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Executive Summary

Hugus Mullison Ditch Project, Level I
Saratoga, Wyoming

November 1999

prepared for

Wyoming Water Development Commission
Herschler Building, 4th Floor
122 West 25th Street
Cheyenne, Wyoming 82002

prepared by

PMPC Civil Engineers
Saratoga, Wyoming
November 15, 1999

Bruce Brinkman
Wyoming Water Development Commission
Herschler Building, 4th Floor
122 West 25th Street
Cheyenne, Wyoming 82002

RE: HUGUS MULLISON DITCH PROJECT, LEVEL I, EXECUTIVE SUMMARY

Mr. Brinkman:

PMPC is pleased to submit 50 copies of the Level I Executive Summary for the Hugus Mullison Ditch Project.

Thank you for the opportunity to submit this executive summary.

Sincerely,

[Signature]

Paul McCarthy, P.E.
PMPC

PM/jcy
EXECUTIVE SUMMARY

Introduction

On June 23, 1999 PMPC entered into a contract with the Wyoming Water Development Commission (WWDC) to provide professional services related to the Hugus Mullison Ditch Project (Project) located in Saratoga, Wyoming. The purpose of the project is to investigate and evaluate alternatives to correct problems associated with the seepage, capacity, storm drainage and operation of the Hugus Mullison Ditch.

Residents living in the low area down stream of the concrete lined portion of the Hugus Mullison Ditch have requested the Town Council to do something about the high groundwater in this area. The Town of Saratoga requested the WWDC to determine possible causes of the high groundwater.

Culverts and other encroachments have been installed in the ditch during the Town’s growth, many without the ditch owner’s approval. The ditch owners, concerned with the effects of the encroachments, wanted the hydraulic capacity of the ditch evaluated downstream of the concrete lining.

Storm water runoff has drained into the Hugus Mullison Ditch since it’s initial construction. Increased development in the Town has caused additional storm water to drain into the ditch. The ditch’s capacity to convey storm water was undefined and the liability of manually operating the ditch to accommodate large storm water inflow events and prevent flooding and ditch damage was a concern to the Town and ditch owners.

The present informal ditch cleaning arrangement has the Town cleaning the concrete lined section and the ditch owners cleaning the unlined sections of the ditch. The ditch owners would like a more formal arrangement considered. Formation of some type of district or board to operate and maintain the ditch could provide a formal arrangement between the Town and ditch owners. The type of district or board formed should be recognized as a government entity and be eligible for loan and grant funding of construction and reconstruction projects through government programs.

Inventory of Existing System

On June 23, 1999, a scoping meeting was held at the Saratoga Town Hall, with representatives from the WWDC, Town of Saratoga, Hugus Mullison Ditch Owners, NRCS and PMPC. Specific problem areas, study goals, system operation, and government entity formation were discussed along with the schedule for completing the project. The representatives from the Town and ditch owners provided insight into existing seepage, capacity, and system operation problems. Possible design alternatives to were discussed.

PMPC conducted a preliminary review of available data from the State Engineer’s Office, and collected several sources of information to provide a map showing lands with water rights in the Town of Saratoga. The main source of information was the State Board of Control Docket.
Figure 1 on page 4 of this summary depicts the lands with water rights under the Hugus Mullison Ditch.

A detailed field investigation of the project was conducted during the last week of June and throughout July 1999. During the months of July, August and the first two weeks of September stations in the canal were surveyed, gauged, and wells monitored.

The purpose of the field investigation was to inventory and assess the condition of the existing structures, measure water surface elevations in the ditches and monitor wells (to promote the seepage analysis), and collect horizontal and vertical survey data on the ditches. The survey data would be used for the analysis of the hydraulic capacity of existing structures and proposed improvements.

The Hugus Mullison Ditch consists of several cmp (corrugated metal pipe) street crossings through the unlined portion of the ditch. The ditch is unlined from just north of Bridge Avenue to the Town Limits. The unlined channel section is approximately 5,150 l.f. from the end of the lined section to the Sheep Rock Ranch. The existing structures located in this area of the ditch are in good to poor condition. Sedimentation is a major problem, along with adverse slopes on many of the crossings through town.

The Sixth Street Ditch consists of four cmp street crossings through the Town of Saratoga, and another cmp crossing is located on Saratoga Land and Cattle’s property. The ditch is unlined and approximately 1,770 l.f. from the diversion at the Hugus Mullison Ditch to the pipe on Saratoga Land and Cattle’s property. The Rochester Avenue crossing has sedimentation problems and it is adversely sloped. The Farm Avenue and Hugus Avenue crossings are also adversely sloped.

Twelve monitor wells were installed along the east and west side of the Hugus Mullison and Sixth Street Ditches on July 5, 1999 to measure ground water levels. These wells augment the five existing monitor wells installed by the Town of Saratoga prior to the start of the study. The water surface, ditch flow, and monitor well water level measurements were taken weekly from the first part of July, 1999 to the middle of September, 1999. The measurements show that as flow depths increased in the Hugus Mullison Ditch, higher ground water levels were observed in the monitoring wells. These water surface changes, along with differences in flow measurements between the measuring stations west of Sixth Street and just south of the Sheep Rock Ranch, suggest that the Hugus Mullison Ditch is seeping in this area. We recommend that flow and monitor well measurements continue to be taken along with water surface levels in the Hugus Mullison and Sixth Street Ditches especially when larger ditch flows occur in May and June during subsequent studies.

Storm water drainage has historically drained into the Hugus Mullison Ditch since it was built in 1884. Over the years, the Town of Saratoga has developed, resulting in increased storm water runoff draining into the ditch. In the previous ditch lining project a floodway overflow structure was installed at the Hobo Pool. The water surface model produced using HEC-RAS shows that the double appropriation (30 cfs) and a 1-hr 10-yr frequency storm (45 cfs) totaling 75 cfs can be accommodated in the existing lined channel. The existing channel can also accommodate the
double appropriation with supplemental supply (50 cfs) and a 1-hr 5-yr storm (24 cfs) totaling 74 cfs according to the water surface model. North of Bridge Avenue a manually operated screw gate exists for use during flood emergencies.

A subsurface soils investigation was conducted on July 5, 1999 at the monitor well locations. The investigation included digging to a depth of approximately 4 feet by hand or with a mechanical auger, logging and sampling the soils, and conducting in-place density tests. In-place density was determined using a nuclear density gage in accordance with ASTM 2922 with tests taken at the ground surface.

The soils were separated into five groups for classification purposes and visual classification was done in accordance with ASTM D2488. The minimum density of the silty soil was determined in accordance with ASTM 4254 and used to estimate the soil permeability within the range that is typical for that soil classification.

A topographic survey of the Hugus Mullison and Sixth Street Ditches was performed to provide horizontal and vertical survey data. The horizontal and vertical data were adjusted to the datum used in the previous ditch lining project. A total station was used to determine horizontal coordinates for the centerline of the ditches and structures in the ditches. Vertical coordinates for typical cross sections and structures in the ditches were obtained using a differential level.

System Design

The purpose of the system design was to identify potential improvements to the existing irrigation/drainage facilities for the Hugus Mullison and Sixth Street Ditches. Specific improvements were developed based on the results of the field investigation and technical analysis.

Hugus Mullison Ditch Alternatives:

1. Concrete lining from Bridge Avenue to the Town Limits.
2. Concrete lining from Bridge Avenue to Cottonwood Acres.
3. Ditch widening from Bridge Avenue to Cottonwood Acres.
4. Ditch widening with an impermeable liner from Bridge Avenue to Cottonwood Acres.
5. Inverted siphon from Sixth Street to the Hugus Avenue ROW, concrete lining from Bridge Avenue to Sixth Street and from Hugus Avenue ROW to Cottonwood Acres.

All of the Hugus Mullison Alternatives include providing a floodway overflow in the Saratoga Avenue ROW to release flood flows into the slough, grading the slough channel and installing box culverts at both street crossings to improve the slough’s capacity.
Sixth Street Ditch Alternatives:

1. Concrete lining from diversion to Saratoga Land and Cattle’s property.
2. Ditch widening from diversion to Saratoga Land and Cattle’s property.
3. Ditch widening with an impermeable liner from diversion to Saratoga Land and Cattle’s property.
4. Inverted siphon along the existing ditch alignment to Saratoga Land and Cattle’s property.
5. Inverted siphon from Cottonwood Acres to the existing ditch on Saratoga Land and Cattle’s property.

Drainage Alternatives:

1. Detention pond on the east edge of the airport to release drainage flows at a slower rate.
2. Storm sewer system to keep drainage from Hugus Avenue from draining into Saratoga Land and Cattle’s drain ditch.
3. Storm sewer system north from Rochester Avenue to Cottonwood Acres (Sixth Street Storm Sewer) if the Town chooses not to participate in using the Hugus Mullison Ditch.

A water surface model was created using the HEC-RAS computer program to calculate water surface elevations at various cross sections and culverts for the Hugus Mullison and Sixth Street Ditches. Models were created for existing and proposed conditions for open channel flow. Siphons were designed for both of the ditches in accordance with the U.S. Department of the Interior’s “Design of Small Canal Structures: Engineering Technology Pertaining Primarily to the Design of Small Canal Structures of Less than 100 cubic-feet-per-second Capacity.”

HUGUS MULLISON DITCH

Ditch and culvert capacity problems were encountered in the water surface model for the Hugus Mullison Ditch under the existing conditions for the double appropriation with supplemental supply flows (50 cfs) to the Sheep Rock Ranch. The problems begin at the Sixth Street Diversion Structure where flow overtops the concrete diversion because adequate head cannot be achieved to force the flow through the existing culverts crossing Sixth Street in the Hugus Mullison Ditch. There are several places where backwater effects from the culvert crossings between Sixth Street and Cottonwood Acres and from Cottonwood Acres to the diversion at Sheep Rock Ranch push the water surface elevation above the west bank of the Hugus Mullison Ditch. The backwater problem areas were determined by using the HEC-RAS computer program. Additional water surface and flow measurements should be taken when higher flows are available in the months of May and June to allow additional calibration of the water surface model using actual high flow field measurements.

All of the Hugus Mullison Ditch alternatives provide capacity for the double appropriation with supplemental supply (50 cfs), and double appropriation without supplemental supply (30 cfs) to
the ditch owners; extra capacity is provided for storm water runoff using the available freeboard in the channel. The freeboard is the depth from the top of the channel bank to the normal water surface.

The 60" diameter pipe siphon design provides capacity for the *double appropriation with supplemental supply* (50 cfs). A siphon is proposed instead of a pipe on grade because minimum earth cover requirements over the top of the pipe on grade could not be met without major changes to existing street grades. No provisions are made for storm water in the siphon alternative.

**SIXTH STREET DITCH**

The Sixth Street Ditch has culvert and channel problems from the diversion from the Hugus Mullison to the culvert located on Saratoga Land & Cattle’s property for the *double appropriation (13 cfs)* flows. The problems are similar to the Hugus Mullison Ditch, with backwater effects from insufficient culvert openings at Rochester Avenue and at Saratoga Land & Cattle forcing the water over the west bank of the Sixth Street Ditch. Additional water surface and flow measurements should be taken when higher flows are available in the months of May and June to allow additional calibration of the water surface model using actual high flow field measurements.

The Sixth Street Ditch alternatives for open channel and siphon designs provide capacity for the double appropriation (13 cfs) to Saratoga Land and Cattle. No capacity is provided for storm water.

A siphon was used instead of a pipe on grade because of cover problems, it would also benefit the Town of Saratoga giving them more useable space in the Sixth Street ROW. The 36" diameter pipe siphon size is large enough to accept the irrigation flows and overcome the head loss between Sixth Street or Cottonwood Acres and the Saratoga Land and Cattle Property.

**STORM WATER DRAINAGE**

The storm water runoff for the portions of the Town of Saratoga draining into the Hugus Mullison Ditch were calculated for developed conditions using the SCS TR-55 Method in HEC-1 to estimate the runoff caused by the 5, 10, 25, and 100 year one hour storm frequencies. The runoff was then routed through the ditch to the existing or proposed floodway overflow structure.

Runoff from the basins draining into the Hugus Mullison Ditch above the Hobo Pool was routed through the ditch to the floodway overflow structure located at the end of Cyprus Avenue to determine the peak flow at the structure. The existing structure will function properly if the wooden boards are set to the elevation that is needed to keep the necessary irrigation flow in the ditch.

Runoff from basins draining into the ditch between the Hobo Pool and Saratoga Avenue was routed through the ditch to a proposed floodway overflow structure located in the Saratoga
Avenue ROW to determine the peak flow at that point. The floodway overflow structure was sized in accordance with the U.S. Department of the Interior’s “Design of Small Canal Structures.” The five and ten year one hour frequency peak runoff was used to size the weir length. The runoff will spill over the weir to relieve the ditch of storm runoff. A manually operated slide gate will also be installed to release water from the ditch into the slough. The gate was designed to release the 25 year storm peak runoff into a 42” diameter pipe that outlets into the slough. Spill flows from the weir are also released into the 42” diameter pipe.

Runoff from basins draining to the Hugus Mullison Ditch north of Saratoga Avenue to the Town Limits was routed through the ditch to Sheep Rock Ranch. There is less runoff in this area and therefore not a threat to cause severe property damage so a floodway overflow structure was not proposed.

The drainage design included providing a detention pond at the Shively Field Airport, a storm sewer for Hugus Avenue to keep storm drainage from entering Saratoga Land and Cattle’s drain ditch, and a storm sewer for a portion of the Town from Rochester Avenue to Cottonwood Acres. The storm sewer from Rochester Avenue to Cottonwood Acres was proposed if the Town of Saratoga chose not to participate in using the Hugus Ditch for release of their storm water runoff.

**Permits for Construction**

We anticipate permits or authorization from, but not limited to, the following agencies:

- **Corps of Engineer’s (COE) – Section 404 Permit**
  If wetlands or the North Platte River are impacted by the construction.

- **Wyoming Game & Fish Department**
  If a Section 404 permit is required, formal approval with the Wyoming Game & Fish Department may be necessary to proceed with construction.

- **Wyoming DEQ, Water Quality Division – Section 401 authorization**
  A Section 401 authorization may be required if the COE requires the Section 404 permit.

- **State Historic Preservation Office**
  Formal approval from the State Historic Preservation Office may be required if the Section 404 permit is required.

- **State Engineer’s Office (SEO)**
  Contact the Surface Water Division to provide information on the construction being performed.

- **Land Ownership and Property Owners**
  Permission should be negotiated for right-of-access from all private landowners for all construction activity on private property associated with the project.
**Project Cost Estimates**

The cost estimates for the Hugus Mullison and Sixth Street Ditch alternatives, the drainage alternatives, and for non-participation by the Town were calculated using 1999 material and labor costs with inflation added to calculate 2001 costs to be used for this study. The construction costs were calculated with a ten percent addition for construction engineering. A contingency of fifteen percent was added to the construction and construction engineering costs to provide a total construction cost. The project cost total includes the preparation of final design plans and specifications, permitting and mitigation, legal fees, acquisition of access and rights of way, and the total construction costs.

The estimated cost of each item was developed and then assigned to the Town and the Hugus Ditch owners in the proportion that each benefited from that specific improvement. Some improvements, such as ditch lining, benefited both parties but to differing degrees. Other improvements, such as replacing street crossings and providing for storm water overflows, primarily benefited the Town and the costs of these items were assigned only to the Town. This cost allocation methodology was developed in concert with representatives of the Town and the Hugus Ditch owners and presented to the Saratoga Town Council. Annual operation and maintenance costs were developed in conjunction with Town and ditch owners.

Annual costs were developed for each alternative for the Town of Saratoga and the Hugus Ditch owners and are summarized in Table 1. Annual debt service amounts are based on a 50% WWDC Grant and a 50% WWDC Loan at 7.25% interest rate for 20 years for the Town and ditch owners portions of each alternative. Annual Town and ditch owners operation and maintenance costs were then added to the annual debt service to arrive at the total annual cost for each alternative.

The economic analysis for drainage improvements separate from the Hugus Ditch Project are tabulated separately in Table 1 and include a detention pond at the airport and a storm sewer in Hugus Avenue.

If the Town elects not to participate in the Hugus Ditch Project it may be responsible for replacing street ditch crossings, installing a storm water wasteway and installing a separate storm sewer system. The cost of the street crossings and the storm water wasteway are included in all of the Hugus Ditch alternatives and are included separately at the bottom of Table 1. The Sixth Street storm sewer is not needed if the Town continues to use the Hugus Ditch for storm drainage.

The annual costs for the separate drainage improvements and the items that may be the Town’s responsibility if the Town decided not to participate in the Hugus Ditch Project are based on a 50% (SL&I) Grant and a 50% SL&I Loan at 7.25% interest rate for 20 years.
## Table 1
Economic Analysis Summary

### ECONOMIC ANALYSIS - SUMMARY
1999 HUGUS MULLISON DITCH PROJECT - LEVEL I STUDY
November 15, 1999

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Conclusions and Recommendations

A WWDC Level II study should be requested to allow the Town of Saratoga and the Hugus Mullison Ditch owners the opportunity to obtain additional groundwater and ditch flow data, select alternatives for further investigations, prepare financial priorities, investigate funding opportunities and develop a ditch maintenance and storm water management agreement between the Hugus Mullison Ditch owners and the Town of Saratoga.

Additional ditch flow, water surface and monitor well level measurements should be obtained before, during, and after high irrigation flows during the months of May and June in the Level II study. PMPC was not able to obtain this information during the Level I study because the contract notice to proceed was issued on June 23, 1999, too late to obtain pre-irrigation groundwater data and high irrigation flow ditch and monitor well measurements.

Measurements were made after June 23 to estimate ditch seepage losses, but these measurements were during low flow periods in the Hugus Mullison and Sixth Street Ditches. The accuracy of determining how much water is seeping from the ditches during these low flows is questionable. Measurements at higher ditch flows would provide more reliable seepage measurements.

Monitor wells north of Farm Avenue near the Hugus Mullison Ditch showed groundwater level changes corresponding to changing water levels in the ditch. Other monitor wells containing groundwater did not show any groundwater level changes corresponding to ditch water level changes. Other monitor wells remained dry during the entire monitoring period. Periodic monitoring well measurements should be continued during the non-irrigation season and during the entire next irrigation season to better define the effects of ditch seepage on the groundwater level.

A ditch maintenance and storm water management agreement was not adopted during the Level I study period. Further discussion of an agreement should be continued between the Town and the ditch owners. The ditch owners are in the process of forming the Hugus Watershed Improvement District through the Saratoga-Encampment-Rawlins (SER) Conservation District. The Hugus Watershed Improvement District (if formed) will be a governmental entity eligible for WWDC loan and grant funding. Formation of this district will give the Hugus Mullison Ditch owners the ability to enter into a binding ditch maintenance agreement with the Town and be a member of a Joint Powers Board with the Town of Saratoga if that management option is found desirable.

The Town did not select a preferred alternative and would like to participate with the Level II sponsor in selecting one or more alternatives for further investigation in a Level II study after additional ditch flow and groundwater data is available.

The Town of Saratoga does not own any water rights in the Hugus Mullison Ditch and cannot be the sponsor for a WWDC Level II study. The Hugus Watershed Improvement District (if formed) is the logical entity to act as the Level II sponsor and request the WWDC continue with this project and conduct a Level II study.