EXECUTIVE SUMMARY

MANAGEMENT PLAN for WATER RIGHTS On MONOLITH RANCH

May, 2004

Prepared For:

City of Laramie
P.O. Box C
Laramie, Wyoming 82073

Prepared By:

FASSETT CONSULTING, LLC

P.O. Box 2255
Cheyenne, Wyoming 82003

In Association With:

Mr. Paul Rechard, P.E. & L.S.

and

WWC ENGINEERING

611 Skyline Road
Laramie, Wyoming 82070

EXECUTIVE SUMMARY

MANAGEMENT PLAN FOR WATER RIGHTS ON MONOLITH RANCH

Introduction

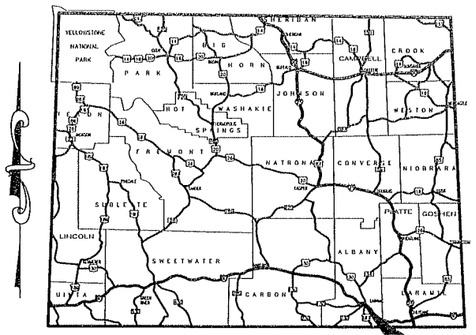
The City of Laramie relies upon a variety of water sources to meet the municipal water demands of its citizens, businesses and other water users. This includes a combination of surface and ground water supplies from the Laramie River and the Casper Aquifer. In 1981 the City made an important long-term investment in a reliable and secure water supply through the purchase of the Monolith Ranch, which included a significant portion of the Dowlin Ditch, the most senior priority water right in the entire Laramie River basin. Portions of this water right were previously purchased and transferred to municipal use in 1945 and 1963. In 1995, the City, with funding provided through the Wyoming Water Development Commission, completed a comprehensive Water Supply Master Plan evaluating its existing water supply sources. This plan, prepared by Western Water Consultants, Inc. began the process of evaluating strategies for meeting the City's continuing growth in population and water demand while protecting their water right and land investments.

In 1998, the City followed up this initial water supply master planning effort with a focused evaluation of the surface water rights associated with Monolith Ranch. This study resulted in a draft water right management plan for the ranch. During this time, the City continued investing in new ground water well supplies to meet its immediate needs. The draft ranch management plan was not finalized nor many of the significant recommendations implemented.

This document is the Executive Summary of the two volume report entitled Management Plan for Water Rights on Monolith Ranch, May 2004, which provides a contemporary review of water law and water management options for the ranch. The 2004 reports also provide recommendations at the City's request for continued professional water supply and water rights advice and expand upon the draft 1998 management plan. This current effort was designed to extend beyond the Monolith Ranch investment and consider all of the City's water rights assets and water supply options and incorporates three primary elements; the City's portfolio of water rights, and future agriculture and public use of the ranch lands. This report addresses the water supply and water right elements of the overall ranch plan and for the future municipal water supply planning of the City.

General Description

The City of Laramie obtains water from two sources: the Casper Aquifer and the Laramie River. The conjunctive use of these two sources has allowed the City great flexibility to meet its municipal water demands. It is in the best interests of the City to manage these water resources wisely and to use both sources as necessary to maximize sound total water resource utilization (see Figure ES-1).



PROJECT LOCATION

R 77 W R 76 W R 75 W R 74 W R 73 W R 72 W

T 16 N T 15 N T 14 N

SPUR WELL FIELD

SPUR RIDGE

City Of Laramie

TURNER WELL FIELD (CITY SPRINGS)

LARAMIE REGIONAL AIRPORT

130

80

230

287

POPE WELL FIELD

SOLDIER SPRINGS

SIMPSON SPRINGS

MONOLITH RANCH BOUNDARY

Porter Lake

Hardigan Lake

Lake Hattie Supply Canal No. 1

MEDICINE BOW NATIONAL FOREST

Lake Hattie Reservoir

Lake Hattie

North Canal

Sevenmile Lakes

Soldier Creek

Harney Creek

Goforth Reservoir

Doulin Ditch

Lake Hattie Supply Canal No. 2

Pioneer Canal

TREATED WATER TRANSMISSION LINES
-20 INCH
-24 INCH

TRANSMISSION LINE -36 INCH

Sodergreen Reservoir

WATER TREATMENT PLANT

Pioneer Canal Enlargement

Laramie River

SAND CREEK ROAD

City Surface Water Diversion At Pioneer Canal Headgate Diversion

0 10,000 FT
SCALE

FIGURE ES-1
EXISTING WATER SOURCES

MANAGEMENT PLAN FOR WATER RIGHTS ON THE MONOLITH RANCH
CITY OF LARAMIE, WYOMING

WWC ENGINEERING

Water development for the City of Laramie has evolved through two distinct phases. The first phase, from 1868 to about 1940, relied on the natural discharge from three nearby springs receiving water from the Casper Aquifer – City, Pope, and Soldier Springs. This gravity fed system was attractive because of the low cost of operation; however, the City could only take what the aquifer offered by way of natural discharge from the springs. With the installation of the Pope Wells in 1937-39, the City began to draw on the storage capacity of the Casper Aquifer to meet its water requirements.

In 1945, the City proceeded with a water right transfer of 10 cfs from the Dowlin Ditch to the Pioneer Canal for municipal use and the Board of Control approved this change of use of water rights. The City constructed a 20-inch pipeline from Sodergreen Reservoir to carry the water to the City in1947. When the City of Laramie made Laramie River water available to the Union Pacific Railroad, the UPRR was willing to exchange its water right in City Springs for the municipal water. In 1963, the City again petitioned the Board of Control to change an additional 4.3713 cfs of Dowlin Ditch water rights to municipal purposes. With the 1964 transfer, the City now has the right to divert from the Laramie River at the Pioneer Canal headgate 14.3113 cfs (9.25 mgd). The City then constructed a water treatment plant near Sodergreen Reservoir with a rated capacity of 6.8 mgd and added a 24-inch pipeline to bring treated water to the City.

Also in 1981, the city drilled a fourth well at the Pope well field and installed wells near City Springs to better control the flow of the springs. Other studies and investigations continued through the decade and in 1991 the water right for City Springs was transferred to Turner No. 2 well. A well was drilled at Soldier Springs in 1999 and the surface water rights of the City were transferred to Soldier No. 1 well later that year. In 2000, a new groundwater source was developed with the drilling of two wells north of Laramie in an area known as the Spur Well. A complete listing of all of the City's water rights is contained in Volume I of the full report.

Water Demands

Water demand forecasting for raw water supply or overall capacity is usually classified as long-term forecasting, with a time range of at least 7 to 10 years. In the case of this study, the planning horizon is 30 years, 2003-2033. Water demand forecasting is most often performed using the per capita demand extrapolation method. This was the method employed in previous Laramie planning efforts (Banner 1981, WWC 1995), and is the method used in this study.

The two most recent comprehensive City water planning studies used linear progression to estimate service area populations out to the planning horizon (Banner 1983, WWC 1995). In this current study, a compounded growth rate is used (1.2% per year) to project population. This method was chosen to maintain consistency with other planning efforts in the City. This rate reflects the projected growth in the populations of the University of Wyoming and the Wyoming Technical Institute and their affect on the City's transportation infrastructure.

In the arid climate of the Laramie River Basin, water demand varies greatly depending on the season. Irrigation demands by Laramie residents, City green space and UW landscaping greatly increase the total water use during the summer season. Average daily demands by season for the decades from 1970 through 2000 were gathered and tabulated. In addition, average daily demand values for 2000-2002, which are considered by many to be severe drought years were also reviewed. These per capita demands were generated by comparing City of Laramie water production figures with the service area population estimates presented previously. The per capita demand method was then used to estimate future municipal water demands by multiplication of estimated population by the per capita unit demands. Table ES-1 presents the projected water demands for the 30-year planning horizon.

Water Supplies

A. Surface Water

The City of Laramie obtains a significant portion of its water supply from the Laramie River, the primary stream in the Upper Laramie River Basin. The City currently diverts municipal water at the Pioneer Canal Enlargement headwork's about 24 miles west of the City. Streamflow data for the Laramie River generally extend from 1912 through 2002 for the USGS streamflow gaging station at Laramie River and on the Pioneer Canal. This flow gaging location is directly reflective of the physical availability of water for the current municipal diversion to the City's water treatment plant.

For this report a detailed low streamflow frequency analysis was prepared to test the reliability of the surface water supply for the municipal diversion at the Pioneer Canal headgate. This analysis was completed in part to evaluate the extreme low streamflow conditions that have existing during the recent drought. Figure ES-2 shows that Laramie River flows are infrequently below 10 cfs, with statistically about a 100-year return interval. This data also shows the reliability of the surface water supply system for the City of Laramie under very extreme conditions. The City's previous investment in the first priority water right is most valuable during these conditions.

B. Groundwater

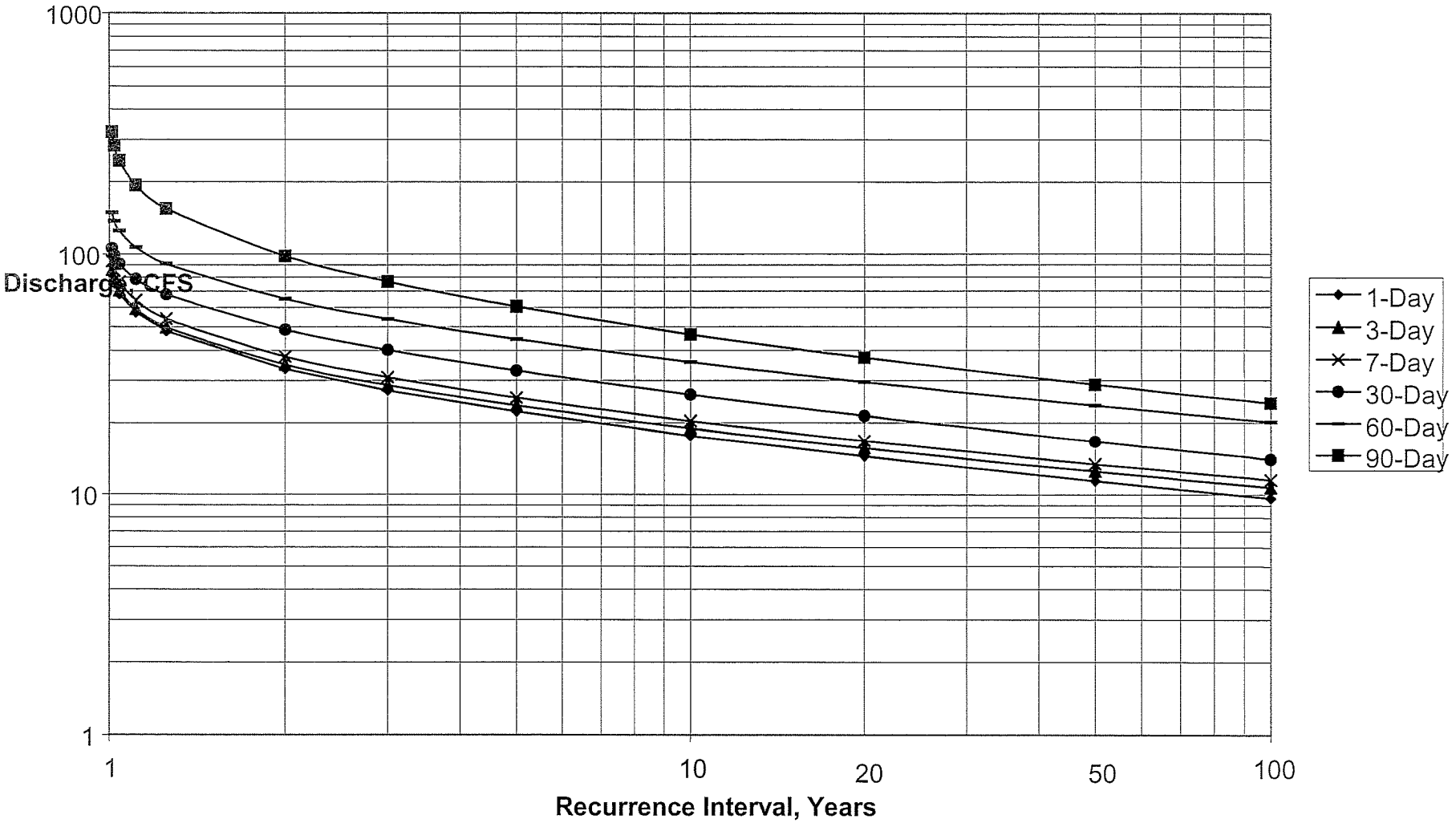
The Casper aquifer is the primary groundwater resource capable of providing adequate water quantity and quality for municipal purposes in the Laramie area. This aquifer is the source of groundwater for the City's Turner, Pope, Soldier and Spur wellfields. Groundwater development projects and studies conducted in the 1990's have also identified potential groundwater resources in the shallower Forelle Limestone and Satanka Shale aquifers that may have future value for municipal irrigation supply.

The combined natural discharge from City Springs (Turner), Pope Springs, and Soldier Springs is approximately 3.5 MGD as documented by prior research studies. Due to the installation of production wells, over the last 20 years, the combined average production from the Turner, Pope, and Soldier wellfields is approximately 3.95 MGD (or about 4,400 AF per year). The total annual production from these wellfields has not varied much over the years

Table ES-1 - City of Laramie Service Area Projected Water Demand

		Average Day Demand, mgd						Annual	Peak Day Demand, mgd			
			M&S	A & O	Summer	Winter	Annual	Total	M&S	A & O	Summer	Winter
	Table 2.1				J,J,A	N,D,J,F,M		Ac-ft			J,J,A	N,D,J,F,M
	Projected	percap	249	175	346	156	222		392	270	523	251
Year	Population	days	61	61	92	151	365		61	61	92	151
2000												
2003	28,772		7.2	5.0	10.0	4.5	6.4	7,155	11.3	7.8	15.0	7.2
2010	31,278		7.8	5.5	10.8	4.9	6.9	7,778	12.3	8.4	16.4	7.9
2020	35,240		8.8	6.2	12.2	5.5	7.8	8,764	13.8	9.5	18.4	8.8
2030	39,705		9.9	6.9	13.7	6.2	8.8	9,874	15.6	10.7	20.8	10.0
2033	41,152		10.2	7.2	14.2	6.4	9.1	10,234	16.1	11.1	21.5	10.3
2040	44,735		11.1	7.8	15.5	7.0	9.9	11,125	17.5	12.1	23.4	11.2
2050												

Figure ES-2 - Laramie R. & Pioneer Canal
N-Day Low Flow Frequency
May 5 - Sept 30 Season



and, on an average annual basis, is slightly higher (i.e., 11%) than the natural discharge from these springs.

In contrast to the wellfields developed at City Springs, Pope Springs, and Soldier Springs, the Spur Wellfield was developed in an area without an active spring, and as such the sustainable yields are less reliable at this location. Casper outcrop areas and commonly used recharge rates suggest that approximately 1 MGD may be recharging the Casper aquifer in the area near the Spur wellfield. However, the estimates of natural recharge does not necessarily equate to a sustainable long-term water yield. The City should continue to monitor water levels, wellfield production, and precipitation to gain a better understanding of the long-term production capabilities at the Spur. Although the apparent poor recovery of water levels following wellfield operation over the last 2-3 years is cause for concern, the hydraulic response over the last 3 years is probably a worst case situation given the consecutive years (2001 and 2002) of well-below average annual precipitation.

The City has enhanced its ability to meet municipal summer peak demands by supplementing the available surface water supplies with the Turner, Pope, Soldier, and Spur wellfields. However, over an average annual basis, wellfield withdrawals (with the apparent exception of Spur) are close to the historical natural spring discharges of the Casper aquifer, and consequently there has not been any noticeable lowering of groundwater level or loss of hydraulic impact to the Casper aquifer. This condition provides the City the opportunity to assess wellfield operation/aquifer management and to consider the further development of the Casper aquifer.

Water Supply Alternatives and Strategies

A number of previous studies address issues related to water supply resource planning in the Laramie area. These studies range from early 20th century studies of groundwater development to more recent studies of the water supply for the City. Many of these studies were reviewed as part of this project and references to these studies are made throughout this report.

This study completed a brief, yet complete and fresh look at the many suggested and studied water projects and also reviewed several contemporary ideas, technical issues and legal or policy changes in water law and water resource development. These projects covered the entire spectrum of opportunities and alternatives and included: transbasin diversions, reservoir storage, water right transfers, a variety of surface water efficiency projects, such as pipelines, lining, alternate uses of water rights, conjunctive use and conservation, and groundwater development projects.

This study, in consultation with City officials, completed a review of the previous research, technical work and alternatives and presents a series of recommended water supply strategies and projects for the City's consideration. In deriving recommendations we relied upon our engineering and practical experiences in similar situations and developed a set of key considerations, criteria and strategies that we believe will best serve the City the Laramie in moving forward on a realistic and structured municipal water supply series of projects, as they

are needed. These criteria included; 1) costs, 2) location of infrastructure needs in relation to the City's service area, 3) the reliability of added water yield, and 4) the institutional procedures and constraints that must be addressed for any water project development.

By applying these criteria we then developed and outlined a series of preferred water supply strategies that can be used to evaluate alternative water supply projects for the City of Laramie. The preferred strategies to prioritize and possibly select water supply projects include those where the City can:

1. Maintain ownership and control over the water supply resources
2. Maximize existing water supply assets and resources
3. Preserve, protect and build upon existing water supply investments

Using these criteria and strategies the study developed a series of preferred surface and groundwater supply projects. These projects included importantly, a focused review and development of a management plan for the water rights on Monolith Ranch. The preferred recommendations balance a combination of surface and ground water development projects to meet the growing modest long-term needs and the average and peaking municipal demands while building in drought year water supply protections by; accessing the groundwater aquifer in the vicinity of Laramie, continuing conservation programs and water supply piping.

By applying these strategies the study also eliminated some alternatives from the recommended list. An important example is; this report does not recommend development of any new municipal water supply reservoirs. Simply stated, such a facility is not needed because: 1) to securely meet the municipal demands when the City can develop the Casper aquifer, an "underground reservoir", 2) it is very costly, and 3) would have to address a variety of time-consuming and uncertain institutional constraints and permitting hurdles.

Monolith Ranch Water Rights Management Plan

The City of Laramie purchased most of the Monolith Ranch and its associated irrigation water rights including that portion of the Dowlin Ditch owned by Monolith, in 1981. The express purpose of the purchase was for the City to obtain that portion of the first priority water right on the Laramie River used on the Monolith Ranch for irrigation, then to change the use of that right to municipal purposes. To date, no portion of the water rights associated with the 1981 acquisition has been transferred from its original irrigation use, because the City has simply not yet needed to access this water supply. However, to best position and prepare the City for using this important and valuable water resource this study completed the work initiated several years ago and outlines; 1) the basic legal and technical standards for the change of use of water rights, 2) specific crop and water management guidance for the irrigated land portions of the ranch, 3) the detailed water measurement and other data collection requirements to support a transfer, and 4) the necessary corrections to the ranch water rights.

Water Supply Components, Strategies and Recommendations

As a result of the analyses and information presented in the report a tabular summary of the water production capabilities for the various components of the City's existing and

recommended water supply projects was prepared and identified as Table ES-2. This table shows the average and peak day water production capabilities of each component that was used in meeting the forecasted demand from the recommended new water projects and actions.

Table ES-3 graphically shows the recommended schedule of water supply projects over the entire 30 year planning horizon (2003 – 2033) reviewed in this report and also presents a summary of the estimated project costs. We believe that this graph presents the long-term plan for additional water supply projects and the general timeline for bringing new projects and facilities on line. Further, for each project, we have prepared an individual table of a specific set of recommended studies, data collection efforts, and other pre-requisite activities that the City should follow to maintain a well-reasoned and funded long-term water project development schedule. This series of nine tables are located after Table ES-3 at the end of this executive summary.

These tables summarize a particular set of recommended projects, and outline a suggested set of detailed activities for each project, many of which can proceed concurrently. Further, as specific activities, technical studies and funding aspects of these projects proceed, the City can customize the activities and sequence the construction of these recommended projects differently yet continue on a schedule to meet the water demands of the City. These types of changes can be accommodated as long as the City follows their historic position of developing water projects ahead of demand, and maintains the important water supply balance between surface and ground water developments.

The details of the recommended projects are discussed below.

A. Monolith Ranch

The water rights associated with the Monolith Ranch should continue to be the cornerstone of the long-term water supply investment for the City of Laramie.

As a result of this study and evaluation of the future municipal water needs the transfer of the Dowlin Ditch irrigation water rights to municipal use, will not be needed until the population growth requires the construction of a new water treatment plant. Until that time, the other recommended water supply components, together with optimizing the existing supplies, will fully meet the municipal needs of the City. The following sections outline the specific recommended actions, water supply projects and strategies for the Monolith Ranch.

i. Water Supply Strategies

The City of Laramie must invest in activities that will prepare the City for the eventual change of use of the Dowlin Ditch water rights and to manage the ranch as a public municipal asset and not as a ranch. These activities are shown on Table ES-M1 and include:

Table ES-2 - Summary of Water Supply Capability

Capability, MGD

	Average Daily Supply		Peak Day Capacity		Remarks
	Minimum Reliable Note 1	Used For Planning Note 2	Rated Note 3	Used For Planning Note 4	
EXISTING WATER RESOURCES					
Laramie River - Existing Diversion Right	6.00	6.00	6.47	16.00	
Turner Wells (City Springs)	1.60	3.95	4.00		
Pope Wells	0.00		5.50		
Soldier Well	1.40				
Spur Wells	0.00		4.00		
TOTAL	9.00	9.95	19.97	16.00	
POTENTIAL WATER RESOURCES					
Pipeline To River, Plant Upgrades and Booster Station.		2.78		2.78	
Simpson Well		0.50		2.00	
Turner Well Field Modifications		0.40		1.60	
Park Irrigation - Surface Water		0.66		2.04	See Appendix F for CIR estimates. Peak Day is based on average July use.

Notes

1 *Minimum reliable supplies are the reliably available surface water flows and spring discharges that would be lost downstream if not captured and used immediately.* See page II-3 text draft, Section II.5c.

2 The supply from the springs are based on the historic use of these resources, which includes pumping during seasons with higher demand.

3 *Rated peak values are as follows:*

River

- Assumes all but 1/100 year type river hydrology, summer diversion with 30% loss, no Sodergreen benefit or clearwell storage

Soldier and Pope Wells

- This value is the maximum that the Pope Soldier pipeline can deliver within a pressure constraint.
- This flow rate was observed in 1998 startup.

Spur Wells

- Instantaneous production maximum observed in 2000 Startup.

Turner Wells

4 *This planning value is based on 1/04 discussion with Mike Lytle. He felt that 16 mgd is the reliable peak capability of the combined sources.*

a. Manage the irrigation operations to maximize crop consumptive use by:

   - Maintaining the Dowlin Ditch water rights on the most productive lands, such as those under the current center pivot irrigation system. The City can seek approval for re-describing the location of the water rights on the irrigated ranch lands, including placing water rights back onto the productive lands from which they were previously transferred. In other words, the City should consistently look to place and maintain the water rights on the best and most productive lands. There is no legal impediment in seeking to place irrigation water rights back on lands that were previously taken out of production.
   - Maintaining diversions, as water supply, climate, canal and sprinkler operating conditions allow, during the entire irrigation and crop growing season of April through October.
   - Maintaining diversions that keep a dense Mountain Meadow Hay crop "well watered" and avoids both the over-diversion (crop inundation) and under-diversion (crop stress), to the extent possible.
   - Implementing agricultural management activities on the ranch to increase crop yields do not directly result in increases the crop consumptive use. However, the City should manage the irrigated crops and irrigation delivery systems to maintain a dense, well-watered crop, which will maximize the City's opportunity to achieve the total theoretical potential crop consumptive use and optimize the amount of water available for transfer from irrigation to municipal purposes.

b. Establish and maintain documentation systems to monitor and record all aspects of the irrigation operations under the Dowlin Ditch including: river diversions and major laterals and sprinkler systems using reporting forms contained in the report Volume II Appendix I. In addition, we recommend the City gather and maintain information on ranch irrigated cropping patterns and annual crop consumptive use estimates using locally gathered climate data (temperature, humidity, evaporation, solar radiation, precipitation, and wind), and the amount and location of the return flows back to the Laramie River basin from the applied irrigation water on the Monolith Ranch lands.

c. The City should establish and consistently maintain the above irrigation strategies, monitoring, data collection and record-keeping systems for a minimum of 5 years, and preferably for 10 years or more. Based upon the population and water demand forecasts outlined in this report, the City should not require access to the surface water supply represented by the Dowlin Ditch water for over ten years and perhaps closer to 20 years.

d. It is our opinion that the need for the Dowlin Ditch water supply is likely tied to the projected increase in municipal daily water demands and need for a new water treatment plant. To maximize the transferable volume of water from the Dowlin Ditch irrigation water rights the City should fully consider locating a new water treatment plant nearer the City. While a variety of economic and other factors must

be considered in any future plant location decision, a near City location would avoid or limit the potential conflicts with other water right appropriators and the likely reductions in the amount of water resulting from a successful upstream transfer of the water rights to a location near the existing water treatment plant. A closer location for a transfer also limits the amount of water that is lost through conveyance and evaporation. The Board of Control must address any potential injury to other appropriators during a change of water rights proceeding.

ii. Water Demand Strategies

Another important water supply recommendation related to Monolith Ranch is to use a portion of the Dowlin Ditch water rights to meet the raw water irrigation needs of the City parks; cemetery, recreation and greenbelt areas, and golf course (see Table ES-M2). While this study evaluated the alternative for drilling new groundwater wells to meet these water demands, we recommend the City study and construct a new phased surface water raw water supply system for the following reasons:

a. By shifting these existing and potential future treated water demands for these uses to a new raw water diversion and distribution system, an equivalent water supply to meet the growing needs of the City's citizens and commercial customers is made available. Whereas, if the same amount of Dowlin Ditch water right were transferred to potable use, it is likely that only about one-half the water would be available for municipal use.

b. This action will also extend the timeline for the significant investment in a new water treatment plant.

c. Preliminary estimates identify a reasonable maximum of approximately 437 acres of these types of irrigation uses within the City water service area. At ultimate build out this project could require the transfer of approximately 437 acres of water rights (about 6 cfs) from the Dowlin Ditch to a new point(s) of diversion near or in town. This raw water system should be designed to allow expansion in phases over time that coincides with the addition of each significant park or green belt area.

d. The City should seek the transfer of those portions of the current irrigation water rights that are located on the least productive crop lands (rough lands) on an acre-for-acre basis. This transfer would not be a change of use, but only a change in place of use and point of diversion for the existing irrigation water rights. As such, no crop consumptive use analysis is required and a downstream transfer will likely be easier and receive fewer objections, because there is only one intervening point of diversion between the Dowlin Ditch headgate and the City of Laramie. However, a review of the return flow conditions will need to be completed.

e. A successful downstream transfer in point of diversion would also increase the flows along the Laramie River during the April through October season to and

possibly through the City enhancing past investments in a greenbelt and pathway system, increasing fish habitat and related aesthetics and natural habitat conditions.

iii. Water Right Investment Strategies

There are two recommended projects related to the other surface water right assets of the Monolith Ranch. These are; 1) the reconstruction of Goforth Reservoir and 2) the rehabilitation of the irrigation systems along Harney and Fivemile Creeks. These facilities and water rights are assets of the Monolith Ranch that we believe should be rehabilitated and protected.

a. Goforth Reservoir – This reservoir, when in good operating condition can capture available water from Harney Creek and be used for irrigation purposes on portions of the ranch land along Harney Creek. In addition, this reservoir can provide some recreational opportunities such as fishing, or be used to provide stock and wildlife water and may also provide a modest supplemental or replacement raw water supply for the City's purposes; if it is delivered to the City boundaries (see Table ES-M3).

   To proceed with the rehabilitation the City should:

   - Complete a hydrology study of Harney Creek to evaluate the expected yield and storage benefits before proceeding with the rehabilitation.
   - Complete the necessary engineering evaluation of the dam, and to develop the required final technical design and cost estimates.
   - Prepare the reconstruction plans and specifications.
   - Obtain any necessary permits from State and Federal agencies, including any changes to the use of the reservoir water right.
   - Seek and obtain funding from available State and local sources.

b. Harney and Fivemile Creek Irrigation Systems – Several irrigation canals have water rights to divert from these creeks to irrigate lands on the Monolith Ranch. These ditch systems, over time should be reconstructed and operated to divert from the available creek supplies and from Goforth Reservoir. While these facilities are not likely to yield any reliable water supply for municipal purposes they will add to the agricultural irrigation base of the Ranch and represent an investment in possible future opportunities to change the use for other local purposes on the ranch, such as recreation and stock or wildlife watering purposes (see Table ES-M4).

c. The City should also continue the existing use of the other groundwater rights located on the ranch for both other ranch agricultural production purposes and to maintain the water rights in good standing. This includes the Hunziker Well currently used for irrigation purposes and a number of small capacity wells used for stock watering.

iv. Annual Monolith Ranch Report

As noted throughout this report, we have discussed and emphasized the importance of adequate and full data collection, analysis and reporting on all aspects of the water management on the Monolith Ranch. In this light, we recommend the City create an annual reporting process for all information related to the water resources of the ranch. This report should include as a minimum:

1. All diversions, storage and return flow measurements.
2. The climate data collected on site.
3. The groundwater level information from Monolith Ranch and the information gathered at the complete set of ground water level monitoring sites related to all of the City's wellfields.
4. Groundwater well production data from the municipal, irrigation and stock watering wells located on the Monolith Ranch, which may include direct meter readings or electric power usage data and conversions to water quantities. A report of all the City's groundwater and surface water supply usage should also be developed.

In addition, the City should annually review the quarterly proceedings of the State Board of Control to monitor any future change of use petitions in order to monitor the Board's policies or changing technical or legal standards for similar water right actions. The City should then implement any new data collection or monitoring required to address the potential technical or legal factors that may be applied to the circumstances of the future transfer of the Dowlin Ditch water rights. The City should also monitor the water rights of other users near City properties and take any actions that may pose a risk to the City municipal water rights.

B. Pipeline to Water Treatment Plant

This project is the highest priority surface water supply project we recommend. This project fits well with the strategies to invest and build upon the City's existing water supply investments. This project will bring immediate municipal benefits by eliminating the water evaporation and seepage losses (approx. 30% of the 14.31 cfs water right or 850 AF per year based upon the recent history of diversions through the Pioneer Canal) that occur between the City's municipal surface water diversion at the headgate of the Pioneer Canal and the water treatment plant. This project will greatly assist the City during periods of drought and, with additional facilities at the water treatment plant, will add approximately 2.78 mgd of available supply for treatment and delivery to the City's customers.

This project can be initiated this year and should be "on-line" in the next 3 to 5 years. To proceed with this project the City should (see Table ES-L1):

1. Proceed to negotiate for the necessary right-of-way from the headgate structure to the water treatment plant. If successful negotiations are not possible the City may need to seek legal remedy to obtain the construction and operating access and rights required.
2. Proceed with any State and federal permitting and the engineering design, plans and specifications for the pipeline.

3. Proceed with the necessary water treatment plant improvements, related to the increased available river inflows, and delivery to the City (see Table ES-L2).
4. Evaluate and seek any necessary funding from a variety of Local, State and Federal sources.

C. Turner Wells Re-operation

This project is the highest priority groundwater supply project we recommend. This project also fits well with the recommended strategy to invest and build upon the City's existing water supply investments. The goal is to effectively control the yield of the springs to reliably increase the yield of the wellfield by 0.40 MGD on an average day demand basis and by 1.60 MGD on a peak day demand basis. The detailed design and hydraulic aspects of this project should be studied and developed over the next 2 to 5 years. However, the City should establish a permanent measuring flume just below the City Springs to collect a constant and reliable set of measurements of the water by-passing the well collection system (see Table ES-G1).

In addition, similar studies to monitor the operations and groundwater levels at and near the Pope and Soldier Springs groundwater wellfields as well as the infrastructure changes to deliver the water to the City service area are also recommended (see Table ES-G2).

D. Simpson Springs - Casper Aquifer Development

This project is a viable new groundwater development project that would be a logical next step in adding to the water supply for the City to meet future municipal water demands. While the development of this project is in the future, the City should file for a groundwater permit for a well at the springs for municipal, irrigation, recreation and stock and wildlife watering purposes. Install a permanent measuring flume to monitor and measure the discharge of the springs. The City should continue to use the existing surface water rights at Simpson Springs while seeking test and production well groundwater permits from the State Engineers Office for development of the Casper Aquifer at the Simpson Spring location. This will help establish the City's priority position, relative to any other development of groundwater resources in this area (see Table ES-G3).

E. Other Actions

This report has summarized and highlighted several important water supply and conservation actions that are categorized as on-going City initiatives and we recommend these activities continue. These include the continuation of the City's water restriction program (which has achieved approx. 6 to 10% savings) and the treated water distribution system leakage control project.

Conclusions

The water supply system for the City of Laramie is physically productive and legally reliable. The City has developed a balanced physical water supply relying upon both surface water and groundwater sources and a reliable legal supply with some of the best and most senior priority water rights in the river basin. Together with continuing the well-reasoned water conservation program of some drought related water restrictions and steady progress of controlling distribution system leakage, this municipal system can be built upon and expanded to meet the forecasted municipal water demands for an increasing population for the long-term.

This water supply system has proven resilient during periods of severe drought (2001-2003) because of the balance in using surface water when it is available and economical with complementary groundwater supplies to meet portions of the base load and summer peaking demands. The groundwater aquifer underlying the area has been used as an "underground reservoir" and filled the gaps in the existing surface water supplies. The Casper aquifer has efficiently provided the long-term carryover water storage to meet the municipal demands during periods of drought. The City does not need to build a new water supply reservoir to meet these demands.

We estimate that these programs together with the recommended projects contained in this report that the City can achieve a 40% increase in their long-term water supply assets and still have the remaining portion of the Dowlin Ditch water rights and the Simpson Springs development in their portfolio for future growth.

Table ES-3 - Water Supply Development and Protection Plan Summary

Resource	Project	Additional Water Provided: Peak Day mgd	Additional Water Provided: Ave Day mgd	Estimated Project Costs: Capital	Estimated Project Costs: Annual	
Monolith Ranch						
ES-M1	Dowlin Ditch Water Rights Maintenance	Note 1, 2		$205,000	$10,000	
ES-M2	Park Irrigation with Surface Water	2.00	0.66	$9,537,500	$0	Note 3
ES-M3	Goforth Reservoir Rehabilitation	Note 1		$441,000	$0	
ES-M4	Five Mile Creek/Harney Creek Irrigation Rehabilitation	Note 1		$231,000	$0	
Laramie River						
ES-L1	Pipeline - River to WTP	0.00	0.00	$3,216,000	$0	Note 4
ES-L2	WTP Upgrades/Booster Station	2.78	2.78	$5,105,000	$0	
Groundwater						
ES-G1	City Springs/Turner Wells	1.60	0.40	$1,530,000	$0	
ES-G2	Spur Well Field and Soldier Well	Note 1		$25,000	$5,000	
ES-G3	Simpson Springs	2.00	0.50	$3,914,500	$0	

Year		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Projected Population		28,772	29,118	29,467	29,821	30,179	30,541	30,907	31,278	31,653	32,033	32,418	32,807	33,200	33,599	34,002	34,410	34,823	35,241	35,664	36,092	36,525	36,963	37,407	37,855	38,310	38,769	39,235	39,705	40,182	40,664	41,152
Demands, MGD																																
	Peak Day	15.05	15.23	15.41	15.6	15.78	15.97	16.16	16.36	16.55	16.75	16.95	17.16	17.36	17.57	17.78	18	18.21	18.43	18.65	18.88	19.1	19.33	19.56	19.8	20.04	20.28	20.52	20.77	21.02	21.27	21.52
	Ave Day	6.39	6.46	6.54	6.62	6.7	6.78	6.86	6.94	7.03	7.11	7.2	7.28	7.37	7.46	7.55	7.64	7.73	7.82	7.92	8.01	8.11	8.21	8.3	8.4	8.5	8.61	8.71	8.81	8.92	9.03	9.14
Supply, MGD Note 5																																
	Peak Day	16.00	16.00	16.00	16.00	16.00	16.00	17.60	17.60	17.60	17.60	17.60	17.60	17.60	17.60	19.60	19.60	19.60	19.60	19.60	19.60	19.60	19.60	19.60	22.38	22.38	22.38	22.38	22.38	22.38	22.38	22.38
	Ave Day	9.95	9.95	9.95	9.95	9.95	9.95	10.35	10.35	10.35	10.35	10.35	10.35	10.35	10.35	11.01	11.01	11.01	11.01	11.01	11.01	11.01	11.01	11.01	13.79	13.79	13.79	13.79	13.79	13.79	13.79	13.79
Surplus Supply, MGD																																
	Peak Day	0.95	0.77	0.59	0.40	0.22	0.03	1.44	1.24	1.05	0.85	0.65	0.44	0.24	0.03	1.82	1.60	1.39	1.17	0.95	0.72	0.50	0.27	0.04	2.58	2.34	2.10	1.86	1.61	1.36	1.11	0.86
	Ave Day	3.56	3.49	3.41	3.33	3.25	3.17	3.49	3.41	3.32	3.24	3.15	3.07	2.98	2.89	3.46	3.37	3.28	3.19	3.09	3.00	2.90	2.80	2.71	5.39	5.29	5.18	5.08	4.98	4.87	4.76	4.65
Work Task Table ES-M1																																
Work Task Table ES-M2																●																
Work Task Table ES-M3																																
Work Task Table ES-M4																																
Work Task Table ES-L1																																
Work Task Table ES-L2																									●							
Work Task Table ES-G1								●																								
Work Task Table ES-G2																																
Work Task Table ES-G3																																●

Notes

1 See detailed discussion in Chapter V. These projects protect water resource assets of the Monolith Ranch

2 These prerequisite actions, studies and ongoing work are leading to a potential transfer of 2,000 to 3,000 AF/Year.

3 There is a large range of potential costs for this project, depending on the water supply source and number of parks to be irrigated. The most extensive project is presented herein. This project is beneficial because it effectively reduces the peak and average day demands on the treated water supply. Demand reductions are proportional to the irrigated acreage.

4 Project L1 without L2 is beneficial and recommended . L1 by itself provides water supply security during drought conditions. L1 and L2 combined provide additional supply.

5 Water supply capability is presented on Table ES-1.

Legend Indicates diligent progress and accelerated project costs towards bringing a new water supply or project on line.

Indicates periodic progress addressing administrative and prerequisite items related to the project, including water rights maintenance. (Typically less cost intensive than construction).

● Indicates critical project completion milestone to overcome projected supply deficit.

Table ES-G3 Simpson Springs

Year	Objective	How or Activity	Estimated Budget Capital	Annual
1	File GW permit application with SEO for Simpson Well	Staff	$2,500	-----
1	Install flume to measure by-pass flows	Staff/consultant	$25,000	-----
2	Define design criteria research and apply for project	Staff	$2,000	-----
2	Financing	Staff	$3,000	-----
3	Engineering, Permitting & ROW	Retain Engineer/Surveyor	$382,000	-----
6	Construction		$3,500,000	-----
		TOTAL BUDGET (2004 VALUE)	$3,914,500	$0

Table ES-M1 Dowlin Ditch Water Rights Maintenance

Year	Objective	How or Activity	Estimated Budget Capital	Annual
1	Redefine water rights acreage to match actually irrigated	Retain consultant/surveyor. Petition to BOC	$40,000	-----
2	Move acreages from poorer lands to better producing lands	Petition BOC	$5,000	-----
2	Irrigation Operations Documentation	Write RFP and retain a professional to prepare a framework and an initial annual report on this topic. See Chapter V, A.i,b.	$25,000	-----
2	BOC Activity Review and Report	Write RFP and retain a professional to prepare a framework and an initial annual report on this topic. See Chapter V, A.i,b.	$25,000	-----
3	Replanting irrigated lands	Retain agronomist Actual acreages dependent on outcome of other plan items	-----	
3	Prepare Local Water Treatment Plant Evaluation for site near City	RFP and retain consultant	$50,000	-----
4	Climatological Station At Ranch	Install Climatological Station At Ranch	$10,000	-----
6	Prepare Irrigation Plan	Retain Consultant to inventory existing conditions of irrigation diversion, delivery and distribution facilities and make recommendations for improvements and financing	$50,000	
2-20	Prepare annual irrigation operations and BOC activity reports discussed above	Staff and periodic outside peer review	-----	$10,000
		TOTAL BUDGET (2004 VALUE)	$205,000	$10,000

Table ES-M2 Park Irrigation with Surface Water

Year	Objective	How or Activity	Estimated Budget Capital	Annual
1	Municipal Irrigation Feasibility Study	Apply to WWDC for Level II Study, to expand on concept from this study and evaluate phased implementation approach	$1,500	-----
2	Participate in Level II study		$1,000	-----
3	Prepare detailed irrigation mapping for each green space, to minimize transfers	Retain Surveyor.	$20,000	-----
3	Transfer water rights	Prepare petition to BOC	$10,000	-----
5	Easements and permits		$5,000	-----
6	Engineering		$1,300,000	-----
7	Construct		$8,200,000	-----
		TOTAL BUDGET (2004 VALUE)	$9,537,500	$0

Engineering and construction costs for this concept are highly dependent on the number of parks, golf course and other green belt areas selected and the water source.
The most extensive irrigation scheme at full build out and budget, is presented.

Table ES-M3 Goforth Reservoir Rehabilitation

Year	Objective	How or Activity	Estimated Budget Capital	Annual
1	Confirm project feasibility	Estimate reservoir firm yield based on hydrologic supply and water rights in the drainage. Retain consultant.	$20,000	-----
3	Apply to WWDC for Rehab Project	(Alternate to above)	$1,000	-----
6	Engineering, Permitting & ROW		$60,000	-----
7	Construct		$360,000	-----
		TOTAL BUDGET (2004 VALUE)	$441,000	$0

Table ES-M4 Five Mile Creek/Harney Creek Irrigation Rehabilitation

Year	Objective	How or Activity	Estimated Budget Capital	Annual
2	Field inspection	Staff	$1,000	-----
5	Design Improvements	Retain consultant	$25,000	-----
7	Clean up water rights	Prepare petition to BOC	$5,000	-----
10	Construct		$200,000	-----
		TOTAL BUDGET (2004 VALUE)	$231,000	$0

Table ES-L1 Pipeline - River to WTP

Year	Objective	How or Activity	Estimated Budget Capital	Annual
1	Begin ROW discussion with landowner and PCLHID	Staff	$3,000	-----
2	Define design criteria	Staff	$2,000	-----
2	Apply to WWDC for Level III grant funding and SRF program for loan	Staff	$3,000	-----
4	Engineering, Permitting & ROW	Retain Engineer/Surveyor	$308,000	-----
6	Construction		$2,900,000	-----
		TOTAL BUDGET (2004 VALUE)	$3,216,000	$0

NOTE: Project L1 without L2 still provides benefits to the City and is recommended. L1 by itself provides water supply security during drought conditions. L1 and L2 combined provide additional municipal supply.

Table ES-L2 WTP Upgrades/Booster Station

Year	Objective	How or Activity	Estimated Budget Capital	Estimated Budget Annual
2	Define design criteria	Staff	$2,000	-----
5	Apply to State, Local, and Federal Agencies for Financing	Staff - SCLIB/WWDC/RUS	$3,000	-----
8	Engineering, Permitting & ROW	Retain Engineer/Surveyor	$765,000	-----
12	Construction		$4,335,000	-----
		TOTAL BUDGET (2004 VALUE)	$5,105,000	$0

Table ES-G1 City Springs/Turner Wells

Year	Objective	How or Activitiy	Estimated Budget Capital	Annual
1	Install flume to measure by-pass flows	Staff/consultant	$25,000	-----
2	Define design criteria for expanded municipal use	Staff	$2,000	-----
2	Apply to WWDC for Level III grant funding and SRF program for project loan	Staff	$3,000	-----
3	Engineering, Permitting & ROW	Retain Engineer/Surveyor	$300,000	-----
4	Construction		$1,200,000	-----
		TOTAL BUDGET (2004 VALUE)	$1,530,000	$0

Table ES-G2 Spur Well Field and Soldier Well

Year	Objective	How or Activity	Estimated Budget Capital	Annual
1-20	Monitoring program, Annual Report and peer review analysis of data collected	Staff/Consultant		$5,000
1	Install flume to measure by-pass - Soldier	Staff/consultant	$25,000	-----
		TOTAL BUDGET (2004 VALUE)	$25,000	$5,000