City of Cheyenne
Board of Public Utilities

Volume 6 – Non-Potable Water Treatment and Distribution

2013 Cheyenne Water and Wastewater Master Plans

Final

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City of Cheyenne

Board of Public Utilities

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Abbreviations and Acronyms

ac	Acre
ac-ft	Acre-feet
ADD	Average Day Demand
BOPU	Board of Public Utilities
City	City of Cheyenne
CCWRF	Crow Creek Water Reclamation Facility
CFU	Colony Forming Units
DCWRF	Dry Creek Water Reclamation Facility
EHS	East High School
ft	Feet
gal	Gallon
gpm	Gallons per Minute
LCCC	Laramie County Community College
LCSD	Laramie County School District
MG	Million Gallons
MG/yr	Million Gallons per Year
mgd	Million Gallons per Day
mL	Milliliter
O&M	Operations and Maintenance
PACL	Polyaluminum chloride

PHD	Peak Hourly Demand
PVGC	Prairie View Golf Course
SCWSD	South Cheyenne Water & Sewer District
Volume 2	Volume 2 – Future Capacity Requirements
WAFB	Warren Air Force Base
WDEQ	Wyoming Department of Environmental Quality
WRF	Water Reclamation Facility
WTP	Water Treatment Plant
yr	Year

6.1 Introduction

The City of Cheyenne (City) Board of Public Utilities (BOPU) has three non-potable water systems that help to maximize the efficient use of the City's water supplies: the raw water irrigation system, the Class B water system and the Class A water system. The primary use for the raw water irrigation and Class A systems is irrigation water while the Class B system is used for construction water and service water at the BOPU's wastewater treatment plants. The purpose of this master plan volume is to document the state of the three existing systems and to provide a strategy for improving and expanding each system to serve more customers in the future. For budgeting and planning purposes, improvements are grouped sequentially into the near-term (2014-2023), mid-term (2023-2033) and long-term (2033-2063) planning horizons. The BOPU has an overall goal to optimize the use of its non-potable water systems in order to help reduce demands on the raw and potable water supplies.

The following topics are addressed in this volume for each of the three non-potable water systems:

- Documentation of the existing users
- A review and analysis of the existing system demands
- Identification of future potential customers
- The future system demands
- A review of BOPU's current non-potable capital improvement project (CIP) list
- Identification of future infrastructure projects including budgetary cost estimates
- Recommendations are provided for future engineering evaluations that would enhance future master planning efforts for these systems

The non-potable water systems are utilized for irrigation and bulk construction water sales. Two of these systems, the raw water system and the Class A system, provide irrigation water to many of the City of Cheyenne's parks. The Class B water system is located at the DCWRF and is only used for bulk water sales for construction use and plant use.

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6.2 Background

6.2.1 Wastewater Classifications

The Wyoming Department of Environmental Quality (WDEQ) has defined the following three classes of wastewater:

- "Class A wastewater is treated wastewater which has received advanced treatment and/or secondary treatment and a level of disinfection so that the maximum number of fecal coliform organisms is 2.2 colony forming units (CFU)/100 mL or less."
- "Class B wastewater is treated wastewater which has received the equivalent of secondary treatment and a level of disinfection so that the maximum fecal coliform level is greater than 2.2 CFU/100 mL but less than 200 CFU/100 mL."
- "Class C wastewater is treated wastewater which has received the equivalent of primary treatment and a level of disinfection so that the maximum fecal coliform level is 200 CFU /100 mL or greater but less than 1000 CFU/100 mL."

The City has non-potable water systems for both Class A treated wastewater and Class B treated wastewater. The BOPU operates two wastewater treatment plants, the Dry Creek Water Reclamation Facility (DCWRF) and the Crow Creek Water Reclamation Facility (CCWRF).

- The DCWRF produces Class B reuse wastewater, which will be referred to as "Class B" throughout this Volume.
- The CCWRF includes a recycled water treatment system with the capability to produce Class A recycle wastewater, which will be referred to throughout this volume as "Class A."

The Class A and Class B systems are interrelated as shown in Figure 6-1. This figure also shows the future option of a reuse line from the DCWRF to the Crow Creek Recycle Water Facility detailed in Section 6.5.8.

6.2.2 WDEQ Reuse Regulations

Chapter 12 of the WDEQ Water Quality Rules and Regulations outlines the standards for the reuse of treated wastewater. Class B wastewater is authorized for irrigation of land with a low or moderate potential for public exposure, as well as irrigation of direct and indirect human consumption food crops. If Class B wastewater is used for reuse on land with a moderate or low potential for public exposure, fencing and signing must be provided.

Class A water is authorized for irrigation of land with a high potential for public exposure in addition to applications permitted for Class B. Treated wastewater must be used for beneficial reuse and cannot exceed the irrigation volumes required at a site. Neither Class A nor Class B water can be applied to agricultural land, forest, or a public contact site. Furthermore, it cannot contaminate a groundwater aquifer or leave the application site as runoff with the potential to enter the State's surface waters. All treated wastewater irrigation systems must be isolated with a 30 foot buffer zone between the reuse site and adjacent property lines.

Storage of Class A water in a pond facility requires a liner if denitrification is not included in the treatment process. However, the CCWRF does include denitrification, so liners will not be required to meet WDEQ regulatory requirements for Class A storage within the BOPU's system. That being said, unlined ponds can lead to significant loss of the stored water due to seepage, so thin liners are recommended to reduce water loss on any new storage pond projects.

6.2.3 Current Class B System Expansion Plans

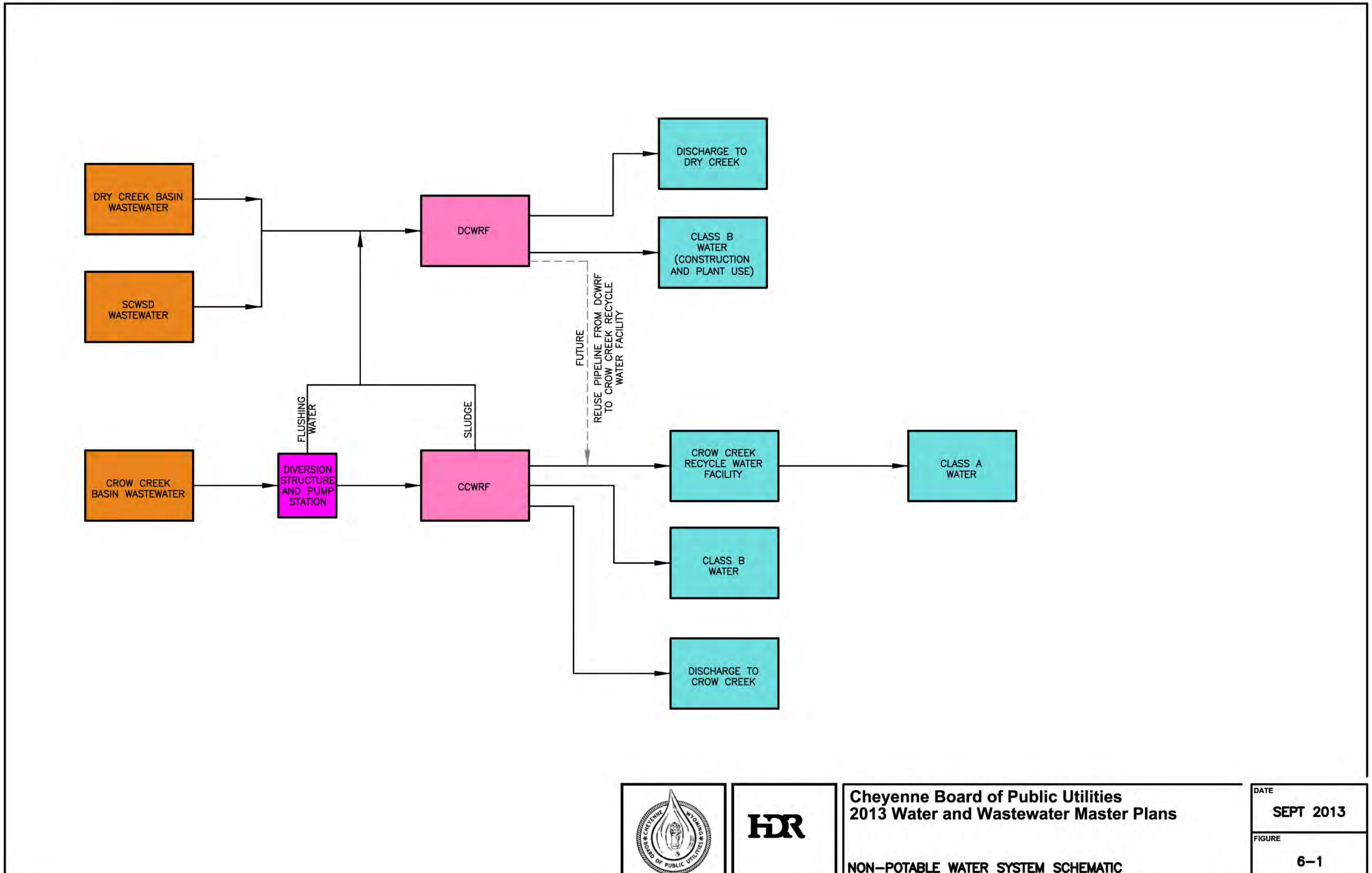
The BOPU's current plans to expand the Class B system are summarized below.

- The addition of a pump station to provide Class B water to the neighboring power generation facility.
- Facility upgrades to DCWRF, and additional pumps included in the Class B pump station to provide a more robust Class B dispensing systems for the sale of non-potable water to Contractors.

6.2.4 Current Class A System Expansion Plans

The BOPU's current plans to expand the Class A system are summarized below.

- The recycled water distribution system is planned to be expanded in 2014 to Holliday Park to deliver up to 0.23 mgd (0.71 ac-ft/day) of Class A water. The plan is to connect to the existing recycled water system near Airport Parkway and 3rd Avenue and extend a pipeline to Holliday Park down Morrie Avenue. The estimated annual demand is 0.08 mgd (70 ac-ft/day) for 29 acres (ac) of irrigated turf.
- The recycled water distribution system is planned to be expanded in 2017 to Mylar and Smalley Park to deliver up to 0.3 mgd (0.92 ac-ft/day) of Class A water.
- The recycled water distribution system is planned to be expanded in 2018 to Central High School and McCormick Junior High to deliver up to 0.3 mgd (0.92 ac-ft/day) of Class A water.


DRY CREEK BASIN WASTEWATER
SCWSD WASTEWATER
DCWRF
DISCHARGE TO DRY CREEK
CLASS B WATER (CONSTRUCTION AND PLANT USE)
FUTURE
REUSE PIPELINE FROM DCWRF TO CROW CREEK RECYCLE WATER FACILITY
FLUSHING WATER
SLUDGE
CROW CREEK BASIN WASTEWATER
DIVERSION STRUCTURE AND PUMP STATION
CCWRF
CROW CREEK RECYCLE WATER FACILITY
CLASS A WATER
CLASS B WATER
DISCHARGE TO CROW CREEK
Cheyenne Board of Public Utilities
2013 Water and Wastewater Master Plans
NON-POTABLE WATER SYSTEM SCHEMATIC
DATE
SEPT 2013
FIGURE
6-1

6.3 Raw Water Irrigation System

For the purposes of this volume, the term, “raw water”, will refer to the raw water used for irrigation of several properties largely owned by the City of Cheyenne and the replenishment of recreational lakes. It does not include raw water used for potable treatment or other small miscellaneous uses. The existing raw water irrigation system has a limited number of customers.

6.3.1 Existing Raw Water Irrigation Distribution System

The raw water irrigation system and its customers are located on the northwest side of BOPU’s service area. The supply for the raw water irrigation system is dominated by surface water sources. These sources include the North and South Crow Reservoirs and the Crystal Reservoir brought in through the Crystal Diversion Structure. The raw water system also has a pipeline from the Ware Infiltration Gallery that supplies limited amounts of raw water in wet years and a Riser well that provides a very limited supply of raw water when necessary. The lakes supplied by this system include: Pearson, Absarraca, Kiwanis, and Sloans. Customers pump raw water from these lakes to irrigate their land. A significant portion of the raw water stored in the lakes is lost to seepage and evaporation. These losses, plus unmetered use, result in a significant amount of unaccounted-for water. Volume 2 – Future Capacity Requirements estimates the amount of unaccounted-for water in the raw water irrigation system at 45%. Further details can be found in Volume 2. The existing raw water irrigation system is shown in Figure 6-3.

6.3.2 Existing Raw Water Irrigation Customers

Table 6-1 lists the four current large raw water customers and their irrigated acres. There are several other small customers who supplement their potable water use with minimal amounts of raw water, but their overall use is negligible. To enhance the BOPU’s raw water supply accounting system, installation of a water meter is recommended on the pipeline from the Ware Infiltration Gallery.

Table 6-1
Raw Water Customers

Description	Irrigated Area (Acres)
Airport Golf Course	85.6
Cheyenne Country Club	112
Warren Air Force Base (WAFB) Golf Course	86
Lions Park	49.6
Total	333

6.3.3 Existing Raw Water Irrigation Demands

Figure 6-2 shows the average monthly raw water irrigation demand between 1999 and 2012 based on data from the last ten years. As expected, the majority of the usage occurs between April and October with July being the peak month followed by June and August.

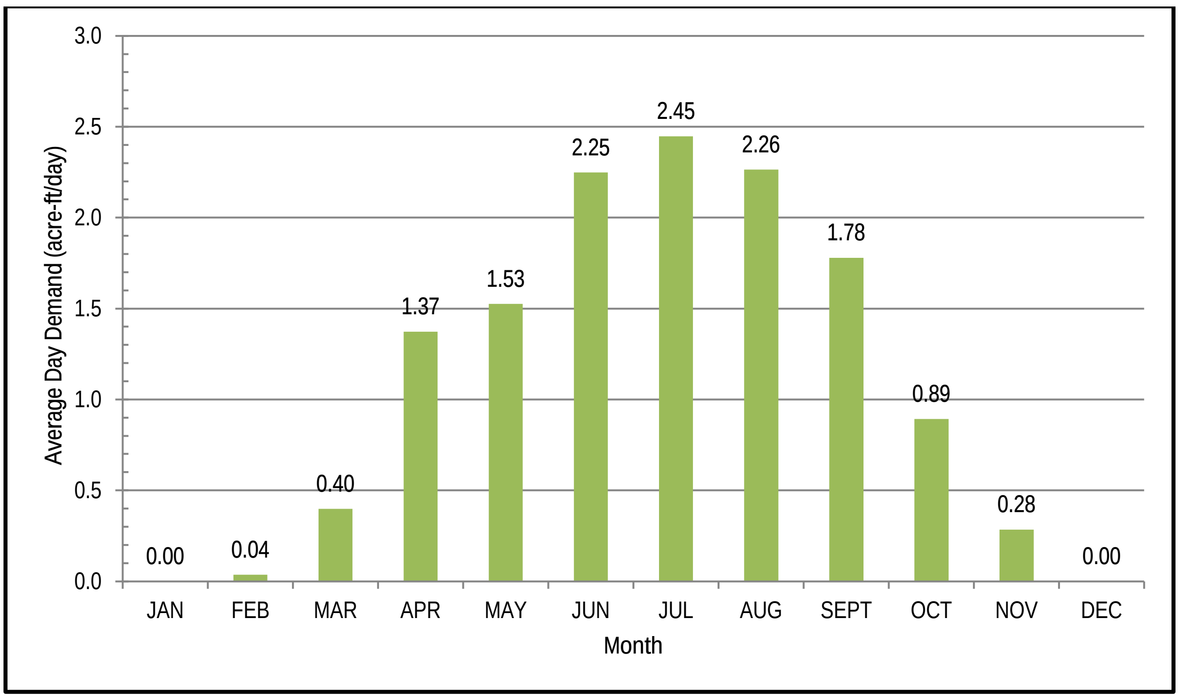


Figure 6-2
Average Monthly Distribution of Raw Water Irrigation Demands

Maximum day demands for the system averaged between 2.0 and 2.5 acre-feet (ac-ft) per day between 1999 and 2012. The years of highest demand include 2000, 2002, and 2012 due to drought conditions. The usage for 2012 was also impacted by the additional demand associated with the Cheyenne Country Club, which remained on the raw water system instead of switching over to the potable water system as they have in the past. The annual raw water irrigation use from 1999 through 2012 is listed in Table 6-2 and shown graphically in Figure 6-3.

Table 6-2
Historic Raw Water Irrigation Use

Year	Use (ac-ft/yr)	Use (MG/yr)	Use (ac-ft/ac/yr)	Use (MG/ac/yr)
1999	536	175	1.29	0.42
2000	738	241	1.77	0.58
2001	578	188	1.39	045
2002	637	208	1.53	0.50
2003	332	108	0.80	0.26
2004	404	132	0.97	0.32
2005	299	98	0.72	0.23
2006	448	146	1.08	0.35
2007	378	123	0.91	0.30
2008	351	114	0.84	0.28
2009	334	109	0.80	0.26
2010	387	126	0.93	0.30
2011	300	98	0.72	0.24
2012	818	267	1.97	0.64
Average	**467**	**152**	**1.12**	**0.37**

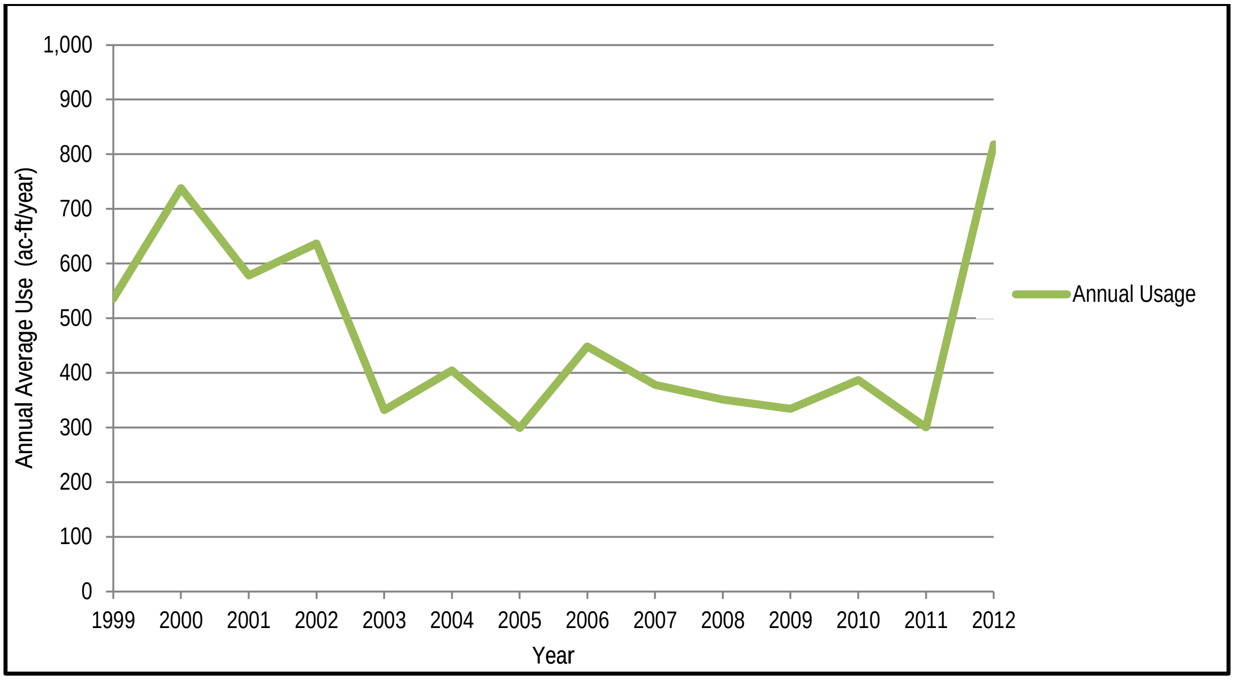
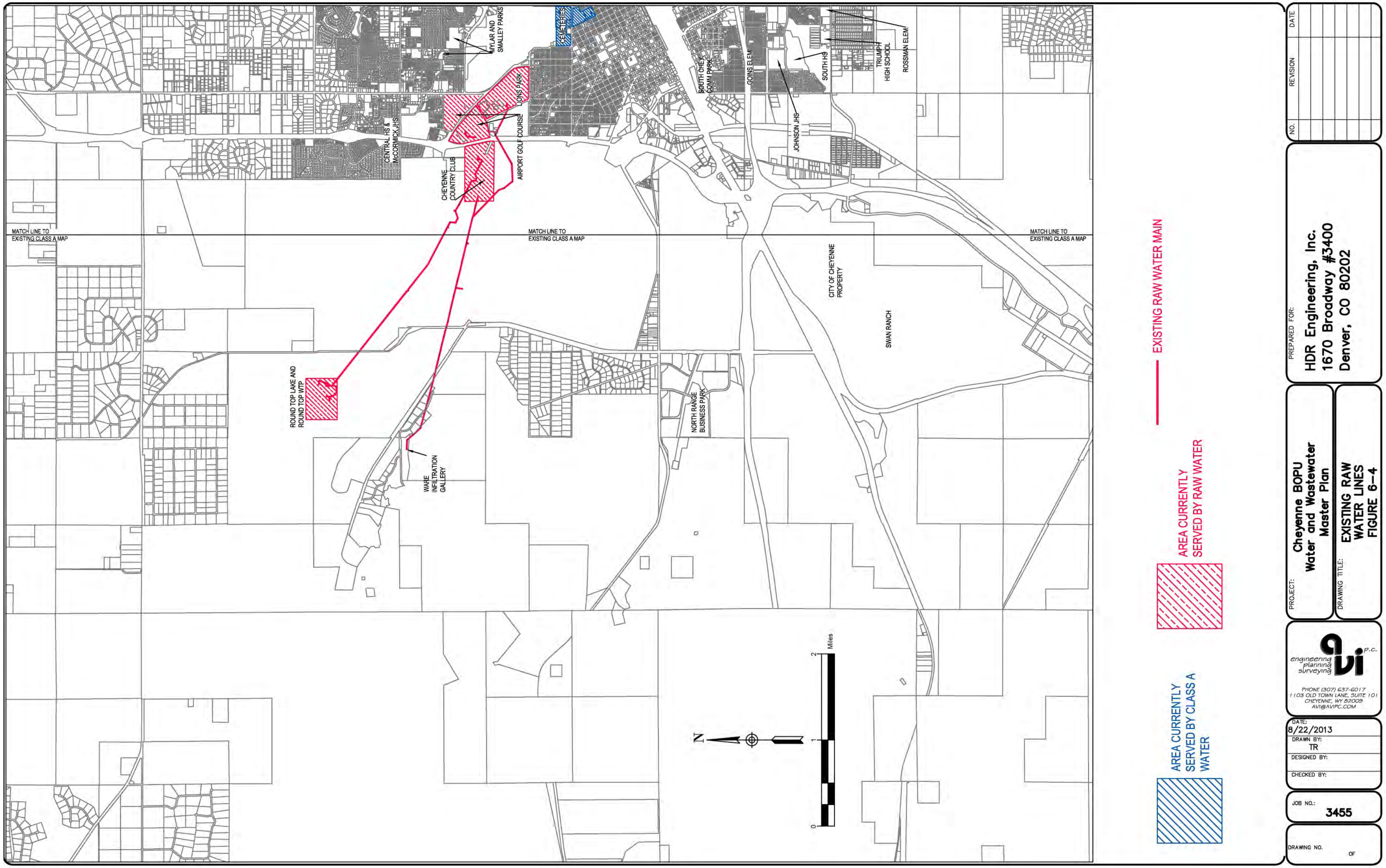


Figure 6-3
Historic Raw Water Irrigation Use

A map showing the existing raw water irrigation pipelines and large customers is presented in Figure 6-4.

6.3.4 Demand Projects

As discussed in Volume 2, the raw water irrigation demand is estimated to increase at a rate of 1% a year. This is due to an increase in unaccounted-for-water and other losses. At this projected growth rate the raw water system will be able to meet the demands of the existing customers. This rate should be revaluated every few years, taking into account less than average snowpack and other factors that could reduce the availability of raw water for irrigation.


TAYLAR AND SMALLEY PARKS
LIONS PARK
AIRPORT GOLF COURSE
CENTRAL HS & McCORMICK JHS
CHEYENNE COUNTRY CLUB
SOUTH CHEY COMM PARK
GOINS ELEM
JOHNSON JHS
SOUTH HS
TRIUMPH HIGH SCHOOL
ROSSMAN ELEM
MATCH LINE TO EXISTING CLASS A MAP
CITY OF CHEYENNE PROPERTY
SWAN RANCH
ROUND TOP LAKE AND ROUND TOP WTP
WARE INFILTRATION GALLERY
NORTH RANGE BUSINESS PARK
Miles
0
1
2
N
EXISTING RAW WATER MAIN
AREA CURRENTLY SERVED BY RAW WATER
AREA CURRENTLY SERVED BY CLASS A WATER
NO.
REVISION
DATE
PREPARED FOR:
HDR Engineering, Inc.
1670 Broadway #3400
Denver, CO 80202
PROJECT:
Cheyenne BOPU
Water and Wastewater
Master Plan
DRAWING TITLE:
EXISTING RAW
WATER LINES
FIGURE 6-4
engineering
planning
surveying
p.c.
PHONE (307) 637-6017
1103 OLD TOWN LANE, SUITE 101
CHEYENNE, WY 82009
AVI@AVIPC.COM
DATE:
8/22/2013
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DESIGNED BY:
CHECKED BY:
JOB NO.:
3455
DRAWING NO.
OF

6.4 Class B Water System

Effluent produced by both the CCWRF and the DCWRF is derived from three sources: in-basin surface water, imported surface water, and groundwater. Only the imported surface water may be used to extinction and is therefore available for Class A or B use. BOPU's SCADA data indicates that approximately 50% of the effluent is currently derived from imported surface water supplies. Consequently, the remaining 50% of the effluent from the DCWRF must be discharged into Crow Creek.

6.4.1 Existing Class B Distribution System

The only uses for Class B treated wastewater currently include construction water use and plant service water at the DCWRF. As such, the Class B system is the only non-potable water system that does not have a distribution system. Customers use a hydrant located at the DCWRF to obtain Class B water for construction use, so they are responsible for the transportation of the construction water.

6.4.2 Existing Class B System Demand

Historically, little fluctuation in Class B usage has occurred over the past five years and throughout the course of each year. Table 6-3 summarizes the annual average day demand for 2007 to 2012. Figure 6-5 shows the average day demand by month for 2007 to 2012. During this time, the average day use was 0.46 ac-ft or 0.15 mgd as calculated in Table 6-3.

Table 6-3
Historic DCWRF Class B Use

Year	Average Day Use (ac-ft)	Average Day Use (mgd)
2007	0.43	0.14
2008	0.46	0.15
2009	0.40	0.13
2010	0.49	0.16
2011	0.46	0.15
2012	0.58	0.19
Average	0.46	0.15

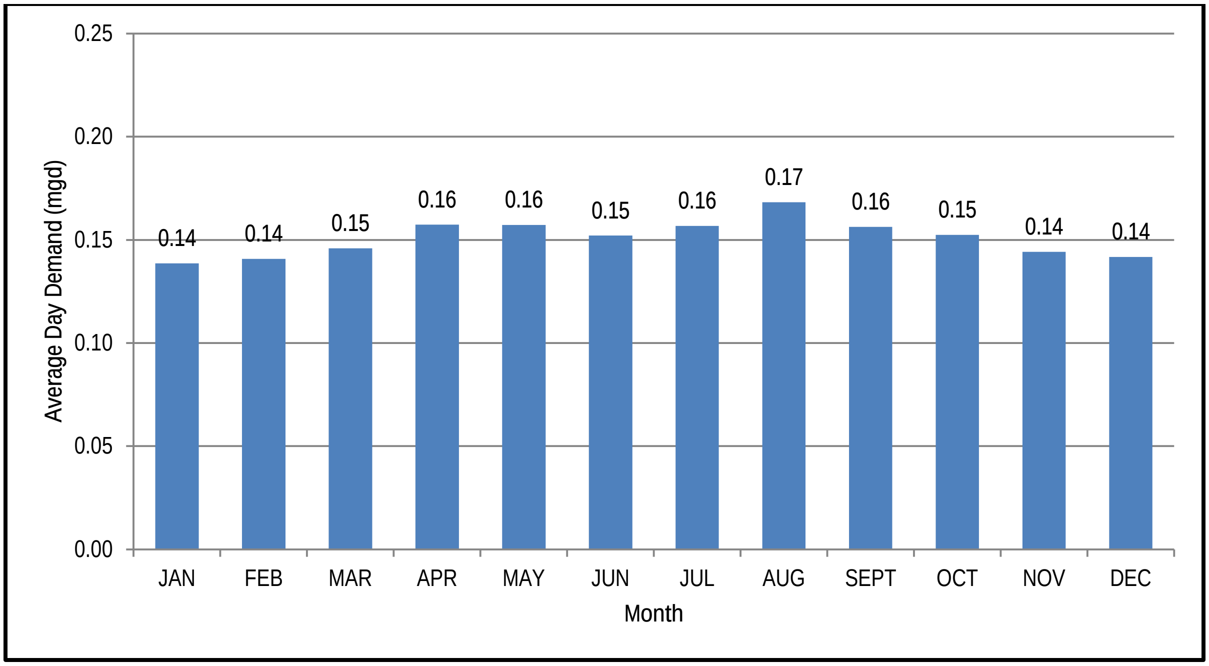

Figure 6-5
Class B Average Day Demand by Month

6.4.3 Prairie Generating Station

The new Cheyenne Prairie Generating Station is a natural gas-fired power plant that is scheduled to begin operation on October 1, 2014. The facility has requested specific amounts of Class B water for use by the station. The projected demand once the facility goes online and the ultimate water demand are documented in a letter from the plant manager to the BOPU dated April 10th, 2013. A copy of the letter is provided in Appendix 6-A. The timing of the ultimate water demand is unknown as it is largely dependent on future growth rates within the City. The station will contribute effluent back to the DCWRF, and these additional flows have been accounted for in wastewater projections provided in Volume 2. Table 6-4 summarizes the projected demands.

Table 6-4
Cheyenne Prairie Generating Station Water Demands

Type of Usage	Peak Flow (gallons/minute)	Max Daily (gallons/day)	Average Daily (gallons/day)
Initial Class B Requirements	622	650,000	65,000
Ultimate Class B Requirements	1,200	2,000,000	900,000

Apart from the Cheyenne Prairie Generating Station, no other individual customers have been identified as potential customers of the Class B system. The remaining balance of the DCWRF could be put to beneficial use if it can be pumped to the Crow Creek Recycle Water Facility and treated for Class A use. This option is discussed in further detail in Section 6.5.8.

6.4.4 Demand Projections

The primary increase in Class B water demand will come from the Cheyenne Prairie Generating Station. Historically, Class B demand has increased at roughly 1% per year and therefore a conservative annual demand increase of 1.5% is used as recommended in Volume 2. The average day Class B demand projection is shown in Table 6-5 and Figure 6-6 through 2063, using 0.19 mgd as the baseline existing demand from Volume 2. The initial Cheyenne Prairie Generating Station demand is factored into the near-term planning period, and the ultimate demand is assumed to occur in the 2053 and 2063 long-term planning periods.

6.4.5 Oversized DCWRF Pumping Station

Construction on a new Class B dispensing station is planned to begin in late 2013 or early 2014. The project not only includes the dispensing station, but also the necessary upgrades at the plant These upgrades include the installation of larger pumps for faster filling of the construction trucks, upgrades to the existing piping to handle the increase in flows, and driveway improvements for better access to the new dispensing station. The project is currently bundled with the construction of a new pump station that will provide Class B water to the Prairie Generation Facility. The BOPU's portion of the project budget is currently limited to the Class B improvements associated with the filling station as previously described, which equates to a budget of $700,000 in 2013 dollars.

Table 6-5
Average Day Class B Demand Projections

Year	Planning Period	Demand (ac-ft/day)	Demand (mgd)
2013	Existing	0.66	0.18
2023	Near-Term	1.03	0.28
2033	Mid-Term	1.14	0.31
2043	Long-Term	4.31	1.17
2053		4.46	1.21
2063		4.64	1.26

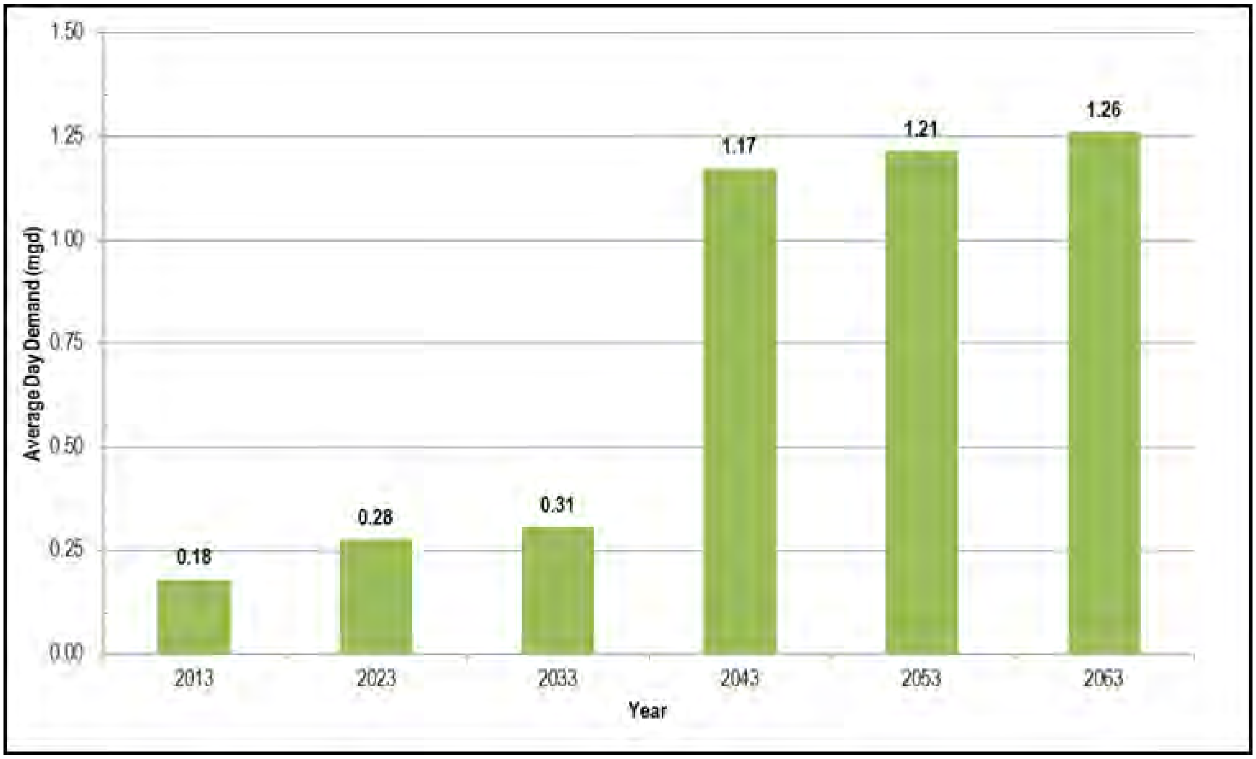

Figure 6-6
Average Day Class B Demand Projections

6.5 Class A Water System

Class A water is an excellent source for non-potable applications because it is not directly impacted by droughts or snowpack accumulations. Class A water is treated to the highest reuse water standards, so it can be used to reduce the demands on raw water and potable water used for irrigation. In order to take advantage of this water source, BOPU built a Class A treatment facility located at the CCWRF site, referred to in this volume as the Crow Creek Recycle Water Facility.

6.5.1 Existing Class A Distribution System

The CCWRF was upgraded between 2004 and 2006 so it can distribute Class A water. The facility currently has an average day capacity of 4 mgd and a peak hour capacity of 5 mgd. Recycled water distribution began in 2007. Two phases of the recycled water distribution system have been completed totaling 14 miles of distribution pipelines.

- Phase 1 was completed in 2007 and supplies 2.2 mgd to 14 locations. This phase of construction also includes the completion of the High Service pump station at CCWRT and a storage pond at the Prairie View Golf Course.
- Phase 2 was completed in 2009 and supplies 0.6 mgd to 5 locations. This phase of construction also included the relining of the Prairie View Golf Course pond and the relocation of the Sun Valley Pump Station.

As of 2012, approximately 277 acres of existing land was irrigated with recycled water.

6.5.2 Existing Class A Customers

The Class A system is utilized to irrigate parks, cemeteries, golf courses, and schools. Table 6-6 lists the metered customers throughout the city with the acreage they irrigate and their average annual Class A use between 2008 and 2012 (excluding 2009, as it was only a partial year of delivery). Figure 6-8 shows the existing Class A system and customers.

Table 6-6:
Class A Customers Summary

Location	Irrigated Area (acres)	Average Use (MG/yr)	Average Use (ac-ft/yr)	Average use (MG/ac/yr)	Average use (ac-ft/ac/yr)
North Community Park Soccer Fields	51.06	21.27	65.28	0.42	1.28
Prairie View Golf Course	42.85	25.87	79.39	0.60	1.85
City of Cheyenne Cemeteries	33.88	18.32	56.22	0.54	1.66
Cahill Park	25.56	19.75	60.61	0.77	2.37
Junior League Baseball Fields	19.74	6.7	20.56	0.34	1.04
VA Hospital	17.4	3.85	11.82	0.22	0.68
Brimmer Park	14.96	10.63	32.62	0.71	2.18
Miscellaneous	11.39	9.7	29.77	0.85	2.61
Dutcher Baseball Fields	10.01	7.36	22.59	0.74	2.26
Cheyenne Regional Airport	9.22	5.34	16.39	0.58	1.78
Converse Softball Fields	8.36	6	18.41	0.72	2.20
Okie Blanchard Stadium	7.68	3.53	10.83	0.46	1.41
Sunrise Elementary	6.05	4.58	14.06	0.76	2.32
Sunvalley Park	5.79	3.55	10.89	0.61	1.88
Miller Field	4.16	3.28	10.07	0.79	2.42
Powers Field	3.25	2.75	8.44	0.85	2.60
Jewish Cemetery	2.99	2.45	7.52	0.82	2.51
United Nations Park	2.48	1.96	6.02	0.79	2.43
Bain Elementary	0.55	0.42	1.29	0.76	2.34
Total	277				

Of the metered customers, the top five customers account for over half of the Class A consumption, as shown in Figure 6-7. Plans to expand the Class A system are currently in place, which would allow for additional customers to receive Class A service (refer to Section 6.2.3).

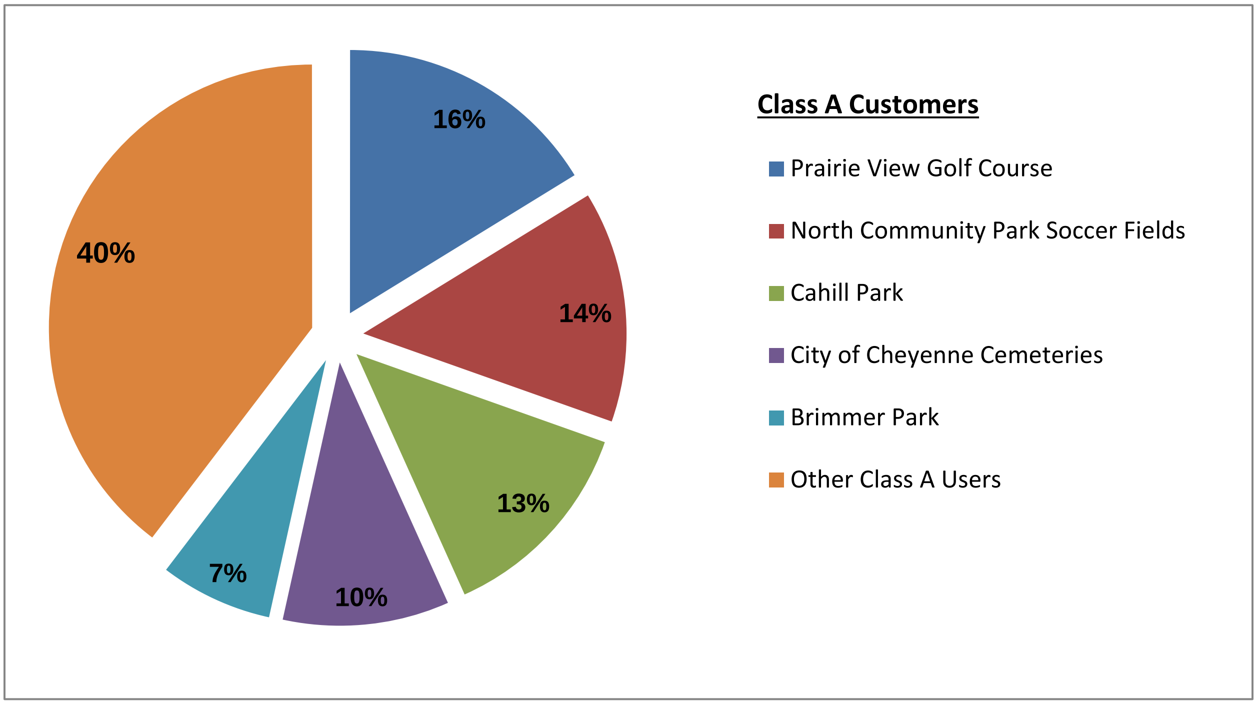

Figure 6-7
Metered Class A Customers

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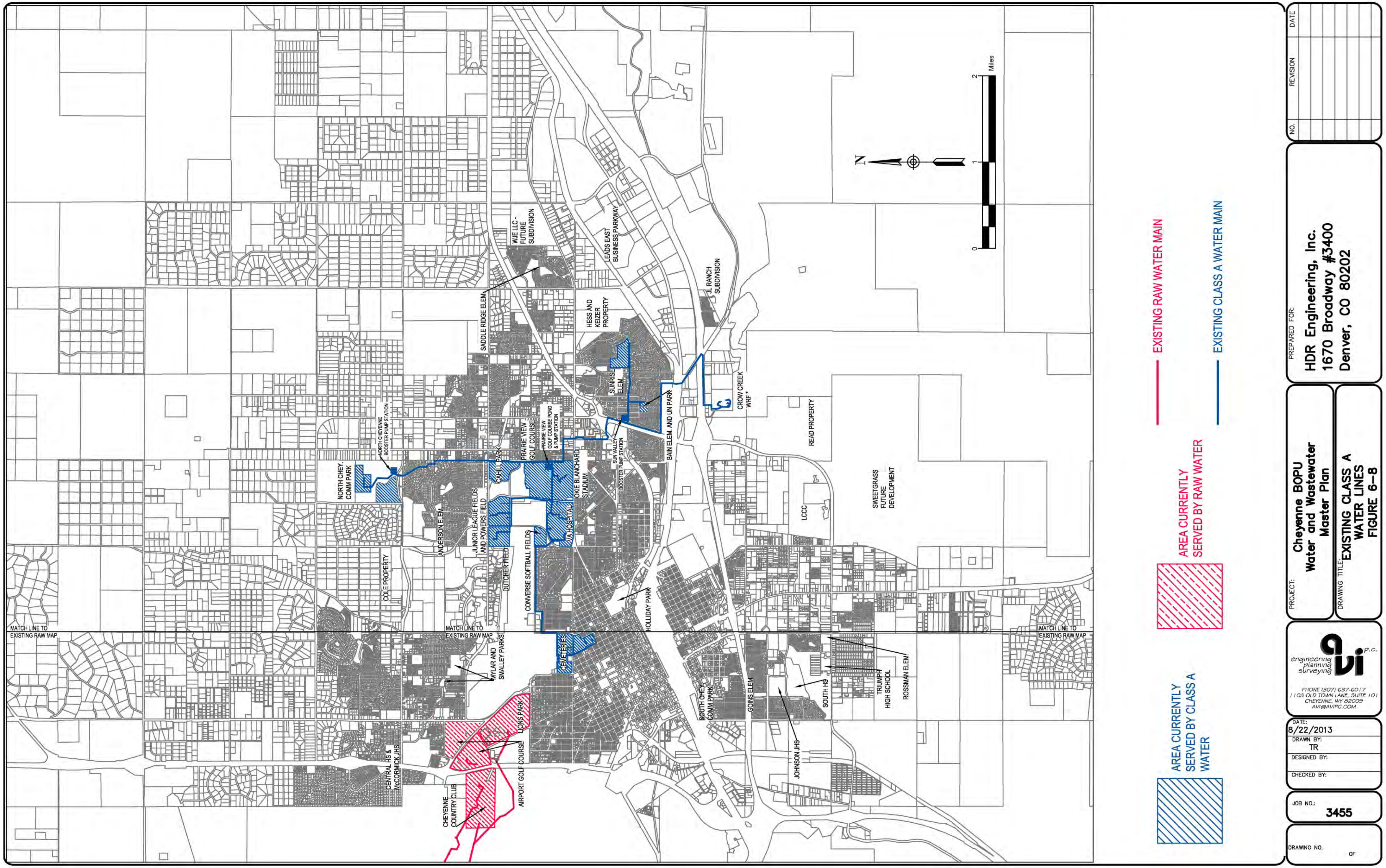
EXISTING RAW WATER MAIN
EXISTING CLASS A WATER MAIN
AREA CURRENTLY SERVED BY RAW WATER
AREA CURRENTLY SERVED BY CLASS A WATER
N
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REVISION
DATE
PREPARED FOR:
HDR Engineering, Inc.
1670 Broadway #3400
Denver, CO 80202
PROJECT:
Cheyenne BOPU
Water and Wastewater
Master Plan
DRAWING TITLE:
EXISTING CLASS A
WATER LINES
FIGURE 6-8
engineering
planning
surveying
p.c.
DATE:
8/22/2013
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OF
MATCH LINE TO EXISTING RAW MAP
WJE LLC FUTURE SUBDIVISION
LEADS EAST BUSINESS PARKWAY
RANCH SUBDIVISION
HESS AND KEIZER PROPERTY
SADDLE RIDGE ELEM.
SUNRISE ELEM.
BAIN ELEM. AND UN PARK
CROW CREEK WRF
READ PROPERTY
NORTH CHEY COMM PARK
PRAIRIE VIEW GOLF COURSE
LCCC
SWEETGRASS FUTURE DEVELOPMENT
ANDERSON ELEM.
JUNIOR LEAGUE FIELDS AND POWERS FIELD
DUTCHER FIELD
CONVERSE SOFTBALL FIELDS
COLE PROPERTY
HOLLIDAY PARK
CEMETERIES
NYLAR AND SMALLEY PARKS
SOUTH CHEY COMM PARK
GOINS ELEM.
JOHNSON JHS
SOUTH HS
TRIUMPH HIGH SCHOOL
ROSSMAN ELEM.
CENTRAL HS & McCORMICK JHS
CHEYENNE COUNTRY CLUB
AIRPORT GOLF COURSE
LIONS PARK

6.5.3 Existing Class A Demand

The current Class A system is under the highest demand in the summer months, with its peak demand in July. Currently, there is no Class A water usage from December through February. Figure 6-9 shows the variation in Class A water use throughout the year based on data from 2007 through 2012. The Class A annual use totals from 2007 to 2012 are summarized in Table 6-7.

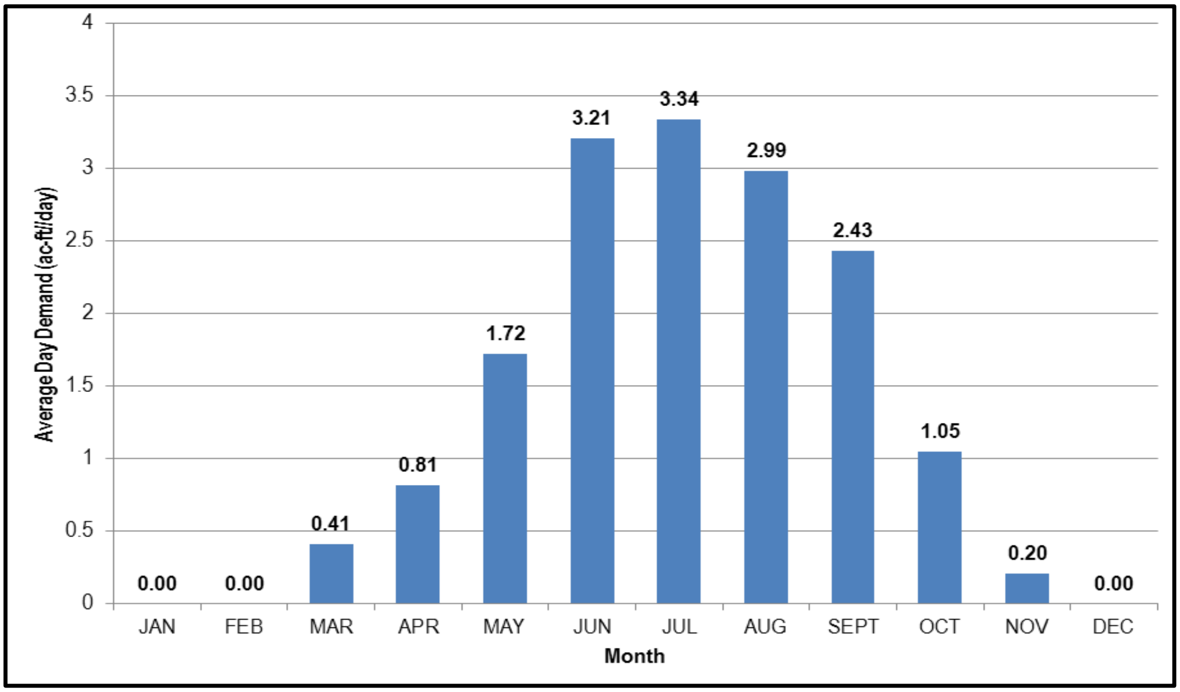

Figure 6-9
Average Monthly Distribution of Class A Demands

Table 6-7
Historic Class A Use

Year	Annual Use (ac-ft/yr)	Annual Use (MG/yr)	Annual Use (ac-ft/ac/yr)(1)	Annual Use (MG/ac/yr)
2007(2)	223	73	1.42	0.46
2008	461	150	2.94	0.96
2009(2)	102	33	0.37	0.12
2010	587	191	2.12	0.69
2011	428	139	1.55	0.51
2012	657	214	2.37	0.77
Average	533	174	2.24	0.73

(1) Includes 157 acres of turf from 2007-2008, and 277 acres of turf from 2009-2012.
(2) Partial year of delivery. Not included in Averages.

6.5.4 Crow Creek Recycle Water Facility

Historically, the demand for Class A water has been sporadic, since the existing infrastructure is relatively new. The Crow Creek Recycle Water Facility is currently capable of treating 4 mgd, but was designed to be expanded to treat 10 mgd. Only an average of 23% of the total wastewater effluent available from the CCWRF is currently treated to Class A standards. The Crow Creek Recycle Water Facility treats the secondary effluent through filtration, with the introduction of coagulation aids upstream as shown in Figure 6-10. The facility is hydraulically connected to the CCWRF's UV disinfection effluent box through a 24-inch pipeline. Following the UV, effluent is sent to a wet well with 3 transfer pumps. The transfer pumps typically operate with two online and one in standby mode. All 3 transfer pumps are equipped with VFD's and are capable of feeding the Crow Creek Recycle Water Facility at a range of 1.0 to 6.3 MGD. The Crow Creek Recycle Water Facility includes a rapid mix chamber followed by two sets of 6 continuous contact upflow Dynasand filters manufactured by Parkson.

To ensure proper coagulation and filtration, the two chemical systems installed at the facility feed polymer and alum. Since the construction of the facility, the alum feed system has been repurposed to feed polyaluminum chloride (PACL), which was found to be a better filter aid. The equipment included in the two chemical feed systems are sized to meet the future 10 mgd demand.

Filtered water flows by gravity to one of two 1.28 MG Class A treated storage tanks (former trickling filters for the CCWRF). At this time, the second tank is in need of repair, so the system is limited to half the storage capacity. Under normal conditions 2.5 MG of storage is available for Class A at the Crow Creek Recycle Water Facility.

The Crow Creek Recycle Facility is typically operated in hand mode during the day by the CCWRF operators. The flow is set by comparing the estimated availability of effluent with the level in the Class A storage tanks and the Prairie View Golf Course Pond. The control system is also equipped with level instruments in the UV channel, Class A Storage tanks and the Prairie View Pond, that turn the system pumps on at high levels and off at low levels, reducing the risk of both overflowing the tanks and pump cavitation.

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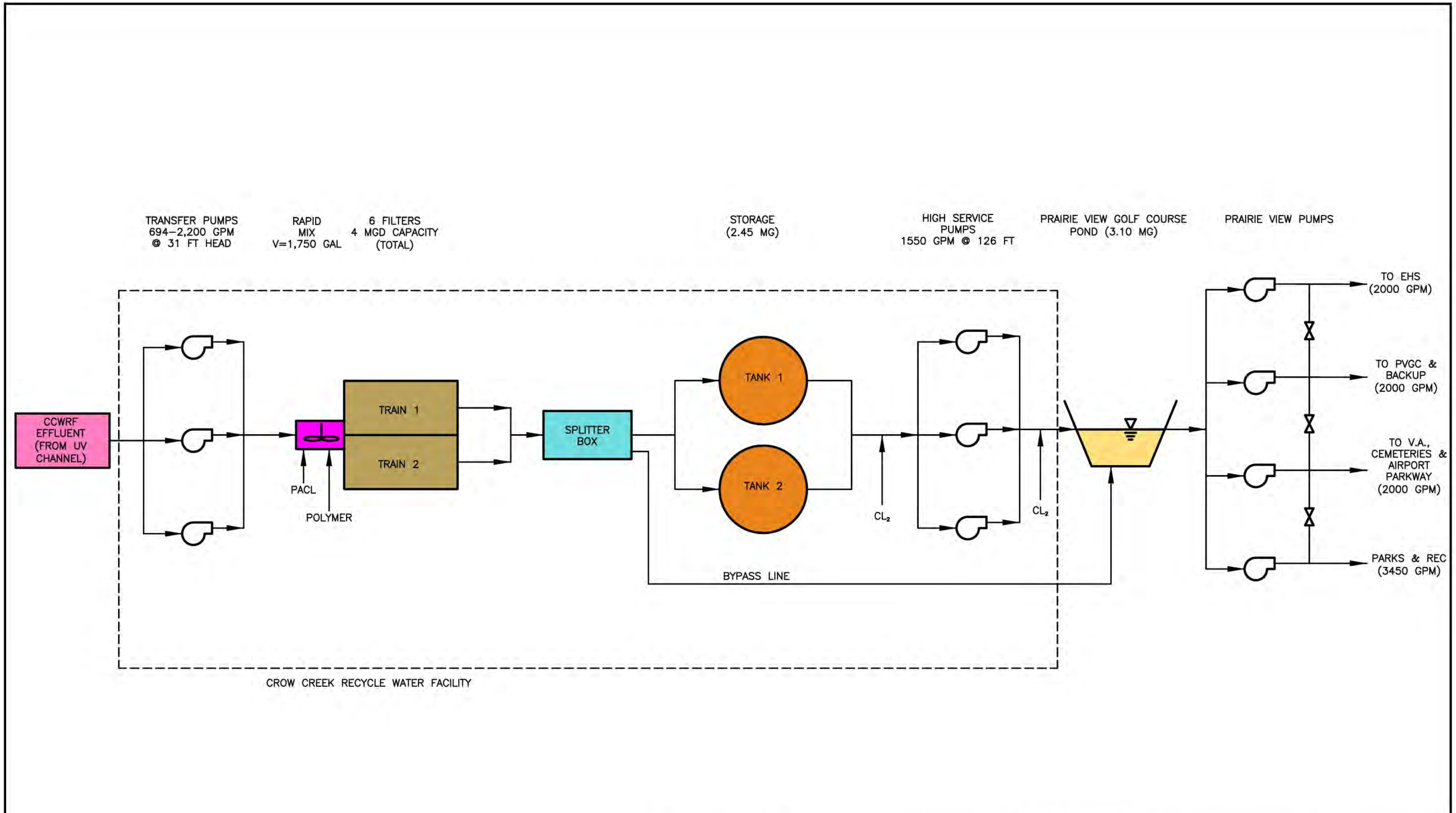


Cheyenne Board of Public Utilities
2013 Water and Wastewater Master Plans

EXISTING CLASS A FACILITIES

DATE
SEPT 2013

FIGURE
6–10

6.5.5 Class A Storage and Pump Stations

Class A water is pumped to either the storage tanks at the Crow Creek Recycle Water Facility or to the Prairie View Golf Course Pond by the high service pump station, which includes three pumps. The pumps are equipped with variable frequency drives (VFDs) for a total pumping capacity of 6.7 mgd at 55 psi of pressure. However, these pumps have additional available space for a future pump as well as an intermediate pump. The Prairie View Golf Course Pond is lined and has a 3.1 MG storage capacity (including the wet well). The pond serves as the source of supply for the golf course and for the Prairie View Golf Course Pump Station. This pump station is equipped with four skids, each containing three pumps, which transport Class A water to the rest of the BOPU Class A customers.

The Class A system has a total storage volume of 5.66 MG between the treated storage tanks at the Crow Creek Recycle Water Facility and the Prairie View Golf Course Pond. This storage is used to meet the peak hour demands of the Class A system. The storage and pumping facilities described above are shown on the Class A system schematic in Figure 6-10. The Prairie View Golf Pump Station was constructed to provide continuous pressure to the Class A system, so the pumps are activated anytime the system pressure drops due to high system demands.

There are also two booster pump stations in the Class A system that are currently used to serve customers on the furthest north and east ends of the system. The Sun Valley Booster Pump Station services customers on 12th Street, which can feed the customers 800 gpm at a boosted pressure up to 100 psi. The other booster pump station at North Cheyenne Park is capable of pumping 1,550 gpm at 126 feet.

6.5.6 Future Class A Customers

Representatives from the BOPU, HDR and AVI met on July 25th, 2013 and identified potential future Class A customers along with their approximate irrigated acreages. The potential Class A customers include future developments, current potable water customers, and current raw water customers. Figure 6-11 shows the locations of the potential Class A customers and their locations relative to the existing Class A system. Table 6-8 lists the potential customers with their approximate irrigated acres.

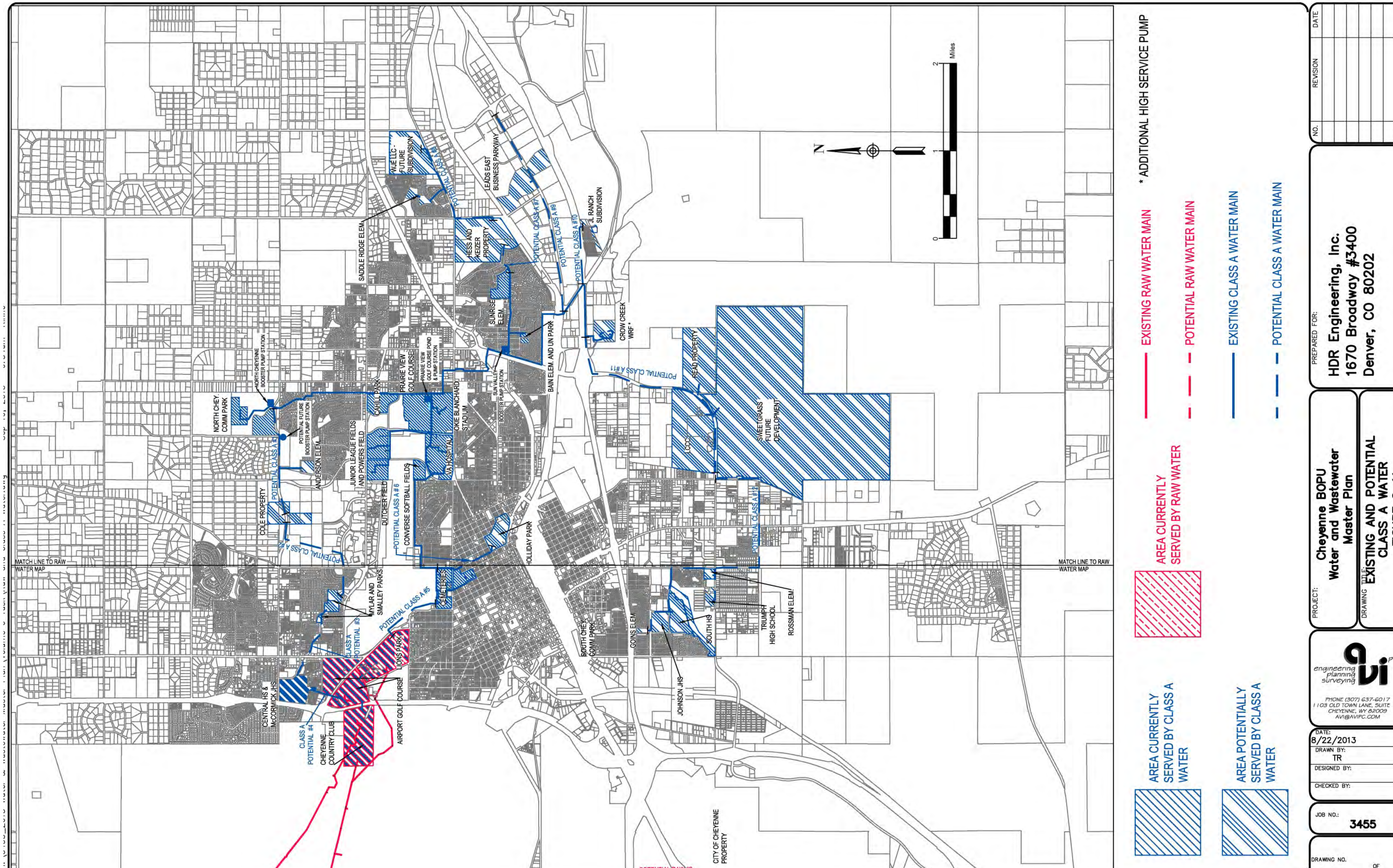
Table 6-8
Potential Class A Customers

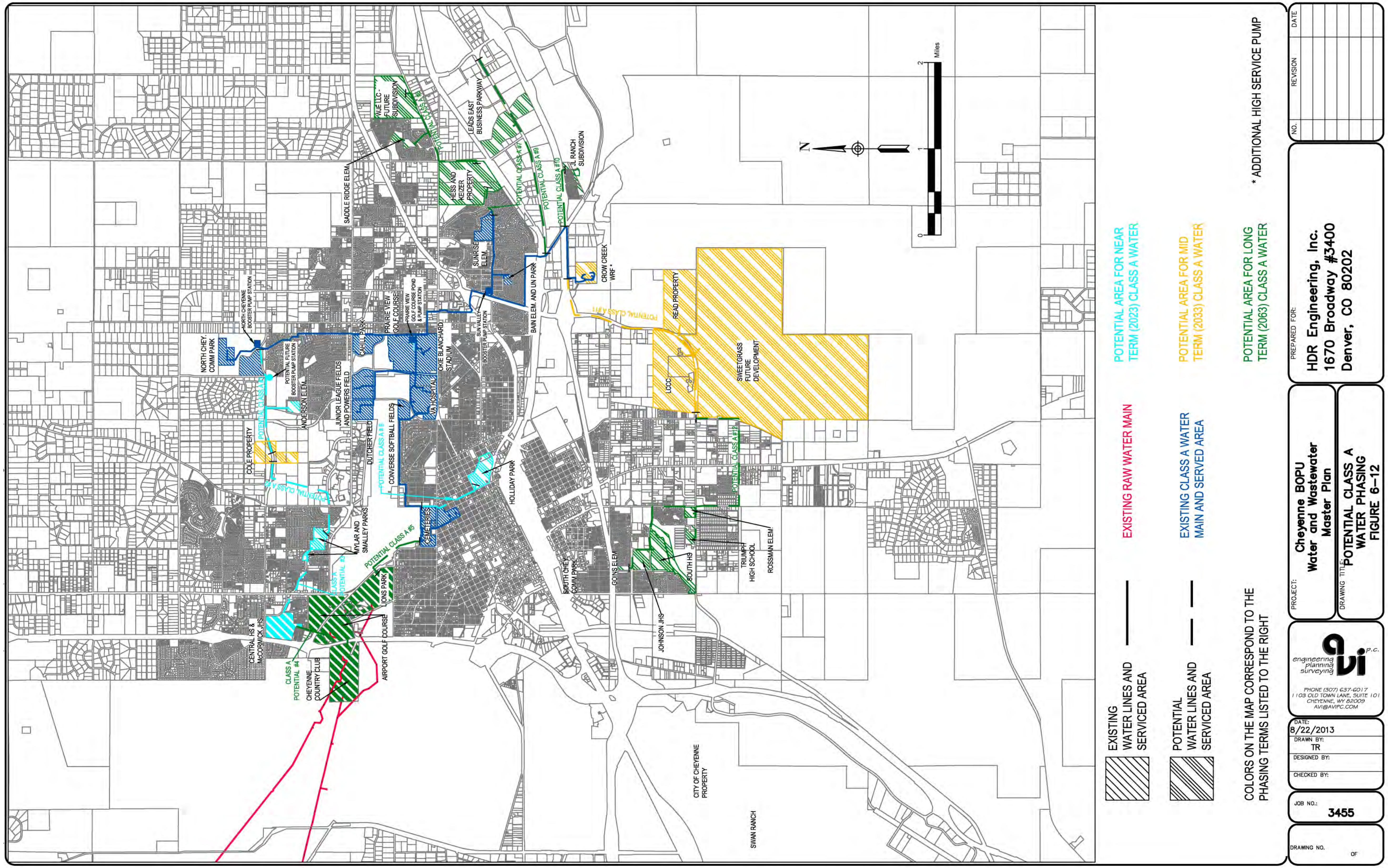
Land Owner	Description	Estimated Irrigated Area (acres)
Cheyenne LEADS	LEADS East Business Parkway Open Space	129
Lummis Livestock Company, LLC	Sweetgrass Land Development	125
Cheyenne Country Club	Currently on the raw water system	112
Kenneth Hess & DSK Ranch LLC	Future Park near Sunrise Elementary	100
WAFB Golf Course	Currently on the raw water system	86
Airport Golf Course	Currently on the raw water system	85.6
City of Cheyenne	South Cheyenne Community Park	80
Lions Park	Currently on the raw water system	49.6
Frank Cole	Future Park off of Storey Drive	45
City of Cheyenne	Holliday Park	29.1
Laramie County Community College (LCCC) Foundation	LCCC Campus	25
Read Company	Future Park off of S. College Drive	18
B and L Land Co.	JL Ranch Open Space	14
WJE LLC	Future subdivision east of Saddle Ridge	13
Central HS & McCormick JHS	Schools in the northwest	12
Ed Murray	Open Space behind South High	10
City of Cheyenne	Mylar and Smalley Parks	8.7
City of Cheyenne	Saddle Ridge Park	7.66
City of Cheyenne	Martin Luther King Junior Park	6.2
	East Business Parkway- Landscaped Median	5
Laramie County School District (LCSD) #1	South High School	5
LCSD #1	Johnson Junior High School	4
City of Cheyenne	Lincoln Park	2
LCSD #1	Anderson Elementary	1.5
LCSD #1	Triumph High School	1
LCSD #1	Rossman Elementary	1
LCSD #1	Saddle Ridge Elementary	1
LCSD #1	Goins Elementary	0.5
	Total Irrigated Area	977

The potential future Class A customers were grouped so new customers could be brought on line gradually to avoid large treatment, storage and pumping infrastructure improvements in the near-term planning horizon. The potential Class A customers were then further grouped into suggested expansion timeframes for the near-term, mid-term, and long-term planning horizons. Figure 6-12 shows the potential customers and Class A system expansion by year and Table 6-9 lists the customers and area added by planning horizons.

Table 6-9
Potential New Class A Customers by Planning Horizon

Land Owner	Description	Estimated Irrigated Area (acres)
Near-term (2023)		
City of Cheyenne	Holliday Park	29.1
Central HS & McCormick JHS	Schools in the northwest	12
City of Cheyenne	Mylar and Smalley Parks	8.7
LCSD #1	Anderson Elementary	1.5
	Near-term (2023) Area Subtotal	51
Mid-term (2033)		
Lummis Livestock Company, LLC	Sweetgrass Land Development	125
Frank Cole	Future Park off of Storey Drive	45
LCCC Foundation	LCCC Campus	25
Read Company	Future Park off of S College Drive	18
	Mid-term (2033) Area Subtotal	213
Long-term (2063)		
Cheyenne LEADS	LEADS East Business Parkway Open Space	129
Cheyenne Country Club	Currently on the raw water system	112
Kenneth Hess & DSK Ranch LLC	Future Park near Sunrise Elementary	100
WAFB Golf Course	Currently on the raw water system	86
Airport Golf Course	Currently on the raw water system	85.6
Lions Park	Currently on the raw water system	49.6
B and L Land Co.	JL Ranch Open Space	14
WJE LLC	Future subdivision east of Saddle Ridge	13
Ed Murray	Open Space behind South High	10
City of Cheyenne	Saddle Ridge Park	7.66
	East Business Parkway- Landscaped Median	5
LCSD #1	South High School	5
LCSD #1	Johnson Junior High School	4
LCSD #1	Saddle Ridge Elementary	1
LCSD #1	Triumph High School	1
LCSD #1	Rossman Elementary	1
LCSD #1	Goins Elementary	0.5
	Long-term (2063) Area Subtotal	624


* ADDITIONAL HIGH SERVICE PUMP
EXISTING RAW WATER MAIN
POTENTIAL RAW WATER MAIN
EXISTING CLASS A WATER MAIN
POTENTIAL CLASS A WATER MAIN
AREA CURRENTLY SERVED BY RAW WATER
AREA CURRENTLY SERVED BY CLASS A WATER
AREA POTENTIALLY SERVED BY CLASS A WATER
PREPARED FOR:
HDR Engineering, Inc.
1670 Broadway #3400
Denver, CO 80202
PROJECT:
Cheyenne BOPU
Water and Wastewater
Master Plan
DRAWING TITLE:
EXISTING AND POTENTIAL
CLASS A WATER
FIGURE 6–11
engineering planning surveying
PHONE (307) 637-6017
1103 OLD TOWN LANE, SUITE 101
CHEYENNE, WY 82009
AVI@AVIPC.COM
DATE:
8/22/2013
DRAWN BY:
TR
DESIGNED BY:
CHECKED BY:
JOB NO.:
3455
DRAWING NO.
OF
NO.
REVISION
DATE
MATCH LINE TO RAW WATER MAP
Miles
N
CROW CREEK WRF *
SWEETGRASS FUTURE DEVELOPMENT
LEADS EAST BUSINESS PARKWAY
CITY OF CHEYENNE PROPERTY
POTENTIAL RAW #2


POTENTIAL AREA FOR NEAR TERM (2023) CLASS A WATER
POTENTIAL AREA FOR MID TERM (2033) CLASS A WATER
POTENTIAL AREA FOR LONG TERM (2063) CLASS A WATER
* ADDITIONAL HIGH SERVICE PUMP
EXISTING RAW WATER MAIN
EXISTING CLASS A WATER MAIN AND SERVED AREA
EXISTING WATER LINES AND SERVICED AREA
POTENTIAL WATER LINES AND SERVICED AREA
COLORS ON THE MAP CORRESPOND TO THE PHASING TERMS LISTED TO THE RIGHT
PREPARED FOR:
HDR Engineering, Inc.
1670 Broadway #3400
Denver, CO 80202
PROJECT:
Cheyenne BOPU
Water and Wastewater
Master Plan
DRAWING TITLE:
POTENTIAL CLASS A
WATER PHASING
FIGURE 6-12
engineering planning surveying
PHONE (307) 637-6017
1103 OLD TOWN LANE, SUITE 101
CHEYENNE, WY 82009
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JOB NO.:
3455
DRAWING NO.
OF
NO.
REVISION
DATE
Miles
SWEETGRASS FUTURE DEVELOPMENT
READ PROPERTY
LCCC
CROW CREEK WRF
SADDLE RIDGE ELEM.
SUNRISE ELEM.
HOLLIDAY PARK
CITY OF CHEYENNE PROPERTY
SWAN RANCH
AIRPORT GOLF COURSE
CHEYENNE COUNTRY CLUB
JOHNSON JHS
SOUTH HS
ROSSMAN ELEM.
NORTH CHEY. COMM PARK
COLE PROPERTY
ANDERSON ELEM.
CONVERSE SOFTBALL FIELDS
LIONS PARK
CENTRAL HS & McCORMICK JHS
HESS AND KEIZER PROPERTY
LEADS EAST BUSINESS PARKWAY
SOUTH CHEY. COMM PARK
GOINS ELEM.
TRIUMPH HIGH SCHOOL
OKIE BLANCHARD STADIUM
DUTCHER FIELD
MYLAR AND SMALLEY PARKS
JUNIOR LEAGUE FIELDS AND POWERS FIELD
PRAIRIE VIEW GOLF COURSE
BAIN ELEM. AND UN PARK
CLASS A POTENTIAL #4
POTENTIAL CLASS A #5

6.5.7 Class A Water Demand Projections

Unlike the raw water irrigation system, the Class A water system expansion is limited to the effluent available from the CCWRF and the DCWRF. Future irrigation demands are seasonal and most of the Class A water will continue to be used by the City to irrigate public grounds. This gives the BOPU the ability to regulate the timing frequency at which the customers irrigate. With the potential to more than double the amount of customers on the Class A system, the BOPU can also control growth by carefully planning which customers are added to the system each year. These aspects of the Class A system allow the BOPU to manage usage demands in a way that is not possible for the potable water and wastewater projections. In addition, peak hour demands on the Crow Creek Recycle Water Facility can be dampened by planning for adequate storage around the system. It is important to take into account all of these factors when projecting future growth of the Class A system.

Projection Assumptions

In order to determine projections for future Class A system projects and demand, the following assumptions have been made:

1) The CCWRF and the DCWRF projected influent flows through 2063 were used from Volume 2 and are summarized below in Table 6-10. The average day supply availability was used for both the CCWRF and the DCWRF. Influent flows to the DCWRF include the sludge and flushing water from the CCWRF.

Table 6-10
Class A Water Supply Availability Projections

		CCWRF			DCWRF[1]		
Year	Planning Period	Average Day (mgd)	Maximum Month (mgd)	Maximum Day (mgd)	Average Day (mgd)	Maximum Month (mgd)	Maximum Day (mgd)
2013	Existing	3.7	4.5	5.3	5.4	6.7	9.9
2023	Near-Term	4.5	5.5	6.5	6.3	7.9	11.7
2033	Mid-Term	5.1	6.6	7.8	7.5	9.4	13.9
2043	Long-Term	5.8	7.5	8.2	8.7	10.8	16.2
2053		6.4	8.2	8.2	9.9	12.4	20.1
2063		6.8	8.2	8.2	10.8	14.3	22.7

[1] Additional flow has been subtracted from the DCWRF supply to account for Class B demands at the Cheyenne Prairie Generating Station.

2) An irrigation season was assumed to take place from April through November based on historic Class A metered usage for an equivalent of 250 days.

3) A value of 34.12 inches per square foot (in/sf) was used to estimate the future average day demands. This is a conservative estimate over 30% higher than Cheyenne's Evapotranspiration (ET) data; however, it factors in unaccounted-for water. This value is explained further in Volume 2.

4) With the potential for greater control over growth and irrigation application, a peaking factor of 5.0 was used for the Class A system to more accurately predict the future improvements required for the system. This peaking factor represents the 50% level of exceedence from Volume 2, as opposed to the 10% level of exceedence that is typically used for potable water. Water conservation efforts for the Class A system should be enacted if the peak hour peaking factor goes much higher than 5.0 since there is a much greater ability to schedule when irrigation occurs with the Class A system than the potable water system.

5) In the state of Wyoming, non-native water (i.e. water that has originated from outside the basin) can be used to extinction. Therefore, the portion of the BOPU's water supply derived from non-native water is available for use in the Class A water system. Volume 2 evaluated the allocation of source contributions to the Sherard WTP using the SWSS model. The percentage of non-native water was projected to increase from 68% in the near-term to 73% in the mid-term and long-term. These same percentages were applied in this analysis to determine the amount of effluent from the CCWRF and the DCWRF available for Class A use.

6) The CCWRF, the DCWRF and the Crow Creek Recycle Water Facility efficiencies for percent of influent available as effluent were developed in Volume 2. The CCWRF was calculated using 84%, the DCWRF using 90%, and the Crow Creek Recycle Water Facility as 82%.

7) All existing raw water customers will be converted to the Class A system by the long-term planning horizon and no new customers will be added to the raw water system.

Non-Potable Water Flow Balance

A flow balance spreadsheet (see Appendix 6-B) was developed for the non-potable systems to approximate the Class A and Class B water available over the next 50 years. The existing values were calculated using the average CCWRF and DCWRF influent values for the month of July in 2007 through 2012. The assumptions listed above were applied to determine the amount of effluent available from each facility. Maximum Class A values include the storage in the Class A system and factor in the effluent that can be treated if the reuse line from the

DCWRF to the CCWRF is constructed between 2023 and 2033, in the mid-term planning horizon.

Class A Projections

Using the potential Class A customer breakdown in Table 6-9, demands were estimated for the near, mid, and long term planning horizons. The irrigated areas include all of the current customers plus the additional new customers for each planning horizon. The addition of new customers in groups provides for stair-step expansion of the Class A system. An irrigation unit demand of 34.12 in/sf was used with an irrigation period of 250 days per year, and a peaking factor of 5.0. The average day demand (ADD) and peak hour demand (PHD) for each planning horizon are shown in Table 6-11.

Table 6-11
Projected Class A Demands with Potential Customers

		Area (acre)	Demand (MG/yr)	Average Day Demand (mgd)	Peak Hour Demand (mgd)
2013	Existing	277	257	1.03	5.14
2023	Near-Term	329	305	1.22	6.09
2033	Mid-Term	542	502	2.01	10.04
2043	Long-Term	663	615	2.46	12.29
2053		799	740	2.96	14.80
2063		1166	1080	4.32	21.61

The average day demands can be met by the current Class A system, but the peak hour demands will require expansion of the current facilities. However, to serve the potential future customers identified for the mid-term planning horizon, the Class A system must be expanded and the Crow Creek Recycle Water Facility will require additional influent to meet demands. Figure 6-13 shows the Class A projections using only influent from the CCWRF and the existing storage values. A recommended approach to add additional influent is to pump Class B water from the DCWRF to the Crow Creek Recycle Water Facility, as discussed in 6.5.8. The maximum Class A water available with storage and a reuse line from the DCWRF to the CCWRF is compared to the ADD and PHD in Table 6-12. Further explanation of Class A storage is in Section 6.5.8.

Table 6-12
Projected Maximum Class A Water Available vs. Demands

		Class A from CC Influent (mgd)	Class A from DC Influent (mgd)	Class A Storage (MG)	Maximum Class A Available (mgd)	Average Day Demand (mgd)	Peak Hour Demand (mgd)
2013	Existing	1.68	0.00	5.66	7.34	1.03	5.14
2023	Near-Term	1.97	0.00	5.66	7.63	1.22	6.09
2033	Mid-Term	2.46	3.40	5.66	11.52	2.01	10.04
2043		2.77	3.49	5.66	11.92	2.46	12.29
2053		3.07	4.05	5.66	12.78	2.96	14.80
2063	Long-Term	3.27	4.45	5.66	13.38	4.32	21.61

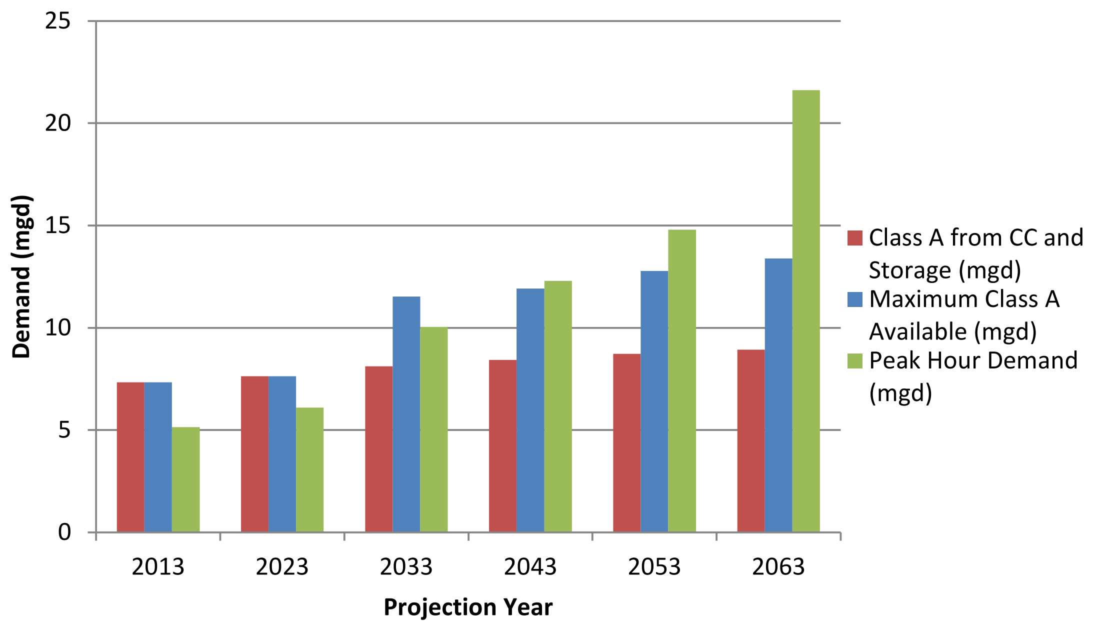


Figure 6-13
Available Class A Water vs. Demands

6.5.8 Future Projects

Reuse Line from the DCWRF to the CCWRF

The CCWRF has existing capacity to meet the demands of the Class A customers in the near-term. However, additional effluent is required to meet the demands of the Class a customers in the mid-term. Additional effluent could be brought to the Crow Creek Recycle Water Facility via a new pipeline from the DCWRF to the CCWRF. The recommended capacity of the reuse pipeline is 5 MGD. AVI developed three alternative routes for the reuse pipeline, which are shown in Figure 6-14. Preliminary sizing suggests a 16-inch pipeline would be required. However, the routes and size should be evaluated again prior to design to determine if the amount of water to be pumped is still available and needed to serve future customers.

All three alternates take the same route leaving the DCWRF. AVI recommends Alternate 1 or 2 over Alternate 3. Alternate 3 takes the best advantage of existing easements, however the easement along South Industrial Road is already congested with existing utilities. Table 6-13 summarizes the alternate lengths and the easements required for each and Table 6-14 breaks down the estimated cost for the reuse line. The cost was estimated using the average length of Alternate 1 and 2 provided by AVI, and the 16-inch estimated unit cost developed by HDR listed in Table 6-16.

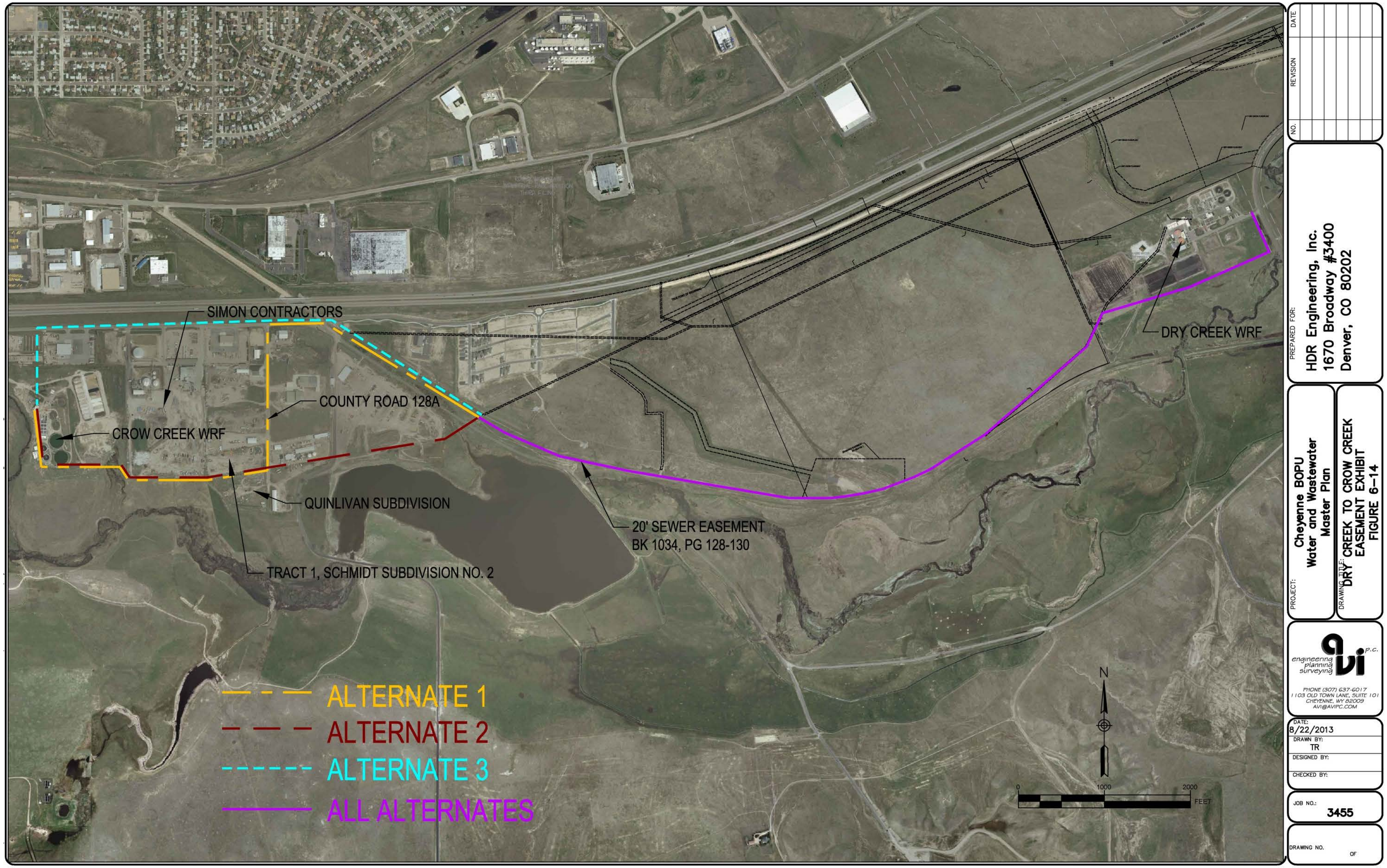
Table 6-13
Reuse Pumpback Line Alternatives

	Length (ft)	Easements Required
Alternate #1	29,370	Richardsons Properties LLC
		Crafco Inc.
		Simon Contractors
Alternate #2	27,430	Star Aggregates Inc. C/O JTL Group Inc.
		Quinlivan Family Trust
		Richardsons Properties LLC
		Crafco Inc.
		Simon Contractors
Alternate #3	27,920	De Wore LTD Partnership

Table 6-14
Reuse Pumpback Line Estimated Costs

Description	Estimated Cost
16-inch Pipe	$10,604,000
Pump Station	$180,000
Total Estimated Cost	**$10,784,000**

In addition to the reuse pipeline, two 2.5 mgd pumps are required initially with a third pump installed in the future to transfer Class B from the DCWRF to the Crow Creek Recycle Water Facility. Two of the pumps would provide 5 mgd firm capacity with the third pump on standby. A pump station is currently undergoing construction at the DCWRF. The pump station will not have room for the additional pumps needed for the reuse line, but will have a knockout wall where the additional pumps can be added in the future.


SIMON CONTRACTORS
COUNTY ROAD 128A
CROW CREEK WRF
QUINLIVAN SUBDIVISION
TRACT 1, SCHMIDT SUBDIVISION NO. 2
20' SEWER EASEMENT
BK 1034, PG 128-130
DRY CREEK WRF
ALTERNATE 1
ALTERNATE 2
ALTERNATE 3
ALL ALTERNATES
N
0
1000
2000
FEET
NO.
REVISION
DATE
PREPARED FOR:
HDR Engineering, Inc.
1670 Broadway #3400
Denver, CO 80202
PROJECT:
Cheyenne BOPU
Water and Wastewater
Master Plan
DRAWING TITLE:
DRY CREEK TO CROW CREEK
EASEMENT EXHIBIT
FIGURE 6-14
engineering
planning
surveying
avi p.c.
PHONE (307) 637-6017
1103 OLD TOWN LANE, SUITE 101
CHEYENNE, WY 82009
AVI@AVIPC.COM
DATE:
8/22/2013
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CHECKED BY:
JOB NO.:
3455
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OF

Recommended Storage

As the Class A system is expanded, timely pumping and storage infrastructure improvements are crucial. The Class A storage requirements are summarized in Table 6-15 by planning horizon.

Table 6-15
Class A Storage Requirements

	Year			
	2013	Near-term (2014-2023)	Mid-term (2024-2033)	Long-term (2034 -2063)
Required Storage Calculations				
Production Rate (MG)	4.0	4.0	4.0	10.0
Operational Storage (MG)	5.66	5.66	5.66	6.16 (1)
Required Storage				
System Storage to meet peak hour demands (MG)	5.14	6.09	10.04	21.61
Storage Surplus/(Deficiency) (MG)	4.52	3.57	(0.38)	(5.45)

(1) Includes an additional 0.5 MG storage tank project constructed in the mid-term.

As shown in Table 6-15, additional Class A storage is not needed until the mid-term planning horizon. The addition of a 0.5 MG storage tank upstream of the Crow Creek Recycle Water Facility is required to meet the Mid-term peak hour demand. This project should be constructed in conjunction with the CCWRF to DCWRF Reuse Pipeline to provide greater operational flexibility through equalization.

In the far-term, the additional storage required is more significant (5.45 MG). This need can be met by converting one of the lakes located in the northwest edge of the BOPU system that is currently used to store raw water into a Class A storage lake. Infrastructure can be added to the long-term planning horizon to install a pump station and pipeline from one of the lakes, such as Sloans Lake, to provide Class A water to WAFB if they become a customer.

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6.6 Recommendations

This section presents the recommended projects for the non-potable water systems. The recommendations include:

- Planning Studies
    - Conservation Plans
    - Communication and Programing Studies and Projects
    - System Modeling
- Infrastructure projects that support growth of the system

The infrastructure projects are all assigned a capital improvement ID with the following format: Planning Period-System-Project Number.

- Planning Periods include:
    - 2013 – In Progress/Completed
    - NT - Near Term (2014-2023)
    - MT - Mid-Term (2024-2033)
    - LT - Long Term (2034-2063)
- Systems include:
    - CA - Class A System
    - CB – Class B System
    - RW - Raw Water Irrigation System
- Project Number is a sequential number for each planning period.

6.6.1 Planning Projects

Class A Water Availability, Meter Program, and the DCWRF to the CCWRF Reuse Pipeline Predesign Study

The last study completed to review the water balance between in-basin and out-of-basin water was in 1999. Before investing in large capital improvement projects to increase the availability of Class A water, it is important to understand the amount of water available to treat at the Crow Creek Recycle Water Facility. An update to the 1999 study of non-native vs. native amounts for water rights is recommended in conjunction with improvements to the existing meters including those at the Crow Creek Recycle Water Facility and on the pipeline from the Ware Infiltration Gallery for raw water irrigation system supply accounting. The information can then be combined with a predesign report for the DCWRF to CCWRF reuse pipeline project that brings Class B effluent from DCWRF to the Crow Creek Recycle Water Facility.

Hydraulic Model and Balance of the Non-Potable Water Systems

Development and calibration of a Class A system hydraulic model to represent the existing system is recommended at the end of the near-term planning period. The benefits of a hydraulic model for this system would be examining service capabilities of the existing infrastructure, evaluating the use of recycled water supply and storage, and assessing the ability to add new customers and the infrastructure needed to serve them. The hydraulic model would help size and route the new infrastructure including distribution pipelines, pump stations, and system storage to most efficiently use available effluent from both WRFs. Prior to developing the hydraulic model, complete recycled water system GIS from as-builts and field investigation would be required, in addition to installing and recording adequate flow and pressure data within the treatment, storage, pumping and distribution facilities to properly calibrate the model.

Conservation Plan

An update to the existing conservation plan is recommended in the mid-term. This will allow for irrigation regulations and conservation measures to be in place to reduce the impact of peak day and peak hour demands on the Class A water system. The reduced impact will give the BOPU more control over existing customers so potential customers may be added to the system with fewer costly infrastructure improvements. The only regulation currently enforced on Class A users is no irrigation permitted between 10am and 5pm.

Plant Organization

Currently, a well defined management system is not in place for the BOPU's non-potable water systems. Operational responsibility and system information are both distributed among many BOPU departments, including water, wastewater, and public relations. HDR recommends that the BOPU consider undertaking a management planning effort to evaluate the staff roles, operational responsibility, data collection needs, and general coordination issues among the three non-potable water systems. This would be particularly valuable for the Class A system, which will continue to increase in size and complexity in the future.

6.6.2 Infrastructure Projects

Transmission mains, pump stations, and storage improvements are recommended for each planning period to support the addition of new customers. Each improvement is identified by a capital improvement code.

Class A Pipelines

Class A pipeline improvements include the installation of any pipeline extensions onto the system that have the ability to serve multiple customers. The following Class A pipeline projects have been identified and are listed by the recommended year of installation.

Near Term (2014-2023)

Improvement Name: Class A Pipeline - Holliday Park Extension

Improvement ID: NT-CA-2

Year: 2014

Description: Main extension from the cemeteries to connect Holliday Park to the non-potable irrigation system.

Scope: 3,940 feet of 4 inch PVC

Purpose: To deliver water to previously unserved customers.

Improvement Name: Class A Pipeline – Mylar and Smalley Park Extension

Improvement ID: NT-CA-3

Year: 2017

Description: Main extension to connect Mylar and Smalley Parks and the Anderson Elementary School to the non-potable irrigation system.

Scope: 15,200 feet of 12 inch PVC

Purpose: To deliver water to previously unserved customers.

Improvement Name: Class A Pipeline –Central and McCormick Park Extension

Improvement ID: NT-CA-5

Year: 2020

Description: Main extension from the North Cheyenne Community Park to Central and McCormick Parks.

Scope: 4,670 feet of 12 inch PVC

Purpose: To deliver water to previously unserved customers.

Mid Term (2024-2033)

Improvement Name: Class A Pipeline – LCCC Extension

Improvement ID: MT-CA-3

Year: 2024-2033

Description: Main extension from the CCWRF to connect the LCCC property to the non-potable irrigation system.

Scope: 13,640 feet of 12 inch PVC

Purpose: To deliver water to previously unserved customers.

Long Term (2034-2063)

Improvement Name: Class A Pipeline – JL Ranch Extension

Improvement ID: LT-CA-4

Year: 2034-2063

Description: Main extension to connect the JL Ranch property to the non-potable irrigation system.

Purpose: To deliver water to previously unserved customers.

Improvement Name: Class A Pipeline – Leads East Business Park and Median Extension

Improvement ID: LT-CA-5

Year: 2034-2063

Description: Main extension to connect the Leads East Business Park, extending on to the median beyond the property. This will connect these two areas to the non-potable irrigation system.

Purpose: To deliver water to previously unserved customers.

Improvement Name: Class A Pipeline – LCSD Extension

Improvement ID: LT-CA-6

Year: 2034-2063

Description: Main extension to connect the Elementary, High School and Junior High properties to the non-potable irrigation system.

Purpose: To deliver water to previously unserved customers.

Improvement Name: Class A Pipeline – Swan Ranch Development Extension

Improvement ID: LT-CA-7

Year: 2034-2063

Description: Main extension to connect the Swan Ranch Development to the non-potable irrigation system.

Purpose: To deliver water to previously unserved customers.

Improvement Name: Class A Pipeline – Saddle Ridge Elementary Extension

Improvement ID: LT-CA-8

Year: 2034-2063

Description: Main extension to connect Saddle Ridge Elementary School and Park to the non-potable irrigation system.

Purpose: To deliver water to previously unserved customers.

Improvement Name: Class A Pipeline – Hess and Keizer Property Extension

Improvement ID: LT-CA-10

Year: 2034-2063

Description: Main extension to connect the Hess and Keizer properties to the non-potable irrigation system.

Purpose: To deliver water to previously unserved customers.

Improvement Name: Class A Pipeline – Airport Golf Course Extension

Improvement ID: LT-CA-11

Year: 2034-2063

Description: Main extension to connect the Airport Golf Course to the non-potable irrigation system.

Purpose: To deliver water to customers previously on the raw water system.

Improvement Name: Class A Pipeline – Lions Park Extension

Improvement ID: LT-CA-12

Year: 2034-2063

Description: Main extension to connect Lions Park to the non-potable irrigation system.

Purpose: To deliver water to customers previously on the raw water system.

Improvement Name: Class A Pipeline – Cheyenne Country Club

Improvement ID: LT-CA-13

Year: 2034-2063

Description: Main extension to connect the Cheyenne Country Club to the non-potable irrigation system.

Purpose: To deliver water to customers previously on the raw water system.

Improvement Name: Class A Pipeline – WAFB Golf Course

Improvement ID: LT-CA-14

Year: 2034-2063

Description: Main extension to connect the WAFB Golf Course to the non-potable irrigation system.

Purpose: To deliver water to customers previously on the raw water system.

6.6.3 Customer Connections

Customer connection projects are limited to small taps or small single customer or development service lines that are not intended to extend the future system. The following customer connection projects have been identified and are listed by the recommended year of installation.

Near Term (2024-2033)

Currently no near term Class A pipeline projects have been identified.

Mid Term (2024-2033)

Improvement Name: Reed Property Connection

Improvement ID: MT-CA-4

Year: 2024-2033

Description: The addition of a new customer tap and service line.

Scope: Connection tap and a service line to the Reed property.

Purpose: To deliver water to previously unserved customers.

Improvement Name: Sweet Grass Development Connection

Improvement ID: MT-CA-5

Year: 2024-2033

Description: The addition of a new tap and a new X inch main.

Scope: A main connection to the Sweet Grass Development.

Purpose: To deliver water to previously unserved customers.

Improvement Name: Cole Property Connection

Improvement ID: MT-CA-6

Year: 2024-2033

Description: The addition of a new customer tap and service line.

Scope: Connection tap and a service line to the Cole property.

Purpose: To deliver water to previously unserved customers.

Long Term (2024-2033)

Currently no long term Class A pipeline projects have been identified.

6.6.4 Pump Stations and Storage Improvements

Near Term (2024-2033)

Improvement Name: Oversized DCWRF Pumping Station

Improvement ID: NT-CB-1

Year: 2014

Description: New bulk dispensing system to meter Class B water used for construction at the DCWRF and upgrades to the facility.

Scope: A dispensing system, larger pumps to fill trucks, upgrades to existing piping, and driveway construction.

Purpose: To provide bulk construction water to contractors at the DCWRF.

Improvement Name: Small Booster Pump Station

Improvement ID: NT-CA-4

Year: 2017

Description: New booster pump station located east of the North Cheyenne Booster Station.

Purpose: Increase pumping capacity to supply Class A water to additional customers.

Improvement Name: High Service Pump Station Improvements

Improvement ID: NT-CA-7

Year: 2023

Description: Pump station upgrades.

Purpose: Increase pumping capacity to supply Class A water to additional customers.

Mid Term (2024-2033)

Improvement Name: The DCWRF bypass and pump station to the CCWRF

Improvement ID: MT-CB-1

Year: 2024-2033

Description: Pipeline and pump station to convey effluent from the DCWRF to the Crow Creek Recycle Water Facility.

Scope: Three 2.5 mgd pumps and a 16-inch pipeline from the DCWRF to the CCWRF.

Purpose: To supply DCWRF effluent to the Class A treatment facility at the CCWRF to increase Class A production.

Improvement Name: Additional 0.5 MG Storage Tank

Improvement ID: MT-CB-2

Year: 2024-2033

Description: An additional 0.5 MG storage tank upstream of the Crow Creek Recycled Water Facility.

Scope: A 0.5 MG above ground storage tank constructed between the pump back and the Crow Creek Recycled Water Facility.

Purpose: To provide storage for peak hour irrigation demands.

Long Term (2034-2063)

Improvement Name: Prairie View Golf Course Pump Station Improvements

Improvement ID: LT-CA-2

Year: 2034-2063

Description: Pump station upgrades.

Purpose: Increase pumping capacity to supply Class A water to additional customers.

Improvement Name: Additional Storage

Improvement ID: LT-CA-3

Year: 2034-2063

Description: Additional Storage for Class A water.

Purpose: Added storage to help meet peak hour demands.

Improvement Name: Sun Valley Pump Station Rehabilitation

Improvement ID: LT-CA-9

Year: 2034-2063

Description: Pump station rehabilitation.

Purpose: Increase pumping capacity to supply Class A water to additional customers beyond the Sun Valley Park and School.

6.6.5 Treatment Improvements

If the BOPU chooses to expand the Class A system to serve all of the potential customers identified in this volume, the Crow Creek Recycle Water Facility will have to be expanded to 10 mgd as shown in Figure 6-15.

Figure 6-15Some equipment has already been installed in the existing facility to make this transition, including a removable rapid mix basin floor, adequate chemical storage and pumping to meet the greater demand, and upstream pipe sizing to meet the requirements of a larger capacity pump installation. The full expansion of the facility including pumping treatment and storage is estimated to cost $2.8 million dollars (in 2013 dollars). Appendix 6-C contains a break-down of the expansion costs.

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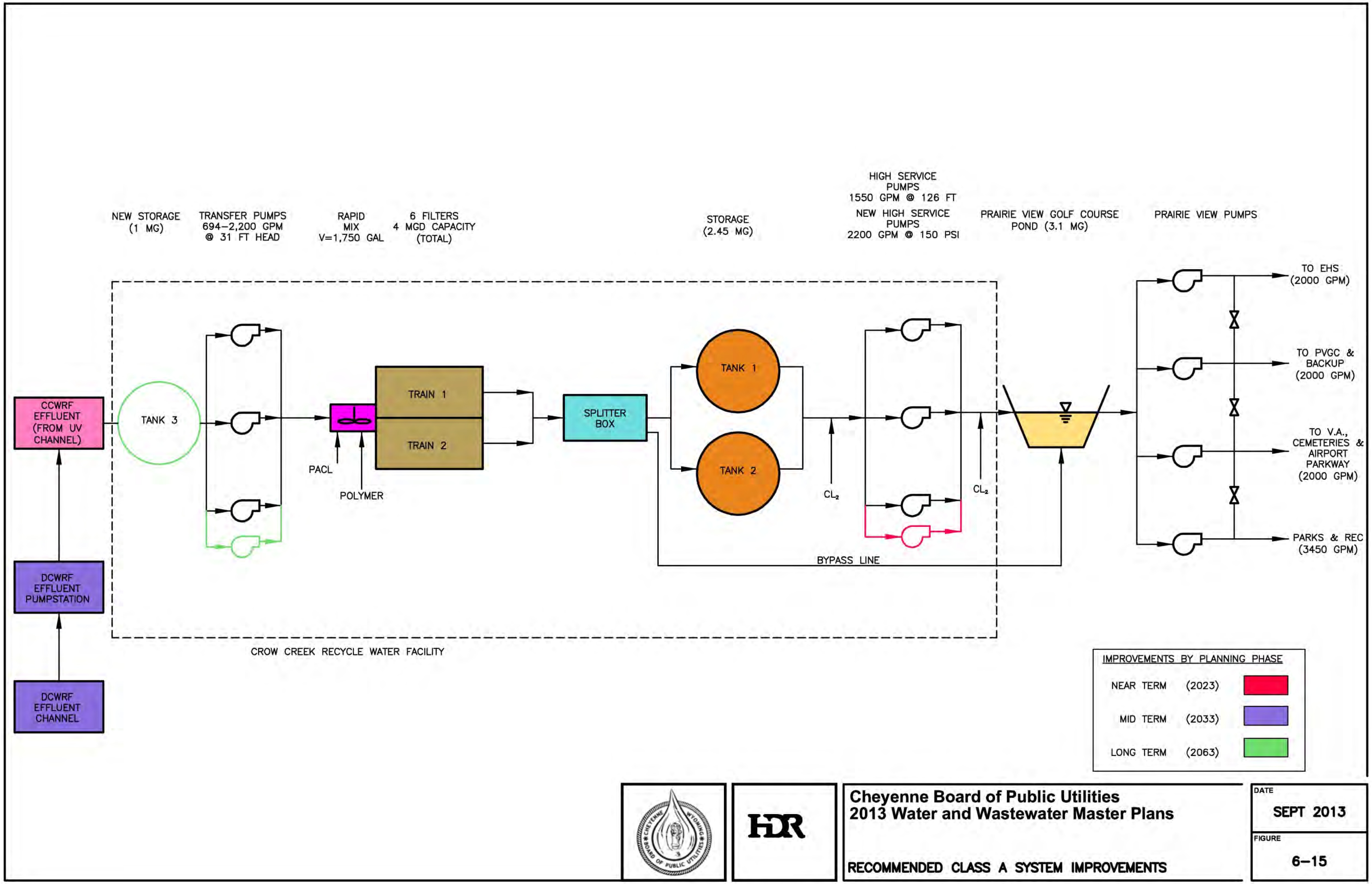
NEW STORAGE (1 MG)
TRANSFER PUMPS 694–2,200 GPM @ 31 FT HEAD
RAPID MIX V=1,750 GAL
6 FILTERS 4 MGD CAPACITY (TOTAL)
STORAGE (2.45 MG)
HIGH SERVICE PUMPS 1550 GPM @ 126 FT
NEW HIGH SERVICE PUMPS 2200 GPM @ 150 PSI
PRAIRIE VIEW GOLF COURSE POND (3.1 MG)
PRAIRIE VIEW PUMPS
CCWRF EFFLUENT (FROM UV CHANNEL)
DCWRF EFFLUENT PUMPSTATION
DCWRF EFFLUENT CHANNEL
TANK 3
PACL
POLYMER
TRAIN 1
TRAIN 2
SPLITTER BOX
TANK 1
TANK 2
CL_2
CL_2
BYPASS LINE
CROW CREEK RECYCLE WATER FACILITY
TO EHS (2000 GPM)
TO PVGC & BACKUP (2000 GPM)
TO V.A., CEMETERIES & AIRPORT PARKWAY (2000 GPM)
PARKS & REC (3450 GPM)
IMPROVEMENTS BY PLANNING PHASE
NEAR TERM (2023)
MID TERM (2033)
LONG TERM (2063)
HDR
Cheyenne Board of Public Utilities
2013 Water and Wastewater Master Plans
RECOMMENDED CLASS A SYSTEM IMPROVEMENTS
DATE
SEPT 2013
FIGURE
6–15

6.7 Capital Improvement Plan

6.7.1 Cost Estimating Assumptions

Annual cost estimates were developed for each of the capital improvement projects from 2015 to 2023 and as a total cost for mid-term (2024-2033) projects. Years 2013 and 2014 are currently budgeted years and the cost estimates from the financial projections provided by BOPU were not revised. Cost estimates were not provided for the long-term projects since they are too far in the future to be certain of their implementation or costs.

The cost estimates developed are order of magnitude costs to give an indication of probable cost to implement. All of these estimates are preliminary in nature. Project order and customer's water needs are two of many variables that may impact the cost estimates provided for the near-term and mid-term. An estimate of this type is normally accurate within +50% or -30%. A 30% design contingency was applied to the total construction costs and a 3.5% per year escalation rate was used to account for inflation. The estimates provided should be reevaluated prior to construction of the facilities. Table 6-16 presents the 2013 unit pipe costs used for the estimates which include a fittings allowance, bedding materials, and installation costs. Appendix 6-D contains more detailed cost estimates for the pipeline projects.

Table 6-16
Pipe Material and Unit Cost Assumptions

Pipe Size (inches)	Pipe Material	2013 Unit Cost ($/lf) [(1)]
8	PVC	$120
12	PVC	$135
16	PVC	$150
18	PVC	$175
20	PVC	$180
21	PVC	$190
24	PVC/DIP	$275
30	Steel/DIP	$325
36	Steel/DIP	$350
42	Steel/DIP	$375

[(1)] Unit costs include a fittings allowance, bedding materials, and installation.

6.7.2 Capital Improvement Plans by Planning Period

Table 6-17, Table 6-18, and Table 6-19 present the near-term (2014-2023), mid-term (2024-2033), and long-term (2034-2063) capital improvement plans for the non-potable water system, respectively. Prior to these capital improvement projects being implemented, the scope and sizing of each project should be verified via pre-design investigation and planning including field confirmations, hydraulic modeling, cost estimating, and siting and/or alignment studies.

Figure 6-16 presents the location of many of the recommended capital improvement s.

Table 6-17
Near-term (2014-2023) Recommended Capital Improvement Plan

Item #	CIP ID	Project	Projection	Projection	Projection	Projection	Projection	Projection	Projection	Projection	Projection	Projection	Near-term Expenditures
			FY 2014	FY 2015	FY 2016	FY 2017	FY2018	FY2019	FY2020	FY2021	FY2022	FY2023	Based on Year of Construction Dollars
1	NT-CB-1 [1]	Oversized DCWRF Pumping Station	$700,000										$700,000
2	NT-CA-2	Water Recycle Pipeline - Holliday Park Extension	$1,000,000										$1,000,000
3	NT-CA-3	Recycle Water Phase III - Mylar and Smalley Park Extensions				$4,215,200							$4,215,200
4	NT-CA-4	Small Booster Pump Station				$142,200							$142,200
5	NT-CA-5	Recycle Water Phase IV - Central & McCormick Park Extension							$1,395,100				$1,395,100
6	NT-CA-6	Irrigation Water Model and Water Balance								$98,800			$98,800
7	NT-CA-7	High Service Pump Station Improvements										$100,100	$100,100
		Total Projects by Year	$1,700,000	$0	$0	$4,357,400	$0	$0	$1,395,100	$98,800	$0	$100,100	$7,651,400
												Average Cost per Year (over 10 years)	$765,100

[1]NT = Near-term
CA = Class A Water System
CB = Class B Water System

Table 6-18
Mid-term (2024-2033) Recommended Capital Improvement Plan

Item #	CIP ID	Project	Cost Estimate (Based on 2028 Dollars)
1	MT-CB-1[1]	DCWRF bypass and pump station to CCWRF	$11,795,064
2	MT-CB-2	Additional 0.5 MG Storage Tank	$1,675,300
3	MT-CA-3	LCCC Extension	$5,574,000
4	MT-CA-4	Reed Property Connection	$25,100
5	MT-CA-5	Sweet Grass Development Connection	$41,900
6	MT-CA-6	Cole Property Connection	$25,100
7	MT-CA-7	Conservation Plan Update	$41,900
-		Total Projects	$19,178,364
		Average Cost Per Year (over 10 years)	$1,917,800

[1]MT = Mid-term
CA = Class A Water System
CB = Class B Water System

Table 6-19
Long-term (2034-2063) Recommended Capital Improvement Plan

Item #	CIP ID	Project
1	LT-CA-1[(1)]	Expansion of the Crow Creek Reuse Facility to 10 MGD (Class A)
2	LT-CA-2	Prairie View Golf Course Pump Station Improvements
3	LT-CA-3	Additional Storage
4	LT-CA-4	Water Recycle Pipeline- JL Ranch Extension
5	LT-CA-5	Water Recycle Pipeline- Leads East Business Park and Median Extension
6	LT-CA-6	Water Recycle Pipeline- LCSD Schools Extension
7	LT-CA-7	Water Recycle Pipeline – Swan Ranch Extension
8	LT-CA-8	Water Recycle Pipeline - Saddle Ridge Elementary and Park Extension
9	LT-CA-9	Sun Valley Pump Station Rehabilitation
10	LT-CA-10	Water Recycle Pipeline – Hess and Keizer Property Extension
11	LT-CA-11	Water Recycle Pipeline – Airport Golf Course Extension
12	LT-CA-12	Water Recycle Pipeline – Lions Park Extension
13	LT-CA-13	Water Recycle Pipeline – Cheyenne Country Club
14	LT-CA-14	Water Recycle Pipeline – WAFB Golf Course

[(1)]LT = Long-term
CA = Class A Water System

Figure 6-16
Non-Potable Water Distribution
Capital Improvement Projects

(available in the inside back cover pocket of this binder)

Appendices

Volume 6 – Non-Potable Water Treatment and Distribution

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Appendix 6-A
Cheyenne Prairie Generation Facility Correspondence

Black Hills Corporation

Jason Hartman
Director Generation Project Engineering
Plant Manager, Cheyenne Prairie Generating Station
Power Delivery

6711 HR Ranch Road
Cheyenne, Wyoming 82007
P: 303.396.5535

April 10, 2013

Mr. Herman Noe
Engineering Manager
Board of Public Utilities
P. O. Box 1469
Cheyenne, WY 82003

Dear Herman,

With the detailed design of the new Cheyenne Prairie Generating Station well underway, we wanted to update you on the anticipated water use requirements for the facility. This information supersedes the letter provided to you on 10/25/2011 by George Tatar. I have highlighted the revised quantities in **BOLD** text. The planned commercial operation date of the facility is October 1, 2014, and potable water for construction will be needed by July 2013.

Revised Requirements:

	Peak Flow (gpm)	Max Daily (gpd)	Average Daily (gpd)
Potable Water	**300**	**260,000**	10,000
Wastewater Effluent	**622**	650,000	65,000
Wastewater Discharge	150	200,000	20,000

It is anticipated that this facility will be expanded over the years to keep up with the robust growth of the City of Cheyenne. While there is no defined timetable for the additional demand, the information below is intended to provide an indication of what the demand might look like in the future.

Future Requirements:

	Peak Flow (gpm)	Max Daily (gpd)	Average Daily (gpd)
Potable Water	**600**	**600,000**	250,000
Wastewater Effluent	1,200	**2,000,000**	900,000
Wastewater Discharge	300	600,000	300,000

The wastewater discharge from the facility will be a concentrate of the wastewater effluent received from the BOPU. A more detailed projection of the discharge will be provided with our industrial pre-treatment discharge permit application forthcoming in the near future.

Please confirm that the BOPU can provide the current requirements for the Cheyenne Prairie Generating Station facility. As discussed in our meeting on April 1, 2013, we are in the process of drafting a water service agreement to formalize our understanding.

Your response by April 24, 2013 is appreciated.

Sincerely

Jason Hartman
Director, Generation Project Engineering
Plant Manager, Cheyenne Prairie Generating Station

Appendix 6-B
Non-Potable System Flow Balance

Existing System Flow Balance
Updated: 8/21/13 Caitlin Kodweis (HDR)

Input	
Calculated	
Not used in calcs	

CCWRF = Crow Creek Water Reclamation Facility
DCWRF = Dry Creek Water Reclamation Facility

2007-2012 July Average Monthly Flow Balance (MGD)

CCWRF Influent	CCWRF Effluent vs. Influent Efficiency	CCWRF Total Effluent	Minimum Effluent Release Required	Class B Available	Percent loss from Class B to Class A treatment and CCWRF storage	Class A Available		DCWRF Influent	DCWRF Effluent vs. Influent Efficiency	DCWRF Total Effluent
3.82	84%	3.21	36%	2.05	18%	1.68		5.95	90%	5.36
*Average of July values from 2007-2012	*From Volume 2		*See Volume 6 text		*From Volume 2			*Average of July values from 2007-2012	*From Volume 2	

Class A available:	1.68
Class A storage:	5.66
Max Class A:	7.34

Existing System Flow Balance
Updated: 8/21/13 Caitlin Kodweis (HDR)

Input	
Calculated	
Not used in calcs	

CCWRF = Crow Creek Water Reclamation Facility
DCWRF = Dry Creek Water Reclamation Facility

2023 Future Average Monthly Flow Balance (MGD) - with DC to CC Reuse Line

CCWRF Influent	CCWRF Effluent vs. Influent Efficiency	CCWRF Total Effluent	Minimum CC Effluent Release Required	Class B Available	Reuse Water Facility Inflow	Percent loss from Class B to Class A treatment and CCWRF storage	Class A Available
4.20	84%	3.53	32.0%	2.40	5.68	18%	4.65

DCWRF Influent	DCWRF Effluent vs. Influent Efficiency	DCWRF Total Effluent	DCWRF Demand	DC Class B	Minimum DC Effluent Release Required	DC to CC Reuse
5.60	90%	5.04	0.22	4.82	32.0%	3.28

*Influent values from Volume 2
*DCWRF Demands projected in Volume 6 (Cheyenne Prairie Generation Station Demand not included, as it was already removed from the DCWRF Influent)
*Effluent release required, explained in Volume 6 (native %)
*Efficiency and % loss values from Volume 2

Class A available:	4.65
Class A storage:	5.66
Max Class A:	10.31

2023 Future Average Monthly Flow Balance (MGD) - without DC to CC Reuse Line

CCWRF Influent	CCWRF Effluent vs. Influent Efficiency	CCWRF Total Effluent	Minimum CC Effluent Release Required	Class B Available	Reuse Water Facility Inflow	Percent loss from Class B to Class A treatment and CCWRF storage	Class A Available
4.20	84%	3.53	32.0%	2.40	2.40	18%	1.97

DCWRF Influent	DCWRF Effluent vs. Influent Efficiency	DCWRF Total Effluent	DCWRF Demand	DC Class B	Minimum DC Effluent Release Required	DC to CC Reuse
5.60	90%	5.04	0.22	4.82	32.0%	0.00

*Influent values from Volume 2
*DCWRF Demands projected in Volume 6 (Cheyenne Prairie Generation Station Demand not included, as it was already removed from the DCWRF Influent)
*Effluent release required, explained in Volume 6 (native %)
*Efficiency and % loss values from Volume 2

Class A available:	1.97
Class A storage:	5.66
Max Class A:	7.63

Existing System Flow Balance
Updated: 8/21/13 Caitlin Kodweis (HDR)

Input
Calculated
Not used in calcs

CCWRF = Crow Creek Water Reclamation Facility
DCWRF = Dry Creek Water Reclamation Facility

2033 Future Average Monthly Flow Balance (MGD) - with DC to CC Reuse Line

CCWRF Influent	CCWRF Effluent vs. Influent Efficiency	CCWRF Total Effluent	Minimum Effluent Release Required	Class B Available	Reuse Water Facility Inflow	Percent loss from Class B to Class A treatment and CCWRF storage	Class A Available
4.90	84%	4.12	27.0%	3.00	7.15	18%	5.86

DCWRF Influent	DCWRF Effluent vs. Influent Efficiency	DCWRF Total Effluent	DCWRF Demand	DC Class B	Minimum DC Effluent Release Required	DC to CC Reuse
6.60	90%	5.94	0.26	5.68	27.0%	4.15

*Influent values from Volume 2
*DCWRF Demands projected in Volume 6 (Cheyenne Prairie Generation Station Demand not included, as it was already removed from the DCWRF Influent)
*Effluent release required, explained in Volume 6 (native %)

*Efficiency and % loss values from Volume 2

Class A available:	5.86
Class A storage:	5.66
Max Class A:	11.52

Existing System Flow Balance
Updated: 8/21/13 Caitlin Kodweis (HDR)

Input
Calculated
Not used in calcs

CCWRF = Crow Creek Water Reclamation Facility
DCWRF = Dry Creek Water Reclamation Facility

2043 Future Average Monthly Flow Balance (MGD) - with DC to CC Reuse Line

CCWRF Influent	CCWRF Effluent vs. Influent Efficiency	CCWRF Total Effluent	Minimum Effluent Release Required	Class B Available	Reuse Water Facility Inflow	Percent loss from Class B to Class A treatment and CCWRF storage	Class A Available
5.50	84%	4.62	27.0%	3.37	7.63	18%	6.26

DCWRF Influent	DCWRF Effluent vs. Influent Efficiency	DCWRF Total Effluent	DCWRF Demand	DC Class B	Minimum DC Effluent Release Required	DC to CC Reuse
6.80	90%	6.12	0.29	5.83	27.0%	4.26

*Influent values from Volume 2
*DCWRF Demands projected in Volume 6 (Cheyenne Prairie Generation Station Demand not included, as it was already removed from the DCWRF Influent)
*Effluent release required, explained in Volume 6 (native %)

*Efficiency and % loss values from Volume 2

Class A available:	6.26
Class A storage:	5.66
Max Class A:	11.92

Existing System Flow Balance
Updated: 8/21/13 Caitlin Kodweis (HDR)

Input	
Calculated	
Not used in calcs	

CCWRF = Crow Creek Water Reclamation Facility
DCWRF = Dry Creek Water Reclamation Facility

2053 Future Average Monthly Flow Balance (MGD) - with DC to CC Reuse Line

Raw Water Wells	Raw Water Evaporation	Raw Water Irrigation Available for use
		0

CCWRF Influent	CCWRF Effluent vs. Influent Efficiency	CCWRF Total Effluent	Minimum Effluent Release Required	Class B Available	Reuse Water Facility Inflow	Percent loss from Class B to Class A treatment and CCWRF storage	Class A Available
6.10	84%	5.12	27.0%	3.74	8.68	18%	7.12

DCWRF Influent	DCWRF Effluent vs. Influent Efficiency	DCWRF Total Effluent	DCWRF Demand	DC Class B	Minimum DC Effluent Release Required	DC to CC Reuse
7.90	90%	7.11	0.34	6.77	27.0%	4.94

*Influent values from Volume 2
*DCWRF Demands projected in Volume 6 (Cheyenne Prairie Generation Station Demand not included, as it was already removed from the DCWRF Influent)
*Effluent release required, explained in Volume 6 (native %)

*Efficiency and % loss values from Volume 2

Class A available:	7.12
Class A storage:	5.66
Max Class A:	12.78

Existing System Flow Balance
Updated: 8/21/13 Caitlin Kodweis (HDR)

Input
Calculated
Not used in calcs

CCWRF = Crow Creek Water Reclamation Facility
DCWRF = Dry Creek Water Reclamation Facility

2063 Future Average Monthly Flow Balance (MGD) - with DC to CC Reuse Line

CCWRF Influent	CCWRF Effluent vs. Influent Efficiency	CCWRF Total Effluent	Minimum Effluent Release Required	Class B Available	Reuse Water Facility Inflow	Percent loss from Class B to Class A treatment and CCWRF storage	Class A Available
6.50	84%	5.46	27.0%	3.99	9.42	18%	7.72

DCWRF Influent	DCWRF Effluent vs. Influent Efficiency	DCWRF Total Effluent	DCWRF Demand	DC Class B	Minimum DC Effluent Release Required	DC to CC Reuse
8.70	90%	7.83	0.39	7.44	27.0%	5.43

*Influent values from Volume 2
*DCWRF Demands projected in Volume 6 (Cheyenne Prairie Generation Station Demand not included, as it was already removed from the DCWRF Influent)
*Effluent release required, explained in Volume 6 (native %)

*Efficiency and % loss values from Volume 2

Class A available:	7.72
Class A storage:	5.66
Max Class A:	13.38

Appendix 6-C
Existing Facility Information

CHEYENNE
REUSE WATER PIPELINE AND PUMPING FACILITIES PROJECT

OPERATION & SERVICE MANUAL INFORMATION

OWNER:
BOARD OF PUBLIC UTILITIES
CITY OF CHEYENNE, WY

ENGINEER:
STATES WEST WATER RESOURCES CORP.
CHEYENNE, WY

CONTRACTOR:
MECHANICAL SYSTEMS, INC.
CHEYENNE, WY

MANUFACTURER:
PUMPS: CORNELL PUMP COMPANY
APCO PRIMING SYSTEM: VALVE AND PRIMER CORP.

MANUFACTURERS REPRESENTATIVE:

WATERWORKS INDUSTRIES INC.
P.O. BOX 3620
CASPER, WY 82602
PH. 307-265-9566 FAX 307-265-3019

CORNELL Cornell Pump Company

Mailing Address:
P.O. Box 6334
Portland, OR 97228-6334
USA

Shipping Address:
Sunrise Corridor Business Center
16261 S.E. 130th Ave.
Portland, OR 97015

OPERATION & SERVICE MANUAL

Cheyenne Reuse Irrigation Pumps
Cheyenne, WY

Representative: Waterworks Industries, Inc.
P.O. Box 3620
Casper, WY 82602
307-265-9566

Supplier: Cornell Pump Company

Materials of Construction
5RB-F16

Parts	Material Code
Volute Casing	CI
Wear Rings	BA
Impeller	BZ
Impeller Washer	ST
Impeller Key	KS
Impeller Screw	SD
Back Plate	CI
Shaft	SP
Shaft Sleeve	BA
Balance Line	SB
Mechanical Seal	Type 1, Carbon vs. Ceramic
Baseplate	Fabricated Steel
Frame	CI

MATERIAL CODE

BA Bronze (SAE 660)
ASTM B144-3B C93200

BZ Bronze (Sae 40)
ASTM B584 C83600

CA Ductile Iron
Nodular NI-QT
H.T. to 400-500 BHN

CI Cast Iron
ASTM A48, Class 30

CP Ductile Iron
ASTM A536-72 GR. 65-45-12
NOD-1B

CJ Cast Iron
ASTM A48, Class 30
With 2%-3% Nickel Added

PB Acrylic Packing

PK Graphited Acrylic

SA Steel
AISI 1045

SC Cast Steel
AISI 1030, ASTM A216

SD Stainless Steel
AISI 302, 303, 304

SE Stainless Steel
AISI 316, ASTM A296-CF8M

SG Stainless Steel
AISI 420
H.T. to 375-500 BHN
(SG double wear rings have
Min. 50 BHN difference)

KS Keystock
AISI C1018

SB Annealed Steel Tubing

SM SAE Grade 5

SP Stress Proof
Equal MOD. SAE 1144

SS Stainless Steel
AISI 416

ST Stainless Steel
AISI 416
H.T. to 300-325 BHN

TE Glass-filled Teflon

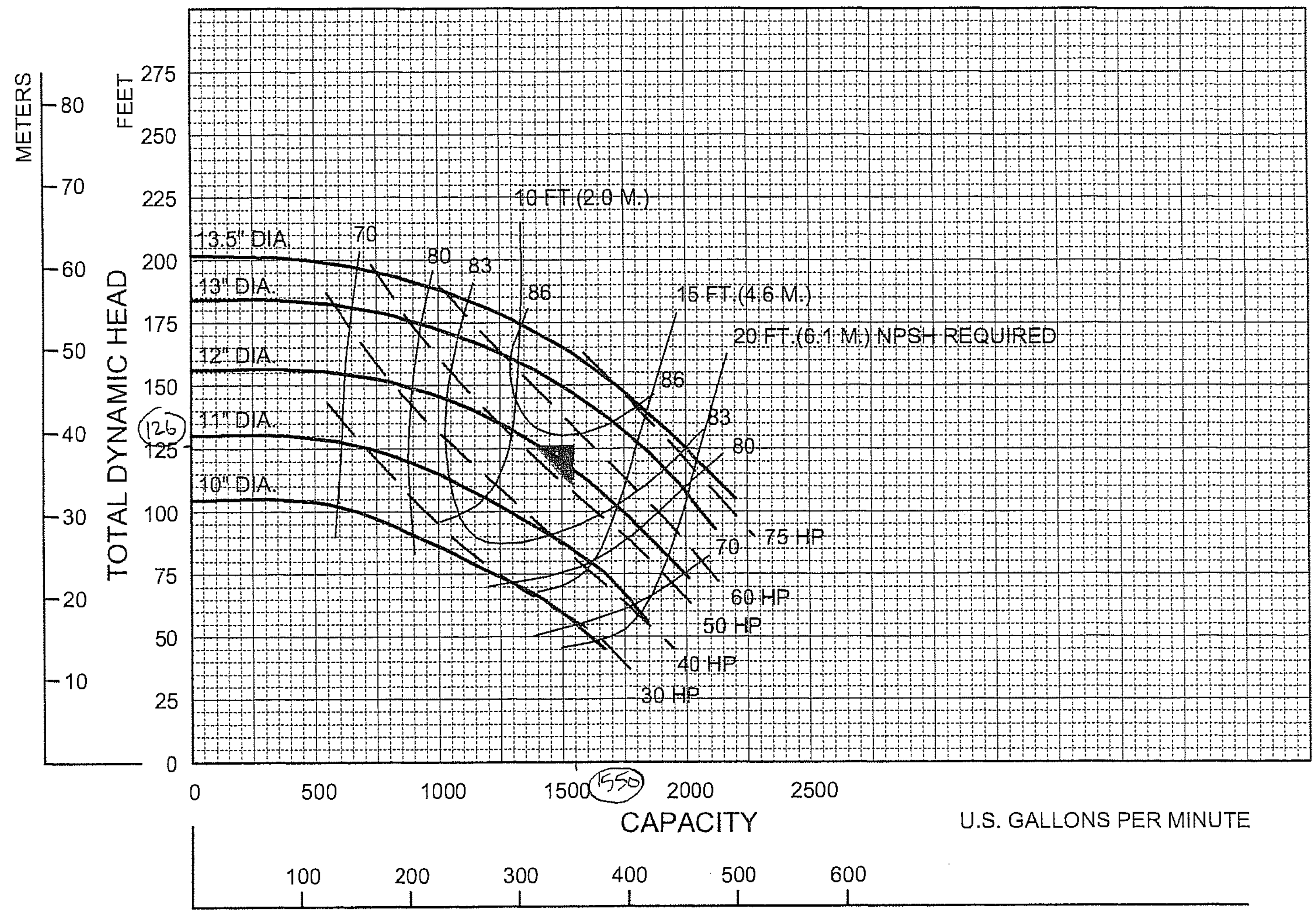
ZK Zamak-3 or equivalent

Feet x .305 = Meters
Inches x 25.4 = Millimeters
GPM x .227 = Cubic Meters/Hour
GPM x 3.785 = Liters/Minute
HP x .746 = KW

Speed	Impeller Dia.	Style	Solids Dia.	N_S	Suction	Discharge	No. vanes
1780	VARIOUS	ENCLOSED	1.0"	1654	8"	5"	6

DOUBLE VOLUTE

MOUNTING CONFIG.: CC, VM, F, VF, EM, VC



1550 GPM @ 126 FT

Performances shown are for cool water, close-coupled electric configuration with packing. Other mounting styles or liquids may require horsepower and/or performance adjustments.

7/99

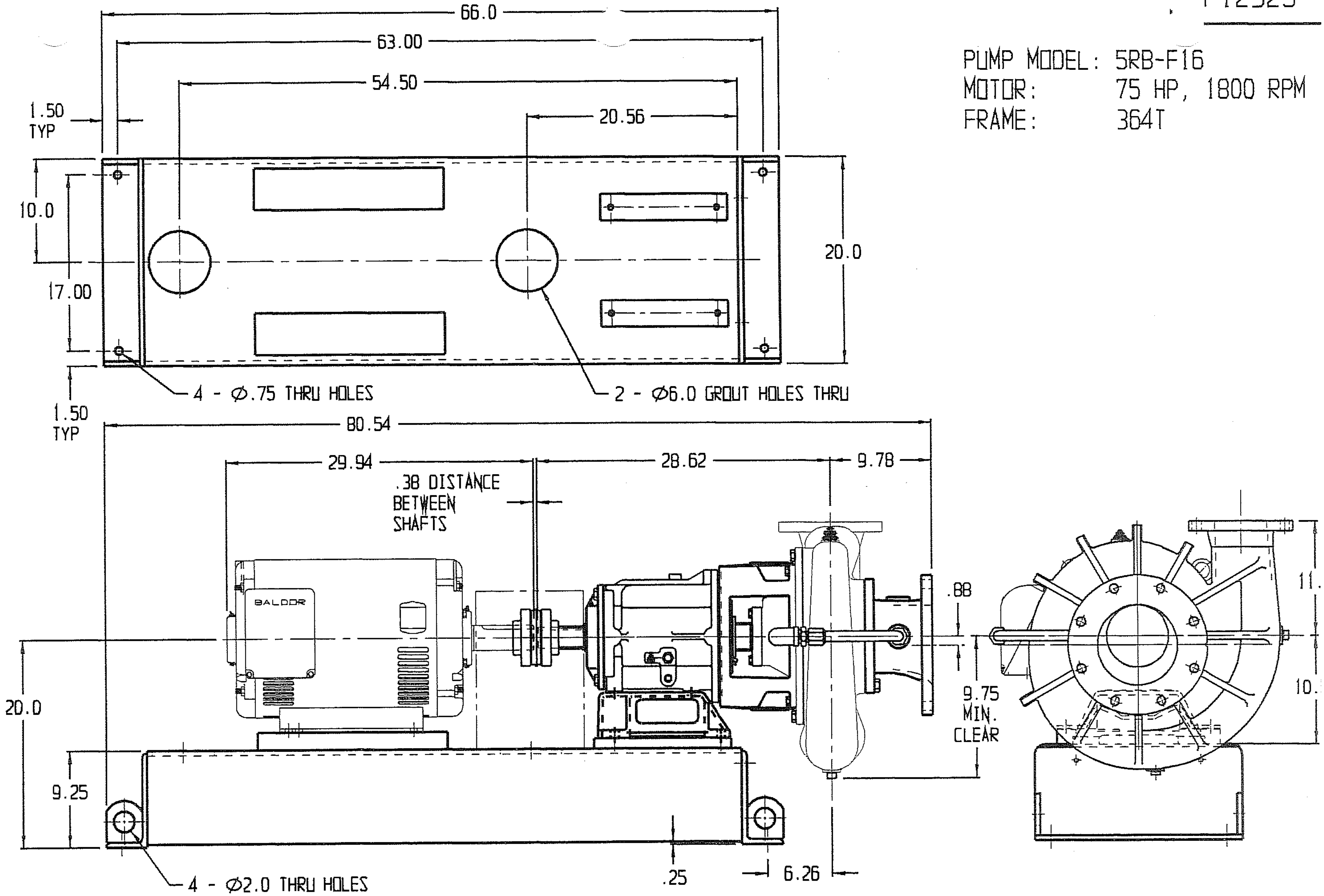
CORNELL
Efficient by Design

Cornell Pump Company • Portland, Oregon

5RB - 1800 RPM

F12329

PUMP MODEL: 5RB-F16
MOTOR: 75 HP, 1800 RPM
FRAME: 364T



NOTES:

1. OVERALL DIMENSION CAN VARY ±.12"

REV. NO.	DESCRIPTION	DATE	BY

CORNELL®

FOUNDATION PRINT: 5RB-F16, BCG, W/GROUT HOLES

DR. MAT	CHECKED SP	DATE 5/2/06	SCALE TO SCALE

CORNELL PUMP COMPANY PORTLAND, OREGON

PATT. NO.
JOB NO.
DWG NO. F12329

CORNELL

Cornell Pump Company
Phone: (503) 653-0330
Fax: (503) 653-0338
Portland, OR 97228-6334 USA

MOTOR INFORMATION

MOTOR SUBMITTAL INFORMATION

CHEYENNE PROJECT

TAG:	HSP-1, HSP-2, HSP-3		
MOTOR MFG:	BALDOR	CONFIG:	HORIZONTAL T-SHAFT
HORSEPOWER:	75	RPM:	1800
ENCLOSURE:	ODP	FRAME:	365T
TYPE:	SUPER-E	SPEED:	1800 RPM INVERTER RATED
VOLTAGE:	230/460V	PH/HZ:	3/60
MOTOR WT:	808 LBS.	L-10 LIFE:	100,000 + HOURS
INSULATION:	CLASS F INVERTER GRADE, CLASS B TEMP RISE @ 1.0SF		
SERVICE FACTOR:	1.15 ON SINE WAVE, 1.0 ON INVERTER OPERATION		

BALDOR
MOTORS • DRIVES • GENERATORS

AC Induction Motor Performance Data

Record # 21222
Typical performance - not guaranteed values

Winding: 44WGW204	**Type:** 4468M	**Enclosure:** OPSB

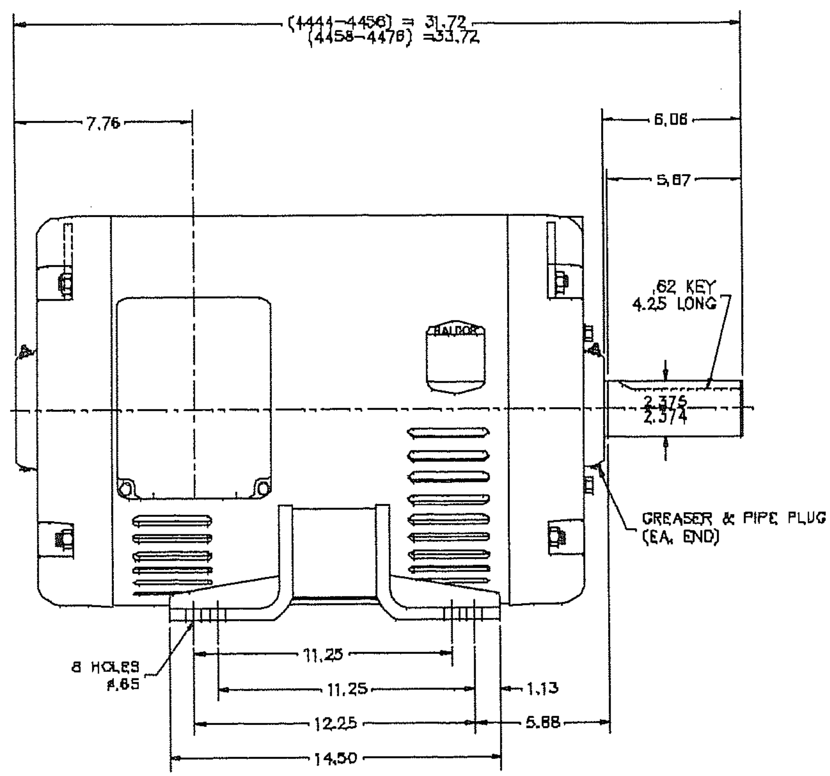
Nameplate Data			
Rated Output (HP)	75		
Volts	230/460		
Full Load Amps	172/86		
R.P.M.	1780		
Hz	60	Phase	3
NEMA Design Code	A	KVA Code	H
Service Factor	1.15		
NEMA Nom. Eff.	95.4	P.F.	86
Rating - Duty	40C AMB CONT		
S.F. Amps			

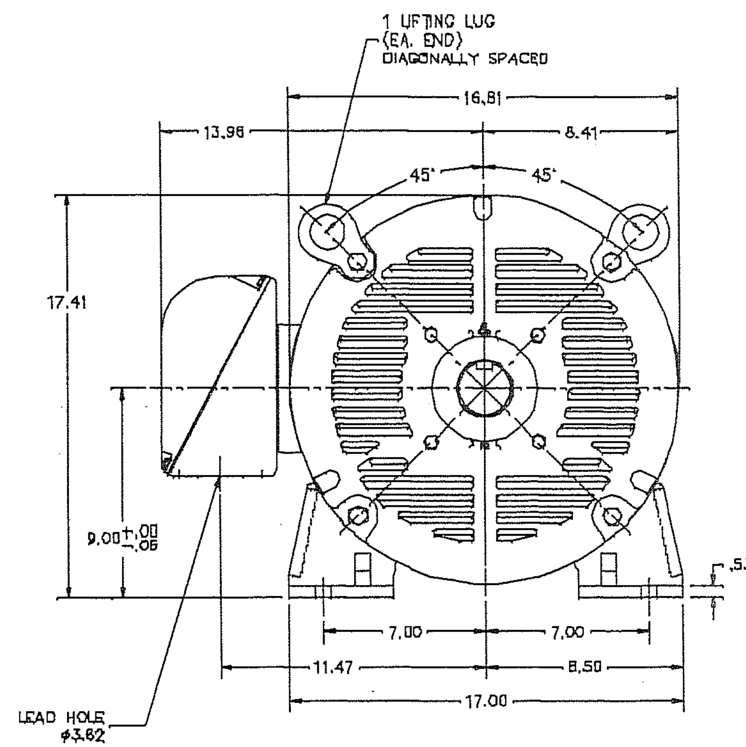
General Characteristics at 460 V, 60 Hz: High Volt Connection	
Full Load Torque	221 LB-FT
Start Configuration	DOL
Break Down Torque	765 LB-FT
Pull-Up Torque	272 LB-FT
Locked-rotor Torque	381 LB-FT
Starting Current	623 Amps
No-load Current	29.5 Amps
Line-line Res. @ 25°C.	0.0614 Ohms
Temp. Rise @ Rated Load	32°C
Temp. Rise @ S.F. Load	39°C

Load Characteristics at 460 Volts, 60 Hz

% of Rated Load	25	50	75	100	125	150	S.F.
Power Factor	53	75	83	86	87	87	87
Efficiency	92.8	95.3	95.8	95.6	95.2	94.7	95.4
Speed	1793	1790	1786	1782	1777	1772	1779
Line Amperes	35.6	49.6	66.5	85.8	106	128	97.9

Baldor Electric Company **Fort Smith, Arkansas**





CUSTOMER IS RESPONSIBLE FOR DETERMINING THAT MOTOR PERFORMANCE IS SUITABLE IN THE APPLICATION.

REV. DESC: SHOW NAMEPLATE ON LAYOUT				BALDOR ELECTRIC Co.
REV. LTR: D	BY: JM	REVISED: 06:28:38 07/15/2003	TDR: 305902	
FILE: AAA00040890			REF: 44LYD051	STD 364-5T OPSB HOR
MTL: –				

44LYD051

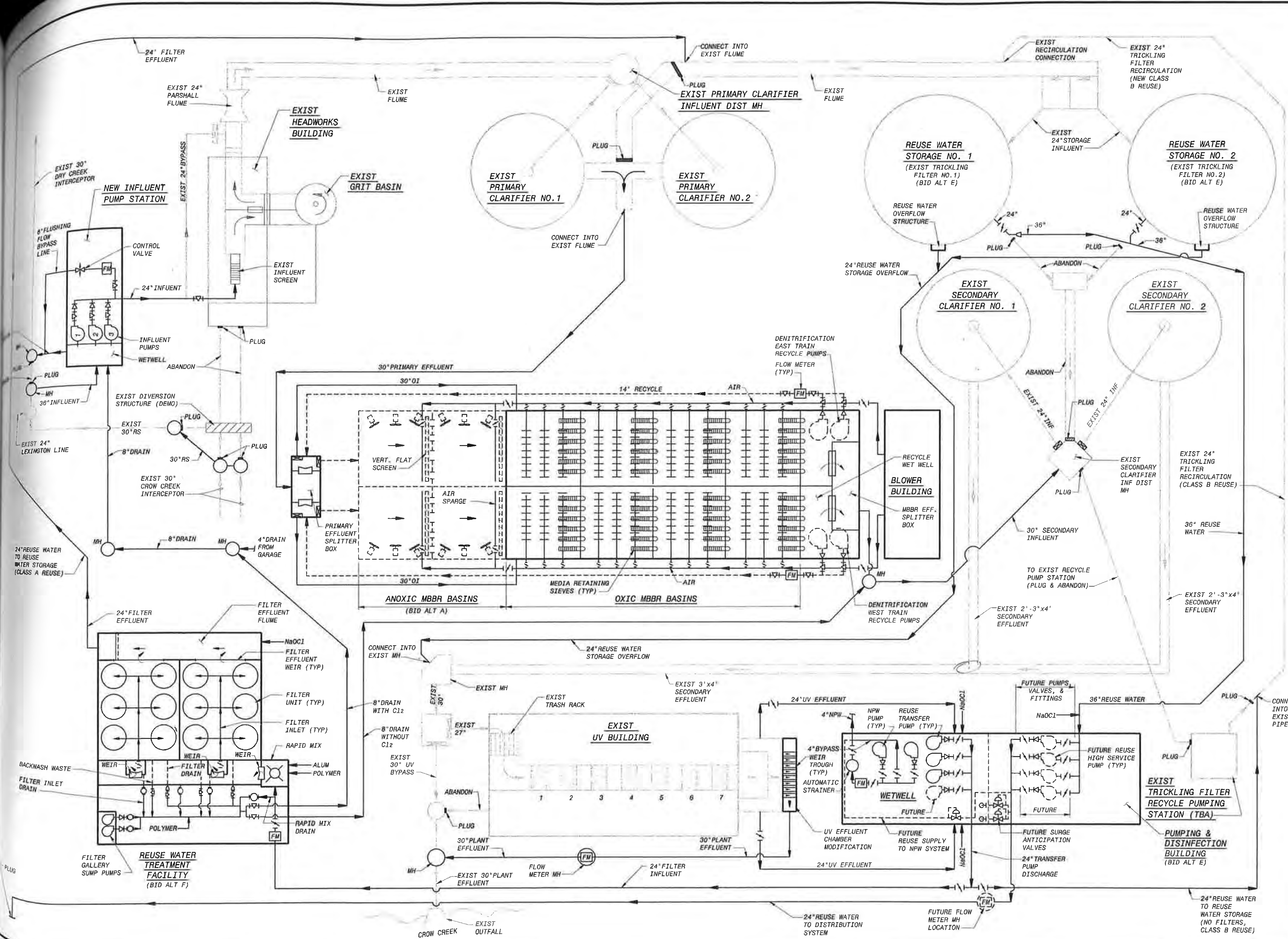
Total Storage in Reuse System

	Length (ft)	***Dia./Width (ft)***	***Depth (ft)***	***Storage (MG)***
Prairie View Pond			14.5	3.02
Prairie View PS Wetwell	62	11	14.5	0.07
Trickling Filter #1		165	9	1.44
Trickling Filter #2		165	9	1.44
			Total Storage =	5.97

Usage by End Users

Reporting	***Avg. July (MG)***	***Hist Max. (MG)***
Clint Bassett (3/3/2008)	1.47	2.84
Parks and Recreation		3.34
Original Design	1.74	2.38

** Does not include North Park, Holliday Park, Miller School, or United Nations



NO. | BY | CK | APP
REVISIONS AND RECORD OF ISSUE

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SAVED: ROB03455, 10/6/2003 8:09:33 AM
DWG VER #:
PLOTTED: ROB03455, 10/6/2003 8:09:20 AM
USER: ROB03455

BLACK & VEATCH Corporation
Denver, Colorado

CHEYENNE, WYOMING
BOARD OF PUBLIC UTILITIES
CROW AND DRY CREEK WWTP IMPROVEMENTS

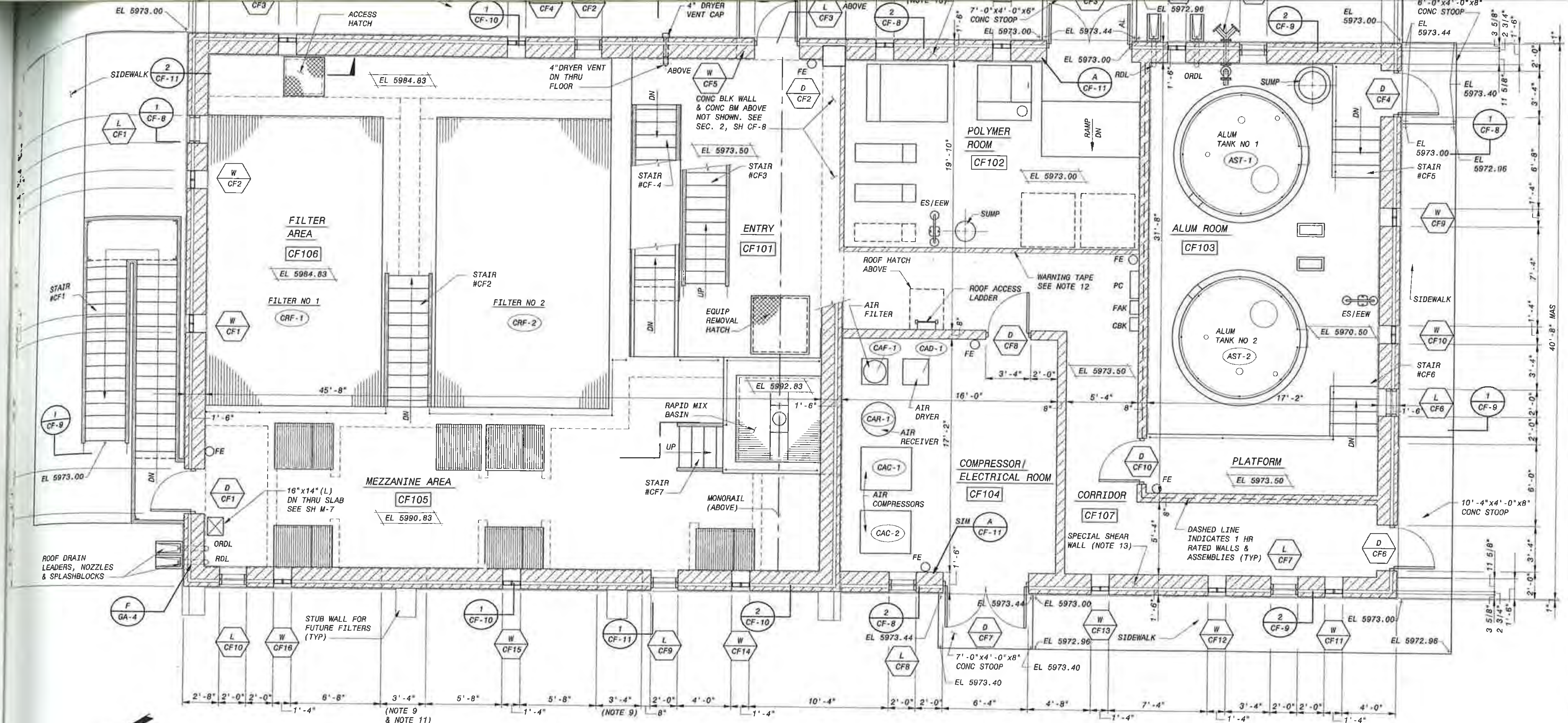
CROW CREEK WWTP
GENERAL
CIVIL
CROW CREEK LIQUID STREAM PROCESS SCHEMATIC

DESIGNED: MDG, DSB
DETAILED: JAC
CHECKED: WLK
APPROVED: MJM
DATE: 10-8-03

PROJECT NO.
131606

GC-1

SHEET
157 OF 314



OPERATING FLOOR PLAN

1/4" = 1'-0"

GENERAL NOTES:

1. ALL DIMENSIONS ARE FROM FACE OF CONCRETE OR FACE OF MASONRY UNLESS OTHERWISE NOTED. DIMENSIONS OF MASONRY UNITS ARE NOMINAL THICKNESS.
2. SEE STANDARD MASONRY DETAIL SHEET GC-9 FOR MASONRY REINFORCING & CONTROL JOINT (CJ) DETAIL. LOCATE CONTROL JOINTS WHERE SHOWN ON FLOOR PLANS & BUILDING ELEVATIONS.
3. SEE STRUCTURAL DRAWINGS FOR CONCRETE DIMENSIONS.
4. FOR STAIR DIMENSIONAL DATA SEE SH. GA-6.
5. SEE MISCELLANEOUS SPECIALTIES SECTION 10990 FOR LIFE SAFETY EQUIPMENT & ABBREVIATIONS.
6. SEE HVAC & PLUMBING DRAWINGS FOR DUCT & PIPING ROUTING. SEE DETAILS ON SH. GA-4 FOR PENETRATION DETAILS.
7. SEE CODE CLASSIFICATION TABLE SH. CF-1
8. ALL FLOOR PENETRATIONS MAY NOT BE SHOWN. SEE HVAC, PLUMBING & ELECT DWGS.
9. PROVIDE TYPE "C" X 4'-8" LONG LINTEL FOR FUTURE DOOR.
10. SEE ROOM FINISH SCHEDULE SPECIFICATION SECTION 09000 FOR ROOM FINISHES.
11. PLACE JAMB REINF FOR FUTURE DOOR
12. PROVIDE 3" WIDE, SELF ADHESIVE VINYL, YELLOW AND BLACK WARNING TAPE AROUND EDGE OF POLYMER AREA.
13. SPECIAL MASONRY SHEAR WALL INDICATED ON PLAN SHALL BE REINFORCED AS SHOWN ON STANDARD MASONRY DETAIL SH. GC-9.

NOTE:
ALL WORK THIS SHEET IS BID ALTERNATIVE F

Date/Time

CHEYENNE, WYOMING
BOARD OF PUBLIC UTILITIES
CROW AND DRY CREEK WWTP IMPROVEMENTS

CROW CREEK WWTP
REUSE WATER TREATMENT FACILITY
ARCHITECTURAL
OPERATING FLOOR PLAN

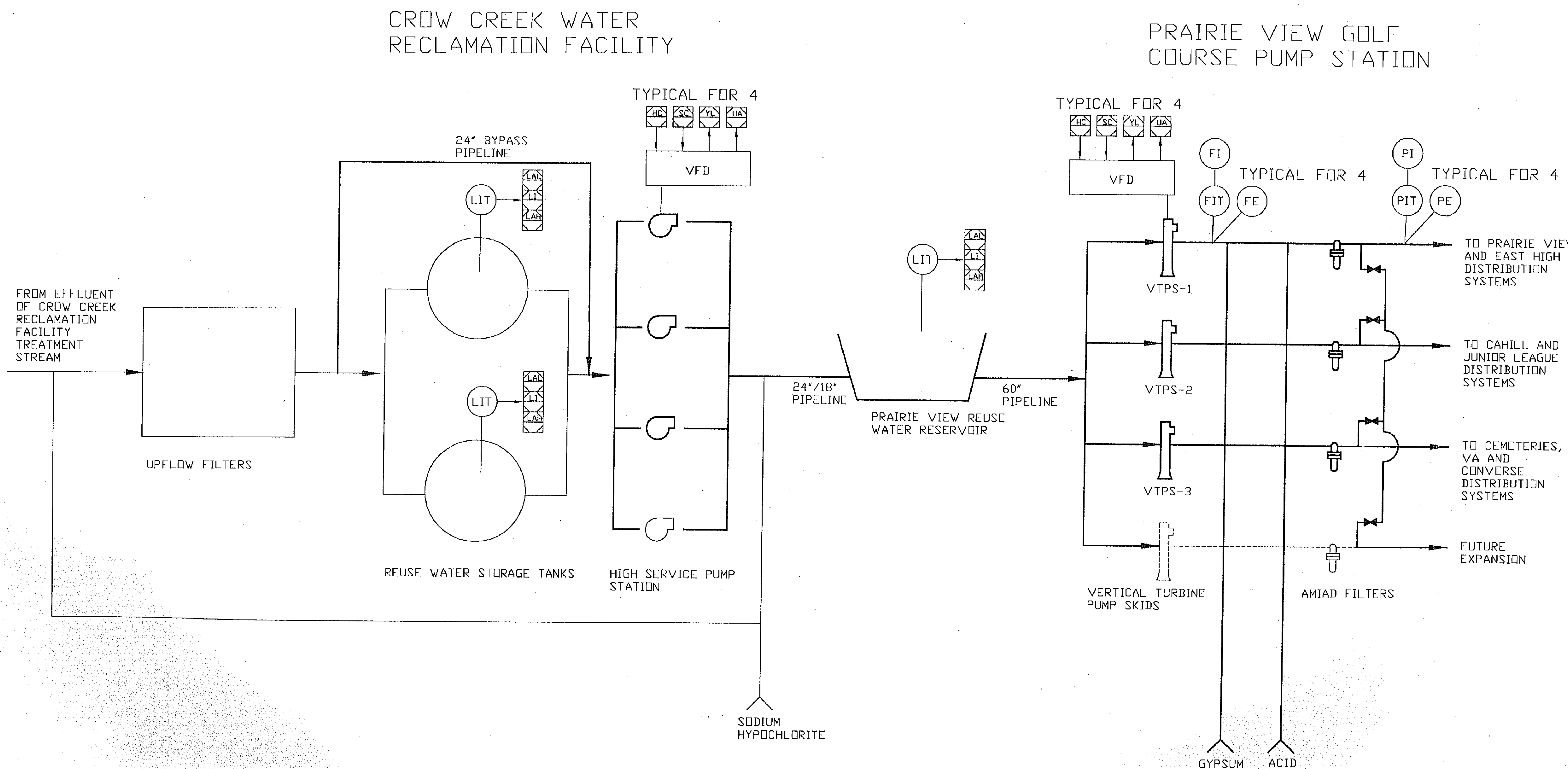
BLACK & VEATCH Corporation
Denver, Colorado

DESIGNED: DKB
DETAILED: DKB
CHECKED: FWS
APPROVED: MJM
DATE: 10-8-03

PROJECT NO.
131606

CF-2

SHEET 51 OF 314



FILE NAME: OVERALL | SCALE: | OPER. JMM | DATE SEPT 2005 | PROJ. # 457 | TASK # 001 | LOC. CHEYENNE, WYOMING | PROJ. REUSE WATER | SEND TO JACK MEENA, PE | PHONE (307) 634-7848

REV	DESCRIPTION OF REVISION	BY	DATE

CHEYENNE, WYOMING
BOARD OF PUBLIC UTILITIES

Rothberg Tamburini Winsor
1576 Sherman Street, Suite 100, Denver, Colorado 80203
303.825.5999 • 303.825.0642 (fax)
www.rtweng.com
Professional Engineers and Consultants

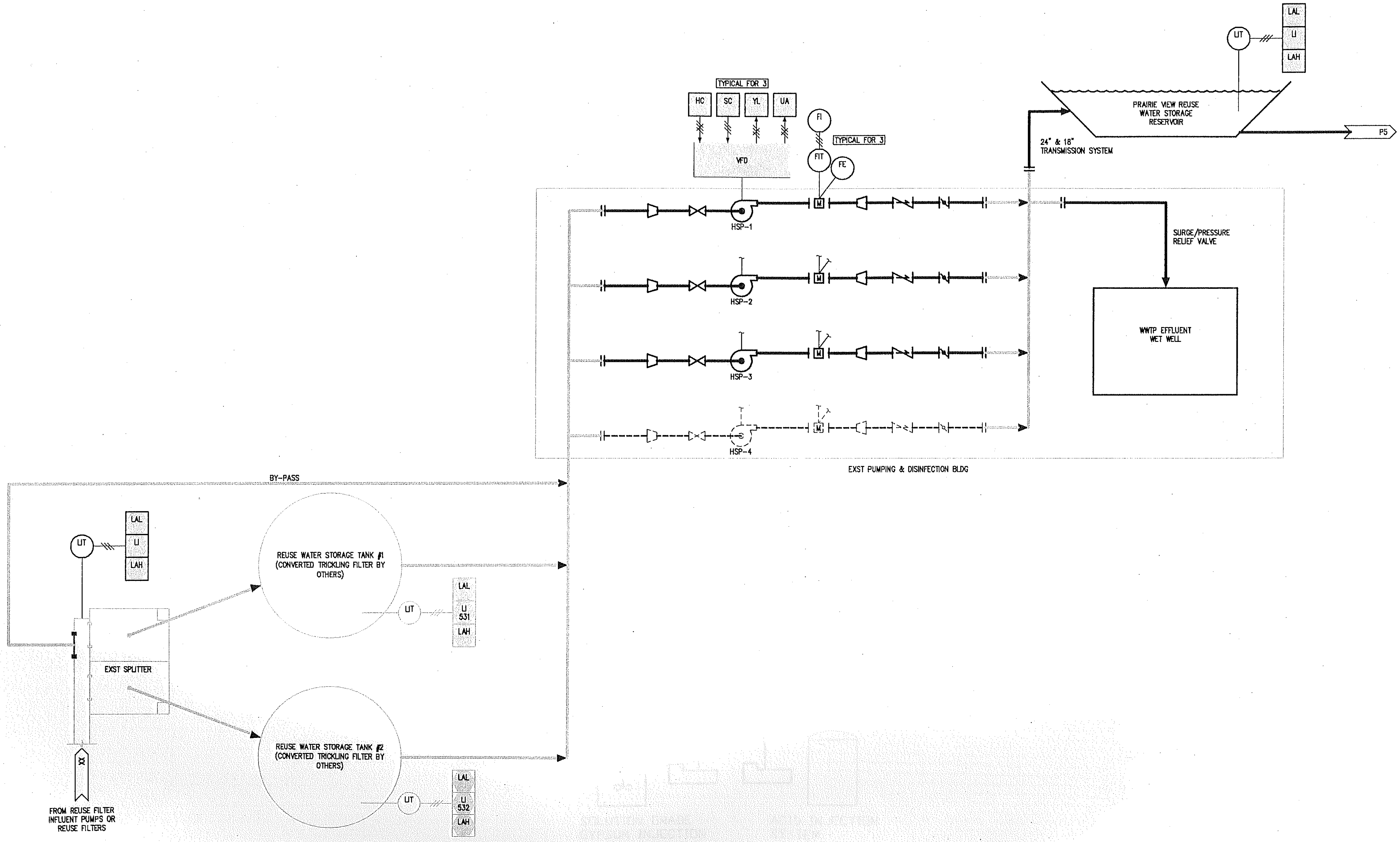
STATES WEST WATER RESOURCES CORPORATION
1904 EAST 15TH STREET
CHEYENNE, WYOMING 82001
(307) 634-7848
(307) 634-7851 FAX

WARNING
0 Ø 0.5
IF THIS BAR DOES NOT MEASURE 0.5" THEN DRAWING IS NOT TO SCALE

DESIGNED JMM
DRAWN JMM
CHECKED VEA
PEER REVIEWED
PROJECT MANAGER JMM
DATE SEPT 2005

CHEYENNE BOARD OF PUBLIC UTILITIES
WATER REUSE PIPELINE AND PUMPING FACILITY PROJECT
OVERALL SYSTEM PROCESS

REVISION
PROJECT 457.001
DRAWING P3
SHEET 4 OF 80



REV	DESCRIPTION OF REVISION	BY	DATE

CHEYENNE, WYOMING
BOARD OF PUBLIC UTILITIES

Rothberg Tamburini Winsor
Professional Engineers & Consultants
1576 Sherman Street, Suite 100
Denver, CO 80203
(303) 825-5999
(303) 825-0842 (fax)

STATES WEST WATER RESOURCES CORPORATION
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CHEYENNE, WYOMING 82001
(307) 634-7848
(307) 634-7851 FAX

WARNING
0 Ø 0.5
IF THIS BAR DOES NOT MEASURE 0.5" THEN DRAWING IS NOT TO SCALE

DESIGNED	JMM
DRAWN	JMM
CHECKED	VEA
PEER REVIEWED	
PROJECT MANAGER	JMM
DATE	MAY 2005

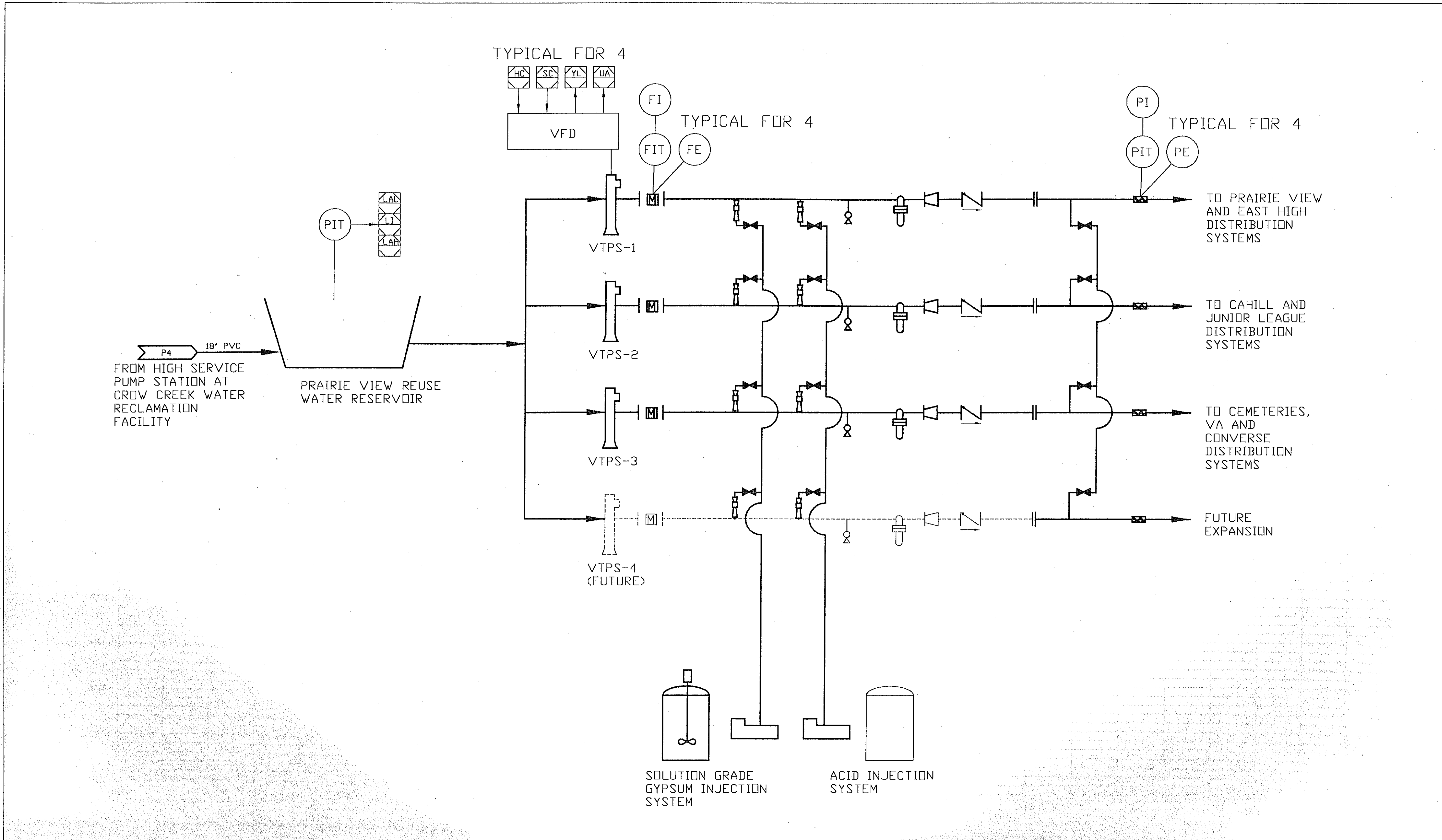
CHEYENNE BOARD OF PUBLIC UTILITIES

WATER REUSE PIPELINE AND PUMPING FACILITY PROJECT

CROW CREEK TRANSFER PUMP STATION

REVISION △
PROJECT 467.001
DRAWING P4
SHEET 52 OF 57

FILE NAME: TITLE
SCALE:
OPER. JMM
DATE MAY 2005
PROJ. 467
TASK 001
LOC. CHEYENNE, WYOMING
PROJ. REUSE WATER
SEND TO JACK MEENA, PE
PHONE (307) 634-7848



FILE NAME: PROCESS	OPER. JMM	PROJ. # 467	LOC. CHEYENNE, WYOMING	SEND TO JACK MEENA, PE
SCALE:	DATE SEPT 2005	TASK # 001	PROJ. REUSE WATER	PHONE (307) 634-7848

REV	DESCRIPTION OF REVISION	BY	DATE
△			
△			
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△			
△			
△			

CHEYENNE, WYOMING
BOARD OF PUBLIC UTILITIES

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1576 Sherman Street, Suite 100
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WARNING
0 ø 0.5
IF THIS BAR DOES NOT MEASURE 0.5" THEN DRAWING IS NOT TO SCALE

DESIGNED	JMM
DRAWN	JMM
CHECKED	VEA
PEER REVIEWED	
PROJECT MANAGER	JMM
DATE	SEPT 2005

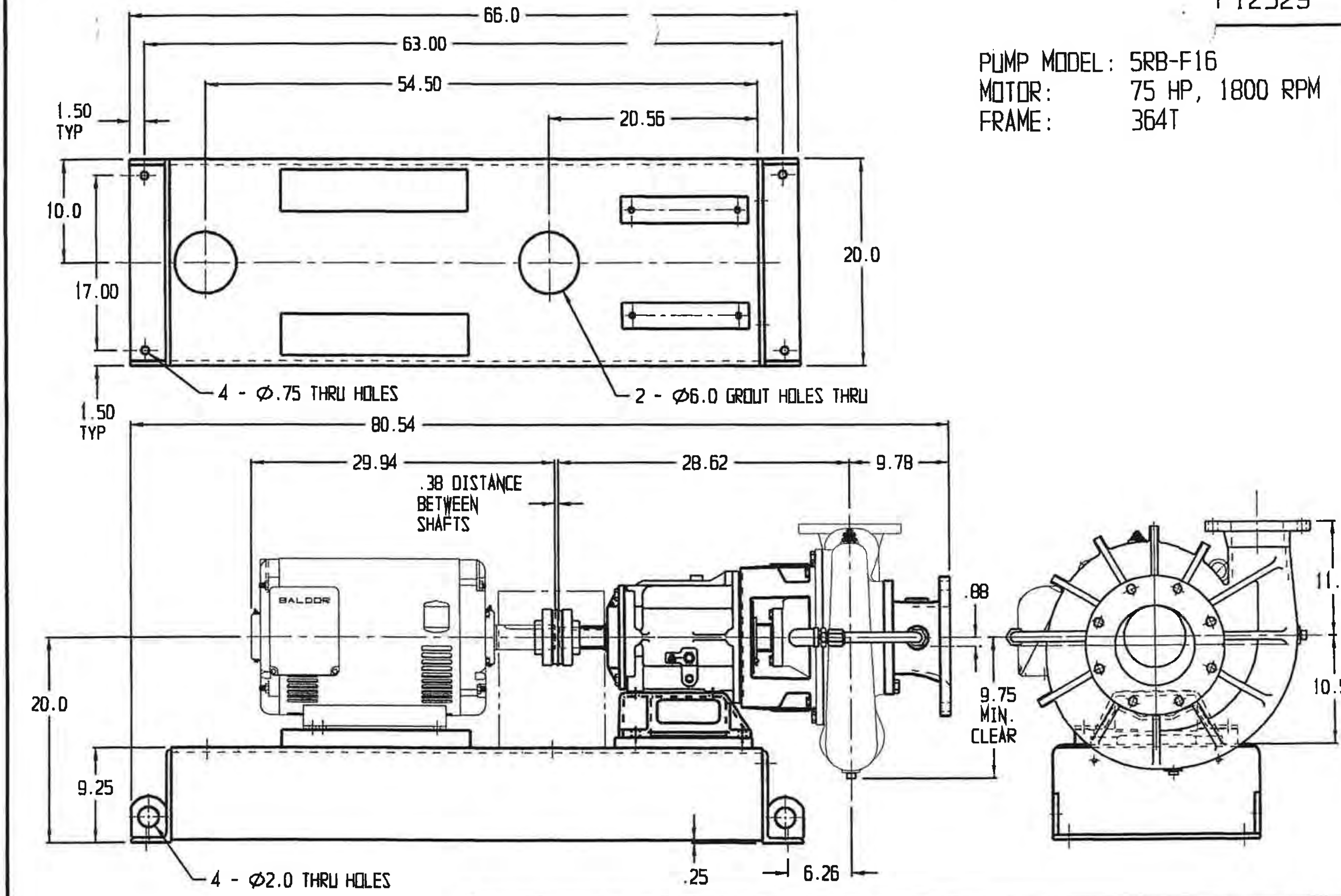
CHEYENNE BOARD OF PUBLIC UTILITIES

WATER REUSE PIPELINE AND PUMPING FACILITY PROJECT
PROCESS INSTRUMENTATION

REVISION △
PROJECT 467.001
DRAWING P5
SHEET 8 OF 80

F12329

PUMP MODEL: 5RB-F16
MOTOR: 75 HP, 1800 RPM
FRAME: 364T



NOTES:

1. OVERALL DIMENSION CAN VARY ±.12"

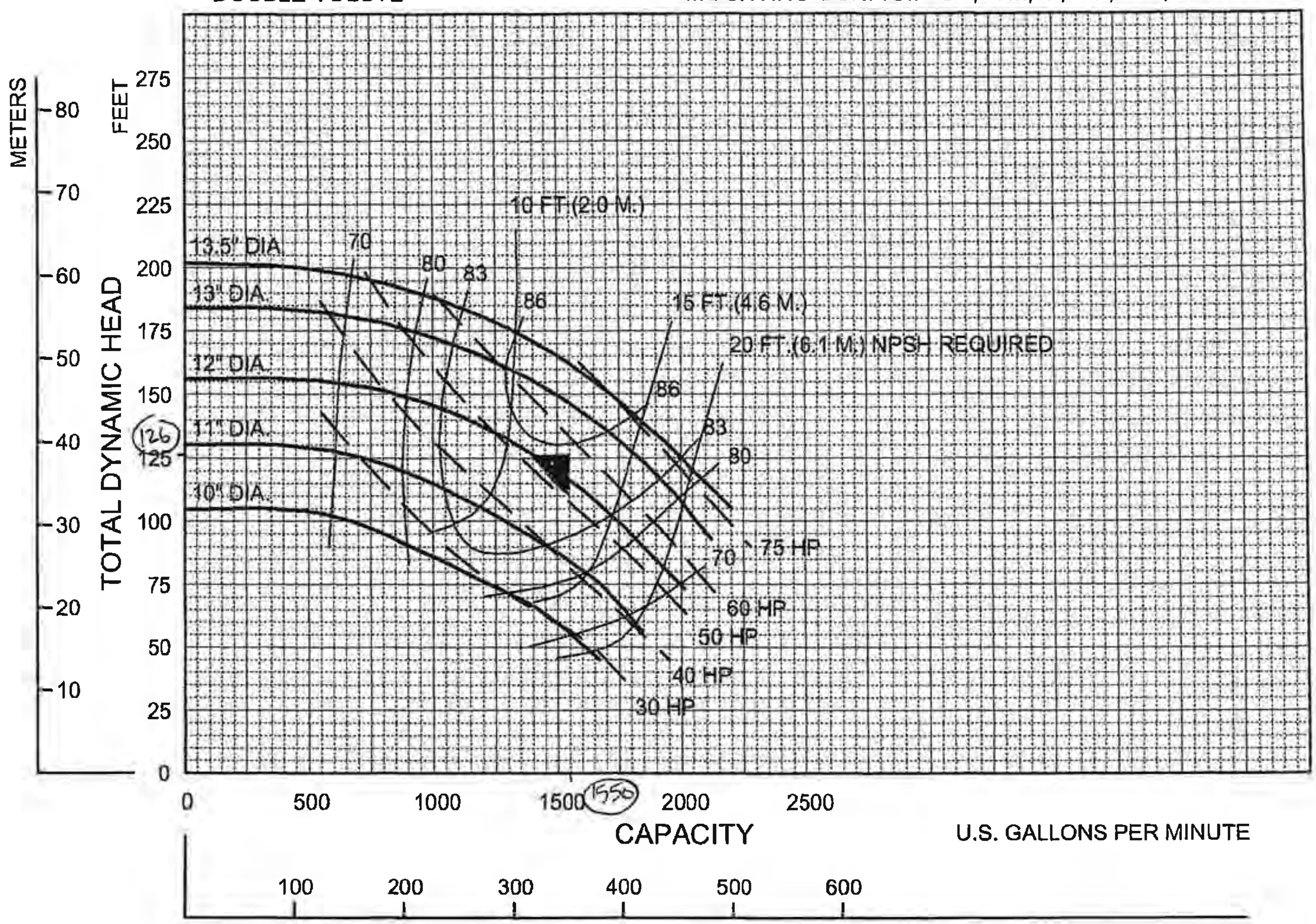
CORNELL®	REV.NO.	DESCRIPTION	DATE	BY
	FOUNDATION PRINT: 5RB-F16, BCG, W/GROUT HOLES		PATT. NO.	
			JOB NO.	
	DR. MAT	CHECKED SP	DATE 5/2/06	SCALE TO SCALE
	CORNELL PUMP COMPANY PORTLAND, OREGON		DWG NO. F12329	

Feet x .305 = Meters
Inches x 25.4 = Millimeters
GPM x .227 = Cubic Meters/Hour
GPM x 3.785 = Liters/Minute
HP x .746 = KW

Speed	Impeller Dia.	Style	Solids Dia.	N_S	Suction	Discharge	No. vanes
1780	VARIOUS	ENCLOSED	1.0"	1654	8"	5"	6

DOUBLE VOLUTE

MOUNTING CONFIG.: CC, VM, F, VF, EM, VC



Performances shown are for cool water, close-coupled electric configuration with packing. Other mounting styles or liquids may require horsepower and/or performance adjustments.

1550 GPM @ 126 FT

7/99

Cornell Pump Company • Portland, Oregon

5RB - 1800 RPM

Appendix 6-D
Cost Estimates

REVISED 9/13/13 Caitlin Kodweis (HDR)
REVISED 9/30/13 T. Quigley

Class A Near-term Projects

Item Description	Potential Class A Lines	Quantity	Unit	Unit Cost	Total Cost
Mylar and Smalley Park - Phase III					
Water Main					
12-inch PVC Pipe including installation	#1 and #2	15,200	LF	135.00	$2,052,000
SUBTOTAL					**$2,052,000**

GENERAL REQUIREMENTS					
Mobilization, Bonds and Insurance (15% of subtotal)			LS		$307,800
Contractor Overhead & Profit (12% of subtotal)			LS		$246,200
Construction Subtotal			**LS**		**$2,606,000**
Year of Construction		2017	YR		
Escalation Rate		3.5%	%		
Escalation Costs (year of construction - 2013)			LS		$2,990,400
Administrative and Easement Costs (5% of construction subtotal)			LS		$130,300
Engineering (12% of construction subtotal)			LS		$312,700
Design Contigency (30% of construction subtotal)			LS		$781,800
	Total Mylar and Smalley Park - Phase III				**$4,215,200**

Item Description	Potential Class A Lines	Quantity	Unit	Unit Cost	Total Cost
Central HS & McCormick JHS - Phase IV					
Water Main					
12-inch PVC Pipe including installation	Raw #1	4,670	LF	135.00	$630,450
SUBTOTAL					**$630,450**

GENERAL REQUIREMENTS					
Mobilization, Bonds and Insurance (15% of subtotal)			LS		$94,600
Contractor Overhead & Profit (12% of subtotal)			LS		$75,700
Construction Subtotal			**LS**		**$800,800**
Year of Construction		2020	YR		
Escalation Rate		3.5%	%		
Escalation Costs (year of construction - 2013)			LS		$1,018,800
Administrative and Easement Costs (5% of construction subtotal)			LS		$40,000
Engineering (12% of construction subtotal)			LS		$96,100
Design Contigency (30% of construction subtotal)			LS		$240,200
	Total Central HS & McCormick JHS - Phase IV				**$1,395,100**

Central & McCormick New Infrastructure Line	
Length	19870 ft
Flow	865 gpm
Diameter	12 in.
Customers	Anderson Elem. Cole Property Mylar & Smalley Central & McCormick
New booster pump station	

Item Description	Potential Class A Lines	Quantity	Unit	Unit Cost	Total Cost
Holliday Park					
Water Main					
8-inch PVC Pipe including installation	#4	3,940	LF	120.00	$472,800
SUBTOTAL					**$472,800**

GENERAL REQUIREMENTS					
Mobilization, Bonds and Insurance (15% of subtotal)			LS		$70,900
Contractor Overhead & Profit (12% of subtotal)			LS		$56,700
Construction Subtotal			**LS**		**$600,400**
Year of Construction		2015	YR		
Escalation Rate		3.5%	%		
Escalation Costs (year of construction - 2013)			LS		$643,200
Administrative and Easement Costs (5% of construction subtotal)			LS		$30,000
Engineering (12% of construction subtotal)			LS		$72,000
Design Contigency (30% of construction subtotal)			LS		$180,100
		Total Holliday Park			**$925,300**

Holliday Park New Infrastructure Line	
Length	3940 ft
Flow	375 gpm
Diameter	8 in

REVISED **9/13/13** Caitlin Kodweis (HDR)

Class A Mid-term Projects

Average of alternates: $11,606,500

Item Description	Quantity	Unit	Unit Cost	Total Cost
DCWRF to CCWRF Reuse Line - Alternate #1				
Water Main				
16-inch PVC Pipe including installation	29,370	LF	150.00	$4,405,500
SUBTOTAL				**$4,405,500**

GENERAL REQUIREMENTS				
Mobilization, Bonds and Insurance (15% of subtotal)		LS		$660,800
Contractor Overhead & Profit (12% of subtotal)		LS		$528,700
Construction Subtotal		**LS**		**$5,595,000**
Year of Construction	2028	YR		
Escalation Rate	3.5%	%		
Escalation Costs (year of construction - 2013)		LS		$9,373,600
Administrative and Easement Costs (5% of construction subtotal)		LS		$279,800
Engineering (12% of construction subtotal)		LS		$671,400
Design Contigency (30% of construction subtotal)		LS		$1,678,500
Total DCWRF to CCWRF Reuse Line - Alternate #1				**$12,003,000**

Item Description	Quantity	Unit	Unit Cost	Total Cost
DCWRF to CCWRF Reuse Line - Alternate #2				
Water Main				
16-inch PVC Pipe including installation	27,430	LF	150.00	$4,114,500
SUBTOTAL				**$4,114,500**

GENERAL REQUIREMENTS				
Mobilization, Bonds and Insurance (15% of subtotal)		LS		$617,200
Contractor Overhead & Profit (12% of subtotal)		LS		$493,700
Construction Subtotal		**LS**		**$5,225,400**
Year of Construction	2028	YR		
Escalation Rate	3.5%	%		
Escalation Costs (year of construction - 2013)		LS		$8,754,400
Administrative and Easement Costs (5% of construction subtotal)		LS		$261,300
Engineering (12% of construction subtotal)		LS		$627,000
Design Contigency (30% of construction subtotal)		LS		$1,567,600
Total DCWRF to CCWRF Reuse Line - Alternate #2				**$11,210,000**

Item Description	Quantity	Unit	Unit Cost	Total Cost
Laramie County Community College				
Water Main				
16-inch PVC Pipe including installation	13,640	LF	150.00	$2,046,000
SUBTOTAL				**$2,046,000**
GENERAL REQUIREMENTS				
Mobilization, Bonds and Insurance (15% of subtotal)		LS		$306,900
Contractor Overhead & Profit (12% of subtotal)		LS		$245,500
Construction Subtotal		**LS**		**$2,598,400**
Year of Construction	2028	YR		
Escalation Rate	3.5%	%		
Escalation Costs (year of construction - 2013)		LS		$4,353,200
Administrative and Easement Costs (5% of construction subtotal)		LS		$129,900
Engineering (12% of construction subtotal)		LS		$311,800
Design Contigency (30% of construction subtotal)		LS		$779,500
Total Laramie County Community College - Phase V				**$5,574,000**

Central & McCormick New Infrastructure Line	
Length	13640 ft
Flow	2162 gpm
Diameter	14 in
Customers	LCCC Sweetgrass Read Property
New high service pump 2200gpm @ 150 psi	

9/27/13

CROW CREEK

Item Description	Quantity	Unit	Unit Cost per MGD	Total Cost			
REUSE WATER TREATMENT FACILITY EXPANSION							
YARD PIPING						Filter Bldg Expansion	
Misc. Buried Piping (gas, pw, npw)	1	LS	25000.00	$25,000			
Connections to Exist	1	EA	25000.00	$25,000			
EARTHWORK							
Soil Excavation	1235	CY	10.44	$12,891			
Backfill	770	CY	13.05	$10,047			
Structural Backfill	90	CY	19.57	$1,761		$8,150.79	
CONCRETE							
Fill Conc	25	CY	260.95	$6,524			
Slabs	120	CY	521.91	$62,629			
Suspended Slabs	33.3	CY	1043.82	$34,794			
Walls	136.7	CY	652.39	$89,160			
Sidewalks & Stoops	320	SF	3.91	$1,253			
MASONRY							
Exterior Walls	2002	SF	33.92	$67,916			
Face Block Only	441.7	SF	13.05	$5,763		$1,901.71	
METALS							
Handrail	100	LF	45.67	$4,567			
Grating	650	SF	32.62	$21,203			
Roof Joists & Deck	1230	SF	45.67	$56,170			
Stairs		LS	7000.00	$42,500			
Misc. Metals	1167	LB	4.24	$4,947		$42,698	
THERMAL AND MOISTURE PROTECTION							
Fully Adheared EPDM & Insulation	410	SF	13.05	$5,350			
Parapet Coping	88.3	LF	10.44	$922			
Roof Curbs	2.3	EA	652.39	$1,522			
Insulation	1077.3	SF	2.61	$2,811		$3,500	
FINISHES							
Joists and Deck	205	SF	3.91	$802			
Paint Epoxy (CMU)	667	SF	4.57	$3,048			
Filter Box Coating	300	SF	9.79	$2,937			
EQUIPMENT							
Continuous Backwash Filtration Equipment	3	EA	235000	$705,000		$705,000	
Filter Installation		LS		$105,750			
INSTRUMENTATION							
Sensors, SCADA		LS		$25,000		$25,000	
PIPING							
Flanged DIP plant	6000	Lb	4.00	$24,000			
Chemical Feed Piping & Valves		LS		$10,000			
Pipe Supports		LS		$8,000			
VALVES							
18 inch Butterfly Valves	6	EA	8500.00	$51,000			
8 inch PV	3	EA	2400.00	$7,200			
4 inch PV	6	EA	1100.00	$6,600			
Drain Ball Valves	6	EA	400.00	$2,400			
Air Relief Valves	3	EA	1000.00	$3,000			
Miscellaneous		LS		$3,500		$73,700	
MECHANICAL							
Heating Ventilation and Air Conditioning		LS	$25,000.00	$25,000			
ELECTRICAL			$0.00	$0			
Lighting, switches, misc		LS	$15,000.00	$15,000			
Wiring, conduit		LS	$15,000.00	$15,000		$9,900	$161,256
MCC, service feeder, breakers		LS	$50,000.00	$50,000			
SUBTOTAL				**$1,546,000**		**$869,850**	
GENERAL REQUIREMENTS							
Mobilization, Bonds and Insurance (15% of total)		LS		$231,900			
Contaractor Overhead & Proffit (12% of total)		LS		$185,500			
CONTINGENCY (35% of total)		LS		$687,200			
TOTAL REUSE WATER TREATMENT FACILITY EXPANSION					**$2,651,000**		