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Executive Summary

Hugus Ditch Rehabilitation Project, Level II
Saratoga, Wyoming

November 2000

prepared for

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

prepared by

PPMMPPCC  CCiivviill  EEnnggiinneerrss
Saratoga, Wyoming

PMPC Civil Engineers
Saratoga, Wyoming
November 1, 2000

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

RE: HUGUS DITCH REHABILITATION PROJECT, LEVEL II STUDY

Mr. Abernathy:

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

Thank you for the opportunity to submit this executive summary.

Sincerely,

Paul McCarthy
PMPC

PM/jcy
EXECUTIVE SUMMARY

Introduction

On June 1, 2000, PMPC entered into a contract with the Wyoming Water Development Commission (WWDC) to provide professional services related to the Level II - Hugus Ditch Rehabilitation Project (Project) located in Saratoga, Wyoming. The project location is shown on Figure 1. The purpose of this project is to provide a reconnaissance rehabilitation study of the Hugus Ditch irrigation system. Project costs for the alternative selected from the Level I Study was determined by PMPC. They were used to determine the cost sharing distribution between the Town and the Hugus Watershed Improvement District when applying to the WWDC for grant and loan funding.

On June 23, 2000, a scoping meeting was held at the Saratoga Town Hall. In attendance were representatives from the WWDC, Town of Saratoga (Town), Hugus Watershed Improvement District (District), Natural Resources Conservation Service (NRCS) and PMPC. The Town and the District decided to line the Hugus Ditch with concrete from the existing lining at Bridge Avenue north to the Town Limits. The project includes lining the Sixth Street Ditch with concrete from the Hugus Ditch to Saratoga Land & Cattle’s south property line. The District requested that flow measuring devices and recorders be included with the improvements to the ditches. The District and the Town requested that the project be done in affordable phases and include reestablishing the berm along the downstream side of the Hugus Ditch to prevent flooding during larger storm events.

The Level I – Hugus Ditch Project was completed May 30, 2000. Monitor well and flow measurements taken during January – May 2000 were used in calibrating the water surface model and groundwater profiles for this study.

The well elevations increased as the ditch flows increased. The water surface elevations, which were measured during higher irrigation flows, made it evident that the constrictions in the unlined ditch affect the ditch capacity. The ditch elevation at the Hobo Pool is 6792 feet. The ditch elevation at Sheep Rock Ranch is 6786 feet. The distance from the Hobo Pool to Sheep Rock Ranch is two miles. The flat slope of the system leaves no room for head loss at the various street crossings through the Town.

The seepage problems associated with the Hugus and Sixth Street Ditch at larger irrigation flows were evident in Town between Sixth Street and Rochester Avenue. The house located at Sixth and Rochester had approximately 10 inches of water standing in the crawl space during the early part of June. The east borrow ditch on Sixth Street had water seeping into it between Rochester Avenue and Farm Avenue.

Storm water runoff draining into the Hugus Ditch can be released at the Hobo Pool overflow structure and at a manually operated screw gate near the end of the existing concrete lining. The liability of manual operation to accommodate the release of additional flow and prevent flood damage is a concern to the Town and District. The additional water overflows a weir into a
concrete lined channel that empties into the North Platte River once the operating level of the
ditch is reached. The manually operated screw gate just north of Bridge Avenue is the only
means of flood relief between the Hobo Pool and the Town Limits.

The Town has a formal agreement, dated July 5, 2000, with the Hugus Ditch Company
(Company) to divert storm water into the Hugus Ditch for purposes of flood control within the
Town Limits. The Town maintains the concrete lined portion of the ditch as it exists in the year
2000. The Company maintains the remaining unlined portion of the ditch. The agreement will
have to be amended when ditch improvements are constructed to determine what each entity will
maintain. The Hugus Ditch Company is a separate entity from the Hugus Watershed
Improvement District. The members of the Hugus Ditch Company are the Sheep Rock Ranch,
Saratoga Land & Cattle and David Christman. The members of the Hugus Watershed
Improvement District are the Sheep Rock Ranch, Saratoga Land & Cattle, and Cottonwood
Acres.

System Design

The Hugus Ditch consists of several corrugated metal pipe (cmp) 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 lineal feet from the end of the lined
section to the Sheep Rock Ranch. The capacity of the ditch is inadequate in the unlined portion
because of constricted flow through the existing cmp street crossings. 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.

The lined portion of the Hugus Ditch from the Hobo Pool to just north of Bridge Avenue is 4,320
lineal feet and is in good condition. Most of the structures located in this section of the ditch are
reinforced concrete box (rcb) culverts.

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

The seepage problems associated with the ditches are occurring in the unlined portions
downstream of Bridge Avenue. Water is seeping from the ditches into lower lying areas and
augmenting a high ground water table.

Storm water drainage has historically drained into the Hugus Ditch since it was built in 1884.
Over the years, developed areas in the Town have increased, resulting in more storm water
runoff draining into the ditch.

The purpose of the system design was to investigate potential improvements to the existing
facilities for the Hugus and Sixth Street Ditches. The Town and District selected the alternative
of lining the Hugus Ditch and Sixth Street Ditch with concrete. The Hugus Ditch would be lined
from Bridge Avenue north to the Town Limits and the Sixth Street Ditch would be lined from the diversion at the Hugus Ditch to Saratoga Land & Cattle’s south property line.

The alternative includes providing an overflow in the Saratoga Avenue ROW to operate the Hugus Ditch and release additional flows including storm water into the slough. Installing box culverts at Rochester Avenue and Saratoga Land & Cattle’s access road crossings would improve the slough’s capacity to convey storm water.

Storm water detention on the airport to release drainage flows at the historic discharge rate was also discussed with the Saratoga Airport Board. Board members decided that a meeting with their engineer and PMPC would be beneficial to determine where and if detention storage could be provided.

HUGUS DITCH

Computer modeling software, HEC-RAS, was utilized to model the existing system. The existing water surface model was calibrated using elevations measured in the ditch during high flows. The water surface was near the top of the concrete lining at Elm Street with approximately 40 cfs in the ditch. The downstream cmp crossings are backing up water so there is limited storm water capacity under existing conditions. The berm along the east bank of the concrete lined portion of the ditch has been obliterated over time and needs to be restored to accommodate storm water flows.

The proposed cross-section of the Hugus Ditch has a 4’ wide bottom, with 1.5 to 1 side slopes, a depth of 3.75’, and a top width of 15.25’. The proposed cross-sections of the concrete lining are smaller than the existing earth ditch. The improved hydraulic properties of the concrete lining allow the use of a smaller cross-section.

The proposed ditch cross-sections provide capacity for the irrigation double appropriation with supplemental supply (50 cfs) and the 5-year frequency storm water runoff (25 cfs) flowing into the ditch. The depth of water for the double appropriation with supplemental supply will be approximately three feet between Bridge Avenue and Sixth Street. The use of elevated turnouts in the Hugus Ditch should be discouraged because backing the water up affects the capacity of the ditch. The freeboard provided to accommodate the 5-year frequency storms is nine inches. Freeboard is the depth from the top of the channel bank to the normal water surface.

SIXTH STREET DITCH

Lining the Sixth Street Ditch will increase the capacity so Saratoga Land & Cattle can receive double appropriation (13 cfs). The existing culvert at Rochester Street is in poor condition and needs to be replaced to have the appropriate capacity.

The remaining street crossings should be replaced because they are adversely sloped. The proposed cross section of the Sixth Street Ditch has a 2’ wide bottom with 1.25 to 1 side slopes, a depth of 2’, and a top width of 7’. The depth of water in the ditch with the double appropriation will be 1.3’ leaving 0.7’ for freeboard.
OVERFLOW DESIGN

Providing an overflow structure in the Saratoga Avenue ROW will improve ditch operation by allowing the automatic release of additional flow that is not needed for irrigation or storm water runoff. It will be similar to the one at the Hobo Pool and will reduce the liability of the Town and the District. This part of the project is included in the Phase I Construction.

![Figure 2 - Hobo Pool Overflow](image)

The overflow structure was sized in accordance with the U.S. Department of the Interior’s “Design of Small Canal Structures.” The 25 year storm peak runoff (95 cfs) was used to size the weir length. The weir will be set to the operating height needed for the irrigation flows in the ditch. When flows in the ditch reach the top of the weir any additional flow will discharge over the weir into a 42” diameter pipe releasing water to the slough. A manually operated slide gate will also be installed to release water from the ditch to provide operational flexibility.

The street crossings through the slough at Rochester Avenue and the Saratoga Land & Cattle Access Road are corrugated metal culverts with limited capacity. New box culverts at these crossings will increase the capacity of the slough to release the storm water flowing out of the Hugus Ditch.

DRAINAGE DESIGN

The Shively Field Airport is currently releasing storm water at higher than historic rates. These flows affect the Hugus Ditch because the ditch can only accept small frequency (5yr) storms when the ditch is carrying the double appropriation of irrigation water. The double appropriation typically lasts 20-30 days in the latter part of May and early June. The Town requested that the Airport provide detention as part of their ongoing improvement project at Shively Field. PMPC had discussions with members of the Airport Board. The members recommended that a meeting with the Airport’s design engineer would be necessary to include storm water detention with the next development phase. The improvements would not be constructed until 2002 or later.

The installation of a storm sewer to drain runoff from Hugus Avenue is included as part of Phase III Construction. The storm sewer will drain flows from Hugus Avenue that presently drain into the Saratoga Land & Cattle Drain Ditch. This will satisfy the request by Saratoga Land & Cattle that the Town discontinue discharging street runoff into this ditch.
Geotechnical Analysis

The borrow material required for backfill to line the Hugus and Sixth Street ditches will come from an off-site source since there does not appear to be enough suitable material in the existing ditch banks. The amount of backfill required for the construction is a major part of the concrete lining costs.

The existing ditch will be cleaned and then backfilled. The proposed channel cross-section will be cut into the backfill and lined with concrete along the existing ditch alignments. Particle analysis of the borrow material used as backfill must be performed in the final design before construction. The material must be a soil that will keep moisture from migrating under the concrete lining. Freeze/thaw cycles can destroy and crack the concrete if moisture is allowed to drain along the back of the side slopes and bottom of the lining.

Surveying

PMPC performed a topographical survey of the street centerline at all the crossings in the unlined sections of the system. The elevations were used to determine the size of culverts that could be used. Some of the sewer lines crossing under the ditches were surveyed by getting invert elevations at manholes. The invert elevations were taken to determine any conflicts with the proposed ditch profiles and sewer line profiles. These elevations were adjusted to the 1983 ditch lining project. Others were located using as-built information from the Town. The topographical information for the profile of the ditches was taken from data in the Level I Study.

Water lines were located at street crossings in the Hugus and Sixth Street Ditches using as-built information from the Town. Gas line locations were identified by KN Energy. The main telephone line locations were identified by Union Telephone.

Project Phasing

Phase I of the construction includes providing flow measuring recorders at the Hobo Pool, Sixth Street Ditch Diversion, and Cottonwood Acres Diversion. Replacing the street crossings in the Hugus Ditch at Main Avenue, Sixth Street, Rochester Avenue, Seventh Street, and Farm Avenue are also a part of Phase I. Another part of the Phase I construction is the overflow structure in the Hugus Ditch at the Saratoga Avenue ROW. The construction items contained in Phase I provide the capacity needed for members of the District to get the irrigation double appropriation flows through Town. The overflow structure improves the operation of the ditch because the additional flows and storm water runoff can be released without manual operation. The seepage associated with the Hugus Ditch should decrease because less headwater is needed to push the flows through the improved crossings. The flow measuring recorders provide an accounting of the water being used by appropriators.

Phase II of the construction includes replacing the street crossings in the Sixth Street Ditch, lining the Sixth Street Ditch with concrete from the Hugus Ditch to Saratoga Land & Cattle’s south property line, and lining the Hugus Ditch from Sixth Street to Farm Avenue. The seepage problems associated with the Sixth Street Ditch will be eliminated. The district will benefit by
having capacity to convey the irrigation double appropriation through the Sixth Street Ditch. The seepage problems that were evident between Sixth Street and Farm Street in June 2000 along the Hugus Ditch will be eliminated as well.

Phase III construction includes replacing the street crossings in the slough at Rochester Avenue and at Saratoga Land & Cattle’s access road, along with the storm sewer for Hugus Avenue. The replacement of the crossings at Rochester Avenue and the Saratoga Land & Cattle access road provide more capacity to convey storm water runoff. The storm sewer for Hugus Avenue will collect runoff that currently flows into the Drain Ditch on Saratoga Land & Cattle’s property.

Phase IV of the proposed construction includes lining the Hugus Ditch from Bridge Avenue to Sixth Street, lining the Hugus Ditch from Farm Avenue to Cottonwood Acres, and replacing the crossing at the Hugus Avenue ROW and the south crossing in Cottonwood Acres. The benefits to this phase are eliminating seepage for the undeveloped properties along the Hugus Ditch. The improved hydraulic properties associated with the concrete lining require less cross sectional area to convey the irrigation and storm water runoff through Town.

Phase V construction includes lining the Hugus Ditch from Cottonwood Acres to the Town Limits and replacing the north crossing in Cottonwood Acres. The benefits are similar to Phase IV; eliminating seepage for the undeveloped properties along the ditch and improved hydraulics to convey flows through Town.

**Project Costs**

The project costs for the Hugus and Sixth Street Ditch were calculated using 2000 material and labor costs with inflation added to calculate 2001 costs to be used for this study. WWDC instructed PMPC to provide an opinion of the probable project costs using the following guidelines:

> The construction costs shall be calculated with a ten percent addition for construction engineering. A contingency of fifteen percent will be added to the construction and construction engineering costs to provide a total construction cost. The project cost total shall include 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.

Each phase for the project is shown in the following table with the total project costs, WWDC eligible costs, State Loan and Investment Board (SL&I) eligible costs, and Federal Aviation Association (FAA) eligible costs.
## Table 1 - Economic Analysis Summary

<table>
<thead>
<tr>
<th>PHASE NO.</th>
<th>DESCRIPTION</th>
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<th>WWDC</th>
<th>SL &amp; I</th>
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<th>DISTRICT</th>
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Permits for Construction

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

- Corps of Engineer’s (COE) – Construction of the Overflow on the Hugus Ditch at the Saratoga ROW will require a Section 404 Permit. Nationwide Permit Number 12 for construction associated with utility line activities.

- Wyoming DEQ, Water Quality Division – Relocation of any Water and Sewer lines will require a Chapter 3 Permit to Construct

- Wyoming DEQ, Water Quality Division – An NPDES Permit for Storm Water Control will be required if more than 5 acres contiguous are disturbed.

- Wyoming DEQ, Water Quality Division – A Section 401 authorization will be required with a COE Section 404 Permit.

- Wyoming Game & Fish Department – Formal approval with the Wyoming Game & Fish Department may be necessary to proceed with construction.

- State Historic Preservation Office – Formal approval from the State Historic Preservation Office will be required if archaeological or historical items are disturbed.

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

- Land Ownership and Property Owners
  Permission will be negotiated for right-of-access from all private landowners for all construction activity on private property associated with the project.
Conclusions and Recommendations

The District is presently experiencing problems associated with the capacity of the Hugus Ditch to convey irrigation flows to appropriators north of Saratoga. The Town has problems with seepage during higher irrigation flows affecting properties along the ditch and capacity to handle storm water runoff flowing into the ditch. Solutions to these problems were identified in the 1999 Level I study. The appropriators of the Hugus Ditch formed a Watershed Improvement District to submit an application to the WWDC for conducting this Level II – Hugus Ditch Rehabilitation Project.

The District and the Town selected the alternative of lining the Hugus Ditch with concrete to the Town Limits, and lining the Sixth Street Ditch with concrete to Saratoga Land & Cattle’s property to eliminate the problems currently being experienced with the seeping ditches. The improvements include providing an overflow structure in the Hugus Ditch to improve ditch operation and allow release of additional flow and storm water runoff back to the North Platte River via the slough. Storm sewer improvements associated with the drainage from Hugus Avenue were included to prevent runoff from draining into the Saratoga Land & Cattle Drain Ditch. Storm water detention at Shively Field was included to release developed flows at historic rates from the developed and future developed lands on the airport.

The improvements were divided into construction phases as requested by the Town and the District. The project was divided into phases so the Town and the District could affordably match the grant funding by the WWDC if the project is approved for Level III Construction. Construction phasing results in increased costs. Mobilization of equipment into and out of the area for each phase is the main contributor to the increased costs. Combining phases would be more cost effective. A minimum of 2,000 lineal feet of concrete lining is required for optimum economic use of a trenching/slipform machine to line the Hugus Ditch.

The improvements benefit the District and the Town but to differing degrees. To meet debt retirement, the District will have to assess the water users based on their benefited acres. The Town and the District will have to enter into a formal agreement or form a recognized government entity to manage the debt retirement if loan funds are obtained from the WWDC.