This is a digital document from the collections of the Wyoming Water Resources Data System (WRDS) Library.

For additional information about this document and the document conversion process, please contact WRDS at wrds@uwyo.edu and include the phrase “Digital Documents” in your subject heading.

To view other documents please visit the WRDS Library online at: http://library.wrds.uwyo.edu

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

Funding for WRDS and the creation of this electronic document was provided by the Wyoming Water Development Commission (http://wwdc.state.wy.us)
GREEN RIVER SUPPLY CANAL REPORT
PHASE I

Prepared for:
Wyoming Water Development Commission
Cheyenne, Wyoming

Prepared by:
Nelson Engineering
Jackson, Wyoming

November 2003
Project No. 02-085-1
TABLE OF CONTENTS
GREEN RIVER SUPPLY CANAL REPORT

I. INTRODUCTION

II. WATER NEEDS AND OWNERSHIP
   Description
   Courthouse List
   Percent Share of Water

III. INVENTORY
   Description
   Tabulation of Findings
   Maps

IV. FLOW MEASURING, MONITORING AND SEEPA GE LOSS
   Measuring
   Methods
   Seepage
   Data Analysis
   Findings
   Seepage
   General
   Methods
   Analysis
   Conclusions

V. POINT OF DIVERSION
   Description
   Alternatives

VI. WATER STORAGE

VII. PROPOSED REHABIL ITATION WORK AND COST
   Safety Problems
   Obligations/Necessities (Underflows)
   Potential Washouts (Low Dike)
   Seepage Loss Repairs & Lining Costs
   Main Diversion

VIII. MAINTENANCE RECOMMENDATIONS
   Proportion Water Quantities
   Phreatiphite Loss, Willows and Trees

APPENDIX
   Geological Report
I. INTRODUCTION

The Green River Supply Canal (GRSC) diverts from Poole's Slough, a branch of and probable former meander, of the Green River. The record point of diversion is in the SE1/4, SE1/4, S4, T33N, R110W, Sublette County, Wyoming. From its point of diversion, the canal flows southerly for approximately 35 miles, terminating at a point easterly of Big Piney and north of State Highway 351.

There are 7,286.1 acres within the GRSC district. Maximum diversions recorded were about 121 cubic feet per second (CFS), about July 28, 2003.

Land served by GRSC is described as relatively arid and high in elevation (6,900 ft. to 7,100 ft. above sea level). The primary use of irrigated land within the district is production of forage for livestock. By far the most prominent crop is grass hay, with some alfalfa. Small grains and cash crops are virtually nonexistent. Typically, the crop is used by the producer as feed for his own herd; however, some is disposed through sale, either locally or exported.

The Irrigation District is governed by a board of three commissioners consisting of John Andrikopoulos, Earl Wright and Scott Thompson.

On June 18, 2002, Nelson Engineering (NE) received notice to proceed on work under contract with the Wyoming Water Development Commission (WWDC) relative to the GRSC. Main objectives of the work were to study:

- Land ownership and mapping.
- Water supply versus water uses and demands.
- Seepage loss and conveyance problems.
- Operational issues such as water management and measurement.
- Diversion structure and structures inventory.
- Erosion concerns.
- Irrigator problems and issues related to water delivery.

Throughout the balance of 2002 and to date in 2003, NE has proceeded with the described scope of service. This report presents the findings of that study.

In this report we have deviated from traditional names for many canal features, particularly the names of lateral, formerly numbered, are now called after the most obvious user or most closely adjacent landowner.
II. WATER NEEDS AND LAND OWNERSHIP

Traditional use, actual irrigated acres, and other such considerations aside, the amount of water carried by GRSC is determined by Wyoming water law. The law is administered by the Wyoming State Engineer. The law states that the district should be able to deliver one CFS per 70 acres of direct or supplemental flow. For the 7,286.1 acres of water rights within the district, this flow would be 104.1 CFS. Wyoming law also allows for a double appropriation under flood flow conditions. Double appropriation would be 208.2 CFS. The GRSC is currently able to transport about 150 CFS, but many reaches of the canal would have to be enlarged in order for it to supply double appropriation.

Cottonwood Creek experiences water shortage in the latter portion of the irrigation season. For that reason, the GRSC was built and supplemental rights established. Enlargement of GRSC would be necessary in order for enough water to be carried to supply any new irrigated lands within the district. Enlargement of the canal would exacerbate seepage loss and be costly relative to the gain of lands. Enlargement would be opposed by other landowners along the canal, other irrigators on the Green River, and by environmental groups. The sum of reasons against enlargement far outweighs the potential gain.

There are lands currently irrigated by GRSC waters that are not listed as being within the district. A boundary change and proper legal work should be done to include these lands. This is shown on the Ownership Map.

Water needs includes water lost to seepage, evaporation, and transpiration. This will be addressed in more detail in Section IV of this report. Cumulative loss of GRSC is high, probably 50%. Each user should share pro rata in this water loss; therefore, if the user's acreage warrants 10 CFS, his actual delivery would be five CFS. It requires a good management plan to adequately divide the available water among district irrigators. Table 2-1 shows the major areas irrigated, their lateral or point of supply, acreage appropriate diversion at one CFS per 70 acres, and the area remaining down canal that must be served. It gives a ratio of flow for the point vs. flow down canal.

Following is a list of landowners keyed to maps of the canal and lands served. Acres on the list are the areas taxed. Area on the map is the land below the GRSC.

II-1
<table>
<thead>
<tr>
<th>ID</th>
<th>Name1</th>
<th>Address</th>
<th>City</th>
<th>State</th>
<th>Zip</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>MILLARD, GLENN R &amp; JOAN E</td>
<td>P.O. BOX 368</td>
<td>DANIEL</td>
<td>WY</td>
<td>83115</td>
</tr>
<tr>
<td>02</td>
<td>RIMPIRE RANCH, LLC</td>
<td>P.O. BOX 350</td>
<td>DANIEL</td>
<td>WY</td>
<td>83115</td>
</tr>
<tr>
<td>03</td>
<td>RIMPIRE RANCH, LLC</td>
<td>P.O. BOX 350</td>
<td>DANIEL</td>
<td>WY</td>
<td>83115</td>
</tr>
<tr>
<td>04</td>
<td>RIMPIRE RANCH, LLC</td>
<td>P.O. BOX 350</td>
<td>DANIEL</td>
<td>WY</td>
<td>83115</td>
</tr>
<tr>
<td>05</td>
<td>JENSEN, DALE &amp; MYRTLE L</td>
<td>P.O. BOX 1326</td>
<td>PINEDALE</td>
<td>WY</td>
<td>82941</td>
</tr>
<tr>
<td>06</td>
<td>MCNEEL RANCHES, LTD</td>
<td>P.O. BOX 159</td>
<td>BIG PINEY</td>
<td>WY</td>
<td>83113</td>
</tr>
<tr>
<td>07</td>
<td>MCNEEL RANCHES, LTD</td>
<td>P.O. BOX 159</td>
<td>BIG PINEY</td>
<td>WY</td>
<td>83113</td>
</tr>
<tr>
<td>08</td>
<td>WRIGHT, EARL C. &amp; JOLEEN LEE L</td>
<td>P.O. BOX 286</td>
<td>PINEDALE</td>
<td>WY</td>
<td>82941</td>
</tr>
<tr>
<td>09</td>
<td>TOLTEN, TIM &amp; TARA</td>
<td>P.O. BOX 345</td>
<td>DANIEL</td>
<td>WY</td>
<td>83115</td>
</tr>
<tr>
<td>10</td>
<td>FISHTAIL CATTLE COMPANY</td>
<td>P.O. BOX 298</td>
<td>BIG PINEY</td>
<td>WY</td>
<td>83113</td>
</tr>
<tr>
<td>11</td>
<td>BARNEY, WILLIAM M. &amp; ANN WELLES</td>
<td>P.O. BOX 10</td>
<td>BIG PINEY</td>
<td>WY</td>
<td>83113</td>
</tr>
<tr>
<td>12</td>
<td>WILSON, LEWIS A. &amp; BETTE L</td>
<td>P.O. BOX 764</td>
<td>BIG PINEY</td>
<td>WY</td>
<td>83113</td>
</tr>
<tr>
<td>13</td>
<td>STURGILL, DEBRA O</td>
<td>P.O. BOX 2222</td>
<td>MARBLETON</td>
<td>WY</td>
<td>82951</td>
</tr>
<tr>
<td>14</td>
<td>PORTER, CHARLES B &amp; ELFREDA H</td>
<td>P.O. BOX 741</td>
<td>BIG PINEY</td>
<td>WY</td>
<td>83113</td>
</tr>
<tr>
<td>15</td>
<td>HOOG, GEORGE P. &amp; DEBORAH S</td>
<td>P.O. BOX 84</td>
<td>BIG PINEY</td>
<td>WY</td>
<td>83113</td>
</tr>
<tr>
<td>16</td>
<td>WRIGHT, LEE J. &amp; EARL G</td>
<td>P.O. BOX 298</td>
<td>PINEDALE</td>
<td>WY</td>
<td>82941</td>
</tr>
<tr>
<td>17</td>
<td>BOWER, RICHARD L. &amp; ROSEMARIE JOY</td>
<td>P.O. BOX 4356</td>
<td>MARBLETON</td>
<td>WY</td>
<td>82951</td>
</tr>
<tr>
<td>18</td>
<td>JAMES, GORDON L &amp; SHARON P</td>
<td>P.O. BOX 755</td>
<td>BIG PINEY</td>
<td>WY</td>
<td>83113</td>
</tr>
<tr>
<td>19</td>
<td>MEERS, KEENEY &amp; JOEAN</td>
<td>BOX 85</td>
<td>BIG PINEY</td>
<td>WY</td>
<td>83113</td>
</tr>
<tr>
<td>20</td>
<td>JAMES, GORDON L &amp; SHARON W</td>
<td>BOX 755</td>
<td>BIG PINEY</td>
<td>WY</td>
<td>83113</td>
</tr>
<tr>
<td>21</td>
<td>STANHOPE, THOMAS W. &amp; JUDITH L</td>
<td>P.O. BOX 1033</td>
<td>BIG PINEY</td>
<td>WY</td>
<td>83113</td>
</tr>
<tr>
<td>22</td>
<td>WRIGHT, LEE J. &amp; EARL G</td>
<td>P.O. BOX 298</td>
<td>PINEDALE</td>
<td>WY</td>
<td>82941</td>
</tr>
<tr>
<td>23</td>
<td>WRIGHT, LEE J. &amp; EARL G</td>
<td>P.O. BOX 298</td>
<td>PINEDALE</td>
<td>WY</td>
<td>82941</td>
</tr>
<tr>
<td>24</td>
<td>WRIGHT, LEE J. &amp; EARL G</td>
<td>P.O. BOX 298</td>
<td>PINEDALE</td>
<td>WY</td>
<td>82941</td>
</tr>
<tr>
<td>25</td>
<td>WRIGHT, LEE J. &amp; EARL G</td>
<td>P.O. BOX 298</td>
<td>PINEDALE</td>
<td>WY</td>
<td>82941</td>
</tr>
<tr>
<td>26</td>
<td>BREGE, DARRO</td>
<td>2445 PENNSYLVANIA BLVD, GREEN RIVER</td>
<td>WY</td>
<td>82935</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>JAMES, GORDON L &amp; SHARON P</td>
<td>P.O. BOX 755</td>
<td>BIG PINEY</td>
<td>WY</td>
<td>83113</td>
</tr>
<tr>
<td>28</td>
<td>ITON. MARLON - T</td>
<td>P.O. BOX 10 BIG PINEY</td>
<td>WY</td>
<td>83113</td>
<td></td>
</tr>
<tr>
<td>Supply Canal</td>
<td>Total Acres Served</td>
<td>Allocated Water, (cfs)</td>
<td># of Headgates</td>
<td>Water per Headgate,</td>
<td>Ratio 1, %</td>
</tr>
<tr>
<td>-------------------</td>
<td>--------------------</td>
<td>------------------------</td>
<td>----------------</td>
<td>--------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>Andrikopoulos Lateral</td>
<td>1,065.66</td>
<td>15.2</td>
<td>N/A</td>
<td>N/A</td>
<td>14.6</td>
</tr>
<tr>
<td>GRSC</td>
<td>616.21</td>
<td>8.8</td>
<td>3</td>
<td>2.9</td>
<td>10</td>
</tr>
<tr>
<td>GRSC</td>
<td>428.59</td>
<td>6.1</td>
<td>2</td>
<td>3.05</td>
<td>7.6</td>
</tr>
<tr>
<td>Smith Lateral</td>
<td>479.00</td>
<td>6.8</td>
<td>2</td>
<td>3.4</td>
<td>9</td>
</tr>
<tr>
<td>GRSC</td>
<td>533.63</td>
<td>7.6</td>
<td>3</td>
<td>2.5</td>
<td>11.4</td>
</tr>
<tr>
<td>Earl Wright Lateral</td>
<td>1,314.00</td>
<td>19.0</td>
<td>N/A</td>
<td>N/A</td>
<td>32</td>
</tr>
<tr>
<td>GRSC</td>
<td>862.00</td>
<td>12.3</td>
<td>3</td>
<td>4.1</td>
<td>30.5</td>
</tr>
<tr>
<td>Thompson Lateral</td>
<td>1,568.00</td>
<td>22.0</td>
<td>9</td>
<td>2.5</td>
<td>79</td>
</tr>
<tr>
<td>GRSC</td>
<td>419.00</td>
<td>6.0</td>
<td>2</td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td><strong>Total =</strong></td>
<td><strong>7,286.09</strong></td>
<td><strong>103.8</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**
- The second and third column of this chart show how many acres each lateral or section of GRSC needs to supply and how much water is needed to satisfy the 1 cfs per 70 acres.
- The "Ratio 1" column represents what the percentage is for allocated water to the amount of water still in GRSC.
- The "Acreage Down Canal" column represents the total amount of acres down canal that still need irrigation water after the lateral turnout or after a certain section of the GRSC.
- The "Water Needed Down Canal" column works the same as the "Acreage Down Canal" column. It's the amount of irrigation water needed down canal after a lateral turnout or after a certain section of the GRSC.
- The "Ratio 2" column represents the percentage of irrigation water that's still needed down canal after a lateral turnout or after a certain section of the GRSC.
III. INVENTORY

Nelson Engineering's field inventory started on July 1, 2002. Zia Yasrobi and Carl Daavettila were the NE team members who completed this task. The inspection and inventory started at the diversion of the canal from the Poole Slough. As a part of this inventory, all the structures on the canal were measured and sketched. A worksheet/waypoint #, referred to as a node #, was given each structure and the latitude and longitude for each structure was recorded so that all structures are included in the GIS map and database of the system. Each structure was then inspected for sufficiency, remaining life, condition of different elements, condition of the canal before and after the structure, and safety. This information will be used by NE to recommend to the District a maintenance and replacement schedule for canal structures. Several photographs of each structure were also taken. To help with structure location, node numbers of all structures appear on Exhibit B, the topographic mapping.

As a part of the canal inventory, all lateral and farm turnouts were located. They were also given a node number. The size and condition of each turnout was recorded. NE also noted whether or not there was evidence indicated if the user had difficulty getting water out of the turnout. Latitude and longitude for each turnout were recorded and photographs were taken and logged.

The seepage areas that were previously identified and marked were also inventoried and given node numbers. The latitude for the start and finish of each seepage area was recorded so that they can be located on the project map.

Also inventoried were the areas of low bank, bank failure and excessive vegetation. This, again, is important information that will be included in the repair and maintenance program for the canal.

In addition to the main canal, all of the major laterals for the canal were also inventoried. Procedures used for the lateral inventory were identical to those used for the main canal.

All items in the inventory can be located on the topographic mapping relative to its corresponding node number. The maps are included in the map packet following this section. Items needing work or replacement will appear in the section entitled “Proposed Rehabilitation Work”. Information pertaining to each item is easily retrievable from the GIS database associated with the mapping.
<table>
<thead>
<tr>
<th>FEATURE</th>
<th>DISC # / PHOTO</th>
<th>WORKSHEET # / WAYPOINT #</th>
<th>LAT.</th>
<th>LONG.</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEAD GATE (HG)</td>
<td>1/ 1,2</td>
<td>007</td>
<td>42° 51.117</td>
<td>109° 58.784</td>
</tr>
<tr>
<td>BRIDGE (BRDG)</td>
<td>1 / 2,4</td>
<td>008</td>
<td>42° 51.117</td>
<td>109° 58.703</td>
</tr>
<tr>
<td>LOW DIKE (LD)</td>
<td>1/ 5</td>
<td>010</td>
<td>42° 50.869</td>
<td>109° 58.703</td>
</tr>
<tr>
<td>LD - BEGINS</td>
<td>1/6</td>
<td>011</td>
<td>42° 50.671</td>
<td>109° 58.765</td>
</tr>
<tr>
<td>ENDS</td>
<td></td>
<td>012</td>
<td>42° 50.590</td>
<td>109° 58.841</td>
</tr>
<tr>
<td>BRDG</td>
<td>013</td>
<td></td>
<td>42° 50.513</td>
<td>109° 58.833</td>
</tr>
<tr>
<td>LD</td>
<td>1/7</td>
<td>014</td>
<td>42° 50.488</td>
<td>109° 58.837</td>
</tr>
<tr>
<td>LD</td>
<td>1/8</td>
<td>015</td>
<td>42° 50.290</td>
<td>109° 58.891</td>
</tr>
<tr>
<td>LD -BEGINS</td>
<td>1/9</td>
<td>016</td>
<td>42° 50.255</td>
<td>109° 58.904</td>
</tr>
<tr>
<td>ENDS</td>
<td></td>
<td>017</td>
<td>42° 50.187</td>
<td>109° 58.920</td>
</tr>
<tr>
<td>FAILED UNDER FLOW SIPHON (FUFS)</td>
<td>1/10-12</td>
<td>018</td>
<td>42° 50.177</td>
<td>109° 58.929</td>
</tr>
<tr>
<td>INFLOW (IF)</td>
<td>1/13</td>
<td>019</td>
<td>42° 50.077</td>
<td>109° 59.019</td>
</tr>
<tr>
<td>STANDING WATER</td>
<td>1/14,15</td>
<td>020</td>
<td>42° 49.987</td>
<td>109° 59.063</td>
</tr>
<tr>
<td>BOTH SIDES OF BANK (SWBS)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UNDER FLOW SIPHON (UFS)</td>
<td>1/16</td>
<td>021</td>
<td>42° 49.953</td>
<td>109° 59.074</td>
</tr>
<tr>
<td>IF</td>
<td>1/17</td>
<td>022</td>
<td>42° 49.899</td>
<td>109° 59.125</td>
</tr>
<tr>
<td>SW- WEST SIDE</td>
<td>1/18</td>
<td>023</td>
<td>42° 49.872</td>
<td>109° 59.198</td>
</tr>
<tr>
<td>UFS</td>
<td>1/19</td>
<td>024</td>
<td>42° 49.732</td>
<td>109° 59.229</td>
</tr>
<tr>
<td>FUFS</td>
<td>1/20</td>
<td>025</td>
<td>42° 49.578</td>
<td>109° 59.300</td>
</tr>
<tr>
<td>UFS</td>
<td>1/21</td>
<td>026</td>
<td>42° 49.400</td>
<td>109° 59.385</td>
</tr>
<tr>
<td>IF</td>
<td>1/22</td>
<td>027</td>
<td>42° 49.313</td>
<td>109° 59.436</td>
</tr>
<tr>
<td>CANAL BANK FAILURE (CBF) 100' IN LENGTH</td>
<td>1/23</td>
<td>028</td>
<td>42° 49.271</td>
<td>109° 59.412</td>
</tr>
<tr>
<td>CANAL BANK FAILURE (CBF) 100' IN LENGTH</td>
<td>1/24</td>
<td>029</td>
<td>42° 49.208</td>
<td>109° 59.383</td>
</tr>
<tr>
<td>COUNTY RD. BRDG</td>
<td>2/1-3</td>
<td>030</td>
<td>42° 49.185</td>
<td>109° 59.385</td>
</tr>
<tr>
<td>CBF- BOTH SIDES</td>
<td>2/5</td>
<td>031</td>
<td>42° 49.063</td>
<td>109° 59.433</td>
</tr>
</tbody>
</table>

**NOTE:** Waypoint numbers in BOLD PRINT represent the corresponding worksheet number which may include a sketch on the back of the inventory sheet. Waypoint numbers not in bold print do not have a corresponding inventory sheet, but are represented on the map with that number.
**GREEN RIVER SUPPLY CANAL INVENTORY**
(inventory taken on 7-1-02 through 7-3-02)

<table>
<thead>
<tr>
<th>Description</th>
<th>Waypoint</th>
<th>Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standing Water &amp; Repaired Dike</td>
<td>2/6</td>
<td>032</td>
<td>42° 48.853</td>
</tr>
<tr>
<td>UFS &amp; Standing Water Uphill of Canal</td>
<td>2/7,8</td>
<td>033</td>
<td>42° 48.718</td>
</tr>
<tr>
<td>UFS</td>
<td>2/9</td>
<td>035</td>
<td>42° 47.991</td>
</tr>
<tr>
<td>Willows – Begin Both Sides</td>
<td>2/10</td>
<td>036</td>
<td>42° 47.828</td>
</tr>
<tr>
<td>Willows – End Both Sides</td>
<td>2/11</td>
<td>037</td>
<td>42° 46.946</td>
</tr>
<tr>
<td>Low Bank 150' Up from Bridge @</td>
<td>2/12</td>
<td>038</td>
<td>42° 46.785</td>
</tr>
<tr>
<td>LB - Begins</td>
<td></td>
<td>039</td>
<td>42° 46.794</td>
</tr>
<tr>
<td>LB - Ends</td>
<td></td>
<td>040</td>
<td>42° 46.808</td>
</tr>
<tr>
<td>Check Structure and Lateral Diversion</td>
<td>2/13-19</td>
<td>139</td>
<td>42° 46.785</td>
</tr>
<tr>
<td>BEGIN SEEP AREA #1</td>
<td>041</td>
<td></td>
<td>42° 46.792</td>
</tr>
<tr>
<td>BEGIN CANAL Flat Section</td>
<td>042</td>
<td></td>
<td>42° 47.050</td>
</tr>
<tr>
<td>UNDERDRAIN (UD)</td>
<td>043</td>
<td></td>
<td>42° 47.071</td>
</tr>
<tr>
<td>END CANAL FLAT SECTION &amp; BEGIN BANK FAILURE</td>
<td>044</td>
<td></td>
<td>42° 47.061</td>
</tr>
<tr>
<td>END SEEP AREA #1, &amp; UNDER DRAIN</td>
<td>045</td>
<td></td>
<td>42° 47.194</td>
</tr>
<tr>
<td>UD</td>
<td>046</td>
<td></td>
<td>42° 47.328</td>
</tr>
<tr>
<td>FUD</td>
<td>047</td>
<td></td>
<td>42° 47.350</td>
</tr>
</tbody>
</table>

**NOTE:** Waypoint numbers in **BOLD PRINT** represent the corresponding worksheet number which may include a sketch on the back of the inventory sheet. Waypoint numbers not in bold print do not have a corresponding inventory sheet, but are represented on the map with that number.
# GREEN RIVER SUPPLY CANAL INVENTORY

(inventory taken on 7-1-02 through 7-3-02)

| Failed Under Drain (FUD) & Begin Seep Area #2 *Int. Canal Bank Failure Ends, Canal Needs Cleaning | 048 | 42° 47.813 | 110° 01.529 |
| End Seep Area #2 | 049 | 42° 47.223 | 110° 01.869 |
| UD | 050 | 42° 47.265 | 110° 01.901 |
| LD - Begins | 2/20 | 051 | 42° 47.275 | 110° 02.370 |
| LD - Ends | 052 | 42° 47.345 | 110° 02.407 |
| UD & Begin Low Dike 300' | 053 | 42° 47.371 | 110° 02.459 |
| HG | 2/21 | 054 | 42° 47.356 | 110° 02.516 |
| Canal Bank Erosion | 3/1 | 055 | 42° 47.261 | 110° 02.034 |
| Begin Seep #3 | 056 | 42° 47.270 | 110° 02.880 |
| UD-6.5 Diameter CMP & Low Dike 300' | 057 | 42° 47.259 | 110° 02.901 |
| UD | 058 | 42° 47.148 | 110° 02.965 |
| HWY BRDG | 3/2 | 059 | 42° 47.112 | 110° 03.019 |
| UD | 060 | 42° 47.149 | 110° 03.351 |
| UD | 061 | 42° 46.934 | 110° 03.420 |
| HWY BRDG | 3/3 | 062 | 42° 46.793 | 110° 03.103 |
| End Seep Area #3 | 063 | 42° 46.667 | 110° 02.987 |
| UD | 064 | 42° 46.631 | 110° 03.038 |
| LD | 065 | 42° 46.400 | 110° 03.008 |
| HG - 18"X30" Oval CMP | 3/4 | 066 | 42° 46.381 | 110° 03.006 |
| HG - EST PIPE DI. 30" & Willows Start Restricting Flow | 067 | 42° 46.855 | 110° 02.735 |
| HG - 24" CMP & Bridge | 3/5,6 | 068 | 42° 45.682 | 110° 02.784 |
| Willows End | 069 | 42° 45.711 | 110° 02.911 |

** Note: Waypoint numbers in BOLD PRINT represent the corresponding worksheet number which may include a sketch on the back of the inventory sheet. Waypoint numbers not in bold print do not have a corresponding inventory sheet, but are represented on the map with that number.
**GREEN RIVER SUPPLY CANAL INVENTORY**

(inventory taken on 7-1-02 through 7-3-02)

<table>
<thead>
<tr>
<th>Waypoint</th>
<th>Start</th>
<th>End</th>
<th>Lon</th>
<th>Lat</th>
</tr>
</thead>
<tbody>
<tr>
<td>UD - BEGINS &amp; WILLOWS</td>
<td>070</td>
<td>42° 45.755</td>
<td>110° 03.004</td>
<td></td>
</tr>
<tr>
<td>LD - ENDS</td>
<td>071</td>
<td>42° 45.760</td>
<td>110° 03.327</td>
<td></td>
</tr>
<tr>
<td>LD - BEGINS &amp; WILLOWS START</td>
<td>072</td>
<td>42° 45.744</td>
<td>110° 03.334</td>
<td></td>
</tr>
<tr>
<td>LD - ENDS</td>
<td>073</td>
<td>42° 45.670</td>
<td>110° 03.367</td>
<td></td>
</tr>
<tr>
<td>UD</td>
<td>074</td>
<td>42° 45.515</td>
<td>110° 03.426</td>
<td></td>
</tr>
<tr>
<td>HG</td>
<td>075</td>
<td>42° 44.838</td>
<td>110° 02.039</td>
<td></td>
</tr>
<tr>
<td>HG - 24&quot; CMP</td>
<td>076</td>
<td>42° 44.527</td>
<td>110° 02.254</td>
<td></td>
</tr>
<tr>
<td>BRDG COUNTY RD.</td>
<td>3/7</td>
<td>077</td>
<td>42° 44.442</td>
<td>110° 02.348</td>
</tr>
<tr>
<td>LB - BEGINS</td>
<td>3/8</td>
<td>079</td>
<td>42° 44.353</td>
<td>110° 02.693</td>
</tr>
<tr>
<td>LB - ENDS</td>
<td>080</td>
<td>42° 44.326</td>
<td>110° 02.717</td>
<td></td>
</tr>
<tr>
<td>UD - PIPE NOT VIS. &amp; WILLOWS BEGIN</td>
<td>081</td>
<td>42° 44.285</td>
<td>110° 02.748</td>
<td></td>
</tr>
<tr>
<td>WILLOWS THICKEN</td>
<td>082</td>
<td>42° 44.171</td>
<td>110° 02.281</td>
<td></td>
</tr>
<tr>
<td>FUD</td>
<td>3/9</td>
<td>083</td>
<td>42° 43.990</td>
<td>110° 02.308</td>
</tr>
<tr>
<td>LD - BEGINS &amp; WILLOWS END</td>
<td>3/10</td>
<td>084</td>
<td>42° 43.861</td>
<td>110° 02.154</td>
</tr>
<tr>
<td>LD - ENDS</td>
<td>085</td>
<td>42° 43.814</td>
<td>110° 02.210</td>
<td></td>
</tr>
<tr>
<td>LD - BEGINS</td>
<td>086</td>
<td>42° 43.783</td>
<td>110° 02.187</td>
<td></td>
</tr>
<tr>
<td>LD - ENDS</td>
<td>3/11</td>
<td>087</td>
<td>42° 43.745</td>
<td>110° 01.954</td>
</tr>
<tr>
<td>BRDG</td>
<td>3/12,13</td>
<td>088</td>
<td>42° 43.739</td>
<td>110° 01.863</td>
</tr>
<tr>
<td>HG - 24&quot; CMP</td>
<td>3/14,15</td>
<td>089</td>
<td>42° 43.653</td>
<td>110° 01.858</td>
</tr>
<tr>
<td>LD - BEGINS</td>
<td>090</td>
<td>42° 43.587</td>
<td>110° 01.919</td>
<td></td>
</tr>
<tr>
<td>LD - ENDS</td>
<td>091</td>
<td>42° 43.589</td>
<td>110° 01.983</td>
<td></td>
</tr>
<tr>
<td>HG - 15&quot; PIPE NEEDS HEADWALL &amp; LOW DIKE FOR 200'</td>
<td>3/16</td>
<td>092</td>
<td>42° 43.418</td>
<td>110° 02.104</td>
</tr>
<tr>
<td>2 OVER SHOOTS</td>
<td>3/17,18</td>
<td>093</td>
<td>42° 43.301</td>
<td>110° 02.374</td>
</tr>
<tr>
<td>BRDG</td>
<td>4/1,2</td>
<td>094</td>
<td>42° 43.297</td>
<td>110° 02.413</td>
</tr>
<tr>
<td>DIVERSION AT CONFL. WITH COTTONWOOD CR.</td>
<td>4/3-6</td>
<td>095</td>
<td>42° 50.869</td>
<td>109° 58.703</td>
</tr>
</tbody>
</table>

**NOTE:** Waypoint numbers in **BOLD PRINT** represent the corresponding worksheet number which may include a sketch on the back of the inventory sheet. Waypoint numbers not in bold print do not have a corresponding inventory sheet, but are represented on the map with that number.
**GREEN RIVER SUPPLY CANAL INVENTORY**

(inventory taken on 7-1-02 through 7-3-02)

<table>
<thead>
<tr>
<th>DIVERSION OFF NORTH COTTONWOOD CR.</th>
<th>4/7-13</th>
<th>196</th>
<th>42° 42.902</th>
<th>110° 02.451</th>
</tr>
</thead>
<tbody>
<tr>
<td>FLOW RECORDER</td>
<td>096</td>
<td></td>
<td>42° 42.888</td>
<td>110° 02.452</td>
</tr>
<tr>
<td>BRIDGE</td>
<td>4/14</td>
<td>097</td>
<td>42° 42.656</td>
<td>110° 02.538</td>
</tr>
<tr>
<td>DIVERSION OFF SOUTH COTTONWOOD CR.</td>
<td>198</td>
<td></td>
<td>42° 42.064</td>
<td>110° 02.121</td>
</tr>
<tr>
<td>FLOW RECORDER</td>
<td>4/15,16</td>
<td>098</td>
<td>42° 42.062</td>
<td>110° 02.128</td>
</tr>
<tr>
<td>FUS</td>
<td>4/18-20</td>
<td>099</td>
<td>42° 41.912</td>
<td>110° 02.140</td>
</tr>
<tr>
<td>OVERSHOOT 18” DIA. CMP</td>
<td>4/21</td>
<td>100</td>
<td>42° 41.754</td>
<td>110° 02.110</td>
</tr>
<tr>
<td>HG</td>
<td>5/1</td>
<td>101</td>
<td>42° 41.552</td>
<td>110° 01.940</td>
</tr>
<tr>
<td>OVERSHOOT 18” DIA. CMP</td>
<td>5/2</td>
<td>102</td>
<td>42° 41.410</td>
<td>110° 01.211</td>
</tr>
<tr>
<td>NEARLY FAILED OVERSHOOT</td>
<td>5/3</td>
<td>103</td>
<td>42° 41.320</td>
<td>110° 01.922</td>
</tr>
<tr>
<td>OVERSHOOT 18” DIA. 300' N OF BRIDGE @</td>
<td>5/4</td>
<td>104</td>
<td>42° 41.125</td>
<td>110° 01.910</td>
</tr>
<tr>
<td>OVERSHOOT 18” DIA.</td>
<td>5/5</td>
<td>105</td>
<td>42° 41.078</td>
<td>110° 01.928</td>
</tr>
<tr>
<td>OVERSHOOT 40” DIA.</td>
<td>5/6,7</td>
<td>106</td>
<td>42° 40.941</td>
<td>110° 01.981</td>
</tr>
<tr>
<td>HG 24” DIA. W/ HOMEMADE ROCK DAM</td>
<td>5/8</td>
<td>107</td>
<td>42° 40.924</td>
<td>110° 02.021</td>
</tr>
<tr>
<td>HG 24” DIA. NEEDS HELP</td>
<td>5/9,10</td>
<td>109</td>
<td>42° 40.858</td>
<td>110° 02.216</td>
</tr>
<tr>
<td>HG 15” DIA.</td>
<td>5/11</td>
<td>110</td>
<td>42° 40.689</td>
<td>110° 02.268</td>
</tr>
<tr>
<td>BRDG</td>
<td>5/12</td>
<td>111</td>
<td>42° 40.680</td>
<td>110° 02.261</td>
</tr>
<tr>
<td>BEGIN BANK EROSION</td>
<td>5/13</td>
<td>112</td>
<td>42° 40.648</td>
<td>110° 02.168</td>
</tr>
<tr>
<td>END BANK EROSION</td>
<td>5/16</td>
<td>113</td>
<td>42° 40.603</td>
<td>110° 02.098</td>
</tr>
<tr>
<td>HG 24” DIA.</td>
<td>5/14</td>
<td>114</td>
<td>42° 40.287</td>
<td>110° 02.287</td>
</tr>
<tr>
<td>BRIDGE</td>
<td>5/15</td>
<td>115</td>
<td>42° 40.042</td>
<td>110° 02.495</td>
</tr>
<tr>
<td>HG 14” HG</td>
<td>5/16</td>
<td>116</td>
<td>42° 39.823</td>
<td>110° 02.485</td>
</tr>
</tbody>
</table>

**NOTE:** Waypoint numbers in **BOLD PRINT** represent the corresponding worksheet number which may include a sketch on the back of the inventory sheet. Waypoint numbers not in bold print do not have a corresponding inventory sheet, but are represented on the map with that number.
**GREEN RIVER SUPPLY CANAL INVENTORY**
(inventory taken on 7-1-02 through 7-3-02)

<table>
<thead>
<tr>
<th>Description</th>
<th>Date</th>
<th>Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>HG 24&quot; DIA. W/ ROCK CHECK DAM 30' DOWN</td>
<td>5/17, 6/1</td>
<td>42° 39.604</td>
<td>110° 02.293</td>
</tr>
<tr>
<td>WILLOWS START</td>
<td>117</td>
<td>42° 39.604</td>
<td>110° 02.293</td>
</tr>
<tr>
<td>SEEP AREA BEGIN</td>
<td>118</td>
<td>42° 39.297</td>
<td>110° 01.642</td>
</tr>
<tr>
<td>STOCK WATERING HOLE</td>
<td>6/2</td>
<td>42° 39.177</td>
<td>110° 01.765</td>
</tr>
<tr>
<td>END SEEP AREA</td>
<td>120</td>
<td>42° 39.097</td>
<td>110° 01.992</td>
</tr>
<tr>
<td>MAJOR BANK FAILURE – BEGINS</td>
<td>121</td>
<td>42° 39.079</td>
<td>110° 02.012</td>
</tr>
<tr>
<td>MAJOR BANK FAILURE – ENDS</td>
<td>122</td>
<td>42° 39.066</td>
<td>110° 02.047</td>
</tr>
<tr>
<td>HG 18&quot; DIA. OUTLET DIVIDES TO TWO 12&quot; PIPES</td>
<td>6/3</td>
<td>42° 39.071</td>
<td>110° 02.041</td>
</tr>
<tr>
<td>12&quot; PIPE W/ NO HEAD GATE</td>
<td>6/4</td>
<td>42° 38.987</td>
<td>110° 01.994</td>
</tr>
<tr>
<td>POSSIBLE DIV. PIPE NOT FOUND</td>
<td>6/5, 6</td>
<td>42° 38.930</td>
<td>110° 01.980</td>
</tr>
<tr>
<td>18&quot; TIN HEAD GATE W/ CONC. HEAD WALL</td>
<td>6/7</td>
<td>42° 38.618</td>
<td>110° 02.076</td>
</tr>
<tr>
<td>LATERAL DIV.</td>
<td>6/8-17</td>
<td>42° 38.603</td>
<td>110° 02.239</td>
</tr>
<tr>
<td>UD – 18&quot; CMP</td>
<td>129</td>
<td>42° 38.483</td>
<td>110° 01.753</td>
</tr>
<tr>
<td>HG – 18&quot; DIA. DRY</td>
<td>7, 2</td>
<td>42° 38.455</td>
<td>110° 01.684</td>
</tr>
<tr>
<td>HG – 18&quot; DIA.</td>
<td>7/3, 4</td>
<td>42° 38.128</td>
<td>110° 01.726</td>
</tr>
<tr>
<td>HG – 18&quot; DIA.</td>
<td>7/5</td>
<td>42° 38.050</td>
<td>110° 01.701</td>
</tr>
<tr>
<td>BRDG</td>
<td>7/6</td>
<td>42° 38.938</td>
<td>110° 01.652</td>
</tr>
<tr>
<td>MOD. SEEP BEGIN</td>
<td>134</td>
<td>42° 37.864</td>
<td>110° 00.837</td>
</tr>
<tr>
<td>MOD. SEEP END</td>
<td>135</td>
<td>42° 37.434</td>
<td>110° 00.758</td>
</tr>
<tr>
<td>BEGIN SIPHON BYPASS (END NOT MARKED)</td>
<td>136</td>
<td>42° 37.387</td>
<td>110° 00.638</td>
</tr>
<tr>
<td>UD – 48&quot; CMP</td>
<td>7/7, 8</td>
<td>42° 37.487</td>
<td>110° 00.296</td>
</tr>
<tr>
<td>SEEP AREA BEGIN</td>
<td>137</td>
<td>42° 37.286</td>
<td>110° 00.476</td>
</tr>
<tr>
<td>TURN OUT MAIN FLOW DIVERTED HERE</td>
<td>7/9, 10</td>
<td>42° 36.923</td>
<td>110° 00.855</td>
</tr>
</tbody>
</table>

**NOTE:** Waypoint numbers in **BOLD PRINT** represent the corresponding worksheet number which may include a sketch on the back of the inventory sheet. Waypoint numbers not in bold print do not have a corresponding inventory sheet, but are represented on the map with that number.
**GREEN RIVER SUPPLY CANAL INVENTORY**

(inventory taken on 7-1-02 through 7-3-02)

<table>
<thead>
<tr>
<th>BRIDGE</th>
<th>7/11</th>
<th>140</th>
<th>42° 36.903</th>
<th>110° 00.866</th>
</tr>
</thead>
<tbody>
<tr>
<td>CANAL DRY</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DOWN FROM HERE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UD – 48” CMP</td>
<td>141</td>
<td></td>
<td>42° 36.881</td>
<td>110° 00.774</td>
</tr>
<tr>
<td>UD – 24” CMP</td>
<td>142</td>
<td></td>
<td>42° 36.661</td>
<td>110° 00.596</td>
</tr>
<tr>
<td>UD – PIPE NOT VIS.</td>
<td>143</td>
<td></td>
<td>42° 36.438</td>
<td>110° 00.526</td>
</tr>
<tr>
<td>UD – PIPE NOT VIS.</td>
<td>144</td>
<td></td>
<td>42° 36.196</td>
<td>110° 00.566</td>
</tr>
<tr>
<td>HG</td>
<td>7/12-14</td>
<td>145</td>
<td>42° 35.876</td>
<td>110° 01.093</td>
</tr>
<tr>
<td>CHECK STRUCTURE</td>
<td>7/15,16</td>
<td>146</td>
<td>42° 35.868</td>
<td>110° 01.106</td>
</tr>
<tr>
<td>HG – 12” DIA. W/ CONC. HEAD WALL</td>
<td>7/17</td>
<td>147</td>
<td>42° 35.827</td>
<td>110° 01.177</td>
</tr>
<tr>
<td>BRDG</td>
<td>7/18</td>
<td>148</td>
<td>42° 35.797</td>
<td>110° 01.182</td>
</tr>
</tbody>
</table>

**NOTE:** Waypoint numbers in **BOLD PRINT** represent the corresponding worksheet number which may include a sketch on the back of the inventory sheet. Waypoint numbers not in bold print do not have a corresponding inventory sheet, but are represented on the map with that number.
Inventory item, number, category

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BR</td>
<td>Bridge</td>
</tr>
<tr>
<td>O</td>
<td>Pipe conveying ditch across and over the GRS</td>
</tr>
<tr>
<td>S</td>
<td>Pipe conveying ditch across and below the GRS</td>
</tr>
<tr>
<td>U</td>
<td>Underground conveying natural stream or draw</td>
</tr>
<tr>
<td>OF</td>
<td>Failed Overhead</td>
</tr>
<tr>
<td>SF</td>
<td>Failed Siphon</td>
</tr>
<tr>
<td>UL</td>
<td>Failed Underslab</td>
</tr>
<tr>
<td>ST</td>
<td>Large diversion structures for major lateral</td>
</tr>
<tr>
<td>WB</td>
<td>Begin section with willow-lined banks</td>
</tr>
<tr>
<td>WE</td>
<td>End section with willow-lined banks</td>
</tr>
<tr>
<td>LD</td>
<td>Low dike or bank section, limited extent</td>
</tr>
<tr>
<td>LDB</td>
<td>End low dike or bank section</td>
</tr>
<tr>
<td>CBK</td>
<td>Cored or eroded bank</td>
</tr>
<tr>
<td>CBKB</td>
<td>Begin cored or eroded bank</td>
</tr>
<tr>
<td>CBKE</td>
<td>End cored or eroded bank</td>
</tr>
</tbody>
</table>

Canal Seepage Levels
- Canal (seepage level not classified)
- High
- Potentially High
- Moderate
- Low

Flow Recording Stations

Seepage Areas - indicated by vegetation

Irrigated Lands

Scale: 1" = 3,000'
Field Data collected: June & July, 2002

Legend

EXHIBIT B - MIDDLE SECTION INVENTORY MAP GREEN RIVER SUPPLY CANAL
<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>Small diversion from the canal (turnout or headgate)</td>
</tr>
<tr>
<td>BR</td>
<td>Bridge</td>
</tr>
<tr>
<td>D</td>
<td>Pipe conveying ditch across and over the GRS</td>
</tr>
<tr>
<td>S</td>
<td>Pipe conveying ditch across and below the GRS</td>
</tr>
<tr>
<td>U</td>
<td>Underdrain conveying natural stream or draw</td>
</tr>
<tr>
<td>DP</td>
<td>Failed Overflow</td>
</tr>
<tr>
<td>SP</td>
<td>Failed Sidle</td>
</tr>
<tr>
<td>UF</td>
<td>Failed Undersain</td>
</tr>
<tr>
<td>ST</td>
<td>Large dimension structures for major lateral</td>
</tr>
<tr>
<td>WB</td>
<td>Begin low side or bank section</td>
</tr>
<tr>
<td>WE</td>
<td>End section with yellow lined banks</td>
</tr>
<tr>
<td>LD</td>
<td>Low side or bank section, limited extent</td>
</tr>
<tr>
<td>LOB</td>
<td>Begin low side or bank section</td>
</tr>
<tr>
<td>LDE</td>
<td>End low side or bank section</td>
</tr>
<tr>
<td>CBK</td>
<td>Caved or eroded bank</td>
</tr>
<tr>
<td>CBKB</td>
<td>Caved or eroded bank at end</td>
</tr>
</tbody>
</table>

Legend:
- Inventory item, number, category
- Canal Seepage Levels
  - High
  - Potentially High
  - Moderate
  - Low
- Flow Recording Stations
- Seepage Areas - indicated by vegetation
- Irrigated Lands

Scale: 1" = 3,000'  
Field Data collected: June 6, 2002

EXHIBIT B - SOUTH INVENTORY MAP  
GREEN RIVER SUPPLY CANAL
IV. FLOW MEASUREMENT, SEEPAGE LOSSES

Measuring

Methods

Nelson Engineering measured and monitored flows in waterways pertinent to the operation of the GRSC during the 2002 and 2003 irrigation seasons. Flow measurements were taken in Poole’s Slough, the GRSC, the Cottonwood Creeks, and laterals diverting from the GRSC. The reasons for gauging and recording of GRSC system are two-fold: First, to understand the overall disbursement of water and second, to attempt to identify seepage areas and quantify seepage losses. Two methods were utilized, flow gauging and flow monitoring. Nelson Engineering, the State Engineers Office, and the WWDC conducted flow gauging periodically throughout both irrigation seasons. Flow monitoring stations were installed to provide a continuous record of flows at selected points along the canal from mid May through mid October of 2003.

Flow gauging is conducted using a current meter (propeller or Doppler) to measure canal flow at a given point. In a reach of the canal that has conditions that are reasonably close to uniform steady flow, an accuracy of plus or minus 5% can be achieved using this methodology. The result is a one-time measure of flow quantity. A record of the dates and results of the flow gauging conducted is contained in the appendix. When flow measurements are taken at the same location at a range of flows, a relationship or rating curve can be created. The rating curve relates the water surface elevation (stage) to the flow in the canal.

A flow monitoring station consisted of a Stevens chart recorder. The chart records the elevation of a float installed in a stilling basin, thereby measuring the stage of the canal continuously. Flow monitoring stations were installed at eight locations along the canal prior to the 2003 irrigation season. In addition to the recorders, staff gauges were installed at each of the stations as another means of measuring canal stage. Station locations are shown on the maps incorporated in this report. Station number and locations are as follows:

# 1. Point of Diversion from Poole’s Slough to GRSC;
# 2. Approximate Property Boundary of Sommers/Miller;
# 3. Andrikopoulos Lateral Diversion Point;
# 4. GRSC at point of inflow to North Cottonwood Creek;
# 5. Point of Diversion from North Cottonwood Creek to cross canal to South Cottonwood Creek;
# 6. Point of Diversion from South Cottonwood Creek;
# 7. Point of Diversion of Smith Lateral;
# 8. Point of Diversion of Earl Wrights Lateral.

Nelson Engineering personnel provided maintenance of the flow monitoring stations and recorded staff gauge readings on periodic basis throughout the 2003 irrigation season. Staff gauge readings were also taken by the Districts ditch rider. Staff gauge readings were used during flow calculations to ensure that chart recordings of stage levels were accurate. Rating
curves constructed utilizing the data from flow gauging were then used to calculate canal flows at each of the Stations.

Data Analysis

Rating curves were constructed from the flow gauging measurements at each station. Rating curves for this analysis were constructed using linear, logarithmic, and exponential best-fit curves of the available data. In most cases, two or more types of curves (linear, log, exponential) were combined to form the rating curve at each station to best correlate the stage versus flow data. Every effort was made to obtain flow gauge measurements for the widest range of flows possible. However, due the unpredictability of day to day canal operations and inflows during snowmelt, the highest range of flows was not measured. Conversely, flow gauging did not capture the lowest range of flows that take place at the beginning and end of irrigation for most of the Stations. Consequently, engineering judgement was used to extrapolate the rating curves for the highest and lowest range of flows. The average estimated error associated with the rating curves is ±5% within the range of flows gauged at each station. Extrapolated portions of the rating curves may have a higher error percentage. Given the estimated error of the flow gauging itself of 5%, we believe it is reasonable to assume a cumulative error of 10% or less of the calculated flows shown on Figures A-D.

Data collection utilizing the flow recorders was not without breakdowns and mechanical problems. Smaller gaps in the recorder flow data were usually caused by a mechanical problem that was fixed on the next field visit. The recorder at Station #4 repeatedly malfunctioned such that little data was available after mid-July. Flow data points shown for the later part of the season represent recording of the canal stage during site visits.

Station #3 was located immediately upstream of the diversion structure for the Andrikopoulos lateral. During flow data analysis, it was noted that the backwater caused by the screw gates closing affected canal stage readings during lower flows. Therefore, data taken after high water when the gates were controlling flow did not correlate to the rating curve, which was established without flashboards. Consequently, data from the time period after August 6, 2003 was discarded as inaccurate.

Findings

Analysis of the canal flow data from both flow monitoring and flow gauging is discussed with respect to three different reaches, the Upper Canal (Poole’s Slough Diversion to Cottonwood Creeks Transit), the Cottonwood Creeks Transit, and the Lower Canal. Seepage losses noted here are discussed in detail in a later portion of this section.

**Upper Canal (Poole’s Slough Diversion to Cottonwood Creeks Transit)**

Flow monitoring stations in this reach were:

- #1 Point of Diversion from Poole’s Slough to GRSC;
- #2 Approximate Property Boundary of Sommers/Miller;
- #3 Andrikopoulos Lateral Diversion Point;
- #4 GRSC at point of inflow to North Cottonwood Creek.
Canal flows at the stations in this reach over the 2003 season are plotted in Figure A. Station locations are shown on the project maps.

The diversion from the Green River to Poole’s Slough was not monitored on regular basis for this study. Flow Station #1 was located at the start of the canal at the diversion from Poole’s Slough. Flows at Station #1 were held constant at about 60 CFS during high water through out May and June. In early July, diverted flow was raised to about 120 CFS in response to reduced inflows into the canal from other sources. The highest diverted flow recorded at Station #1, was 121 CFS that occurred on July 28, 2003. From this date until the canal flows were sharply reduced in mid September, the diverted flow rate follows the flow rate of the Green River. Flows in the period from August to late September were generally in the range of 65 to 80 CFS.

The highest flows recorded in this reach of the canal occurred downstream at Stations #2 and #3 from late May through late July. This data indicates that 70 to 80 CFS of inflow is occurring in the reach between the Poole’s Slough Diversion and Station #2 (no source of inflow is indicated between #2 and #3). During this period, considerable flows were observed entering the GRSC from irrigated lands below the Todd Ditch. Other sources of inflow in this reach noted during the 2002 canal inventory, are ditches that divert from Pooles Slough upgradient of the GRSC diversion including the Danielson, Woods, Sutton #1, and Slate ditches. Several failed siphons in this reach likely also contribute to GRSC inflows. Inflow into this reach decreased to about 30 CFS in mid-June and then gradually decreases to nothing by late July. This would indicate that the Todd Ditch and upgradient laterals are shut down for haying in late July and/or the falling level in Horse Creek and the Green River reduced available flows for these ditches.

No recharge is indicated from these sources later in the irrigation season. In fact, after late July, seepage losses of approximately 10 CFS are indicated between Station #1 and Station #2.

The first major diversion from the canal, the Andrikopoulos Lateral is located just downstream from Station #3. Measurements of flow in this lateral were conducted on 8/5/02 and 7/1/03; measured flow on both dates was 21 CFS. The staff gauge readings taken over the irrigation season during site visits indicate that flows in this lateral were maintained in the range from 19 to 26 CFS from May until mid September with most S.G. readings indicating flows of about 21 CFS.

In May and June, total irrigation usage (including the Androkropolis Lateral) and seepage losses in the reach between Stations #2 and #4 were measured at approximately 90 CFS. Usage and seepage flow out of the canal in this section decrease after mid-July. Irrigation diversion on Glen Millards property was shut off in late July, as is indicated by the decreasing difference in flow between Station #2 and Station #4. Significant seepage losses are indicated in this section of the canal, particularly within the Soaphole Basin. These losses are discussed in detail in the Seepage portion of this section.
Cottonwood Creeks Transit

Flow monitoring stations in this reach included:

# 4. GRSC at point of inflow to North Cottonwood Creek;
# 5. Point of Diversion from North Cottonwood Creek to cross canal to South Cottonwood Creek;
# 6. Point of Diversion from South Cottonwood Creek;
# 7. Point of Diversion of Smith Lateral;

Canal flows at the stations in this reach over the 2003 irrigation season are plotted in Figure B. Station locations are shown on the project maps.

Flow data was collected on three occasions for the channels of concern at the Cottonwood Transit. Data is presented in the Table IV-1 below with all flows in CFS. Shaded data was obtained using rating curves and flow-monitoring data, all other data was obtained from flow gauging.

<table>
<thead>
<tr>
<th>Date</th>
<th>North C'wood In</th>
<th>STA # 4 Flow</th>
<th>Beta Ditch Out</th>
<th>STA # 5 Flow</th>
<th>North C'wood Out</th>
<th>South C'wood In</th>
</tr>
</thead>
<tbody>
<tr>
<td>8/6/02</td>
<td>5±</td>
<td>27</td>
<td>0</td>
<td>33.1</td>
<td>0</td>
<td>6±</td>
</tr>
<tr>
<td>7/1/03</td>
<td>5±</td>
<td>49</td>
<td>9</td>
<td>51</td>
<td>&lt;2</td>
<td>5</td>
</tr>
<tr>
<td>7/10/02</td>
<td>4.5</td>
<td>57</td>
<td>12</td>
<td>58</td>
<td>1.5</td>
<td>0.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Date</th>
<th>STA # 6 Flow</th>
<th>South C'wood Out</th>
<th>Flow Balance (Out-In)</th>
<th>STA # 7 Flow</th>
<th>STA.#6-#4</th>
<th>STA.#7-#4</th>
</tr>
</thead>
<tbody>
<tr>
<td>8/6/02</td>
<td>37</td>
<td>&lt;2</td>
<td>0±</td>
<td>39</td>
<td>+10</td>
<td>+12</td>
</tr>
<tr>
<td>7/1/03</td>
<td>61</td>
<td>11</td>
<td>23±</td>
<td>63</td>
<td>+12</td>
<td>+14</td>
</tr>
<tr>
<td>7/10/02</td>
<td>52</td>
<td>0.6</td>
<td>4</td>
<td>Not Measured</td>
<td>-5</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Table IV-1. Cottonwood Transit Flow Measurements

Flow measurements of 8/6/02 and 7/10/02 indicate a nearly balanced flow across the transit from Station #4 to Station #6. The validity of the third measuring event (7/1/03) is questionable because of the indicated flow imbalance of approximately 20 CFS across the transit. A closer inspection of this measurement reveals that the cross over channel flow at Station #5 of 51 CFS is 7 CFS higher than the flow balance to this point should indicate. From Station #5 to Station #6 an additional gain of over 15 CFS would be required to achieve the outflows down South Cottonwood and the GRSC at Station #6. Because this amount of inflow seemed unlikely, further data analysis was conducted.
Figure B shows that the flow at Station #6 was calculated as being in the range of 20 to 25 CFS greater than that of Station #5 for most of the irrigation season. The calculated flows for Station #5 in comparison to Station #4 seem to follow the expected pattern, i.e. North Cottonwood provides excess water to the cross-over canal during high water in May and June, following which the flows in the cross-over canal match those of the GRSC inflows into North Cottonwood Creek closely. Given this confirmation of the Station #4 and #5 calculations, the accuracy of the rating curve used to calculate flows for Station #6 was re-examined.

The majority of the canal and creek reach consisting of the cross-over canal, South Cottonwood Creek, and the canal from Station #6 to Station #7 is located down-gradient of acreage irrigated by the Jigger and El Ranchero Ditches. This area is heavily flood irrigated throughout most of the irrigation season and therefore provides inflows to the GRSC in this reach. The calculated flows shown in Figure D indicate the reach in between Station #6 and Station #7 receiving inflow of up to 15±CFS prior to late June. Flows at #6 and #7 match closely from late June to early July (confirmed by the flow gauge measurement on July 1), then a loss of 5 to 10 CFS is indicated throughout the rest of the season. Early season inflows can be explained by operation of the Jigger and El Rancho ditches causing inflows. Late season losses can be explained by usage within the reach from Station #6 to Station #7 and seepage. The calculated flows shown in Figure B show considerable inflows across the Cottonwood Transit from Station #4 to #6.

If Station #7 is considered to be the point of measurement at the end of the Cottonwood Transit, Figure C shows the relevant flow data. Figure C shows that from the period from late May to the beginning of September, the canal gains water across the Cottonwood Transit. The higher gains of up to 25 CFS occur during high water. During high water, the major source of inflow is believed to be the Cottonwood Creeks. Smaller inflows of 5 to 10 CFS are shown from mid-June to mid August. These inflows are slightly above the presumed accuracy of the analysis and are likely from the flood irrigated ground upgradient with the primary sources of water being the Jigger and El Rancho ditches.

The data shows that there is a net gain of water into the GRSC across the Cottonwood Transit during high water on the Cottonwood Creeks. This period occurred from mid-May through late June in 2003. From late June through mid August, a small net gain was indicated across the Cottonwood Transit. The source of this inflow is water from upgradient irrigation ditches. Field observations of the upgradient irrigated ground noted that the fields were saturated with surface standing water of up to several inches of depth. Concentrated surficial streams of running water were observed throughout these fields. It is reasonable to conclude that a significant amount of recharge to the GRSC occurs in this reach. Conversely, the data indicate that when the upgradient ditches are shut off, there is little gain or loss in the GRSC across the Cottonwood Transit.

Lower Canal

Flow monitoring stations in this reach were:

# 7. Point of Diversion of Smith Lateral;
# 8. Point of Diversion of Earl Wrights Lateral.
Canal flows at the stations in this reach over the 2003 season are plotted in Figure D. Station locations are shown on the project maps. An additional flow measurement was conducted on July 1 2003 at the point of diversion of the Thompson Lateral.

Flows at Station #8 were relatively constant over the period from June through early September. Flow at this Station was typically in the 30 to 40 CFS range during this period. Usage and losses in the reach between Stations #7 and #8 ranged from 30 to 40 CFS in June and gradually decreased to 25 CFS in mid July. By early August, the usage and losses decreased to about 10 CFS in this reach. It is important to note that the constant flows at Station #8 imply that irrigators in this reach used less water as less water became available in order to allow a relatively constant flow at Station #8.

A flow measurement was taken upstream of the Thompson lateral on July 2 2003. Flow was gauged at 16 CFS. Flow gauging below Earl Wrights lateral on the same date measured 20 CFS indicating a loss and usage of about 4 CFS in the reach between these two stations.

During the 2003 season, GRSC flows reached the end of the canal until about mid July. Some water was conveyed to the lower reaches of the canal throughout most of the irrigation season.

Seepage

General

This portion of the report consists of an assessment of seepage losses from the GRSC. Nelson Engineering assessed canal seepage loss for this study using two methods. The first was to identify seepage areas using aerial photos, information from landowners and irrigators, and visual evidence from a field inspection of the canal. The results of this initial assessment were used to identify areas where seepage loss was significant. The second phase consisted of monitoring and measuring flows in sections of the canal identified in the first portion of the study. In particular, high seepage rates were visually noted in the Soap Hole Basin. Flow gauging data in this reach was conducted to provide quantitative data for losses in this area.

Methods

Field Observations and Landowner Information

NE and a geological engineer from a sub-consultant (SEH), conducted a geological field inspection of the canal during the first week of July 2002. With the exception of the sections identified as “Not Evaluated” on the project map, the full length of the canal was inspected. The results of this inspection are a geologic report on the canal contained in the appendix and a qualitative evaluation of seepage loss over the length of the canal. Qualitative categories of seepage severity were defined and cataloged as follows:
Potentially high seepage at times with high surface water flows and groundwater levels in the Green River and Cottonwood Creek Valleys are low; tan on the maps. Relatively high seepage shown in red on the maps. Moderate seepage shown in yellow on the maps. Low seepage shown in green on the maps.

Visual evidence of seepage noted included standing water, sub-irrigated vegetation, running water in draws down slope from the canal, boils or seeps, and alkaline deposits. Aerial photography was also examined to determine areas of leakage indicated by non-irrigated areas that contain uncharacteristically lush vegetation and/or phreatophytic plants. Information provided by landowners and irrigators in the course of the study was invaluable in determining seepage areas.

Excessive seepage has damaged the lower dike in several locations. Several "boils" where water is seeping through the dike under pressure and soil fines are being washed or "piped" out were noted. These locations will eventually fail unless repaired. Two additional areas exhibit extensive tension cracks accompanied by seepage. These latter areas will continue to experience slope failures and need to be repaired. All the foregoing locations are noted in the canal inventory section of this report and are included in the database associated with the mapping.

**Flow Gauging and Flow Monitoring**

Flow gauging was conducted in the reaches of the canal in the Soap Hole Basin that were suspected of high seepage loss. Flow monitoring data was used to provide additional information for the seepage analysis. Although some of loss observed during flow gauging is due to evapotranspiration and evaporation, the percentage of loss is believed to small compared to seepage.

Analysis

**Canal Above Andrikopoulos Lateral**

In the first half of the irrigation season, inflows from upgradient ditches masked any seepage loss occurring during irrigation usage (Figure A). From mid to late August, seepage losses in the reach between Stations #1 and #2 of about 10 CFS are indicated. Flows in Stations #2 and #3 track each other indicating little seepage loss in this reach.

**Soap Hole Basin**

The canal transits above the Soap Hole basin in a reach that starts at the Andrikopoulos Lateral and ends just prior to the Cottonwood Transit. Topographically, the canal is incised into the hillside and crosses a series of ephemeral drainages (draws) throughout most of this area. Visual and qualitative evidence of high seepage includes:
1. Areas of high seepage from the canal were noted during the field investigation. In some reaches, as shown on the inventory map in Exhibit B, the canal dike is close to failing because of seepage induced slope instability.

2. During the irrigation season, all of the drainages entering the Soap Hole were dry upslope of the canal, all carry water downslope of the canal. The only possible source of water for these areas is canal seepage. Drainages that collect canal seepage on the north and east sides of the Soap Hole carry significant flows. In May of 2008 a V-notch weir was placed immediately below the canal transit of the drainage located approximately ¾ mile west of Highway 89. Flow was measured at about 0.7 CFS. Flows were observed to increase down the channel as more seepage entered the drainage.

3. In Exhibit A, the aerial photography clearly shows areas of vegetation thriving in areas downslope from the canal.

4. Significant seepage on Mr. Glen Millard’s property is indicated by several areas that do not dry up when irrigation flows to these areas are stopped. Many of these wet areas dry up after the canal is shut down confirming that the canal is the water source.

Flow gauging to determine the seepage loss across a 5.5-mile reach of the Soap Hole was conducted in the summer of 2002 and 2003. The results are shown on Table IV-2.

<table>
<thead>
<tr>
<th>Date</th>
<th>Start of 1st High Seepage Area in Soap Hole</th>
<th>South Highway 189 Crossing</th>
<th>Total Seepage Loss (CFS)</th>
<th>Loss per Mile (CFS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8/5/02</td>
<td>54</td>
<td>48</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>7/1/03</td>
<td>108</td>
<td>92</td>
<td>16</td>
<td>3</td>
</tr>
</tbody>
</table>

From the Table it can be seen that the loss per mile at the higher flow rate is nearly triple the loss at the lower flow rate. On a percentage basis, the loss at each of the flow rates is in the 12% to 15% range. From this data, we conclude that a significant percentage of the canal flow is lost to seepage in this reach. Although not measured due to irrigation usage, reaches in the Soap Hole downstream from the study reach with similar topography most likely have similar seepage rates. Using a conservative estimate of an additional 4 miles with similar seepage losses, the total seepage loss across the Soap Hole is estimated to exceed 20% of typical canal flows during the irrigation season.

*Cottonwood Transit*

Seepage losses across the Cottonwood Transit were masked by the inflow from upgradient ditches throughout most of the 2003 irrigation season. Seepage losses were likely insignificant as compared to recharge in this section of the canal. During dry years these ditches may have little or no water in the later months of the season and seepage losses across the transit may have an impact on water delivery to GRSC users below the Cottonwood Transit.
Lower Canal

In several reaches of the canal that transit draws, visible evidence of leakage was noted during the field investigation. Exhibit A shows several areas of lush vegetation watered by canal leakage. Unlike the Soap Hole, seepage was not evaluated as high in any of the reaches of the lower canal. Flow gauging, specifically to determine seepage losses, was not conducted in the lower canal, as the seepage losses are not judged to be as severe.

Conclusions

The GRSC suffers from significant loss due to seepage, especially in the Soap Hole Basin. In dry years and/or when upgradient ditches located in the Green River and Cottonwood Creek valleys do not supply the canal with significant inflows, seepage losses become critical. When water is scarce, seepage losses are likely large enough to impact the ability of the canal to supply allocated water to all users, in particular those users farthest down canal.
Figure A
GRSC Flow Stations 1-4, 2003

Inflow from Todd & Upper Ditches 70-80 CFS

USAGE/LOSS STA. 3 TO STA. 4 80 CFS

USAGE/LOSS STA. 2 TO STA. 4 35 CFS

- Station #1
- Station #2
- Station #3
- Station #4
- Green River At Warren Bridge

Date

5/14 6/3 6/23 7/13 8/2 8/22 9/11

GRSC Flow (CFS)

Green River Flow (CFS)
Figure B
GRSC Flow Stations 4-6, 2003

Date
5/14 6/3 6/23 7/13 8/2 8/22 9/11

Flow (CFS)
0 20 40 60 80 100 120

- Station #4
- Station #5
- Station #6

02-085 12/7/2004 FIG. B STA4-6 Chart 2
Figure C
GRSC Flow Stations 4,5,7, 2003

Flow (CFS)

Date

0 5/14 6/3 6/23 7/13 8/2 8/22 9/11

Station #4 — Station #5 — Station #7
Figure D
GRSC Flow Stations 7,8, 2003

Flow (CFS)

Date
5/14 6/3 6/23 7/13 8/2 8/22 9/11

Station #7
Station #8
V. POINT OF DIVERSION

Description

The point of diversion for GRSC, as listed in State Engineer records, is from Pooles Slough in the SE1/4, SE1/4, S4, T33N, R110W. Pooles Slough is a former meander and branch of the Green River. Flow from Green River into Pooles Slough is regulated at a point in the SW1/4, SE1/4, S31, T34N, R110W. Regulation is accomplished by stop logs in a double culvert made of two old boiler sections. It is very difficult and dangerous to operate. Length of flow in Pooles Slough is approximately three miles. This condition is illustrated on the map accompanying this report.

The land at the diversion from Green River to Pooles Slough was one of the many historic cattle ranches of the Green River Valley. Traditionally and historically, the owners have cooperated with GRSC in providing the desired flow into Pooles Slough. There is no written agreement for access or regulation from the ranch to GRSC. The ranch has now been subdivided and sold to wealthy individuals as a “fisherman’s paradise”, or fisherman’s club. Pooles Slough is a “signature stream”, or prime stretch of the fishing water of the ranch. Although current ranch management insists that they will continue to operate in harmony with GRSC, the possibility of conflict between ideal fishing flow vs. flow needed for irrigation is obvious.

Alternatives

There are three alternatives to this problem:

1) Obtain a written agreement from the ranch (club) allowing access across ranch lands to the diversion structure and participation in management of the flow into Pooles Slough. This agreement should define the quantities of flow required by GRSC, those that are necessary for all other diversions from Pooles Slough, and acknowledge rights of access and rights of management of GRSC personnel. In addition, a new, safer, and easier to operate structure should be designed for the location.

2) Petition the Wyoming State Engineers Office for a change of point of diversion and means of conveyance. The point of diversion change would be to the diversion from Green River to Pooles Slough. The means of conveyance change would name Pooles Slough as a conveyance. Under Wyoming law, this would automatically carry right-of-access and right-of-management. Again, a new, safer, and easier to operate structure should be designed for the location.

3) Petition for and construct a change of point of diversion and means of conveyance to a point on the Green River below the mouth of Pooles Slough. This would divorce GRSC and Soaphole Ditch from dependence on the management of Pooles Slough. However, it would require the cooperative management of GRSC and Soaphole Ditch. It would require obtaining land rights from the owners, construction of a diversion structure on Green River, construction of a mile or more of canal and construction of a bifurcation structure for turning part of the flow into Soaphole Ditch.

Of the alternatives, (3) is by far the most desirable, however, it is also the most expensive. Cost estimate of the structures only appear in Section VII.
VI. WATER STORAGE

Irrigators along Cottonwood Creek have often experienced shortages of water in the latter part of irrigation seasons. This fact is acknowledged in the “Green River Basin Plan” and also in the “Green River Groundwater Recharge and Alternate Storage, Level 1 Project”. A traditional method of augmenting irrigation water needs is storage. This is addressed in the two studies. The two studies mentioned above were reviewed as part of this project.

Of the reservoir sites listed in those reports, only the following are applicable to the GRSC irrigators:

<table>
<thead>
<tr>
<th>REPORT</th>
<th>NAME</th>
<th>SIZE (AF)</th>
<th>SEC., TWSHP., RANGE</th>
<th>USE</th>
</tr>
</thead>
<tbody>
<tr>
<td>GRBP</td>
<td>GREEN RIVER LAKES ENL. G.R. CANAL</td>
<td>250,000</td>
<td>2, 39, 109</td>
<td>IRR, POWER</td>
</tr>
<tr>
<td>GRBP</td>
<td>KENDALL</td>
<td>100,000</td>
<td>33, 36, 111</td>
<td>IND, MUN, IRR</td>
</tr>
<tr>
<td>GRBP</td>
<td>LOWER KENDALL</td>
<td>100,000</td>
<td>4, 35, 111</td>
<td>REC, IND, MUN, IRR</td>
</tr>
<tr>
<td>GRBP</td>
<td>SOUTH COTTONWOOD</td>
<td>6,000</td>
<td>12, 32, 115</td>
<td>IRR</td>
</tr>
<tr>
<td>GRBP</td>
<td>COTTONWOOD #1</td>
<td>1,465</td>
<td>16, 32, 115</td>
<td>IRR</td>
</tr>
<tr>
<td>GRBP</td>
<td>HORSE CREEK</td>
<td>36,660</td>
<td>7, 34, 114</td>
<td>IRR</td>
</tr>
<tr>
<td>GRBP</td>
<td>MIDDLE BEAVER</td>
<td>5,905</td>
<td>29, 36, 112</td>
<td>IRR</td>
</tr>
<tr>
<td>GRBP</td>
<td>NORTH COTTONWOOD</td>
<td>10,805</td>
<td>24, 33, 115</td>
<td>IRR</td>
</tr>
<tr>
<td>GRBP</td>
<td>SOUTH BEAVER</td>
<td>5,905</td>
<td>24, 35, 114</td>
<td>IRR</td>
</tr>
<tr>
<td>GRBP</td>
<td>SOUTH COTTONWOOD</td>
<td>10,805</td>
<td>11, 32, 115</td>
<td>IRR</td>
</tr>
<tr>
<td>GRBP</td>
<td>SOUTH HORSE CREEK</td>
<td>36,660</td>
<td>30, 34, 114</td>
<td>IRR</td>
</tr>
<tr>
<td>RASLI</td>
<td>SOUTH COTTONWOOD</td>
<td>6,000</td>
<td>12, 32, 115</td>
<td>IRR</td>
</tr>
<tr>
<td>RASLI</td>
<td>WARREN BRIDGE</td>
<td>?</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>RASLI</td>
<td>G.R. ENLARGEMENT</td>
<td>250,000</td>
<td>2, 39, 109</td>
<td>IRR, POWER</td>
</tr>
<tr>
<td>RASLI</td>
<td>KENDALL (UPPER)</td>
<td>100,000</td>
<td>33, 36, 111</td>
<td>IND, MUN, IRR</td>
</tr>
<tr>
<td>RASLI</td>
<td>KENDALL (LOWER)</td>
<td>100,000</td>
<td>4, 35, 111</td>
<td>REC, IND, MUN, IRR</td>
</tr>
</tbody>
</table>

Of these, all but the Cottonwood sites would require that the Green River be a means of conveyance. It is indicated in these reports that the Green River does not suffer potential irrigation shortages at GRSC point of diversion; therefore, those sites become unnecessary unless significant enlargement of the GRSC is anticipated.

The unit cost per acre-feet (a.f.) of storage for seven reservoirs considered in the “Recharge and Alternate Storage Level 1” report was summarized. Average cost per a.f. for seven reservoirs was $3,850/a.f. The nearest reservoir of size comparison was “McNinch Wash” at 5,600/a.f. and $3,482/a.f. The South Cottonwood Reservoir, at 6,000/a.f. and an assumed cost of $3,850/a.f., would be $23,104,285.00/a.f. It is assumed that such costs are prohibitive without substantial assistance from the WWDC.
VII. PROPOSED REHABILITATION WORK AND COST ESTIMATION

Safety Problems

Two structures, at Andikopoulos lateral and at Diversion from South Cottonwood, the access walkways are deemed unsafe. An inexpensive correction for the problems has been designed. Results are presented in this section. At South Cottonwood Diversion, a gate wheel and minor steel repair work is also needed.

Obligations/Necessities

It is GRSC’s obligation to replace failed underdrains that are necessary to maintain irrigation patterns in existence before the canal was built. There are several of these. It is necessary to replace failed underdrains that do not function and/or provide points of leakage loss. There are several of these also. The Underdrain Cost Estimation summarizes their replacement.

Potential Washouts

Low dike areas, seepage boils and tension fractures represent potential washout and loss of irrigation time for all down-canal users. Repair of these areas is summarized in the Low Dike Estimations.

Seepage Loss/Lining

Seepage losses occur over the full length of the GRSC. However, some identified areas are much higher than others. Because lining costs, using bentonite or EPDM membrane are high, only the high seepage areas have been proposed as lined. Lining costs are summarized in Seepage Reduction.

Main Diversion

The main diversion structure, whether from Green River to Pooles Slough, or from the Green River below the mouth of Pooles Slough, is an expensive structure. Estimates for construction are from NE experience in construction of a similar diversion structure from Shoshone River to Hunt Canal. Estimates are included in the summary “Costs of all Recommended Rehabilitation Work”.
COSTS OF ALL RECOMMENDED REHABILITATION WORK

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety Problems</td>
<td>$6,740.00</td>
</tr>
<tr>
<td>Obligations/Necessity-Underdrain</td>
<td>$5,150.00</td>
</tr>
<tr>
<td>Potential Washouts</td>
<td>$30,000.00</td>
</tr>
<tr>
<td>Seepage Reduction – Lining</td>
<td>$400,000.00</td>
</tr>
<tr>
<td>Main Diversion</td>
<td>$263,000.00, $751,250.00</td>
</tr>
<tr>
<td>Engineering</td>
<td>$75,000.00, $826,250.00</td>
</tr>
<tr>
<td>Contingencies Legal &amp; Administrative</td>
<td>$165,250.00, $991,500.00</td>
</tr>
<tr>
<td>Approximate WWDC Grant</td>
<td>$495,750.00</td>
</tr>
<tr>
<td>Approximate WWDC Loan</td>
<td>$495,750.00</td>
</tr>
<tr>
<td>(Low interest)</td>
<td></td>
</tr>
</tbody>
</table>
GREEN RIVER SUPPLY CANAL
and SOUTH COTTON WOOD CREEK

EXISTING PLAN

SCALE: N.T.S.

EXISTING PROFILE

SCALE: 1/8"=1'-0"

EXISTING WOOD BRIDGE TO
BE REPLACED WITH PRE-CAST
HOLLOWCORE CONCRETE PLANK.
SEE IMPROVEMENT PLAN.

REPLACE BACKFILL IN SCORED AREAS AND INSTALL RIP-RAP FOR 20' ABOVE AND BELOW WING WALLS.

NOTE - LATERAL #1 DIVERSION GATE IS SIMILAR.

INSTALL 4" WIDE X 8" THICK X 22'-4"
LONG PRECAST HOLLOW CORE
CONCRETE PLANK.

INSTALL 36" HIGH 2" O.D. STEEL PIPE HAND RAIL.

NOTE - LATERAL #1 DIVERSION GATE IS SIMILAR.
## Green River Supply Canal

02-085-1  
Diversions Safety Improvements

<table>
<thead>
<tr>
<th>Labor and Material Description</th>
<th>Estimated Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>4'-0&quot; Wide x 8&quot; Thick x 22' Long Pre Cast Concrete Plank F.O.B. Big Piney</td>
<td>$1,130.00</td>
</tr>
<tr>
<td>Concrete Plank Installation Truck Crane = 4 hrs @ $85.00/hr Labor &amp; Miscellaneous = 6 hrs @ $100.00/hr</td>
<td>$940.00</td>
</tr>
<tr>
<td>Back Filling and Site Grading with Back-Hoe 8 hrs @ $50/hr</td>
<td>$400.00</td>
</tr>
<tr>
<td>Rip-rap Installed at $35/cy x 20 cy</td>
<td>$700.00</td>
</tr>
<tr>
<td>New Headgate Wheel and General Steel Repairs</td>
<td>$400.00</td>
</tr>
</tbody>
</table>

**Total Estimated Cost for Repairs = $3,570.00**

<table>
<thead>
<tr>
<th></th>
<th>Estimated Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lateral #1 Diversion Gate in need of similar repairs</td>
<td>$3,570.00</td>
</tr>
<tr>
<td>Minus Headgate Wheel, etc.</td>
<td>-$400.00</td>
</tr>
</tbody>
</table>

**Total Estimated Cost for Repairs = $3,170.00**

*Combined Costs for both Structures = $6,740.00*
## Underdrains

<table>
<thead>
<tr>
<th>Node</th>
<th>Length, (ft)</th>
<th>Pipe Dia., (in)</th>
<th># of Flared Sections</th>
<th>CMP Cost per ft., 14 gauge</th>
<th>HDPE Cost per ft.</th>
<th>Flared End Cost, CMP</th>
<th>Cost of CMP Pipe</th>
<th>Cost of HDPE Pipe</th>
<th>Installed CMP Cost</th>
<th>Installed HDPE Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>100</td>
<td>36</td>
<td>2</td>
<td>$23.09</td>
<td>$28.00</td>
<td>$306.00</td>
<td>$2,921.00</td>
<td>$3,412.00</td>
<td>$8,763.00</td>
<td>$10,236.00</td>
</tr>
<tr>
<td>25</td>
<td>100</td>
<td>24</td>
<td>2</td>
<td>$15.58</td>
<td>$15.03</td>
<td>$130.00</td>
<td>$1,818.00</td>
<td>$2,861.00</td>
<td>$7,290.00</td>
<td>$5,289.00</td>
</tr>
<tr>
<td>47</td>
<td>100</td>
<td>30</td>
<td>2</td>
<td>$19.34</td>
<td>$23.65</td>
<td>$248.00</td>
<td>$2,430.00</td>
<td>$2,861.00</td>
<td>$7,290.00</td>
<td>$8,583.00</td>
</tr>
<tr>
<td>48</td>
<td>100</td>
<td>30</td>
<td>2</td>
<td>$19.34</td>
<td>$23.65</td>
<td>$248.00</td>
<td>$2,430.00</td>
<td>$2,861.00</td>
<td>$7,290.00</td>
<td>$8,583.00</td>
</tr>
<tr>
<td>83</td>
<td>100</td>
<td>36</td>
<td>2</td>
<td>$23.09</td>
<td>$28.00</td>
<td>$306.00</td>
<td>$2,921.00</td>
<td>$3,412.00</td>
<td>$8,763.00</td>
<td>$10,236.00</td>
</tr>
<tr>
<td>99</td>
<td>100</td>
<td>30</td>
<td>2</td>
<td>$19.34</td>
<td>$23.65</td>
<td>$248.00</td>
<td>$2,430.00</td>
<td>$2,861.00</td>
<td>$7,290.00</td>
<td>$8,583.00</td>
</tr>
</tbody>
</table>

Total Estimated Installed Cost = $44,850.00 $51,510.00

## Prices per linear foot:

<table>
<thead>
<tr>
<th>Pipe Dia., (in)</th>
<th>CMP 16 gauge</th>
<th>CMP 14 gauge</th>
<th>CMP 12 gauge</th>
<th>HDPE 14 gauge</th>
<th>HDPE 12 gauge</th>
<th>Flared End Sections</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>$12.83</td>
<td>$15.58</td>
<td>$21.00</td>
<td>$15.03</td>
<td>$23.65</td>
<td>$130.00</td>
</tr>
<tr>
<td>30</td>
<td>$16.02</td>
<td>$19.34</td>
<td>$25.80</td>
<td>$23.65</td>
<td>$28.00</td>
<td>$130.00</td>
</tr>
<tr>
<td>36</td>
<td>$19.24</td>
<td>$23.09</td>
<td>$30.61</td>
<td>$28.00</td>
<td>$28.00</td>
<td>$130.00</td>
</tr>
</tbody>
</table>

Price Source: ROSCO Inc. - Casper, Wyoming
Note: CMP flared ends are compatible with the HDPE pipe.
Minimum depth of dirt required = 1 ft.
Width of dirt required = 13 ft.
Cost of Barrow Dirt = $8.00/\text{yd}^3$
$1 \text{yd}^3 = 27 \text{ft}^3$

### Low Dikes

<table>
<thead>
<tr>
<th>Begin Node</th>
<th>End Node</th>
<th>Dist., (ft.)</th>
<th>Vol., (ft$^3$)</th>
<th>Volume, (yd$^3$)</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>12</td>
<td>300</td>
<td>3,900</td>
<td>144</td>
<td>$1,155.56</td>
</tr>
<tr>
<td>11</td>
<td>12</td>
<td>644</td>
<td>8,372</td>
<td>310</td>
<td>$2,480.59</td>
</tr>
<tr>
<td>14</td>
<td>17</td>
<td>1,730</td>
<td>22,490</td>
<td>833</td>
<td>$6,663.70</td>
</tr>
<tr>
<td>28</td>
<td>17</td>
<td>100</td>
<td>1,300</td>
<td>48</td>
<td>$385.19</td>
</tr>
<tr>
<td>29</td>
<td>17</td>
<td>100</td>
<td>1,300</td>
<td>48</td>
<td>$385.19</td>
</tr>
<tr>
<td>38</td>
<td>40</td>
<td>150</td>
<td>1,950</td>
<td>72</td>
<td>$577.78</td>
</tr>
<tr>
<td>39</td>
<td>40</td>
<td>761</td>
<td>9,893</td>
<td>366</td>
<td>$2,931.26</td>
</tr>
<tr>
<td>51</td>
<td>52</td>
<td>470</td>
<td>6,110</td>
<td>226</td>
<td>$1,810.37</td>
</tr>
<tr>
<td>53</td>
<td>52</td>
<td>300</td>
<td>3,900</td>
<td>144</td>
<td>$1,155.56</td>
</tr>
<tr>
<td>57</td>
<td>52</td>
<td>300</td>
<td>3,900</td>
<td>144</td>
<td>$1,155.56</td>
</tr>
<tr>
<td>65</td>
<td>52</td>
<td>500</td>
<td>6,500</td>
<td>241</td>
<td>$1,925.93</td>
</tr>
<tr>
<td>71</td>
<td>73</td>
<td>107</td>
<td>1,391</td>
<td>52</td>
<td>$412.15</td>
</tr>
<tr>
<td>79</td>
<td>80</td>
<td>205</td>
<td>2,665</td>
<td>99</td>
<td>$789.63</td>
</tr>
<tr>
<td>84</td>
<td>85</td>
<td>410</td>
<td>5,330</td>
<td>197</td>
<td>$1,579.26</td>
</tr>
<tr>
<td>86</td>
<td>87</td>
<td>1,227</td>
<td>15,951</td>
<td>591</td>
<td>$4,726.22</td>
</tr>
<tr>
<td>90</td>
<td>91</td>
<td>277</td>
<td>3,601</td>
<td>133</td>
<td>$1,066.96</td>
</tr>
<tr>
<td>92</td>
<td>91</td>
<td>200</td>
<td>2,600</td>
<td>96</td>
<td>$770.37</td>
</tr>
</tbody>
</table>

Total Estimated Cost = $29,971.26
Seepage Loss Repairs and Lining Costs

Canal reaches in the Soap Hole Basin were identified to have high seepage losses that significantly impact canal operation. There are approximately three miles, or 16,000 feet, of identified high seepage areas on the canal in the Soap Hole. Lining these areas would greatly increase the efficiency of the canal and allow down canal users to receive water in times of shortage. The lining cost data shown in the Table below was obtained from a Bureau of Reclamation demonstration project published in 2001. Assuming an average canal width of 24 feet a rough estimate of lining costs for different liner types are as follows:

<table>
<thead>
<tr>
<th>Type</th>
<th>Cost per Lineal Foot</th>
<th>Total Cost 16,000 Linear Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geomembranes PVC, HDPE, Hypalon, VDPE</td>
<td>$25-$35</td>
<td>$480,000±</td>
</tr>
<tr>
<td>Roller Compacted Concrete/Shotcrete</td>
<td>$50-$60</td>
<td>$880,000±</td>
</tr>
<tr>
<td>Geocomposite Clay Liner (Bentomat)</td>
<td>$20-$30</td>
<td>$400,000±</td>
</tr>
</tbody>
</table>
VIII. OPERATION AND MAINTENANCE RECOMMENDATIONS

Proportion Water Quantities

During the irrigation season of 2003 there appeared to be sufficient water in the upper (above Cottonwood Creek) canal most of the season. This was provided by direct diversion from Pooles Slough and return flow from irrigation above the canal. Recorders show (Section IV) that this situation lasted until about August 16th, after which there was not a full 1 cfs per 70 acres of the district. This shortage would be more pronounced in a year of less runoff. It is also important that a pro rata share of the water reach the Cottonwood Transfer, especially when Cottonwood flows are reduced.

To serve lands below Cottonwood Creek at 1 cfs per 70 acres, the diversion from South Cottonwood should be 73.9 CFS. The same phenomenon of the upper canal appears to be true here. Adequate water from direct diversion and return flow from Jigger Ditch and El Rancho Ditch lasts until August. Beyond August, there is not a full 1 cfs per 70 acres. Again, this shortage could be more severe in other years.

What we refer to as Wright Lateral requires 19.0 CFS to serve 1,314 acres, and down canal lands need 40.7 CFS, for a combined 59.7 CFS. At only one time in the past season, during the last of June, 50 CFS reached this point. Therefore, the records indicate all lands in this portion of the district suffered a shortage. That being all lands served by the lateral and lands on down canal.

The question is, how to more equitably proportion the water, both during periods of surplus and shortage. To assist the district and the ditch rider, refer to the table in Section II. The table presents a ratio by which the volume of water should be proportioned at each of eight nodes along the system. The proportioning should allow for loss.

There are many factors influencing the proportion of water going to each irrigator. Some irrigators want water at times others do not, and this is understood. However, as a general rule, we believe utilization of the ratios set forth and incorporation and share of loss will result in major operational improvement and more equitable distribution of water. To emphasize this point the table is reproduced here.
<table>
<thead>
<tr>
<th>Supply Canal</th>
<th>Total Acres Served</th>
<th>Allocated Water, (cfs)</th>
<th>Ratio 1, %</th>
<th>Acreage Down Canal</th>
<th>Water Needed Down Canal, (cfs)</th>
<th>Ratio 2, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andrikopoulos Lateral</td>
<td>1,065.66</td>
<td>15.2</td>
<td>14.6</td>
<td>6220.43</td>
<td>88.6</td>
<td>85</td>
</tr>
<tr>
<td>GRSC</td>
<td>616.21</td>
<td>8.8</td>
<td>10</td>
<td>5604.22</td>
<td>79.8</td>
<td>93</td>
</tr>
<tr>
<td>GRSC</td>
<td>428.59</td>
<td>6.1</td>
<td>7.6</td>
<td>5175.63</td>
<td>73.7</td>
<td>79</td>
</tr>
<tr>
<td>Smith Lateral</td>
<td>479.00</td>
<td>6.8</td>
<td>9</td>
<td>4696.63</td>
<td>66.9</td>
<td>85</td>
</tr>
<tr>
<td>GRSC</td>
<td>533.63</td>
<td>7.6</td>
<td>11.4</td>
<td>4163</td>
<td>59.3</td>
<td>70</td>
</tr>
<tr>
<td>Earl Wright Lateral</td>
<td>1,314.00</td>
<td>19.0</td>
<td>32</td>
<td>2849</td>
<td>40.3</td>
<td>58</td>
</tr>
<tr>
<td>GRSC</td>
<td>862.00</td>
<td>12.3</td>
<td>30.5</td>
<td>1987</td>
<td>28</td>
<td>48</td>
</tr>
<tr>
<td>Thompson Lateral</td>
<td>1,568.00</td>
<td>22.0</td>
<td>79</td>
<td>419</td>
<td>6</td>
<td>13</td>
</tr>
<tr>
<td>GRSC</td>
<td>419.00</td>
<td>6.0</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total =</td>
<td>7,286.09</td>
<td>100</td>
<td>103.8</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Phreatiphite Loss, Willows and Trees

In the 1980’s Bob Burman, a professor of Agriculture/Engineering at the University of Wyoming, and several of his students, conducted experiments aimed at quantifying the use of water by certain plants. They found that an average size cottonwood tree releases, through transpiration, over 250 gallons of water per day into the atmosphere. An average willow releases one-half that amount. Everyone enjoys the color and visual delight of trees and willows in a semi-arid, high plains setting. But bear in mind that they are competing for the district’s water. In all future maintenance and cleaning operations, sections of the canal having heavy tree and willow growth should be given precedence and all willows and trees removed.

If a landowner wants or needs tree and willow growth, or wind shelter for example, he should carry a lateral into the desired area and let the growth happen on his share of the water.
APPENDIX
Geology

Geologic Setting. The Green River Supply Canal is located in the northwest portion of the Green River Basin in western Wyoming. Broad, locally dissected uplands, and moderate to steep slopes flanking intermittent to perennial stream valleys characterize the portion of the basin traversed by the canal. The general geology of the canal alignment is illustrated on Figures 1, 2, and 3 - geologic sections of representative reaches of the canal. The locations of these sections are shown on the maps displayed at the end of this Appendix. Overall, the canal is underlain by a thick section of sedimentary rocks that generally dip slightly toward the east. Oriel and Platt (1980) mapped these rocks as the La Barge member of the early Eocene Wasatch Formation (Tw1, on the order of 50 million years old). Locally thick deposits of alluvial sand and gravel terrace deposits (Qtg) of late Tertiary to early Quaternary (or Pleistocene) age (on the order of one to two million years old) are present on rolling upland surfaces and in broad valleys (e.g., flanking and within Soap Hole Basin). Various younger (Holocene and Pleistocene) deposits including colluvium (Qc), alluvial fans (Qaf), and alluvial terraces (Qt) on slopes and alluvium (Qal) in the adjacent swales and valleys locally overlie the sedimentary rocks and older terrace gravels. Younger gravel deposits inferred to be Holocene in age (i.e., younger than about 10,000 years) are locally present capping upland areas. The origin of these sometimes fairly widespread gravel deposits is uncertain.

Bedrock Descriptions. The La Barge member of the Wasatch Formation (Tw1) is generally described as “red and brown mudstone and conglomerate, yellow sandstone, and minor pisolitic [consisting of rounded grains] limestone” (Oriel and Platt, 1980). BLM (1995), based on work by Welder (1968) and drilling at a proposed sanitary landfill expansion site near the southern end of the canal, describe the Wasatch Formation in this area as follows:

"The Wasatch Formation is characterized as silty to sandy claystone containing interbedded fluvial siltstone-sandstone lenticular beds. It is variegated in color with red, orange, purple, brown, green, and gray predominating (Welder, 1968). The Wasatch is massive in structure with no distinct bedding planes, fracture or joint patterns. It is weakly cemented and erosive. Where dissected by streams, the Wasatch Formation is manifested as badland topography and is defined as erosional remnants. Geotechnical investigations conducted at the site of the existing landfill indicate the Upper Wasatch Formation consists of 12 to 18 feet of silty fine sand, silty clay, fine sandy silt, and wind-deposited sands." (pp.17-18)

Recent logs of four monitoring wells at the Marbleton landfill site (Nelson Engineering, 2002) indicate that sandstone and siltstone are the predominant local rock types in that area. Claystone

is present only in very minor, thin beds at the landfill site. These logs also show a widely varying weathering profile in the Wasatch Formation, ranging from as little as 15-20 feet to as much as 60-65 feet. This weathering profile is herein defined as the interval at the top of the rock section that is characterized by little to no cementation and descriptions in soils versus rock nomenclature (e.g., silt versus siltstone).

Overall, these various descriptions of the Wasatch Formation encompass the range of conditions observed in outcrops along the canal alignment during the field reconnaissance. As a general rule, the Wasatch units observed in outcrop tended to be finer-grained (sandy silt to siltstone) and of low to at most moderate plasticity (locally silty clay to claystone). Most of the exposures were heavily to moderately weathered, which may explain the apparent higher fines content. Sandstone, although present, was not as common as the finer-grained units. Conglomerate and limestone were not noted in the exposures briefly examined along the canal alignment.

**Surficial Deposits Descriptions.** The various surficial deposits encountered along the canal alignment are briefly described here; the quoted descriptions are all from Oriel and Platt (1980) unless indicated otherwise. Alluvial deposits mapped as QaI are described as “Well to poorly sorted, unconsolidated gravel, sand, and silt in channels and flood plains. As much as 20 m thick”. The older alluvial terrace deposits (Qtg) are described as “Unconsolidated coarse to fine gravel. As much as 100 m thick.” The younger gravel deposits (Qg) are only described as “Unconsolidated gravels of uncertain origin.” Alluvial fan deposits (Qaf) are described as “Poorly sorted, unconsolidated sand and gravel. As much as 100 m thick.” Colluvium (Qd) is described as “Unconsolidated rock and unstratified angular debris on hillsides.” Note that the thickness of these various deposits as shown in the geologic sections (Figures 2 through 4) are estimated; actual thicknesses are unknown.

All of the surficial deposits observed in natural and cut exposures along the canal alignment are generally as described above, except that most of these deposits contained some to a substantial fraction of finer grained sand to silt/clay fines as a matrix. This reflects the fact that most of the available exposures observed were quite shallow and within the weathered zone for these deposits.

**Seepage Conditions.** Most of the canal alignment is excavated in surficial deposits or weathered sedimentary bedrock as described previously. The hydraulic conductivity of the surficial deposits is highly variable depending on the gradation (especially degree of sorting and amount of fines) and the density or compactness of the material. Given the generally granular nature, non- to low plasticity, and unconsolidated condition of these deposits, they are likely at least moderately, and locally highly, permeable. This conclusion also applies to the downslope dike section along the canal as it appears to have been constructed from borrow from the adjacent ditch cut and placed with little or no intentional compaction.

Primary hydraulic conductivity of unweathered Wasatch Formation bedrock would tend to be relatively low, especially in the finer-grained units. Secondary permeability through joints and fractures can sometimes be significant, but is not judged a major issue here. This is due to the general absence of significant jointing in these units and the location of the canal in the
weathered zone where such discontinuities would typically be sealed with fines. Locally higher conductivity could be present where poorly to uncemented sandstone or sand beds are present.

It is likely that most of the seepage observed during the field reconnaissance occurs as flow through more the more granular, relatively loose, and generally non-plastic surficial deposits, dike fill and weathered sedimentary rock. In many locations the seepage likely follows the underlying contact of less weathered to fresh and/or otherwise low permeability bedrock. This seepage flows downslope (i.e., downgradient), sometimes saturating a relatively thin zone of surficial deposits or weathered rock and sub-irrigating fields under the canal. In some locations the seepage emerges on the surface as evidenced by flowing or ponded water or accumulations of salts on the ground surface.

**Geologic Hazards.** No large-scale slope instability was noted along the canal alignment or is shown on published geologic maps of the area. Local raveling of the steep upslope cut is relatively common along the canal, and locally there are small, somewhat deeper debris slides. However, these do not appear to significantly impact the safety or capacity of the canal. There are several locations (as noted in the accompanying field reconnaissance tabulation) where conditions are moving toward local failure of the canal dike. These include areas of local slumping, internal erosion (piping), and foundation boils. In general, it appears that the canal dike slopes are at about their angle of repose, and are thus susceptible to failure due to aggravating conditions (such as excessive seepage, oversteepening due to erosion or grading, earthquake shaking, etc.). There were several locations along the canal where the section had been reconstructed. It is not known if some of these areas were rebuilt due to slope failures, overtopping or replacement of bypass piping.

The canal is located in a region of moderately high seismicity adjacent to the Intermountain Seismic Belt to the west. The Darby thrust fault is the nearest known structure regarded as active and capable of producing potentially large, damaging earthquakes. It is within approximately 15 miles of the canal alignment. This fault and random earthquakes (i.e., events not associated with any known fault or other seismogenic structure) are the sources of potential future seismicity in the area. Probabilistic ground motions along the canal alignment have been generated utilizing the U.S. Geological Survey Seismic Hazard Mapping Project website at http://eqint.cr.usgs.gov/eq/cgi-bin/zipcode.cgi. Peak ground accelerations (PGA) as a function of the probability of the predicted acceleration being exceeded in any 50-year exposure period along the canal are:

- 10 percent probability of exceedence in 50 years – PGA = 0.10g
- 2 percent probability of exceedence in 50 years – PGA = 0.20g

These levels of peak ground acceleration are sufficient to cause damage to susceptible structures and facilities, including saturated and/or poorly compacted, oversteepened earth fills and natural slopes.

It is important to note that even if a portion of the canal failed due to slope instability triggered by seepage or earthquake, there does not appear to a high potential for injury or loss of life. It is much more likely that the result would be economic loss due to local flooding and erosion and the cost to rebuild the canal reach.
NOTE: 20x VERTICAL SCALE EXAGGERATION
NOTE: 20x VERTICAL SCALE EXAGGERATION
NOTE: 20x VERTICAL SCALE EXAGGERATION