EXECUTIVE SUMMARY

TOWN OF DIXON WATER SUPPLY PROJECT
LEVEL II

SUBMITTED TO THE
WYOMING WATER DEVELOPMENT COMMISSION

JANUARY 4, 1994
EXECUTIVE SUMMARY

FOR

DIXON WATER SUPPLY PROJECT - LEVEL II

PREPARED FOR:

WYOMING WATER DEVELOPMENT COMMISSION
HERSCHLER BUILDING
122 W. 25TH STREET
CHEYENNE, WY 82002

PREPARED BY:

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FORT COLLINS, CO 80525
(LA PROJECT NO. WY-WDC-07)

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Authorization and Purpose

In the Fall of 1992, the Town of Dixon submitted an application to the Wyoming Water Development Commission (WWDC) to fund a Level II study for a conceptual design of an alternative water supply source for the Town of Dixon. On May 18, 1993 Lidstone & Anderson, Inc. entered into a contract with the WWDC to provide professional services related to the Level II Dixon Water Supply Project. The purpose of this project was to (1) investigate alternative water filtration options for the existing water supply source; (2) upon approval by the WWDC, provide well design and construction services for the evaluation of ground water development options; and (3) prepare conceptual designs and costs for the selected water supply alternative.

Project Location and History of Existing System

The Town of Dixon is located in southern Carbon County, Wyoming. Currently the Town supplies water to 72 taps. The population served by the community system averages 85 to 90 people. The existing Dixon water supply was originally constructed in the late 1950's and consists of a steel torch-slotted well casing buried below the bed of the Little Snake River. Water from this infiltration gallery enters a wet well, where it is chlorinated. The water is then pumped to a chlorine contact chamber and then to the municipal distribution system. Ultimately the water is pumped to a 100,000 gallon storage tank, north of town.

The present system is not filtered. Individual taps within the system are unmetered. Existing problems with the water supply system involve both water quantity and water quality. With the exception of peak demand periods, the system typically provides sufficient water to meet the domestic needs for the residents. During periods of peak demand and during periods where there is very little surface flow in the Little Snake River, adequate water supply can be a problem. Rusting and deterioration of the infiltration gallery pipe and the cast iron lines within the distribution system have been identified as ongoing water quality problems in the current water system. Excessive concentrations of iron, manganese and iron bacteria have also been problematic for water users.

The major problem facing the Town of Dixon pertains to regulation of water quality. The current water source is the Little Snake River via diversion through an infiltration gallery. Although the water meets primary drinking water standards, the EPA classifies the infiltration
gallery as an unfiltered surface water source subject to the requirements of the recently promulgated Surface Water Treatment Rule (SWTR: 40 CFR Part 141, Subpart H). With the enactment of the SWTR, treatment of the present water supply source is required to comply with EPA requirements.

Overview of the Level II Investigation

Two possible water supply alternatives were identified by the WWDC for a Level II study; filtration of the existing surface water supply (Level II, Phase I) or the construction of a ground water well (Level II, Phase II). Lidstone & Anderson, Inc. initiated the Phase I investigation to include: (1) the construction of two alluvial wells; (2) a pilot study of a 3M Bag Filtration system; (3) water quality and Microparticulate Analysis (MPA) of the 3M Bag Filters; and (4) preparation of a summary report and submittal to the EPA.

The pilot study was successfully completed and was found to meet the EPA requirements for alternative water treatment under the SWTR. The 3M Bag Filtration technology was identified as a low capital cost treatment alternative with no additional or unique operator certification requirements.

The WWDC, Lidstone & Anderson, Inc. and the Town of Dixon compared the filtration alternative to the previous Level I recommendation to drill a deep ground water well (proposed Phase II). All parties recognized that the existing surface water supply source (with modifications) could meet long-term water supply and water quality criteria. Hydrogeologic data suggest that the ground water option had potential quantity and quality problems. On this basis the WWDC and Lidstone & Anderson, Inc. recommended to the Town of Dixon the construction of a new infiltration gallery, intake structure, and filtration of the surface water source.

The following conceptual design components associated with the construction of a new municipal infiltration gallery intake structure and water treatment of the surface water source were developed.

(1) **Construction of a New Infiltration Gallery**

The current infiltration gallery consists of one torch-slotted iron pipe of indeterminate alignment and length buried under a side channel of the Little Snake River. The production capacity of the existing infiltration gallery is highly influenced by the depth of water over the "slotted pipe". The existing system requires frequent maintenance during the low water period of the year to ensure sufficient head over the infiltration gallery.
Two locations for a new infiltration gallery were evaluated: (1) immediately downstream of the existing infiltration gallery (within the old meander channel); and (2) in the mainstem of the Little Snake River. A conceptual design for both locations was developed. A schematic diagram of the proposed infiltration gallery alternatives are presented as Figure 1. The design included: (a) evaluation of the infiltration gallery with the existing river material as backfill; (b) evaluation of the infiltration gallery with various sand/gravel filter materials as backfill; (c) development of specifications for the screen (slot size and open area); (d) evaluation of pipe flow within the transmission pipe; and (e) assessment of potential clogging of the infiltration pipe. Preliminary design information is provided in sufficient detail to estimate capital construction costs.

Aquifer test data from the construction of the alluvial wells established the hydraulic characteristics of the alluvial aquifer and water transmission to the proposed infiltration gallery. Prior to the final design of the infiltration gallery, a detailed evaluation of long-term ground water conditions in the alluvial material underlying the river should be completed to determine the viability of the water source during periods of extremely low flows or droughts.

(2) Construction of a Permanent Diversion Structure in the Mainstem of the Little Snake River

Currently water is diverted into the abandoned channel by a structure located along the mainstem of the Little Snake River. This diversion structure requires annual maintenance during the low flow period of the year to deliver the required head over the infiltration gallery. A hydrologic analysis was conducted to provide a design basis for a diversion structure on the Little Snake River associated with the new infiltration gallery. The hydrologic analysis included the determination of peak discharges associated with various storm events and the flow duration analysis of low flow events. Discharges ranging from the 2-to the 100-year flood event were used to assess the impacts of the diversion structure on local increases in flooding and overall stability of the structure (50-year design).

In addition to the evaluation of peak flows, an analysis was conducted to determine the design event for assessing the hydraulic efficiency of the proposed diversion structure. Based on the data analysis, a 120-day low flow discharge with a recurrence period of two (2) years was selected for the hydraulic evaluation of the diversion structure. The 2-year, 120-day low flow discharge was estimated to be 100 cfs.

Based on the hydrology, a hydraulic evaluation of the diversion structure was conducted. The hydraulic evaluation included an assessment of the existing channel hydraulics followed by a determination of the channel hydraulics after construction of the diversion structure. As indicated on Figure 1, the proposed diversion structure is located on the main stem of the Little Snake River.

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Figure 1. Alternative Infiltration Gallery Alignments.
Various configurations of the diversion were analyzed in accordance with the following criteria:

- ensure the diversion of not less than 10 cfs during a flow event of 100 cfs; and
- incorporate a low flow notch or low point in the diversion structure to maximize the diversion during a low discharge and minimize the flooding impact during a high discharge.

To meet these criteria, a diversion structure with a maximum height of 3.5 feet near the channel banks and three feet near the low flow notch will be required. A small chute or "cut" across the existing peninsula will be integrated into the design to promote conveyance of flows to the infiltration gallery, circumvent aggradation at the entrance to the side channel, minimize the required height of the diversion structure, minimize the impacts of the constructed diversion on the inherent geomorphic instability.

The diversion structure may be constructed of various materials including rock riprap, grouted rock, reinforced concrete or roller compacted concrete. If rock riprap is utilized, the riprap should incorporate a median size not less than 18 inches in diameter.

One design alternative replaces the diversion structure with a rock sill at approximately the same location on the mainstem of the Little Snake River. The rock sill will be placed near channel grade. The infiltration gallery is installed at a location immediately upstream of the rock sill within the mainstem and a transmission pipeline conveys flow to the wet well and pump house. The principal raw water intake would be from the main channel, rather than the old meander or side channel.

Channel hydraulics associated with the rock sill will be essentially the same as for existing conditions. The proposed rock sill is not greater than one (1) foot in height and is intended to pond water in the immediate vicinity of the infiltration gallery. The pipeline for this alternative may vary from 600 feet to approximately 1,000 feet in length depending on the alignment. Based on geomorphic analysis, the placement of a second "off-line" collector pipe in the old meander in the vicinity of the existing infiltration gallery is recommended for this alternative. It will function as a viable source of water should the channel of the Little Snake River avulse into the existing side channel.

(3) Replacement of the Existing Wet Well and Pump House

The locations of the existing wet well and pump house are presented on Figure 1. Although the system is fully operational, some deterioration of the wet well has occurred. Replacement of the existing structure is justified by the proposed 40-year design life of the
project. The new wet well will be constructed to a similar depth as the existing structure. A clean-out mechanism will be designed for the wet well and it will incorporate a mechanism for jetting and backflushing the infiltration gallery.

A new pump house will be constructed at the wet well location. The structure will provide sufficient space for the wet well, pumps, chlorination, pre-filtration and bag filtration system. Ventilation will be provided.

(4) Construction of Treatment Facilities Sufficient to Address EPA Requirements Under the SWTR

Construction of a new infiltration gallery and intake structure combined with treatment of the source water by bag filtration will provide the Town of Dixon with a high quality community water supply in compliance with EPA regulations. The conceptual design of the water treatment program represents a low capital cost Alternative Surface Water Treatment Technology. The system will meet the EPA requirements for a minimum of two log cycles of giardia removal through filtration. It will also reduce current problems of excess iron, iron bacteria and manganese within the distribution system.

Chemical and microbiologic studies found that ferric iron, manganese and iron bacteria are present in all parts of the Dixon water distribution system. These parameters have resulted in water taste, water odor and staining problems within the existing system. During the Dixon pilot test study it became apparent that the bag filter's highly efficient removal of iron, manganese and iron bacteria was significantly reducing individual bag life thereby increasing O&M costs. The design effort addressed the O&M concerns and determined that strict pH control, control of excess chlorine, and pre-filtration of the Dixon water system would substantially mitigate these concerns.

A schematic diagram of the proposed water treatment system is provided as Figure 2. Chlorine will be added to the raw water at the wet well/ infiltration gallery intake and will result in the oxidation of the dissolved (ferrous) iron and assist in the reduce the biological activity of the iron bacteria. A multi-media two vessel package filter plant (prefilter), rated at 10 to 15 microns will receive prechlorinated waters from the wet well and will remove precipitated (ferric) iron and bacteria. The prefilter can be backflushed on a regular basis. Water from the prefilter will then enter a minimum three vessel bag filtration system (NS 122 (304) stainless vessels, 3M #525A Bag Filters, or equivalent) for final filtration. Following final filtration, lime or CaO may be added to the system to ensure maintenance of the system pH above 7.2. Additional chlorine may be added at the chlorine contact chamber, if residual chlorine concentrations are below 0.2 mg/l.

Operation of the water treatment process will be a trial and error procedure. The principal concern is to ensure sufficient time for the oxidation process associated with
Figure 2. Schematic Depicting Recommended Water Treatment System.
chlorination to occur prior to pre-filtration. Final design will determine the location of the
treatment facilities with respect to the chlorine contact chamber.

(5) Replacement of the Transmission and Distribution Lines and Construction of an isolated
Transmission Line to the Storage Tank

As-built drawings indicate that the existing transmission line from the wet well to the
chlorine contact chamber line is 6-inch PVC. Field investigation indicates that the old cast iron
line (CIP) may still be in the ground. This portion of the transmission line (100 lineal feet) will
be replaced if it is made of cast iron.

The existing main transmission line also serves as a distribution line for the Dixon Water
System. Future DEQ/WQD regulations may require the construction of an isolated transmission
line. Construction of approximately 6,130 lineal feet of new 6-inch and 8-inch line will be
required at some future date, but because of budgetary constraints is not recommended as part
of the current project. Similarly approximately 1,450 lineal feet of existing cast iron distribution
line should be replaced with PVC. The replacement of this distribution line will eliminate one
additional source of iron and manganese in the water system.

(6) Water Conservation Measures to Reduce O&M Costs for the Maintenance of the Water
Supply and Treatment Facilities

Both the WWDC and the project team recognize that the O&M costs of any water
treatment system can be prohibitive. Water use dictates all aspects of the maintenance costs for
the water system and the current evaluation suggests that the Town of Dixon may benefit from
water conservation. Installation of individual water meters at all points in the distribution system
and the institution of a rate schedule based on water usage will promote water conservation and
reduce line maintenance, filtration and chemical treatment costs. Given the anticipated costs
associated with O&M of the proposed system, continued and future testing requirements to meet
EPA regulations and the current water consumption rates, installation of water meters is
recommended.

With respect to bag filters (materials) alone, under the current usage and without pre-
filtration, the Town of Dixon can anticipate paying $3,400 per year in filter costs. Assuming
a 30% reduction in water usage, filter costs will average approximately $2,400. With pre-
filtration (assuming a 50% increase in bag life) coupled with water conservation, annual cost of
filters would approach $1,650.
Evaluation of Project Costs

Table 1 presents the construction costs for the water supply and the water treatment improvements associated with the Dixon Water Supply Project. These construction costs are calculated in accordance with guidelines prepared by the WWDC (1993). WWDC-funded improvements include construction of the infiltration gallery, diversion structure, wet well, and the transmission lines. Water treatment improvements can be funded by the Wyoming Farm Loan Board, and include the filtration system, associated distribution line replacement and installation of water meters.

Table 1. Total Project Costs and Repayment Plan.

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<th>Item</th>
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<th>Farm Loan Board-Funded Water Treatment Improvements</th>
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<td>Loan @ 33% (WWDC)</td>
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Conclusions and Recommendations

A low capital cost water treatment alternative, which utilizes the existing surface water source was identified for the Town of Dixon. Lidstone & Anderson, Inc. recommends the replacement of the existing infiltration gallery, construction of a permanent river diversion structure, the installation of a package pre-filtration plant and bag filters. This Level III project
will meet EPA requirements and improve the quality of the existing source, while minimizing annual O&M costs. This alternative has been presented to EPA and approval has been received. No ground water investigations have been conducted and the ground water option developed during the Level I Investigation remains unexplored.

(1) The proposed treatment system will meet the EPA requirements for a minimum of two log cycles of giardia removal through filtration. It will also reduce the current problems of excess iron, iron bacteria and manganese within the distribution system.

(2) Reconstruction of the existing infiltration gallery is an essential element of the design to meet both surface water quantity and quality. Construction of a permanent water diversion structure will eliminate the needs for annual maintenance and ensure compliance with federal and state regulations.

(3) The installation of pre-filtration and the sequenced water treatment program will increase bag life and reduce overall materials and maintenance costs.

(4) The installation of water meters and the institution of a new water rate schedule based on usage will promote water conservation and reduce overall maintenance costs for the system.

(5) The replacement of existing cast iron lines within the water system (both transmission and distribution) will improve overall water quality and reduce maintenance of the lines.

(6) The construction of a new transmission line should remain as a long-term goal for the Town of Dixon.