Mailing Address:
Water Resources Data System
University of Wyoming, Dept 3943
1000 E University Avenue
Laramie, WY 82071

Physical Address:
Wyoming Hall, Room 249
University of Wyoming
Laramie, WY 82071

Phone: (307) 766-6651
Fax: (307) 766-3785

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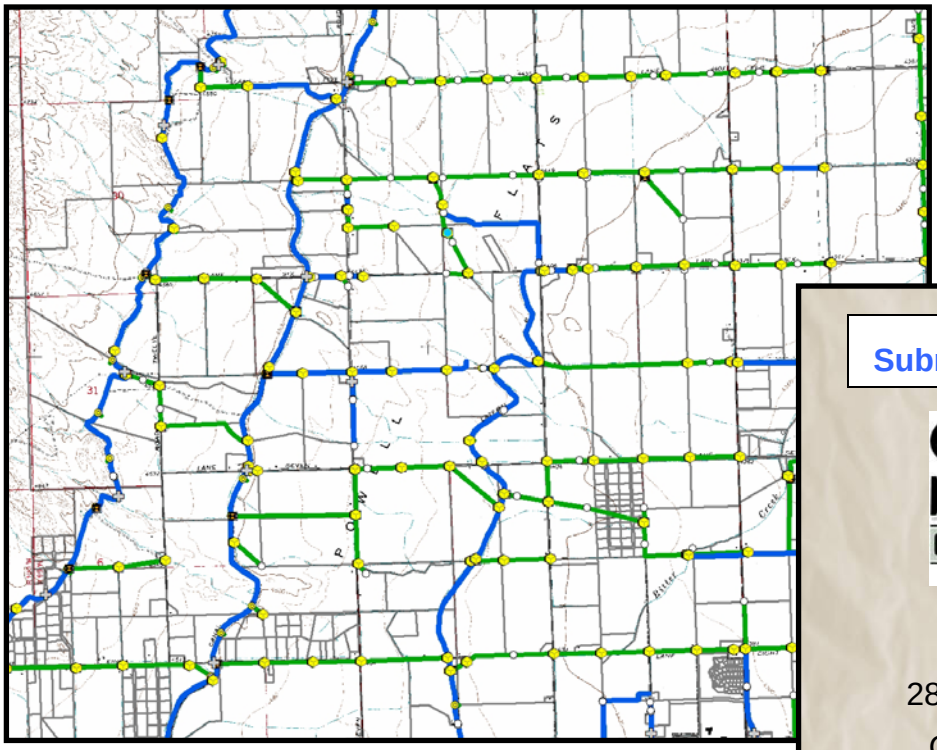
Executive Summary for

SHOSHONE IRRIGATION DISTRICT REHABILITATION AND GIS, LEVEL II STUDY

To: WYOMING WATER DEVELOPMENT COMMISSION



Professional Engineer (Civil)
JAMES G. EVANS
9032
Date 11-24-08
WYOMING

Submitted by:

Sage CIVIL ENGINEERING

2824 Big Horn Ave.
Cody, WY 82414
Phone: (307) 527-0915
Fax: (307) 527-0916
sce@sagecivilengineering.com

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1 Introduction

Sage Civil Engineering (SCE) was chosen to complete the Shoshone Rehabilitation and GIS, Level II Study. The notice to proceed was issued in June of 2006. This project had two main purposes. The first was to produce a Geographic Information System (GIS) for use by the District in their everyday operations. The second was to evaluate the Buck Springs Undershot, Corbett Tunnel, Corbett Dam and other miscellaneous structures as deemed necessary for existing condition and possible rehabilitation actions.

Initial scoping meetings were conducted with representatives of the WWDC, Shoshone Irrigation District and Sage Civil Engineering. The overall plan for the GIS was reviewed at that time and input from all parties was obtained. Based on these meetings and subsequent conversations, the GIS format was determined and the conceptual designs completed.

Purpose

Several goals were identified for this project. These goals involve different aspects of the system and are listed below.

Irrigation System Mapping – Map the Shoshone Irrigation system including the delivery system, underground and open drains, and Bureau of Reclamation Land Classification Maps for inclusion in a GIS.

Structure Inventory and Evaluation – Study the entire system for structures to evaluate the condition of all structures with special attention given to the Corbett Dam intake, the floor of the Corbett tunnel and the Buck Springs Undershot. Conceptual Designs and Cost estimates have been prepared for those structures or portions of structures found to require major repairs.

Creation of GIS – Create a GIS system based on the mapping and structural evaluation of the system. The GIS includes georeferenced Land Classification maps, land ownerships and water rights.

GIS Training – Training of District personnel in how to utilize the GIS.

Deliverables – Deliverable items will include: Map Books, GIS, “One Call of Wyoming” Registration, Conceptual Designs Cost Estimates and Report.

2 GIS Development

2.1 Base Mapping

The development of the GIS began by identifying and gathering information from outside sources to use as base maps for the mapping to be completed by Sage Civil Engineering. This included data such as aerial photos, 7.5 minute USGS Quadrangles, Park County GIS data, Drain Maps and Land Classification Maps. This information came from a variety of sources including Natural Resources

Conservation Service, Park County and Shoshone Irrigation District. Some of this data was not previously georeferenced. For use in the GIS, all the maps were georeferenced.

2.2 Development of the GIS Structure

To organize the mapping tasks to be completed, a data dictionary was created to plan and document the structure of the GIS. This work included determining:

1. The features to be mapped.
2. The data to be collected on each feature.
3. The best formats and methods to store the data.
4. How the data is related to other portions of the database.

This dictionary formed the framework which guided all of the mapping completed for the project.

The Shoshone GIS can be thought of as three separate GIS's, the

1. Irrigation System Infrastructure,
2. Closed Drains Infrastructure and
3. Land Classification Mapping.

The various features that make up all of these subparts of the GIS and the data required for each were determined.

Irrigation System Features

The irrigation system was the most complex and contained the largest variation of mapped features. These were:

- Bridges
- Control Structures
- Simple Turnouts
- Drain Inlets
- Measurement Locations
- Open Ditches
- Pipelines
- Simple Nodes
- Undershots
- Vents

Detailed data was collected on these features. This data primarily consisted of unique identifiers, basic dimensions, measuerment types, notes, etc. At the completion of the mapping the maps were recorded for use under the One Call of Wyoming utility locating system.

Closed Drain System Features

The closed drain system contained only two features – 1) Closed Drain Line and 2) Closed Drain Point. These two features were used to map the closed drains within the District. Minimal data was collected on these features. Primarily, the

lengths of the pipelines and the material with which the manholes were constructed were the only data recorded. At the completion of the mapping the maps were recorded for use under the One Call of Wyoming utility locating system.

Land Classification Mapping

The land classifications were mapped using only a single feature. This feature consisted of polygons depicting the land classification of a certain area. The most important data associated with this mapping consisted of the number of acres within each polygon. Other data such as the structure irrigating the parcel, county parcel data, etc. was also recorded.

2.3 Field Mapping

Once the structure, features and data were identified, SCE began the field mapping. To accomplish this task, a handheld GPS was utilized in conjunction with software that allowed input of a data dictionary to provide an electronic field questionaire to record the data electronically at the time of mapping. All of the features and data were input and each feature that could be field mapped was visited and located. Over 3,000 individual features were mapped.

2.4 Digitized Mapping

It was not feasible to map some features in the field either because the feature was not visible above ground or the accuracy obtained by field mapping was not deemed necessary. The underground pipelines and canals were digitized from aerial photos. The underground drain pipelines were digitized using a combination of aerial photos and historic drain maps. The lines were corrected to match locations where manholes were found and field mapped. The land classification maps were mapped from the previously digitized maps provided by the District. These were georeferenced and the polygons were digitized.

2.5 GIS Search Tool

To facilitate the use of the GIS, a set of tools was created to aid the District in navigating the GIS. These tools allow the District to identify, display data, print reports and create maps. Comprehensive manuals for use of these tools have been provided as part of the final report.

3 Structure Inventory and Evaluation

In general, the District has been proactive in structure replacement and facility upgrades and these maintenance and rehabilitation efforts have been successful. Previous projects have replaced or repaired the majority of the large structures within the system and many miles of open ditch have been converted to pipelines for reduced maintenance and increased efficiency. Consequently, the irrigation system is overall in very good condition.

The structure inventory and evaluation was separated into two categories, 1) Previously identified structures and 2) Newly identified structures. The previously

identified structures were those items specifically identified in the Scope of Services. The newly identified structures were those structures that, after the mapping was complete, were determined to be in need of rehabilitation.

3.1 Previously Identified Structures

The structures identified by the District and included in the scope were:

- Buck Springs Undershot and Canal Lining
- Corbett Tunnel
- Corbett Dam

These structures were determined to be deficient during previous evaluations. These are all structures that were some of the first constructed on the project - first put into service in 1908. As this report is being written, they are completing their 100th season in service. For the most part they are functioning well, however some degradation is beginning to appear and they are in need of repair.

3.2 Newly Identified Structures

During the field survey process, all structures (checks, drops, turnouts, measurement devices, undershoots, and drains) were evaluated and assigned a condition rating ranging from 1 to 5, with a 5 indicating the poorest condition. All structures receiving a rating of 4 or 5 were considered to be nearing the replacement stage, with checks and drops receiving this rating included in the overall cost estimate. Turnouts, measurement devices, minor undershots, and drains were not included in the rehabilitation estimate regardless of rating. Undershoots and drains with poor ratings were rated such because of plugged inlets and outlets. Replacement of the pipes is not anticipated for these features. The best option for poorly-rated turnouts and measurement devices is to simply correct them as part of routine maintenance by the District.

4 Conceptual Designs and Cost Estimates

4.1 Conceptual Level Designs

Conceptual Level Designs and Cost Estimates for the specific structures included in the scope of work for this study were prepared. As discussed above these were:

- Buck Springs Undershot (Consists of two parts – 1) The Undershot Piping and 2) the canal lining over the embankment.)
- Corbett Tunnel
- Corbett Dam

Detailed cost estimates for the rehabilitation of these structures are included below.

Table 4.1 Buck Springs Undershot Canal Lining Estimates

Buck Springs Canal Lining - Level III

Preparation of Final Designs and Specifications	$ 5,000.00
Permitting and Mitigation	$ -
Legal Fees	$ 500.00
Acquisition of Access and Rights of Way	$ -

Project Components				
Item	Unit	Estimated Quantity	Estimated Unit Price	Estimated Total Price
Mobilization	LS	1	$10,000.00	$10,000.00
Removal of Existing Concrete	LS	1	$5,000.00	$5,000.00
Scarify/Recompact Subgrade incl. Cr. Base	LS	1	$6,500.00	$6,500.00
Class B Concrete	CY	265	$300.00	$79,500.00
Reinforcing Steel	LB	14500	$1.25	$18,125.00
Underdrain	LS	1	$3,000.00	$3,000.00
			Construction Cost Subtotal	**$122,125.00**
			Engineering Costs	$12,212.50
			Subtotal #2	$134,337.50
			Contingency	$20,150.63

Construction Cost Total	$154,488.13
Project Cost Total	$159,988.13

Table 4.2 Buck Springs Undershot and Estimates

Buck Springs Undershot - Level III

Preparation of Final Designs and Specifications	$ 9,000.00
Permitting and Mitigation	$ 1,000.00
Legal Fees	$ 500.00
Acquisition of Access and Rights of Way	$ 500.00

Project Components				
Item	Unit	Estimated Quantity	Estimated Unit Price	Estimated Total Price
Mobilization	LS	1	$10,000.00	$10,000.00
Unclassified Excavation	CY	3600	$8.00	$28,800.00
Removal of Wingwalls, Headwalls, & Pipe	LS	1	$4,000.00	$4,000.00
RCP - 72 inch	LF	80	$400.00	$32,000.00
Pipe Bedding	CY	60	$25.00	$1,500.00
Wing/Headwalls (Class B Concrete)	CY	45	$500.00	$22,500.00
Reinforcing Steel	LB	3900	$1.75	$6,825.00
Cofferdam & Pump	LS	1	$2,500.00	$2,500.00
			Construction Cost Subtotal	**$108,125.00**
			Engineering Costs	$10,812.50
			Subtotal #2	$118,937.50
			Contingency	$17,840.63

Construction Cost Total	$136,778.13
Project Cost Total	$147,778.13

Table 4.3 Corbett Tunnel Estimate

Corbett Tunnel - Level III

Preparation of Final Designs and Specifications	$ 7,000.00
Permitting and Mitigation	$ -
Legal Fees	$ 500.00
Acquisition of Access and Rights of Way	$ -

Project Components				
Item	Unit	Estimated Quantity	Estimated Unit Price	Estimated Total Price
Mobilization	LS	1	$10,000.00	$10,000.00
Dewatering	LS	1	$2,500.00	$2,500.00
Surface Preparation (Cleaning)	SF	52000	$1.50	$78,000.00
Bonding Agent	SF	52000	$1.00	$52,000.00
Topping Application	CF	4500	$16.00	$72,000.00
			Construction Cost Subtotal	**$214,500.00**
			Engineering Costs	$21,450.00
			Subtotal #2	$235,950.00
			Contingency	$35,392.50

Construction Cost Total	$271,342.50
Project Cost Total	$278,842.50

Table 4.4 Corbett Dam Estimate

Corbett Dam - Level III

Preparation of Final Designs and Specifications	$ 44,000.00
Permitting and Mitigation	$ 2,000.00
Legal Fees	$ 4,000.00
Acquisition of Access and Rights of Way	$ 4,000.00

Project Components

Item	Unit	Estimated Quantity	Estimated Unit Price	Estimated Total Price
Diversion Dam				
Mobilization	LS	1	$ 5,992.59	$ 5,992.59
Surface Preparation Upper Wall	SF	2360	$ 2.91	$ 6,873.44
Surface Preparation Lower Wall	SF	5502	$ 2.33	$ 12,819.55
Gunnite Grout Application	CF	1035	$ 24.46	$ 25,321.06
Localized Rebar Repairs	EA	8	$ 1,863.98	$ 14,911.87
Gate Structure				
Mobilization	LS	1	$ 6,439.83	$ 6,439.83
Surface Preparation - Vertical and Sloped Walls	SF	3336	$ 2.91	$ 9,716.02
Surface Preparation - Floor	SF	600	$ 2.33	$ 1,397.99
Gunnite Grout Application	CF	378	$ 24.46	$ 9,247.69
Sluice Gate Removal	EA	3	$ 2,562.98	$ 7,688.93
Sluice Gate Refurbish/Repair	EA	3	$ 5,824.95	$ 17,474.85
Sluice Gate Re-Install	EA	3	$ 2,562.98	$ 7,688.93
Localized Rebar Repairs	EA	6	$ 1,863.98	$ 11,183.90
Tunnel Inlet Structure				
Mobilization	LS	1	$ 10,796.31	$ 10,796.31
Existing Slab Demolition	SF	1640	$ 0.28	$ 466.00
Remove and Dispose of Debris	CF	2000	$ 2.33	$ 4,659.96
Prepare Subgrade	SF	1640	$ 2.61	$ 4,287.16
Replace Fill Material	CY	14	$ 176.41	$ 2,469.78
12" Slab	CY	61	$ 744.83	$ 45,434.61
Surface Preparation - Floor	SF	1200	$ 2.33	$ 2,795.98
Surface Preparation - Vertical and Sloped Walls		1050	$ 2.91	$ 3,058.10
Gunnite Grout Application	CF	288	$ 24.46	$ 7,045.86
Gate Removal	EA	2	$ 3,727.97	$ 7,455.94
Gate Refurbish/Repair	EA	2	$ 5,824.95	$ 11,649.90
Gate Re-Install	EA	2	$ 3,727.97	$ 7,455.94
Localized Rebar Repairs	EA	6	$ 1,863.98	$ 11,183.90
Weir / Spillway 400 FT				
Mobilization	LS	1	$ 2,254.00	$ 2,254.00
Excavation/Inspection	SF	21200	$ 0.47	$ 4,240.00
Surface Preparation	SF	7200	$ 2.33	$ 7,200.00
Gunnite Grout Application	CF	600	$ 24.46	$ 6,300.00
Localized Rebar Repairs	EA	6	$ 1,863.98	$ 4,800.00
Cofferdam and Temporary Road				
Mobilization	LS	1	$ 13,300.00	$ 13,300.00
Sheet Piling	SF	5862	$ 21.32	$ 125,000.00
Temporary Road	LS	1	$ 8,000.00	$ 8,000.00

Construction Cost Subtotal	**$426,610.09**
Engineering Costs	$42,661.01
Subtotal #2	$469,271.10
Contingency	$70,390.67

Construction Cost Total	$539,661.77
Project Cost Total	$593,661.77

Conceptual Level Designs and Cost Estimates for the newly identified structures during the structure evaluation portion of the project were also provided. This group includes:

- 275-358 CFS Drop Structure
- 20 cfs Drop Structure
- 20 cfs Check Structure
- 40 cfs Check Structure
- 80 cfs Check Structure
- 100 cfs Check Structure

The summary table below lists the projects in order of priority for replacement. The determining factor in setting the priority of each structure was the flow rate

that passes through the structure. Of course physical condition would factor greatly into prioritizing a replacement schedule, but since all the structures shown were considered to be nearing the same condition rating, the principal factor in determining priority is its flow rate. The Buck Springs Undershot, Buck Springs Canal Lining, Corbett Tunnel and Corbett Dam projects are listed as the highest priority for two reasons. 1) They have been identified by the District as being a high priority and 2) they affect the entire system. The remaining, smaller structures are listed below the District-identified structures in order of priority.

Table 4.5 Project Summary Estimate

Structure Name	Location	Structure Type	Preparation of Final Designs & Specifications	Permitting & Mitigation	Legal Fees	Acquisition of Access & Rights-of-Way	Cost of Project Components (Construction Estimate)	Construction Engineering (10%)	Subtotal	Contingency (15%)	Construction Cost Total	Total Project Cost at Year One	Total Project Cost at Year 5 (6% Inflation/year)
Buck Springs Undershot	Garland Canal Sta. 265	Concrete Pipe/Headwalls	$9,000	$1,000	$500	$500	$108,125	$10,813	$118,938	$17,841	$136,778	$147,778	$197,760
Buck Springs Canal Lining (Concrete)	Garland Canal Sta. 265	Concrete	$5,000	$0	$500	$0	$122,125	$12,213	$134,338	$20,151	$154,488	$159,988	$214,100
Corbett Tunnel	Sta. 38+55 - Sta. 91+35	Concrete	$7,000	$0	$500	$0	$214,500	$21,450	$235,950	$35,393	$271,343	$278,843	$373,154
Corbett Dam		Concrete	$44,000	$2,000	$4,000	$4,000	$426,610	$42,661	$469,271	$70,391	$539,662	$593,662	$794,453
SG021	Garland Canal	358 cfs Drop	$10,000	$0	$200	$0	$99,100	$9,910	$109,010	$16,352	$125,362	$135,562	$181,412
SG027	Garland Canal	358 cfs Drop	$10,000	$0	$200	$0	$99,100	$9,910	$109,010	$16,352	$125,362	$135,562	$181,412
SG028	Garland Canal	358 cfs Drop	$10,000	$0	$200	$0	$99,100	$9,910	$109,010	$16,352	$125,362	$135,562	$181,412
SG031	Garland Canal	358 cfs Drop	$10,000	$0	$200	$0	$99,100	$9,910	$109,010	$16,352	$125,362	$135,562	$181,412
SG032	Garland Canal	275 cfs Drop	$10,000	$0	$200	$0	$99,100	$9,910	$109,010	$16,352	$125,362	$135,562	$181,412
SG034	Garland Canal	275 cfs Drop	$10,000	$0	$200	$0	$99,100	$9,910	$109,010	$16,352	$125,362	$135,562	$181,412
SG036	Garland Canal	275 cfs Drop	$10,000	$0	$200	$0	$99,100	$9,910	$109,010	$16,352	$125,362	$135,562	$181,412
SG037	Garland Canal	275 cfs Drop	$10,000	$0	$200	$0	$99,100	$9,910	$109,010	$16,352	$125,362	$135,562	$181,412
SA003	Lateral A	100 cfs Check	$2,000	$0	$200	$0	$8,900	$890	$9,790	$1,469	$11,259	$13,459	$18,011
SA009	Lateral A	100 cfs Check	$2,000	$0	$200	$0	$8,900	$890	$9,790	$1,469	$11,259	$13,459	$18,011
SA015	Lateral A	100 cfs Check	$2,000	$0	$200	$0	$8,900	$890	$9,790	$1,469	$11,259	$13,459	$18,011
SA016	Lateral A	100 cfs Check	$2,000	$0	$200	$0	$8,900	$890	$9,790	$1,469	$11,259	$13,459	$18,011
SA021	Lateral A	100 cfs Check	$2,000	$0	$200	$0	$8,900	$890	$9,790	$1,469	$11,259	$13,459	$18,011
SUV005	Lateral UV	80 cfs Check	$2,000	$0	$200	$0	$8,750	$875	$9,625	$1,444	$11,069	$13,269	$17,757
S10A013	Lateral 10A	20 cfs Drop	$4,000	$0	$200	$0	$9,600	$960	$10,560	$1,584	$12,144	$16,344	$21,872
S10A014	Lateral 10A	20 cfs Drop	$4,000	$0	$200	$0	$9,600	$960	$10,560	$1,584	$12,144	$16,344	$21,872
S50F004	Lateral 50F	20 cfs Drop	$4,000	$0	$200	$0	$9,600	$960	$10,560	$1,584	$12,144	$16,344	$21,872
ST008	Lateral T	40 cfs Check	$2,000	$0	$200	$0	$7,350	$735	$8,085	$1,213	$9,298	$11,498	$15,387
SV003	Lateral V	40 cfs Check	$2,000	$0	$200	$0	$7,350	$735	$8,085	$1,213	$9,298	$11,498	$15,387
S11U011	Lateral 11U	20 cfs Check	$2,000	$0	$200	$0	$5,700	$570	$6,270	$941	$7,211	$9,411	$12,593
S1W013	Lateral 1W	20 cfs Check	$2,000	$0	$200	$0	$5,700	$570	$6,270	$941	$7,211	$9,411	$12,593
											Total	**$2,473,000**	**$3,310,000**

5 Summary

The Shoshone Rehabilitation and GIS, Level II Study resulted in a combination of products and conclusions for consideration by the District and the WWDC.

- A Geographic Information System (GIS) consisting of three distinct parts was created for use by the District. These parts were: Irrigation System, Closed Drains and Land Classification Map.
- The GIS includes a variety of base mapping such as USGS Quadrangles, aerial photography from various years obtained by SCE, or provided by the District and georeferenced by SCE.
- An interface tool was provided to facilitate use of the GIS.
- Map Books were provided for use by the District.
- In addition to the Buck Springs Undershot, Corbett Dam and Corbett Tunnel lining, other structures throughout the system were evaluated. Several of these were identified as in need of rehabilitation.
- Conceptual designs and cost estimates were prepared for each identified structure.
- The replacement of structures was prioritized based on their relative importance and project condition.

The GIS created through this project will aid the District in their ongoing operation. It will be a useful tool for determining:

- Maintenance activities
- Water conservation measures
- Long term planning for future management of the District.

Maintenance activities can be optimized with the mapping and record keeping capabilities of the GIS. This will result in better planning for off-season maintenance, weed spraying, etc. It will also help with identifying problem areas subject to moss buildup, silt deposition or other maintenance problems.

For some of the same reasons, the GIS will help the District with water conservation planning and implementation. Currently, the District is taking several steps to conserve water including: water user education, installation of measurement structures and replacement of open laterals with pipelines to prevent seepage losses and reduce maintenance costs. The capability of the GIS to produce high quality maps and track infrastructure will aid in all of these activities.

As with most other irrigation districts, the Shoshone Irrigation District is coping with increased development within the District boundaries resulting in a transition from agricultural land use to other uses. Long term planning to address this and other issues facing the District will require accurate and up-to-date information.


Sage
CIVIL ENGINEERING