Executive Summary

Saratoga Master Plan Update and Level I Study

A Wyoming Water Development Commission Project

March 2003

PMPC Civil Engineers
Saratoga, Wyoming

in association with
TST Inc. of Denver
Denver, Colorado

Hinckley Consulting
Laramie, Wyoming

Water Right Services, LLC
Cheyenne, Wyoming
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INTRODUCTION

The Saratoga Municipal Water System serves the Town of Saratoga located in southern Carbon County, Wyoming. The water system is a shared operation between the Town of Saratoga, Carbon County, Impact Joint Powers Board (Board) and the Town of Saratoga (Town). The Board owns and manages capital improvements made to the water system. The Town operates, maintains and administers the day to day functions of the water system.

The Level I study included evaluating the existing water system, estimating future system needs, investigating groundwater as an alternative water supply, preparing water system improvement recommendations and providing information to update Saratoga's 1978 Master Plan.

CONCLUSIONS

The Level I study pointed out the serious situation Saratoga faces with regard to their surface water supply both with their water rights and the impacts future EPA regulations will have on water systems using surface water sources. The groundwater investigation revealed that further investigation of a groundwater supply northeast of Saratoga is warranted and the Board elected to pursue a Level II Groundwater Investigation Program through the Wyoming Water Development Commission.

Additional system operational changes and system improvements were developed and presented to the Board. The Board is waiting for completion of the Groundwater Investigation Program before taking action on operational changes and system improvements. These changes are discussed briefly in this Executive Summary.

SERVICE AREA DEMAND PROJECTIONS

Saratoga is presently investigating ways to promote economic development. Saratoga 3000, an ad hoc citizens group promoting economic development in the Saratoga area determined a population of 3,000 is necessary to make the community economically viable. Using a 3,000 population is contrary to commonly accepted population projections but the accepted projections do not account for an aggressive economic development group in a small community. The study area population of 3,000 was discussed with and approved by the Board and is used as the planning population.

The project study area and projected populations were also discussed with and approved by the Saratoga Town Council and the Saratoga Planning Commission. The project study area is shown on Figure 1 - Project Area Map. Lands controlled by the State and Federal governments were not included in the potential development areas.

The Town of Saratoga has jurisdiction over development in the one mile buffer zone outside the Saratoga corporate limits. The Town's jurisdiction can be extended to two miles when the Town's population reaches 2,000. Saratoga is in the process of adopting a land use plan for the one mile buffer zone.
FIGURE 1
PROJECT AREA MAP

SARATOGA - MASTER PLAN UPDATE & LEVEL 1 STUDY
WYOMING WATER DEVELOPMENT COMMISSION

JOB NO. 7012.090
FILE NO. SARA9611.DWG
SCALE AS SHOWN
DRAWN BY: LMW
DATE: 3-11-03

118 E. BRIDGE AVE. P.O. BOX 370
SARATOGA, WYOMING 82331
307-326-8301
Town facilities including municipal buildings, parks and other facilities are generally unmetered. Municipal water consumption was reviewed with water department personnel and estimated municipal consumption values were used in preparing water consumption quantities.

<table>
<thead>
<tr>
<th>Population</th>
<th>1,726</th>
<th>3,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Daily Water Consumption</td>
<td>387,767 gal/day</td>
<td>673,987 gal/day</td>
</tr>
<tr>
<td>Average Daily Water Consumption</td>
<td>270 gpm</td>
<td>468 gpm</td>
</tr>
<tr>
<td>Average Daily Per Capita Water Consumption</td>
<td>225 gpcd</td>
<td>225 gpcd</td>
</tr>
<tr>
<td>Annual Water Consumption</td>
<td>435 Acre Ft/Year</td>
<td>755 Acre Ft/Year</td>
</tr>
<tr>
<td>Maximum Daily Water Consumption</td>
<td>945,800 gal/day</td>
<td>1,643,917 gal/day</td>
</tr>
<tr>
<td>Maximum Daily Water Consumption</td>
<td>657 gpm</td>
<td>1,142 gpm</td>
</tr>
<tr>
<td>Maximum Daily Per Capita Water Consumption</td>
<td>548 gpcd</td>
<td>548 gpcd</td>
</tr>
<tr>
<td>Maximum Hour Water Consumption (Estimated to be 175% of Maximum Daily Water Consumption)</td>
<td>1,150 gpm</td>
<td>2,000 gpm</td>
</tr>
</tbody>
</table>

Table 1 Projected Water Consumption

WATER RIGHTS

A review of available data from the Wyoming State Engineer's Office was conducted by Water Right Services, LLC. A tabulation of the Town's surface water rights is presented in Table 2.

<table>
<thead>
<tr>
<th>Permit No.</th>
<th>Source</th>
<th>Facility Name</th>
<th>Priority</th>
<th>Amount</th>
<th>Status</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Terr.</td>
<td>North Platte River</td>
<td>Saratoga Municipal Intake</td>
<td>18880816</td>
<td>0.07 cfs*</td>
<td>adj</td>
</tr>
<tr>
<td>2</td>
<td>6040 Enl.</td>
<td>North Platte River</td>
<td>Saratoga Municipal Intake</td>
<td>19611128</td>
<td>0.04 cfs</td>
<td>adj</td>
</tr>
<tr>
<td>3</td>
<td>21744</td>
<td>North Platte River</td>
<td>Saratoga Municipal Intake</td>
<td>19560928</td>
<td>2.00 cfs</td>
<td>adj</td>
</tr>
<tr>
<td>4</td>
<td>6046 Enl.</td>
<td>North Platte River</td>
<td>Saratoga Municipal Intake</td>
<td>19601108</td>
<td>2.00 cfs</td>
<td>adj</td>
</tr>
<tr>
<td>5</td>
<td>7299 Enl.</td>
<td>North Platte River</td>
<td>Saratoga Municipal Intake</td>
<td>19780815</td>
<td>6.28 cfs</td>
<td>un-adj</td>
</tr>
</tbody>
</table>

1- Limited to 12.08 af-year to be diverted May 1 to Sept.30 of each year.
2- Limited to 7.65 af-year to be diverted May 1 to Sept.30 of each year.
* 1 cfs = 448.8 gpm

Also diverted through the Saratoga Municipal Intake is the George B. Storer Appropriation - 0.285 cfs - Terr. - 18830402 and the George B. Storer Appropriation 0.025 cfs - Terr. 1886

Table 2 Town of Saratoga - Existing Surface Water Rights

The George B. Storer appropriations (0.31 cfs) are for Old Baldy Club (OBC) water to be treated at the Saratoga Water Treatment Plant (SWTP) and delivered to OBC. OBC may make water from these appropriations, in excess of OBC's needs, available to the Town through an appropriate water use agreement.
SARATOGA AREA MASTER PLAN

The Town of Saratoga is presently developing a Saratoga Area Master Plan that includes the Town and a one mile buffer zone outside the Town limits. The Town was provided a digital copy of the Level I Study that can be adapted and incorporated into the Town Master Plan.

Expanding the water service area outside the current Town Limits will require annexation of the new service areas or modification of current Town Ordinances that prohibit supplying water to additional areas outside the Town Limits.

WATER SUPPLY PLANNING

The Town of Saratoga currently draws its municipal water supply from the North Platte River. Because the town relies on the North Platte River, it is subject to priority regulation from downstream senior users. In certain years, this includes Pathfinder Reservoir, a call for which precludes exercise of rights junior to December 6, 1904. Current Wyoming State Engineer policy is to honor a call for this right only through April 30. Although such a call has the potential to restrict water diversions by Saratoga, the Town’s senior rights were sufficient to meet demands in 2002. The following options are available to provide additional water for Saratoga:

1. Cheyenne Stage II Water - A contract between Cheyenne and Saratoga could be used to provide water during times of regulation but would not guarantee a permanent water supply.

2. Purchase of irrigated lands and transfer of existing water rights is an option but would not provide water during the critical period. This is the least attractive approach.

3. Look for stored water close to Saratoga and enter into a temporary use agreement. Again this does not provide for a permanent water supply.

4. Develop a groundwater supply for municipal purposes. It is important to keep in mind that wells must be in a location that is not considered as interconnected with the North Platte River. This is necessary as the Town does not want the wells regulated if a call is put on the river. This is the best option for the Town to consider as it would provide a year round water supply which would be subject to less regulation.

If a groundwater supply of sufficient quantity and quality can be identified and verified, it could provide several significant advantages over the current surface water source:

- more stable quality (i.e. free from springtime turbidity upsets)
- no treatment required beyond disinfection to maintain transmission and distribution system residual
- decreased testing and analysis requirements
- more stable quantity (i.e. available through drought years)
- less subject to regulation for senior users
- higher winter water temperature (i.e. fewer line freezing problems)
GROUNDWATER INVESTIGATION

Groundwater development potential in the vicinity of Saratoga, Wyoming was evaluated based on published reports, the files of the Wyoming State Engineer’s Office, original field investigations, local interviews, and laboratory analysis of groundwater samples. The following conclusions were reached:

1. The two aquifers with the potential for supplying sufficient quantities of water to replace the current and future Saratoga water supply are the alluvial aquifer along the North Platte River and the North Park Formation underlying the larger Saratoga area.

2. The productivity and, most importantly, the groundwater quality of the alluvial aquifer does not appear suitable due to the limited thickness of these deposits and the pervasive influence of mineralized groundwater from the underlying bedrock.

3. The North Park Formation clearly has the potential to provide suitable quantities of water of acceptable quality in the Saratoga area, but is quite variable in both quality and quantity.

4. The spatial distribution of North Park groundwater characteristics indicates high productivity and acceptable water quality may be available on the order of 3-4 miles east and northeast of Saratoga.

5. An exploration program to confirm the productivity and groundwater quality of the North Park Formation east and northeast of Saratoga is recommended to provide the design information necessary to make informed decisions on long-term water supply development for the town.

Figure 2 - Groundwater Investigation Map includes two suggested exploration sites to evaluate the North Park Formation; a primary site in the southeast corner of Section 5, T17N, R83W and an alternate site in the southwest corner of Section 32, T18N, R83W. The primary site is assumed to be the easier of the two to develop if an acceptable groundwater resource were verified, due to land ownership, access, and isolation from existing groundwater users. Groundwater interference concerns were voiced by various well owners interviewed for the Level I study. The primary site also corresponds with the north end of a speculative "basement fracture system" mapped by Montagne (1991).

The alternate site is suggested by balancing proximity to Saratoga (reducing development expense), proximity to the "known quantity" represented by the large spring and irrigation wells along Lake Creek, initial indications of acceptable groundwater quality, a nearby small spring, and public land ownership. Table 3 presents summary data for these two sites.

At either site, the target would be sandstone and conglomerate layers within the North Park Formation of sufficient thickness to produce the desired quantities of groundwater. In the absence of a detailed stratigraphic model of the North Park Formation, and given the wide disparity in thickness estimates, drilling to depths on the order of 800 - 1000 feet should be anticipated. Local experience indicates that a casing-and-screen well completion should be anticipated.
### Table 3 - Inferred Characteristics of Groundwater Exploration Sites

<table>
<thead>
<tr>
<th>Primary Site</th>
<th>Alternate Site</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location: T17N, R83W, Sec. 5dd</td>
<td>T18N, R83W, Sec. 32ccc</td>
<td></td>
</tr>
<tr>
<td>Land Ownership: BLM</td>
<td>BLM</td>
<td></td>
</tr>
<tr>
<td>Surface Elevation: 6880</td>
<td>6860</td>
<td></td>
</tr>
<tr>
<td>Depth-to-Water (ft): 30</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>North Park Fm. Thickness (ft): 400</td>
<td>400</td>
<td>Crist (1990)</td>
</tr>
<tr>
<td></td>
<td>1000</td>
<td>Montagne (1991)</td>
</tr>
<tr>
<td>Total Dissolved Solids (mg/l): 300</td>
<td>350</td>
<td></td>
</tr>
<tr>
<td>Temperature (°F): 55</td>
<td>55</td>
<td></td>
</tr>
</tbody>
</table>

Saratoga's current peak day demand would be met with a supply of 660 gpm; the projected peak day demand under the aggressive economic growth scenario is 1,150 gpm, see Table 2. Thus, the exploration program should be directed at evaluating the feasibility of groundwater production on the order of 1,200 gpm. It is not necessary, however, to achieve this level of production from a single well.

Water quality is obviously a key consideration. Exploratory drilling should provide for monitoring gross water quality (e.g. conductivity) at various depths in order to allow selective completion of a well if necessary. There is little reason to expect groundwater quality to improve with depth, so drilling could best be discontinued at an appropriate threshold water quality with due consideration for the possibility of blending water from different zones.

**Conceptual Cost Estimate**

An analysis was performed to determine the distance from Saratoga that groundwater could be economically developed and be cost competitive with improving the existing surface water treatment plant. The groundwater search area was established by determining the maximum transmission line length that would make the total Groundwater Alternative Budget equal to the most economical Surface Water Treatment Alternate cost plus the present worth value of the anticipated annual operation and maintenance savings realized with a groundwater source.

The estimated annual operation and maintenance savings will result from reduced chemical and labor costs. Electrical power costs were investigated and found to be approximately equal for both surface and groundwater alternates. The cost of purchasing additional surface water during periods of river regulation or obtaining additional senior surface water rights is not included in the analysis.
• SPRINGFED POND

NOTE: THE VALUE LISTED FIRST IS CONDUCTIVITY (umhos/cm), FOLLOWED BY GROSS ALPHA ACTIVITY (pCi/l). THE LETTER ID CORRESPONDS WITH TABLES 5-2a & 5-2b.
The economical transmission line search length was determined to be 16,100 ft. from the existing water distribution system. Both well exploration sites shown on Figure 2 are within the 16,100 ft. transmission line search length.

Surface Water Alternate Cost Estimate $1,191,985

Anticipated net annual O&M savings with groundwater source:
- Chemical savings $20,000
- Labor savings $20,000
- Total $40,000

Present worth value of annual O&M savings ($40,000, 6%, 20 years) $458,800

Groundwater Alternative Budget $1,650,785

WATER SYSTEM INVESTIGATION

Water Supply
Surface water and groundwater are the only practical sources of water available to the Town. Groundwater is preferred if a source is found that is more economical to develop than making needed improvements to the surface water treatment plant.

Saratoga's surface water quality is generally considered good but will still require treatment plant improvements to comply with future treatment regulations. An acceptable groundwater supply will only require disinfection.

Water Treatment
The surface water supply has seasonal and predictable changes in water quality but is also subject to rapid, extreme, and unpredictable changes. The Saratoga Water Treatment Plant (SWTP) does not have the facilities to control or modify the water quality entering the treatment plant and the operation must continually respond to the high turbidity that occurs seasonally or intermittently from localized rainfall events. A capital improvement priority that was identified is a pre-sedimentation basin equipped with chemical addition for coagulation and mechanical solids removal. The pretreatment facility will stabilize the influent water quality and improve the treated water quality.

The Environmental Protection Agency (EPA) finalized two new drinking water regulations that are scheduled for implementation in 2004; the Stage 1 Disinfectant/Disinfection By-Products Rule (Stage 1 D/DBPR) and the Long Term 1 Enhanced Surface Water Treatment Rule (LT1ESWTR). These rules are very complex and will affect the operation of the SWTP.

The SWTP is a diatomaceous earth (DE) treatment filtration facility. The plant is equipped with two DE filters with a combined treatment capacity of 1.8 MGD. The performance of the treatment plant however, is seriously compromised during periods of high turbidity or high color in the water supply. The operators respond to these events by operating the two DE filters in series using the first unit as a roughing filter and the second unit as the finishing filter.

The plant has consistently met the current standards of the safe drinking water regulations. As a DE treatment facility, the SWTP will avoid all of the new and extremely stringent turbidity limits required by LT1ESWTR. The turbidity requirements for DE treatment plants will remain 1.0 NTU. However, future safe drinking water
regulations will require greater safeguards for the water consumer and require enhanced degrees of pathogen removal and inactivation and a reduced level of DBP in the finished water supplies. Compliance with the future safe drinking water regulations by the SWTP is highly problematic unless improvements are added to the facility.

The SWTP must comply with the regulatory standards for the Stage 1 D/DBPR and LT1ESWTR by January 2004. In addition more restrictive safe drinking water regulations are being proposed and will certainly be implemented within the planning horizon of this study. The LT2ESWTR will strengthen particulate removal and inactivation requirements, especially with respect to Cryptosporidium. Utilities will be required to complete baseline source water pathogen monitoring to determine if increased treatment is required. Utilities such as Saratoga who serve populations of less than 10,000 will likely be required to monitor for E. coli on a bi-weekly basis over a year period. If concentrations exceed 50/100 ml, monitoring for Cryptosporidium may be required. If Cryptosporidium are detected in the source waters, additional log removal credits will be required.

Two treatment alternatives were investigated that will provide the treatment technologies required to achieve long term compliance with EPA’s safe drinking water regulations with the realistic realization that these regulations will be more stringent in the future. The most economical alternative involved installing a pre-sedimentation facility, keeping the DE filters and improving the ozone disinfection system at a conceptual estimated cost of $1,191,985. The second alternative utilized the DE filters as roughing filters, installing Microfiltration units and improving the disinfection system.

**Water Distribution System**
The distribution system was designed to operate as three distinct pressure zones. Operation and maintenance of multiple pressure reducing valve (PRV) installations has proved cumbersome. Multiple PRV installations must be coordinated to control pressures. All PRV installations are in vaults requiring that confined space permit and entry procedures be followed to enter and adjust the valve settings. PRV installations near the SWTP are under water most of the year. The distribution system is now operated as one pressure zone. If the system is to continue as a one zone operation, the four existing pressure reducing valve stations should be removed and individual pressure reducing valves installed on all individual water services having a residual operating pressure exceeding 70 psi. The individual pressure reducing valves should be set to provide a 65 psi, or lower, discharge pressure. These pressure valves should be located with the water meter.

The preferred method to combine the three existing pressure zones is to remove the existing pressure reducing valves and check valves and replace them with the same size pipe that is in place on each side of the valves. The pressure reducing valve vaults should also be removed. The Conceptual Level Opinion Of Cost to remove the pressure reducing valves is $69,515.

The existing and future distribution system operations were simulated using WaterCad computer modeling software. Multiple piping scenarios were investigated to determine the capacity of the existing system and the effects various operating conditions and piping changes will have on the distribution system's capacity.

The existing system can supply the design 3,000 population's maximum day demand of 1,142 gpm, maintain a 20 psi minimum residual system pressure and supply a minimum 1,000 gpm fire flow to most areas of Saratoga. The minimum fire flow was 515 gpm. Removing the pressure reducing valves increases the minimum fire flow to 537 gpm.
Meters, Meter Reading and Billing
The Town began requiring water meters in the 1970's. All water services are now metered with the exception of some municipal buildings and parks. Water meters are mechanical devices and are subject to wear and mechanical malfunctions. There isn't a meter replacement program nor is there a large meter testing and calibration program in place.

Saratoga's water meters are presently equipped with remote odometer type readouts typically located where they can be read without entering the buildings and meter vaults. The readings are written in a meter book and then transcribed into the Town's utility billing program. Reading meters is time consuming and writing down the initial meter reading and then manually transcribing the reading into the computer billing program introduces multiple chances for errors in the process.

Installing and reading water meters on all unmetered services, installing the correct types of meters and proper meter maintenance will reduce unaccounted for water, improve water system revenues and allow determining system leakage.

Meter reading and billing procedures should be changed to take advantage of developing technology. A touch read or radio read system can be incorporated into the existing system that will reduce human errors, decrease man hours needed to read meters and increase water accountability.

The Conceptual Level Opinion Of Cost to replace the existing turbine meters with compound meters, install meters on unmetered Town services, replace all small meters, install individual pressure reducing valves and implement a "Radio Read" meter reading program is $1,848,000. The cost preparation assumed 50% of the small meters will be installed in new meter pits and 50% will be installed in buildings and crawl spaces.

Water Storage Facilities
The existing storage system includes two 1,000,000 gallon standpipes and a 100,000 gallon tank at the Old Baldy Club. The combined effective tank storage capacity is adequate for the projected 3,000 population.

The initial standpipe is a welded steel tank constructed in 1978. This tank was inspected by divers in 1999 while the tank was in service. The inspection revealed numerous deficiencies in the interior of the tank. The second standpipe is a bolted steel tank constructed in 2002. Construction of this second standpipe will now allow the initial standpipe to be removed from service for cleaning, painting and other needed maintenance.

ECONOMIC ANALYSIS AND PROJECT FINANCING
State and Federal loan and grant programs commonly available to Wyoming municipal water systems were investigated. With present interest rates, the most attractive funding approach is to secure a 50% grant from the State Lands and Investments Board or the Wyoming Water Development Commission and finance the remaining 50% of the project with a 2 ½% interest loan from the Wyoming State Revolving Fund.