz is the windspeed at distance Z above the surface.

b. Fetch Lengths and Depths - The Fetch length (F) is the horizontal distance in miles, in the direction of the wind, over which the wind generates waves or creates a wind setup. An average fetch length was determined for each wind direction that could cause wind and wave runup at a location. Each average fetch length was determined by drawing nine radials at 3 degree increments centered on the wind direction and arithmetically averaging the radial lengths. The fetch lengths were determined for the water at the 100-year lake elevation, 4212 feet.

The Average Fetch Depth (D), or predominant depth of water, in feet, over each average fetch length, was estimated from 7.5 minute quadrangle maps of the Great Salt Lake area. The Depth at Toe of shore line (ds), where the embankment changes slope to more horizontal, was estimated for the Box Elder County shore line locations from shore line profiles of the Great Salt Lake.

c. Design Winds - The design windspeed for each fetch was computed in accordance with ETL 1110-2-305, dated 17 February 1984. The design wind is that which will generate the largest significant wave for the fetch. The overland windspeeds were corrected to overwater windspeeds, using Figure 2 in ETL 1110-2-305, "Determining Sheltered Water Wave Characteristics" by Vincent and Lockhart. The northwest fetch against the shore line near Perry is shorter than 10 miles. For a fetch shorter than 10 miles, the ratio R of windspeed overwater, Uw, to windspeed overland, Ul, is 110 percent. For the fetches longer than 10 miles, the overwater windspeeds are 90 percent of the overland windspeeds.

Figure 4 (in ETL 1110-2-305) is used to obtain a range of wave heights, periods and corresponding durations that bracket site windspeeds. These selected windspeeds and durations are plotted on the windspeed-duration curve. The intersection of the two windspeed-duration curves indicates the design wind that will generate the largest significant wave for the limited available fetch.

Significant wave characteristics were developed, based upon the fetch length (F), design windspeed and wind duration (the time in which the wind will generate the largest significant wave for the fetch.) The significant wave characteristics are:

Significant wave height (Hs) - the average height in feet of the highest one-third waves of a given wave group; height is measured as vertical distance between crest and preceding trough;

Wavelength - the horizontal distance in feet between similar points on two successive waves; wave period (Ts) - the time in seconds for a wave crest to travel a distance equal to one wave length;

Deepwater Wave Length (Lo) - measured in feet, equals 5.12 times the wave period squared:

$$Lo = 5.12 \times T^2$$

Wave length type - deepwater or shallow-water.

Some of the above characteristics are shown in the example sketch on Chart 2. If the average water depth (D) over the fetch length (F) is less than half the deepwater wave length (Lo), then the wave growth is affected by the bottom, and the computed design windspeed and fetch length are used to predict the significant shallow-water wave height and period. Shallow-water wave length conditions apply for all fetches at the Box Elder County shore line locations. The design windspeed just computed, and the fetch, should be used to predict the significant shallow-water wave height and period from the graphs in Section E, ETL 1110-2-305.

d. Wave Runup (R) - The wave runup on a smooth, impermeable slope was estimated from Figures 7-8 through 7-13 in the Coastal Engineering Research Center publication, the SHORE PROTECTION MANUAL, published in 1984 by the Department of the Army. Wave runup is the vertical rise in feet above the stillwater level caused by the significant wave. Stillwater level is the elevation of the water surface without wind or wave action. In this case, the stillwater level is the 100-year lake elevation. The wave runup is a function of the slope of the shore line (cotangent θ), the wave period Ts, the depth (ds) of the water at the toe of the embankment, and the deepwater wave height. The deepwater wave height, H'o, is equivalent to the observed shallow-water wave height if unaffected by refraction or friction. The deepwater wave height for each fetch and the design wind speed were determined from Figure 4 in ETL 1110-2-305. Since the shore line slopes are so flat at the Appledale Slough, west of Perry, and Willard Reservoir locations, a minimum value of 0.1 was assumed for the relative runup, R/H'o, on Figures 7-8 to 7-10 in the SHORE PROTECTION MANUAL. A higher value was used for the relative runup, R/H'o, for Shaw Spring, where the slope of the shore line is steeper. A runup correction factor k, for scale effects, using curves on Figure 7-13 in the SHORE PROTECTION MANUAL, was applied to the runup values obtained from Figures 7-8 to 7-10.

e. Theta (θ) and Cotangent Theta (θ) - θ is the angle of the shore line or embankment relative to horizontal. Cotangent θ is the slope of the shore line, or the ratio of horizontal distance to

vertical rise. An example of cotangent θ is shown on Chart 2. The slope of the shore line at three Box Elder County locations is greater than 100 feet horizontal, to 1 foot vertical rise.

f. Slope Roughness Factor (r) - The wave runup values obtained from Figures 7-8 to 7-12 are for smooth, impermeable slopes. A roughness and porosity correction factor r was applied to the wave runup to account for the effects of other structure slope characteristics. The Shaw Spring shore line locations are adjacent to mud flats and are assumed to have smooth, impermeable surfaces, without vegetation. A slope roughness factor of 1.0 was assumed for the Shaw Spring locations. For the other three locations, vegetation is assumed to be growing at the 100-year lake elevation. A slope roughness factor of 0.85 was assumed for those shore lines.

3. Wind Setup. - Wind setup is determined from the SHORE PROTECTION MANUAL, and is defined as the vertical rise in the stillwater level at the embankment caused by the design wind over the fetch length. Wind setup was computed using the formula:

$$S=\frac{U^2 \times F}{1400 \times D}$$

where:

S is setup in feet above the stillwater level,
U is the design windspeed in miles per hour,
F is the fetch length in miles,
D is the average water depth in feet over the fetch.

4. Total Water Level Increase. - The wave runup and wind setup were combined for the wind directions affecting each location. This sum of wave runup plus wind setup was then adjusted for the wave angle (angle adjustment factor), if necessary.

For a wave hitting the shoreline at an angle greater than 40° from "shore normal", a wave reduction factor RH was applied, from Figure C-2 in ETL 1110-2-305. An example of "shore normal" and the direction of the wave hitting the shoreline is shown on Chart 3, Figure 1. Chart 3, Figure 2 shows the relationship between the angle at which the wave hits the shoreline and the wave reduction factor RH.

The total water level increase for each wind direction, from northeast clockwise to northwest, that could affect the shore line, was compared with the others at each of the four shore line locations. Table 2 lists the highest total water level increase and related windspeed at each location and the data relevant to design wind setup and wave runup. For Shaw Spring, two fetches have almost the same water level increase. For the shore line west of Perry, the critical fetch is shorter than 10 miles.

The wave height elevation, in feet N.G.V.D. is the sum of the water level increase and the stillwater surface elevation, the 100-year lake level.

In paragraph 2d above, a value of 0.1 was used as the minimum value of R/H'o in Figures 7-8 through 7-10 in the SHORE PROTECTION MANUAL. This value was extrapolated from the extension of the curves for slopes flatter than one on ten (Cotangent $\theta$ = 10). Since three of the shore lines are so flat, with slopes ranging from cotangent $\theta$ = 200 to cotangent $\theta$ = 1000, the actual value of R/H'o is really smaller than 0.1. However, further extrapolation was even more uncertain. For the shore lines at these locations, the wave runup listed in Table 2 is a maximum value.

5. Special Considerations. - The Coastal Engineering Research Center in Vicksburg, Mississippi, was consulted regarding an issue that arose during this study. It concerned whether the wave runup would be different at the shore line elevation of 4212 feet (100-year stillwater lake elevation) and at the higher landward elevation where the wave ended. It was decided to use the same wave height elevation at the 4212-foot shore line and at the higher landward elevation, despite the flat slopes. The landward limit of flooding is where the shore line is at the wave height elevation listed on Table 2.

6. Breaking Wave. - The breaking point of the design wave is defined as the point where the wave crest first begins to curl over the face of the wave. The breaking point is an intermediate point in the breaking process between the first stages of instability and the area of complete breaking. The lake depth that initiates breaking is some distance lakeward of the beach and is not necessarily the depth at the toe of the embankment. A range of lake depths where breaking is initiated was computed for each of the locations on the Box Elder County shore line, using procedures on pages 7-4 to 7-8 of the 1984 edition of the SHORE PROTECTION MANUAL. The breaker height, Hb, was computed for the Deepwater Wave Height, and was then adjusted by the ratio of the Shallow-water Wave Height to the Deepwater Wave Height. The maximum and minimum water depths of the breaking wave, db(max) and db(min), respectively, were developed using Figures 7-2 and 7-3 in the SHORE PROTECTION MANUAL. Table 3 presents the parameters used to develop these water depths.

TABLE 2

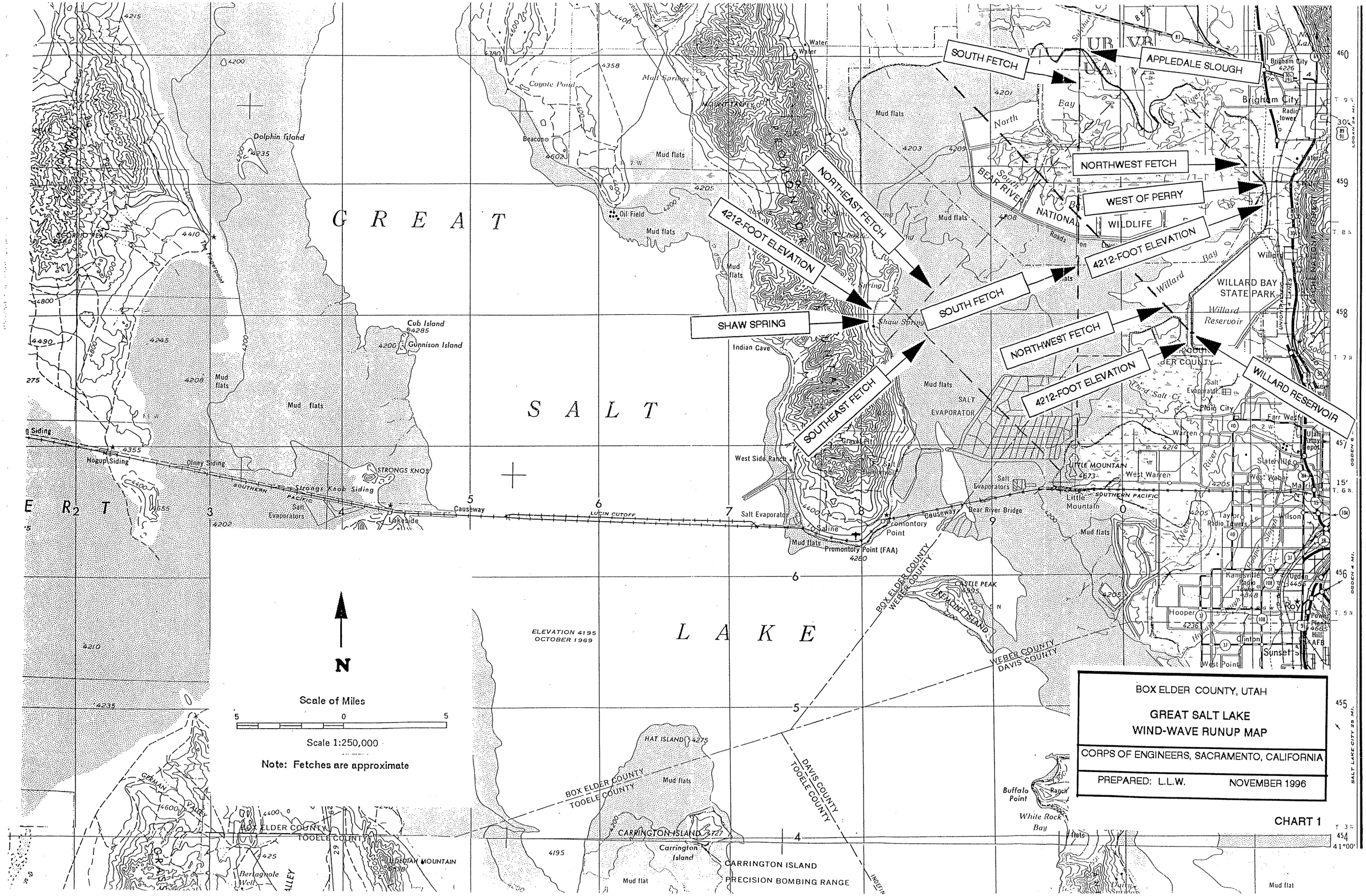
GREAT SALT LAKE WIND/WAVE RUNUP

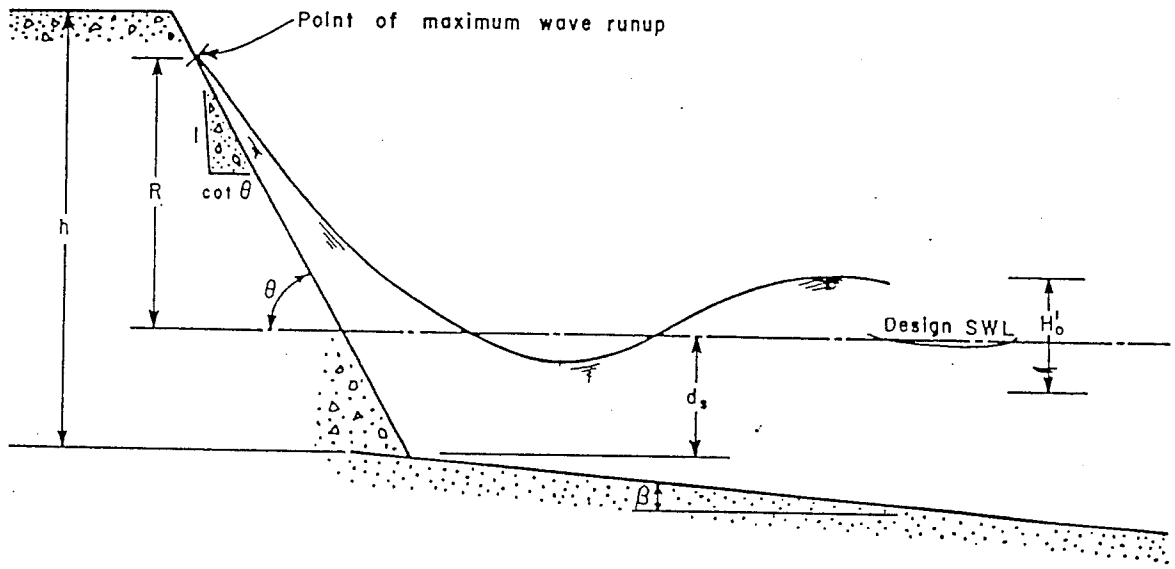
BOX ELDER COUNTY, UTAH

| Location<br>Embankment Description | Symbol | Units | SHAW SPRING BOOTHE VY. Shore Line | SHAW SPRING BOOTHE VY. Shore Line | APPLEDALE SLOUGH Shore Line | WEST OF PERRY Shore Line | WILLARD RESERVOIR Shore Line |
|---|---|---|---|---|---|---|---|
| Wind Direction | | | Southeast | Northeast | South | Northwest | Northwest |
| 100-Year Lake Elev. | | (ft.NGVD) | 4212 | 4212 | 4212 | 4212 | 4212 |
| Fetch Length | F | (mi) | 22 | 16.6 | 19 | 5.9 | 17.3 |
| Average Fetch Depth | D | (ft) | 12 | 9 | 7 | 5 | 8 |
| Depth at Toe | ds | (ft) | 7 | 7 | 6 | 5 | 2 |
| Overland Wind | | | | | | | |
| Elev above ground | | (ft) | 20 | 20 | 20 | 20 | 20 |
| 1-Minute Wind | | (mph) | 40 | 40 | 49 | 59 | 59 |
| 60-Minute Wind | | (mph) | 32 | 32 | 40 | 48 | 48 |
| Adjusted to 33 ft | | | | | | | |
| 1-Minute Wind | | (mph) | 43 | 43 | 53 | 63 | 63 |
| 60-Minute Wind | | (mph) | 35 | 35 | 42 | 51 | 51 |
| Overwater Wind | | | | | | | |
| 1-Minute Wind | | (mph) | 39 | 39 | 47 | 70 | 57 |
| 60-Minute Wind | | (mph) | 31 | 31 | 38 | 56 | 47 |
| Design Wind Speed | U | (mph) | 28.5 | 29 | 35 | 55.5 | 43 |
| Wind Duration | | (min) | 103 | 85 | 65 | 26 | 55 |
| Signif.Wave Height | Hs | (ft) | 2.7 | 2.3 | 2.14 | 2.3 | 2.8 |
| Wave Period | Ts | (sec) | 3.75 | 3.4 | 3.5 | 3.3 | 3.9 |
| Wave Type | | | Shallow | Shallow | Shallow | Shallow | Shallow |
| Deepwater Wave Height | H'o | (ft) | 5.1 | 4.7 | 6.1 | 6 | 7.6 |
| Cotangent Theta (Slope) | cot O | (ft/ft) | 13 | 13 | 400 | 200 | 1000 |
| ds/H'o | | | 1.37 | 1.49 | 0.98 | 0.83 | 0.26 |
| H'o/(g*Ts^2) | | | 0.0113 | 0.0126 | 0.0155 | 0.0171 | 0.0155 |
| R/H'o | | | 0.28 | 0.28 | 0.1 | 0.1 | 0.1 |
| Wave Runup (smooth slope) | R | (ft) | 1.43 | 1.32 | 0.61 | 0.60 | 0.76 |
| Runup Corr. Factor | k | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Slope Roughness Factor | r | | 1.00 | 1.00 | 0.85 | 0.85 | 0.85 |
| Wave Runup | R*k*r | (ft) | 1.43 | 1.32 | 0.52 | 0.51 | 0.65 |
| Wind Setup | S | (ft) | 1.06 | 1.11 | 2.38 | 2.60 | 2.86 |
| Combined Wind+Wave | | (ft) | 2.49 | 2.42 | 2.89 | 3.11 | 3.50 |
| Angular Spread | | (deg) | 0 | 0 | 45 | 45 | 45 |
| Angle Adjustment | | (in %) | 100 | 100 | 89 | 89 | 89 |
| Water Level Increase | | (ft) | 2.49 | 2.42 | 2.58 | 2.76 | 3.12 |
| Wave Height Elevation | | (ft.NGVD) | 4214.5 | 4214.4 | 4214.6 | 4214.8 | 4215.1 |

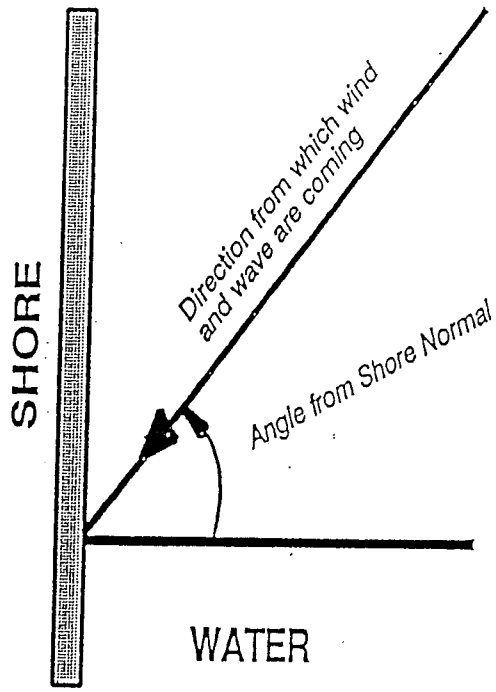
TABLE 3
DEPTH OF BREAKING WAVE
BOX ELDER COUNTY, UTAH

| Location<br>Embankment Description | Symbol | Units | SHAW SPRING BOOTHE VY. Shore Line | SHAW SPRING BOOTHE VY. Shore Line | APPLEDALE SLOUGH Shore Line | WEST OF PERRY Shore Line | WILLARD RESERVOIR Shore Line |
|---|---|---|---|---|---|---|---|
| Wind Direction | | | Southeast | Northeast | South | Northwest | Northwest |
| 100-Year Lake Elev. | | (ft.NGVD) | 4212 | 4212 | 4212 | 4212 | 4212 |
| Cotangent Theta (Slope) | cot O | (ft/ft) | 13 | 13 | 400 | 200 | 1000 |
| Beach slope | m | | 0.077 | 0.077 | 0.003 | 0.005 | 0.001 |
| H'o/(g*Ts^2) | | | 0.0113 | 0.0126 | 0.0155 | 0.0171 | 0.0155 |
| Deepwater Wave Height | H'o | (ft) | 5.1 | 4.7 | 6.1 | 6 | 7.6 |
| Hb/H'o (from Fig 7-3) | | | 1.05 | 1.05 | 0.95 | 0.95 | 0.95 |
| Breaker Height | Hb | (ft) | 5.4 | 4.9 | 5.8 | 5.7 | 7.2 |
| Wave Period | Ts | (sec) | 3.75 | 3.4 | 3.5 | 3.3 | 3.9 |
| (g*Ts^2) | | | 452.8 | 372.2 | 394.5 | 350.7 | 489.8 |
| Hb/(g*T^2) | | | 0.01183 | 0.01326 | 0.01469 | 0.01626 | 0.01474 |
| db/Hb (From Fig. 7-2) | | | | | | | |
| Lower Limit | Beta | | 1.13 | 1.2 | 1.38 | 1.44 | 1.38 |
| Upper Limit | Alpha | | 1.6 | 1.62 | 1.65 | 1.7 | 1.65 |
| Shallow-water Wave Hgt | Hs | (ft) | 2.7 | 2.3 | 2.14 | 2.3 | 2.8 |
| Ratio Shallow/Deepwater Wv | Hs/H'o | | 0.529 | 0.489 | 0.351 | 0.383 | 0.368 |
| New Breaker Height - | | | | | | | |
| Hb*(Hs/H'o) | Hb | (ft) | 2.84 | 2.42 | 2.03 | 2.19 | 2.66 |
| Water Depth @ Breaking Wave | db | (ft) | | | | | |
| db(min)+Beta*Hb | db(min) | (ft) | 3.2 | 2.9 | 2.8 | 3.1 | 3.7 |
| db(max)=Alpha*Hb | db(max) | (ft) | 4.5 | 3.9 | 3.4 | 3.7 | 4.4 |
| Bottom Elev.Breaking Wave | | (ft) | | | | | |
| db(min) Elev | | (ft.NGVD) | 4208.8 | 4209.1 | 4209.2 | 4208.9 | 4208.3 |
| db(max) Elev | | (ft.NGVD) | 4207.5 | 4208.1 | 4208.6 | 4208.3 | 4207.6 |


GREAT SALT LAKE
SOUTH FETCH
APPLEDALE SLOUGH
NORTHWEST FETCH
WEST OF PERRY
4212-FOOT ELEVATION
NORTHEAST FETCH
SHAW SPRING
SOUTHEAST FETCH
WILLARD RESERVOIR
BOX ELDER COUNTY, UTAH
GREAT SALT LAKE
WIND-WAVE RUNUP MAP
CORPS OF ENGINEERS, SACRAMENTO, CALIFORNIA
PREPARED: L.L.W. NOVEMBER 1996
CHART 1
N
Scale of Miles
Scale 1:250,000
Note: Fetches are approximate
ELEVATION 4195
OCTOBER 1969
CARRINGTON ISLAND
PRECISION BOMBING RANGE
BOX ELDER COUNTY
TOOELE COUNTY
DAVIS COUNTY
WEBER COUNTY
Brigham City
Willard
Perry
Plain City
Warren
West Warren
Slaterville
West Weber
Marriott
Taylor
Wilson
Ogden
Roy
Hooper
Clinton
Sunset
West Point
Kaysville
Farr West
Willard Bay
WILLARD BAY STATE PARK
Willard Reservoir
Bear River Bay
Bear River Bridge
Causeway
Promontory Point
Promontory Point (FAA)
Salt Evaporators
Lakeside
Hogup Siding
Olney Siding
Strongs Knob Siding
STRONGS KNOB
Dolphin Island
Cub Island
Gunnison Island
Coyote Pond
Mud Springs
Beacon
Oil Field
Shaw Spring
Indian Cave
West Side Ranch
Gravel Pit
Saline
Little Mountain
LITTLE MOUNTAIN
CASTLE PEAK
FREMONT ISLAND
HAT ISLAND
Carrington Island
Buffalo Point
Ranch
White Rock Bay
Berlaghole Well
LEDEDAH MOUNTAIN
GERMAN VALLEY
Mud flats
SOUTHERN PACIFIC
LUCIN CUTOFF
BEAR RIVER NATIONAL WILDLIFE REFUGE
Radio tower
Radio Towers
Power Plant
Hill AFB
Salt Evaporator
SALT EVAPORATOR




Definition sketch: wave runup and overtopping.




DEFINITION OF ANGLE FROM SHORE NORMAL

Figure 1. Shore Angle From Shore Normal.

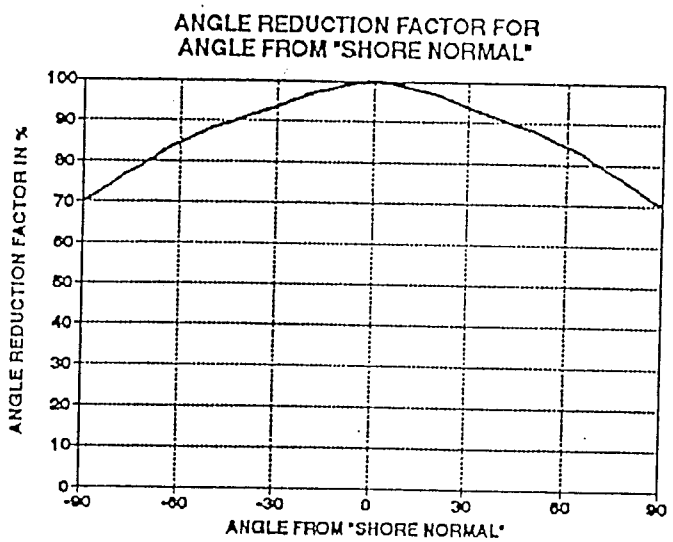



Figure 2. Angle Reduction from Shore Normal.

# Appendix G

Coastal Geomorphology of Great Salt Lake and Vicinity

# COASTAL GEOMORPHOLOGY OF GREAT SALT LAKE AND VICINITY

*by Donald R. Currey, University of Utah*

## ABSTRACT

The Great Salt Lake coast is subdivided into three shoreline zones: high, submerged, and historic, and the geomorphic history of prominent features dating from late Pleistocene Lake Bonneville and Holocene Great Salt Lake is summarized. The initial transgression of the Bonneville lacustral cycle, to a threshold-controlled set of earlier Bonneville shorelines, caused extensive geomorphic modification of the coast. A subsequent mid-Bonneville regression was followed by a final transgression to a later Bonneville shoreline, at which time the original, Bonneville-level threshold in southern Idaho was breached and the lake regressed rapidly as downcutting established a much lower, Provo-level threshold. During the ensuing stillstand an earlier and a later Provo shoreline were separated by slight additional downcutting of the threshold. Increasing aridity finally caused abandonment of the Provo threshold and regression to the Stansbury shoreline, and shortly thereafter to the threshold of Lake Puddle, which was briefly fed by inflow from Lake Bonneville. Further regression to basin-floor levels and then a minor transgression to the Gilbert shoreline concluded the Lake Bonneville saga.

Great Salt Lake apparently diminished to a large playa surrounded by giant desiccation polygons during one or more intervals of maximum mid-Holocene aridity. Fracture zones near Dolphin Island and west of Antelope Island also occur in the submerged shoreline zone. Late Holocene and historic geomorphic features include several shorelines, transverse and parabolic dunes of oolitic sand, and bird-foot deltas at the mouths of the larger influents, particularly the Bear River.

## INTRODUCTION

The Great Salt Lake landscape is coastal in character, perhaps to a greater degree than any other nonmarine landscape in the western hemisphere. Conspicuous landforms and immense volumes of near-surface materials owe their coastal character to processes that have operated not only along the shores of the present lake, but also along the shores of its much larger and much smaller predecessors. Although the Great Basin hydrologic region (figure 1) includes more than 150 other desert basins (Morrison, 1965, p. 265), none of the other basins contains a lake that rivals Great Salt Lake in area or in extent of active shoreline. During the last major glacial-lacustral cycle, in late Pleistocene time, none of the others contained a lake that closely rivaled Lake Bonneville in area, depth, volume, and intensity of coastal processes. The geomorphic history of some of the more prominent features in the Great Salt Lake coastal landscape, as reconstructed by ongoing studies, is summarized in this chapter.

## COASTAL ZONES

The coast of Great Salt Lake can be regarded as extending from the highest level attained by Lake Bonneville to the lowest level exposed in post-Bonneville time. Furthermore, the Great Salt Lake coast can be readily subdivided into three major zones (figure 2), viz., a high shoreline zone above the highest level reached by the lake in historic time (about 1284 m, or 4212 feet), a submerged shoreline zone below the lowest historic level (about 1277 m, or 4191 feet), and a historic shoreline zone in the altitude range between 1277 and 1284 m (4191 and 4212 feet).

### High Shoreline Zone

Several shorelines in the high shoreline zone are so well developed that they are apparent to even a casual observer. The conspicuous shorelines are all products of the last major lacustral cycle, or Bonneville cycle, and in large part acquired their distinctive form during the maximum and regressive stages of that cycle. Shorelines related to transgressive stages of the Bonneville cycle are locally conspicuous, but are very discontinuous in visible expression and are considered here only briefly. Shorelines related to pre-Bonneville lacustral cycles are preserved only in the subsurface at scattered localities and are not considered here.

#### Bonneville Shoreline

Water bodies in the Bonneville basin during the Bonneville cycle were limited in size by topography at Red Rock Pass, in southern Idaho, where the lowest point on the perimeter of the basin had an altitude of about 1550 m (5085 feet) (Crittenden, 1963, p. E14). The geomorphic features that developed along the shores

of the largest water bodies comprise the Bonneville shoreline (plate 1 in pocket), which in the vicinity of Great Salt Lake is really a zone containing several individual shorelines. The type locality of the Bonneville shoreline can very appropriately be regarded as "the great bar at Stockton, Utah" (Gilbert, 1890, p. 97 and plate IX), 10 km (6 miles) southwest of Tooele. In the vicinity of Great Salt Lake the upper limit of the Bonneville shoreline zone now ranges in altitude from about 1573 to 1623 m (5160 to 5325), or up to 73 m (240 feet) above the original threshold-controlled altitude, because of isostatic rebound due to subsequent decreases in water load. Many interpretations regarding the number and age of lake stands in the Bonneville shoreline zone have been proposed by previous workers and have been summarized by Morrison (1965, p. 274, and 1966, p. 86). Ongoing studies utilizing available radiocarbon dates place the ages of an earlier set of Bonneville shorelines and of a separate later Bonneville shoreline between 19,000 and 13,000 years ago.

Figure 1. Location of Great Salt Lake and vicinity within the Great Basin hydrologic region.

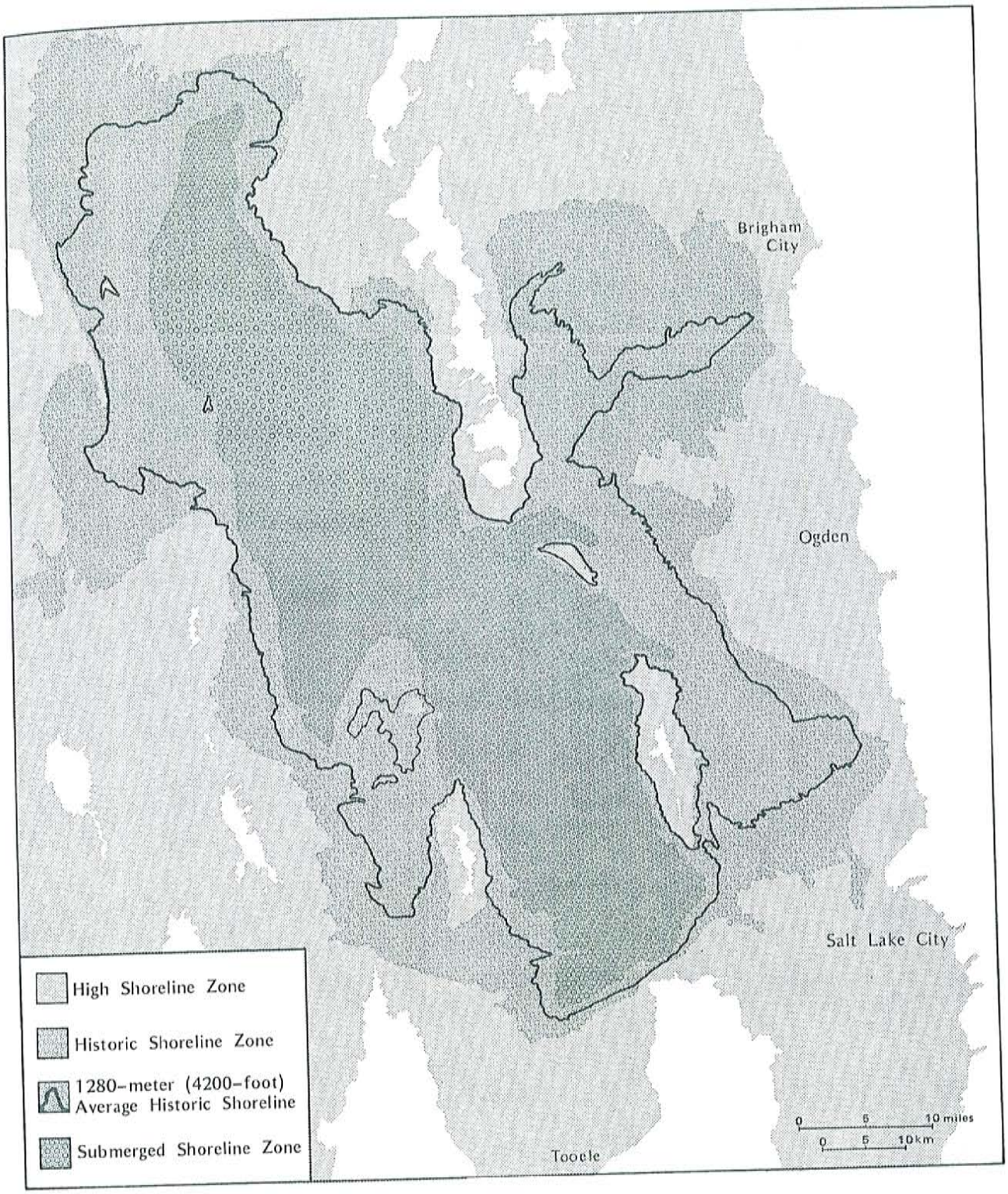



Figure 2. The three major coastal zones of Great Salt Lake and vicinity.

At localities with abundant beach deposits, such as baymouth barriers and cuspate forelands, gravels were laid down at three closely-spaced levels as the initial Bonneville transgression haltingly culminated under threshold control in the Bonneville shoreline zone. Away from the stable threshold at Red Rock Pass, which was subject to only negligible loading, the basin responded to the enormous water load imposed by Lake Bonneville—then approaching a maximum depth of about 350 m (1150 feet)—by sustaining substantial rates of isostatic depression. Therefore, in what is now Great Salt Lake and vicinity, between 64 and 225 km (40 and 140 miles) south of Red Rock Pass, lake stages that successively reached and were stabilized by overflow at the Pass produced beaches at successively higher positions. Of the three beaches that comprise the earlier set of Bonneville shorelines, the lowest contains nearly half of the total sediment; the second also contains about half of the sediment and partially to completely overlies the first at altitudes that average about 6 m (20 feet) higher; the third, with less than 5 percent of the sediment, typically occurs as a single beach ridge or small spit at the top of the morphostratigraphic sequence, again about 6 m (20 feet) above the previous level.

At localities with less abundant deposits, geomorphic expression of the Bonneville shoreline is typically incomplete because the uppermost beach ridge is so weakly developed. Wherever present, however, the uppermost ridge seems to represent the same, relatively brief event. Despite diligent search, ongoing studies thus far have failed to detect a higher shoreline, however faint, at any locality in the northern half of the Bonneville basin. Following the brief stand at the uppermost earlier Bonneville shoreline, a major regression to levels considerably below the Bonneville shoreline zone appears to have occurred in the midst of the Bonneville cycle.

After significantly lower stages had intervened for several thousand years, the Bonneville cycle waxed again in a final transgression to the Bonneville shoreline zone. Relatively limited geomorphic work appears to have been accomplished by the final transgression, possibly because equilibrium coastal landforms and materials were already largely in place on the terrain that was being transgressed. The final transgression culminated at the later Bonneville shoreline. At sites favorable for deposition, such as the north edge of the Stockton Bar, where a good cross-sectional view is available, the later Bonneville shoreline is expressed as a single beach ridge inset into or superimposed on the much more massive deposits of the earlier Bonneville shorelines. At many erosional sites, such as Long Bench (figure 3), near North Ogden, the later Bonneville shoreline is a distinctive boulder-beach trimline on foreshore slopes that date from the initial transgression. In the vicinity of Great Salt Lake the altitudes of the later Bonneville shoreline now range from approximately 1567 to 1606 m (5140 to 5270 feet), or up to 56 m (185 feet) above the original threshold-controlled altitude and about 6 to 17 m (20 to 55 feet) below the uppermost of the earlier Bonneville shorelines. The later shoreline was clearly controlled by the Bonneville threshold, but was positioned slightly below the earlier high shorelines because net isostatic rebound during the preceding low-stage interval had caused central-basin topography to emerge relative to Red Rock Pass. The stand at the later Bonneville shoreline was short-lived, being terminated prematurely by a precipitous regression of Lake Bonneville to the Provo level, about 105 m (345 feet) below.

Along erosional segments of the Bonneville shoreline, cliffs and shore platforms are developed far more prominently in piedmont alluvium (figure 3) than on bedrock. In alluvium, the cliff/platform junction appears to approximate closely the highest water level. On bedrock, the only evidence of the uppermost Bonneville shoreline is commonly a faint erosional trimline. Moreover, at many bedrock localities the uppermost shoreline is obscured by post-shoreline talus, and whatever visible expression of the Bonneville shoreline does exist is due to the two more protracted stands that occurred somewhat before and slightly below the highest stand.

Alluvial fan sediments, colluvium, and other unconsolidated materials of non-lacustrine origin are readily reworked during the transgressive portion of a lacustral cycle. The most massive depositional features, including Gilbert's (1890, p. 135-153) "embankments of the intermediate shore-lines," appear to date from the initial transgression, when the preexisting landscape was in maximum disequilibrium with shore-zone hydrodynamics and, hence, was most vulnerable to wholesale reworking by lacustrine processes. As the initial transgression approached the Bonneville shoreline zone, pre-lacustral materials were eroded, clay and silt sizes were winnowed away in suspension, and, at many localities, prodigious quantities of sand and gravel were delivered to depositional sites by longshore transport. Where clearly evident, directions of longshore transport are shown by arrows in plate 1. Partial cementation of gravels by interstitial tufa occurs widely in the Bonneville shoreline zone, but tufa that is lithoid and nodular in form seems to be localized mainly at the later Bonne-

ville shoreline. Beaches at and near the Bonneville shoreline appear to have been the sources of at least some of the silica sand that comprises isolated parabolic dunes high on the west slope of the Lakeside Mountains.

Streams, discharging runoff and sediment from upland drainages adjacent to the coast of Great Salt Lake, have shaped the Bonneville shoreline in two main ways—by supplying sediments to beaches and deltas as the shoreline was being formed, and by dissecting segments of the shoreline during regressive stages and in post-Bonneville time. Beaches were nourished with sediments from incoming streams at many localities, but deltas were able to prograde the Bonneville shoreline only at the two localities where glacial outwash was most abundant. A small fan-shaped delta was deposited at the mouth of Big Cottonwood Canyon, about 5 km (3 miles) downvalley from the termini of contemporaneous glaciers. A compound fan-shaped delta was deposited at the mouths of Little Cottonwood and Bells canyons in direct contact with contemporaneous glaciers (plate 1). A recent study has shown that the contiguous moraines and shoreline at Bells Canyon date from the maximum of the last major glacial-lacustral cycle (Madsen and Currey, 1979). Elsewhere in the Great Basin, comparably juxtaposed moraines and

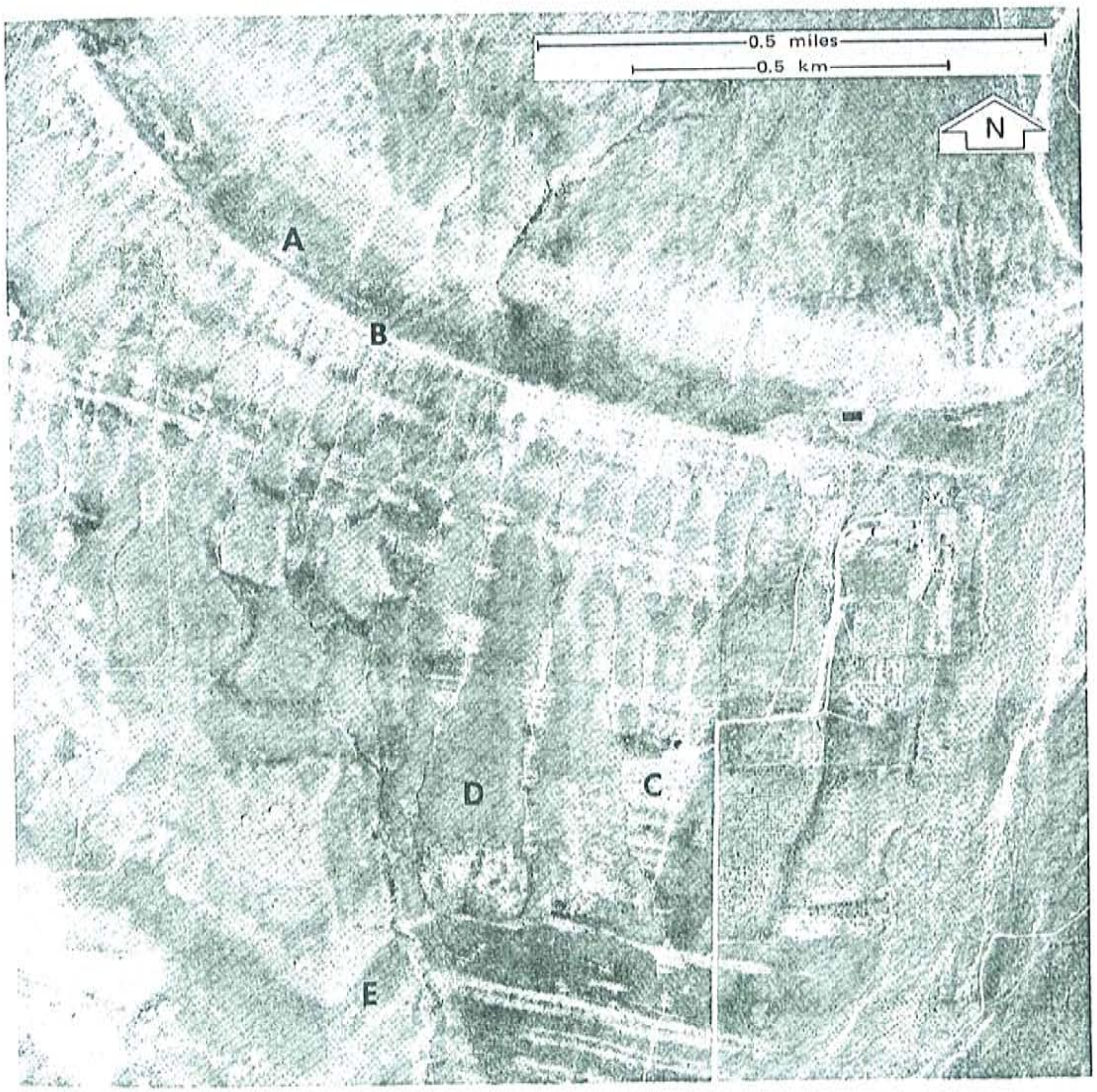



Figure 3. Long Bench, 2.2 km (1.4 miles) north of North Ogden, showing a pre-Bonneville alluvial fan (upper right) deeply notched by earlier Bonneville shorelines (A) and further modified by the later Bonneville shoreline (B). Transgressive boulder beaches (C) are overlain by lacustrine silts (D) that were not removed during the rapid regression to the Provo shoreline (E). Aero Service Corp. photo 5-000077, 13 Apr 1962

shorelines occur only near Mono Lake, in eastern California. At literally hundreds of localities, including the two glacial outwash deltas, shoreline features have been conspicuously dissected by cross-cutting drainage in post-shoreline time.

## Provo Shoreline

The shoreline having the greatest geomorphic development, representing the lake level of greatest duration, is the Provo shoreline (plate 1). The type locality of the Provo shoreline is the Provo River delta, in the vicinity of Provo (Gilbert, 1890, p. 126). Probably during the later stages of the Bonneville-cycle transgressions and certainly at the earlier Bonneville shorelines and again at the later Bonneville shoreline, lake levels had several times reached and been controlled by the Bonneville threshold at Red Rock Pass. What had begun as intermittent, non-catastrophic overflow eventually led to hydraulic breaching of weakly indurated geologic materials and rapid lowering of the threshold about 105 m (345 feet). The resulting catastrophic flood, which severely devastated downstream reaches of the Snake River drainage in Idaho, has been termed the Bonneville Flood (Malde, 1968, p. 2). Much of the regression from the later Bonneville shoreline to the Provo shoreline was so rapid that at many localities recently-deposited, fine-grained lacustrine sediments suffered very little erosion at the edge of the receding lake (figure 3). The lowering of Red Rock Pass ceased in resistant bedrock at an altitude of about 1445 m (4740 feet), as indicated by ongoing studies, thereby establishing the Provo threshold and stabilizing the level of Lake Bonneville at the Provo shoreline. In the vicinity of Great Salt Lake the altitudes of the Provo shoreline now range from about 1460 to 1501 m (4790 to 4925 feet), or up to 56 m (185 feet) above the original threshold-controlled altitude, because of post-Provo isostatic rebound. As with the Bonneville shoreline, previous workers have offered a host of interpretations regarding the number, age, and duration of lake stands at the Provo shoreline (Morrison, 1965, p. 274, and 1966, p. 86). Increasing numbers of radiocarbon dates gradually appear to be placing the Provo shoreline in the interval from about 14,000 to 12,500 years ago.

Exceptionally well developed depositional landforms, including spits, tombolos, cuspate forelands, bayhead beaches, and baymouth barriers, occur at many localities along the Provo shoreline. At localities with extensive progradational sequences, beach ridges were deposited at two quite distinct levels (figure 4). The two

Figure 4. Evaporating Ponds Spit (Eardley and others, 1957, p. 1159), 5 km (3 miles) southwest of South Jordan, showing a cuspate foreland with the earlier Provo shoreline (A) and the later Provo shoreline (B) accentuated by dikes. USDA-ASCS photo AAL-2MM-27, 9 Oct 71.

sets of beach ridges contain roughly equal volumes of sediment, with the upper set having prograded first, apparently under conditions of waning isostatic rebound to waxing isostatic depression, and the lower set having prograded subsequently, but with no evidence of interruption, apparently under conditions of continuing to waning isostatic depression. Wherever observed in the Bonneville basin, the later set of Provo beach ridges is consistently about 3.7 m (12 feet) below the earlier set. The beach ridges at the Provo shoreline, therefore, appear to record a slight downcutting at Red Rock Pass following the isostatic "turnaround" that resulted from unloading and reloading during the mid-Bonneville subcycle. Abandonment of the Provo shoreline, from patently hydroclimatic causes, seems to have been relatively abrupt. The regression of Lake Bonneville apparently continued with only minor pauses to the Stansbury shoreline, over 110 m (360 feet) below.

Where erosion predominated over deposition at the Provo shoreline—typically on steep bedrock headlands fully exposed to wave energy from the northwest, west, and southwest—an erosion platform that attained

widths of as much as 100 m (330 feet) is at many localities the most conspicuous landform in the Great Salt Lake landscape. The platform, which slopes gently basinward from the cliff/platform junction, is a shelf of truncated bedrock that is overlain by a shallow cover of beach gravels. Almost invariably, the outer edge of the platform is fringed with seemingly enormous quantities of conglomeratic and lithoid tufa, generally as a double-layered tufa drapery extending 10 m (33 feet) or more downslope from the platform level. Development of the erosion platform was very dependent on local variations in exposure to wave energy, but development of the tufa drapery tended to be quite consistent from place to place. Individually and in combination, the erosion platform and tufa drapery are almost unmistakable geomorphic signatures of the Provo shoreline. Traced laterally to progradational segments of the Provo shoreline, the erosion platform merges with the lower beach ridge level. Isostatic "turnaround" coupled with a very slight lowering of the controlling threshold apparently provided optimum conditions for sustained local erosion within a narrow altitudinal range at the Provo shoreline. The erosion platform is, in general, overlain by remarkably little post-Provo coverhead.

Almost every Wasatch Front stream that entered Lake Bonneville at the Provo shoreline deposited at least a small delta, although much of the deltaic form was subsequently destroyed by dissection as the streams regraded downward in post-Provo time. The two largest deltas, one at the mouth of the Weber River and one fed by drainage from Big Cottonwood, Little Cottonwood, and Bells canyons, are several tens of square kilometers in area. All of the deltas are of the high-gradient, fan-shaped type, and consist mainly of bed-load sands and gravels. In many respects, the Lake Bonneville deltas are more akin to alluvial fans than to the low-gradient, suspended-load deltas that are typical of large modern rivers. The relatively coarse sediments received by Wasatch Front deltas included alluvium from high-energy mountain streams, outwash from glacial and periglacial sources, and materials from fluvial trenching of higher beaches. In every case, deltas at the Provo shoreline are larger than those at the Bonneville shoreline, mainly because of the longer continuous stand at the lower shoreline and because large volumes of upstream sediments were scoured and then redeposited as streams regraded to the lower shoreline. The large size of the Provo - level delta at the mouth of the Weber River is probably due in part to material scoured from Morgan Valley and other upstream reaches of the Weber River drainage, which had been heavily alluviated during the peaks of the Bonneville cycle. The Big Cottonwood-Little Cottonwood-Bells delta at the Provo level was in part constructed of materials recycled from Bonneville-level deltas at the same localities. Although glaciers and Lake Bonneville probably were never contiguous after the time of the earlier Bonneville shorelines, glacial outwash must have continued to be locally abundant at least until the abandonment of the Provo shoreline, by about which time the main glacier in Little Cottonwood Canyon had receded to what is now the location of Snowbird (Madsen and Currey, 1979).

## Stansbury Shoreline

The most conspicuous shoreline between the Provo level and the surface of Great Salt Lake is in many places the Stansbury shoreline, about midway between (plate 1). The type locality of the Stansbury shoreline is Stansbury Island (Gilbert, 1890, p. 134), where it stands out on very steep slopes as a solitary tufa band with a vertical width of about 10 m (33 feet). The Stansbury shoreline is unrelated to any exterior threshold, posing what was once termed the "Stansbury problem" (Gilbert, 1890, p. 187) and leading to a search within the Bonneville basin for topography that might have provided interior threshold control at that level. No such interior threshold has been found and the Stansbury shoreline is now believed to have resulted from hydrologic equilibrium within its closed basin (Eardley and others, 1957, p. 1164). Incomplete studies suggest that in the vicinity of Great Salt Lake the altitudes of the Stansbury shoreline now range from about 1347 to 1378 m (4420 to 4520 feet), implying about 31 m (100 feet) of differential isostatic rebound since the shoreline features were formed. The most recent stand at the Stansbury shoreline clearly postdates the Provo shoreline and probably occurred between about 12,000 and 11,000 years ago, according to the chronology that is emerging from ongoing studies.

The Stansbury shoreline is notable for the variability of its geomorphic expression, which is usually as beach ridges, erosion platforms, or tufa deposits, and which ranges from very conspicuous to scarcely perceptible. The beach ridges, which are usually best developed in bays, seem to mark the upper limit of the Stansbury shore zone. The tufa-band deposits, which are most conspicuous on the steepest slopes, clearly mark the lower limit, although interstitial tufa is common in gravels throughout the Stansbury shore zone. The erosion platforms, seemingly intermediate within the zone, are not nearly as flat as those at the Provo shoreline, and probably reflect a greater range of water levels

due to the absence of threshold control. Additional study will help to clarify the extent to which earlier stands at or near the Stansbury level may have been involved in creating the assemblage of geomorphic and stratigraphic features that have customarily been ascribed to the Stansbury shoreline.

### Lake Puddle Shoreline

Shortly after Lake Bonneville regressed below the Stansbury shoreline, probably between 12,000 and 11,000 years ago, a lake formed in Puddle Valley, about 100 km (62 miles) west of Salt Lake City. Lake Puddle, which had a maximum area of 114 $km^2$ (44 square miles) within a basin of 404 $km^2$ (156 square miles) and a maximum depth of about 20 m (65 feet), was fed at its north end by inflow from Lake Bonneville (plate 1). The site of the inflow, now traversed by a paved highway 21 km (13 miles) north of the I-80 interchange at Low, is marked by a lobate, steep-fronted delta. Giant ripples on the top of the delta are indicative of high-velocity inflow. The altitude of the Lake Puddle shoreline, or diffuse shore zone, is now about 1340 m (4400 feet). Strong development of shore features was precluded by the lake's small size and brief duration. Precipitation within Puddle Valley basin, the maximum altitude of which is now only 2015 m (6612 feet), could not have been sufficient to prevent rapid dwindling of Lake Puddle after Lake Bonneville fell below the inflow threshold. The life span of this curious lake-on-a-peninsula-in-a-lake may have been no more than a few hundred years.

### Gilbert Shoreline

Of the more frequently-mentioned shorelines in the high shoreline zone, the Gilbert shoreline (plate 1) occurs at the lowest altitudes and is generally the least conspicuous. What can be regarded as a series of type localities of the Gilbert shoreline has been described by Eardley and others (1957, p. 1156-1157 and plates 1-3). In the vicinity of Great Salt Lake the altitudes of the Gilbert shoreline now range from about 1292 m (4240 feet) to about 1310 m (4300 feet), which implies that up to 18 m (60 feet) of differential isostatic rebound has occurred in post-Gilbert time. That magnitude of differential rebound, together with ongoing studies utilizing radiocarbon dating, suggests that the Gilbert shoreline dates from latest Pleistocene time, probably from between 11,000 and 10,000 years ago. The Gilbert shoreline is clearly fresher than any of those above it and, particularly on alluvial piedmonts, is clearly less preserved than any of the visible shorelines below it.

The Gilbert shoreline appears to represent a transgression and fluctuating stand following an interval of lower lake stages. Indications of this are seen in the Great Salt Lake Desert, for example, where it appears that prior eolian dunes were flooded and reshaped in the Gilbert shore zone. Cliffs and erosional platforms are best developed where pre-Gilbert coastal materials were poorly indurated, as along Bluff Road, near Syracuse (figure 5). Nevertheless, cliffs and boulder-strewn abrasion ramps are locally quite evident on well-exposed bedrock headlands. At many localities, sand and gravel from erosional sites was moved by longshore transport to accreting beach ridges at adjacent depositional sites, commonly at the heads of small bays. The largest constructional features at the Gilbert shoreline are spits, among the more notable of which are the distal portion of The Fingerpoint, on the northwest shore of Great Salt Lake, and those near Magna and Mills Junction, near the south shore. Most of the large constructional features at the Gilbert shoreline consist of two contiguous or partially superimposed beach ridges, the crests of which may be as much as 2 m (7 feet) above laterally-adjacent, coeval abrasion platforms. Some of the beaches are capped by dune sand, most of which is well stabilized by vegetation. Deltas graded to the Gilbert shoreline, most notably portions of the Bear River delta north of Corinne, tend to be of the low-gradient, flood-plain type, and consist mainly of suspended-load sediments. The configuration of the Gilbert shoreline appears to be almost completely unrelated to possible control by outflow over an interior threshold within the Bonneville basin, but ongoing studies do suggest the possibility that surface water from the now-separate Sevier River system may have last flowed into the northern half of the Bonneville basin, via the Old River Bed that terminated in what is now Dugway Proving Ground, during the stand at the Gilbert shoreline.

### Late Holocene Shorelines

Several shorelines, not mapped in plate 1, are locally conspicuous in the altitude range between the Gilbert shoreline and the historic shoreline zone. Although the stratigraphy of these fresh-appearing shorelines has only recently come under intensive study, it seems certain that most of them date from late Holocene time. As such, they postdate not only the Gilbert shoreline, but the principal geomorphic features in the submerged shoreline zone (discussed below) as well. Informal names and possible ages suggested by Currey (1977, p. 87) for the two most conspicuous late Holocene shorelines in Great Salt Lake State Park, on the north end of Antelope Island, are adapted for use here.

The higher of the two, approximately halfway between the modern surface of Great Salt Lake and the Gilbert shoreline, is the Fremont shoreline, which may date from between 5000 and 4000 years ago. The lower one, approximately midway between the modern lake and the Fremont shoreline, is the Eardley shoreline, which may date from between 3000 and 2000 years ago. However, it is quite apparent that when ultimately resolved, the late Holocene geomorphic history of Great Salt Lake will prove to be far more complex than is suggested by this simple two-fold model.

On gently-shelving portions of the Great Salt Lake coast the late Holocene shorelines generally occur as low-relief erosional scarplets (figure 5) and as discontinuous depositional ridges. In more steeply-shelving areas the shorelines tend to be more strongly developed, usually as boulder beaches at sites that were predominantly erosional and as beach ridges at depositional sites. As many as a dozen late Holocene beach ridges occur locally in cross-bay and cuspate sets, such as at the south end of Stansbury Island. At some localities the beach ridges are capped by relatively inactive foredunes that

Figure 5. Davis County coast, 3 km (2 miles) west of Syracuse, showing the Gilbert shoreline (paralleled by Bluff Road, upper right diagonal) and two prominent late Holocene shorelines (at left). The east-west highway (center) crosses Farmington Bay (left edge) to Antelope Island. USDA-ASCS photo AAK-2FF-37, 29 May 65.

were essentially contemporaneous with the beaches, and at others the late Holocene beach ridges have been overridden by transverse and parabolic dunes that were initiated later, within the historic shoreline zone. Abandoned channels on the surfaces of low-gradient deltas, and alluvial terraces farther upstream, mark the former courses of streams, such as the Jordan River, that were once graded to late Holocene lake levels.

### Submerged Shoreline Zone

There is much paleoclimatic evidence (e. g., Street and Grove, 1979, figure 12a) to indicate that exceptionally low lake levels occurred in the Southwest during mid-Holocene time. A convergence of absolute dates and age estimates places this interval—often referred to by terms such as Altithermal, Hypsithermal, and Climatic Optimum—between 7500 and 5000 years ago. Indeed, there is a large body of evidence from many areas in the western U. S. to suggest that two intervals of maximum aridity about 7000 to 6500 and 6000 to 5500 years ago were separated by an interval of increased effective moisture about 6500 to 6000 years ago (Benedict and Olson, 1978, p. 184). Given the documented paleoclimatic history of the intermountain region, it is reasonable to hypothesize that Great Salt Lake declined to levels significantly lower than the historic shoreline zone at least once during mid-Holocene time. Detailed stratigraphic analysis of Holocene bottom sediments in Great Salt Lake, which eventually can be expected to provide a definitive test of this hypothesis, is still in its infancy. However, two geomorphic features that occur widely in the submerged shoreline zone—at altitudes below 1277 m (4191 feet)—do seem relevant to broad aspects of the mid-Holocene history of Great Salt Lake and are discussed in the next two sections.

### Mid-Holocene Playa

The floor of Great Salt Lake rivals the Bonneville Salt Flats in flatness. The lowest and fattest part, now at altitudes almost entirely between 1271 and 1274 m (4170 and 4180 feet) is about 100 km (62 miles) long in a north-northwest direction, up to 26 km (16 miles) wide, and about 1450 km$^2$ (560 square miles) in area (plate 1). On the floor of the south arm (Katzenberger, 1975) this submerged plain has a uniform slope of about 0.2 m per km (1 foot per mile) to the east-northeast, with the result that the edge of the plain near Fremont and Antelope islands is about 3 m (10 feet) lower than the edge near Carrington and Stansbury islands. After adjusting for the east-northeast slope, the residual local microrelief on the plain is almost everywhere less than 0.4 m per km (2 feet per mile) and in many places is essentially nil.

From a geomorphic standpoint, the planar floor of Great Salt Lake is best explained by a very shallow or transient water body, wherein wave base and particularly the water surface itself frequently coincided with and smoothly graded the bottom. Apart from now being under 6 to 9 m (20 to 30 feet) of water, the floor of Great Salt Lake is topographically indistinguishable from many of the large subaerial playas that are flooded only intermittently in drier regions of the Basin and Range Province. The east-northeast slope of the lake floor is of a magnitude and direction that can be readily accounted for by differential isostatic rebound since mid-Holocene time, although tectonism involving subbottom fault blocks could also have been a factor. Even at the lowest lake stages, salt marshes and saline ponds would have been maintained along the eastern margin of the basin floor by diminished, but still significant, runoff from the Wasatch and Uinta mountains. Elsewhere on the basin floor, ground-water-discharging salt flats grading into moist, saline mud flats would have been the most extensive surface types. As the available evidence is reconstructed here, the floor of Great Salt Lake was a playa landscape at least briefly during mid-Holocene time.

### Mid-Holocene Polygons

Polygonal fissure patterns, in every respect identical to giant desiccation polygons described from 39 playas elsewhere in the Great Basin (Neal and others, 1968), occur in the submerged shoreline zone of Great Salt Lake. Polygons ranging from clearly visible to partially veiled by younger sediments occur over about 400 km$^2$ (155 square miles) of the lake bed (plate 1), and have been observed at altitudes as low as 1275 m (4183 feet) on aerial photographs taken in November, 1965, when the surface altitude of Great Salt Lake was 1277.8 m (4192.3 feet) (figure 6). The polygonal patterns tend to be irregular random orthogonal; most of the individual polygons are between 15 and 100 m (50 and 330 feet) across, and the largely-infilled fissures usually appear to be about 1 m (3 feet) wide at the top. The reported tendency of fissure spacing to be about 10 times fissure depth (Neal and others, 1968, p. 83) and the habit of desiccation fissures to develop above the water table provide a basis for estimating former water levels. On this basis, it can be inferred from observable polygons that at the time of polygon formation water levels were probably no higher than the adjacent playa surface. The desiccation polygons and the playa surface

would seem to have formed simultaneously during one or more mid-Holocene intervals of maximum aridity.

### Fracture Zones

What appear to be fracture zones can be observed on the bed of Great Salt Lake in two areas (plate 1). From near Monument Point, at the south end of Hansel Valley, the Dolphin Island fracture zone has an arcuate trend that averages approximately S 25 W over a distance of at least 21 km (13 miles). The zone includes two prominent parallel linears and a roughly parallel pattern of what may be sink holes produced by solution of evaporites or by ground-water discharge. The Dolphin Island fracture zone was modified by, and therefore predates, shore-zone processes during Holocene low-lake stages. Topographic expression suggests that the bed of Great Salt Lake may be downthrown or may have subsided to the east.

From 4 km (2.5 miles) west of White Rock, near the northwest end of Antelope Island, the White Rock fracture zone trends N 30 W for about 1.6 km (1 mile). The zone consists of at least 10 subparallel, *en echelon* elements (figure 6), each of which appears to be slightly downthrown to the southwest. The visible fractures in the zone appear not to have been modified by coastal processes and may be of very late Holocene age.

### Historic Shoreline Zone

As described elsewhere in this Bulletin, the shoreline of Great Salt Lake has ranged from a historic high altitude of 1284 m (4212 feet) in 1873 to a historic low of 1277 m (4191 feet) in 1963. Although a very dynamic zone from the viewpoint of its human contemporaries, the lacustrine features of the historic shoreline zone are inherently less pronounced than those of the high shoreline zone, where greater fetches were conducive to higher shoreline energies. Some of the geomorphic features in the historic zone, it should be added, represent prehistoric shorelines within the zone. In many gently-shelving areas partial planation of the historic shoreline zone has tended to produce knob-and-swale topography, with remnants of older lake beds projecting above intervening washouts. On steeply-shelving headlands erosional shorelines are marked by lag deposits that range from distinctive boulder beaches to

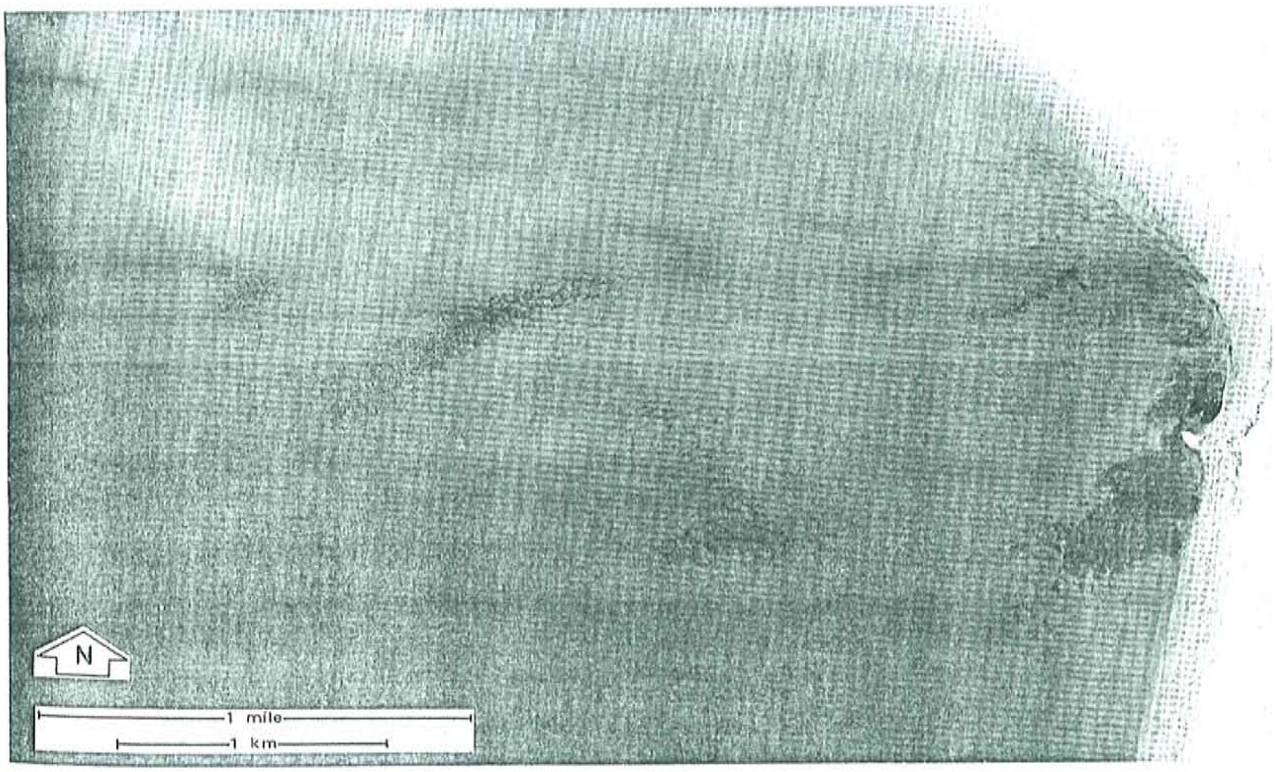



Figure 6. White Rock Bay, near the northwest end of Antelope Island, showing submerged features, including mid-Holocene desiccation polygons (center) and the White Rock fracture zone (left center). White Rock is at right center. Intermountain Aerial Surveys photo GS-VBIV 2-192, 9 Nov 65.

indistinct stone lines. Small berms, usually either of oolitic sand or of gravel derived from oolitic beachrock, are common constructional landforms. Shallow lagoons are locally enclosed by barrier berms, particularly where the coast is embayed. In terms of area, saline mud flats are by far the predominant landform in the historic shoreline zone.

At many localities in and adjacent to the historic shoreline zone, lacustrine landforms are subordinate to landforms produced by eolian processes. Water-laid berms are buried by foredune ridges at localities where the wind has been able to transport ample quantities of oolitic sand from the exposed foreshore to the vegetation line. Where copious quantities of sand have been moved in that fashion the coastal landscape is dominated by small dune fields (plate 1). Almost without exception, sand dunes in the vicinity of Great Salt Lake are predominantly oolitic and are oriented to receive onshore winds from the northwest (Dean, 1978, p. 104). The dunes range from highly active to quite stable and are primarily of the transverse type, with secondary parabolic dunes projecting downwind from local blowouts.

Of final geomorphic note within the historic shoreline zone are the mouths of the three largest entering rivers, where predominantly fine-grained fluvial loads and minimal lacustrine energies have combined to produce deltas that locally approach the classic bird-foot form. The most striking example is the Bear River delta (figure 7), in North and South bays of the Bear River Migratory Bird Refuge. Incipient bird-foot deltas occur at the mouths of Weber River distributaries in the

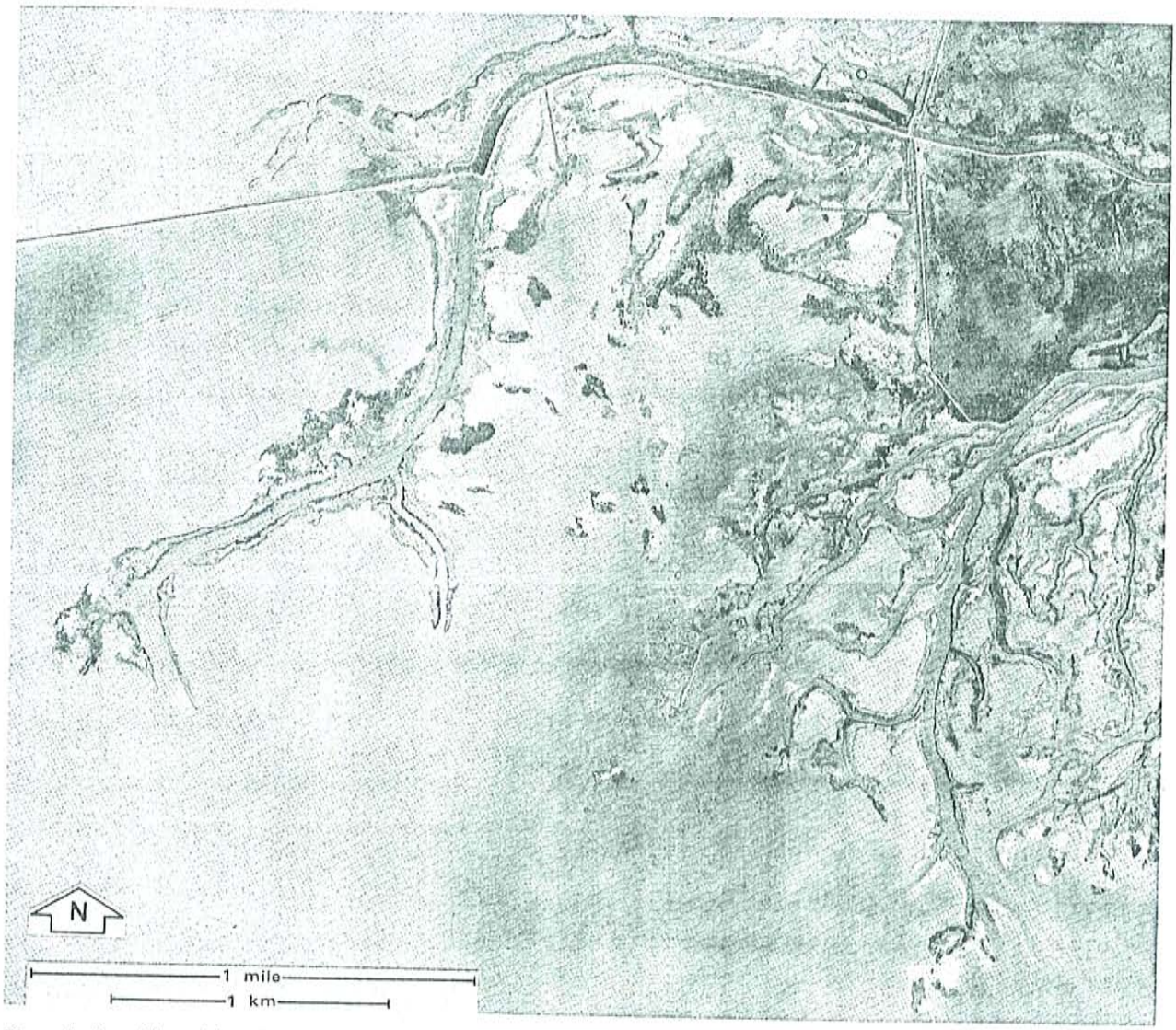
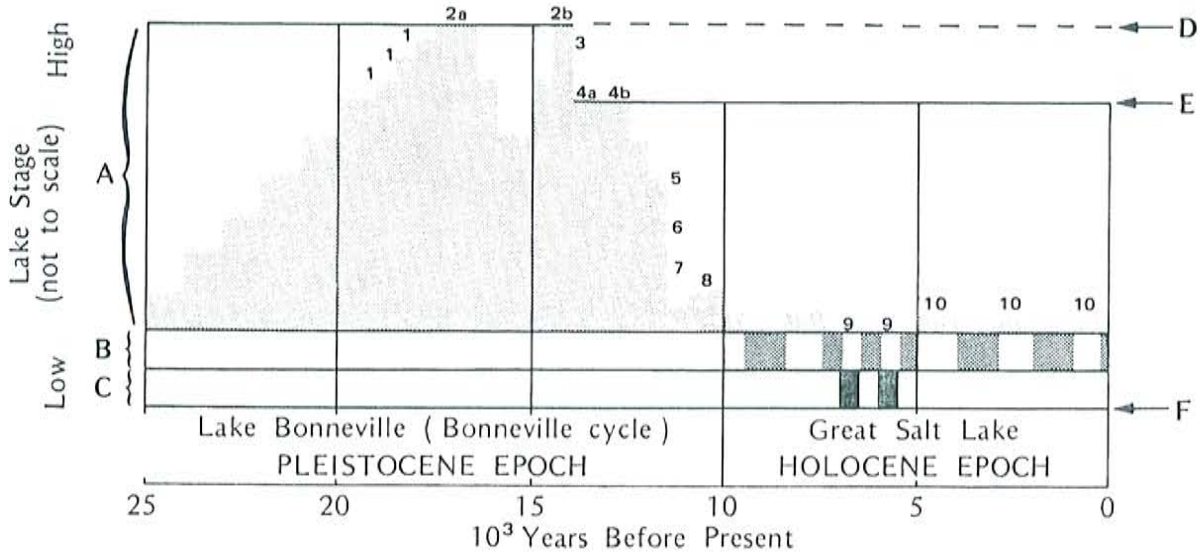



Figure 7. Bear River delta, showing the inactive Old River Channel (upper left) and the active Mouth of Bear River (lower right), with bird-foot distributary patterns of natural levees. Intermountain Aerial Surveys photo GS-VBIV 2-149, 9 Nov 65.

Harold S. Crane, Ogden Bay, and Howard Slough waterfowl management areas, and at the mouth of the Jordan River, in Farmington Bay Waterfowl Management Area. At the mouth of the Bear River, greater quantities of suspended sediment have resulted in higher rates of deltaic progradation. In each area, lacustrine energies have been artificially minimized by dikes or causeways.

## SUMMARY OF LATE QUATERNARY GEOMORPHIC HISTORY

The geomorphic events reviewed above, which substantiate major aspects of interpretations proposed in the early 1950s (Morrison, 1965 and 1966, figures 2C, 2D, and 2E), but depart somewhat from previous interpretations on the basis of information being developed by ongoing studies that are utilizing regional-scale morphostratigraphic, tectonostratigraphic, and chronostratigraphic methods, are summarized schematically in figure 8. Several transgressive shorelines (figure 8-1), some possibly under threshold control, prograded locally during the later stages of the initial Bonneville transgression. The initial transgression culminated under threshold control at three earlier Bonneville shorelines (figure 8-2a), the uppermost of which is only moderately developed. A subsequent regression to relatively low stages during mid-Bonneville time was followed by a final Bonneville transgression that culminated at the later Bonneville shoreline (figure 8-2b), which was below the earlier Bonneville shorelines because of intervening net isostatic rebound. The later shoreline is weakly expressed, its development having been arrested by hydraulic failure of the Bonneville threshold (figure 8-D) at Red Rock Pass, which produced a catastrophic flood (figure 8-3) and a rapid regression to the Provo threshold (figure 8-E). A long stillstand at the earlier Provo shoreline (figure 8-4a) was continued at the later Provo shoreline (figure 8-4b) after a small additional increment of threshold downcutting. Growing aridity eventually caused abandonment of the Provo threshold and regression to a fluctuating stand at the Stansbury shoreline




A. High shoreline zone
B. Historic shoreline zone
C. Submerged shoreline zone
D. Bonneville threshold
E. Provo threshold
F. Great Salt Lake playa

1. Transgressive shorelines
2a. Earlier Bonneville shorelines
2b. Later Bonneville shoreline
3. Bonneville Flood
4a. Earlier Provo shoreline
4b. Later Provo shoreline
5. Stansbury shoreline
6. Lake Puddle level
7. Danger Cave level
8. Gilbert shoreline
9. Mid-Holocene playa stage(s)
10. Late Holocene shorelines

Figure 8. Schematic representation of late Quaternary fluctuations of Lake Bonneville and Great Salt Lake.

(figure 8-5). Quickening regression lowered lake stages briefly to the inflow threshold of Lake Puddle (figure 8-6) and then, stepwise through a series of minor shorelines, to levels approaching the floor of the basin, well below the level of Danger Cave (figure 8-7), near Wendover. A minor transgression that culminated in a dual stand at the Gilbert shoreline (figure 8-8), was the final episode in the history of late Pleistocene Lake Bonneville. Little is known about the early Holocene history of Great Salt Lake. It is probable that the floor of the Lake was exposed as a large playa (figure 8-F), with extensive surrounding tracts of giant desiccation polygons, during one and possibly two mid-Holocene intervals of maximum post-Bonneville aridity (figure 8-9). A complex sequence of shorelines, including two or three that are locally quite prominent (figure 8-10), developed at relatively low altitudes in late Holocene time.

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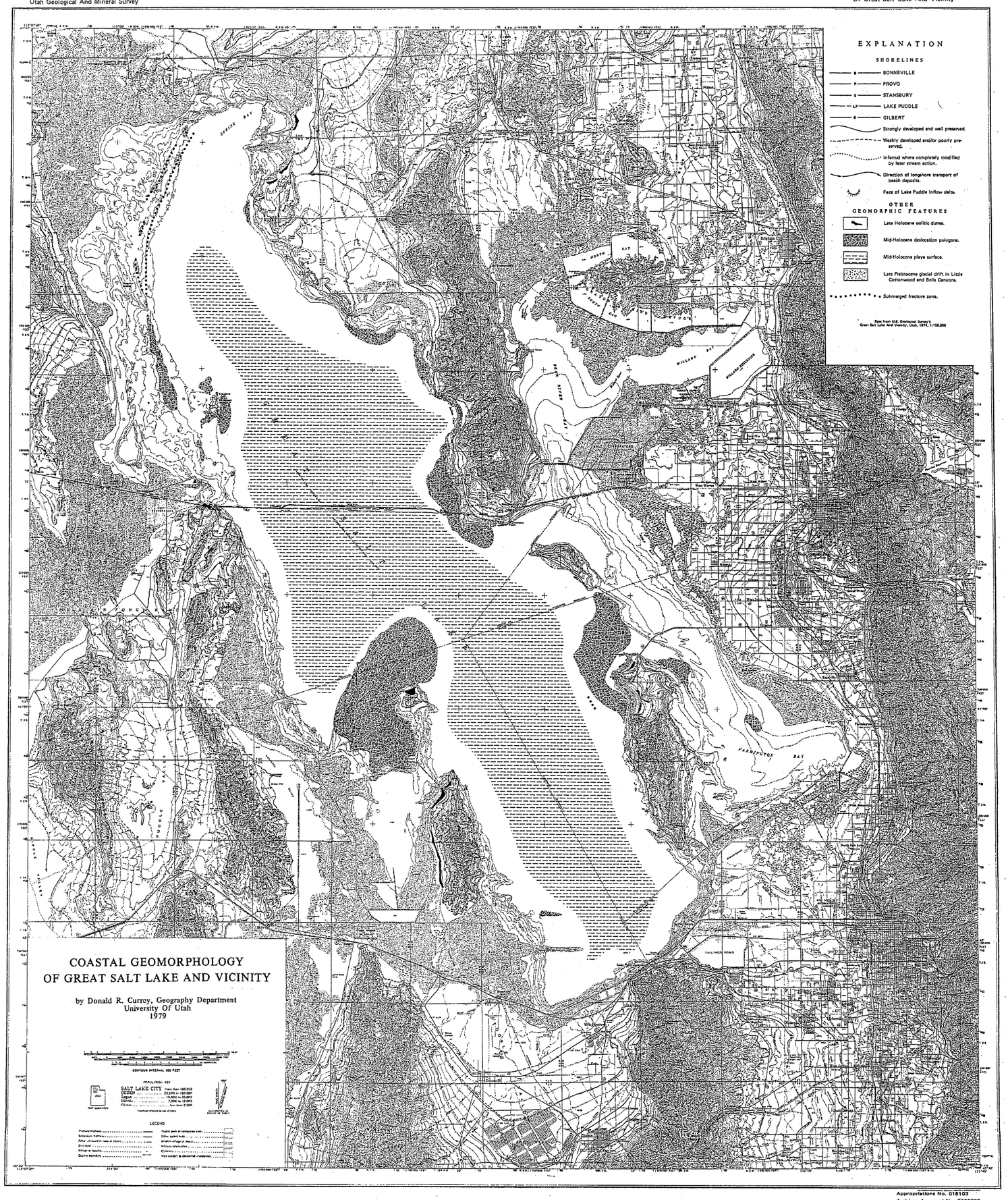
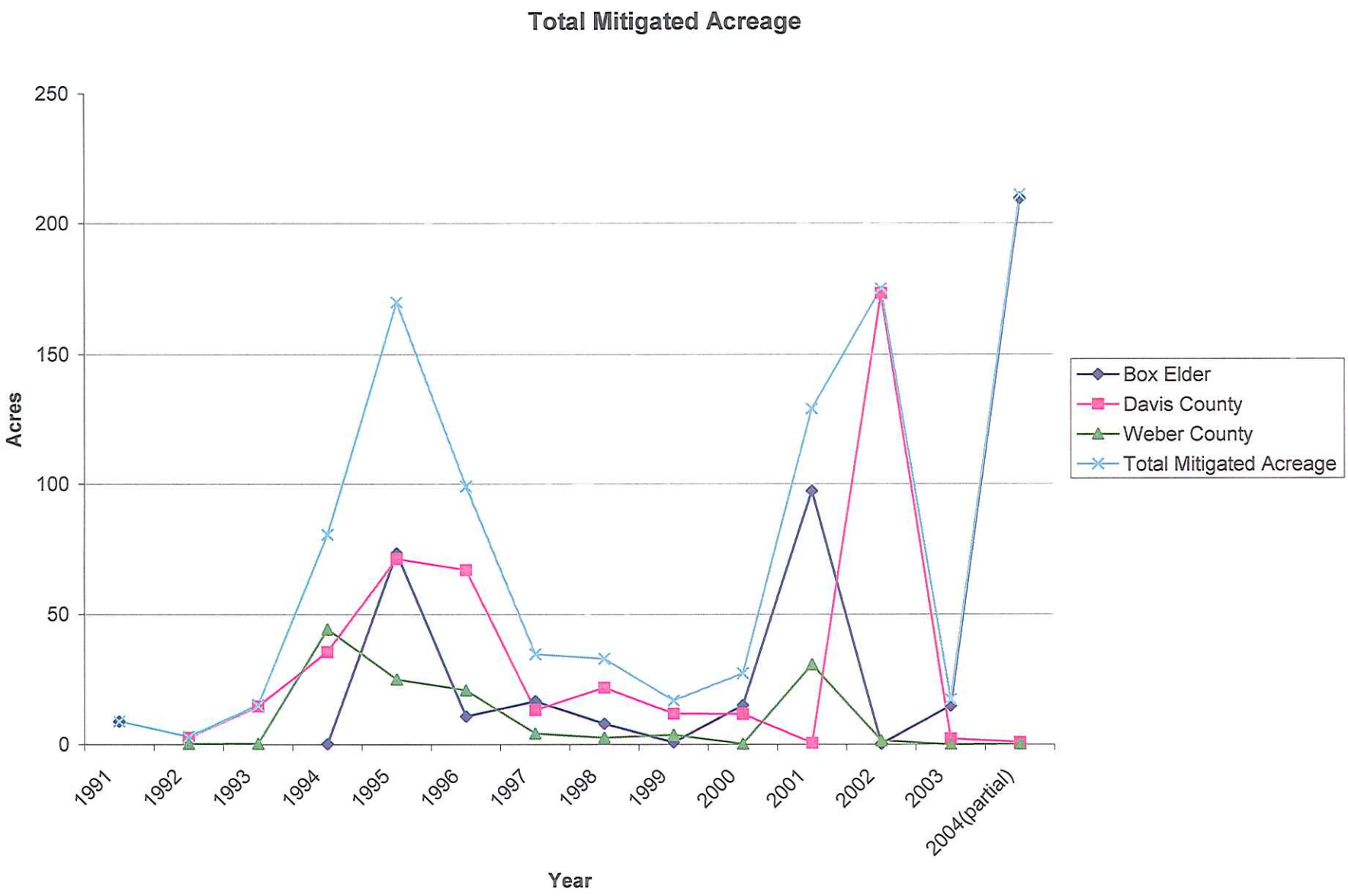
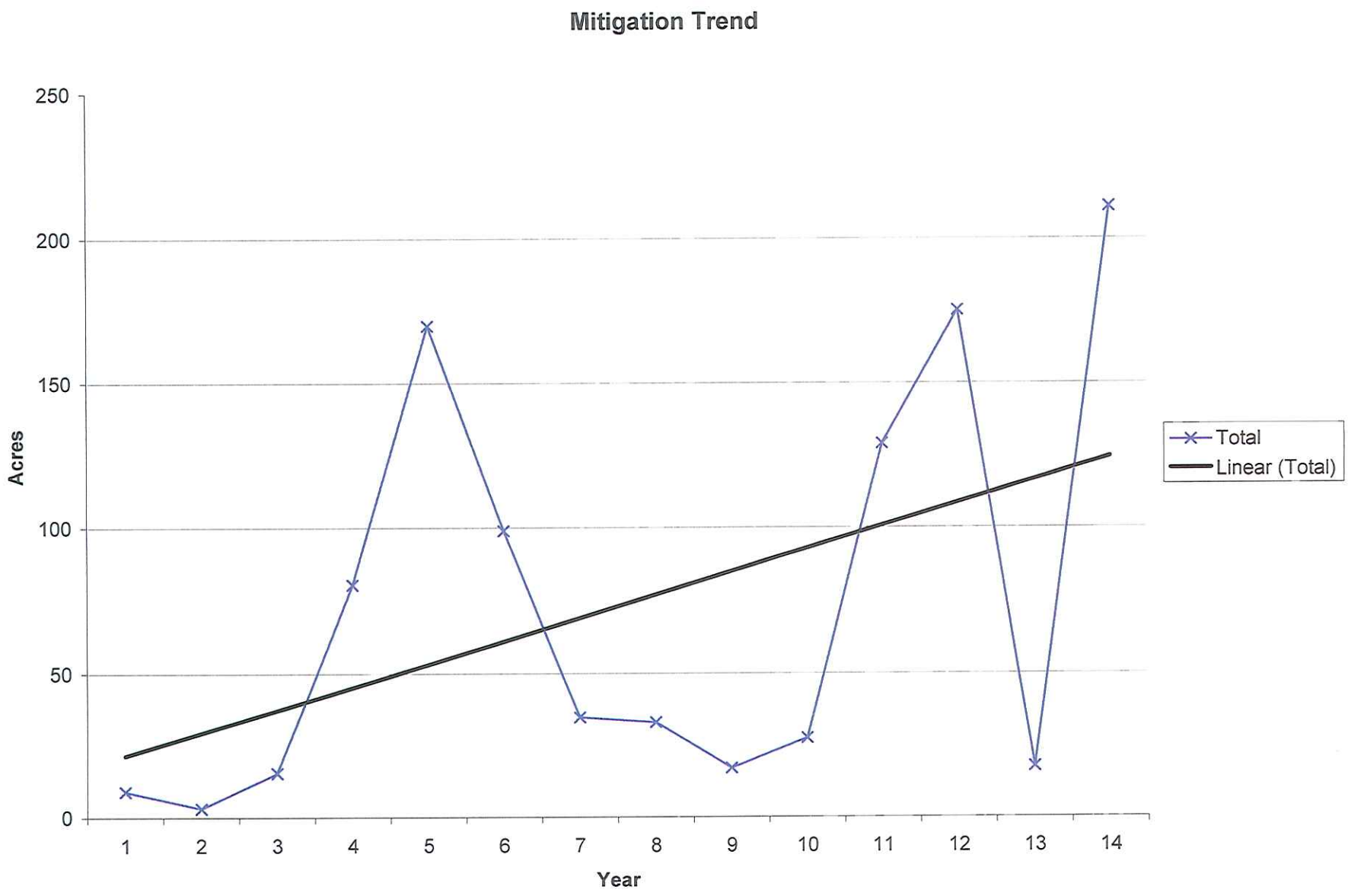


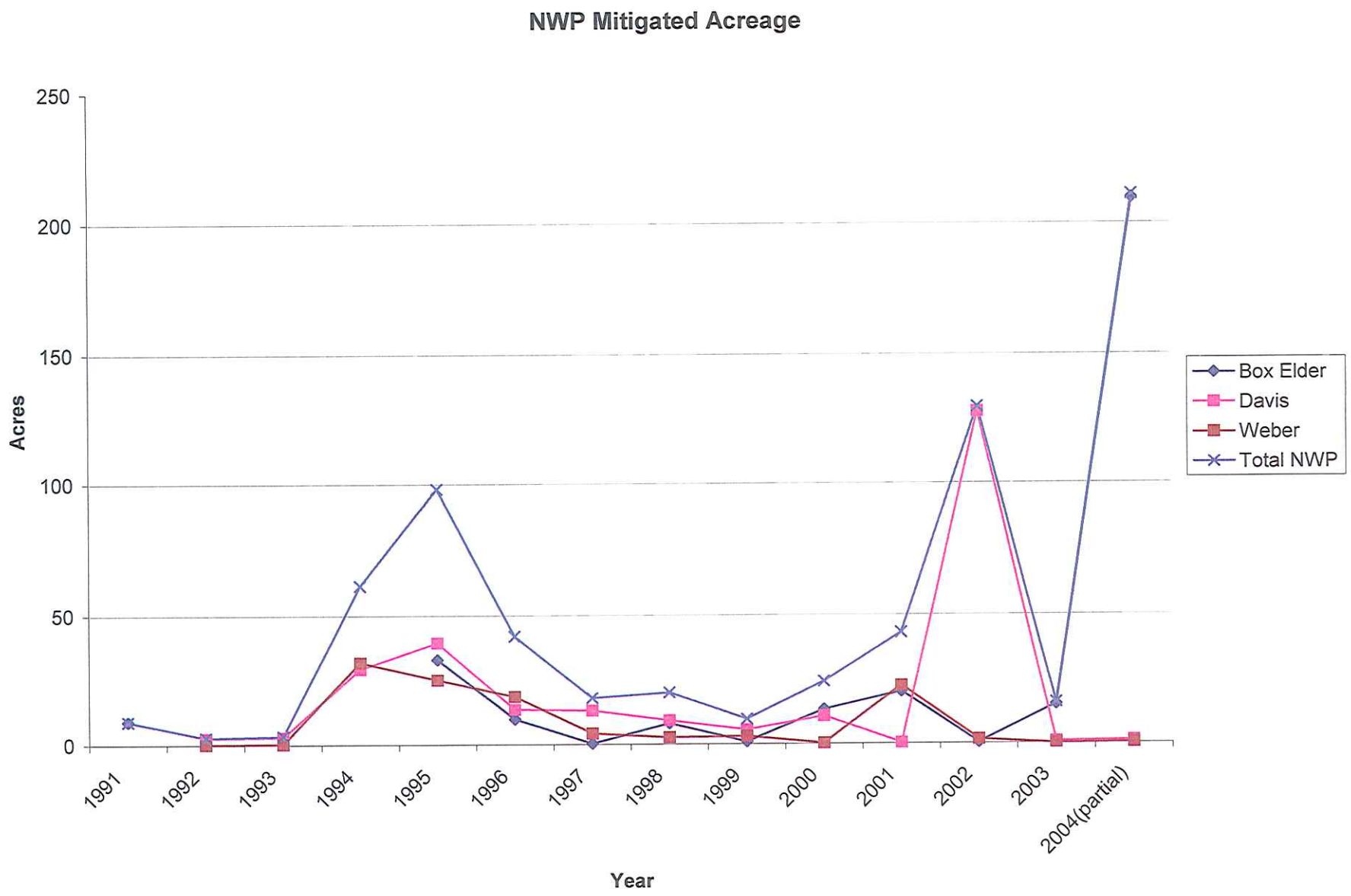

Appropriations No. 016103
Archives Approval No. 7900525

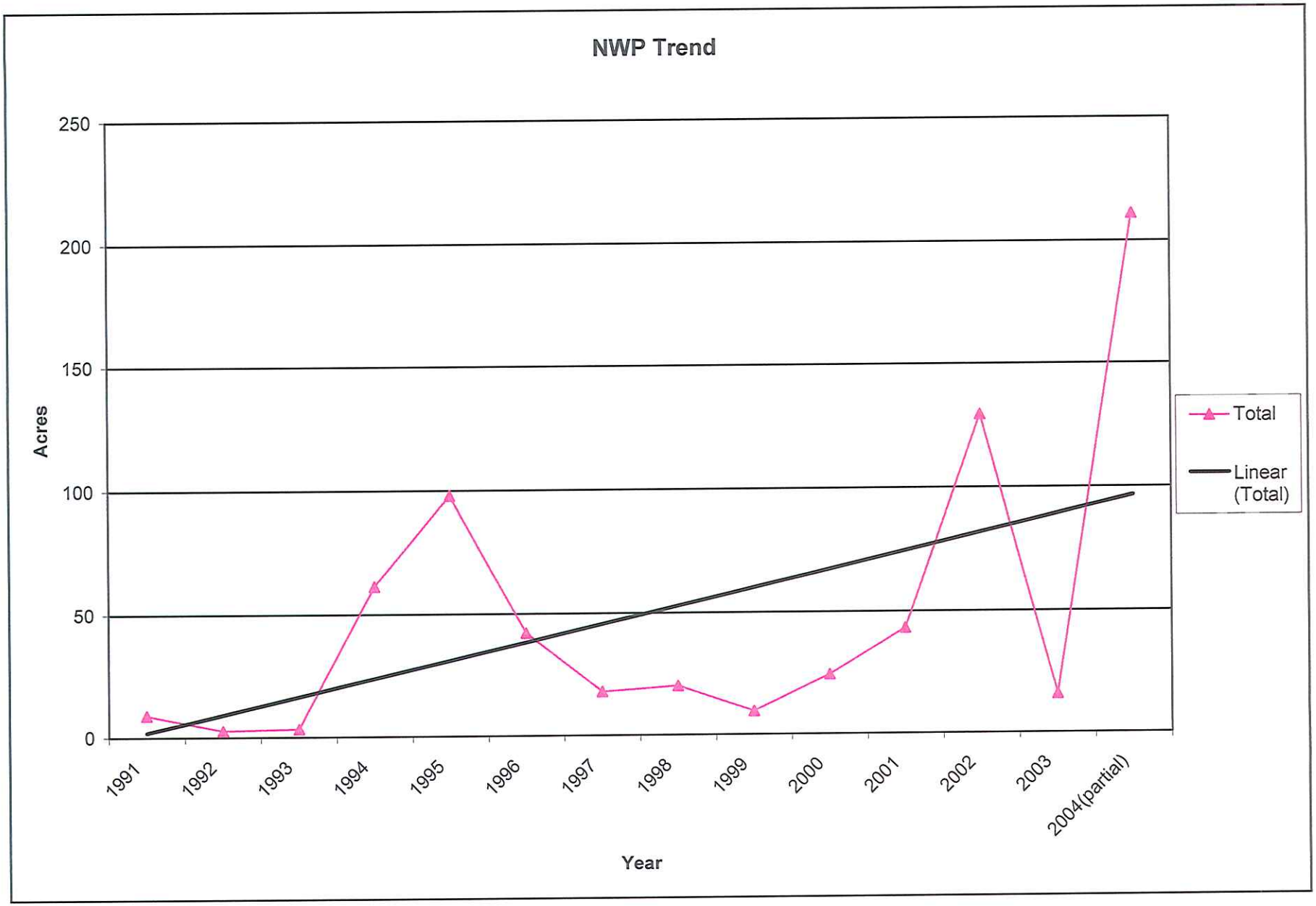
# Appendix H

USACE Mitigation History in Box Elder, Daveis and Weber Counties


Total Mitigated Acreage
250
200
150
100
50
0
Acres
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004(partial)
Year
Box Elder
Davis County
Weber County
Total Mitigated Acreage


Mitigation Trend
250
200
150
100
50
0
Acres
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Year
Total
Linear (Total)


NWP Mitigated Acreage
250
200
150
100
50
0
Acres
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004(partial)
Year
Box Elder
Davis
Weber
Total NWP


NWP Trend
250
200
150
100
50
0
Acres
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004(partial)
Year
Total
Linear (Total)

Permitted Wetland Impacts (ac)

| | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004(partial) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Box Elder County | 9 | | | 0.3 | 16.119 | 11.868 | 29.18 | 8.241 | 3.96 | 15.25 | 79.209 | 11.67 | 5.821 | 201.96 | 392.578 |
| Davis County | | 1.862 | 9.821 | 23.434 | 50.575 | 32.441 | 11.37 | 16.952 | 17.331 | 12.007 | 3.254 | 9.865 | 3.072 | 0.243 | 192.227 |
| Weber County | | 0.158 | 0.35 | 33.3 | 22.273 | 12.17 | 4.38 | 2.581 | 2.73 | 1.1 | 13.936 | 3.871 | 0.412 | 0.25 | 97.511 |
| | 9 | 2.02 | 10.171 | 57.034 | 88.967 | 56.479 | 44.93 | 27.774 | 24.021 | 28.357 | 96.399 | 25.406 | 9.305 | 202.453 | 682.316 |

Mitigated Wetland Acreage

| | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004(partial) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Box Elder County | 9 | | | 0.3 | 73.35 | 10.978 | 16.88 | 8.17 | 0.97 | 15.28 | 97.3 | 0.35 | 15.1 | 209.6 | 457.278 |
| Davis County | | 2.941 | 15.028 | 35.802 | 71.26 | 67.03 | 13.56 | 22.19 | 12.181 | 11.97 | 0.86 | 173.171 | 2.398 | 1.103 | 429.494 |
| Weber County | | 0.158 | 0.35 | 44.35 | 25.18 | 21 | 4.35 | 2.7 | 3.86 | 0.25 | 30.957 | 1.57 | 0.009 | 0.25 | 134.984 |
| | 9 | 3.099 | 15.378 | 80.452 | 169.79 | 99.008 | 34.79 | 33.06 | 17.011 | 27.5 | 129.117 | 175.091 | 17.507 | 210.953 | 1021.756 |

Permitted NWP (ac)

| | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004(partial) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Box Elder County | 9 | | | | 10.109 | 9.908 | 0.481 | 8.071 | 3.96 | 13.28 | 1.409 | 1.07 | 5.821 | 201.96 | 265.069 |
| Davis County | | 1.512 | 2.221 | 17.092 | 31.175 | 10.391 | 11.02 | 4.052 | 11.341 | 10.767 | 2.754 | 4.085 | 1.402 | 0.243 | 108.055 |
| Weber County | | 0.158 | 0.35 | 21.77 | 22.273 | 9.82 | 4.38 | 2.581 | 1.99 | 1.1 | 5.582 | 3.871 | 0.412 | 0.25 | 74.537 |
| | 9 | 1.67 | 2.571 | 38.862 | 63.557 | 30.119 | 15.881 | 14.704 | 17.291 | 25.147 | 9.745 | 9.026 | 7.635 | 202.453 | 447.661 |

Mitigated Wetland Acreage

| | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004(partial) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Box Elder County | 9 | | | | 33.1 | 9.818 | 0.38 | 8.07 | 0.97 | 13.31 | 20.2 | 0.35 | 15.1 | 209.6 | 319.898 |
| Davis County | | 2.611 | 3.028 | 29.46 | 39.76 | 13.63 | 13.21 | 9.29 | 5.551 | 10.73 | 0.36 | 127.571 | 0.728 | 1.103 | 257.032 |
| Weber County | | 0.158 | 0.35 | 32.01 | 25.18 | 18.65 | 4.35 | 2.7 | 3.12 | 0.25 | 22.603 | 1.57 | 0.009 | 0.25 | 111.2 |
| | 9 | 2.769 | 3.378 | 61.47 | 98.04 | 42.098 | 17.94 | 20.06 | 9.641 | 24.29 | 43.163 | 129.491 | 15.837 | 210.953 | 688.13 |

IMPACTED WETLAND ACREAGE (NON-TIDAL)

Restoration

| | | Requested IP | Requested GP/NW | Permitted IP | Permitted GP/NW | Mitigated IP | Mitigated GP/NW | Enf Violation | ement |
|---|---|---|---|---|---|---|---|---|---|
| Box Elder County | | | | | | | | | |
| 190107651 | GREAT SALT LAKE MINERALS | 2500.000 | | 2500.000 | | 4210.000 | | | |
| 199101163 | UDOT US 89/91 BRIGHAM TO WELLSVILLE | | 9.000 | | 9.000 | | 9.000 | | |
| 199450022 | BLM (4 DIKES) SALT WELLS SPRINGS | 0.300 | | 0.300 | | 0.300 | | | |
| 199550130 | VICTOR ROMER'S ROAD CROSSING (NW-14 | | 0.009 | | 0.009 | | | | |
| 199550233 | VICTOR ROMER'S (VIO.) BRIGHAM A-T-F NW14 | | | | | | | 0.250 | |
| 199550360 | SANDERS SHRIMP CO. 5 AF BOAT HARBORS IP | 0.260 | | 0.260 | | | | | |
| 199550400 | BAKER SPRING DIKES AT LOCOMOTIVE WMA (GP | | 0.100 | | 0.100 | | | | |
| 199550439 | BEAR RIVER CLUB POND & ROAD (IP) | 0.500 | | 0.500 | | 35.000 | | | |
| 199550529 | PERRY CITY'S DALE YOUNG PARK PATH NW-26 | | 0.100 | | 0.100 | | 0.100 | | |
| 199550540 | THE BUZINAS BROTHERS DIV STRUCTURE NW-3 | | 0.100 | | 0.100 | | | | |
| 199550541 | OCEAN STAR BOAT HARBOR-INDIAN COVE (IP) | 0.100 | 0.100 | 0.100 | 0.100 | | | | |
| 199550633 | BOX ELDER CO. JAIL FILL (PDN) (9.7 AC.) | | 9.700 | | 9.700 | | 33.000 | | |
| 199550706 | BEAR RIVER MIGRATORY BIRD REFUGE (GP-44) | 5.000 | | 5.000 | | 5.000 | | | |
| 199650029 | MORTON INT. ACCESS RD. WIDENING NW-26 | | 0.088 | | 0.088 | | 0.008 | | |
| 199650054 | NORTH SHORE LIMITED PARTNERSHIP CANAL IP | 0.800 | | 0.800 | | | | | |
| 199650093 | MAYOR POND'S BRIGHAM CITY NW-26 | | 0.100 | | 0.010 | | | | |
| 199650127 | RON & STEVE'S WATER CONT STRUC (NW18) PDN | | 0.010 | | 0.010 | | 0.010 | | |
| 199650183 | SALT CREEK WMA BY-PASS-CHANNEL GP-44 | | 9.700 | | 9.700 | | 9.700 | | |
| 199650541 | GP-40 MCMURDIE FARMS DEWEY SPRING | | 0.100 | | 0.100 | | 0.100 | | |
| 199650560 | STANGL'S ACCESS ROAD - 3.25 MI. (IP) | 1.160 | | 1.160 | | 1.160 | | | |
| 199750020 | WESTWOOD SUBDIV. PHASE 1 BRIGHAM NW-12 | | 0.100 | | 0.100 | | 0.100 | | |
| 199750064 | WILLARD BAY NORTH JETTY REPAIR (NW-3) | | 0.100 | | 0.100 | | 0.100 | | |
| 199750364 | DANIEL WOOLDRIDGE LOT, FILL .07 AC. NW26 | | 0.070 | | 0.070 | | 0.070 | | |
| 199750439 | BRIGHAM CITY, SIDEWALK ON FOREST ST NW26 | | 0.100 | | 0.100 | | 0.100 | | |
| 199750458 | VULCRAFT MIT. FOR 8629 INDIV. PERMIT | 0.100 | | 0.100 | | 0.100 | | | |
| 199750465 | LORIN SMITH HOUSE PAD FILL BRIGHAM NW-26 | | 0.100 | | 0.100 | | 0.100 | | |
| 199750556 | BRIGHAM, BEECHER SPRING DEVELOPMENT NW26 | | 0.010 | | 1.000 | | 0.010 | | |
| 199750745 | POINTE PERRY, ROLAND WALKER | 28.600 | | 28.600 | | 16.400 | | | |

IMPACTED ND ACREAGE (NON-TIDAL)

Restoration

| | | Requested IP | Requested GP/NW | Permitted IP | Permitted GP/NW | Mitigated IP | Mitigated GP/NW | Enforcement Violation |
|---|---|---|---|---|---|---|---|---|
| 199850014 | BRIGHAM CITY - DEV. BEECHER SPR. - IP | 0.070 | 0.070 | 0.070 | 0.070 | 0.070 | 0.070 | |
| 199850032 | BEAR RIVER BIRD REFUGE DIKES/CANALS GP44 | | 8.000 | | 8.000 | | 8.000 | |
| 199850045 | WATER LINE CROSSING | | 0.001 | | 0.001 | | | |
| 199850206 | SALT CREEK INC. DREDGE HARBOR GSL IP | 0.100 | | 0.100 | | 0.100 | | |
| 199950030 | WILLARD WILDLIFE AREA DOG POND (NW-26) | | 2.990 | | 2.990 | | | |
| 199950058 | I-15 BRIGHAM TO HONEYVILLE WIDENING NW26 | | 0.710 | | 0.710 | | 0.710 | |
| 199950544 | WALMART SEWERLINE, CORINNE NW12 | | 0.200 | | 0.200 | | 0.200 | |
| 199950613 | BOB DAVIS VIOLATION PERRRY CITY | | 0.060 | | 0.060 | | 0.060 | |
| 200050336 | UNION PACIFIC RAILROAD EMERGANCY PERMIT | | 10.500 | | 10.500 | | 10.500 | |
| 200050480 | WAL-MART STORE | | 0.470 | | 0.470 | | 0.500 | |
| 200050551 | WAL-MART STORES INC. PLAT B DEVELOPMENT | | 0.340 | | 0.340 | | 0.340 | |
| 200050560 | HONEYVILLE WATER SKI POND NW-42 | 1.970 | 1.970 | 1.970 | 1.970 | 1.970 | 1.970 | |
| 200150004 | BRIGHAM CITY AIRPORT EXTENSION (IP) | 77.100 | | 77.100 | | 77.100 | | |
| 200150050 | PROMENTORY POINT MARINA GSL (IP) | 0.700 | | 0.700 | | | | |
| 200150306 | REPLACE MALAD BRIDGE, ELWOOD 01-29-02SA | | 0.010 | | 0.010 | | | |
| 200150378 | MANTUA BOAT RAMP (BRIGHAM CITY) (NW-3) | | 0.001 | | 0.001 | | | |
| 200150401 | WETLAND DELINEATION, BRIGHAM CITY | | 0.200 | | 0.200 | | 0.200 | |
| 200150474 | PIPELINE REPLACEMENT, PERRY 01-29-04SA | | 0.001 | | 0.001 | | | |
| 200150510 | NORTH AMERICAN WATERFOWL MANAGENT PLAN | | 1.197 | | 1.197 | | 20.000 | |
| 200250065 | PACIFICORP BEN LOMOND SUBSTATION | | 0.130 | | 0.095 | | | |
| 200250079 | ROGER OYLER POND RESTORATION | | 0.270 | | 0.270 | | | |
| 200250124 | WALMART SEWERLINE EXTENSION | | 0.340 | | 0.340 | | 0.340 | |
| 200250435 | SEWER LAGOONS EXPANSION PROJECT, PERRY | 10.600 | | 10.600 | | | | |
| 200250457 | BRIGHAM CITY WEST FOREST STREET UTILITY | | 0.010 | | 0.010 | | 0.010 | |
| 200250503 | PIPE BURIAL MALAD RIVER 02-29-07SA | | 0.002 | | 0.002 | | | |
| 200250504 | RIVER BANK BUILDUP | | 0.001 | | 0.001 | | | |
| 200250505 | ROAD WIDENING WILLOW CREEK 02-29-02SA | | 0.001 | | 0.001 | | | |
| 200250513 | BEAR RIVER DIVERSION USFWS 02-29-04SA | | 0.001 | | 0.001 | | | |
| 200250519 | STREAM MEANDOR IMPROV. 02-13-02SA | | 0.350 | | 0.350 | | | |

| | | Requested | | Permitted | | Mitigated | | En. ement |
|---|---|---|---|---|---|---|---|---|
| Restoration | | IP | GP/NW | IP | GP/NW | IP | GP/NW | Violation |
| 200350080 | R&P WETLANDS AND WATERFOWL DIKE REPAIR | | 5.000 | | 5.000 | | 15.000 | |
| 200350241 | REGGIE PETERSON DIKE REPAIR | | 0.100 | | 0.100 | | 0.100 | |
| 200350383 | BRIDGE OVER WILLARD CREEK 03-29-01SA | | 0.001 | | 0.001 | | | |
| 200350388 | ROAD AND PIPELINE CONSTRUCTION | | 0.250 | | 0.250 | | | |
| 200350484 | SPRING MAINTENANCE | | 0.470 | | 0.470 | | | |
| 200450024 | BEAR RIVER REFUGE PLOWING PROJECTS | | 200.000 | | 200.000 | | 200.000 | |
| 200450044 | DIKE ENLARGEMENT AND REHABILITATION | | 1.760 | | 1.760 | | 9.400 | |
| 200450214 | BRIGHAM CITY CHANNEL MAINTANCE | | 0.200 | | 0.200 | | 0.200 | |
| | Box Elder County Totals | 2627.360 | 265.193 | 2627.360 | 266.058 | 4347.200 | 319.998 | 0.250 |
| Davis County | | | | | | | | |
| 199250185 | ANDERSON, J. - SHADOW ACRES-CENTERVILLE | | 0.360 | | 0.360 | | 1.400 | |
| 199250205 | KAMBOURIS | | 0.172 | | 0.172 | | 0.231 | |
| 199250287 | FARMINGTON STORM WATER CANAL | | 0.500 | | 0.500 | | 0.500 | |
| 199250309 | FARMINGTON SEWERLINE | | 0.350 | | 0.350 | | 0.350 | |
| 199250327 | PIPELINE CONNECTION IN CENTERVILLE | | 0.130 | | 0.130 | | 0.130 | |
| 199250328 | KENDELL-VIO WETLAND ADJ WEBER RIVER | 0.500 | | | | | | 0.390 |
| 199250329 | WINCHESTER-VIO WETLAND ADJ WEBER RIVER | 0.826 | | | | | | 0.130 |
| 199250330 | COOK-VIO WETLAND ADJ WEBER RIVER | | | | | | | 0.990 |
| 199250331 | PEEK-VIO WETLAND ADJ WEBER RIVER | 0.700 | | 0.350 | | 0.330 | | 0.710 |
| 199250335 | THURGOOD-ROAD IN THORNFIELD SUB. KAYSVIL | 0.870 | | | | | | |
| 199350024 | CLINTON DRAIN ACCESS | | 0.030 | | 0.030 | | | |
| 199350055 | FARIWAY COVE-HAIGHT CREEK AND WETLANDS | | 0.110 | | | | | |
| 199350090 | BAILEY, CLARON - VIO IN CENTERVILLE | | | | | | | 0.150 |
| 199350091 | VIO - WILLIAM STAFFORD | | | | | | | 0.120 |
| 199350104 | CLEARFIELD-CENTER ST EXPANSION | | 0.010 | | 0.010 | | 0.010 | |
| 199350123 | DAVIS COUNTY SCHOOLS | | 1.110 | | 1.110 | | 1.110 | |
| 199350139 | SLEEPY HOLLOW SUB. - VIO MID.FK. KAYS | | | | | | | 0.150 |
| 199350215 | MARCHANT THORNFIELD SUBDIVISION VIO | | | | | | | 0.050 |
| 199350229 | GOURLEY C WD FARMINGTON | | 0.470 | | 0.470 | | 1.000 | |

IMPACTED AND ACREAGE (NON-TIDAL)

Restoration

| | | Requested IP | Requested GP/NW | Permitted IP | Permitted GP/NW | Mitigated IP | Mitigated GP/NW | Enforcement Violation |
|---|---|---|---|---|---|---|---|---|
| 199350271 | BROWER VIO ON S FORK HOLMES CREEK | | | | | | | 0.100 |
| 199350279 | HAFB BLOOD, MARCUS WD | | 0.100 | | 0.100 | | 0.100 | |
| 199350283 | SYRACUSE STORM DRAIN DAVIS CO | 7.600 | | 7.600 | | 12.000 | | |
| 199350295 | RAVENBERG / INTERMOUNTAIN SURVEYING VIO | | 0.250 | | 0.250 | | 0.500 | |
| 199350310 | JORDAN FUR & REC BOAT SLIPS | | 0.006 | | 0.006 | | | |
| 199350334 | FARMINGTON CTY NW26 KAMBOURIS LANE | | 0.215 | | 0.215 | | 0.218 | |
| 199350352 | WELKER, STEVE - S.P. INVESTMENT CO. | | 0.010 | | 0.010 | | | |
| 199350353 | DAVIS CO. PARKING LOT FOR CAUSEWAY | | 0.020 | | 0.020 | | | |
| 199450006 | MILLER R S WEBER BUILDING LOT | 0.092 | | 0.092 | | 0.092 | | |
| 199450028 | CANNON, GARFF - FARMINGTON RESIDENCE | | 0.150 | | 0.150 | | 0.150 | |
| 199450029 | FOXBRIDGE SUBDIVISION / WRIGHT RD CROSS | | 0.260 | | 0.260 | | 0.260 | |
| 199450037 | SUN QUEST DEV - GOLF COURSE IN SYRACUSE | | 0.520 | | 0.520 | | 11.230 | |
| 199450067 | BROCKBANK - GOLDEN MEADOWS SUBDIVISION | | 0.500 | | 0.500 | | 0.500 | |
| 199450110 | HOGGAN, K.-FIELDCREST SUBD.-WOODS CROSS | | 2.400 | | 2.400 | | 2.400 | 0.800 |
| 199450129 | SAVAGE INDUSTRIES - CENTERVILLE BUSINESS | | 3.000 | | 3.000 | | 3.000 | |
| 199450170 | UDOT - FENCE REPLACEMENT ON I-15 | | 0.070 | | 0.070 | | | |
| 199450242 | BLOCK VALVE AND BUILDING - CONOCO | | 0.002 | | 0.002 | | | |
| 199450250 | NIELSON, R. / MAYWOOD DEVELOPMENT | | 2.000 | | 2.000 | | 2.000 | |
| 199450251 | PARKER, EVAN-RELOCATION OF SWALE-HOOPER | | 0.460 | | 0.460 | | 0.760 | |
| 199450253 | WOODSIDE HOMES-FOXBRIDGE SUB. PLATS H, I | | 0.920 | | 0.920 | | 1.000 | |
| 199450257 | PSC DEVELOPMENT-COURTYARD AT PAGES LANE | | 2.500 | | | | | |
| 199450265 | LAYTON CITY PARKS & REC-BOARDWALK | | 0.010 | | 0.010 | | | |
| 199450285 | CROWLEY, M.-JOCKEY CLUB SUBD./FARMINGTON | | 0.850 | | 0.850 | | 0.850 | |
| 199450289 | JOHNSON, BRUCE - ACCESS ROAD, FARMINGTON | | 0.080 | | 0.080 | | | |
| 199450303 | STENQUIST, LEE - SUNSET DRIVE WIDENING | | 0.110 | | 0.110 | | | |
| 199450319 | ARGYLE, RALPH - ARGYLE FARMS SUBDIVISION | | 2.000 | | 2.000 | | 2.000 | |
| 199450357 | TAYLOR, J.-CENTERVILLE INDUSTRIAL PARK | | | | | | | 0.800 |
| 199450360 | TAYLOR, L. - CLEARFIELD APARTMENTS | 6.250 | | 6.250 | | 6.250 | | |
| 199450364 | WESTHOFF, S.-FILL REMOVAL-SE GLOVER LANE | | 0.030 | | 0.030 | | 0.030 | |

Restoration

| | | Requested | | Permitted | | Mitigated | | Enforcement |
|---|---|---|---|---|---|---|---|---|
| | | IP | GP/NW | IP | GP/NW | IP | GP/NW | Violation |
| 199450368 | JOHANSEN, R. - TWO HOUSES ON BURKE LANE | | 0.720 | | 0.720 | | 0.500 | |
| 199450378 | TELEMARK DEV.-MEADOW CREEK VILLAGE - ROY | | 2.200 | | 2.200 | | 2.200 | |
| 199450459 | KAYSVILLE CITY CORP-500 EAST EXTENSION | | 1.660 | | | | | |
| 199450489 | CLC ASSOCIATES - CENTERVILLE TARGET | | 0.810 | | 0.810 | | 2.580 | |
| 199450520 | SLEEPY HOLLOW SUB. - VIO MID.FK. KAYS | | | | | | | 0.900 |
| 199550226 | WELLING, LAWRENCE - DRAINED WETLAND | | 0.600 | | 0.600 | | | |
| 199550248 | DAVIS COUNTY - BARNARD CREEK | | 0.005 | | 0.005 | | | |
| 199550252 | SYMPHONY HOMES - CENTERVILLE WET MEADOW | 19.400 | 9.900 | 19.400 | 9.900 | 31.500 | 22.000 | |
| 199550260 | GRAMOLL-WD | | 0.080 | | 0.080 | | | |
| 199550296 | PERRY HOMES-CAVE HOLLOW SUBD-CENTERVILLE | | 0.110 | | 0.110 | | 0.110 | |
| 199550340 | PAYNE, EARL S. - VIOLATION IN SYRACUSE | | | | | | | 0.030 |
| 199550393 | LAYTON CITY/DICKAMORE-SEWER LINE-KAYS CR | | 0.110 | | 0.110 | | 0.220 | |
| 199550433 | KLEIN, D. - WD IN CENTERVILLE | | 0.100 | | 0.100 | | | |
| 199550436 | M.C. GREEN & SONS - CENTERVILLE PROJECT | | 7.700 | | 7.700 | | 4.000 | |
| 199550438 | DAVIS COUNTY - REGIONAL DETENTION BASIN | | 0.900 | | 0.900 | | 1.000 | |
| 199550482 | JORDAN FUR & RECLAMATION-NEW DUCK PONDS | | 7.000 | | 7.000 | | 7.000 | |
| 199550490 | LODDER, C. - OLD MILL FARMS - KAYSVILLE | | 3.000 | | 3.000 | | 3.000 | |
| 199550514 | UDOT - POND MAINTENANCE I-15/S.R. 232 | | 0.050 | | 0.050 | | | |
| 199550567 | ASPEN SPRINGS/MARVIN NEFF - CENTERVILLE | | 0.500 | | 0.500 | | 0.500 | 0.500 |
| 199550578 | WRIGHT, G. - OLD SHEPARD COMMONS | | 0.250 | | 0.250 | | 0.250 | |
| 199550701 | SINGLEY, J. - JET SKI PONDS - FARMINGTON | | 1.430 | | 1.430 | | 1.430 | |
| 199550736 | FARMINGTON BAY WATERFOWL MANAGEMENT AREA | | 0.250 | | 0.250 | | 0.250 | |
| 199650040 | PROWS BECKNELL & ALLES - FARMINGTON DEV. | 22.050 | | 22.050 | | 53.400 | | |
| 199650053 | HAMLET DEVELOPMENT - VILLA D'FRANCE SUBD | | 5.000 | | 5.000 | | 5.000 | |
| 199650162 | WOODSIDE HOMES - FIDDLERS CREEK SUBD. | | 0.140 | | 0.140 | | 0.140 | |
| 199650239 | MARTINEZ, R-RESIDENCE AND BARN - W POINT | | 0.500 | | 0.500 | | 2.300 | |
| 199650249 | DALTON/LONDON PROPERTY | | 0.870 | | 0.410 | | 1.230 | |
| 199650270 | MODERN PACKAGING - 200 WEST, FARMINGTON | | 0.100 | | 0.100 | | 0.100 | |
| 199650338 | BANGERTER, R-CENTERVILLE WD-1150 W 850 N | | 0.001 | | 0.001 | | | |

IMPACTED WETLAND ACREAGE (NON-TIDAL)

Restoration

| | | Requested | | Permitted | | Mitigated | | En. Violation |
|---|---|---|---|---|---|---|---|---|
| | | IP | GP/NW | IP | GP/NW | IP | GP/NW | |
| 199650373 | HIGH DESERT PROPERTIES-OAKRIDGE PARK | | 0.430 | | 0.430 | | 0.400 | |
| 199650412 | JONES PROPERTY - 1500 N. WEST BOUNTIFUL | | 0.230 | | 0.230 | | | |
| 199650428 | S. DAVIS SEWER DISTRICT - NEW SEWER LINE | | 0.100 | | 0.100 | | 0.100 | |
| 199650502 | FARMINGTON BAY BOAT LAUNCH | | 0.010 | | 0.010 | | | |
| 199650503 | WESTERN STATES DEV-TOON PROPERTY-CLINTON | | 0.260 | | 0.260 | | 0.260 | |
| 199650522 | ADAMS, J - WD IN WEST KAYSVILLE | | 0.200 | | 0.200 | | 0.200 | |
| 199650552 | EQUIVEST DEV - SYRACUSE MEADOWS SUBD. #3 | | 0.250 | | 0.250 | | 0.250 | |
| 199650556 | CLC ASSOCIATES - LAYTON TARGET | | 0.210 | | 0.210 | | 0.300 | |
| 199650621 | WOODSIDE HOMES - MEADOW CROSSINGS SUBD. | | 0.250 | | 0.250 | | 0.250 | |
| 199650646 | PACIFIC DEV.- NORTH PARK VILLAGE-LAYTON | | 2.300 | | 2.300 | | 3.100 | |
| 199750097 | DWR - FOOTBRIDGES AT FARMINGTON BAY | | 0.070 | | 0.070 | | | |
| 199750141 | LODDER, C.P.-SINGLE FAMILY HOME-CTRVILLE | | 0.900 | | 0.900 | | 0.900 | |
| 199750162 | DAVIS CO - 200 SOUTH STORM DRAIN | | 2.340 | | 2.340 | | 2.340 | |
| 199750180 | JENSEN, C-COMMERCIAL DVLPMT - KAYSVILLE | | 0.500 | | 0.500 | | 0.500 | |
| 199750307 | SUBDIVISION-ISOLATED WETLAND | | 1.860 | | | | 2.970 | |
| 199750363 | SMITH-BRUBAKER/CHERRY MEADOWS LAYTON | | 0.800 | | 0.800 | | 0.900 | |
| 199750390 | TURVILLE, S.-PARKSIDE SUBD.-KAYSVILLE | | 2.500 | | | | | |
| 199750464 | DIVERSIFIED HABITATS-RAINEY MIT. SITE | 0.350 | | 0.350 | | 0.350 | | |
| 199750504 | PERRY HOMES - PARK MEADOW SUBDIVISION | | 1.900 | | 1.900 | | 1.900 | |
| 199750804 | IVORY HOMES-WD ON HILLFIELD RD., LAYTON | | 0.950 | | 0.950 | | 2.000 | |
| 199750805 | MILLER, R-CONTINENTAL ESTATES-FARMINGTON | | 1.000 | | 1.000 | | 1.000 | |
| 199750806 | WOODSIDE HOMES-CHELSIE PARK SUBDIVISION | | 0.700 | | 0.700 | | 0.700 | |
| 199850043 | FURST CONSTRUCTION-LEGACY RETIREMENT INN | | | | | | | 0.900 |
| 199850071 | VENTER, WILLEM; PLEASANT CK SUBDIVISION | | 0.170 | | 0.170 | | 5.730 | |
| 199850106 | SIERRA-GULF LLC-SPRING MEADOWS SUBD. | | 0.350 | | 0.350 | | 0.350 | |
| 199850257 | DIKE REPAIR | | 0.100 | | 0.100 | | | |
| 199850271 | SEWER LINE | | 0.100 | | 0.100 | | | |
| 199850369 | DRAINAGE IMPROVEMENTS | | 0.001 | | 0.001 | | | |
| 199850417 | FEIZ, KUNTZ, KELLY - LAYTON SITE | | 0.450 | | 0.450 | | 0.450 | |

IMPACTED ND ACREAGE (NON-TIDAL)

Restoration

| | | Requested IP | Requested GP/NW | Permitted IP | Permitted GP/NW | Mitigated IP | Mitigated GP/NW | Enforcement Violation |
|---|---|---|---|---|---|---|---|---|
| 199850431 | LINGARD - FARMINGTON SUBDIVISION | | 0.060 | | 0.060 | | 0.060 | |
| 199850472 | REDWOOD VILLAGES, WETLANDS, DEVELOPMENT | 12.900 | | 12.900 | | 12.900 | | |
| 199850473 | DAVIS COUNTY - ANTELOPE ISLAND CULVERT | | 0.001 | | 0.001 | | | |
| 199850553 | JBJ ASSOCIATES, LLC - FARMINGTON | | 0.400 | | 0.400 | | 0.400 | |
| 199850560 | NELSON, BRENT - CASTLEBERRY & NEWBERRY | | 0.050 | | 0.050 | | | |
| 199850578 | SMITH, EDWARD - CENTERVILLE INDUSTRIAL | | 1.300 | | 1.300 | | 1.300 | |
| 199850599 | PACE, LARRY & KAY | | 1.070 | | 1.070 | | 1.000 | |
| 199950056 | SHERIFF, MERRILL - WAREHOUSE | | 1.690 | | 1.690 | | 1.700 | |
| 199950065 | UDOT - US-89 AND SOUTH WEBER DRIVE | | 0.800 | | 0.800 | | | |
| 199950086 | SKYPARK AIRPORT MEL ROZEMA GORDON MILLS | 3.360 | | 3.360 | | 4.000 | | |
| 199950181 | OLSEN, GOURDIN, H. - DRAINAGE SYSTEM | | 0.001 | | 0.001 | | 0.001 | |
| 199950262 | BALLARD, DAVID CANYON MEADOW SOUTH WEBER | 1.230 | | 1.230 | | 1.230 | | |
| 199950486 | SYRO, INC. - CENTERVILLE JD | | 2.550 | | 2.550 | | 2.550 | |
| 199950536 | WILLIAMS, GREG - DIVERSIFIED HABITATS JD | | 1.300 | | 1.300 | | 1.300 | |
| 199950542 | PRINCE, ALAN - WEST BOUNTIFUL SITE / WD | 1.400 | | 1.400 | | 1.400 | | |
| 199950614 | NEW STATE INC. - POND 46 SOUTH | | 5.000 | | 5.000 | | | |
| 200050066 | USB PROPERTIES - CENTERVILLE INDUSTRIAL | | 3.000 | | 3.000 | | 3.000 | |
| 200050083 | SPETH, MICHAEL - KAYSVILLE PARCEL | | 0.037 | | 0.037 | | | |
| 200050162 | PHEASANT VILLAGE - JD | | 0.080 | | 0.080 | | 0.080 | |
| 200050340 | 1350 FRONTAGE ROAD IN FARMINGTON | 1.240 | | 1.240 | | 1.240 | | |
| 200050341 | JOHN DIAMOND POND RESTORATION | | 7.200 | | 7.200 | | 7.200 | |
| 200050569 | TR TECH WETLAND DEVELOPMENT SYRACUSE | | 0.450 | | 0.450 | | 0.450 | |
| 200150198 | SOUTH DAVIS COUNTY SEWER LEVEE REPAIR | | 0.010 | | 0.010 | | 0.010 | |
| 200150248 | HIRSCHI POND | 0.500 | | 0.500 | | 0.500 | | |
| 200150275 | DAVIS COUNTY SEWER LINE REPLACEMENT | | 0.100 | | 0.100 | | 0.100 | |
| 200150367 | BOYER COMPANY, (WHEELER FARM 415 ACRES) | | 0.050 | | 0.050 | | 0.050 | |
| 200150371 | WEST BOUNTIFUL FLOOD PROJECT | | 0.100 | | 0.100 | | 0.100 | |
| 200150372 | JENSEN BANK STABLIZATION | | 0.001 | | 0.001 | | | |
| 200150387 | MCDONALD RETAINING WALL | | 0.100 | | 0.100 | | 0.100 | |

| | | Requested | | Permitted | | Mitigated | | Enf. ement |
|---|---|---|---|---|---|---|---|---|
| Restoration | | IP | GP/NW | IP | GP/NW | IP | GP/NW | Violation |
| 200150434 | LEGACY PARKWAY PROJECT 01-31-15SA | | 0.020 | | 0.020 | | | |
| 200150435 | LEGACY PARKWAY PROJECT, 01-31-14SA | | 0.001 | | 0.001 | | | |
| 200150436 | GABION ROCK BASKETS, 01-31-13SA | | 0.002 | | 0.002 | | | |
| 200150457 | BURIED GAS PIPELINE, FARMINGTON 01-31-12 | | 0.100 | | 0.100 | | | |
| 200150461 | ENLARGE STREAM CHANNEL, MILLCRK 01-31-11 | | 0.140 | | 0.140 | | | |
| 200150469 | RESTORE ROCK-WALL BERM 01-31-08SA | | 0.250 | | 0.250 | | | |
| 200150473 | LEGACY PARKWAY PROJECT 01-31-18SA | | 0.360 | | 0.360 | | | |
| 200150494 | CHANNEL WIDENING KAYSVILLE 01-31-16SA | | 0.080 | | 0.080 | | | |
| 200150539 | REROUTE STEED CRK, FARMINGTON 01-31-20SA | | 1.190 | | 1.190 | | | |
| 200150540 | CHANNEL EXCAVATION, SPRING CRK 01-31-19 | | 0.250 | | 0.250 | | | |
| 200250005 | SEWER TRUNKLINE RELOCATION, S DAVIS CO | | 0.170 | | 0.170 | | 0.170 | |
| 200250056 | NATURE CONSERVANCY SHORELANDS VISITOR FA | | 0.570 | | 0.490 | | | |
| 200250081 | COVEY, KENT DUCK POND EXPANSION | | 0.001 | | 0.001 | | | |
| 200250179 | UDOT, SHEPARD CRK, 89 X SHEPARD LN IMP | 8.070 | 0.450 | 5.780 | 0.450 | 45.600 | | |
| 200250279 | QUESTAR, WETLANDS & JORDAN PIPELINE XING | | 2.400 | | 2.400 | | 2.400 | |
| 200250283 | C. DAVIS SEWER, GSL WETLANDS, RELOCATION | | 0.001 | | 0.001 | | 0.001 | |
| 200250291 | TNC, SUGAR FACTORY DRAIN, RESTORATION | | 0.500 | | 0.500 | | 125.000 | |
| 200250475 | BRIDGE ON SR-106 FARMINGTON 02-31-07SA | | 0.010 | | 0.010 | | | |
| 200250499 | CREEK BRUSH CLEARING 02-31-08SA | | 0.060 | | 0.060 | | | |
| 200250500 | CREEK BRUSH CLEARING 02-31-05SA | | 0.002 | | 0.002 | | | |
| 200250523 | COMMERCIAL DEVELOPMENT 02-57-13SA | | 0.001 | | 0.001 | | | |
| 200350093 | CENTERVILLE, HOME DEPOT SITE, UTILITY X | | 0.680 | | 0.680 | | 0.680 | |
| 200350165 | IRRIGATION DITCH HOLMES CRK 03-31-01SA | | 0.001 | | 0.001 | | | |
| 200350171 | LAYTON CITY, KAYS CK, RESERVOIR | | 0.001 | | 0.001 | | | |
| 200350338 | BOYER CO., FARMINGTON RANCHES EAST DEVT. | | 0.048 | | 0.048 | | 0.048 | |
| 200350527 | DREDGING BOAT SLIPS | | 0.010 | | 0.010 | | | |
| 200350589 | CHASE LANE VILLAGE PHASE III | 1.670 | | 1.670 | | 1.670 | | |
| 200350723 | RESTORATION HOLMES CRK 03-31-10SA | | 0.230 | | 0.230 | | | |
| 200450007 | HAWKINS COMPANIES, UNKN SPRING, RESIDENT | | 0.200 | | 0.200 | | 1.100 | |

| | | Requested | | Permitted | | Mitigated | | Enforcement |
|---|---|---|---|---|---|---|---|---|
| Restoration | | IP | GP/NW | IP | GP/NW | IP | GP/NW | Violation |
| 200450111 | ROAD XING HOWARD SLOUGH 03-31-09SA | | 0.040 | | 0.040 | | | |
| 200450198 | OUTFALL STRUCTURE DAVIS COUNTY 03-31-06 | | 0.003 | | 0.003 | | 0.003 | |
| | Davis County Totals | 89.008 | 115.743 | 84.172 | 106.573 | 172.462 | 256.942 | 6.720 |
| 0.420 | | | | | | | | |
| Weber County | | | | | | | | |
| 199250304 | N.UTAH RADIO CONTROLLED AIRCRAFT CLUB | | 0.158 | | 0.158 | | 0.158 | |
| 199250357 | VIO - ALLEN, DAVID | | | | | | | 1.800 |
| 199250358 | VIO- JOHN, DUANE | | | | | | | 0.700 |
| 199350185 | UDOT/WEBER CO-1100 W BRIDGE/EXTENSION | | 0.350 | | 0.350 | | 0.350 | |
| 199350340 | RASMUSSEN VIO RIVERDALE | | 0.100 | | | | | |
| 199450020 | OGDEN NATURE CENTER/MARY COX W-D | | 0.390 | | 0.390 | | 0.230 | |
| 199450102 | SMEDLEY- COUNTRYBROOK SUBDIVISION - ROY | | 1.450 | | 1.450 | | 1.430 | |
| 199450109 | RAMSEY, R.-MOUNTAIN SHADOWS SUBD.-OGDEN | | 2.450 | | 2.450 | | 9.200 | |
| 199450185 | HANSEN & ASSOC. - MOUNTAIN VIEW ESTATES | | 2.100 | | 2.100 | | 3.700 | |
| 199450186 | USFS-MAPLES TRAIL RELOCATION/WHEELER CR. | | 0.060 | | 0.060 | | | |
| 199450205 | SAUNDERS ADVERTISING - N. OF 12TH ST/I15 | | 0.030 | | 0.030 | | | 0.050 |
| 0.020 | | | | | | | | |
| 199450249 | IPSON, D.-FILL & ROAD CROSSING IN SWALE | | 0.020 | | 0.020 | | | |
| 199450254 | WOLF RIDGE SUBD. PHASES I AND II - EDEN | | 0.060 | | 0.060 | | 0.250 | |
| 199450283 | BUXTON INC. - SHADOW VALLEY ESTATES | | 0.010 | | 0.010 | | 0.010 | |
| 199450298 | GARDNER ENGINEERING-FOXCHASE SUBDIVISION | | 0.100 | | 0.100 | | 0.470 | |
| 199450307 | WEST HAVEN CITY PARK | 11.430 | 9.880 | 11.430 | 9.880 | 12.240 | 11.400 | |
| 199450320 | UDOT-RIVERDALE RD. BRIDGE REPLACEMENT | 0.100 | | 0.100 | | 0.100 | | |
| 199450356 | ADAMS, B.-ROAD CROSSING ADJ. TO WEBER R. | | 0.080 | | 0.080 | | | |
| 199450405 | U.S. AIR FORCE - PLANE CRASH IN HOOPER | | 0.020 | | 0.020 | | | 0.100 |
| 0.100 | | | | | | | | |
| 199450422 | HEATHERWOOD SUBDIVISION - PHASES 3, 4, 5 | | 4.500 | | 4.500 | | 4.500 | |
| 199450446 | BIRD, P.-MEADOWLARK SUBD IN FARR WEST | | 0.620 | | 0.620 | | 0.820 | |
| 199450487 | PETERSEN, JERRY - VIO ON BURCH CREEK | | | | | | | 0.500 |
| 199550022 | UDOT - S.R. 126 WIDENING | | 0.060 | | 0.060 | | 0.060 | |
| 199550044 | ROBINSON, AMY - HOUSE IN WEST WEBER | | 0.100 | | 0.100 | | 0.100 | |
| 199550046 | HINSHAW, J. - FARR WEST/POND IN WETLAND | | 0.220 | | 0.220 | | 0.220 | |

| Restoration | | Requested IP | Requested GP/NW | Permitted IP | Permitted GP/NW | Mitigated IP | Mitigated GP/NW | En. Violation | ement |
|---|---|---|---|---|---|---|---|---|---|
| 199550067 | BELNAP, M. - CROSSING ON S. FORK WEBER | | 0.030 | | 0.030 | | 0.030 | | |
| 199550149 | UNION PACIFIC RR-RIVERDALE VIOLATION | | | | | | | 0.350 | |
| 199550194 | WANGSGARD, CLARK - VIO IN HUNTSVILLE | | 0.170 | | 0.170 | | 0.280 | | |
| 199550293 | HESS, G.-FILL IN WETLANDS ON WEBER RIVER | | | | | | | 0.200 | 0.200 |
| 199550295 | HUNTSVILLE TOWN WATER SYSTEM IMPROVEMENT | | 0.100 | | 0.100 | | 0.100 | | |
| 199550329 | ANDRAE, M - LOT 92 PATIO SPRINGS, EDEN | | 0.003 | | 0.003 | | | | |
| 199550378 | UDOT - INTERSECTION IMPROVEMENT, ROY | | 0.070 | | 0.070 | | | | |
| 199550487 | CROWLEY/HAWS DEV.-RIVERDALE SUBDIVISION | | 2.050 | | 2.050 | | 4.700 | | |
| 199550492 | WANGSGARD, S. - WETLANDS IN HUNTSVILLE | | | | | | | 0.100 | 0.100 |
| 199550499 | QUITIQUIT, J. - BRIDAL VEIL ESTATES -ROY | | 1.440 | | 1.440 | | 1.440 | | |
| 199550560 | JENSEN, G.-COBBLE GLEN SUBD.-PLAIN CITY | | 0.280 | | 0.280 | | 0.340 | | |
| 199550587 | WESTERN STATES DEV - BROOK MEADOW SUBD. | | 2.500 | | 2.500 | | 2.910 | | |
| 199550740 | SMITH & EDWARDS - VIO IN NORTH WEBER CO. | | 0.250 | | 0.250 | | 0.250 | 15.000 | 14.750 |
| 199650051 | WOODSIDE HOMES - SUMMER MEADOWS SUBD. 3 | | 0.090 | | 0.090 | | 0.970 | | |
| 199650121 | GLASMANN FARM - JOHN HANSEN / OGDEN CITY | | 3.920 | | 3.920 | | 9.880 | | |
| 199650272 | FRANDSEN, M-POND RESTORATION-HUNTSVILLE | | 0.250 | | 0.250 | | 0.250 | | |
| 199650299 | WEBER BASIN WCD - CULINARY PIPELINE XING | | 0.020 | | 0.020 | | 0.020 | | |
| 199650301 | WADMAN, J.- VIO IN PLEASANT VIEW | | | | | | | 0.250 | 0.250 |
| 199650360 | WARD, MERLIN - VIO ON 1900 N, PLAIN CITY | | | | | | | 0.100 | 0.100 |
| 199650391 | GREAT AMERICAN HOMES - OLYMPIA PARK SUBD | 2.350 | 2.350 | 2.350 | 2.350 | 2.350 | 2.600 | | |
| 199650501 | CRONQUIST, J - REGAL COUNTRY ESTATES | | 0.830 | | 0.830 | | 3.500 | | |
| 199650555 | IMPACT DEVELOPMENT-ROYAL VISTA SUBD.-ROY | | 1.260 | | 1.260 | | 1.300 | | |
| 199650586 | NUTEAM - WHISPER WILLOW SUBD. - N. OGDEN | | 0.110 | | 0.110 | | 0.120 | | |
| 199650589 | DMJM/SMITH, C.-ACCESS ROAD-PLEASANT VIEW | | 0.170 | | 0.170 | | | | |
| 199650606 | SNOWBASIN - PHASE I FACILITIES | | 0.010 | | 0.010 | | 0.010 | | |
| 199750258 | VIO INVESTIGATION - OGDEN | | | | | | | 0.070 | |
| 199750259 | GSLM,S LITTLE MOUNT. RAILROAD SPUR. NW26 | | 3.980 | | 2.850 | | 2.850 | | |
| 199750436 | WAYMENT, G. - FILL IN WETLAND | | | | | | | 0.100 | |
| 199750525 | KOZ CONSTRUCTION-KOZY ACRES-WEST HAVEN | | 1.500 | | 1.500 | | 1.500 | | |

| Restoration | | Requested IP | Requested GP/NW | Permitted IP | Permitted GP/NW | Mitigated IP | Mitigated GP/NW | En. Violation | ement |
|---|---|---|---|---|---|---|---|---|---|
| 199750775 | WOLF CREEK RESORT-DRIVING RANGE | 1.800 | | | | | | | |
| 199750787 | ROAD CROSSING-WETLAND | | 0.030 | | 0.030 | | | | |
| 199850141 | NIXON, D.-CANYON RANCHES-MILL CREEK | | 1.000 | | 1.000 | | 1.500 | | |
| 199850219 | CATHODIC PROTECTION DEVICES | | 0.080 | | 0.080 | | | | |
| 199850259 | HOWARD, L. WEBER CK, ACCESS DIKE | | 0.001 | | 0.001 | | | | |
| 199850312 | SLOUGH DREDGING | | 0.900 | | 0.900 | | 0.900 | | |
| 199850510 | RINDLESBACHER, D. LYNN - MEADOW RIDGE | | 0.300 | | 0.300 | | 0.300 | | |
| 199850539 | FARR WEST CITY - DREDGE TRIB TO WEBER R | | 0.300 | | 0.300 | | | | |
| 199950009 | U.S. DEVELOPMENT - OLYMPIA PARK WEST | 0.740 | | 0.740 | | 0.740 | | | |
| 199950043 | ADAMS AVE TURNPIKE - STORMWATER DETENSIO | | 0.370 | | 0.370 | | 2.000 | | |
| 199950258 | LARSEN, DEBBIE - FARR WEST WETLAND FILL | | 0.280 | | 0.280 | | 0.330 | | |
| 199950273 | R & J CONST. 2100 SUBDIVISION N. OGDEN | | 0.290 | | 0.290 | | 0.390 | | |
| 199950505 | 1625 N RD CROSSING, POPLAR ESTATES SUBDV | | 0.400 | | 0.400 | | 0.400 | | |
| 199950603 | HADLEY, STEPHEN - HUNTSVILLE DITCH | | 0.050 | | 0.050 | | | | |
| 199950676 | SPECIAL SERVICE DISTRICT (WHSSD) SEWER | | 0.600 | | 0.600 | | | | |
| 200050086 | BSA - CAMP KIESEL NEAR CAUSEY RESERVOIR | | 0.100 | | 0.100 | | | | |
| 200050222 | WALL, NIEL - GLASSMAN POND PROPERTY | | 0.250 | | 0.250 | | 0.250 | | |
| 200050604 | 01-35-02SA ROCK BARBS ON WEBER RIVER | | 0.750 | | 0.750 | | | | |
| 200150184 | ROY WCD, HOWARD SLOUGH, 2NDARY RESERVOIR | 1.604 | | 1.604 | | 1.604 | | | |
| 200150189 | RETAIL COMPLEX, BIG COTTNWOOD CREEK GP40 | | 0.007 | | 0.007 | | | | |
| 200150219 | SA, WEBER RIVER, RIVERDALE WATERLINE | | 0.010 | | 0.010 | | | | |
| 200150220 | SA, WEBER RIVER, MITIGATE EROSION | | 0.010 | | 0.010 | | | | |
| 200150221 | SA, OGDEN RIVER, QUESTAR GAS COMPANY | | 0.010 | | 0.010 | | | | |
| 200150243 | UDOT, REGION ONE, WEBER RIVER 00-35-51SA | | 0.200 | | 0.200 | | | | |
| 200150257 | RIVERDALE CITY TRAIL | | 0.043 | | 0.043 | | 0.043 | | |
| 200150258 | IVORY HOMES ROY/CLINTON | 6.750 | | 6.750 | | 6.750 | | | |
| 200150265 | SA 01-35-13, STORM DRAIN RELOCATION | | 0.014 | | 0.014 | | | | |
| 200150338 | MARSH HOLDERS WETLNAD ENHANCEMENT | | 4.700 | | 4.700 | | 22.000 | | |
| 200150346 | DREDGE BENNET CRK 01-35-15SA | | 0.001 | | 0.001 | | | | |

IMPACTED AND ACREAGE (NON-TIDAL)

| | | Requested | | Permitted | | Mitigated | | Enforcement |
|---|---|---|---|---|---|---|---|---|
| | | IP | GP/NW | IP | GP/NW | IP | GP/NW | Violation |
| Restoration | | | | | | | | |
| 200150347 | GAS PIPELINE, LIBERTY 01-35-14SA | | 0.020 | | 0.020 | | | |
| 200150348 | RIVERWOOD DRIVE ROAD CONSTRUCT. 01-35-16 | | 0.010 | | 0.010 | | | |
| 200150374 | ROCKY MOUNTIAN REAL ESTATE STORM WATER | | 0.490 | | 0.490 | | 0.560 | |
| 200150437 | REPAIR SCOUR DAMAGE, OGDEN 01-35-40SA | | 0.067 | | 0.067 | | | |
| 200250154 | SIMKOWIAK, DAVID TIFFANY BLUFF HOUSING | | 0.270 | | 0.270 | | 0.270 | |
| 200250161 | UDOT SPRING & CROOKED CK ROAD WIDENING | | 0.390 | | 0.390 | | 1.150 | |
| 200250276 | OGDEN CITY, PINEVIEW RES., PUMP HOUSES | | 0.142 | | 0.142 | | 0.142 | |
| 200250458 | UPRR, GSL, LAKESIDE BRIDGE MAINTENANCE | | 0.008 | | 0.008 | | 0.008 | |
| 200250477 | RECOVERY TRENCH- DEISEL 02-35-04SA | | 0.001 | | 0.001 | | | |
| 200250482 | RECREATIONAL BOATING PARK 02-35-12SA | | 0.010 | | 0.010 | | | |
| 200250496 | DETENTION FACILITY 02-35-24SA | | 3.000 | | 3.000 | | | |
| 200250498 | RIVER PARKWAY TRAIL BRIDGE 02-35-13SA | | 0.050 | | 0.050 | | | |
| 200350108 | BRIDGE ABUTMENTS S FORK-OGDEN 03-35-01SA | | 0.001 | | 0.001 | | | |
| 200350380 | DAM SAFETY MODIFICATIONS 03-35-16SA | | 0.400 | | 0.400 | | | |
| 200350381 | BRIDGE INSTALLMENT WEBER RIVER 03-35-13S | | 0.001 | | 0.001 | | | |
| 200350584 | UTILITY RELOCATION WEBER RIVER 03-35-42 | | 0.009 | | 0.009 | | 0.009 | |
| 200350717 | PEDESTRIAN BRIDGES OGDEN RIVER 03-35-49 | | 0.001 | | 0.001 | | | |
| 200450152 | STREAM REHAB HOOPER SLOUGH 04-35-03SA | | 0.250 | | 0.250 | | 0.250 | |
| | Weber County Totals | 24.774 | 59.957 | 22.974 | 58.727 | 23.784 | 96.450 | 19.320 |

15.520

# Appendix I

Service Area Map – NWI DATA and SCS Soil Associations

stantec.com

# Memo

Stantec

| | | | |
|---|---|---|---|
| To: | Amy Defreese<br>Utah Regulatory Office | From: | Matt Betts<br>Salt Lake City Office |
| File: | 86200388 | Date: | April 3, 2006 |

**Reference: Machine Lake Mitigation Bank Service Area Response to USACE Comments on March 31 presentation**

## Summary of 3/31 Presentation

This letter is in response to the Corps comments provided in your email (Email attached for reference) following our meeting on Friday, March 31st, 2006 regarding the proposed service area for the Machine Lake Area Mitigation Bank (MLA). The Corps had previously requested that the MLA demonstrate the potential wetland types the bank could mitigate as part of the service area discussions. This was accomplished by determining the wetland types at the bank and the location of similar wetland types around the Great Salt Lake.

## Wetland Map

The National Wetland Inventory (NWI) maps were used to identify wetland types based on availability of published data for the Great Salt Lake Area. The analysis of the MLA property resulted in approximately 20 Cowardin wetland classifications being identified at the MLA. These were consolidated into 6 general categories of wetland types on the maps produced for our meeting on March 31st. These categories allowed for readability but were still able to display the diverse wetland types present in the MLA. The breakpoint for this consolidation was determined to be the class level in the Cowardin classification system. Thus all of the Palustrine Emergent Marsh (PEM) subclasses were consolidated and included all of the subclasses, types, water regimes and any special modifiers within that class.

## Soil Classification Map

The Corps also requested a map outlining soil classifications within the proposed service area. Using the information provided by the Corps in your email on February 16th, Stantec identified the soil associations shown on our map we presented on March 31st. However, the information in the Feb. 16th email only discussed the Soil Conservation Service's Soil Survey of Box Elder County – Eastern Part and did not reference the remaining areas around the Great Salt Lake in the proposed service area. By using the information in the listed soil associations in your February 16th email, similar soil association were identified

around the remaining portions of the Great Salt Lake and presented on the Service Area Soil Map.

Response to Emailed Comments:

1. In response to the Corps' first comment that a suitable service area could be identified using the overlap of wetland types and soil associations. We would like to propose that the outside perimeter of the soil associations be utilized as the basis of the service area. This would contain the same wetland types presented at our meeting as occurring within the MLA. Some areas without the specific soil associations below the Stansbury shoreline would be removed and some areas above the Stansbury shoreline in places in Box Elder, Weber and Tooele Counties would be added.

   It would not be feasible or manageable to draw detailed boundary lines only around those areas having an overlap of the NWI wetlands and the soil associations as implied in the March 31st email. This would produce a speckled map with a service area that would be discontinuous and unnecessarily complicated to define, display and to understand. Furthermore, as we discussed, the NWI data used has obvious drawbacks being 25+ years old and we recognize that things will have changed since the publication of these maps in 1981. However, this is the dataset available that covers the Great Salt Lake area that has been adopted by the federal agencies and the scientific community. The NWI mapping also demonstrates the changes that have occurred at the MLA since the maps were published. Significant areas mapped as PEM at the MLA have converted to upland or to mudflat/playa. These areas would be restored by the MLA.

   Limiting the service area to only those areas that have an overlap of the NWI data and the soil associations would exclude wetlands around the lake that could be successfully mitigated at the bank but have not been accurately mapped by the NWI or have changed since the NWI was completed. It was not our intention to suggest that all wetlands are shown on the maps we provided to the Corps at our meeting on March 31st. Our purpose was to demonstrate that the wetland types available at the MLA are widespread throughout the Great Salt Lake Valley and impacts to those wetland types can be effectively mitigated at the MLA from a much larger service area than the MBRT has proposed.

   Frankly we believe the service area could legitimately be noticeably larger based on true wetland type occurrence. Wetland occurrence is fairly common on non-hydric soil series. The NRCS Hydric Soils List shows non-hydric soil series with up to 10% of the individual soil unit containing

hydric inclusions. Examples of this include the Draper and Steed soils in the Soil Survey of Davis-Weber Area. This exemplifies how localized wetlands may still meet the criteria for hydrophytic vegetation, hydrology and hydric soils but be located within a non-hydric soil unit.

We firmly believe wetland occurrence is far more important than underlying soil classification in a Bank, such as at the MLA, where highly functioning wetlands have been known to exist in the past and water regimes can be managed. However, we are willing to compromise as set forth above.

2. In response to the Corps second comment, the soil associations used were defined by landscape position, soil formation, elevation, climate, soil drainage and water regime. The document titled "MBRT changes to Feb06 rebuttal" stated that soils similar to the Lasil-Fridlo Association and the Playa-Saltair Association would be suitable for demonstrating compatibility with the mitigation bank. These descriptions were reviewed in detail along with pages 200-205 of the Soil Survey of Box Elder County – Eastern Part, also provided in your Feb. 16th email. The emphasized portions of that document included statements that the soils left by the receding Lake Bonneville can have variation in texture (pg 200). The Climate section refers to the semiarid conditions on the lake plains, low lake plains, low lake terraces and recent fans can range from 4225 to 4500 ft elevation (pg 202). The Relief section categorizes landforms differently using elevations of 4200 to 4375 ft to describe lake plains, low lake terraces, valley bottoms and flood plains (pg 203). This section goes on to describe the Logan, Roshe Springs, Magna, Placeritos, Kirkham and Sunset soils as being "in stream drainageways, floodplains and along valley bottoms" within this landform classification (pg 204).

   Based on the provided information, similar soil associations were determined for the remaining areas around the Great Salt Lake. These areas were identified based on their descriptions in the General Soil Map section at the front of each Soil Survey. The Corps concerns regarding the specific soil associations are addressed below.

   a) Box Elder County – Soil Associations 11 (Honeyville-Greenson-Collett), 12 (Lasil-Fridlo), and 13 (Playa-Saltair) were chosen to include in the map presented at the March 31st meeting. First, this seemed appropriate because the published Soil Conservation Service Soil Survey had grouped them as similar types. Second, the descriptions of the associations revealed some interesting details when compared with the current Natural Resource Conservation Service (NRCS) hydric soils list posted on their website. The Honeyville-Greenson-Collett Association has a slightly higher percentage of its area containing hydric soils than the Lasil-Fridlo Association. Thirdly, the elevations described in the

Honeyville-Greenson-Collett range from 4250-4355 ft while the Lasil-Fridlo range from 4220-4600. And last, excluding the Honeyville-Greenson-Collett would eliminate areas closely tied to the MLA via the Reeder Overflow. The Reeder Overflow carries water from the Bear River and it did not make sense to exclude areas on the Bear River and the lower Malad River mapped as the Honeyville-Greenson-Collett Association. This is especially apparent since the Lasil-Fridlo Association would include portions of the Malad River near Plymouth and the area near Howell along Blue Creek that are higher elevation than the Honeyville-Greenson-Collett association that the Corps requested be removed.

b) Using the Soil Survey of Davis-Weber Area, soil associations numbered from 6-10 were chosen. This again was based on the descriptions of the soil associations in the front of soil survey. On the map, soil associations 6 (Sunset-Kirkham-Martini) and 7 (Ironton-Logan-Draper) are described as being found on flood plains and terraces. But further review of the description in the text shows these soil associations to be closely tied to associations 8-10 shown on the map. Both associations in question begin on the low lake plains and range in elevation from 4220 to 4600 ft elevation.

The Sunset-Kirkham-Martini is described as being located "in a single irregularly shaped area on the nearly level floodplains of the Weber and Ogden River." Two of the major soil series in this association were listed in the pages of the Soil Survey of Box Elder County – Eastern Part as being "wet because of position" in the "in stream drainageways, floodplains and along valley bottoms (pg 204)." Excluding this association does not make sense when reviewed with these similar conditions found along the Reeder Overflow and Black Slough inside the MLA. Mitigation of riverine wetlands is often difficult due to lack of suitable habitat available near the impact area. The MLA has riverine habitat that can be enhanced and protected providing mitigation for potential impacts in the Sunset-Kirkham-Martini Association.

The Ironton-Logan-Draper Association has 40% of the soil series within the association being listed as hydric. The Logan series comprises 20% of the area within this type while the minor component soils cover an addition 20%. These minor component soils include Roshe Springs, Woods Cross and Cudahy soils. All are listed by the NRCS as hydric soil series. This soil association begins within 0.5 miles of the Great Salt Lake from Wood Cross to Farmington and exclusion of this soil would exclude unreasonably areas of similar wetlands from the mitigation bank service area. Other areas where this soil association is located include an area 'about 1 mile west of Kaysville', and two areas in Weber County.

Again, as stated in the description of the soil association, this soil association begins at 4220 ft elevation and with the high proportion of hydric soils in this soil association it is very suitable for inclusion in the MLA Service Area.

c) In Salt Lake County, the Corps email stated that the soil associations 1 and 2 were suitable because they exist on lake plains but the soil association 3 (Chipman-Magna-Ironton) was not because it was described as existing on flood plains. The description of the soil association describes this type as existing from 4200-4500 ft elevation. The concept that floodplains should not be mitigated at the bank is not correct since the MLA has significant riverine wetlands along the Reeder Canal and the Black Slough. As stated above, similar flood plains exist on the MLA site and can be mitigated effectively at the MLA.

Furthermore, the removal of Chipman-Magna-Ironton does not make sense because this is the soil type mapped along the Jordan River beginning at the Great Salt Lake. Removal of this soil association would leave a service area that would allow impacts on the east bank of the Jordan River in Davis County to be mitigated in the MLA but disallow mitigation for impacts to areas on the west bank do the same. In summary, the Corps has suggested that riverine and floodplain soil associates be removed. In view of the fact that they exist in the MLA, that would not be a supportable position.

In conclusion, we feel that the outside perimeter of the soil associations as mapped represent an acceptable compromise for defining the service area. And the soil associations shown on the map presented at the March 31st meeting are representative of both soil type and landform position that exist at the bank.

**STANTEC CONSULTING INC.**

Matthew Betts, CFM
Ecologist
mbetts@stantec.com

Attachment: Summary of Soil Associations
Email from USACE on March 3/31 with Corps comments

c. Karen Nichols, P.E. - Stantec Consulting
Jeff Appel - Ray, Quinney and Nebeker

**Box Elder – Eastern Part Soil Associations**

**Honeyville- Greenson-Collett Association**

Elevations: 4250-4355

Major components
Honeyville 25%
Greenson 15%
Collett 15%

Minor components
25% Roshe Springs*, Logan*, Kirkham soils
20% remainder - Cudahy*, Draper, James Canyon, Magna*, Martini, Peteetneet*, Sunset and Woods Cross* soils

**Lasil- Fridlo Association**

Elevations: 4220-4600

Major components
Lasil 25%
Fridlo 15%

Minor components
10% Airport*
10% Stokes
10% Placeritos
5% Payson
5% Arave*
20% remainder – Gooch*, Lakeshore*, Lewiston, Woods Cross*, Warm Springs*, Syracuse, Greenson, and Refuge soils

**Playas- Saltair Association**

Elevations: 4205-4225

Major Components
65% Playas*
20% Saltair*

Minor Components
15% remainder – Logan*, Pogal, and Refuge soils



* -- Indicates that the NRCS has listed this soil series on their August 2005 National Hydric Soils List

**Box Elder – Western Part Soil Associations**

**Playas- Saltair Association**

Elevations: 4210-4230

Major Components
75% Playas*
5% Saltair*

Minor Components
20% remainder – Salt Flats*, Dynal, Skumpah, and Swingler soils



* -- Indicates that the NRCS has listed this soil series on their August 2005 National Hydric Soils List

**Davis-Weber Soil Associations**

**Sunset- Kirkham-Martini Association**

Elevations: 4220-4600

Major components
Sunset 50%
Kirkham 20%
Martini 20%

Minor components
10% remainder – Refuge, Steed, Wayment* soils

**Ironton-Logan-Draper Association**

Elevations: 4220-4600

Major components
Ironton 40%
Logan* 20%
Draper 20%

Minor components
20% Roshe Springs*, Woods Cross* and Cudahy* soils

**Warm Springs-Syracuse Association**

Elevations: 4210-4350

Major Components
60% Warm Springs*
25% Syracuse

Minor Components
15% remainder – Harrisville, Leland, Gooch*, Ford* and Croy soils

**Leland-Payson-Warm Springs Association**

Elevations: 4210-4350

Major Components
30% Leland
30% Warm Springs*
20% Syracuse

Minor Components
10% remainder -- Syracuse, Airport*, Terminal, Saltair*, Arave*, and Logan* soils



* -- Indicates that the NRCS has listed this soil series on their August 2005 National Hydric Soils List

**Saltair-Wayment-Arave Association**

Elevations: 4200-4215

Major Components
35% Saltair*
30% Wayment*
25% Arave*

Minor Components
10% remainder – Lakeshore* and Refuge soils



* -- Indicates that the NRCS has listed this soil series on their August 2005 National Hydric Soils List

**Salt Lake Soil Associations**

**Saltair-Jordan-Lasil Association**

Elevations: 4200-4300

Major components
Saltair* 40%
Jordan 15%
Lasil 15%

Minor components
30% remainder – Leland, Terminal, Decker and Mixed Alluvial Land soils

**Decker-Lasil-Terminal Association**

Elevations: 4200-4300

Major components
Decker 40
Lasil 15%
Terminal 15%

Minor components
30% remainder – Saltair*, Bramwell, hardpan variant, Chipman, Harrisville and Leland soils

**Chipman-Magna-Ironton Association**

Elevations: 4200-4500

Major Components
40% Chipman
20% Magna*
15% Ironton

Minor Components
25% remainder – Bramwell, Decker, Kidman Taylorsville, Welby and Mixed Alluvial Land soils



* -- Indicates that the NRCS has listed this soil series on their August 2005 National Hydric Soils List

**Tooele Soil Associations**

**Playas-Saltair-Salt Flats Association**

Elevations: 4200-4300

Major components
Playas* 76%
Saltair* 15%
Salt Flats*s 7%

Minor components
2% remainder – Skumpah, Dynal, Kanosh, Yenrab, Logan*, and Tooele soils

**Kanosh-Bramwell-Logan* Association**

Elevations: 4200-5500

Major components
Kanosh 36%
Bramwell 21%
Logan* 20%

Minor components
23% remainder – Skumpah, Saltair*, Yenrab, Birdow, Taylorsflat and Playas* soils



* -- Indicates that the NRCS has listed this soil series on their August 2005 National Hydric Soils List

# Appendix J

Nesting Ecology of Redhead Duck on Knudson Marsh

RECEIVED
FEB 1 4 2003
BY:

# NESTING ECOLOGY OF THE REDHEAD DUCK ON KNUDSON MARSH, UTAH

by

Thomas Claud Michot

A thesis submitted in partial fulfillment
of the requirements for the degree

of

MASTER OF SCIENCE

in

Wildlife Science

Approved:

David R. Anderson
Major Professor

J. B. Low
Committee Member

Arthur D. Bolmquist
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Logan, Utah

1976

## ACKNOWLEDGMENTS

Funding and materials for this project were made available through the Utah Cooperative Wildlife Research Unit. I would like to express my sincere appreciation to Dr. David R. Anderson, Unit Leader and my major professor for his inspiration and guidance during the writing of the thesis, and to Dr. Jessop B. Low, former Unit Leader, for his help and advice as major professor during my field studies.

I would also like to thank Graduate Committee members, Professor Arthur H. Holmgren, for his inspiration and critical review of the thesis, and Dr. Kieth L. Dixon for his helpful suggestions. Timothy K. Lowrey and Evan D. Ela assisted in my field work; for their help and friendship I am grateful.

Finally, I would like to thank my wife, Kay, for her patience and encouragement, and for her help in typing the drafts. To her I dedicate this work.

Thomas Claud Michot

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# ABSTRACT

Nesting Ecology of the Redhead Duck on

Knudson Marsh, Utah

by

Thomas Claud Michot, Master of Science

Utah State University, 1976

Major Professor: Dr. David R. Anderson
Department: Wildlife Science

Redhead duck (*Aythya americana*) nesting and habitat change was studied in Knudson Marsh, Utah, in 1974 and 1975, and compared with earlier studies from 1950 and 1955 on the same marsh. Water conditions in 1975 were found to be similar to those in 1950, both years of favorable habitat, yet there was a decline in numbers of redheads from 500 pairs in 1950 to 50 pairs in 1975. The number of nests found also declined from 151 in 1950 to 49 in 1975. Water conditions were poor in 1955 and slightly more favorable in 1974, but there was a decline from 95 pairs and 49 nests in 1955 to 50 pairs and 23 nests in 1974. Success of active nests was greater in the present study than in 1950, but hatching success in successful nests was greater in 1950. No appreciable change in the vegetational composition of the marsh was detected between 1950 and the present study.

(61 pages)

# INTRODUCTION

Knudson Marsh (Figure 1) is located in the Salt Lake Valley of Utah, an area which has been considered one of the most productive redhead (*Aythya americana*) breeding grounds in the United States (Williams and Nelson 1943). Wingfield (1951) and Weller et al. (1958) studied Knudson Marsh and thereby provided a basis for comparative research in the 1970's. Changes in the redhead population could therefore be detected, and the habitat assessed to determine a basis for population fluctuations.

Knudson Marsh is located 3.2 kilometers west of Brigham City, Utah (sections 29-37, T. 9N., R. 2 W., SLM), and is surrounded by salt flats. Unit 5 of the Bear River Migratory Bird Refuge lies 2.4 kilometers south of Knudson Marsh, and the nearest road is 2.4 kilometers to the north, thus isolating the study area and virtually eliminating human disturbance during the breeding season. Cattle graze the surrounding vegetation in the summer, and hunting and trapping takes place on the marsh in the fall and winter.

Knudson Marsh is privately owned, 101 hectares in size, and is divided into an upper marsh of 70 hectares, and a lower marsh, the two being connected by several channels and separated by salt flats (Weller et al. 1958). This study, as the two previous ones, deals only with the

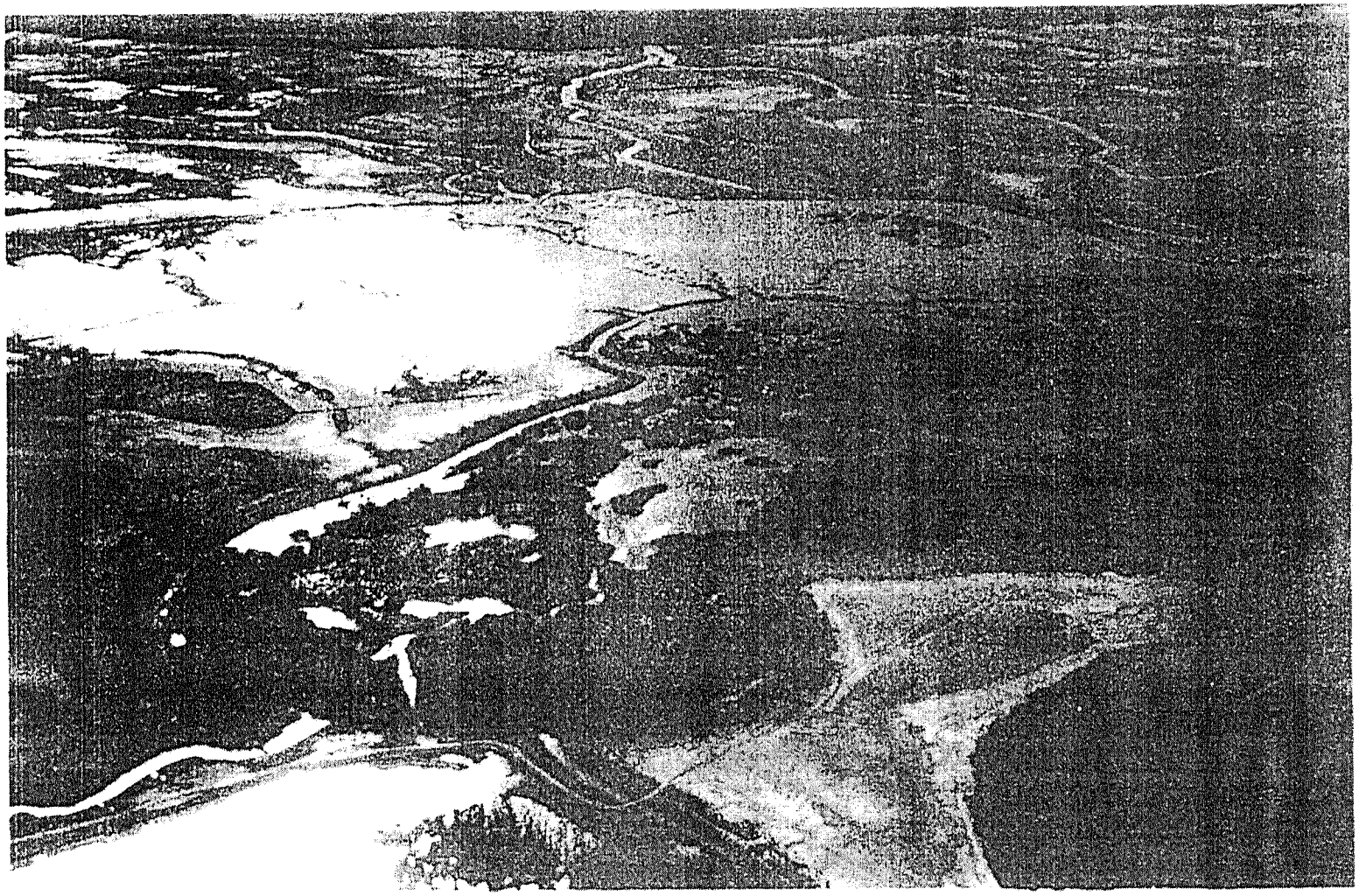

Figure 1. Knudson Marsh, Box Elder County, Utah, 1975.

upper marsh. Detailed descriptions of the study area can be obtained from Wingfield (1951) and Weller et al. (1958).

The water level in Knudson Marsh is determined by the amount of water coming into the marsh from Black Slough on the north, and by the amount of water flowing out of the marsh on the south end. The incoming water comes from melted snow from the Wellsville Mountains, as well as local precipitation. The earthen dike on the south end of the lower marsh has two large culverts through which water leaves the marsh to flow into Reeder Channel and south to Unit 5 of the Bear River Migratory Bird Refuge. These culverts can be blocked to regulate the outflow of water from the marsh. Because the marsh is privately owned, and not managed for waterfowl use to any great extent, the water level fluctuates from week to week, and the conditions vary from one year to the next.

The high duck nesting densities found at Knudson Marsh in the 1950's were second only to island nesting situations. This was attributed to the marsh's island-like setting, there being a channel which almost completely surrounds the vegetation in the marsh, as well as the fact that the water is well interspersed with vegetation. Even so, there was a drastic decrease in waterfowl production from 1950 to 1955, due to drought and grazing (Weller et al. 1958). This study was undertaken to determine what changes have taken place since then and to hopefully give some insight as to the causes of these changes.

The primary objectives of this study were:

1. To determine the breeding population densities of redheads on Knudson Marsh.

2. To determine population trends by comparing this study with previous studies.

3. To determine the factors involved, productivity changes and their effects on the population.

As the study progressed, the following hypothesis was set up: the redhead population of Knudson Marsh has declined due to changes in habitat.

# LITERATURE REVIEW

## Nesting Studies

According to Weller (1964), redheads originated in the alkaline water of the southwestern United States, and only recently has the breeding range spread to include the prairie pothole region of the northern U. S. and southern Canada. Redheads have been studied throughout their breeding range since the early part of this century. Early nesting studies were made by Wetmore (1921) in Utah and Weydemeyer (1933) in Montana. A more intensive nesting study was made at the Bear River Migratory Bird Refuge by Williams and Marshall (1938), followed by an unpublished report on the management of the species in Utah (Williams and Nelson, 1943).

While these studies were taking place in Utah, the redhead was also being studied in Iowa, first by Bennett (1938) and then by Low (1940), who later published the first monographic study of the species (Low 1945). Mendall (1945) reported redheads breeding in New Brunswick, which was the first record of such in any of the maritime provices. The redhead population in southern Manitoba, however, was thought to be seriously declining (Hochbaum 1946) at this time, despite excellent environmental conditions.

The first waterfowl study on Knudson Marsh was made in 1950 (Wingfield 1951; Wingfield and Low 1955), when the productivity of mallards (Anas platyrhynchos), cinnamon teal (Anas cyanoptera), ruddy duck (Oxyura jamaicensis), and redheads was studied. That study was followed up in 1955 by Weller et al. (1958) and by the present study.

Duck production was studied at Gray's Lake in southeastern Idaho from 1949 to 1951 (Steel et al. 1956), and at Tule Lake and Lower Klamath National Wildlife Refuges in northern California, one of the major western redhead breeding areas (Miller and Collins, 1954). This northern California study was followed up by Rienecker and Anderson (1960), who monitored the change in production that occurred in 5 years. Lokemoen (1966) studied the redhead population of the Flathead Valley area in western Montana.

Olsen (1964) investigated canvasback and redhead breeding populations in Manitoba, where the breeding ranges of these two species overlap. Keith (1961) studied waterfowl ecology on small impoundments in southern Alberta. Waterfowl production in the prairie pothole region was also studied by Stoudt (1971) in Saskatchewan and Smith (1971) in Alberta. The adaptability of the redhead in nesting situations was shown by McKnight (1974), who found many redheads nesting on dry land in Utah, and Williams (1975), who found redheads breeding as far south as Jalisco, Mexico.

## Population and Movement Studies

Banding operations at Bear River Migratory Bird Refuge in Utah as early as the 1920's and 1930's resulted in papers on redhead migration by Williams (1944), Van Den Akker and Wilson (1949) and Hickey (1952). Brakhage (1953) studied migration and mortality of ducks banded at Delta, Manitoba, while similar studies were made by Weller and Ward (1959) on hand-reared redheads and Bensen and DeGraffe (1958) on redheads banded in New York.

Weller's (1964) paper is probably the most complete study to date on redhead distribution and migration; banding data were utilized, as well as data from population cansuses on the breeding and wintering grounds. Robbins (1949), Lensink (1964) and Rienecker (1968) also published studies based on band recoveries. The effect of restrictive hunting regulations on canvasbacks and redheads was studied by Geis and Cooch (1972). Additional information on redhead population status and life history is presented in Bellrose (1976).

Redheads on their wintering grounds were studied by Heit (1948) and Kiel (1957): Low (1941) studied the birds during their spring migration. Sex and age ratios were investigated by Bellrose et al. (1961). Thornburg (1973) studied diving duck movements on an upper Mississippi River pool, and brood movements in Manitoba were studied by Evans et al. (1952).

## Anatomical, Physiological and Behavioral Studies

Weller (1957) completed a comprehensive paper on the growth, weights and plumages of the redhead, and Ryan (1972) studied body weight changes of wintering diving ducks. Dane and Johnson (1975) investigaged a method of age determination of female redheads from wing feather examinations and measurements. Age and sex identification from wing plumages was also presented in a key by Carney (1964).

Redhead nest parasitism was reported by Friedmann (1932), Erickson (1948) and McKinney (1954). Weller (1959) did a monographic study on redhead parasitism, using data gathered at Knudson Marsh, Utah, and southern Manitoba.

Dzubin (1955) reported on home range in waterfowl, and Oring (1964) studied postbreeding behavior. Weller (1965) published a paper on the chronology of pair formation in redhead and scaup. Smart (1962) studied biological problems involved in the restocking of redheads and Bensen and Browne (1973) studied the establishment of breeding colonies of redheads by releasing hand reared birds.

Food habits of adult and juvenile diving ducks were studied by Bartonek and Hickey (1969a and b). Sugden (1969) studied food selection and energy requirements in Alberta. Food habits were also investigated by Bergman (1973), who studied postbreeding canvasbacks and redheads, and McMahan (1970), who studied redheads on their Texas wintering

grounds. General information on redhead behavior, anatomy and life history is presented in Johnsgard (1975) and Bellrose (1976).

# METHODS

## Breeding Population Censuses

Aerial counts were made on 2 June 1974, and 22 May and 11 June 1975, to estimate the breeding population of redheads on Knudson Marsh. These counts were made from a Cessna 150 at about 90 to 150 meters above the marsh; ground counts were conducted in the early part of the breeding season.

## Nesting Survey

The emergent vegetation was systematically searched in 1974 to locate nests of redheads, mallards, cinnamon teal, and ruddy duck. An additional search was made for redhead nests in 1975. Each nest found was marked with a cane (*Phragmites australis*) placed five feet north of the nest. The inflorescence of the cane was usually visible above the cover vegetation, and a piece of paper tape with the number of the nest on it was placed around the culm.

The following data were recorded for each nest found: nest number, duck species, date and time found, vegetation type, height and density of vegetation, water depth, height of the nest over water, amount of down present, degree of concealment, number of host eggs and parasitic eggs, flushing distance, and distance of the nest from open water.

The nests were visited periodically to determine the number of eggs and the fate of the nest.

## Water Levels

Water level fluctuations were monitored from a graduated marker on the north end of the marsh. Records were kept throughout the breeding season for both years.

Records of the water flow of the Bear River at the Collinston, Utah, guaging station were obtained from the U. S. Geological Survey. These records were useful in comparing the available water supply of the four years of study: 1950, 1955, 1974 and 1975.

## Vegetation Analysis

A vegetation analysis was made in 1974 by grid point sampling to estimate the percent cover of each species and the ratio of open water to vegetation. The dominant vegetative cover was recorded every 25 paces along 31 north-south transects, which were 25 paces apart. A cover map was made from aerial photographs in order to study the change in habitat between 1950 and 1975. A diversity index (Pielou 1975) was conducted on each map.

## Previous Studies

Uncited data used in this paper from 1950 were taken from Wingfield (1951) and Wingfield and Low (1955). Data from 1955 are from Weller et al. (1958) and Weller (1959). Results from all four years of study are not presented in every section because data may have been lacking from one or more years.

# RESULTS

## Habitat Change

### Water levels

Annual fluctuations in the flow of the Bear River at the Collinston, Utah gauging station from 1931 to 1975 are shown in Figure 2. Although Knudson Marsh does not obtain its water from the Bear River, this graph gives an indication of the annual variation in water conditions of the area. The water flow in 1950 (1,642,000 acre/feet) was higher than any of the other three years of study, and was well above the 45 year average (1,168,000 acre/feet). Since the water conditions in the late 1940's were favorable, Knudson Marsh in 1950 had plenty of dense emergent vegetation and plenty of water, thus producing excellent redhead nesting habitat.

After 1952, however, water conditions declined drastically and in 1955, the third year of drought, the marsh habitat was in poor condition. Water conditions after 1955 varied greatly, with a peak in 1971. By 1974, the third year of study at Knudson Marsh, the Bear River flow was still quite high. The dike below the marsh, however, had been damaged and the water level in the marsh dropped quite rapidly after the spring thaw. The dike was repaired late in the summer of 1974, after the ducks had finished nesting. The Bear River flow in 1975 was good,

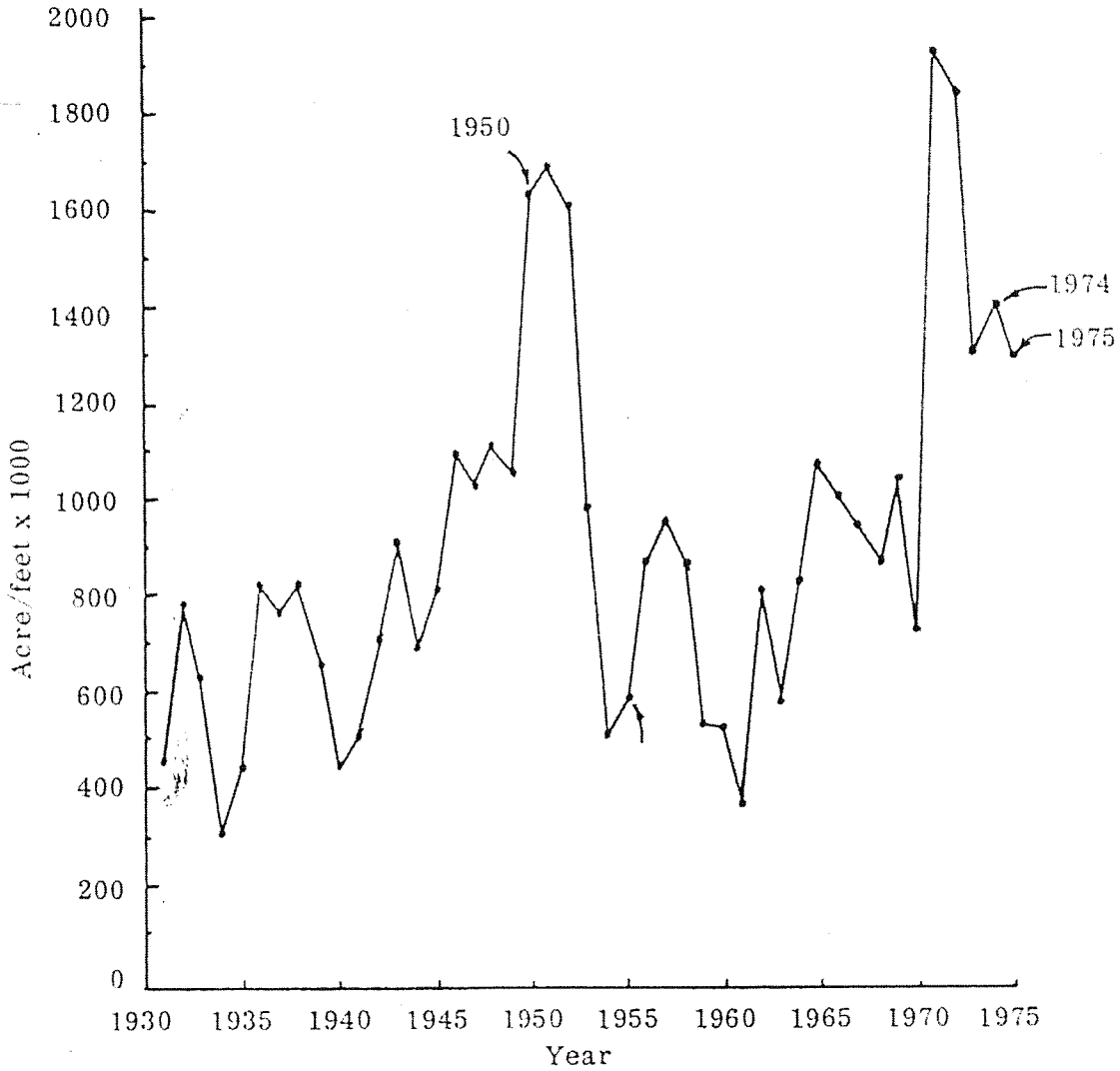


Figure 2. Annual discharge in acre-feet of the Bear River near Collinston, Utah (from US Geological Survey records).

and the water conditions at Knudson Marsh were also good, as the water was retained by the repaired dike.

In April, 1950, there were 2 to 30 cm of water in the marsh vegetation. By late May and early June the vegetation in the northern portion of the marsh was no longer inundated, but the channels and open ponds were still full of water, and the southern portion of the marsh had 2 to 15 cm of water in the vegetation. Most of the redhead nests were constructed over 1 to 8 cm of water (Table 1), and cattle seldom entered the marsh. The hardstem bulrush (Scirpus acutus) reached 2 to 3 meters in height and became so dense that it was almost impossible for a man to walk through it.

In 1955, the shallow ponds and channels in Knudson Marsh were dry by late May, and the water level in the main pool had receded drastically by early July. Only one nest was constructed over water (Table 1), and cattle had entered the marsh by April. The hardstem bulrush never reached 2 meters in height except on the borders of channels and potholes, and it was relatively easy to walk through, being less dense than in 1950 and having been thinned out even more by cattle. The new growth of vegetation was not dense enough to change the general appearance of the marsh from brown to green.

The marsh vegetation was covered with 1 to 8 cm of water in late March, 1974, but by the end of April the water was gone from most of the vegetated areas. By late May, most of the shallow ponds and potholes were dry, and the main pool was mostly exposed mud flats by

Table 1. Depth of water under redhead nests, Knudson Marsh, Utah.

| Variable | Percent of nests | | | |
|---|---|---|---|---|
| | 1950 | 1955 | 1974 | 1975 |
| No water | 24 | 98 | 100 | 4 |
| 1-8 cm | 60 | 2 | 0 | 46 |
| 9-16 cm | 14 | 0 | 0 | 21 |
| 17-34 cm | 2 | 0 | 0 | 29 |
| Total nests | 122 | 42 | 23 | 28 |

late June. No redhead nests were constructed over water (Table 1). The water conditions in the marsh seemed to be almost as poor as in 1955, but the cattle did not enter the marsh until late June and the hardstem bulrush was quite tall (up to 2.5 meters) and dense, and the marsh had a lush green appearance. Apparently the favorable conditions in the early 1970's enabled the vegetation to retain its vigor through 1974, whereas the drought years in the early 1950's severely curtailed the vegetative growth by 1955.

Through most of the 1975 breeding season the marsh retained 1 to 30 cm of water in the vegetation, and the channels and potholes never dried up. Most of the redhead nests were constructed over 1 to 16 cm of water (Table 1), and the cattle never entered the marsh. The hardstem bulrush grew up to 2 to 3 meters high and was very dense. The water level was maintained by controlling the outflow of water through the culverts on the south end of the marsh.

## Vegetation

The ratio of open water to total vegetation in Knudson Marsh increased slightly from 1950 to 1974 (Table 2), but this change is not believed to have had any effect on the redhead nesting ecology. The ratio for both years is close to the 35:65 ratio which Williams and Nelson (1943) found to be the preferred water:cover ratio for redheads in Utah. The changes in open water and vegetation are shown in the cover maps from 1950 (Figure 3) and 1975 (Figure 4).

Table 2. Vegetation changes on Knudson Marsh, Utah.

| Variable | 1950 | 1974 |
|---|---|---|
| General type: | % of total marsh area | |
| Open water | 31.0 | 37.8 |
| Vegetation (all spp.) | 69.0 | 62.2 |
| Vegetation type: | % of total vegetation | |
| Hardstem bulrush | 56.2 | 58.0 |
| Olney bulrush | 24.1 | 21.1 |
| Alkali bulrush | 0.8 | 0.0 |
| Cattail | 12.4 | 2.0 |
| Saltgrass | 6.5 | 18.6 |
| Cane | 0.1 | 0.2 |
| Total | 100.1 | 99.9 |

Knudson Marsh, Utah, 1981, showing cover types and open water (from Wingfield 1981).

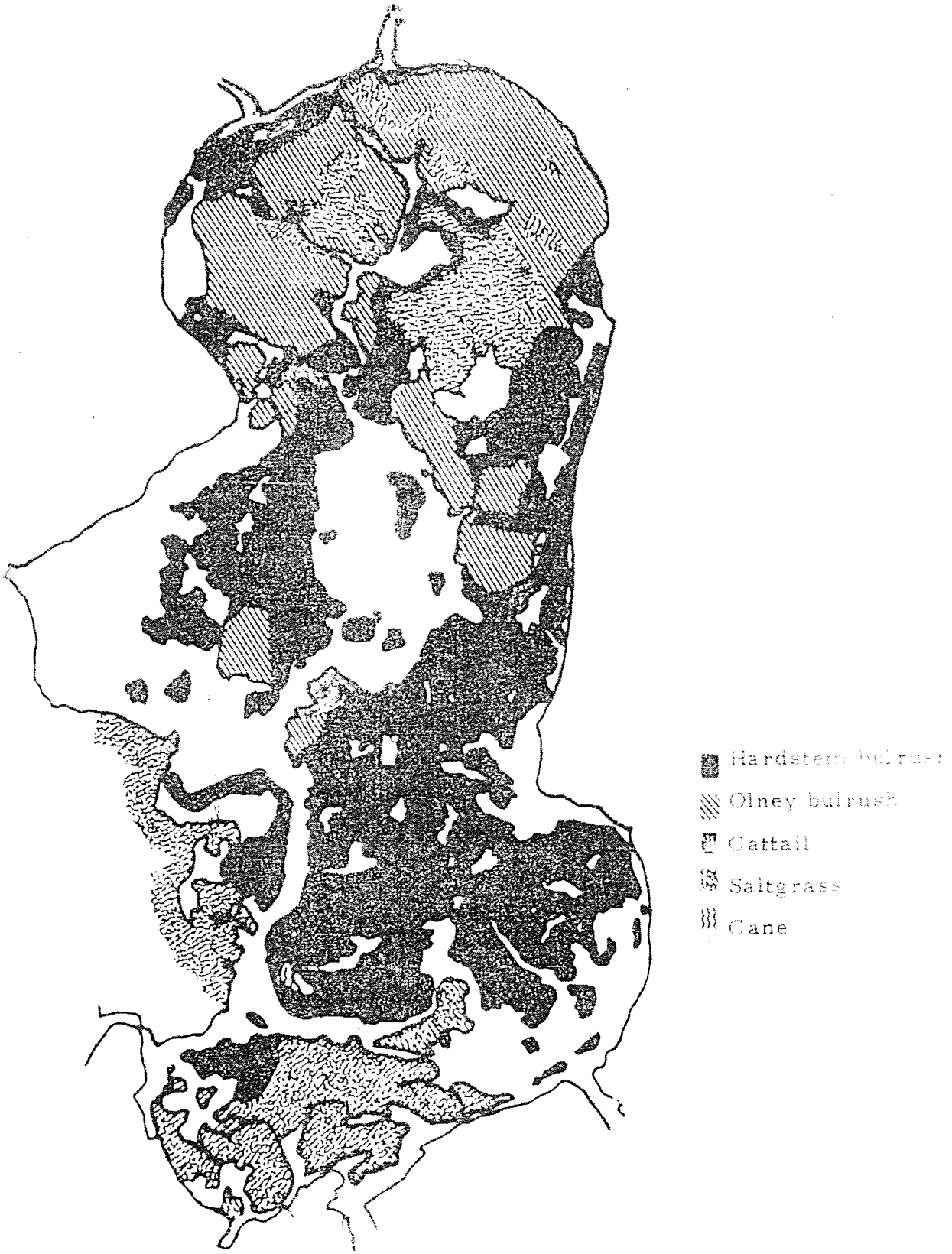


Figure 4. Knudson Marsh, Utah, 1975, showing cover types and open water.

Hardstem bulrush, the favored cover species for nesting redheads (Williams and Marshall 1938; Williams and Nelson 1943; Wingfield 1951; Bellrose 1976), seemed to be present in about the same proportion in 1974 as in 1950 (Table 2). The only major differences in the species composition of the cover were the increase in saltgrass (Distichlis spicata) and the decrease in cattail (Typha latifolia). Neither of these two species have been shown to be important as redhead nesting cover on Knudson Marsh.

Wingfield (1951) reported competition between hardstem bulrush and cattail on Knudson Marsh and that the latter was being invaded by the former. He also noted an increase in cattail on the southern portion of the marsh, on areas which were bare of vegetation in 1937, citing deeper water as the cause for this change. Bolen (1964), however, found that water depth creates differences between open water and vegetated areas, but not between different vegetation zones, and that soil salinity is more closely correlated with vegetational zonation. In addition, it has been found that cattail only germinates on mud flats which have been exposed for at least 24 hours (A. H. Holmgren, personal communication).

The cattail was probably replaced in different areas of the marsh between 1950 and 1974 by saltgrass, hardstem bulrush, and open water. The fact that alkali bulrush (S. paludosus) is now non-existent on Knudson Marsh (Table 2) supports Bolen's (1964) contention that it is a pioneer species which is usually superseded by other emergent

vegetation due to reduced salinity or intrusion by other salt tolerant species.

The two small clumps of cane present in 1950 were still in the same locations at the time of this study and no change was detected. The percentage of Olney bulrush (S. olneyi) also showed no change during the 24 hour period (Table 2). There was no apparent change in vegetational zonation from 1950 to 1955 (Weller et al. 1958).

A diversity index (Pielou 1975) did show a significant difference ($w = 38$, $p < 0.032$) by a Wilcoxon rank sum test (Hollander and Wolfe 1973) between the 1950 and 1975 maps (Figures 3 and 4). This difference in diversity was not believed to have affected redhead nesting to any great extent, but reflects subtle changes in the marsh composition.

Other vascular plants found on Knudson Marsh during the 1974 vegetation survey are listed in Table 8 (Appendix). The submerged aquatics, pondweed (Potomogeton pectinatus) and widgeongrass (Ruppia maritima), were much more numerous in 1975 when there was deeper water in the marsh; in 1974 submersed aquatics were extremely rare. The non-dominant terrestrial species formed the main components of the understory vegetation. I believe these species were present in great numbers only during dry years when there was no standing water in the vegetation.

## Breeding Populations

The redhead population of Knudson Marsh at the time of this study declined markedly from what it was in the early 1950's (Table 3). The present study took place during two years of extreme water conditions, 1974 and 1975, which correspond closely to the conditions of 1955 and 1950, respectively. It would seem appropriate, therefore, to compare the populations of years of similar habitat conditions, i.e., to compare 1950 with 1975 and 1955 with 1974, to determine if there has been a long term change in the population.

Table 3. Redhead data from Knudson Marsh, Utah.

| Variable | 1950 | 1955 | 1974 | 1975 |
|---|---|---|---|---|
| Redhead breeding pairs | 500 | 95 | 50 | 50 |
| Redhead nests | 151 | 49 | 23 | 49 |
| Average eggs hatched[a] per redhead nest | 3.9 | -- | 2.4 | 1.9 |
| Average eggs hatched[a] per hectare | 6.8 | -- | 0.8 | 1.3 |

[a]Includes parasitic redhead eggs hatched in nests of other species.

The fact that the breeding populations of 1974 and 1975 were the same, yet the number of nests increased from 23 to 49, can be explained in that nesting is more easily influenced by local conditions. When the birds arrived early in the breeding season in 1974, the marsh was in

fairly good condition. The water level dropped rapidly, however, thus curtailing the nesting of many hens. Birds were present in 1974, but they did not nest to the extent that they did in 1975 when the water conditions were more favorable.

During the two years of favorable conditions on the marsh, 1950 and 1975, the breeding population decreased from 500 to 50 pairs (90 percent decrease) and the number of nests decreased from 151 to 49 (67 percent decrease). In the unfavorable years, 1955 to 1974, the population dropped from 95 to 50 pairs (47 percent decrease) and from 49 to 23 nests (53 percent decrease). Treating these four years as being representative of a long term trend, it is apparent that the redhead population of Knudson Marsh has undergone a decline in this 26 year period which cannot be related to habitat changes.

## Nest Characteristics

### Cover types

Hardstem bulrush was found to be the preferred nesting cover species for redheads during 3 years of study (no data are available from 1955) at Knudson Marsh (Table 4). During 1950 and 1974, when the marsh vegetation was systematically searched for nests, 75 percent and 70 percent of the nests, respectively, were found in hardstem bulrush, which comprised less than 60 percent of the total vegetation. In 1975 this cover type was searched to a much greater extent than other types.

Cattail and saltgrass were utilized rarely in 1950, and not at all in 1974 and 1975. Olney bulrush was found to be a secondary cover type.

Distance from open water

Redhead nests appear to have been closer to open water ($X^2$ = 22.4, d.f. = 4, $p < 0.005$) in the present study than in 1950 (Table 4). No nests were found farther from open water than 9 meters in 1975 and 23 meters in 1974; in 1950, however, nests were found at 30+ meters from open water.

Table 4. Data from redhead nests in relation to cover type and open water, Knudson Marsh, Utah.

| Variable | % of nests | | |
|---|---|---|---|
| | 1950 | 1974 | 1975 |
| Cover type: | | | |
| Hardstem bulrush | 75 | 70 | 97 |
| Olney bulrush | 20 | 30 | 3 |
| Cat tail | 4 | 0 | 0 |
| Saltgrass | 1 | 0 | 0 |
| Total nests | 125 | 23 | 36 |
| Distance from open water: | | | |
| 0.0 - 1.8 m | 8 | 26 | 25 |
| 2.1 - 4.6 m | 15 | 22 | 36 |
| 4.9 - 7.6 m | 26 | 13 | 11 |
| 7.9 -15.2 m | 38 | 31 | 28 |
| 15.5 + m | 13 | 9 | 0 |
| Total nests | 125 | 23 | 36 |

It is advantageous for a redhead hen to construct her nest close to open water to facilitate easy escape when disturbed. In 1950, when redhead densities were quite high, there may have been competition for nest sites close to open water, and many nests had to be constructed in less favorable sites, at a greater distance from open water. In 1974 and 1975, however, with much smaller numbers of redheads nesting, a greater percentage of hens were able to secure a favorable nest site close to open water.

Clutch size

The average redhead clutch sizes for the 3 years of study are fairly similar (Table 5). The figures shown represent the maximum number of eggs associated with each nest, including eggs outside of the nest and in the water around the nest. This deviates from the standard definition of clutch, which includes eggs laid by only one female. The wide range in the numbers of eggs per clutch may be due to the large occurrence of intraspecific parasitism.

Redhead clutch sizes reported in the literature have averaged from 8.6 (McKnight 1974) to 13.8 (Miller and Collins 1954). Williams and Nelson (1943) examined 918 nests in Utah, and found a mean clutch of 10.5 eggs, with a range of one to 39. Williams and Marshall (1938) found that 343 nests on the Bear River Refuge averaged 12.5 eggs, with a maximum clutch of 39. Weller (1959), however, believes that the

true clutch of the redhead is smaller. He found that 17 unparasitized redhead nests averaged 7.3 eggs, ranging from five to nine.

Table 5. Clutch sizes in redhead nests, Knudson Marsh, Utah.

| Variable | 1950 | 1974 | 1975 |
|---|---|---|---|
| Average clutch | 13.5±0.7 | 12.5±1.4 | 12.8±1.3 |
| Range | 1-50 | 3-28 | 2-44 |

## Reproductive Success

The redhead's unusual reproductive behavior, which results in nest parasitism, seems to lower the reproductive success (Weller 1959). This is due to the fact that many redhead parasitic eggs are never incubated. Often dump nests are deserted, or parasitic eggs are laid after the host has already started incubating their eggs, thus they hatch before the parasitic eggs are fully incubated.

The success of redhead nests from three years at Knudson Marsh is shown in Table 6. Data are not presented from 1955 because Weller believed the redhead productivity was affected by his activities in the marsh, including nest trapping and daily disturbances to the nests (M. W. Weller, personal communication).

Table 6. Redhead egg and nest data from Knudson Marsh, Utah.

| Variable | 1950 | | 1974 | | 1975 | |
|---|---|---|---|---|---|---|
| | Sample size | % hatch or successful | Sample size | % hatch or successful | Sample size | % hatch or successful |
| Total redhead nests | 151 | -- | 23 | -- | 49 | -- |
| Redhead nests active when found | 125 | 30.4 ±4.1 | 13 | 53.8 ±13.8 | 23 | 56.5 ±10.3 |
| Redhead nests of known fate | 122 | 31.1 ±4.2 | 23 | 30.4 ±9.6 | 46 | 28.3 ±6.6 |
| Successful redhead nests | 38 | -- | 7 | -- | 13 | -- |
| Total redhead eggs in redhead nests | -- | -- | 276 | 18.1 ±2.3 | 628 | 12.1 ±1.3 |
| Redhead eggs in successful redhead nests | 482 | 72.8 ±2.0 | 82 | 61.0 ±5.4 | 204 | 37.3 ±3.4 |
| Redhead eggs in active when found redhead nests | 1629 | 21.8 ±1.0 | 163 | 30.7 ±3.6 | 293 | 25.9 ±2.6 |
| Total redhead eggs in all nests[a] | 3672 | 13.1 ±0.5 | 319 | 17.2 ±2.1 | 726 | 12.3 ±1.2 |
| Redhead eggs hatched[a] | 480 | -- | 55 | -- | 89 | -- |

[a]Includes redhead eggs from redhead nests plus redhead eggs laid in nests of other species.

Nesting success

The nest successes for redhead nests of known fate seem to be very close for the three years. The percent of active nests which were successful, however, appears to have increased significantly since 1950. The reason for this increase is not readily apparent, but it is possible that there was a higher incidence of intraspecific parasitism in 1950, as evidenced by the high average clutch of 13.5 (Table 5). This high intraspecific parasitism resulted in a high nest desertion rate; thus a smaller percentage of nests was successful. The greater incidence of predation in 1950 may have also contributed to the low nest success.

Predation was found to be a limiting factor to nest success in 1950, but not in the present study. Thirty nests (24.6 percent of total redhead nests) were lost to predation in 1950, primarily by California gulls (*Larus californicus*) and striped skunks (*Mephitis mephitis*). The success of active nests which were not preyed upon was 41.3 percent, still slightly lower than the successes for 1974 and 1975. Nine redhead nests in 1974 had been preyed upon, but six of these were deserted when found, so they may have been preyed upon after the hen had already deserted the nest. The other three nests (13.0 percent of total redhead nests) were believed to have been deserted due to predation. Only one redhead nest in 1975 had been preyed upon, and it had already been deserted when found.

Many redhead nests in the present study had been deserted when found, especially during the early part of the nesting season. Most of these desertions can undoubtedly be attributed to the redhead's weak reproductive habits (Weller 1959). Many deserted nests contained a small number of eggs. These may have been deposited by semiparasites before they began construction of their own nests, and were never incubated. Other nests with large clutches were probably deserted as a result of disturbance during intraspecific parasitism.

Redhead nesting success, as reported in the literature, is quite variable, ranging from 15 percent (Lokemoen 1966) to 88 percent (Rienecker and Anderson 1960). This variability is probably due primarily to the parasitic behavior of this species. The success at Knudson-Marsh obviously falls somewhere between these extremes, and it is impossible to draw any conclusions by comparing the nest success of this population with that of other redhead populations in North America.

Hatching success

The hatching success of redhead eggs in successful nests shows a significant decrease between the 1950 study and the 1974 and 1975 studies (Table 6). The reason for the low hatching success in 1975 is probably that a large number of eggs were laid in nests which were deserted due to intraspecific parasitism or were never incubated. There was one nest in 1975 which contained a total of 44 eggs, obviously from more than one hen. The nest was incubated, though, and one egg

hatched. This probably biased the hatching success of that year to some extent.

The hatching success in 1950 is significantly higher than those of the present study, although the nesting success for that year appears to be the same as or lower than those of the present study. The reason for this discrepancy is not fully understood, and cannot be explained with the data available from this study.

Productivity

The composition of Knudson Marsh, plus the belief that many hens moved their broods off the marsh to be reared (Wingfield and Low 1955), made accurate brood counts virtually impossible. The only estimate of production available, therefore, is the number of eggs that hatched. The change in total marsh production from year to year, as would be expected, was directly proportional to the change in numbers of nests found (Table 6).

The production of redheads expressed in eggs hatched per hectare (Table 3) shows a drastic decrease from 6.8 in 1950 to 0.8 and 1.3 in 1974 and 1975, respectively. This is to be expected, since there were fewer birds on the marsh during the present study, and fewer nests. Perhaps a better expression of productivity is the number of eggs hatched per redhead nesting effort. The fact that this figure also shows a decline from 3.9 to 2.4 and 1.9 (Table 3) indicates a true change in productivity. The standard deviations for 1974 and 1975 are 0.7 and 0.4, respectively,

but insufficient data are avilable from 1950. Consequently, the significance of this apparent decline in productivity could not be assessed. The average number of eggs hatched per active redhead nest was 3.9 for 1950 and 4.2 and 3.9 for 1974 and 1975. This implies that the productivity has not changed.

## Interspecific Parasitism

The primary hosts for redhead nest parasitism in Knudson Marsh were mallards and cinnamon teal, mainly because they were the most abundant. Ruddy ducks, which nested in small numbers on Knudson Marsh, were also parasitised to some extent. Canvasbacks (*Aythya valisineria*), which are important as host species in other areas, do not usually nest in the Knudson Marsh area. Although mallards and cinnamon teal are both known as upland nesters, they construct over-water nests quite frequently in Knudson Marsh. This makes them acceptable hosts to parasitic redheads.

The data from mallard and cinnamon teal nests are presented in Table 7. Search efforts in 1975 were concentrated in the hardstem bulrush habitat, thus many dabbler nests constructed in other cover types were undoubtedly not located.

Apparently a greater percentage of mallard nests were parasitized in 1975 (84.6 percent) than in the other study years, but parasitism of cinnamon teal nests was greatest in 1950 (75.9 percent). The percent of nests of both species parasitized was lowest in 1974 (36.2 percent)

Table 7. Data from mallard and cinnamon teal nests, Knudson Marsh, Utah.

| Variable | Mallard | | | | Cinnamon teal | | | | Total | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1950 | 1955 | 1974 | 1975[a] | 1950 | 1955 | 1974 | 1975[a] | 1950 | 1955 | 1974 | 1975[a] |
| Number of nests | 390 | 171 | 13 | 13 | 172 | 57 | 34 | 20 | 562 | 228 | 47 | 33 |
| % nests parasitized by redhead | 69.5 ±2.6 | 68.0 ±4.0 | 23.1 ±11.7 | 84.6 ±10.0 | 75.9 ±3.6 | 53.7 ±7.8 | 41.2 ±8.4 | 40.0 ±11.0 | 71.4 ±2.1 | 49.6 ±3.8 | 36.2 ±7.0 | 57.6 ±8.6 |
| % host eggs hatched | 58.9 ±0.9 | -- | 64.5 ±5.5 | 38.3 ±6.3 | 40.8 ±1.7 | -- | 46.6 ±3.1 | 21.8 ±4.7 | 55.1 ±8.2 | -- | 50.8 ±2.8 | 29.0 ±3.9 |
| % redhead eggs hatched | 5.9 ±0.6 | -- | 33.3 ±13.6 | 16.4 ±5.0 | 6.5 ±0.9 | -- | 2.9 ±2.8 | 9.5 ±4.5 | 6.1 ±0.5 | -- | 10.9 ±4.6 | 13.4 ±3.5 |
| % nests successful | 65.7 ±2.6 | 67.3 ±4.5 | 60.0 ±15.5 | 50.0 ±14.4 | 35.7 ±4.0 | 34.1 ±7.4 | 51.6 ±9.0 | 27.8 ±10.6 | 56.3 ±2.3 | 58.3 ±4.0 | 53.7 ±7.8 | 36.7 ±8.8 |
| % unparasitized nests successful | 64.0 ±4.8 | 66.0 ±7.7 | 62.5 ±17.1 | 100.0 | 41.0 ±8.4 | 44.0 ±11.7 | 47.1 ±11.4 | 30.0 ±14.5 | 58.3 ±4.3 | 58.9 ±6.6 | 51.9 ±9.6 | 36.4 ±14.5 |
| % parasitized nests successful | 66.4 ±3.2 | 68.0 ±5.4 | 50.0 ±35.3 | 45.4 ±15.0 | 32.7 ±4.5 | 26.0 ±9.1 | 50.0 ±13.4 | 25.0 ±15.3 | 55.5 ±2.7 | 57.9 ±5.1 | 50.0 ±12.5 | 36.8 ±11.1 |
| Host eggs/ parasitized nest | 9.2 | 7.2 | 6.7 | 5.0 | 5.4 | 8.3 | 7.6 | 2.5 | 8.0 | 7.4 | 7.4 | 3.9 |
| Host eggs/unparasitized nest | 9.4 | 8.3 | 9.0 | 7.5 | 8.6 | 10.1 | 9.0 | 6.1 | 9.3 | 8.8 | 9.0 | 6.3 |
| Redhead eggs/ parasitized nest | 6.0 | 5.5 | 4.0 | 5.0 | 6.6 | 4.0 | 2.4 | 5.2 | 6.2 | 5.1 | 2.7 | 5.1 |
| Host + redhead eggs/nest | 12.5 | 10.2 | 9.4 | 9.6 | 10.5 | 12.0 | 9.2 | 6.7 | 12.4 | 10.7 | 9.2 | 7.8 |

[a] Search efforts in 1975 concentrated in hardstem bulrush cover type.

and highest in 1950 (71.4 percent). These years were also the years of lowest and highest number of nests found, respectively, which supports Olson's (1964) and Bellrose's (1976) contentions that the intensity of parasitism parallels that of normal nesting. Williams and Nelson (1943) found that only 6 percent of other species nests were parasitized by redheads.

Redheads generally laid fewer eggs per parasitized nest in 1974 (2.7 per nest). This was true for both mallards (4.0 per nest) and cinnamon teal (2.4 per nest). In 1975 there were more redhead eggs (5.1) per parasitized nest than host eggs (3.9). Some mallard and cinnamon teal hens were found incubating nests which contained all redhead eggs. Apparently the host eggs had been pushed out of the nest and into the water by the parasitic hens, and the hosts continued to incubate.

The number of host eggs per unparasitized nest was always found to be greater than the host eggs per parasitized nest. This supports Weller's (1959) contention that the presence of parasitic eggs stifles ovulation in the host.

The total number of eggs (host and redhead) per nest was greatest in 1950 for mallards (12.5) and in 1955 for cinnamon teal (12.0). This figure was lowest in 1974 for mallards (9.4) and in 1975 for teal (6.7).

Redhead parasitism did not seem to affect the nest success of the host species, as there is no significant difference between nest successes of parasitized and unparasitized nests (Table 7). The mallard nest success apparently did not change significantly in the four years of study.

The cinnamon teal success, however, seemed to be slightly higher in 1974. Weller (1959) also found that redhead parasitism did not affect mallard or cinnamon teal nest success.

The hatching success of mallard eggs, as well as redhead eggs in mallard nests, seemed to be highest in 1974 (64.5 percent and 33.3 percent, respectively). The teal hatching success was quite low in 1975 (21.8 percent), whereas the hatching of redhead eggs in teal nests was relatively high (9.5 percent). Williams and Nelson (1943) found that 24 percent of the redhead eggs and 96 percent of the host eggs hatched in parasitic nests. These figures were much higher than the ones for Knudson Marsh.

## Other Bird Species

It appears that the numbers of mallard and cinnamon teal nests found on Knudson Marsh have decreased since 1950 (Table 7). The ruddy duck was also studied intensively in 1950 by Wingfield, but insufficient nests were found in later years to allow meaningful comparison.

Weller et al. (1958) reported that the number of Canada goose (*Branta canadensis*) nests found on Knudson Marsh decreased from the 146 and 144 found by C. S. Williams in 1940 and 1941 to 30 in 1950 and 25 in 1955. I estimated 100 pairs of geese nested on the marsh in 1975.

Wingfield (1951) found a small colony (65 nests) of great blue herons (*Ardea herodias*) in the upper marsh, as well as two smaller colonies composed of white-faced ibis (*Plegadis chihi*), snowy egret

(*Leucophoyx thula*) and black-crowned night heron (*Nycticorax nycticorax*) nests. No ibis or egret nests were found in 1955, but a few great blue heron and night heron nests were found on the upper and lower marsh, respectively.

A small colony of night herons nested on the upper marsh in 1974, and a small number of ibises, egrets and great blue herons nested on the lower marsh. A large colony of ibises (673 nests), along with scattered egrets and night herons, was found on the upper marsh in 1975, and 141 ibis nests and a number of great blue heron, night heron, and egret nests were found on the lower marsh. Apparently the ibis population of the area north of the Great Salt Lake varies from year to year in choice of a colonial nesting site (ibis data from D. E. Capen, personal communication).

# DISCUSSION

This study has attempted to test the hypothesis that the redhead population of Knudson Marsh has declined due to changes in habitat. This hypothesis was not supported because no substantial change in redhead habitat was found between 1950 and 1975, yet the population has declined markedly during this period. These conclusions were derived from only four years of study over a 26 year period. It is now known that there were fewer redheads on the marsh at the time of this study than there were in the early 1950's; what fluctuations may have occurred between 1955 and 1974, however, are not known.

It is possible that the redhead population in 1950 was much higher than average, but the marsh is apparently capable of handling such a high density of nesting redheads. The reason for the drastic difference between the populations of 1950 and 1975, two years of similar habitat conditions, remains unknown. My opinion is that the difference is not related to the conditions at Knudson Marsh.

The marshes of the Great Salt Lake Basin, (including Knudson Marsh) are important as major redhead producing areas. The breeding population of this area (Great Basin population) is not as high as the population of the prairie parkland pothole region of the northern U. S. and southern Canada (prairie population). The nesting densities in the

Great Basin marshes are high (Bellrose 1976), however, and Knudson Marsh has a density of nesting redheads which is higher than that found in most wetland areas.

It seems logical that Knudson Marsh, being an area of prime redhead habitat, would have a breeding density which is higher than average. In years of a high Great Basin redhead population, areas such as Knudson Marsh may reach carrying capacity (which I assume is near the 1142 pairs per square kilometer found in 1950), and surplus redheads would nest in secondary and marginal habitat. When the redhead population is low, however, there would be no need to utilize marginal habitat if areas of primary habitat are not at their carrying capacity. Consequently, areas such as Knudson Marsh should be last to show a decrease in numbers during years of a low Great Basin population. The density of redheads on Knudson Marsh in 1975 was only 10 percent of the assumed carrying capacity, which would seem to indicate that either the Great Basin population of redheads has decreased from what it was in 1950, or that there was more primary habitat available in 1975 than in 1950, thus spreading out the breeding population.

Improvements in the form of state and federal wildlife refuges have taken place over the last 25 years in the Great Basin area. It is believed, however, that the total acreage of prime wetlands has not increased significantly, since there may have been an increase in wetland drainage and irrigation use of water supplies on private lands. It

is unlikely, therefore, that the redheads moved to other marshes in the Great Basin that were not available in 1950.

Another explanation to a decrease at Knudson Marsh is a decrease in the Great Basin population. Such a population decrease could have come about in a number of ways. The redheads that once nested in Great Basin marshes may have shifted to another breeding area, such as the Canadian prairies. There may have been an increase in mortality, from hunting or other causes. It is also possible that a decrease in productivity has occurred due to behavioral or physiological changes.

Olson (1964) noted that the redhead is now a common nester in the prairie pothole region of Canada, but it was not abundant there in the early part of this century. Further investigation of the literature, however, reveals that insufficient data are available from the early 1900's and late 1800's to come to any valid conclusion regarding the abundance of redheads at that time. Weller (1964) postulated that redheads originated in the alkaline marshes of the southwestern United States and have only recently invaded the prairie pothole region. This may be an explanation for a decrease in the Great Basin population, but not necessarily so.

If redheads did leave the Great Basin and shift to the prairie region, we should have seen an increase in the prairie population over the past 25 years. Data supporting this, however, are lacking. It is believed by some authorities that the prairie redheads have decreased

from the 1950's to the early 1970's. The U. S. Fish and Wildlife Service breeding ground survey did show a substantial increase in redheads for 1975, but this figure is imprecisely estimated for redheads. Survey estimates for the 1955-75 period do not indicate a trend.

Increased mortality is another possible reason for a decline in the numbers of redheads. Hochbaum (1946) reported that redheads in the Canadian prairie potholes were suffering a serious population decline despite excellent environmental conditions. He said it was "highly unlikely" that they moved elsewhere to breed, and that hunting pressure was probably a more likely explanation.

Geis and Crissey's (1969) study seemed to support Hochbaum's explanation. They determined that redhead and canvasback survival rates increased and mortality rates decreased during the closed seasons from 1960 to 1963. Rienecker (1968) however, found that the closed seasons did not seriously affect the mortality rates of California redheads. In addition, the continental redhead population has failed to show an increase, despite restrictive harvest regulations since 1960. It is doubtful, therefore, that an increase in hunting mortality is responsible for the decline in the numbers of redheads, and there are no data available to indicate a change in other types of mortality.

A third possible reason for a decrease in the Great Basin redhead population is a change in productivity. No significant decrease in productivity was noted at Knudson Marsh in this study. Weller (1959) noted a low productivity among redheads because of their "innately weak

reproductive habits." They seem to desert nests more frequently than do other species, and lay many eggs in nests other than their own. Many of these eggs are never incubated and do not hatch. Consequently there is much fluctuation in the productivity of redheads.

Most redheads are semiparasitic, i.e., they lay eggs in other nests early in the nesting season when most other species are in the peak of nesting, then build their own nests and incubate later in the season (Weller 1959). In this respect, nest parasitism may be an added luxury which may or may not be beneficial to the population in a given year, but the late redhead nests will support the population in years of low production from parasitism. There may be years when a large number of young redheads are hatched parasitically, and the population will have a significant increase.

Another explanation for the perpetuation of a trait which is seemingly detrimental to the redhead's reproductive success is differential parasitic success. Although Weller (1959) found that nest parasitism was not beneficial, Olson (1964) found that redhead productivity was greatly increased by interspecific parasitism. Olson's study took place in southern Canada, where canvasbacks were the primary hosts. He found that parasitism was an effective method of avoiding competition between redheads and canvasbacks during years of limited resources. Because the canvasback is very similar and closely related to the redhead, it may be a better host than mallards and cinnamon teal, which serve as primary hosts in the Great Basin area. Consequently, redhead

parasitism would be more successful in the prairie region than in the Great Basin, where canvasbacks rarely nest. Because there is considerable mixing of Great Basin and prairie redheads on the wintering grounds, however, isolation of one population segment does not occur (Weller 1964). In this way, the parasitic trait is perpetuated in the Great Basin redhead population, although it may not be beneficial to that population.

Sufficient data are not available to determine whether there has been a long term decrease in productivity. The apparent decrease shown for Knudson Marsh may not be significant. It is possible that there is much fluctuation in productivity as a result of the redhead's reproductive behavior and the population has not yet recovered from a downward trend. More research is needed in order to determine the effect of parasitism on productivity. It is not known if nest parasitism is a genetic trait, and very little is known about the survival and behavior of parasitic young.

I believe that the decrease in the number of nesting redheads on Knudson Marsh, despite the fact that no habitat change was found, indicates a decrease in the Great Basin population. This decrease is believed to have occurred largely as a result of productivity fluctuations. There may have been a long term shifting of redheads from the Great Basin population to the prairies, but there is no evidence to support this. Increased mortality is not believed to have been an important factor in the population decline.

Further research is needed on the effect of nest parasitism on redhead productivity, and on the survival and behavior of parasitically reared young. The status of redhead breeding habitat and breeding populations in the western U. S. needs to be assessed, and purchase and/or management of areas such as Knudson Marsh is highly recommended. More accurate data is needed on the present status and distribution of the continental redhead population.

# SUMMARY

1. Redheads were studied on Knudson Marsh, Utah, during the breeding seasons of 1974 and 1975. This study was compared with earlier works by Wingfield (1951) and Weller et al. (1958) on the same area.

2. The study area is 70 hectares in size and is located in the Great Salt Lake Valley, where North America's greatest concentration of nesting redheads is found (Bellrose 1976).

3. The total marsh vegetation was systematically searched for nests in 1974; search efforts in 1975 were concentrated for the most part in the hardstem bulrush cover type.

4. Redhead, ruddy duck, mallard and cinnamon teal nests were marked and monitored, nest data were collected, and the fate of each nest was determined.

5. Habitat change was determined from a vegetation analysis conducted in 1974 by grid point sampling, and from cover maps made from aerial photographs.

6. Water conditions in the marsh were generally favorable in 1950 and 1975, and poor in 1955 and 1974.

7. No substantial change in the ratio of open water to emergent vegetation was detected. The ratio was 31:69 in 1950, and 38:62 in 1974.

8. The only major changes found in the species composition of the cover vegetation were a decrease in cattail from 12.4 percent to 2.0 percent and an increase in saltgrass from 6.5 percent to 18.6 percent. These two species were not found to be important as redhead nesting cover.

9. No significant change was found in the percent composition of hardstem bulrush, which was the preferred redhead nesting cover species.

10. During the two years of favorable conditions on the marsh, 1950 and 1975, the breeding population decreased from 500 to 50 pairs (90 percent decrease) and the number of nests decreased from 151 to 49 (67 percent decrease).

11. A decrease was also found in the two years of poor habitat conditions, 1955 and 1974, from a breeding population of 95 pairs to 50 pairs (47 percent decrease), and from 49 nests to 23 nests (50 percent decrease).

12. Hardstem bulrush was found to be the preferred cover type for redhead nests in the three years of study for which data was available: 1950, 1974, and 1975. This cover type composed less than 60 percent of the total marsh vegetation, yet 75, 70 and 90 percent, respectively, of the redhead nests found were in this cover type.

13. Redhead nests were constructed at a greater distance from open water in 1950 than in the present study, when there was less

competition for nest sites close to open water because of the lower density of nesting birds.

14. No significant difference was found between the average redhead clutch sizes for 1950, 1974 and 1975 due to the high variation in number of eggs per nest.

15. Nesting success in redhead nests which were active when found was greater in the present study than in 1950, although the success of all nests of known fate was unchanged.

16. Predation was higher in 1950 (24.6 percent of total nests preyed upon) than in the present study, when it was a very minor factor in nest success.

17. Hatching success in successful nests was significantly higher in 1950 (72.8 percent) than in the present study (61.0 percent and 37.3 percent).

18. Redhead productivity, both in terms of eggs hatched per hectare and eggs hatched per nesting effort, showed a decline from 1950 to the present study, although the latter comparison may not be significant.

19. Mallards and cinnamon teal were the primary hosts for redhead interspecific parasitism, which seemed to parallel normal nesting. The highest percentage of nests parasitized was in 1950 (the year of maximum redhead nesting) when 71.4 percent of the host nests were parasitized. In 1974, the year of lowest parasitism (and redhead nesting), 36.2 percent of the nests were parasitized.

20. Redhead parasitism was not found to affect the nest success of the host species.

21. There seemed to be fewer mallards, cinnamon teal and ruddy ducks nesting on Knudson Marsh in the present study than in earlier ones. Canada geese and colonial nesting birds, however, seemed to have increased on the marsh.

22. The decreases shown in the redhead population of Knudson Marsh were not found to have been related to changes in habitat.

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Table 8. Plant species present on Knudson Marsh, Utah, 1974 (names from Holgren and Reveal 1966).

| Scientific name | Common name |
|---|---|
| *Amaranthus* sp. | Amaranth |
| *Apocynum cannabinum* L. | Dogbane |
| *Asclepias incarnata* L. | Swamp Milkweed |
| *Chenopodium album* L. | Lambsquarters |
| *Cyperus* sp. | Flatsedge |
| *Distichlis spicata* L. | Desert Saltgrass |
| *Eleocharis macrostachya* Britton | Common Spike-rush |
| *Helianthus annuus* L. | Sunflower |
| *Hordeum jubatum* L. | Foxtail Barley |
| *Lemna minor* L. | Common Duckweed |
| *Monolepis nuttalliana* (Schult.) Green | Monolepis |
| *Phragmites australis* (Cav.) Trin. x Steud.[a] | Cane |
| *Polygonum persicaria* L. | Smartweed |
| *Polypogon monspeliensis* (L.) Desf. | Rabbitfoot Grass |
| *Pot amogeton pectinatus* L. | Fennelleaf Pondweed |
| *Ruppia maritima* L. | Widgeongrass |
| *Salicornia europaea* L. ssp. rubra (A. Nels.) Breitung | Glasswort |
| *Scirpus acutus* Muhl. | Hardstem Bulrush |
| *Scirpus olneyi* A. Gray | Olney Bulrush |
| *Senecio hydrophilus* Nutt. | Water Groundsel |
| *Solanum dulcamara* L. | Nightshade |
| *Triglochin maritima* L. | Shore Arrowgrass |
| *Typha latifolia* L. | Common Cattail |
| *Xanthium strumarium* L. | Cocklebur |

[a] *Phragmites communis* Trin. in Holmgren and Reveal (1966).

# VITA

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Master of Science

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# Appendix K

Important Bird Area Information on Bear River Bay

Audubon

Important Bird Areas



# Utah Important Bird Areas Program

## An Introduction



**Background on the Important Bird Areas Program**

While operating independently within the State, the Utah Important Bird Area (IBA) Program is contributing to an international IBA effort initiated in 1985 by BirdLife International. The program reached the United States in 1995, where Audubon is now administrator of the project. Under the auspices of Audubon, state-based programs are identifying Important Bird Areas within each state.

IBAs are sites that provide essential habitat for one or more species of bird. IBAs include sites for breeding, wintering, and/or migrating birds. The IBA Program is designed to be proactive, voluntary, participatory, science-based and credible. The IBA program works to identify, monitor and conserve sites for birds. The program connects to other IBA sites throughout the United States and the world. Additional information about the Important Bird Area Program in the United States can be found at www.audubon.org/bird/iba.

**Background on the Utah IBA Program**

In Dec. 2001 there was a general kick-off meeting for the Utah IBA program.

Subsequently, a Utah IBA Technical Committee was formed, comprised of numerous bird experts and enthusiasts from Audubon, other birding groups and federal and state representatives. The Utah Technical Committee has established the State-specific criteria and a nomination form for the Utah IBA program based on the World Bird Database (operated by Audubon in the United States and BirdLife International for the numerous participating countries). The Technical Committee will identify Utah's IBAs and forward sites that are potentially of continental or global significance to Audubon's National Technical Committee for their review. Val Grant, President of Bridgerland Audubon Society, Chairs the Technical Committee.

A Steering Committee will be formed that will help in other efforts associated with the IBA program such as overseeing monitoring and conservation efforts at the IBA sites that are selected. Wayne Martinson, who has worked as Utah Wetlands Coordinator for Audubon, is the Utah IBA Coordinator.

**Next Steps for the Utah IBA Program**

Nominations for the Utah Important Bird Area Program are solicited on an on-going basis. Nominations can be received from any interested party. Five Utah IBA sites were announced in May 2003 and 10 additional sites were announced in May 2004. Additional sites will be announced in future months and years.

**You are encouraged to participate in the Utah IBA Program**

Every effort is being made to involve all interested persons and organizations in the Utah IBA program.

If you would like to receive additional information about the Utah IBA program including the nomination form and the criteria, please contact Wayne Martinson at 801-355-8110 or wmartinson@audubon.org or visit the following links.

**For more information on the Utah IBA Program see the following links**

- **To review a list of sites that have been nominated or identified click:**

  **IBA Sites Nominated and Selected**
  (as of May 2004)

- **To review the Utah IBA criteria and obtain a copy of the nomination form click:**

  **IBA Site Nomination Criteria**

  IBA Site Nomination Form:
  **PDF Format** or **Word Format**

- **For a list of the UT IBA Technical Committee Members click:**

  **IBA Technical Committee Members**

- **If you would like to receive additional information about the Utah IBA program please contact:**

  Wayne Martinson
  (801) 355-8110
  wmartinson@audubon.org.

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Audubon

Important Bird Areas



# IBA Sites Nominated and Selected

## Important Bird Areas Program in Utah



If you would like additional information regarding other possible Important Bird Areas in Utah, please contact:

Wayne Martinson
wmartinson@audubon.org
or 801-355-8110

**AUDUBON RECOGNIZES TEN NEW 'IMPORTANT BIRD AREAS' IN UTAH**

Announcement Comes on Eve of International Migratory Bird Day (May 8, 2004)

Salt Lake City, UT, Wednesday, May 5, 2004 - The Utah Important Bird Areas (IBA) program, which operates under the auspices of the National Audubon Society, has added ten new IBA sites in Utah: The five major bays on Great Salt Lake - Farmington, Ogden, Bear River, Gilbert (or South Arm), and Gunnison (or North Arm); Provo and Goshen Bay on Utah Lake; Cutler Marsh-Amalga Barrens in Cache County; the Upper Strawberry Watershed in Wasatch County; and, Lytle Preserve in Washington County.

These ten new sites add to the five sites recognized last year at this time: Fish Springs National Wildlife Refuge, Ouray National Wildlife Refuge, Deseret Land and Livestock Ranch, Fremont River within Capitol Reef National Park, and Clear Lake Waterfowl Management Area.

The announcement comes on the eve of International Migratory Bird Day (May 8, 2004), which highlights the perils and journeys of migratory birds. The announcement also occurs during National Wetlands Month. Important Bird Areas are sites that provide essential habitat for one or more species of bird, and meet criteria established by Utah's IBA Technical Team, which includes many of the state's leading ornithologists.

"The IBA program is an excellent way to identify critical areas for birds across the world and in Utah," declares Val Grant, president of Bridgerland Audubon Society and chair of Utah's IBA Technical Team. "The inclusion of specific properties grants no management authority nor enables any landowner restrictions from the IBA program. But by working cooperatively with landowners, the hope is that the areas can continue to be monitored and conserved for the future."

Eight of the new IBAs focus mostly on the Great Salt Lake and the Greater Great Salt Lake Watershed. The valuable habitats include the open water of Great Salt Lake, the freshwater at the wildlife management areas, mudflats, playas, riparian areas and uplands. The Upper Strawberry Watershed and Lytle Preserve accentuate the tremendous variety in habitats that are important for birds in Utah - from a high mountain valley and reservoir dominated by

sagebrush steppe, mountain riparian, aspen forest and conifer forest to Mojavian Desert, lowland riparian and desert scrub.

The eight IBAs in the Greater Great Salt Lake Watershed are being nominated primarily for their value to a tremendous variety and number of waterbirds. The following provides counts for just one bird for each area: 81,927 American Avocets at Farmington Bay; 335,051 Wilson's Phalaropes at Ogden Bay; 200,818 Green-winged Teal at Bear River Bay; 24,154 American White Pelicans at Gunnison Bay; and 778,260 Eared Grebes at Gilbert Bay. Survey data also shows 12,261 Mallards at Provo Bay, 1,390 White-faced Ibis at Goshen Bay, and 30 Great Blue Herons at Cutler Marsh-Amalga Barrens.

The other two nominations also host a variety of birds including birds that are listed as Utah State Sensitive Species and/or Utah Partners in Flight Priority Species. The Upper Strawberry Watershed provides habitat for more than 100 Greater Sage-Grouse, while Lytle Preserve is home to roughly 100 Gamble's Quails.

In addition to being State Important Bird Areas, each of the five bays of Great Salt Lake will also be nominated as Globally Important Bird Area sites. One criterion for becoming a global IBA is to have more than 1 percent of the world's population of a particular bird species. Each bay of the Great Salt Lake easily fulfills this global criterion. There are more than 20 species that have more than 1 percent of their world population on various bays of the Great Salt Lake including: Tundra Swan, Cinnamon Teal, White-faced Ibis, and Marbled Godwit. A good way to find out more is to attend the Great Salt Lake Bird Festival coming up on May 14-22, www.greatsaltlakebirdfest.com

The IBA Program is designed to be proactive, voluntary, science-based, and credible. The Utah program connects to other IBA sites throughout the U.S. through the National Audubon Society, and the world through BirdLife International. Additional information about the national program can be found at www.audubon.org/bird/iba.

Wayne Martinson, Utah Important Bird Areas Coordinator for Audubon states, "The 15 announced IBA sites provide a good base for the statewide IBA program. We look forward to designating additional IBAs in Utah in the future."

*Audubon is dedicated to protecting birds and other wildlife and the habitat that supports them. Our national network of community-based nature centers and chapters, scientific and educational programs, and advocacy on behalf of areas sustaining important bird populations, engage millions of people of all ages and backgrounds in positive conservation experiences.*

**Note: The following is additional contact information as well as information for each of the fifteen sites.**

For further information about the IBA program please contact:

Wayne Martinson, Utah Important Bird Areas Coordinator
National Audubon Society,
wmartinson@audubon.org or (801)355-8110

Val Grant, Chair, Utah Important Bird Areas Technical Committee
President, Bridgerland Audubon Society
biores@mtwest.net or (435)753-5370

For more about International Migratory Bird Day,

Bob Walters, Watchable Wildlife Program Coordinator
Utah Division of Wildlife Resources

bobwalters@utah.gov or (801)538-4771

For more information about the Great Salt Lake Bird Festival,

Neka Roundy, Davis County Tourism
tour@co.davis.ut.us or 801-451-3286
www.greatsaltlakebirdfest.com

For Directions to birding areas available to the public for many of the IBA sites see the Wasatch Audubon Website www.wasatchaudubon.org and go to the Great Salt Lake Birding Trails Map as well as the Southwest Utah Birding Trails Map.

**RECOGNIZED MAY 2004**

**Goshen Bay and Provo Bay**

Utah Lake is one of the most important wetland systems in Utah for waterfowl and shorebird populations in terms of actual bird use. However, not all of the lake is equally important. Approximately 90-95% of lake use occurs in both the Provo and Goshen Bays depending on lake levels. Shorebirds and migratory birds seek flat, shallow ponds on which to feed, rest, and breed. Therefore, when lake levels are high the birds tend towards Goshen Bay. However, when levels are low, as they currently are and have been in recent years, Provo Bay provides the most valuable habitat for shorebirds and migratory birds. The health of both bays is necessary in order to respond to fluctuating lake levels and provide the necessary habitat. The two greatest threats to these areas are lost upland and shoreland habitat from encroaching development, and water quality in the lake. If shorebirds and migratory birds are to succeed in their current population numbers, the bays of Utah Lake are critical to their survival. Statement by: Tom Aldrich, Waterfowl Program Coordinator, Utah Division of Wildlife Resources, July 2003.

Goshen Bay includes 13,000+ Acres. Landowners included in the nomination are: Bureau of Land Management, Utah Reclamation Mitigation and Conservation Commission, Utah Division of Forestry, Fire and State Lands (for sovereign lands) and Utah Division of Wildlife Resources. Highest five bird species counts in area: White-faced Ibis 1,390 Green-winged Teal 1,290 Wilson's Phalarope 1,260 Mallard 973 California Gull 585.

Provo Bay includes 6,400 acres, but the nomination states that only about 1,920 acres is included because of the land dispute between the State of Utah and private property owners regarding sovereign lands. Landowners included in the nomination are: Utah Division of Forestry, Fire and State Lands (for sovereign lands) and Utah Division of Wildlife Resources. The following are total survey numbers, but only about 30% of these numbers are actually considered as part of the nomination at this time because of the land dispute. Highest five bird species counts in area: Green-winged Teal 14,680 Mallard 12,261 White-faced Ibis 6,247 American Avocet 4,009 Northern Pintail 3,846.

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**Farmington Bay**

An excellent overview of the ecological setting, waterbird biology and habitat management of the Great Salt Lake and the surrounding wetlands is provided in "Avian Ecology of Great Salt Lake" by Tom Aldrich and Don Paul in Great Salt Lake: An Overview of Change. ( Edited by J. Wallace Gwynn, Ph.D., Special Publication of the Utah Department of Natural Resources, 2002.) The following description of Farmington Bay is from this article. (A clarification to the

quote below, Bear River Bay is the freshest region.)

> Farmington Bay is the next freshest region, with a salinity of approximately 60 parts per thousand (ppt) when GSL is at 4,200 feet (1,280.2 m) above sea level. It does not provide a submergent vegetation community due to the elevated salinity, but has a relatively complex plankton community compared to the south and north arms of the lake. It supports some important halophiles (for example, brine flies) in conjunction with some macroinvertebrates that tolerate diluted brine environments, but it is too saline to support a fishery. There is a significant wetlands influence in this region, often modified by the associated transitory shoreline, especially in the Layton/Kaysville Marsh area. . . . This effect is also visible at the south end of the bay, west of Farmington Bay Waterfowl Management Area (WMA). The open-water reaches of this region are an important waterfowl habitat in late fall and winter. The shorelines are important to breeding and migrating shorebirds. (Also, add that Jordan River adds about 14% of the total water flows to GSL.)

The Farmington Bay IBA nomination includes 12 survey areas, 121,533 acres. Landowners included in the nomination at this point in time are: Utah State Division of Forestry, Fire and State Lands (for sovereign lands), Utah Division of Wildlife Resources, The Nature Conservancy, The Utah Reclamation Mitigation and Conservation Commission, Utah State Division of Parks and Recreation, New State. Inc. and Harrison Reclamation Co.

Survey data show 11 bird species having over 1% of their world's population at Farmington Bay. Highest five bird species counts in area: Wilson's Phalarope 108,629 American Avocet 81,927 Black-necked Stilt 47,596 American Coot 32,309 Gadwall 30,642.

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**Gilbert Bay (and Ogden Bay)**

An excellent overview of the ecological setting, waterbird biology and habitat management of the Great Salt Lake and the surrounding wetlands is provided in "Avian Ecology of Great Salt Lake" by Tom Aldrich and Don Paul in Great Salt Lake: An Overview of Change. (Edited by J. Wallace Gwynn, Ph.D., Special Publication of the Utah Department of Natural Resources, 2002.) The article states that, "Within the GSL basin there are essentially four water regions with differing ecologies. These regions are Bear River Bay, Farmington Bay, the Gilbert Bay (southern arm) and Gunnison Bay (north arm). . . . The major differences between these regions is salinity, although there are other features that play roles in defining their ecological peculiarities." The Utah IBA Technical Team chose to split Gilbert Bay into two IBA nominations - Gilbert Bay and Ogden Bay. This was done for the following reasons: 1. Gilbert Bay is a very large area; 2. Ogden Bay while not diked off from the rest of Gilbert Bay is an easily definable area; 3. Gilbert Bay has limited freshwater inflows and adjoining wetland areas as compared to Ogden Bay; 4. The bird usage of Ogden Bay and its surrounding wetlands is in many cases quite different from Gilbert Bay; 5. The Utah State Legislature has provided for management authority of Ogden Bay by the Utah Division of Wildlife Resources while only the southern part of Gilbert Bay has been given this possibility; and, 6. The brine shrimp industry is allowed to harvest in Gilbert Bay, but not in Ogden Bay.

The following description in the article by Tom Aldrich and Don Paul is however generally applicable to the area defined as Gilbert Bay for the purposes of this IBA nomination: "Gilbert Bay (south arm) of GSL is the largest reach of water on the lake, with a salinity of 100 to 140 ppt at 4,200 feet (1,280.16 m) above sea level. At this salinity the lake's chemical and biological properties eliminate most in-lake predatory influences (predatory macroinvertebrates, fish, etc.) on the obligate halophiles (for example, brine shrimp and brine flies). These macroinvertebrates flourish under ideal conditions (especially at salinities in excess of 120 ppt) producing millions of pounds of potential protein for birds that have special behaviors or adaptations to exploit this food source. The lake can be unusually productive; during one study,

the average production of brine fly biomass was 7.9 g/square meter (Collins, 1980). During some harvest seasons, the brine shrimp industry removes more than 13.9 million pounds (6.3 million kg) of brine shrimp cysts and detritus from Gilbert Bay (south arm) Gilbert Bay.

The Gilbert Bay or South Arm IBA nomination includes 12 survey areas, 589,649 acres. Landowners included in the nomination are: Utah Division of Forestry, Fire and State Lands (for sovereign lands), Kennecott Utah Copper Corporation (for Inland Sea Shorebird Reserve), National Audubon Society, Utah Reclamation Mitigation and Conservation Commission, and Utah State Division of Parks and Recreation.

Survey data show 5 bird species having over 1% of their world's population at Gilbert Bay. Highest five bird species counts in area: Eared Grebe 778,260 Wilson's Phalarope 458,553 California Gull 70,501 Franklin's Gull 47,519 American Avocet 33,191.

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**Ogden Bay**

The description above applies to the western section of Ogden Bay. But on the eastern section. The Weber and Ogden Rivers provide roughly 14% of the total water quantity for Great Salt Lake. (This includes precipitation and subsurface flows.) The Weber and Ogden Rivers provide water for Ogden Bay WMA. Other smaller streams enter Ogden Bay as well. This IBA includes wetlands and associated upland areas as well as riparian areas that are part of Howard Slough and Ogden Bay Wildlife Management Areas as well the shoreline and sovereign lands of Ogden Bay.

The Ogden Bay IBA nomination includes 8 survey areas and 63,148 acres. Landowners included in the nomination are Utah Division of Forestry, Fire and State Lands (for sovereign lands), Utah Division of Wildlife Resources, and Utah State Division of Parks and Recreation.

Survey data show 13 bird species having over 1% of their world's population at Ogden Bay. Highest five bird species counts in area: Eared Grebe 681,890 Wilson's Phalarope 335,051 Franklin's Gull 59,041 California Gull 49,722 American Avocet 33,191.

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**Bear River Bay**

An excellent overview of the ecological setting, waterbird biology and habitat management of the Great Salt Lake and the surrounding wetlands is provided in "Avian Ecology of Great Salt Lake" by Tom Aldrich and Don Paul in Great Salt Lake: An Overview of Change. ( Edited by J. Wallace Gwynn, Ph.D.,

> Bear River Bay is the freshest region and receives the largest volume of riverine inflow. Its near-surface salinity is similar to that of the Bear River. This system is bounded on the north and east by state, federal, and private wetlands; on the south by industry; and to the west by the Promontory Mountains. This bay is fresh enough to support a community of submergent hydrophytes including sago pondweed (Potamogeton pectinatus) and widgeon grass (Ruppia maritima). There are significant islands of emergent wetlands here, especially in the east part of the bay in the Willard Spur. . . . An ecological element of vital importance to pisciverus birds in this area is the fishery that persists when the lake elevation is higher than 4,200 feet (1,280.2 m) above sea level. The avian community at Willard Spur is exceptionally complex. With its species richness, diversity and overall abundance, this area continually provides one of the most magnificent displays of bird life on the lake. Although the smallest region on the lake, it makes an exceptional contribution to the lake's avian population.

The Bear River Bay IBA nomination includes survey areas and 142,268 acres. Landowners included in the nomination are Utah State Division of Forestry, Fire and State Lands (for sovereign lands), U.S. Fish and Wildlife Service, Utah Division of Wildlife Resources, Bear River Club and Marsh Holders Inc.

Survey data show 19 bird species having over 1% of their world's population at Bear River Bay. Highest ten bird species counts in area. Note: used top ten for this area because the tenth bird listed (White-faced Ibis at 57,615 birds in one survey count) is higher than the highest fifth bird in the other four bays, (which was American Avocet in Ogden Bay at 37,159.) Green-winged Teal 200,818 Western Sandpiper 190,000 Mallard 151,814 Wilson's Phalarope 136,305 Gadwall 134,002 Northern Pintail 104,644 American Avocet 89,395 Northern Shoveler 76,363 American Coot 63,012 White-faced Ibis 57,615.

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**Gunnison Bay**

In "Avian Ecology of Great Salt Lake" by Tom Aldrich and Don Paul in Great Salt Lake: An Overview of Change. (Edited by J. Wallace Gwynn, Ph.D., Special Publication of the Utah Department of Natural Resources, 2002.) The following description of Gunnison Bay is from this article: ,

> Gunnison Bay is the second largest expanse of open water. The north arm is bounded by salt playas and the Locomotive Springs WMA on the north; by the Promontory Mountains on the east; by the Hogup Mountains on the west; and by the Southern Pacific Railroad causeway on the south. It is also the most remote and xeric region of the lake and, perhaps more importantly, the most saline. Salinity ranges between 240 and 280 ppt. Gilbert Bay is presently a hypersaline system dominated by halophytic bacteria; it is too salty for brine shrimp and brine flies to persist. Currently, it appears to be a salt trap with possibly 3 to 5 vertical feet (1 to 1.5 meters) of salt precipitate on the lake floor. It possesses several minor wetlands that function to support small populations of unique birds. Gunnison Island has provided a nesting habitat for an impressive number of American white pelicans (Pelecanus erythrorhynchos) and California gulls (Larus californicus) before, and since settlement of the area by Anglo-Americans. For birds choosing to nest on this remote island, the tradeoff is a predator-free nesting environment for marathon flights to forage and gather food for young.

The Gunnison Bay IBA nomination includes 3 survey areas and 23,053 acres. Landowners included in the nomination are: Utah Division of Forestry, Fire and State Lands (for sovereign lands) Utah Division of Wildlife Resources and Bureau of Land Management.

Survey data show 2 bird species having over 1% of their world's population at Gunnison Bay. The first two bird species counts below are from Fremont Island. The other three counts are from Locomotive Springs and Salt Wells Flat. Highest five bird species counts in area: American White Pelican 24,154 California Gull 23,318 American Avocet 439 Snowy Plover 377 Black-necked Stilt 185.

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**Cutler Marsh - Amalga Barrens**

Cutler Marsh - Amalga Barrens area is within the Great Salt Lake watershed. It can be viewed as a higher elevation extension of the freshwater marshes, riparian areas, playas and mudflats of the nearby Great Salt Lake. For example, the American White Pelicans that feed at Cutler Reservoir nest at Gunnison Island, located on Great Salt Lake's Gunnison Bay.

The IBA includes approximately 10,000 acres. Landowners at this point in time include: Utah Power, Utah Division of Wildlife Resources, Bridgerland Audubon Society and Utah State Division of Forestry, Fire and State Lands (for sovereign lands).

The area qualifies as an IBA based upon use by American White Pelicans, which is a state sensitive species. The area also qualifies based upon use by American Avocets and Black-necked Stilts, which are Partners in Flight Piroity species. And it also qualifies based upon use as a congregatory site for wading birds such as White-faced Ibis and Great Blue Herons. Survey data show the following. White-faced Ibis 375 Franklin's Gull 275 American White Pelican 200 White-faced Ibis 125 American Avocet 150 Black-necked Stilt 60 Great Blue Heron 30.

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**Upper Strawberry Watershed**

The Upper Strawberry Watershed provides a wide variety of valuable habitat for birds including Shrubsteppe, Sub-Alpine Conifer, Aspen, Mountain Riparian and Open Water.

The Upper Strawberry Watershed qualifies as an Important Bird Area due its use by over 100 Greater Sage-grouse, 200 American White Pelican, and over 10 American Three-toed Woodpecker. These three birds are classified as Species of Concern by the State of Utah. Also because of the wide variety of non-forested and forested habitat types, a wide variety of migratory land birds are known to nest or regularly occur in the Upper Strawberry Watershed, including Partner's in Flight Priority species of Brewer's Sparrow, and Broad-tailed Hummingbird. Finally, according to survey data the reservoir also provides significant habitat for 100 Clark's and 1,200 Western Grebes as well as 60 Caspian Terns.

The acreage included in the nomination is 125,880 acres and is located in Wasatch County. The primary landowner included in the nomination is the Uinta National Forest, with some land owned by Utah Division of Wildlife Resources also included in the nomination.

A good contact for additional information regarding this IBA is: Jeffrey Waters, Heber Ranger District, Uinta National Forest, 2460 South Hwy. 40, P.O. Box 190, Heber City, UT 84032 (435) 654-7227 (Office)

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**Lytle Preserve**

Lytle Preserve is situated astride the Beaver Dam Wash, approximately eight miles north of the Utah/Arizona border and two miles east of the Utah/Nevada border. It is situated within the northeastern most portion of the Mojave Desert physiographic region in Washington County. The land slopes towards and eventually drains into the Virgin River and hence into the Colorado River and Lake Mead. The dominant feature of the Preserve is the Desert Riparian Woodlands along the Beaver Dam Wash, a stream which flows year round. Dominated by Fremont Cottonwoods, this vegetation represents an important migration corridor through the desert. Some neotropical migrants nest here as well. It is one of the most unique habitats in the state in terms of Mojavian Desert species. Specific species such as the Joshua Tree (Yucca brevifolia var.) is not found anywhere else in the state.

The area qualifies as an IBA based upon survey data showing up to 100 Gamble's Quail, 15 pair of Lucy's Warbler and six pair of Bell's Vireo, which are all Utah Partner's in Flight Priority Species. Over 200 bird species have been recorded on the preserve. The Birds of Lytle Ranch Preserve Field Checklist was compiled by Merrill Webb, February 2004.

The area includes approximately 700 acres. The Preserve is owned and operated by Brigham

Young University as a research and educational facility.

For additional information contact Ken Packer at the Monte L Bean Life Science Museum, Brigham Young University, 801-422-5052.

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## SITES RECOGNIZED MAY 2003

### Fish Springs National Wildlife Refuge

Fish Springs National Wildlife Refuge was established in 1959. It consists of 17,992 acres and is located in Juab County. From Tooele, drive south for 25 miles on UT-36, then follow the Pony Express Trail signs for 75 miles to the refuge.

Refuge habitats include salt grass uplands, desert shrub, mudflats and spring fed saline marsh impoundments. The refuge provides 10,000 acres of critical wetlands. Fish Springs NWR qualifies as an Important Bird Area because of the valuable wetlands, playas and other habitat types on the refuge. Fish Springs NWR is the only significant wetland in over 50 miles and it serves as a vital stopping point for migrant birds.

Survey data show that Fish Springs has significant waterfowl populations including counts of over 7,000 Northern Pintail, over 5,800 American Wigeon, over 2,800 Redhead and over 1,200 Canada Geese. Fish Springs also has large numbers of shorebird use such as 500 White-faced Ibis and 170 Snowy Plover. Furthermore, Fish Springs has recorded high numbers of songbird use such as 200 Yellow Warblers and 116 Yellow-rumped Warblers.

For further information please contact Jay Banta, Refuge Manager, or Jim Graham, Refuge Operations Specialist, 435-831-5353.

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### Ouray National Wildlife Refuge

Ouray National Wildlife Refuge was established in 1961. It consists of 11,987 acres and is located in Uintah County. The Refuge is 27 miles southwest of Vernal on Highway 88.

The refuge includes approximately 19 square miles of bottomlands and river surface in six naturally occurring bottoms along the shallowly entrenched Green River. The current management emphasis of the refuge is given to the riparian habitat and to function more as a migrational stop-over for migratory birds. The major habitat types on the refuge include lowland riparian, wetlands, shrubsteppe, high desert scrub, water and grassland. Ouray NWR is considered to have the most significant single stand of riparian cottonwood on the entire Green River and perhaps the entire Colorado River drainage.

Specific bird surveys provide lots of data including the following numbers: migrating Canada geese - 3,000 in 2001; mallards - 10,000 on Green River in December 2,000; bald eagles - 160 seen at a time in the past couple of years; and, American white pelicans - peaking at 1,400 in mid-September to mid-November.

For further information please contact Dan Alonzo, Project Leader or Diane Penttila, Biologist, 435-545-2522.

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**Deseret Land and Livestock Ranch**

Deseret Land and Livestock Ranch is private land, owned by Farm Management Company of the Church of Jesus Christ of Latter-Day Saints. It consists of 200,000 acres and is located in Rich County. Public access is through fee-guided tours only, arranged through Westwings birding company of SLC, UT. (Contact westwings@sisna.com or 801-487-WILD.)

Deseret Land and Livestock Ranch qualifies as an IBA because of the valuable and diverse habitats on the Ranch. The eastern half of the ranch includes sagebrush-steppe, grassland, riparian, wetland, lakes, ponds, rock and juniper habitats. It is flat to rolling topography. The western half of the ranch includes mountain sagebrush, mountain shrub, aspen, mixed aspen conifer, mixed conifer, subalpine fir and mountain riparian habitats. It is mountainous.

The diverse habitats result in over 260 bird species being found at Deseret Land and Livestock. The following are a few examples from survey data of the significant bird usage: more than 2,000 Sage Grouse, more than 2,000 waterfowl, more than 7,000 Canada Geese, 20 breeding pair of Long-billed Curlew, 50 breeding pair of Franklin's Gulls, 30 breeding pair of Burrowing Owl, 100 breeding pair of Virginia's Warbler and 50 breeding pair of Broad-tailed Hummingbirds.

For further information please contact: Rick Danvir, Wildlife Manager, 435-793-4161.

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**Fremont River within Capitol Reef National Park**

The Fremont River, Capitol Reef National Park IBA site consists of 14 miles of riparian habitat for a total of 3,230 acres within the Park. It is located in Wayne County, 12 miles east of Torrey on State Route 24.

The Fremont River is a lush oasis of abundant flora and fuana in an otherwise arid landscape of desert scrub and slickrock. As such it is extremely important to resident birds within the riparian area and from surrounding xeric habitats. Migrants depend on the river system as a stopover site to rest and feed before continuing their journey.

There have been a recorded 165 bird species that use this area. Survey data show that Fremont River within Capitol Reef National Park has significant populations of birds including estimates of 1,000 Blue Grosbeak, 1,000 Virginia's Warbler, 1,000 Brewer's Sparrow, 1,000 Black-throated Grey Warbler, 200 Broad-tailed Hummingbird and 50 Lewis' Woodpecker.

For further information please contact Tom Clark, Chief of Resource Management and Science, 435-425-3791 Ext. 144.

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**Clear Lake Waterfowl Management Area**

Clear Lake Waterfowl Management Area is owned and managed by the Utah Division of Wildlife Resources. It was purchased in the 1930's. It consists of 6,190 acres and is located in Millard County. Follow US50/6 west out of Delta for about 5 miles to SR-2257. Go south on S-257 for 16 miles to gravel county road, which is marked with a sign to Clear Lake. Go east on county road for 7 miles.

Refuge habitats include wetland/marsh, open water areas, uplands and some cultivated food plots. The water supply comes from springs located on the east side of the wetlands. Most of the Waterfowl Management Area is closed to public access March 1 to July 31 to protect

nesting and breeding birds. Clear Lake is the 7th largest (out of 25) Utah Division of Wildlife Resources (DWR) waterfowl management areas. It is the largest waterfowl DWR management area not in close proximity to the Great Salt Lake.

Survey data show that Clear Lake has significant waterfowl populations including counts of 6,000 Northern Pintail, 4,000 Redhead, 6658 Mallard, 2,472 Green-winged Teal and 2,210 American Wigeon. It also has large numbers of shorebird use including 1,900 American Avocet and 210 Black-necked Stilts.

For further information please contact Lynn Zubeck, Manager for Clear Lake at 435-864-4607, or Tom Aldrich, Waterfowl Coordinator at 538-4789.

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Dec. 2003 - Great Salt Lake Waterbird Survey: Numbers of a Bird Species by Survey Site
Note: Numbers below, except where noted, are for the peak numbers during a particular survey period divided by the number of years surveyed.

| **Bear River Bay Areas** | **Species** CAGU | CANV | CITE | COGO | EARG | FOTE | FRGU |
|---|---|---|---|---|---|---|---|
| 23- Rainbow | 1,021 | 2 | 127 | 0 | 4 | 23 | 96 |
| 24 - South Harold Crane | 211 | 2 | 393 | 0 | 38 | 43 | 100 |
| 25 - Harold Crane WMA | 731 | 40 | 846 | 32 | 266 | 167 | 809 |
| 27 - South Bear River | 3,186 | 480 | 1,797 | 16 | 4,055 | 217 | 9,575 |
| 28 - Willard Spur | 541 | 369 | 290 | 10 | 1,285 | 337 | 2,305 |
| 29A Bear River Refuge | 3,569 | 119 | 5,145 | 0 | 3,932 | 201 | 9,903 |
| 30 - Bear River Club | 117 | 14 | 122 | 0 | 132 | 41 | 214 |
| 32 - Public Shooting Grounds WMA | 339 | 31 | 1,450 | 0 | 119 | 165 | 212 |
| 33 - Salt Creek WMA | 499 | 42 | 689 | 0 | 31 | 20 | 125 |
| 34 A - East Promontory N | 343 | 0 | 30 | 7 | 19 | 42 | 216 |
| 34 B - East Promontory S | 8,236 | 1 | 181 | 1,798 | 561 | 21 | 2,911 |
| 37 - Bear River Bay | 13,740 | 26 | 236 | 0 | 3,213 | 257 | 3,752 |

Source: Draft Great Salt Lake Waterbird Survey - Five Year Report (1997-2001). Submitted by Don S. Paul and Ann E. Manning, Great Salt Lake Ecosystem Project, June 2002, Utah Division of Wildlife Resources.

Dec. 2003 - Great Salt Lake Waterbird Survey: Numbers of a Bird Species by Survey Site
Note: Numbers below, except where noted, are for the peak numbers during a particular survey period divided by the number of years surveyed.

| **Bear River Bay Areas** | **Species** GADW | LBDO | LESC | MAGO | MALL | NOPI | NSHO |
|---|---|---|---|---|---|---|---|
| 23- Rainbow | 172 | 100 | 2 | 18 | 558 | 615 | 616 |
| 24 - South Harold Crane | 431 | 304 | 136 | 129 | 1,348 | 909 | 612 |
| 25 - Harold Crane WMA | 1,206 | 1,797 | 271 | 895 | 3,354 | 3,927 | 1,570 |
| 27 - South Bear River | 37,483 | 8,245 | 545 | 6,918 | 36,119 | 15,209 | 11,870 |
| 28 - Willard Spur | 737 | 4,382 | 19 | 1,560 | 1,161 | 3,753 | 2,377 |
| 29A Bear River Refuge | 13,450 | 5,580 | 1,271 | 16,956 | 18,838 | 18,840 | 16,674 |
| 30 - Bear River Club | 313 | 272 | 67 | 68 | 60 | 498 | 330 |
| 32 - Public Shooting Grounds WMA | 1,840 | 43 | 227 | 2 | 4,032 | 36,420 | 2,578 |
| 33 - Salt Creek WMA | 633 | 278 | 37 | 63 | 1,373 | 7,238 | 714 |
| 34 A - East Promontory N | 673 | 0 | 11 | 5 | 180 | 722 | 1,647 |
| 34 B - East Promontory S | 56 | 0 | 67 | 3 | 29 | 325 | 771 |
| 37 - Bear River Bay | 1,580 | 12,535 | 744 | 323 | 935 | 17,669 | 6,927 |

Source: Draft Great Salt Lake Waterbird Survey - Five Year Report (1997-2001). Submitted by Don S. Paul and Ann E. Manning, Great Salt Lake Ecosystem Project, June 2002, Utah Division of Wildlife Resources.

Dec. 2003 - Great Salt Lake Waterbird Survey: Numbers of a Bird Species by Survey Site

Note: Numbers below, except where noted, are for the peak numbers during a particular survey period divided by the number of years surveyed.

| **Bear River Bay Areas** | **Species** AGWT | AMAV | AMCO | AMWI | AWPE | BNST | CAGO |
|---|---|---|---|---|---|---|---|
| 23- Rainbow | 1,261 | 580 | 261 | 110 | 67 | 202 | 287 |
| 24 - South Harold Crane | 1,612 | 4,524 | 1,556 | 171 | 33 | 709 | 360 |
| 25 - Harold Crane WMA | 4,406 | 3,088 | 1,514 | 1,141 | 895 | 1,391 | 1,419 |
| 27 - South Bear River | 39,723 | 18,975 | 11,937 | 860 | 8,197 | 7,536 | 407 |
| 28 - Willard Spur | 5,099 | 3,547 | 3,995 | 468 | 3,938 | 1,038 | 533 |
| 29A Bear River Refuge | 52,584 | 23,240 | 10,778 | 2,929 | 3,902 | 14,582 | 2,874 |
| 30 - Bear River Club | 399 | 958 | 354 | 62 | 129 | 314 | 896 |
| 32 - Public Shooting Grounds WMA | 12,126 | 873 | 5,912 | 5,511 | 261 | 942 | 723 |
| 33 - Salt Creek WMA | 3,818 | 927 | 960 | 567 | 187 | 577 | 819 |
| 34 A - East Promontory N | 3,881 | 427 | 833 | 1,900 | 946 | 25 | 682 |
| 34 B - East Promontory S | 430 | 4,122 | 1,293 | 645 | 208 | 33 | 5,990 |
| 37 - Bear River Bay | 7,492 | 5,318 | 5,819 | 268 | 26,230 | 4,986 | 8,499 |

Source: Draft Great Salt Lake Waterbird Survey - Five Year Report (1997-2001). Submitted by Don S. Paul and Ann E. Manning, Great Salt Lake Ecosystem Project, June 2002, Utah Division of Wildlife Resources.

Dec. 2003 - Great Salt Lake Waterbird Survey: Numbers of a Bird Species by Survey Site

Note: Numbers below, except where noted, are for the peak numbers during a particular survey period divided by the number of years surveyed.

| **Bear River Bay Areas** | **Species** RBGU | REDH | RPHA | RUDU | SNEG | TUSW* | WEGR |
|---|---|---|---|---|---|---|---|
| 23- Rainbow | 68 | 62 | 1 | 16 | 81 | | 4 |
| 24 - South Harold Crane | 57 | 95 | 0 | 21 | 46 | 12 on Harold Crane | 2 |
| 25 - Harold Crane WMA | 37 | 586 | 1 | 312 | 103 | | 30 |
| 27 - South Bear River | 92 | 569 | 0 | 1,168 | 204 | | 1,541 |
| 28 - Willard Spur | 287 | 1,391 | 10 | 1,493 | 368 | 2,334 | 266 |
| 29A Bear River Refuge | 868 | 1,647 | 1,600 | 2,130 | 312 | 12,166 | 253 |
| 30 - Bear River Club | 107 | 48 | 10 | 18 | 313 | 26,842 | 7 |
| 32 - Public Shooting Grounds WMA | 146 | 254 | 0 | 215 | 119 | Bear River & Davis Clubs | 65 |
| 33 - Salt Creek WMA | 52 | 116 | 16 | 167 | 43 | 2 | 14 |
| 34 A - East Promontory N | 675 | 152 | 2 | 30 | 25 | | 77 |
| 34 B - East Promontory S | 209 | 649 | 0 | 467 | 17 | | 30 |
| 37 - Bear River Bay | 1,556 | 7,720 | 1,027 | 1,038 | 110 | Also, 380 Chesapeake Club & Vicinity | 3,024 |

Main Source: Draft Great Salt Lake Waterbird Survey - Five Year Report (1997-2001). Submitted by Don S. Paul and Ann E. Manning, Great Salt Lake Ecosystem Project, June 2002, Utah Division of Wildlife Resources.

*For Tundra Swan - Aerial Swan Survey of the Great Salt Lake by Utah Division of Wildlife Resources on Nov. 19, 1997.

Dec. 2003 - Great Salt Lake Waterbird Survey: Numbers of a Bird Species by Survey Site
Note: Numbers below, except where noted, are for the peak numbers during a particular survey period divided by the number of years surveyed.

| **Bear River Bay Areas** | **Species** WESA | WFIB | WIPH | LBCU |
|---|---|---|---|---|
| 23- Rainbow | 0 | 720 | 40 | 6 |
| 24 - South Harold Crane | 0 | 577 | 66 | 5 |
| 25 - Harold Crane WMA | 0 | 2,147 | 676 | 35 |
| 27 - South Bear River | 14,004 | 8,120 | 5,572 | 0 |
| 28 - Willard Spur | 12 | 3,592 | 4,210 | 0 |
| 29A Bear River Refuge | 52,396 | 16,006 | 26,541 | 1 |
| 30 - Bear River Club | 5 | 1,378 | 47 | 1 |
| 32 - Public Shooting Grounds WMA | 1 | 849 | 120 | 2 |
| 33 - Salt Creek WMA | 6 | 1,304 | 242 | 4 |
| 34 A - East Promontory N | 1 | 284 | 18 | 30 |
| 34 B - East Promontory S | 0 | 172 | 80 | 44 |
| 37 - Bear River Bay | 0 | 2,121 | 33,638 | 2 |

Source: Draft Great Salt Lake Waterbird Survey - Five Year Report (1997-2001). Submitted by Don S. Paul and Ann E. Manning, Great Salt Lake Ecosystem Project, June 2002, Utah Division of Wildlife Resources.

3-24-05

Table 1 (Continued): **Estimated Population of Selected Bird Species in North America with Number and Percent of the Population on or by the Five Major Bays of Great Salt Lake**

Notes: Numbers for the bays, except where noted, are maximum numbers during a survey period for the GSL Waterbird Survey from 1998-2001. (Source: Great Salt Lake Ecosystem Project, Utah Division of Wildlife Resources.) Information is provided only for species that had 1% or over of the North American population for that species in at least one bay on the Great Salt Lake.

| Bird Species | Estimated North American Population* | Great Salt Lake Bays # observed/% of North American Population | | | | |
|---|---|---|---|---|---|---|
| | | Farmington | Ogden | Bear River | Gunnison | Gilbert |
| California Gull | 621,000 | 19,920<br>**3.2%** | 49,722<br>**8.0%** | 26,042<br>**4.2%** | 25,000**<br>**4.0%** | 72,306<br>**11.6%** |
| Franklin's Gull | 470,000 to 1,490,000 | 16,875<br>**1.1%** | 59,041<br>**4.0%** | 29,073<br>**2.0%** | | 47,519<br>**3.2%** |
| Forster's Tern | Greater than 119,500 (or 70,500 to 77,250) | | 2,393<br>**<2.0%** | 1,412<br>**<1.2%** | | 1,500<br>**<1.3%** |
| American Avocet | 450,000 | 81,927<br>**18.2%** | 37,159<br>**8.3%** | 89,395<br>**19.9%** | | 33,519<br>**7.4%** |
| Black-necked Stilt | 151,400 | 47,596<br>**31.4%** | 11,307<br>**7.5%** | 36,327<br>**24.0%** | | |
| Long-billed Dowitcher | 500,000 | 8,087<br>**1.6%** | 7,682<br>**1.5%** | 26,203<br>**5.2%** | | |
| Marbled Godwit | 171,500 | | 2,513<br>**1.5%** | 43,860<br>**25.6%** | | |
| Wilson's Phalarope | 1,500,000 | 108,629<br>**7.2%** | 335,051<br>**22.3%** | 136,305<br>**9.1%** | | 458,553***<br>**30.6%** |
| Western Sandpiper | 3,500,000 | | | 190,090<br>**5.4%** | | |
| Snowy Plover | 17,400 - 18,000 | 243<br>**1.4%** | 127<br>.07% | | 377<br>**2.1%** | 615<br>**3.4%** |

*The North American bird population numbers are taken from: Implementing the IBA Program in the U.S: Criteria, Thresholds, and their Application. *Prepared by:* Daniel K. Niven, Senior Scientist for Bird Conservation National Audubon Society, 1150 Connecticut Avenue, Washington, DC 20036, Draft November 2003. (The primary source of North American population data is Wetlands International (2002), *Waterbird population estimates – Third edition.* Wetlands International Global Series No.12, Wageningen, The Netherlands. In some cases more recent data is used.

**1993 Great Salt Lake California Gull Survey by Kevin W. Robinette, Patricia A. White and Frank P. Howe, Utah Division of Wildlife Resources (Number is for Gunnison Island. It does not include counts at Locomotive Springs or Salt Wells. In 1998, 4,148 California Gulls were counted during one survey period at these two areas.)

***Estimate from 2000 Wilson's Phalarope Survey, Great Salt Lake, Utah, July 28, 2000. By Utah DWR GSL Ecosystem Project, Don S. Paul, Lindsey H. Dewey and Ann Manning

3-24-05 Table 2: (Continued) **Estimated 1% of North American Populations of Selected Bird Species and Number of Times This Was Exceeded on the Five Major Bays of Great Salt Lake from 1998 to 2001**

Notes: From 1988 through 2001 there were 17 survey periods for the Great Salt Lake Waterbird Survey going from April through September. Additional detailed information for each bird species is provided below the table. Survey data is primarily from Great Salt Lake Ecosystem Project, Utah Division of Wildlife Resources. As noted below different surveys were used for California Gulls at Gunnison Island and Wilson's Phalaropes for Gilbert Bay.

| Bird Species | 1% of Estimated North American Population* | Great Salt Lake Bays # of survey periods over 1% by year | | | | |
|---|---|---|---|---|---|---|
| | | Farmington | Ogden | Bear River | Gunnison | Gilbert |
| California Gull | 6,210 | Eight in 98<br>One in 99<br>13 in 00<br>Six in 01 | Nine in 98<br>Four in 99<br>Nine in 00<br>11 in 01 | Four in 98<br>Four in 99<br>Seven in 00<br>14 in 01 | Separate Survey | 14 in 98<br>16 in 99<br>17 in 00<br>17 in 01 |
| Franklin's Gull | 9,800 | One in 98<br>One in 99<br>Five in 00<br>One in 01 | Seven in 98<br>One in 99<br>Five in 00<br>Nine in 01 | Five in 99<br>Three in 00<br>Two in 01 | | Five in 98<br>Three in 99<br>One in 00<br>Two in 01 |
| Forster's Tern | Greater than 1,200, (If 739, then more for Bear River) | | One in 99<br>One in 01 | (One in 98)<br>Two in 99<br>(Six in 01) | | One in 98 |
| American Avocet | 4,500 | 10 in 98<br>Nine in 99<br>12 in 00<br>17 in 01 | Two in 98<br>Eight in 00<br>Six in 01 | 12 in 98<br>14 in 99<br>15 in 00<br>14 in 01 | | 10 in 98<br>Nine in 99<br>Eight in 00<br>Nine in 01 |
| Black-necked Stilt | 1,514 | Six in 98<br>Five in 99<br>10 in 00<br>14 in 01 | Four in 98<br>Six in 99<br>Eight in 00<br>Six in 01 | Nine in 98<br>11 in 99<br>Nine in 00<br>10 in 01 | | |
| Long-billed Dowitcher | 5,000 | One in 01 | Two in 00 | Five in 98<br>Six in 99<br>One in 00 | | |
| Marbled Godwit | 1,715 | | Two in 00<br>One in 01 | Six in 98<br>Eight in 99<br>11 in 00<br>Seven in 01 | | |
| Wilson's Phalarope | 15,000 | Three in 99<br>Three in 00 | Three in 98<br>Three in 99<br>Five in 00<br>Three in 01 | Three in 99<br>One in 01 | | Separate Survey |
| Western Sandpiper | 35,000 | | | One in 98<br>Three in 00<br>One in 01 | | |
| Snowy Plover | 177 | Two in 99<br>Three in 01 | | | Two in 98<br>Six in 01 | Six in 98<br>Six in 99<br>Five in 00<br>Four in 01 |

*The North American bird population numbers are taken from: Implementing the IBA Program in the U.S: Criteria, Thresholds, and their Application. *Prepared by:* Daniel K. Niven, Senior Scientist for Bird Conservation National Audubon Society, 1150 Connecticut Avenue, Washington, DC 20036, Draft November 2003. (The primary source of North American population data is Wetlands International (2002), *Waterbird population estimates – Third edition.* Wetlands International Global Series No.12, Wageningen, The Netherlands.

**The following is more detailed information for bird species that had survey counts with over 1% of their estimated North American Population. The information is primarily provided by Bay by survey period and by numbers counted and then total number of times the 1% estimate was exceeded. Source: Great Salt Lake Waterbird Survey Data from 1998 through 2001 from Great Salt Lake Ecosystem Project, Utah Division of Wildlife Resources.** As discussed below different surveys were used for California Gulls at Gunnison Island and Wilson's Phalaropes at Gilbert Bay.

**California Gull: (1% is 6,210.)**

**Farmington Bay: 1998: #1 – 6,641; #2 – 27,156; #3 – 6,904; #8 – 6,347; #9 – 8,338; #11 – 11,799; #14 - 6,247; #15 – 19,920. (Eight Total)**

**1999: # 17 – 6,441. (One Total)**

**2000: # 1 – 7,250; #2 – 6,363; #3 – 6,476; #5 – 6,218; #6 – 8,128; #7 – 6,644: #9 – 8,671; - #9 – 8,671; #10 – 7,761; #12 – 8,755; #13 – 9,537; #14 – 7,418; #16 – 8,675; #17 – 9,054. (13 Total)**

**2001: # 2 – 7,488; #3 – 7,269; #7 – 6,626; #13 – 14,694; #14 – 11,574; #17 – 6,578. (Six Total)**

**Ogden Bay: 1998: #8 – 14,218; #9 – 11,368; #10 – 24,988; #11 – 38,673; #12 – 7,595; #13 – 7,807; #14 – 17,697; #15 – 8,746; #16 – 14,739. (Nine Total)**

**1999: #10 – 11,538; #12 – 14,858; #13 – 24,780; #14 – 9,600. (Four total)**

**2000: #7 – 12,769; #8 – 7,954; #11 – 7,599; #12 – 16,829; #13 – 14,369; #14 – 25,474; #15 – 14,360; #16 – 11,803; #17 – 16,310. (Nine Total)**

**2001: #7 – 15,511; #8 – 13,745; #9 – 14,746; #10 – 12,954; #11 – 15,717; #12 – 20,194; #13 – 19,722; #14 – 33,927; #15 – 28,196; #16 – 8,352; #17 – 33,368. (11 Total)**

**Bear River Bay: 1998: #10 – 7,223; #12 – 15,853; #13 – 8,226; #17 – 8,778. (Four Total)**

**1999: #10 – 6,731; #12 – 9,704; #13 – 21,884; #14 – 10,802. (Four Total)**

**2000: ##9 – 26,042; #10 – 28,143; #11 – 10,243; #12 – 14,029; #13 – 7,933; #14 – 11,368; #16 – 14,197. (Seven Total)**

**2001: #4 – 6,770; #5 – 13,186; #6 – 14,646; #7 – 11,217; #8 – 10,775; #9 – 13,423; #10 – 8,180; #11 – 11,088; #12 – 14,338; #13 – 11,639; #14 – 22,644; #15 – 17,746; #16 – 19,769; #17 – 15,599 (14 Total)**

Gunnison Bay: The 1993 Great Salt Lake California Gull Survey by Kevin W. Robinette, Patricia A. White and Frank P. Howe, Utah Division of Wildlife Resources, provides information on nine surveys conducted at Gunnison Island from 1982 through 1993. The counts for California Gulls for these years were: 1982 – 3,032; 1983 – 9,450; 1986 – 10,000; 1987 – 10,000; 1989 – 12,700; 1990 – 20,300; 1991 – 19,000; 1992 – 25,000 and 1993 – 25,000. Counts of California

Gulls have not occurred since 1993. Also, as indicated on the Gunnison Bay IBA nomination there is some use by California Gulls of Locomotive Springs and Salt Wells. (Note: The final Gunnison Bay IBA nomination form has incorrect numbers for California Gulls at Gunnison Island and the ones above should be used.)

The draft Gunnison Island Management Plan dated July 2003 discusses California Gulls and says in part: "A large complex of nesting California Gulls nests in association with the pelicans. This gull colony consistently averages 19,000 to 21,000 breeding adults approximately 12 – 15% of the total lake's breeding population. This site is also one of the most secure sites over time for breeding California Gulls."

**Gilbert Bay: 1998: #3 – 9,210; #4 – 26,369; #5 – 25,296; 6; #6 – 36,060; #7 – 6,469; #8 – 33,829; #9 – 23,971; #10 – 38,134; #11 – 44,641; #12 – 52,062; #13 – 29,533; #14 – 20,245; #15 – 38,498; #16 – 11,958. (14 Total)**

**1999: #1 – 11,952; #2 – 20,115; #3 – 12,513; #4 – 9,908; #5 – 8,614; #6 – 9,568; #7 – 23,686; #9 – 30,861; #10 – 31,500; #11 – 33,538; #12 – 52,062; #13 – 20,537; #14 – 11,806; #15 – 28167; #16 – 31,651; #17 – 22,861. (16 Total)**

**2000: #1 – 19,957; #2 – 26,686; #3 – 38,056; #4 – 41,536; #5 –36,291; #6 – 47,456; #7 – 31,601; #8 – 38,876; #9 – 45,506; #10 – 36,640; #11 – 67,874; #12 – 47,571; #13 – 72,306; #14 – 44,108; #15 – 71,055; #16 – 70,501; #17 – 54,185. (17 Total)**

**2001: #1 – 33,368; #2 – 32,086; #3 – 35,900; #4 – 29,193; #5 – 28,648; #6 – 25,865; #7 – 35,795; #8 – 42,032; #9 – 44,547; #10 – 58,070; #11 – 41,840; #12 – 22,026; #13 – 28,902; #14 – 21,792; #15 – 52,059; #16 – 31,060; #17 – 13,442. (17 Total)**

**Franklin's Gull: (1% is 9,800.)**

**Farmington Bay: 1998: #16 – 9,813. (One Total)**

**1999: #16 – 11,388. (One Total)**

**2000: #10 – 10,216; #13 – 13,795; #14 – 14,089; #16 – 16,875 #17 – 13,422. (Five Total)**

**2001: #10 – 11,195. (One Total)**

**Ogden Bay: 1998: #8 – 22,804; #9 – 26,185; 10 – 26,533; #11 – 46,434; #12 – 31,854; #13 – 24,361; #14 – 18,507. (Seven Total)**

**1999: 12 – 14,774; #13 – 19,778. (Two Total)**

**2000: #11 – 17,282; 12 – 44,096; #13 – 35,732; #14 – 40,818; #15 – 12,731. (Five Total)**

**2001: #8 – 12,247; #9 – 11,745; 10 – 36,589; #11 – 33,666; #12 – 18,213; #13 – 59,041; #14 – 14,323; #15 – 18,937; #16 – 12,221. (Nine Total)**

**Bear River Bay: 1998: -**

**1999: #3 – 18,409; #5 – 21,152; #12 – 13,015; #14 – 12,231; #17 – 20,896. (Five Total)**

**2000: #10 – 18,944; #11 – 29,073; #12 – 13,596. (Three Total)**

**2001: #2 – 13,140; #3 -14,164. (Two Total)**

**Gilbert Bay: 1998: #8 – 20,076; 10 – 12,354; #11 – 47,519; #12 - 21,998; #14 – 15,234. (Five Total)**

1999: #11 – 11,334; #12 – 23,423; #14 – 17,732. (Three Total)
2000: #15 – 13,318. (One Total)
2001: #14 – 12,350. (One Total)

Forster's Tern : (1% is Greater than 1,200 or 739.)
Ogden Bay: 1999: #12 – 1,357. (One total)
2001: #9 – 2,393. (One total)
Bear River Bay: 1998: #12 – 934. (One total)
1999: #12 – 1,261; #13 – 1,412.
2001: #3 – 939; #5 – 1,041; #6 – 860; #7 – 849; #9; 782; #12 – 1,097. (Six Total)
Gilbert Bay: 1998: #15 – 1,506. (One Total)

American Avocet: (1% is 4,500.)
Farmington Bay: 1998: #1 – 5,545; #2 – 6,552; #8 – 6,018; #11 – 8,549; #12, 6,632; #13 – 9,865; #14 – 9,699; #15 – 11,807; #16 – 14,601; #17 – 6,643. (10 Total)
1999: #1 – 5,876; #2 – 4,749; #11 – 6,201; #12, 7,639; #13 – 4,553; #14 – 6,450; #15 – 5,755; #16 – 16,358; #17 – 7,505. (Nine Total)
2000: # 1 – 4,597; #7 – 6,017; #8 – 6,783; #9 – 10,449; #10 – 32,184; #11 – 28,605; #12 – 39,384; #13 – 56,899; #14 – 66,825; #15 – 41,653; #16 – 81,927; #17 – 31,357. (12 Total)
2001: #1 – 7,798 # 2 – 15,165; #3 – 5,278; #4 – 7,126; #5 – 15,407; #6 – 11,837; #7 – 9,529; #8 – 8,228; #9 – 48,690; #10 – 34,549; #11 – 52,262; #12 – 42,926; #13 – 68,647; #14 – 48,838; #15 – 50,168; #16 – 38,983; #17 – 24,647. (17 Total)
Ogden Bay: 1998: #9 – 6,361; #11 – 4,843. (Two Total)
1999: -
2000: #7 – 6,534; #8 – 7,845; #9 – 12,431; #10 – 13,078; #11 – 5,483; #12 – 8,388; #13 – 5,196; #14 – 4,798. (Eight Total)
2001: #7 – 6,883; #13 – 32,838; #14 – 19,683; #15 – 23,559; #16 – 37,159; #17 – 23,718. (Six Total)
Bear River Bay: 1998: #1 – 11,395; #2 – 6,875; # 8 – 12,935; #9 – 15,330; #10 – 26,227; #11 – 9,622; #12 – 62,272; #13 – 50,642; #14 – 32,444; #15 – 16,653; #16 – 6,065; #17 – 18,690. (12 Total)
1999: #1 – 11,528; #2 – 31,677; #3 – 21,812; #5 – 5,919; #7 – 5,444; #9 – 18,325; #10 – 74,184; #11 – 6,446; #12 – 64,293; #13 – 56,796; #14 – 75,424; #15 – 40,316; #16 – 48,565; #17 – 57,821. (14 Total)
2000: #1 – 27,400; #2 – 66,500; #3 – 15,460; #4 – 8,838; #6 – 6,339; #7 – 27,570 #8 – 31,238; #9 – 74,031; #10 – 68,568; #11 – 89,395; #12 – 83,885; #13 – 21,538; #14 – 18,483; #15 – 13,703; #16 – 57,643. (15 Total)
2001: #1 – 11,050; #2 – 22,045; #3 – 13,153; #4 – 7,095; #8 – 12,400; #9 – 20,379; #10 – 18,154; #11 – 31,903; #12 – 15,643; #13 – 8,732; #14 – 8,359; #15 – 24,393; #16 – 23,367; #17 – 5,829. (14 Total)

Gilbert Bay: 1998: #7 – 5,713; #8 – 12,358; #9 – 15,464; #10 – 17,827; #11 – 26,675; #12 – 33,191; #13 – 23,579; #14 – 19,899; #15 – 20,384; #16 – 17,110. (10 Total)

1999: #9 – 4,542; #10 – 9,848; #11 – 13,884; #12 – 23,116; #13 – 16,943; #14 – 21,630; #15 – 12,053; #16 – 33,519; #17 – 11,768. (Nine Total)

2000: #9 – 6,448; #11 – 6,127; #12 – 4,710; #13 – 8,795; #14 – 13,010; #15 – 12,831; #16 – 19,486; #17 – 9,637. (Eight Total)

2001: #9 – 7,394; #10 – 8,516; #11 – 11,091; #12 – 10,684; #13 – 16,281; #14 – 15,279; #15 – 25,670; #16 – 9,597; #17 – 7,568. (Nine Total)

Black-necked Stilt: (1% is 1,514.)

Farmington Bay: 1998: #2 – 1,851; #10 – 1,596; #11 – 1,766; #13 – 3,336; #14 – 3,971; #15 – 4,534; #16 – 4,850. (Six Total)

1999: #12 – 4,186; #13 – 3,643; #14 – 3,936; #15 – 3,379; #16 – 4,035. (Five Total)

2000: #7 – 2,154; #8 – 3,466; #9 – 4,595; #10 – 16,014; #11 – 20,343; #12 – 37,474; #13 – 47,596; #14 – 35,854; #15 – 6,925; #16 – 6,991. (10 Total)

2001: #3 – 2,778; #4 – 2,540; #5 – 2,467; #6 – 2,569; #7 – 6,954; #8 – 3,867; #9 – 7,143; #10 – 9,913; #11 – 7,591; #12 – 7,866; #13 – 6,561; #14 – 12,809; #15 – 9,231; #16 – 8,687. (14 Total)

Ogden Bay: 1998: #13 – 4,450; #14 – 4,016; #15 – 3,411; #16 – 3,632. (Four Total)

1999: #11 – 1,629; #12 – 2,766; #13 – 5,746; #14 – 7,238; #15 – 11,307; #16 – 3,637. (Six total)

2000: #7 – 1,907; #8 – 6,531; #9 – 5,864; #10 – 5,334; #11 – 1,524; #12 – 2,942; #13 – 3,408; #14 – 2,295. (Eight Total)

2001: #12 – 1,932; #13 – 3,119; #14 – 4,285; #15 – 6,956; #16 – 10,784. (Five Total)

Bear River Bay: 1998: # 8 – 1,562; #9 – 9,583; #10 – 9,494; #11 – 3,756; #12 – 36,327; #13 – 29,067; #14 – 9,047; #15 – 23,615; #17 – 8,302. (Nine Total)

1999: #2 – 12,473; #6 – 2,479; #7 – 1,581; #9 – 11,530; #10 – 26,617; #11 – 3,585; #12 – 33,233; #13– 27,429; #14 – 19,318; #15 – 23,017; #16 – 6,348. (11 Total)

2000: #4 – 2,297; #6 – 2,554; #7 – 5,317 #8 – 4,153; #9 – 14,945; #10 – 11,751; #11 – 12,597; #12 – 6,487; #13 – 1,826. (Nine Total)

2001: #2 – 2,627; #3 – 1,880; #7 – 1,578; #9 – 11,751; #10 – 10,233; #11 – 28,120; #12 – 6,873; #13 – 3,869; #14 – 11,391; #15 – 2,912. (10 Total)

Long-billed Dowitcher: (1% is 5,000.)

Farmington Bay: 2001: #4 – 8,087. (One Total)

Ogden Bay: 2000: #3 – 7,540; #4 – 7,682. (Two Total)

Bear River Bay: 1998: #12 – 19,965; #13 – 23,167; #14 – 25,049; #15 – 14,896; #17 – 15,347. (Five Total)

1999: #4 – 19,156; #12 – 16,695; #13 – 24,113; #15 – 26,203; #16 – 5,874; #17 – 6,250. (Six Total)

2000: #15 – 6,571. (One Total)

**Marbled Godwit: (1% is 1,715.)**

**Ogden Bay: 2000: #2 – 2,204; #3 – 2,513. (Two Total)**
**2001: #3 – 1,786. (One total)**

**Bear River Bay: 1998: #9 – 3,853; #10 – 14,497; #12 – 2,702; #13 – 12,751; #15 – 7,558; #17 – 5,880. (Six Total)**
**1999: #2 – 6,747; #11 – 6,412; #12 – 15,052; #13– 9,015; #14 – 34,528; #15 – 20,083; #16 – 14,070; #17 – 10,260. (Eight Total)**
**2000: #1 – 1,922; #2 – 26,343; #4 – 2,002; #8 – 6,647; #9 – 7,859; #10 – 22,044 #11 – 43,860; #12 – 34,294; #13 – 16,353; #14 – 9,411; #15 – 38,883. (11 Total)**
**2001: #2 – 5,258; #9 – 4,802; #10 – 7,702; #11 – 6,067; #13 – 6,838; #14 – 3,504; #15 – 9,047. (Seven Total)**

**Wilson's Phalarope: (1% is 15,000.)**

**Farmington Bay: 1999: #12 – 21,509; #13 – 108,629; #14 – 17,860. (Three Total)**
**2000: #10 – 19,576; #11 – 17,208; #13 – 27,162. (Three Total)**

**Ogden Bay: 1998: #8 – 34,348; #9 – 61,797; #11 – 29,915. (Three Total)**
**1999: #10 – 68,172; #11 – 55,513; #12 – 34,959. (Three Total)**
**2000: #7 – 24,206; #8 – 38,586; #9 – 196,819; #10 – 335,051; #11 – 85,981. (Five Total)**
**2001: #8 – 60,107; #9 – 140,086; #12 – 194,820. (Three Total)**

**Bear River Bay: 1999: #5 – 20,085; #9 – 19,171; #10 – 136,305. (Three Total)**
**2001: #13 – 42,090 (One Total)**

**Gilbert Bay:** The 2000 Wilson's Phalarope Survey, Great Salt Lake, Utah July 28, 2000, By Don S. Paul, Lindsey H. Dewey and Ann Manning, provides detailed survey data for 2000, and survey data from 1882 through 1999 when similar surveys were conducted. About 95.2% of the total Wilson's Phalaropes estimated in 2000 were in Gilbert Bay. Note: Do not have details on where Phalaropes were found in other years, **so 2000 data is most reliable count**. Using 95.2%, the following are estimates for Phalarope use of Gilbert Bay from 1995 through 2000: 1995 – 254,184; 1996 – 238,000 to 285,600; 1997 – 182,529; 1998 – 235,416; 1999 – 71,083; **2000 – 458,553.**

Also, due to landowner discretion, the dike for U.S. Magnesium is not included in the Gilbert Bay IBA nomination. Therefore, the GSL Waterbird survey counts for this area are not included in the Gilbert Bay IBA nomination. However, there were significant counts of Wilson's Phalaropes from this dike and most of these Phalaropes would likely have been in Gilbert Bay rather than Stansbury Bay, which is where U.S. Magnesium has their salt operation. The following provides numbers for the times when Wilson's Phalaropes exceeded 1% of the total population in Gilbert Bay, including the counts from the dike for U.S. Magnesium.

Gilbert Bay: 1998: #9 – 110,710; #10 – 92,467. (Two Total)
1999: #9 – 108,258; #10 – 72,993; #12 – 15,485. (Three Total)
2001: #8 – 239,596. (One Total)

**Western Sandpiper: (1% is 35,000.)**

**Bear River Bay: 1998: #10 – 49,302. (One Total)**
**1999: #10 – 190,090; #11 – 41,250; #12 – 45,000. (Three Total)**

2001: #10 – 47,152. (One Total)

Snowy Plover: (1% is 177.)

Farmington Bay: 1999: #13 – 201; #14 – 199. (Two total)
2001: #11 – 193; #16 – 236; #17 – 243. (Three total)

Gunnison Bay: 1998: #5 – 184; #7 – 245. (Two total)
2001: #6 – 187; #8 – 236; #9 – 362; #10 – 377; #13 – 270; #14 – 196. (Six Total)

Gilbert Bay: 1998: #1 – 221; #8 – 204; #9 – 335; #10 - 233; #11 – 615; #12 – 214. (Six Total)
1999: #4 – 194; #10 - 475; #11 – 251; #12 – 252; #14 – 393; #16 – 204. (Six Total)
2000: #2 – 262; #4 – 264; # 9 – 192; #10 – 207; #14 – 249. (Five Total)
2001: #4 – 288; #6 – 270; #7 – 212; #13 – 278. (Four Total)

3-24-05 Table 2: **Estimated 1% of North American Populations of Selected Bird Species and Number of Times This Was Exceeded on the Five Major Bays of Great Salt Lake from 1998 to 2001**

Notes: From 1988 through 2001 there were 17 survey periods for the Great Salt Lake Waterbird Survey going from April through September. Additional detailed information for each bird species is provided below the table. Survey data is primarily from Great Salt Lake Ecosystem Project, Utah Division of Wildlife Resources. As noted below different surveys were used for Eared Grebes, and Tundra Swans as well as American White Pelicans at Gunnison Island.

| Bird Species | 1% of Estimated North American Population* | Great Salt Lake Bays # of survey periods over 1% by year | | | | |
|---|---|---|---|---|---|---|
| | | Farmington | Ogden | Bear River | Gunnison | Gilbert |
| Green-winged Teal | 39,000 | | One in 01 | Four in 98<br>Five in 99<br>Two in 00<br>Three in 01 | | |
| Cinnamon Teal | 2,600 | Two in 98<br>One in 00 | Two in 98<br>Two in 99<br>Three in 00<br>Four in 01 | Eight in 98<br>Seven in 99<br>Eight in 00<br>13 in 01 | | |
| Eared Grebe | 37,000 | | Special Surveys | | | Special Surveys |
| Western Grebe | >1,200 | | | Six in 98<br>Seven in 99 | | |
| Gadwall | 39,000 | | | One in 98<br>Three in 98<br>Five in 99 | | |
| Northern Pintail | 36,000 | | | Three in 01 | | |
| Northern Shoveler | 38,000 | | | Four in 98<br>One in 99 | | |
| Ruddy Duck | 11,000 | Four in 98<br>Five in 00<br>Two in 01 | | | | |
| Tundra Swan | 1,813 | Special Surveys | Special Surveys | Special Surveys | | |
| American White Pelican | >1,800 | Three in 98<br>One in 00 | | Eight in 98<br>11 in 99<br>15 in 00<br>Six in 01 | Separate Survey at Gunnison Island | |
| White-faced Ibis | 1,500 | Eight in 98<br>Four in 99<br>Eight in 00<br>12 in 01 | Three in 98<br>Nine in 99<br>Eight in 00<br>Nine in 01 | 15 in 98<br>13 in 99<br>13 in 00<br>15 in 01 | | |

*The North American bird population numbers are taken from: Implementing the IBA Program in the U.S: Criteria, Thresholds, and their Application. *Prepared by:* Daniel K. Niven, Senior Scientist for Bird Conservation National Audubon Society, 1150 Connecticut Avenue, Washington, DC 20036, Draft November 2003. (The primary source of North American population data is Wetlands International (2002), *Waterbird population estimates – Third edition.* Wetlands International Global Series No.12, Wageningen, The Netherlands.

**The following is more detailed information for bird species that had survey counts with over 1% of their estimated North American Population. The information is primarily provided by Bay by survey period and by numbers counted and then total number of times the 1% estimate was exceeded. Source: Great Salt Lake Waterbird Survey Data from 1998 through 2001 from Great Salt Lake Ecosystem Project, Utah Division of Wildlife Resources.** As discussed below different surveys were used for Eared Grebes, and Tundra Swans as well as American White Pelicans at Gunnison Island.

**Green-winged Teal (1% is 39,000)**

**Ogden Bay: 2001: #17 – 42,189. (One Total)**

**Bear River Bay: 1998: #13 – 103,637; #14 – 144,103; #15 – 91,226; #17 – 200,818. (Four Total)**

**1999: #13 – 40,642; #14 – 82,103; #15 – 124,300; #16 – 78,586; #17 – 164,773. (Five Total)**

**2000: #14 – 51,162; #15 – 64,935. (Two Total)**

**2001: #15 – 40,226; #16 – 57,636; #17 – 40,475. (Three Total)**

**Cinnamon Teal: (1% is 2,600.)**

**Farmington Bay: 1998: #14 – 3,902; #17 – 3,235. (Two Total)**

**2000: #15 – 8,975. (One Total)**

**Ogden Bay: 1998: #15 – 2,730; #16 – 4,269. (Two Total)**

**1999: #16 – 4,826; #17 – 4,133. (Two Total)**

**2000: #15 – 4,296; #16 – 3,271; #17 – 5,012. (Three Total)**

**2001: #14 – 5,415; #15 – 2,805; #16 – 4,518; #17 – 6,302. (Four Total)**

**Bear River Bay: 1998: #8 – 4,011; #9 – 4,274; #10 – 9,797; #12 – 10,808; #13 – 16,632; #14 – 9,964; #15 – 14,945; #17 – 15,039. (Eight Total)**

**1999: #1 – 4,809; #2 – 5,384; #9 – 8,629; #10 – 28,275; #12 – 4,324; #13 – 9,645; #14 – 5,814. (Seven Total)**

**2000: #1 – 6,042; #2 – 3,678; #7 – 5,262; #8 – 7,491 #9 – 7,248; #12 – 3,270; #14 – 3,703; #15 – 7,324. (Eight Total)**

**2001: #1 – 3,461; #2 – 9,752; #6 – 3,538; #7 – 5,599; #8 – 3,963; #9 – 9,843; #10 – 6,755; #11 – 4,210; #12 – 9,032; #14 – 10,685; #15 – 9,735; #16 – 6,720; #17 – 2,685. (13 Total)**

**Eared Grebe: (1% is 37,000)**

The 2001 Great Salt Lake Eared Grebe Photo Survey by Don S. Paul, John Neill and Ann Manning, (Utah Division of Wildlife Resources, Great Salt Lake Ecosystem Project) provides counts for the numbers of Eared Grebes on Great Salt Lake from 1997 through 2001. Total survey numbers were: 1997 - 1,460,151; 1998 - 522,287; 1999 - 1,008,656, 2000 - 1,127,307; 2001 - 666,652 for 2001 for both Ogden and Gilbert Bay. As discussed in the Gilbert Bay and Ogden Bay IBA nominations, the 2001 survey was used to estimate that 53.3% of the Eared Grebes were in Gilbert Bay and 46.7% were in Ogden Bay. The survey actually showed just under 30% was in Gilbert Bay and just over 70% was in Ogden Bay. But roughly 1/3 of what was considered Ogden Bay for the Eared Grebe report was west of Fremont and Antelope Islands or what is considered the Gilbert Bay area for the purposes of the IBA nomination. (1/3 of 70% = 23.3% +30% = 53.3% for Gilbert Bay). Using the above

information the following can be calculated, **with best reliance of distribution for the 2001 survey numbers:**

**Ogden Bay:** 1997 – 778,260; 1998 – 278,379; 1999 – 537,613; 2000 – 600,855; **2001 – 339,181.**

**Gilbert Bay:** 1997 – 681,891; 1998 – 243,908; 1999 – 47,042; 2000 – 526,452; **2001 – 297,181.**

**Western Grebe: (1% is Greater Than 1,200.)**

**Bear River Bay: 1998: # 6 – 4,412; #10 – 1,269; #11 – 1,790; #12 – 1,655; #14 – 1,347; #15 – 1,376. (Six Total)**

**1999: #3 – 2,115; #5 – 1,387; #6 – 2,588; #7 – 1,645; #9 – 1,583; #16 – 1,925; #17 – 1,709. (Seven Total)**

**Gadwall: (1% is 39,000.)**

**Bear River Bay: 1998: #17 – 134,002. (One Total)**

**Northern Pintail: (1% is 36,000.)**

**Bear River Bay: 1998: #14 – 53,675; #15 – 75,411; #17 – 89,231. (Three Total)**

**1999: #13 – 43,087; #14 – 60,736; #15 – 53,526; #16 – 122,888; #17 – 47,069. (Five Total)**

**2001: #15 – 39,155; #16 – 104,644; #17 – 40,654. (Three Total)**

**Northern Shoveler: (1% is 38,000.)**

**Bear River Bay: 1998: #13 – 41,377; #14 – 50,151; #15 – 43,496; #17 – 76,363. (Four Total)**

**1999: #15- 42,302. (One Total)**

**Ruddy Duck: (1% is 11,000.)**

**Farmington Bay: 1998: #1 – 15,818; #2 – 17,294; #14 – 14,274; #17 – 13,925. (Four Total)**

**2000: #1 – 11,540; #2 – 15,482; #10 – 11,563; 14 – 18,264; #17 – 11,752. (Five Total)**

**2001: #1- 17,565; #2 – 13,822. (Two Total)**

**Tundra Swan: (1% is 1,813.)**

The Utah Division of Wildlife Resources conducts Aerial Swan Surveys of the Great Salt Lake. The surveys are conducted annually, with surveys generally going from the first part of October through mid- March. The following data is from Tom Aldrich, UDWR Waterfowl Coordinator starting from Oct 1995 through Nov. 2004. During this time period there were almost weekly aerial surveys for the last part of October through the first of January. The following provides the highest numbers of aerial swans counted through each survey season, first for the entire Great Salt Lake, and then for Farmington, Ogden and Bear River Bays.

Highest Counts for each year for Great Salt Lake: Nov. 14, 1995 – 19,979; Nov. 19, 1996 – 29,500; Nov. 19, 1997 – 41,928; Dec. 8, 1998 – 39,057; Nov. 29, 1999 – 32,970; Nov. 8, 2000 – 21,423; Nov. 21, 2001 – 25,720; Nov. 5, 2002 – 32,301; Nov. 18, 2003 – 30,266.

**Highest Counts for Farmington Bay for each year with over 1% in bold:** 3/14/96 – 10; **3/14/97 – 1,844;** 1/6/98 – 1,474; **3/19/99 – 2,485; 3/15/00 – 1,814; 11/8/00 – 2,992; 3/15/02 – 3,053;** 12/24/02 – 1,608; **11/18/03 – 3,048.**

Highest Counts for Ogden Bay for each year with over 1% in bold: 3/14/96 – 918; **3/14/97 – 4,958; 3/18/98 – 3,642; 3/19/99 – 2,938;** 3/15/00 – 1,715; **3/15/01 – 3,424; 3/15/02 – 2,594;** 1/6/03 – 1,150; **11/18/03 – 3,163.**

Highest Counts for Bear River Bay for each year with over 1% in bold: **11/14/95 – 19,979; 11/19/96 – 29,274; 11/19/97 – 41,736; 12/1/98 – 38,582; 11/29/99 – 31,480; 11/8/00 – 16,272; 11/21/01 – 25,716; 11/5/02 – 32,270; 11/12/03 – 24,871.**

American White Pelican: (1% is Greater than 1,800.)

Farmington Bay: 1998: #12 – 2,765; #13 – 4,850: #16 – 1,909. (Three Total)
2000: #14 – 1,841. (One Total)

Bear River Bay: 1998: #9 – 3,823; #10 – 5,589; #12 – 9,426; #13 – 9,743; #14 – 20,176; #15 – 17,272; #16 – 17,822; #17 – 14,760. (Eight Total)
1999: #2 – 2,135; #5 – 2,522; #9 – 3,370; #10 – 12,797; #11 – 4,885; #12 – 17,987; #13 – 35,924; #14 – 25,535; #15 – 28,744; #16 – 30,837; #17 – 24,114. (11 Total)
2000: #1 – 2,428; #2 – 3,589; #3 – 3,315; #4 – 3,381; #5 – 3,586; #6 – 6,082; #7 – 11,019; #8 – 13,868; #9 – 15,558; #10 – 10,246; #11 – 17,260; #12 – 16,489; #13 – 5,337; #14 – 6,138; #15 – 1,996. (15 Total)
2001: #4 – 1,845; #8 – 2,594; #9 – 9,035; #10 – 3,873; #11 – 5,447; #12 – 1,867. (Six Total)

Gilbert Bay: The Utah Division of Wildlife Resources conducts annual surveys at Gunnison Island, where the Pelicans breed. The total counts from 1995 through 2002 are: 1995 – 11,198; 1196 – 17,210; 1997 – 16,834; 1998 – 18,849; 1991; 15,739; 2000 – 24,154; 2001 – 21,458; 2002 – 14,722.

White-faced Ibis: (1% is Greater than 1,500.)

Farmington Bay: 1998: #6 – 2,068; #7 – 1,701; #8 – 2,772; #10 – 6,014; #11 – 7,256; #12 – 3,650; #13 – 3,603; #14 – 1,821. (Eight Total)
1999: #8 – 2,244; #10 – 4,020; #11 – 2,749; #12 – 1,804. (Four Total)
2000: #7 – 2,413; #8 – 3,766; #9 – 4,043; #10 – 6,488; #11 – 6,052; #12 – 4,048; #13 – 4,444; #14 – 5,905. (Eight Total)
2001: # 2 – 1,757; #3 – 1,504; #5 – 2,310; #6 – 7,316; #7 – 4,985; #8 – 2,716; #9 – 4,528; #10 – 3,588; #11 – 3,023; #12 – 2,748; #13 – 1,798; #14 – 2,066. (12 Total)

Ogden Bay: 1998: #10 – 2,179; #11 – 2,045; #13 – 2,011. (Three Total)
1999: #7 - 2,481; #8 – 2,348; #9 – 2,120; #10 – 1,807; #11 – 1,804; #12 – 3,400; #13 – 3,108; #14 – 1,911; #15 – 2,440. (Nine Total)
2000: #2 – 2,985; #5 – 2,006; #9 – 1,994; #10 – 2,817; #11 – 4,555; #12 – 4,955; #13 – 2,329; #14 – 3,797. (Eight Total)
2001: #3 – 1,674; #4 – 2,667; #7 – 1,721; #8 – 2,290; #9 – 2,936; #10 – 2,264; #11 – 2,431; #12 – 1,612; #14 – 2,587. (Nine Total)

Bear River Bay: 1998: #1 – 1,520; #2 – 3,778; #3 – 2,405; #5 – 13,409; #6 – 3,540; #7 – 11,657 # 8 – 5,742; #9 – 11,380; #10 – 18,342; #11 – 3,596; #12 – 57,615; #13 – 27,886; #14 – 7,881; #15 – 3,581; #16 – 2,002. (15 Total)

1999: #4 – 2,928; #5 – 15,576; #6 – 18,798; #7 – 9,462; # 8 – 1,977; #9 – 6,022; #10 – 12,595; #11 – 2,657; #12 – 22,607; #13 – 17,360; #14 – 27,320; #15 – 14,899; #16 – 5,604. (13 Total)

2000: #2 – 3,306; #3 – 12,907; #4 – 9,781; #5 – 19,275; #6 – 6,728; #7 – 5,154; # 8 – 10,568; #9 – 39,225; #10 – 28,002; #11 – 44,063; #12 – 22,125; #13 – 7,736; #14 – 6,530. (13 Total)

1998: #2 – 4,827; #3 – 23,332; #4 – 13,875; #5 – 6,714; #6 – 4,062; #7 – 5,053; # 8 – 12,188; #9 – 27,398; #10 – 20,729; #11 – 26,274; #12 – 17,226; #13 – 17,931; #10,876; #15 – 1,728; #16 – 1,870. (15 Total)

3-24-05

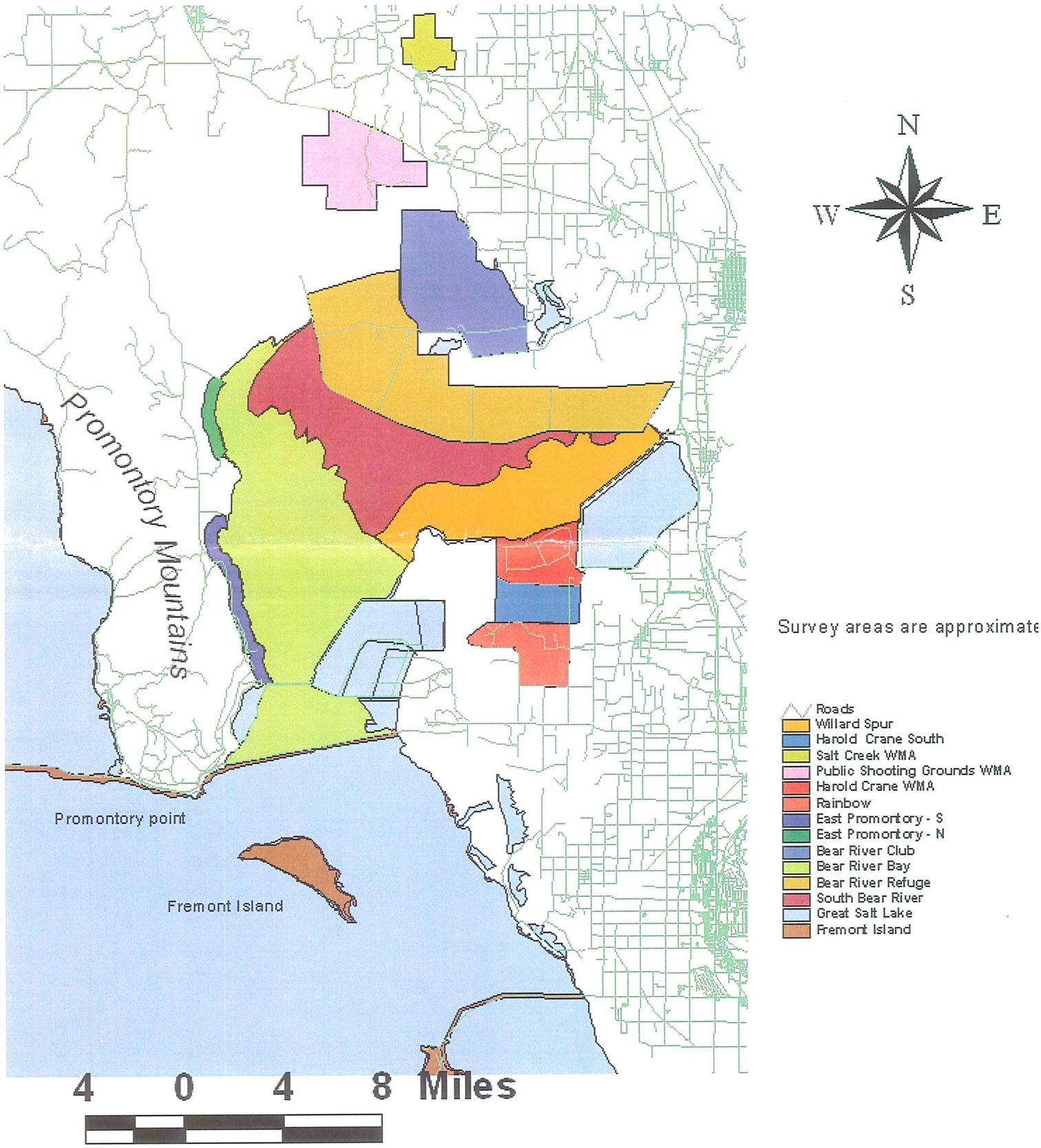
Table 1: **Estimated Population of Selected Bird Species in North America with Number and Percent of the Population on or by the Five Major Bays of Great Salt Lake**

Notes: Numbers for the bays, except where noted, are maximum numbers during a survey period for the GSL Waterbird Survey from 1998-2001. (Source: Great Salt Lake Ecosystem Project, Utah Division of Wildlife Resources.) Information is provided only for species that had 1% or over of the North American population for that species in at least one bay on the Great Salt Lake.

| Bird Species | Estimated North American Population* | Great Salt Lake Bays # observed/% of North American Population | | | | |
|---|---|---|---|---|---|---|
| | | Farmington | Ogden | Bear River | Gunnison | Gilbert |
| Green-winged Teal | 3,900,000 | 25,944<br>0.7% | 42,189<br>**1.1%** | 200,818<br>**5.1%** | | |
| Cinnamon Teal | 260,000 | 8,975<br>**3.5%** | 6,302<br>**2.4%** | 28,275<br>**10.9%** | | |
| Eared Grebe | 3,700,000 | 15,336<br>0.4% | 681,891**<br>**18.4%** | 27,850<br>0.8% | | 778,260**<br>**21.0%** |
| Western Grebe | 120,000+<br><10,000 | | | 4,412<br>**<3.7%** | | |
| Gadwall | 3,900,000 | 20,723<br>.5% | 25,827<br>0.7% | 134,002<br>**3.4%** | | |
| Northern Pintail | 3,600,000 | 29,143<br>0.8% | 27,995<br>0.8% | 122,888<br>**3.4%** | | |
| Northern Shoveler | 3,800,000 | 30,089<br>0.8% | 28,366<br>0.7% | 76,363<br>**2.0%** | | |
| Ruddy Duck | 1,100,000 | 18,264<br>**1.7%** | 3,826<br>0.3% | 6,487<br>0.6% | | |
| Tundra Swan | 181,300 | 3,053<br>**1.7%** | 4,958<br>**2.7%** | 41,736<br>**23.0%** | | |
| American White Pelican | Greater than 180,000 | 4,850<br>**2.7%** | 1,281<br><.7% | 35,924<br>**<20.0%** | 24,154***<br>**<13.4%** | |
| White-faced Ibis | Greater than 150,000 | 7,316<br>**<4.9%** | 4,955<br>**<3.3%** | 57,615<br>**<38.4%** | | |

*The North American bird population numbers are taken from: Implementing the IBA Program in the U.S: Criteria, Thresholds, and their Application. *Prepared by:* Daniel K. Niven, Senior Scientist for Bird Conservation National Audubon Society, 1150 Connecticut Avenue, Washington, DC 20036, Draft November 2003. (The primary source of North American population data is Wetlands International (2002), *Waterbird population estimates – Third edition.* Wetlands International Global Series No.12, Wageningen, The Netherlands.

**Estimate Based from 2001 Great Salt Lake Eared Grebe Photo Survey, Utah DWR GSL Ecosystem Project, Don S. Paul, John Neill and Ann Manning.

***Gunnison Island Surveys conducted by Utah Division of Wildlife Resources from 1963 through 2002.

# Bear River Bay IBA