Sand Coulee Water District

Water System Improvements

Engineer Report

NCI Engineering

Engineer:
NCI Engineering Co.
Great Falls, Montana

2013

FINAL

SAND COULEE WATER SYSTEM IMPROVEMENTS

ENGINEER'S REPORT
(TECHNICAL NARRATIVE)

Prepared for:

Mr. Tom Henderson
Remediation Division
Montana Department of Environmental Quality
P.O. Box 200901
Helena, MT 59620-0901

MONTANA
JOHN ALAN
NEIL
4682 E
REGISTERED
PROFESSIONAL ENGINEER

Prepared by:

NCI Engineering Company
4509 North Star Blvd.
P.O. Box 6350
Great Falls, MT 59406

June, 2013

1.0 GENERAL

The town of Sand Coulee is a small unincorporated residential community of approximately 180 people. Sand Coulee, a drainage beginning in the foothills of the Little Belt Mountains, is located in Cascade County, Montana. The town site is approximately eight miles southeast of Great Falls (Figure 1-1). Historically the area experienced extensive coal mining activities during the early 20th century. Past mining activities have negatively impacted the town's water source and water system infrastructure. The abandoned mines have partially dewatered the Kootenai Formation which has been the source for the community's public water supply. While the community has experienced recurring water shortages, options for new water supplies have been limited by the impacts of the coal mining activities. Acid mine drainage has contaminated surface water and shallow groundwater in the area. In addition, the existing water distribution system was installed in areas filled with coal waste remaining from the mining operations. Based on these conditions, the Montana Department of Environmental Quality Abandoned Mine Lands Program (DEQ-AML) is working to develop a reliable source of potable water and eliminate exposure to coal wastes in the water distribution system.

The Madison aquifer was identified as the best candidate for a new source of potable water for the community (Hydrometrics, 2011). The DEQ Public Water Supply Division (DEQ-PWS) approved construction of Sand Coulee Water District (Water District) Well 5 in the Madison aquifer on September 23, 2011 and approved the well discharge piping on July 16, 2012. Well 5 was brought into service on August 31, 2012. A Groundwater Certificate for 35 gallons per minute/10 acre-ft was issued for Well 5. The Water District submitted a Beneficial Water Use Permit application for an additional 48 acre-feet of groundwater from the Madison aquifer on May 16, 2013.

A back-up well (Well 6) is being planned while water rights issues are being determined. Now that a reliable primary potable water source is available to the town of Sand Coulee the imminent community need is a project to replace the deteriorated water distribution system and storage tank with a system meeting current DEQ water system standards.

1.1 ENGINEER'S REPORT

This engineer's report follows the outline, numbering system and information required by CIRCULAR DEQ 1, Standards for Water Works, February 24, 2006 Edition, Chapter 1, Submission of Plans. When a section is not applicable to this project it is annotated as NOT USED or NOT APPLICABLE.

1.11 General information

Existing Water Works.

1. Storage Tank. The existing water storage facility is a bolted steel, above ground, cylindrical tank providing 100,000 gallons of usable storage. The available storage volume does not provide adequate fire flow storage or the DEQ-1 required maximum day demand (MDD) requirement. Based upon DEQ-1 design requirements for both MDD and fire flow an adequately sized storage facility should supply a minimum of 135,000 gallons. The existing tank is also in poor condition. A recent tank evaluation completed 3/2010 indicated the tank is in need of interior cleaning, sand blasting and interior recoating. The exterior of the tank exhibits surface corrosion and a need for recoating as well. The ladder/handrail system needs maintenance and the tank does not meet OSHA entrance/exit requirements. Significantly there are visual signs of stored water leakage near the bottom of the tank where the bottom shell plates meet the floor plates. For some period the existing water level controls have been problematic as they are susceptible to ice cake movement. This has resulted in frequent failure of the water level controls. Additionally, the tank has no flow metering capability. Given the condition of the tank, modification of the tank is deemed a poor option. Therefore, in this project the tank will be replaced

2. Distribution System. The existing water distribution system consists of 6" transite piping, 6" PVC (installed in 1987 and funded by the Abandoned Mines program) and 4" thin walled solvent weld, plastic piping. The 4" piping is not AWWA/NSF approved, not pressure rated, and has a history of consistently failing (two recent major failures in 3/2010). Residential services are typically ¾" diameter pipe. Water service pipe material varies between copper, galvanized, and poly ethylene pipe. The Water District bylaws state that service lines from the curb stop to the residence are the responsibility of the individual property owner.

3. Metering System. No water meters, storage tank or well/pumping system flow measuring devices are currently included in the existing Water District system.

4. Fire Protection. The existing water system has only one fire hydrant. DEQ - 1 requires hydrant spacing at each street intersection and at intermediate points between intersections. Fire hydrants must be provided as recommended by the fire protection agency. This recommendation is 500 foot spacing between hydrants. In accordance with DEQ-1 (8.4.3), hydrant leads must be a minimum of 6-inches in diameter. In view of these criteria, the existing town of Sand Coulee water system does not provide an adequate fire protection.

5. Pressure. The existing water system provides adequate water pressure. There are no known pressure problems existing throughout the District. Due to the gravity nature of the primary sources and elevated level of the storage tank, the pressure near the middle of the community has been consistently measured at approximately 69psi, which is indicative of the elevation of the existing tank. Residents do not report any water pressure problems from the current system when there service lines are fully open and not broken or filled with coal slack debris.

6. System Problems. The existing 4" piping consistently fails in the following described manner. When a break develops, the 4 inch plastic pipe typically splits open from glued coupling to coupling and generally in a straight, continuous line. Where these breaks develop the existing 4" piping typically accumulates a significant amount of granular coal/coal slack materials. District maintenance personnel report this condition is extensive and occurs for all the distribution system piping except the 6 inch PVC pipe installed in 1987. Compounding the coal slack entry problem there is no means of flushing the distribution system to remove settled deposits of coal/coal slack. Further, the existing system is not looped and there is not a sufficient number or location of fire hydrants.

   The actual source of the settled granular coal within the distribution system is unknown. However, what is known is that it is not uncommon for the coal deposits to plug service connections or come through faucets in many, if not all, Sand Coulee residences. As a result, many residences have been forced to install filters to remove suspended granular coal/coal slack and incur water pressure problems at faucets. The accumulated granular coal present in the existing water distribution system could potentially lead to health concerns for the community.

   The District does not presently treat their source water. The District takes disinfection measures only when system maintenance or repair is performed. Common bleach is used as a disinfectant.

   a. Existing Sewerage Facilities.

      All dwellings and residences are connected to individual septic systems. There is no community sewage system currently available in the town of Sand Coulee. Neither the town nor Cascade County Health Department possesses complete sanitary system records of the type, location or condition of these individual septic systems. As the potential exists for new water system construction to conflict with existing individual septic systems, the Cascade County Board of Health (BOH) has been contacted for direction. The BOH has agreed to provide the project sponsor with written policy and guidance to govern methods handling these potential conflicts.

b. Area Served.

The water planning area for this project includes the entire Water District boundary. Sand Coulee Vicinity Map and District Boundary and Planning Area are shown in Appendix 'A'.

The community of Sand Coulee is accessed via State Secondary routes 226 or 227 and lies approximately 8 miles from Great Falls, MT.

The Water District was formed in November 2009. Prior to that the water system was operated and maintained by Water Users Association that was established in 1959. The Water District serves strictly a residential area. No businesses currently exist within the District, nor are any currently projected..

c. Jurisdiction, Names and Mailing Address.

Sand Coulee is an unincorporated community, organized under the laws of the State of Montana. Management of the Water District is the responsibility of the Board of Directors, as authorized under Title7, Chapter 13, Parts 22 and 23. The Water District is primarily responsible for meeting the requirements of the Montana Water Quality Act. Members of the current Water District Board and staff are as follows:

Kent Luoma, President
Pat Darko, Board member
Mike Waldner, Board member
Kelly Luoma, Bookkeeper
Mary Ann Freeman, Secretary

Address: Sand Coulee Water District,
P.O. Box 97,
Sand Coulee, MT 59472

d. NOT APPLICABLE

1.1.2 Extent of water works system.

a. Description of the nature and extent of the area to be served is addressed above

b. There are no provisions for extending the water works system in the future.

c. Sand Coulee is a residential community with an aging population. Correspondingly, it is a community of limited growth potential. A reasonable determination is that future requirements for water service that supports industrial, commercial, or institutional establishments is considered negligible.

1.1.3 Alternate Plans

There are no feasible alternate water works plans for the Sand Coulee Water System Improvements project. The water system situation and needs of the community fit MDEQ Circular DEQ 3 standards for a small water system.

1.1.4 Site Conditions

Sand Coulee is located in a narrow valley floor with an average elevation of approximately 3465 feet MSL. The coulee exhibits a slight drop in grade of 1-2% in a northeasterly direction. Adjacent flat top bluffs lay directly north and south of the town. These hem the community in and the bluffs rise to elevations of approximately 3700 feet MSL. This difference in elevation is approximately 235' above the average elevation of the Sand Coulee valley bottom. The surrounding area is generally agricultural and rangeland. Trees and vegetation survive mostly in the valley areas or adjacent to water collection/transport areas such as irrigation ditches. As noted before, the community was originally established as a coal mining town. As a result there are many abandoned mines in and around the Sand Coulee town site. Coal mining in Sand Coulee began in the late 1880's and continued for approximately 60 years before the mines played out.

Soils. Soils information for the Sand Coulee area was obtained from the NRCS website. Vicinity soils are listed as Bitton and Roy Soils with 10-65% slopes and Fergus silty clay loams (located primarily in and around Sand Coulee Community) with 2-15% slopes. Both soil types are considered well drained with no frequency of flooding. The Bitton and Roy soils are reported to have a profile from 1-60 inches in depth and be comprised of stony loam to very stony loam. The Fergus silty clay loam material has a profile from 1-60 inches and is comprised of silty clay loams. Neither of these soil type exhibit properties that may be problematic with installation or replacement of water main or service utilities. Both soil types appear to be a good backfill material for utilities. The water table has been observed in the immediate vicinity of the "Rusty Ditch" tributary (see below) and is currently being monitored. At the present time all excavations for this project are above the groundwater table.

Groundwater. Based on local GWIC well logs, area groundwater levels average approximately 130 feet to 636 feet below ground surface (bgs). Groundwater to be used for Sand Coulee water system comes from Well 5 drilled into the Madison aquifer. An electronic disk with report of the installation, hydrostratigraphy, aquifer and water quality testing titled SAND COULEE WATER DISTRICT PUBLIC WATER SUPPLY WELL INSTALLATION FINAL REPORT dated August 2012 is attached to this report in Appendix "B". Further, a second report by Hydrometrics Inc. for the DEQ Remediation Division titled SAND COULEE WATER DISTRICT WATER SUPPLY ASSESEMENT, dated January 2011, assesses three specific water source options for the town of Sand Coulee detailing topographic, hydrogeologic, existing wells and other groundwater features pertinent to this project. This report is attached on an electronic disk as Appendix "C".

Surface Water. Surface waters in the area include the unnamed tributary to Sand Coulee Creek flowing through the Sand Coulee community. This stream is commonly referred to as Rusty Ditch. Rusty Ditch connects with Sand Coulee Creek. Sand Coulee Creek lies northeast of the community. Sand Coulee Creek, flowing in a northerly direction ultimately joins the Missouri River. Neither the unnamed tributary nor Sand Coulee Creek are described as major streams and are classified as a 5th code watershed. There are no lakes within the immediate area. As reported in the DNRC interactive mapping program there are no wetlands existing within the Sand Coulee Water District area. The community is located in an area outside the 500 year flood plain.

1.1.5 Water Use Data

a. Description of population trends. In order to establish the present population residing within the District boundary population calculations were based on the existing number of water services (73), and information from the 2000 Census related to the average number of people per household. Using this information there are 80,357 people and 32,547 households in Cascade County. This ratio equates to 2.47 people per household. Hence, multiplying 2.47 people per household times 73 water services in (2.47 X 73) = 181 people.

   Estimating a population increase of 1% per year for 22 years (2035) then multiplying the current population of 181 people by the projected population increase yields a calculated future water system design requirement of 225 people by the year 2035. (181 people X 1.01^{22} = 225)

b. Present water consumption and projected ADD, MDD and fire flows. There are no meters on the existing water system including well head meters, tank meters or residential meters therefore actual water accounting could not be performed. DEQ-AML-Hydrometrics assessed historical, current, and future domestic and irrigation use by the community during the development of the DNRC Beneficial Use Permit application (Hydrometrics, 2012).

Current: Based upon the present population of 181 people, estimated current water usage per capita of 100 gallons per day the calculated current average daily demand (ADD) is 18,100 gpd. Using a peak fact of 4 (PF=4) the maximum daily demand (MDD) is 72,400 gpd. The total water storage capacity required for fire flow (500 gpm for 2 hrs) is 60,000 gallons, but cannot be met by the current system storage availability.

Future and Design: Based upon the projected population of 225 people and adjusting the water usage per capita to 150 gallons per day the calculated design average daily demand (ADD) is 33,750 gpd and includes consideration for lawn and garden irrigation water. Using a PF = 4 the maximum daily demand (MDD) is 135,000 gpd. The total water storage design capacity for fire flow (750 gpm for 2 hrs) is 90,000 gpd. Fire flow minimum requirements for the town of Sand Coulee are 500 gpm for 2 hours. Fire flow design storage capacity exceeds the minimum requirement.

c. Present yield of the sources of water supply. Well 5 has a tested capacity of 150 gpm based on a 24 hour pumping test Based on the minimal drawdown recorded during the pumping test (see Appendix, the maximum capacity is estimated to exceed 500 gpm. Until the DNRC beneficial use permitting process is complete, production from Well 5 is limited to 35 gpm and an annual volume of 10 acre-ft. For the purpose of this report, Well 5 design yield is 35 gpm.

1.1.6 Flow requirements

a. See hydraulic analysis Appendix "D".

b. Required fire flow is 500 gpm for 2 hours. Design fire flow for the new water system is 750 gpm for 2 hours.

1.1.7 Sewage system available

Presently there is not a public sewage system in the town of Sand Coulee. Residences are served by privately owned, individual septic systems. Many of these systems are not documented regarding location, size or construction. Surveys have been conducted to remedy this shortfall, but results have not been complete and often what has been found is not of sufficient detail to be useful. In addition, the septic tank density in Sand Coulee is medium and high. Therefore, all utility work within the community will have to be performed in coordination with the Cascade County Sanitarian relative to the location of existing septic systems and drainfields with the new water distribution system route. Currently, the Cascade County Health Department is developing written policy that will guide DEQ/AML in the formulation of construction documents informing project managers, the Water District Board and Contractors of their responsibilities should water line and septic system conflicts arise.

The NRIS online mapper indicates that there are presently 30 underground tank facilities in the area and 2 active underground storage (UST) sites.

1.1.8 Sources of water supply

1.1.8.1 Surface water source of supply. – NOT USED

1.1.8.2 Groundwater source of supply.

Wells 3, 4, and 5 are currently used as sources of potable water for the community. Pending approval of the Groundwater Beneficial Use Permit application, Well 5 will be the groundwater source supplying the town of Sand Coulee. Wells 3 and 4 will remain in service as backup wells for the Water District. Pending approval of the Groundwater Beneficial Use Permit, an additional well (Well 6) will be completed in the Madison aquifer by the DEQ AML program to serve as a backup well for the Water District.

1.1.9 Proposed treatment process

Water treatment. No water treatment measures are presently performed or required by the District. Water is disinfected only when repair work or maintenance is done, and bleach is used as a disinfectant if bacteriological tests come back positive. Likewise, the new groundwater source will not require treatment as evidence from the well installation final report (see sub-section 1.1.8.2) dated August, 2012 indicates.

Since the Sand Coulee Water District water system is a community system, Montana regulations require it to monitor microbiological, chemical and radiological quality. For microbiological quality testing, community water supplies must sample for total coliform bacteria on a monthly basis (at minimum – based on population), in accordance with the Total Coliform Rule. Coliform bacteria are not a disease producer, however, are often associated with disease-causing organisms which in turn makes it a good index of bacteriological safety of water.

Based on population, Sand Coulee Water District WSD is only required to sample for total coliform once monthly. Chemical quality testing includes lead and copper (Lead and Copper Rule); nitrate + nitrite as nitrogen (Phase II Rule); and volatile organic chemicals and inorganic chemicals (Phase II & V). Sampling frequency of chemical quality of a community water system varies. Typically, radiological quality testing is required quarterly to every nine years for a community water system. For Sand Coulee, combined radium testing is required once every three years and for gross alpha particle activity, once every nine years. In Montana, radiological content testing includes combined radium-226 and radium-228 and gross alpha particle activity (including radium-226 and 228 but excluding radon and uranium).

1.1.10 Waste disposal

Use of the proposed water works system under this design does not contemplate waste disposal requirements.

1.1.11 Automation

The control system shall consist of the following work:

Well House – New Master Station

a. Unit will provide centralized control and monitoring of the water system.
b. Unit will include new web based SCADA system providing remote notification of alarms and web based operator interface.
c. The new controller shall be programmed to monitor; One (1) Water Tank level (remote transducer 4-20mA signal); One (1) Remote Flow meter (4-20 mA signal); Four (4) Well Levels (remote transducer 4-20mA signal). Controller shall provide on/off control for four (4) will submersible (see well data schedule) pump alteration, low well cut out and restore.
d. Receive metered flow input and well level input.

Remote Operator Workstation

a. New laptop computer shall be provided to allow monitoring of the new web based SCADA system via internet connection and ability to change set points.
b. Provide new well drawdown level monitoring via well level transducer.

Tank (150,000 gallon)

Laptop computer shall be provided to be used to access the website.

See well data below.

SAND COULEE WELL DATA								
Pump House No.	**Well No.**	**New Transducer Required**	**Design Pump Rate**	**HP**	**Completion Depth**	**Well Diameter**	**Completion Interval**	**Status**
1 (New)	1	No	35 GPM +/-	1.5	180 +/-	8"	3"	Abandon
	2	No	35 GPM +/-	?	200 +/-	8"	3"	Abandon
	3	✓	35 GPM +/-	?	200 +/-	8"	3"	Active
	4	✓	35 GPM +/-	3	200 +/-	8"	3"	Active
	5	✓	35 GPM +/-		800 +/-	8"	3"	Active
	6	Future	35 GPM +/-		800 +/-	8"	3"	Future

The operator display shall be the local operator interface to the water system. All system parameters monitored or controlled shall be viewable and adjustable via the operator interface. The screens shall be easily interpreted by the operator. Easily recognizable/intuitive symbols shall be used for graphically displaying the system. Each screen shall be an active/dynamic graphical representation of the system or associated specific parameters.

System setpoints shall be provided. Each setpoint shall have a user adjustable (0-999) seconds time delay to prevent momentary process fluctuations from impacting alarm or control.

A menu system shall be provided for the user with proper access to change setpoints, setup pump starts, stops, alarms, alarm delays and setup pump alternation.

The following displays shall be provided:

a. Overview
b. Site Specific Display
    i. Elevated Storage Tank
        Tank Level
        Setpoints
        High & Low Level Alarm
        Station Power Status
    ii. Well House
        Motor (ea) Status (Pump Well 3, 4, 5 and 6 [Future]) – In Auto, Call, Run, Fail, Run Time,
        Motor (ea) Soft H-O-A
        System Flow Rate & Total
        Well Drawdown Level
        Setpoints
        Well Low Level Cutout and Restore
        Station Power Status

Alarm Screen

a. When an alarm is activated it shall be logged with a time and date stamp and displayed in the alarms summary screen until the operator acknowledges it.
b. A historical screen shall provide a historical log for the most recent 64 events
c. Trend Screen
    i. A trend screen showing, a minimum of, the last 2 hours of level/ pressure/flow fluctuations.
    ii. Tank Level
    iii. Well 3 Level
    iv. Well 4 Level
    v. Well 5 Level
    vi. Well 6 Level (Future)
    vii. Flow

1.1.12 Project sites

Project site was constrained for all practical consideration to following the location and routes of the existing water system including well site, storage tank site and water main line routes. Minor improvements were made in the layout of the new water distribution system, including looping the system, adding valves and an additional 21 fire hydrants.

1.1.13 Financing

The design and construction of this project is fully funded by the Office of Surface Mining through the Remediation Division of the Montana Department of Environmental Quality. This design and construction funding source allows the Sand Coulee Water District to maintain their same rate structure providing adequate funding for future water system operation and maintenance.

Revenue. The average monthly residential water user fee is a base rate of $35.00 per month. There is a connection fee of $100.00 for any new services. The Department of Commerce (based upon census information available for a large census area surrounding the District) established **target rate for water is $38.28/month**, therefore the District realizes that utility improvements will likely require a further rate increase.

The following Table summarizes the current rate schedule, based on a single connection for each residential user.

Existing Rate Structure and System Income	
Monthly Rate Structure	**Residential Units**
$35.00 Flat	73
Average Monthly Revenues	*$2,555.00*
Average Yearly Revenue	*$30,660*

The following Table provides a record of annual water income and expense statements for the past 3 years. During this period the monthly flat water rate was $25.00.

TABLE II-6

Utility Revenue and Expense History				
Fiscal Year	**Total Revenue**		**Total Expenditures Operations and Maintenance**	**Net Income or (deficit)**
2007	$11,718		16,192	$(4,474)
2008	$14,339		48,634	$(34,295)
2009	$17,013		20,189	$(3,176)
Average			**28,400**	

The District currently has no debt obligation.

<u>Managerial Capacity</u>.

1. Sand Coulee Water District was organized under the laws of the State of Montana. Management of the District is the responsibility of the Board of Directors, as authorized under Title7, Chapter 13, Parts 22 and 23. The District is primarily responsible for meeting the requirements of the Montana Water Quality Act. Board members of the District act as the local government for purposes of operating a utility such as a water system. A Board has the authority to make special assessments, set and collect user fees, provide man-power and operating costs, and pay off debt. Members of the current District Board and staff are as follows:

   Kent Luoma, President
   Pat Darko, Board member
   Mike Waldner, Board member
   Kelly Luoma, Bookkeeper
   Mary Ann Freeman, Secretary

   Address: Sand Coulee Water District,
   P.O. Box 97,
   Sand Coulee, MT 59472

   The Sand Coulee Water District was formed under Montana State law in November 2009. Prior to that the water system was operated and maintained by Water Users Association that was established in 1959. The Sand Coulee Water District (SCWD) serves strictly a residential area. No businesses currently exist within the District, nor are any projected too.

2. The District Board described above serves wholly as the administrative and management organization for the Sand Coulee water system. This organizational layout has been in effect since the establishment of the Water User Association in 1959 and transition to a Water District in 2009. The function and responsibilities of each position described above are self-explanatory.

3. Certified water system operator and operator back-up is Kent Luoma, operator and Pat Darko, back-up operator.

4. All water system records are maintained at the residence of Kent Luoma, P.O. Box 26, Sand coulee, MT 59472

5. A copy of the Sand Coulee Water District by-laws is attached in Appendix B.

Technical, Operational, and Maintenance Capacity

As the existing Sand Coulee Water System has been successfully operated and maintained for the past 30 years +, this fact should point to the community's capacity to continue using the same technical, operational, and maintenance programs that have led to their past proven satisfactory conduct to their new and significantly improved water system.

1.2 **Plans** – are attached to this report, Appendix "E"

1.3 **Specifications** - are attached to this report, Appendix "F"

1.4 **Design Criteria** – This project is not a surface water treatment project, therefore this section does not apply.

Calculations

MUNICIPAL ENVIRONMENTAL TRANSPORTATION WATER RESOURCES AIRPORTS SUBDIVISIONS

NEIL CONSULTANTS INC. GREAT FALLS • PHOENIX • KALISPELL (406)453-5478

PROJECT SAND COULEE WATER JOB NO.

PURPOSE SHEET OF

COMPUTED BY J. NEIL CHECKED BY DATE

Pump DATA:

HYDROMETRIC WELL DEPTH - 460 feet
STATIC Water elevation - 370 feet
DRAW DOWN DURING pump test _2 feet

HEADLOSS:

HORIZONTAL piping 65 LF - 3" + 50' - 6"
DROP PIPE 555 LF - 3-inch drop pipe

3":
3 inch
60 gpm - 1.17'/100 LF × 620 = 7.25
100 gpm - 3.10'/100 LF × 620 = 19.22
150 gpm - 5.16'/100 LF × 620 = 31.99

6"
6"
60 gpm < 0.10'/100 - × 50 feet = .05
150 gpm - 0.15'/100 LF × 50 feet = .05
fitting hl Allowance = 3 feet

Elevations: Top Well No. 3694.0
Top WATER TANK = 3722
overflow = 3720.43 3720.43
pump elev. = ~~3294~~ 460' ~~32~~34
WATER elev. = 3324 ± 20' 3324
396.43 ± 20'
416 - 376.43 + 10' TDH

IF WATER ELEV. DROPS TO Pump ELEV.
3720.43
- ~~3294~~ ~~3234~~ 3234
486.43 FEET + 40.5 (Dynamic Head)

Recommend using 425'-430' TOTAL Dynamic HEAD

Expected RANGE Could be depending on water elev in well: 386-500 ~~400-440~~ TDH @ flow of 65 to 50 gpm

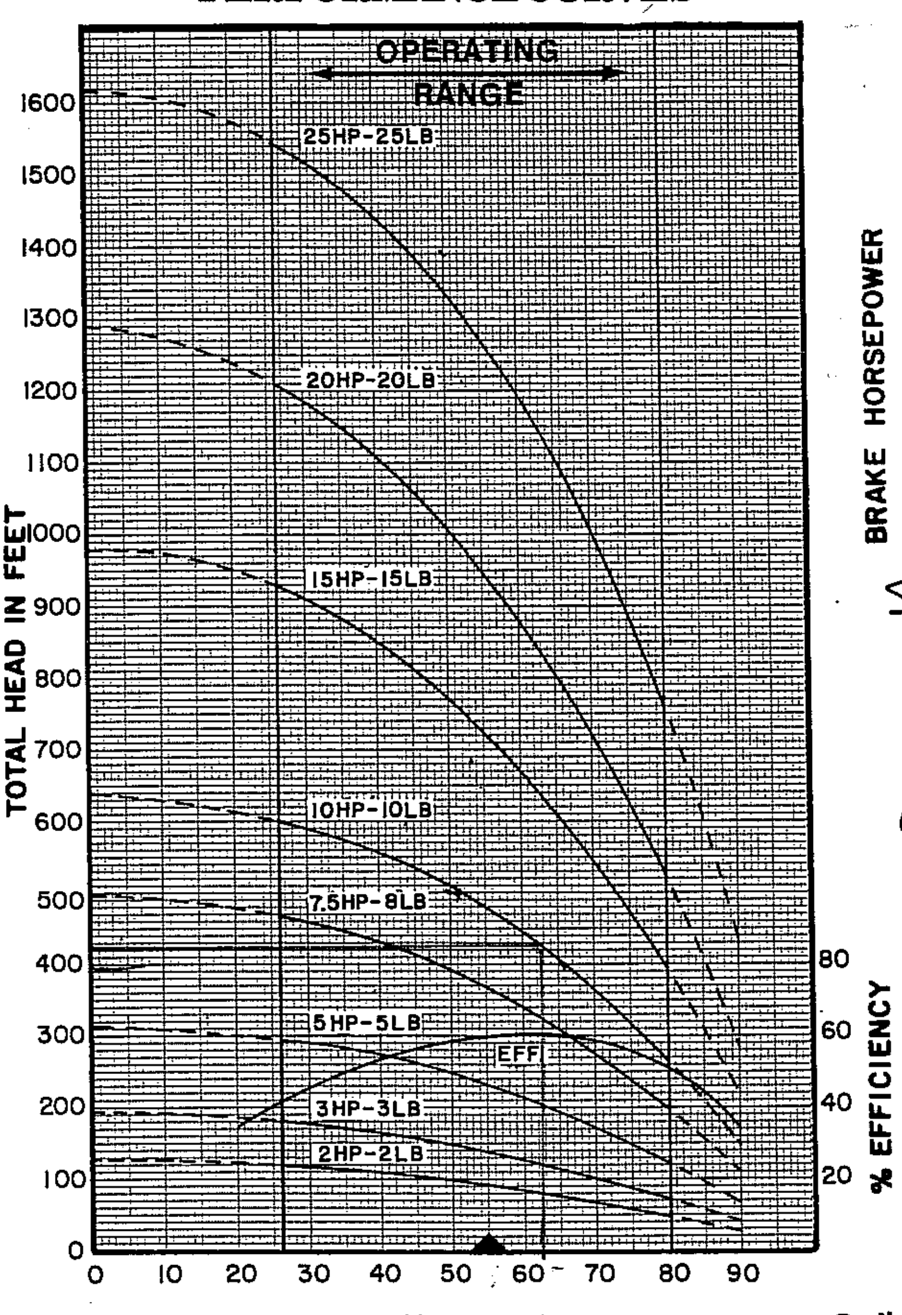
time to fill an Empty tank: 1.73 DAYS @ 62 gpm

Summary recommend: 10 Hp (480 V or 240 V)
62 gpm Capacity
3450 RPM, 60% eff.
6-inch pump.

NOTE: 150 gpm size pump was not recommended due to the increased HP req'd = 25 HP for 150 gpm. The extra tank fill time was Acceptable to the owner

55 GPM SERIES "LB" PUMPS

PERFORMANCE CURVES



Shut off head = 600'

60 gpm will fill 150,000 ga 1.73 DAYS

10 HP

60% eff.

62 gpm @ 420' TDH SAY 60 gpm

▲ RATED FLOW

Note: Continuous operation outside operating range will void warranty.

MODEL LB 55 GPM — RPM 3450
STAGE "LB" SERIES

370' ww level
30 High tank
+ 29 Dyn. Head loss
429

GUARANTEED AS MINIMUM PERFORMANCE ONLY IF CERTIFIED

MINIMUM WELL SIZE 6" I.D.

Jake Neil

From: Ralph McGillivray <ralphm@nciengineering.com>
Sent: Tuesday, May 07, 2013 2:42 PM
To: 'Mark Rhodes'; 'Gary Shick'
Cc: 'Jake Neil'
Subject: RE: Sand Coulee Water Rights for Well #5

Thanks Mark,
As soon as you have numbers we can use please let us know.....

thanks,
Ralph Mcgillivray
NCI Engineering
406-453 5478

From: Mark Rhodes [mailto:MRHODES@hydrometrics.com]
Sent: Tuesday, May 07, 2013 2:09 PM
To: 'Ralph McGillivray' (ralphm@nciengineering.com); Gary Shick
Subject: Sand Coulee Water Rights for Well #5

Gary/Ralph,
I apologize for the delay in getting back with you, Greg and Bill were out until yesterday. The water right application for the new well #5 in Sand Coulee is still going back and forth between us and the DNRC. The current application indicates we will use a 150 gpm pump set at a depth of 460'.
-Mark

Mark W. Rhodes, P.E.
Hydrometrics, Inc.
3020 Bozeman Avenue
Helena, MT 59602
Office: 406-443-4150 x123
Cell: 406-431-1637
mrhodes@hydrometrics.com

#1207 SAND COULEE WATER PER

05 MAR 13

WATER STORAGE CALCULATIONS

GIVEN: THERE ARE NO RELIABLE WATER USAGE RECORDS AVAILABLE FOR SAND COULEE : DOMESTIC USAGE IS BASED UPON 150 gal/day/person

DESIGN POPULATION: 225 persons

ADD: 150 gpdp x 225 p = 33,750 gal/dy

PF: 4 from chart

MDD: 33,750 gal x 4 ≃ 135,000 gal/dy

PHD: 135,000 gal / 1440 min/dy ≃ 94 gpm
(PEAK HOURLY DEMAND)

FIRE FLOW: 2 hr @ 850 gpm (RESIDENTIAL ONLY)

SIZE STORAGE TANK — ASSUME 160,000 gal TANK NOMINAL
*152,000 gal USABLE

(OS)
OPERATIONAL SYSTEM: 33,750 gpd, DEQ 1, 7.0.1.b. SIZING = 24hr ADD

(ES)
EQUALIZING STORAGE: $ES = (PHD - Q_{WELL}) \times 150$ min

(94 gpm − 35 gpm) x 150 min
↳ GUESS

ES = 8,850 gal

(FSS)
FIRE SUPPRESSION STORAGE: (750 gpm x 120 min = 90,000 gal)
~~850 gpm x 120 min = 102,000 gal~~

(DS)
DEAD STORAGE : 160,000 − 144,600 = 15,400 gal

OK!

1' − 5,563 gal (31' ϕ TANK)

OS + ES + FS + DS
33,750 + 8,850 + 90,000 + 15,400 = 148,000 gal < *152,000 gal OK!

PROJECT SAND COULEE JOB NO. 0902
PURPOSE PRELIMINARY COST EST BY JEFF SHEET 1 OF
COMPUTED BY GS CHECKED BY DATE 18 MAR 10

CRITERIA FOR WELL PRODUCTION & STORAGE

⇒ POP. 200

USE 100 gal/per/day

PEAKING FACTOR 4

200 × 100 × 4 = 80,000 gal/day

$\frac{80{,}000 \text{ gal/day}}{1440 \text{ min/day}}$ = 55 gpm MAX DAY DEMAND

⇒ TRY 150 gal/per/day

200 × 150 × 4 = 120,000 gal/day

$\frac{120{,}000 \text{ gal/day}}{1440 \text{ min/day}}$ = 83 gpm MAX DAY DEMAND

⇒ TRY POP 173 & 100 gal/per/day

173 × 100 × 4 = 69,200 gal/day

$\frac{69{,}200 \text{ gal/day}}{1440 \text{ min/day}}$ = 48 gpm MAX DAY DEMAND

JEFF SAID HE CALCULATED 98 gpm FOR MAX DAY DEMAND ???

⇒ AUX POWER - DID NOT SEE A LINE ITEM
IS JEFF BANKING ON 3.2.1.3 b. ?

⇒ FLOOD PROTECTION NONE

⇒ FIRE PROTECTION ; FIRE CHIEF LARRY BUTLER
734-5660

⇒ STORAGE

EXISTING TANK CAPACITY 110,000 gal

MIN STORAGE: 80,000 gal

IRRIGATION (180 day)
AVG DAILY USE 80,000 gal
FIRE FLOW 500 gpm/2 hrs 60,000 gal
RESERVE

140,000 gal

REQUIRED ADDITIONAL STORAGE:

140,000 gal − 110,000 gal = 30,000 gal

CURRENT USE: (18 gpm is keeping up)

200 × 18 = 3,600 gal/day

200 × (18+28) = 9,200 gal/day
60,000

69,200 gal/day

FOR COMPARISON:

(JUDITH GAP, POP 160, DESIGN PER CAPITA = 137 GPCD

AVG DAILY DEMAND	=	21,920 GPD
MAX DAILY DEMAND	=	94,256 GPD
PEAK HOURLY DEMAND	=	3,927 GPH
FIRE FLOW	=	1000 gpm

CHECK JUDITH GAP CALCS FOR SAND COULEE COMPARISON:

160 X 137 = 21,920 GPD   AVG DAILY DEMAND FROM WATER RECORDS

21,920 X (4.3) = 94,256 GPD
↳ PEAK DEMAND FROM CHART

$\frac{94,256 \text{ GPD}}{24 \text{ HR/DAY}}$ = 3,927 GPH

FIRE FLOW - 1000 gpm/2hr from est & FIRECHIEF CONCURRENCE

SAND COULEE: NO DATA, ASSUME USE = 100 gpcd
POP 200, DESIGN PER CAPITA (INCLUDES IRRIGATION)
USE 100 gpcd

⇒ AVG DAILY DEMAND:
200C X 100 gpcd = 20,000 GPD

⇒ MAX DAILY DEMAND
20,000 GPD X 4PF = 80,000 GPD

⇒ PEAK HOURLY DEMAND:
$\frac{80,000 \text{ GPD}}{24 \text{ H/D}}$ = 3,333 GPH

⇒ FIRE FLOW:
1000 GPM/2hr = 1000 X 120 = 120,000 gal
TRY
500 gpm/2hr = 60,000 gal STORAGE

⇒ REQUIRED STORAGE

MIN. STORAGE AVG DAILY 20,000 GPD
FIRE FLOW 60,000
80,000 gal

⇒ REQUIRED WELL PRODUCTION

MAX DAILY DEMAND = 80,000 gal/DAY / 1440 min/DAY = 56 gpm

⇒ WATER STORAGE VOLUME COMPONENTS

OPERATIONAL STORAGE (OS)
EQUALIZING STORAGE (ES)
STAND-BY STORAGE (SB)
FIRE SUPPRESSION STORAGE (FSS)
DEAD STORAGE (IF ANY) DS

TOTAL TANK VOLUME = OVERFLOW − OUTLET × TANK AREA

OS = 2.5 × 110 gpm = 275

ES = (PHD − Qs)(150 min) = 0 PHD = PEAK HOURLY DEMAND

FSS = (FF)(tm)
500 gpm × 120 min = 60,000 gal

MUNICIPAL ENVIRONMENTAL TRANSPORTATION WATER RESOURCES AIRPORTS SUBDIVISIONS

NEIL CONSULTANTS INC. GREAT FALLS • PHOENIX • KALISPELL (406)453-5478

PROJECT SAND COULEE JOB NO. 0902

PURPOSE IRRIGATION SHEET 5 OF

COMPUTED BY CHECKED BY DATE

IRRIGATION: USE 0.1 AC PER DWELLING &

600 gal/DAY PER 1000 SF.

43,560 x 0.1 = 4,356 SF

$\frac{4,356\ SF}{1000\ SF}$ x 600 gpd x 73 = 190,792 gal IRRIGATION

DAILY AVERAGE WATER USE PER HOUSEHOLD

270 gpd x 73 HOUSEHOLDS = 19,710 gpd

PRETTY CLOSE TO 20,000 gpd

TOWN LOT = 50 x 150 = 7500 x 0.4 = 3000 SF

1800 x 73 = 131,400 gal

4356x73 SF x 1.5"/12"/FT x 1 wk x 7.48 gal/CF x 4 wks month

.41 gpm (1.67 gpm) for 6 hr = 600 gal

~~73 x 5 gpm x 6 hr/day / 1440 m/day~~

73 x 5 gpm x 360 m/1 = 131,400 gal/day

g/min 360 m/1 hr

PROJECT ________ JOB NO. 0902

PURPOSE ________ SHEET 6 OF ____

COMPUTED BY ________ CHECKED BY ________ DATE ________

IRRIGATION	130,000 GPD
AVG DAILY USE	80,000 GPD
FIRE FLOW	60,000
	270,000 GAL

SAY 1/2 THE TOWN IRRIGATES

THEN

IRRIGATION	65,000 GPD
AV DAILY USE	80,000 GPD
FIRE FLOW	60,000
	205,000 GAL

MUNICIPAL ENVIRONMENTAL TRANSPORTATION WATER RESOURCES AIRPORTS SUBDIVISIONS

NEIL CONSULTANTS INC. GREAT FALLS • PHOENIX • KALISPELL (406)453-5478

PROJECT: SAND COULEE WATER JOB NO. 0902

PURPOSE: STORAGE SHEET ____ OF ____

COMPUTED BY ____ CHECKED BY ____ DATE ____

CURRENT TANK REQ 94 K GAL AVAIL 110,000 GAL

FUTURE TANK REQ 102.5 K GAL 110,000 GAL

WELL FUTURE 62.5 gpm

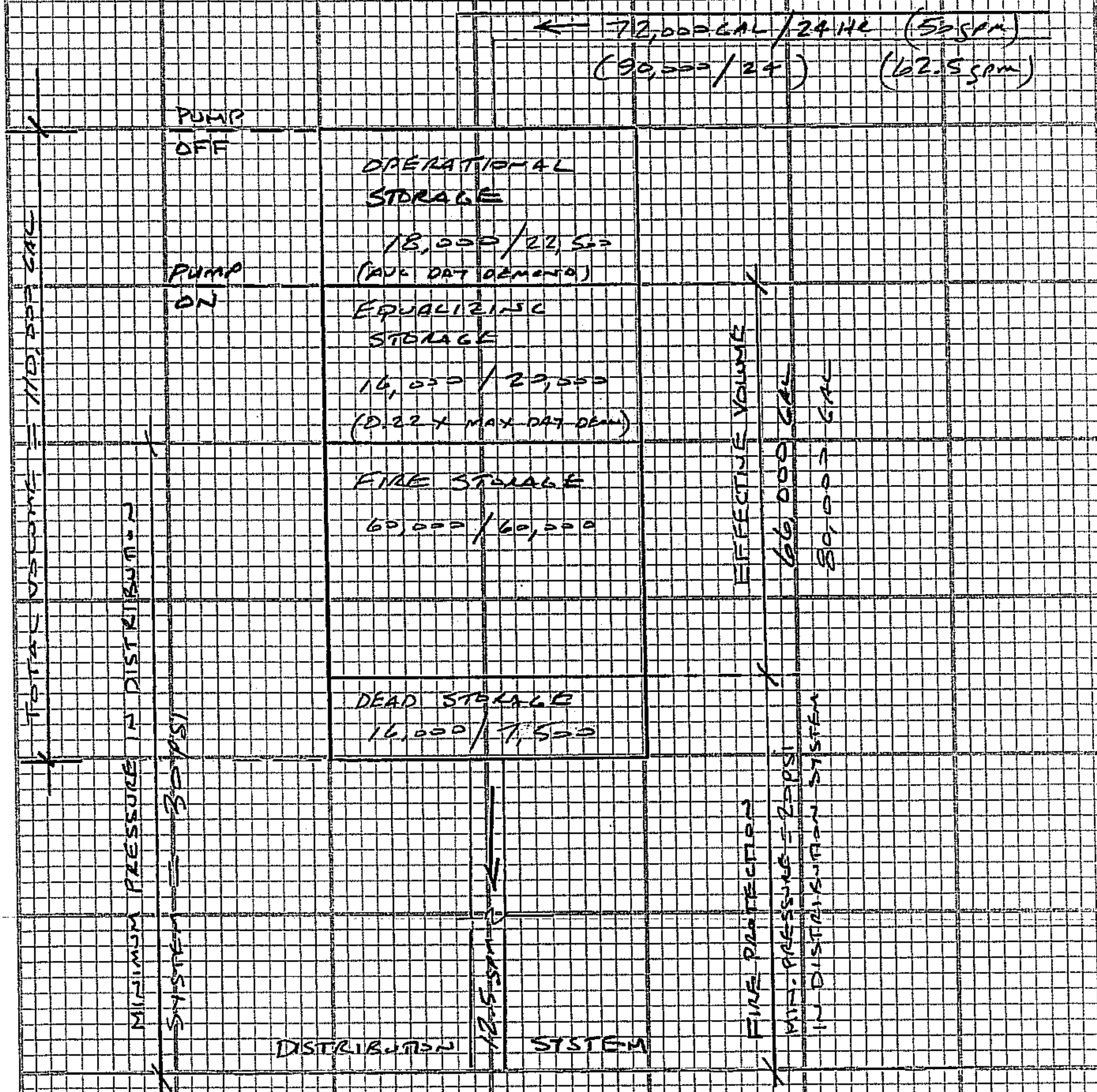


TABLE II-2

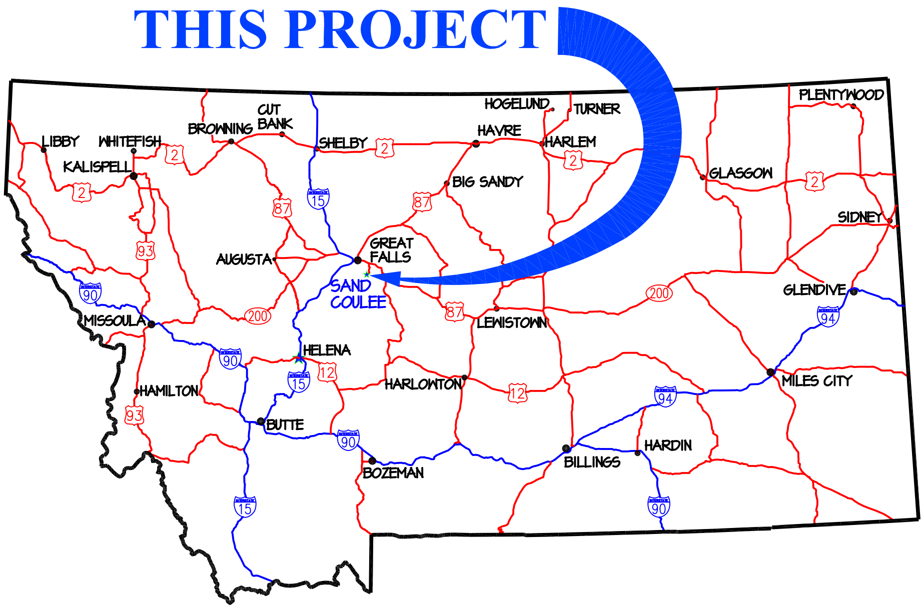
DEMAND TYPE	(GPD)	GPM (based upon a 16 hour demand day)
PRESENT POPULATION 181 People		
Average Daily Demand *1	18,100	19
Maximum Daily Demand*2	72,400	76
FUTURE POPULATION 225 People		
Average Daily Demand *1	22,500	24
Maximum Daily Demand *2	90,000	96
Present Well Capacity *3	Operating 24hrs/day total gallons	GPM
Well #2 (off line in 2/2010)	0	0
Well #3	25,920	18
Well #4	40,320	28
Total Well Production (3+4)	**66,240**	**46**
Well Production with Largest Well out of service	**25,920**	**18**
% Wells can meet maximum daily demand with largest well out of service for present population of 181 people	**35.8%**	**23.7%**
% Wells can meet maximum daily demand with largest well out of service for future population of 225 people	**28.8%**	**18.8%**

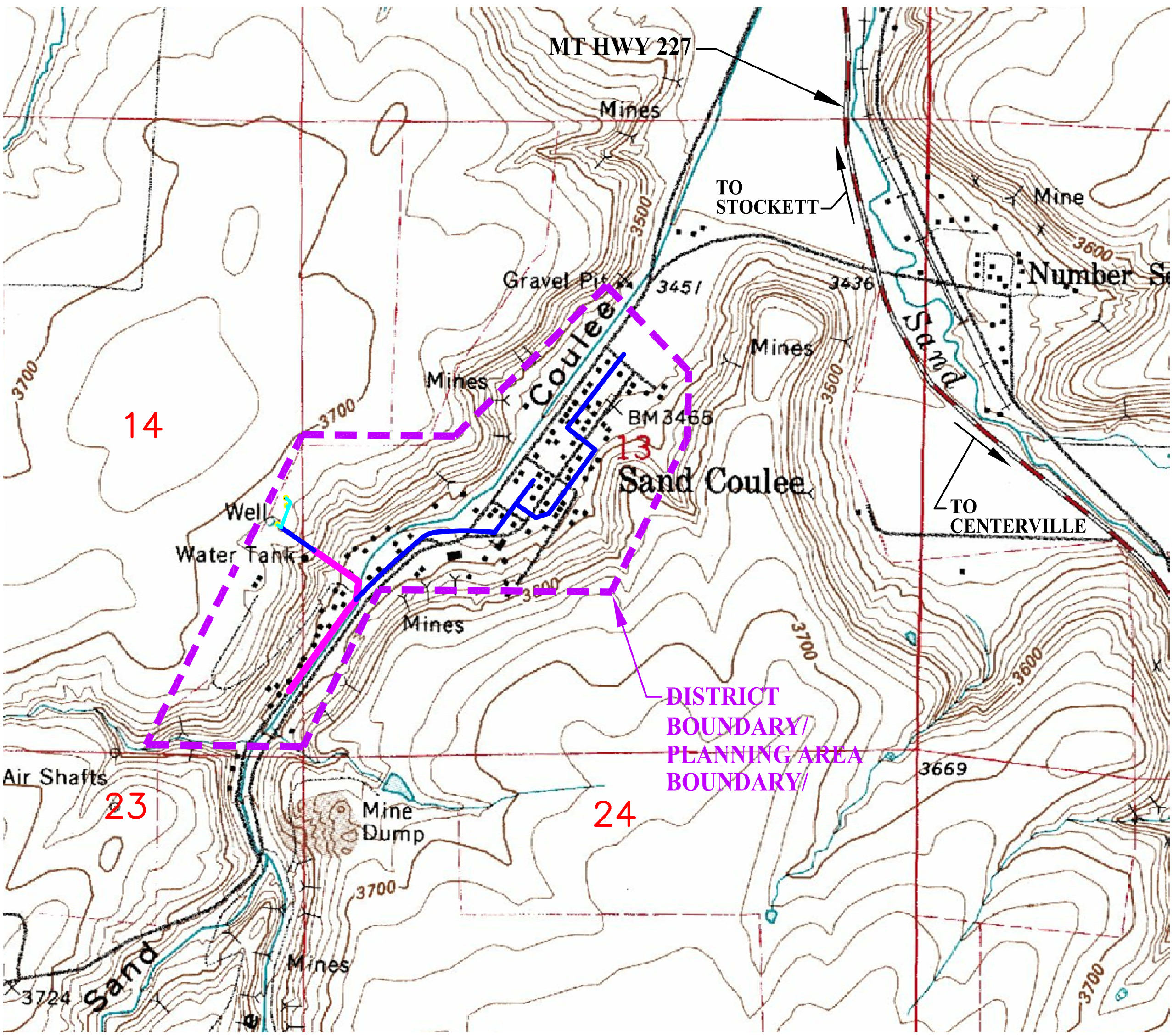
*1. Estimated domestic use based upon 100 gallons/day/person

*2. Utilized peaking factor of 4

*3 Based upon District flow pumping existing wells utilizing full discharge sized piping

Appendix A





NCI Engineering
NCI Engineering Co.
4509 North Star Blvd.
P.O. Box 6350
Great Falls, MT 59406-6350
Phone 406-453-5478
Fax 406-453-2009

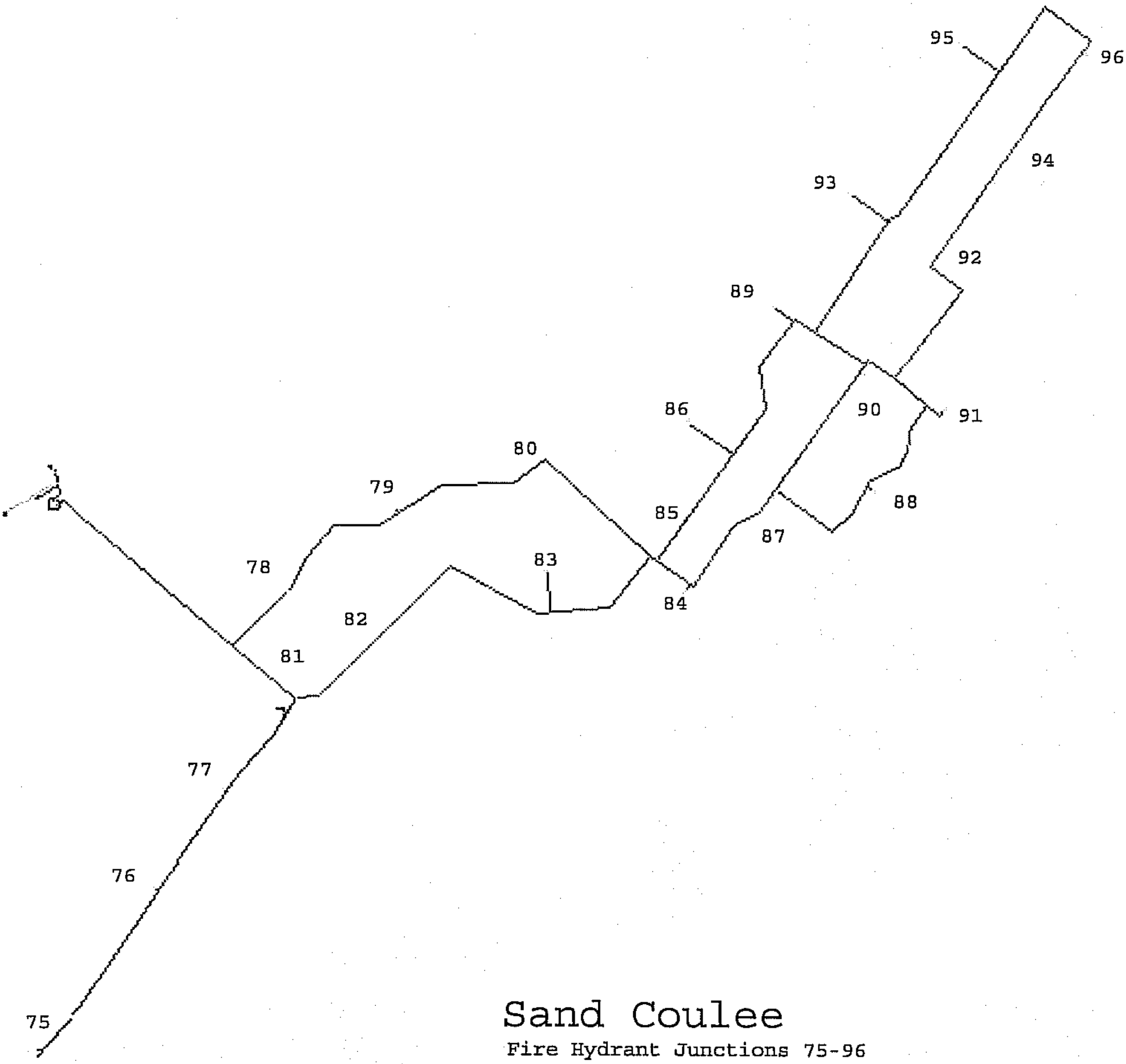
SAND COULEE VICINITY MAP AND BOUNDARY AREA

DRAWING #
APPX -A
1207

Appendix B

Appendix C

Appendix D



Sand Coulee

Fire Hydrant Junctions 75-96

bśŒ ŕ ǪĂĽ' ś - b ŕ śł

Node ID	Elevation ft	Demand GPM	Head ft	Pressure psi
Junc 14	3512	5.00	3676.95	71.47
Junc 15	3500	5.00	3674.01	75.40
Junc 16	3500	5.00	3673.93	75.36
Junc 17	3500	5.00	3673.25	75.07
Junc 18	3500	5.00	3673.93	75.36
Junc 19	3502	5.00	3660.62	68.73
Junc 20	3507	5.00	3645.14	59.86
Junc 21	3514	5.00	3619.94	45.90
Junc 22	3492	5.00	3673.93	78.83
Junc 23	3504	5.00	3673.92	73.63
Junc 24	3504	5.00	3673.92	73.63
Junc 25	3502	5.00	3673.93	74.50
Junc 26	3489	5.00	3673.93	80.13
Junc 27	3489	5.00	3673.89	80.11
Junc 28	3499	5.00	3673.84	75.76
Junc 29	3499	5.00	3673.84	75.76
Junc 30	3481	5.00	3673.76	83.52
Junc 31	3480	5.00	3673.73	83.94
Junc 32	3479	5.00	3673.71	84.37
Junc 33	3479	5.00	3673.71	84.37
Junc 34	3476	5.00	3673.68	85.66
Junc 35	3477	5.00	3673.68	85.22
Junc 36	3477	5.00	3673.68	85.22
Junc 37	3482	5.00	3673.68	83.05
Junc 38	3478	5.00	3673.66	84.78
Junc 39	3472	5.00	3673.66	87.38
Junc 40	3472	5.00	3673.66	87.38
Junc 41	3470	5.00	3673.66	88.24

Node ID	Elevation ft	Demand GPM	Head ft	Pressure psi
Junc 42	3464	5.00	3673.65	90.84
Junc 43	3464	5.00	3673.65	90.84
Junc 44	3504	5.00	3676.40	74.70
Junc 45	3504	5.00	3676.38	74.69
Junc 46	3506	5.00	3676.14	73.72
Junc 47	3508	5.00	3675.88	72.74
Junc 48	3508	5.00	3675.61	72.63
Junc 49	3508	5.00	3675.48	72.57
Junc 50	3507	5.00	3675.18	72.87
Junc 51	3489	5.00	3674.80	80.51
Junc 52	3490	5.00	3674.61	79.99
Junc 53	3490	5.00	3674.61	79.99
Junc 54	3481	5.00	3673.85	83.56
Junc 55	3480	5.00	3673.78	83.97
Junc 56	3479	5.00	3673.75	84.38
Junc 57	3479	5.00	3673.72	84.37
Junc 58	3477	5.00	3673.69	85.23
Junc 59	3477	5.00	3673.69	85.23
Junc 60	3477	5.00	3673.68	85.22
Junc 61	3471	5.00	3673.67	87.81
Junc 62	3471	5.00	3673.66	87.81
Junc 63	3471	5.00	3673.66	87.81
Junc 64	3464	5.00	3673.66	90.84
Junc 65	3463	5.00	3673.66	91.28
Junc 66	3496	5.00	3673.69	76.99
Junc 67	3491	5.00	3673.69	79.16
Junc 68	3487	5.00	3673.68	80.89
Junc 69	3487	5.00	3673.68	80.89

Node ID	Elevation ft	Demand GPM	Head ft	Pressure psi
Junc 70	3494	5.00	3673.68	77.85
Junc 71	3492	5.00	3673.68	78.72
Junc 72	3489	5.00	3673.68	80.02
Junc 73	3491	5.00	3673.68	79.15
Junc 74	3494	5.00	3673.68	77.85
Junc 75	3514	750.00	3619.44	45.69
Junc 76	3507	5.00	3645.14	59.86
Junc 77	3502	5.00	3660.62	68.73
Junc 78	3504	5.00	3676.40	74.70
Junc 79	3508	5.00	3675.48	72.57
Junc 80	3490	5.00	3674.61	79.99
Junc 81	3501	5.00	3674.93	75.36
Junc 82	3494	5.00	3673.93	77.96
Junc 83	3492	5.00	3673.92	78.83
Junc 84	3499	5.00	3673.84	75.76
Junc 85	3481	5.00	3673.85	83.56
Junc 86	3482	5.00	3673.78	83.10
Junc 87	3479	5.00	3673.71	84.37
Junc 88	3487	5.00	3673.68	80.89
Junc 89	3478	5.00	3673.69	84.79
Junc 90	3476	5.00	3673.68	85.66
Junc 91	3494	5.00	3673.68	77.85
Junc 92	3472	5.00	3673.66	87.38
Junc 93	3473	5.00	3673.66	86.95
Junc 94	3470	5.00	3673.66	88.24
Junc 95	3465	5.00	3673.66	90.41
Junc 96	3464	5.00	3673.65	90.84
Junc 101	3501	5.00	3674.93	75.36
Junc 102	3494	5.00	3673.93	77.96

Appendix E

Appendix F