Preliminary Design Report

for

Pioneer Village
Water Distribution System

Town of Keenesburg, Weld County, Colorado

PIONEER VILLAGE
COLORADO
EST. 2019

SDD Project Number: 1919-001

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Note that Sanitary Sewer Calculations were provided as a supplement to this report. Refer to Appendix K.

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Executive Summary

This section has been prepared to provide a brief and concise summary of the detailed information proposed in the following pages.

Pioneer Village is a Planned Development Community currently proposed in Weld County approximately 3 miles northwest of the Town of Keenesburg. Today no potable infrastructure exists adjacent to the site to support its development. This report outlines Strategic Site Designs (SSD) approach to developing the required infrastructure while also assisting the Town of Keenesburg develop their water resources and infrastructure to meet future demands.

Pioneer Village is proposed to build out in 38 phases over a period of 38 years. StackLot, Pioneer Village's principal land planner has identified conceptual land uses and densities within each phase which was used to build our demand curve(s). Keenesburg contracted FEI to complete a Water Master Plan in 2018. FEI completed their analysis based on two horizon years, 5 and 20, which correlates to Years 2023 and 2038. Our team assumed that Pioneer Village would commence construction in 2023 and would build out through 2060. To perform our future demand analysis and size infrastructure for both communities, the Town of Keenesburg's growth rates used by FEI were linearly extended at 2.8% per year from 2038 through 2060.

Currently, the Town of Keenesburg's raw water supply portfolio contains 660.7 AF of Laramie-Fox Hills (LFH) groundwater and 139.6 AF of Lost Creek (LC) groundwater. Pioneer Village has access to approximately 2,418 AF of sustainable Lost Creek groundwater and 750 AF of Laramie-Fox Hills groundwater underlying the Pioneer Village Property. Given production rates from the LFH wells average approximately 10% of the LC wells, the LFH wells will be the principle constraint controlling the buildout for each community.

Based on the current blending method utilized by the Town of Keenesburg to produce potable water, both the Town and Pioneer Village plan to undertake service of the growing demands using this same strategy for an interim period of 15 to 23 years. Given the LFH and LC supplies are not considered "renewable", over time Pioneer will work diligently to transition to the Box Elder Creek source as the principle raw water supply. As Pioneer grows and generates returned flows to Box Elder in the form of treated wastewater effluent, an augmentation plan will be finalized specifying a volume of alluvial groundwater that can be extracted and used to produce potable water. This reduces reliance on the LFH supply allowing that aquifer to be better managed for sustainability. Box Elder is not considered viable at the Project's onset because there are no returned flows at the moment and being under the influence of surface water; a significant capital investment into an RO treatment facility would be required.

To provide potable water in phases 1 through 15, SSD proposes an expansion of the Keenesburg gathering, blending and storage facility in the initial phases of Pioneer. With access to LC water matching their LFH supply, the Town could produce 1.180 MGD before Pioneer would need to construct a second gathering system and blending facility in Year 2038 for additional demands occurring in 2039. Pioneer's raw water supply allows for production of 1.339 MGD per day using the same means to produce water used by Keenesburg today which would supply the collective demands through Year 2055. In 2056, either 1) additional LFH rights would be required or 2) Box Elder raw water (and RO Treatment) would be required to support any future development should growth consistent with that proposed herein be experienced. The collective ADD for both communities in 2060 is 2.852 MGD.

The Keenesburg expansion will require a replacement of the existing blending facilities header pipes to increase production capacity to 1,300 GPM and construction of four (4) new LFH wells and associated gathering system piping. The estimated costs of these improvements are $2,276,000. *Note our estimate* *is infrastructure related and does not account for LC water rights acquisition costs.* The Pioneer system will cost significantly more due to a lack of existing LFH wells, a raw water supply gathering system and storage infrastructure. The 2056 buildout will require up to eighteen LFH wells, two additional Lost Creek wells, a new 1,550 GPM blending facility, 2.5 million gallons of elevated water storage tank capacity, and a 20” potable water transmission line from Keenesburg to Pioneer. The estimated cost of the Pioneer infrastructure is $33,872,430.00.

Our proposal herein is grounded in a maximization of the LFH supply due to the quality and simplicity of producing potable water; however, in Phase 16 and beyond demands on the LFH supply will grow to a point where sustainability becomes a focal point of the raw water supply evaluation. At that time, Pioneer Village shall commence a phase by phase evaluation of implementing RO treatment of the BE and LC supplies, continued blending of the LC/LFH supply or a combination of both methods to produce high-quality potable water. Blending will continue, and will assist in meeting drinking water standards, but will not be adequate by itself as the ratio of LFH water is managed to reduce demand on the aquifer.

Section 1.0 – Project and Overall System Description

Pioneer Village is proposed as a large community development located northwest of the Town of Keenesburg and is primarily bounded by Weld County Road 22 to the south, County Road 49 to the west and County Road 55 to the east. The bulk of development will occur in Sections 5, 6, 7 and 8 of Township 1 North and Section 32 of Township 3 North. The Project lies within Weld County and will be annexed into the Town of Keenesburg in two phases based on continuity requirements. Annexation 1 was completed in early 2020.

Section 2.0 – Existing System Overview and SSD Design Approach

Based on information available to our team and discussions with the Town of Keenesburg staff, our approach to developing a water system for Pioneer Village will be a multifaceted design which seeks to deliver potable water to future residents while also working closely with the Town to expand their existing collection, treatment and distribution system(s) to meet future demands lying outside of Pioneer Village's limits.

As outlined in the Pioneer Village Water Supply Report prepared by Wright Water Engineers, Pioneer Village will rely on three water sources to support the development's potable and non-potable needs:

- Lost Creek (LC) alluvial groundwater
- Non-Tributary Denver Basin Groundwater (Laramie-fox Hills (LFH)) and
- Box Elder (BE) Alluvial Groundwater

The Town of Keenesburg also relies on the Lost Creek and Laramie-fox Hills ground water to produce their potable water supply.

Currently, the Town of Keenesburg produces their potable water supply by operating two individual raw water gathering systems which collect groundwater from wells drilled into the LFH and LC basins and conveys it to their treatment facility located on the northeast corner of County Road 14 and 55 also known as the "Well No. 7 Treatment System". The treatment facility consists of a small CMU building which houses the 4" header pipes for each gathering system and the sodium hypochlorite injection system. Once water passes through each header, the sources are combined immediately downstream of the CMU building and prior to entering the first of two 0.25 MG storage tanks[1]. A standpipe is utilized in the first tank which encourages a "blending" effect prior to entering the distribution system. The Town currently blends the two sources at a ratio of 1-part LFH to 1-part LC to achieve the desired water quality.

While blending is effectively producing potable water, it does create one major pitfall for both the Town of Keenesburg and Pioneer Village: the interdependence of LFH raw water and LC raw water. Because the desired water quality is achieved by blending the LFH and LC supplies at a 50/50 rate, both the Town and Pioneer Village will need to maintain equivalent access (or "rights") to each aquifer unless a pre-treatment measure is implemented on the Lost Creek Supply thereby shifting its blend ratio above 50%.

Another issue our team has identified is a potential capacity issue at the current blending facility. Assuming a maximum velocity of 7 feet per second as recommended by pipe and fitting manufacturers to reduce effects of water hammer and also protect any cement linings within ductile iron piping, the

[1] One tank is a welded steel tank which was rehabilitated in 2018. The other tank is a bolted steel tank constructed in 2016. The blending facility discharges directly into the bolted steel tank via a standpipe which eliminates short circuiting and provides adequate chlorine contact times.

current plant capability to produce 0.47 MGD. As discussed in later sections, this production rate does not meet the Towns projected demand in Year 2023 per Table 3 in the FEI Water Master Plan.

Similarly, CDPHE "recommends"[2] that any water system be capable of storing the maximum daily demand (MDD) at a minimum. Assuming the treatment facility is up-graded or replaced to produce the maximum daily demand, the Town will also require construction of new storage facilities prior to the 2038 horizon (MDD=0.941 MGD) per Table 3 of the FEI Plan.

Note the blending facility and storage capacities outlined in the prior paragraphs are independent of any Pioneer Village Demands. ***As such, significant opportunities exist for the Town of Keenesburg and Pioneer Village to collaborate on system improvements being beneficial to both entities.***

Our design approach will be specific to addressing deficiencies in the Keenesburg system while developing the new system for Pioneer Village.

Section 3.0 – Water Rights and Well Infrastructure Summary

Based on Section 3 of the Town of Keenesburg's Master Plan, they have the following Water Rights Appropriated for use:

Table 1 – Keenesburg Annual Water Appropriation

	Appropriation	
Aquifer	**Acre Feet**	**MG**
Laramie-Fox Hills	660.7 AF	215.3
Lost Creek	139.6 AF	45.5

As shown in Table 1, Keenesburg currently has LFH and LC appropriations of 660.7 AF and 139.6 AF, respectively. As discussed in Section 2.0, the Town currently blends at a rate of 50/50 LFH versus LC and therefore their annual potable water production to achieve the required water quality is 279.2 AF.

In connection with the above referenced allocation, the Town currently operates a total of six (6) permitted raw water wells. Five (5) wells have been drilled into the LFH aquifer and one (1) into the LC aquifer. A summary of each well is provided below[3]:

Table 2 – Town of Keenesburg Permitted LFH Wells

Well	Permit Number	AA Volume (AF/yr)	Maximum Pumping Rate	Year Constructed
No. 2*	58990F	32	50	1960
No. 4*	31587F	50	50	1966
No. 5*	23522F	60	150	1979
No. 7*	23850F	65	160	1979
No. 12	3401F	10	50	1962
	TOTAL	**217**	**460 (410 to #7)**	

As shown in Table 2, the current LFH well infrastructure in place has a permitted annual appropriation of 217 AF and a maximum combined pump rate of 460 gallons per minute (GPM).

Table 3 below summarizes the Town's Lost Creek Well Information.

[2] Storage of the ADD is the current requirement.

[3] Well information courtesy of FEI Water Master Plan prepared by FEI. Reference Sections 3.3.1 and 3.3.2

Table 3 – Town of Keenesburg Permitted LC Wells

Well	Permit Number	AA Volume (AF/yr)	Maximum Pumping Rate	Year Constructed
No. 11	31652F	139.6	650	1939
	TOTAL	**139.6**	**650**	

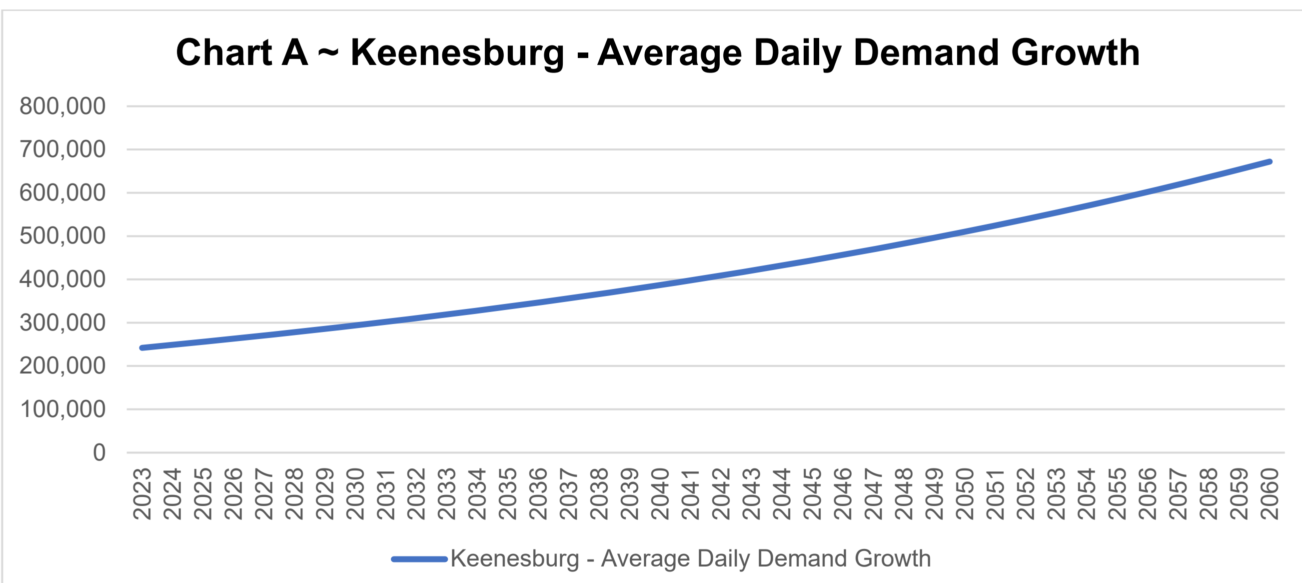
The major takeaways from Tables 2 and 3 include:

1. The Town currently has insufficient permitted wells to maximize their yearly allocation of Laramie-Fox Hills Water (217 vs 660.7 permitted)
2. Keenesburg would also need as many as four (4) new wells to match the 650 GPM pumping rate of their Lost Creek well.
3. The Town has a disproportional holding of LFH versus LC (660.7 vs 139.6). When blending at a 50/50 ratio, the Town's capacity development hinges upon the acquisition of an additional Lost Creek appropriation.

Having established the Town's current appropriation and maximum production rates for each well, our team will now contrast those appropriations with the demand(s).

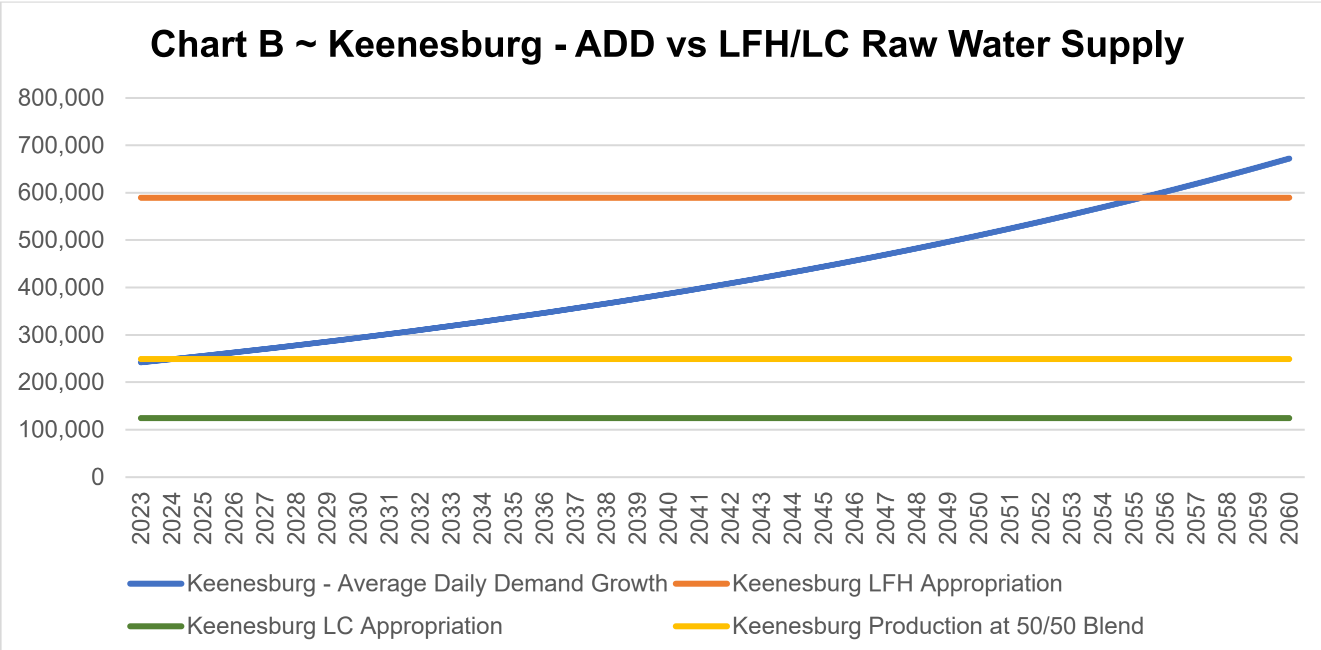
The FEI Water Master Plan identified three specific evaluation periods in their report: 1) Current Service Area (2019), 2) Future Service Area (2023) and Future Service Area (2038). Since the purpose of this report is to outline the design of the Pioneer System whose demand is anticipated to come online in 2022 or 2023, ***our team has utilized the Town's Master Plan information for Years 2023 through 2038***. Since Pioneer Village proposes a buildout over 38 Phases (or Years), the Town's anticipated growth rate was extended to align the horizons at Year 2061.

The Chart below summarizes the Town's projected growth in Average Daily Demand (ADD)[4].



[4] Note our ADD growth for the Town of Keenesburg is based on the average of 102 GPCD which is a weighted average between summer and winter months since the Town supplies irrigation demands via the Potable Water System. When comparing the ADD Growth between FEI's 2023 and 2038 figures, that number was approximately 2.80% and therefore that figure was projected linearly through 2061 in this Report.

As shown in Chart A, by Year 2060, Keenesburg's average daily demand will peak at 672,296 gallons per day. With the ADD trend line established, our team then compared that growth to the Town's current water portfolio to assess their constraints.



As shown in Chart B above, the 2024 ADD for the Town (independent of any Pioneer Village Demand) will exceed the Town's current capacity to produce water at a rate of two times the Lost Creek supply of 139.6 AF or 0.125 MGD. The Laramie-Fox Hills holdings is sufficient to supply Keenesburg's ADD through the proposed planning period should they acquire Lost Creek Rights equivalent to their current Laramie-Fox Hills supply.

With the Town of Keenesburg's principle *raw water supply constraint* being identified as their current Lost Creek supply, our team will complete the same analysis for Pioneer Village.

In the prior paragraphs, our team developed the Town of Keenesburg's ADD growth curve and analyzed it against their current supplies of Laramie-Fox Hills and Lost Creek water. In the forthcoming paragraphs, our team will complete the same analysis for Pioneer Village.

Currently, Pioneer Village has access to three raw water sources which are identified in the Water Supply Report prepared by Wright Water Engineers included in the Appendices. Each supply is summarized below:

Table 4 – Pioneer Village Annual Water Supply

	Supply	
Aquifer	**Acre Feet**	**MG**
Laramie-Fox Hills	750[5]	260.7
Lost Creek	2,418	787.9
Box Elder Creek	Refer to WWE WSR, Paragraph 4.0[6]	
Arapahoe Aquifer[4]	284	92.5

[5] 750 AF lie under Pioneer Villages 3,400 Acres, 800 AF supply in locations shown in WWE Report
[6] Requires preparation and approval of an Augmentation Plan

As shown in Table 4, Pioneer Village has an available supply of 750 AF and 2,418 AF of Laramie-Fox Hills underlying Pioneer Village and sustainable Lost Creek water, respectively. Assuming Pioneer Village utilized the same treatment means to produce potable water as the Town of Keenesburg does, Pioneer Village's maximum yearly production rate would be 1,500 AF, or the current supply of LFH water blended at a 1:1 ratio with the LC supply.

To access the LFH and LC raw water supplies, Pioneer Village will also utilize a series of Municipal Wells. At this time, Pioneer Village has access to twenty (20) permitted wells drilled into the Lost Creek aquifer. A summary of each well is provided below.

Table 5 – Pioneer Village Permitted LC Wells

Well[7]	Permit Number	AA Volume (AF/yr)	Observed Well Production Rate[8]	Year Constructed
No. 1	1773FP	79.9	Unknown	
No. 2	1772FP	125.3	Unknown	
No. 3	1774FP	27.8	Inoperable	
No. 4	1771RFP	83.2	Inoperable	
No. 5	31612FP	65.4	500	
No. 6	31653FP	98.0	500	
No. 7	31654FP	116.8	500	
No. 8	31536FP	84.6	700	
No. 9	1730FP	92.0	1,200	
No. 10	1731FP	82.2	1,000	
No. 11	31595FP	163.5	1,200	
No. 12	31542FP	193.3	Unknown	
No. 13	8535FP	96.9	Unknown	
No. 14	8533FP	84.0	Unknown	
No. 15	8534FP	81.5	Unknown	
No. 16	6419FP	347.2	600	
No. 17	9175FP	301.4	800	
No. 18	31568FP	152.0	500	
No. 19	9430FP	124.7	800	
No. 20	15550FP	200.4	1,300	
	TOTAL	**2,600**	**9,600 (Known)**	

As shown in Table 5, Pioneer Village currently has access to 2,600 AF of Lost Creek water. WWE has estimated the sustainable yield to be 2,418 AF. It should be noted that these figures are based on current information and are subject to change. Any alterations in the LC supply directly impacting the design herein will be addressed concurrently with their transfer.

As of this draft, Pioneer Village has an appropriation of 800 AF of Laramie-Fox Hills Water; however, no wells have been drilled into the aquifer to extract the supply.

In addition to the Laramie-Fox Hills and Lost Creek supplies, Pioneer Village also has access to 284.27 AF/Year of Arapahoe Aquifer, not Non-Tributary groundwater. This water underlies property located a significant distance from Pioneer Village and the existing Lost Creek gathering system; therefore, dependence on that source is not feasible for this initial planning period given the capital investment

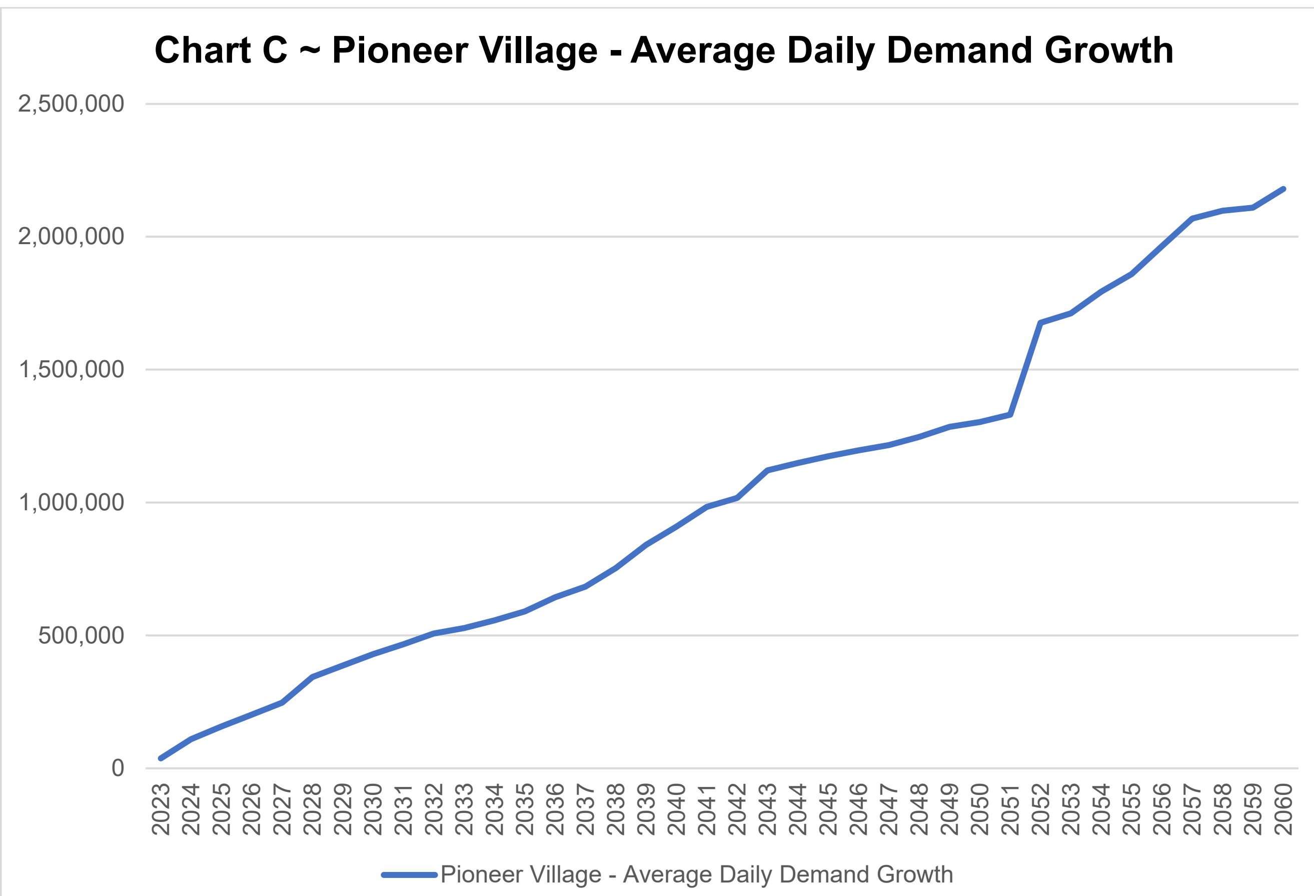
[7] Pioneer Villages Lost Creek Supply will primarily be produced by Wells 1 through 11 and 16 through 20 which total 2,144 AF of appropriation(s). Peak Potable Production will require approximately 1,597 AF.
[8] Pumping rates are based upon flow information provided by H-2 Enterprises which currently operates the Lost Creek gathering system. Contact Doug Cook or Matt Wulf

required to develop that supply.. Moving forward, it may be held in the District's portfolio as a back-up source pending development of the Box Elder Creek source(s) in the event of an emergency.

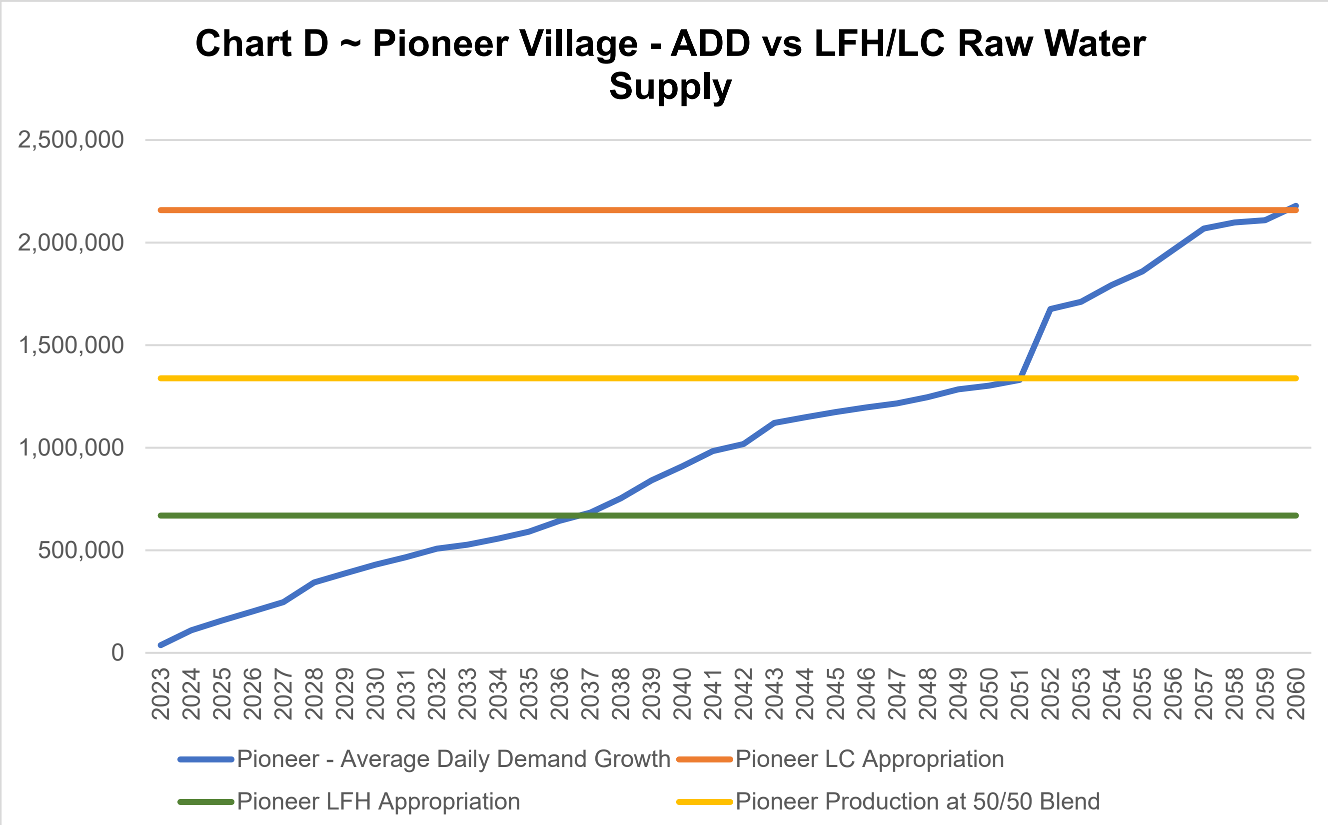
Similar to our analysis performed for the Keenesburg supply, the existing raw water supply was compared to the anticipated demands to check for capacity concerns.

Our analysis of the Keenesburg supply and demand was based upon figures developed by FEI as part of the Town's Master Plan using historical trend information (2.80% growth per year over the analysis period). Pioneer varies in that regard since no existing information is available. To develop the Pioneer demands, our team utilized the Phasing Plans prepared by StackLot along with the anticipated land uses and densities. Based on market studies and the approximate number of lots planning area, StackLot estimated that Pioneer would build out in approximately thirty-eight (38) Phases. Our analysis assumes that one phase will develop per year, or 38 years. Our demands were assumed to commence in 2023 to align with the Town's 5-year (2023) demand growth projection. A summary of Pioneer Village's ADD growth is provided on the following page.

Another important item to address related to Pioneer Village's demand development is irrigation. Given characteristics of the development, irrigation demands for individual residences and commercial parcels will be served via the potable system and therefore those associated demands are included **<u>in addition to</u>** the 0.3 SFE (or 266 GPD per unit) domestic use. Commercial irrigation demands are based upon the parcel acreage. Irrigation use was determined using an application rate of 0.3 inches per day; or an average daily demand of 2,232 gallons per irrigated acre per day.



As shown in Chart C, Pioneer Village's ADD will peak at 2.18 MG per day. Table D below summarizes Pioneer's ADD growth compared to the current LFH and LC raw water supplies as well as the production rate allowed by the constraining LFH supply.

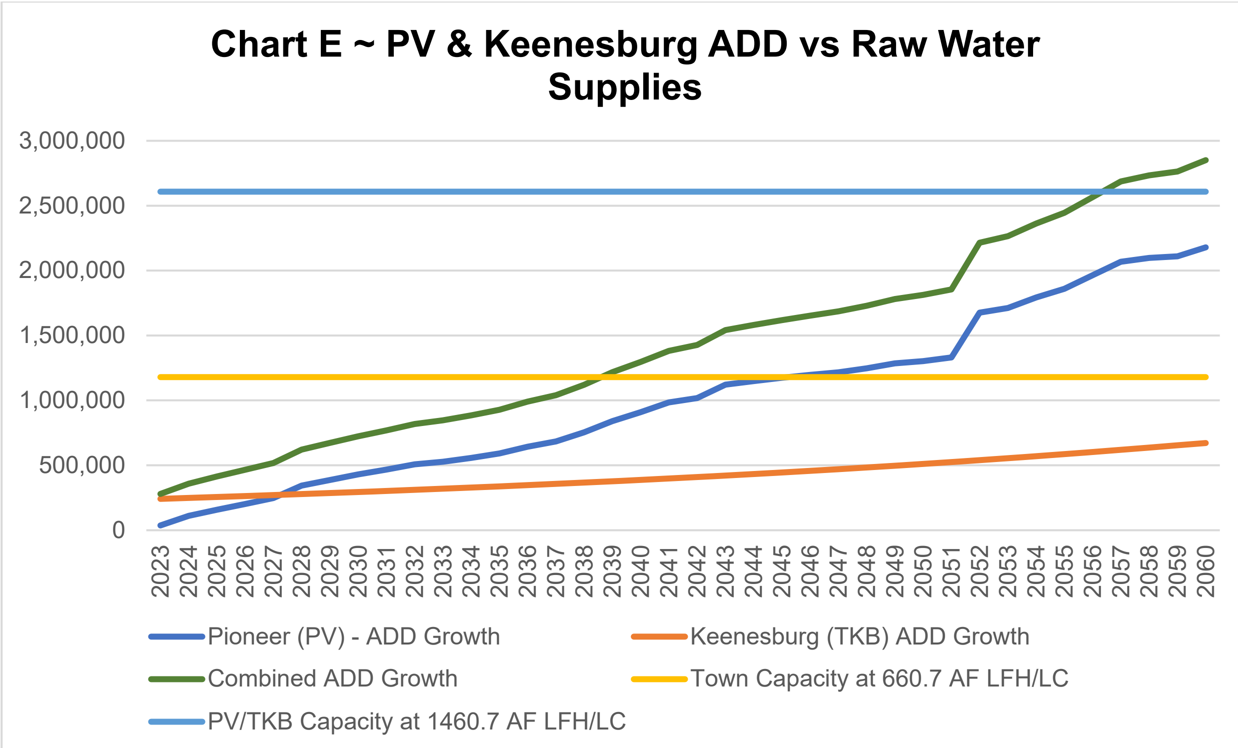


The principle takeaway from Chart D is that Pioneer Village could develop a blending facility independent of the Town's system and produce up to 1.428 MG per day of potable water at a 50/50 ratio of LFH to LC water and the LFH supply of 800 AF. This production rate would supply Pioneer with potable water through Year 2052 based upon the current development plan.

In addition to the raw water supply constraint, a second growth limiting factor in the initial phase(s) of Pioneer Village's growth is development of a LFH gathering system. In order to regulate and achieve a 50/50 blending ratio, Pioneer Village will need a gathering system for the Lost Creek wells and a separate gathering system for the Laramie-Fox Hills Wells which will converge at a blending facility similar to the Town's. In addition to the gathering system(s), Pioneer will also need to drill a number of Laramie-Fox Hills wells to access that supply.

Given the initial capital cost to develop Pioneer's Laramie-Fox Hills supply, our team would recommend that the Village and the Town of Keenesburg collaborate on an initial solution that addresses 1) Pioneer's Laramie-Fox Hills raw water shortfall, 2) Keenesburg's Lost Creek shortfall and 3) would allow Pioneer to develop their initial phases without constructing a LFH gathering system. This approach would assist Pioneer Village by lessening the initial capital investment (for a limited number of customers) in the collection and treatment infrastructure and allow for growth of a capital investment budget which could be used to develop the gathering system and build Pioneers blending facility at a later date. This would also increase bulk water sales for the Town of Keenesburg which would allow further investment into the development of their system.

Chart E below summarizes the volume of potable water that could be produced by Keenesburg and Pioneer based on current water rights.



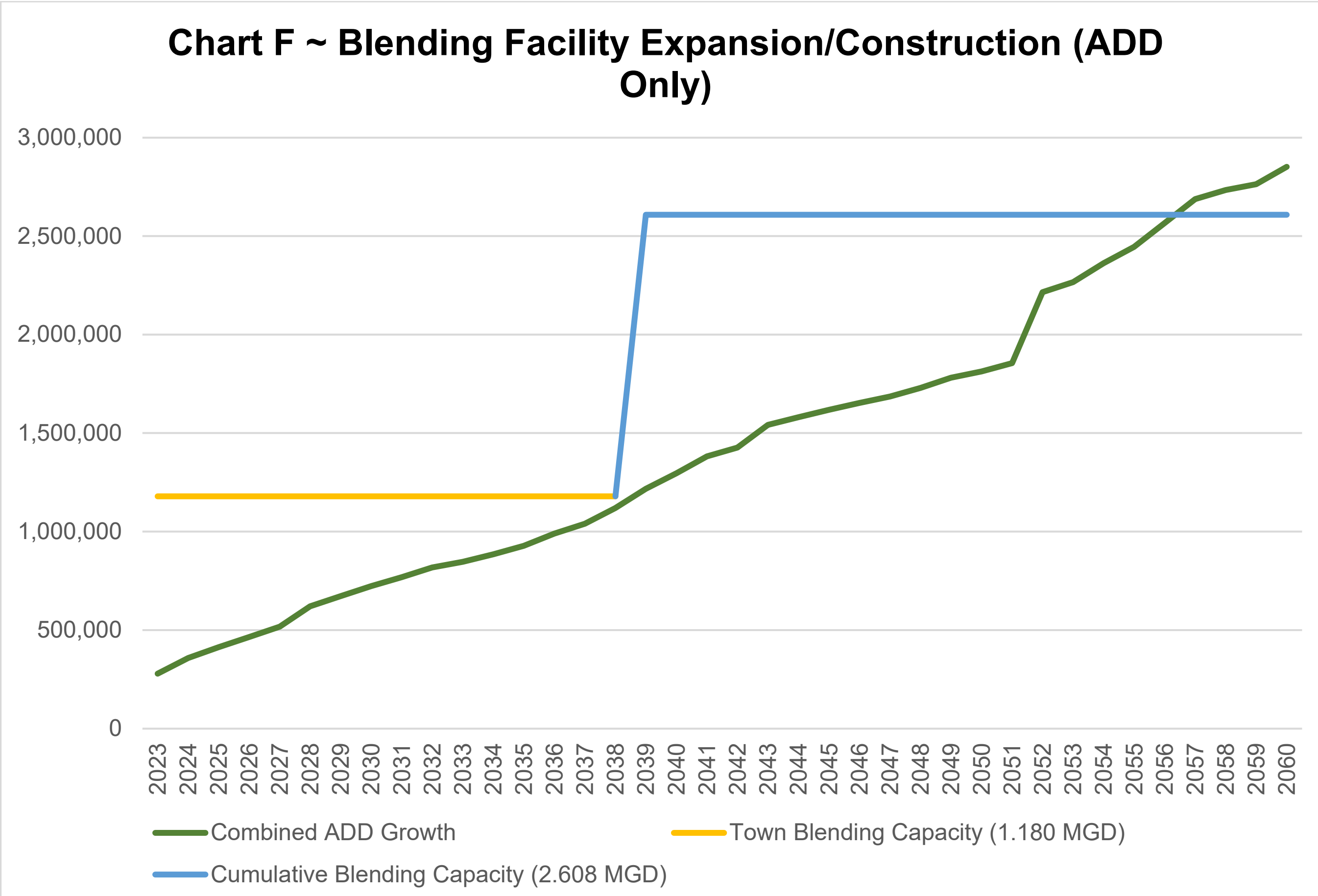
There are some key points summarized in Chart E.

1. To meet the Town's ADD (50/50 Blending) in Year 2060 at the projected growth rate, they would need to acquire an additional 236.9 AF of Lost Creek Water. When producing the ADD in Year 2060, the Town would have a surplus supply of 287.2 AF of LFH water.
2. If the Town of Keenesburg were to add 521.1 AF of Lost Creek raw water supply to their existing portfolio, thereby matching their LFH supply, they would have access to enough raw water when blending at a 50/50 rate to meet Keenesburg **and** Pioneer Village's ADD through Year 2038.
3. By combining the Town and Pioneer Villages LFH supply, the Total Demand for each entity could be met through Year 2056 at which time additional raw water from Box Elder Creek would be required.

Given the Town of Keenesburg has a net surplus of LFH water and Pioneer Village has a net surplus of LC water, these two entities have a mutually beneficial relationship given their opposing needs. As such and for reasons already discussed, our team recommends the following approach. Our proposal is solely based on engineering and any conveyance or bulk water sales would need to be resolved amongst the two entities.

1. In Year 1 of Pioneer's development, the Town of Keenesburg could expand the existing blending facility sufficiently to allow for production of their full 660.7 AF of Laramie-Fox Hills supply. At a 50/50 blend rate, the Town would be able to produce approximately 1.179 MGD which would supply the Town and Keenesburg's ADD through approximately Year 2038. In Year 2038, Pioneer would construct a second blending facility closer to the Village that would allow for Production of their full volume of Laramie-Fox Hills supply, or 1.429 MGD. This would give a total daily production volume of 2.608 MGD (based solely on allowable production per water supply

availability)[9]. That would give the Town and Pioneer adequate capacity to produce their individual ADD's through Year 2056. To produce the **full** ADD in Year 2060, an additional 205 AF of LFH would need to be acquired. Based on the non-renewable nature of the groundwater supplies, it is assumed that deficient will met in the form of municipal wells drilled into the Box Elder alluvium once an augmentation plan is prepared and subsequently approved.



Our team prefers this approach because of one major benefit; ***redundancy***. In the initial phases of Pioneer Village whereby the Town produces potable water and delivers via the transmission main to be constructed along County Road 55, Pioneer is solely reliant on this feed. In the event of a catastrophic failure, Pioneer in its entirety could be left without water until system repairs are performed. The same can be said for the Town of Keenesburg. In the event of any major failure upstream of the Town, residents of Keenesburg could also experience a similar situation. Having two blending facilities independent of one another would create some level of redundancy for Pioneer and Keenesburg given the ability for each facility to feed the inoperable system during down periods.

Having established the supply, demand(s) and timing required to develop both Pioneer and Keenesburg's potable water infrastructure necessary to meet their individual needs, our team will transition to sizing the gathering system(s), treatment works and storage facilities. Moving forward, our team will utilize the following information:

[9] It should be noted that the intention is to utilize returned flows from the WWTF discharged into Box Elder Creek to mitigate Pioneer's reliance on the LFH and Lost Creek Supplies. The secondary water source is also crucial to mitigate any future degradation in water quantity or quality from the two (2) groundwater sources.

Table 6 – Pioneer Village & Keenesburg Projected MDD

Entity	2038 ADD MGD (AF/Yr)	2060 ADD MGD (AF/Yr)	2038 MDD MGD (AF/Yr)	2060 MDD MGD (AF/Yr)
Keenesburg[10]	0.366 (410)	0.672 (753)	0.915 (1,025)	1.680 (1,882)
Pioneer	0.753 (843)	2.180 (2,442)	1.130 (1,266)	3.270 (3,663)
TOTAL	**1.119 (1,253)**	**2.852 (3,195)**	**2.045 (2,291)**	**4.950 (5,545)**

Because the Maximum Daily Demand (MDD) is a representation of the total demand that could occur on any given day within the planning period, the gathering, treatment and storage infrastructure has to be capable of producing and distributing that volume of water to mitigate the risk of a major pressure loss and/or draining the system. Should a major pressure drop occur or insufficient water be present in the system for items such as fire service, a major public safety issue could occur.

Section 4.0 – Water Gathering, Treatment and Storage

As described in the previous section(s), the SSD team will now outline our plans for the design, expansion and implementation of the water gathering systems, treatment infrastructure and storage facilities. Our expansion plan is based on information depicted in Chart F in Section 2.0. Chart F showcases how the Town of Keenesburg could expand and operate a 1.179 MGD blending facility at their current site through 2038 when Pioneer would facilitate construction of a 1.429 MGD blending facility in 2038. The operation of two blending facilities would allow for a combined total production rate to 2.608 MGD or 1460.7 AF/Year *(Keenesburg's 660.7 AF plus Pioneer Villages 800 AF)*.

Section 4.1 – Town of Keenesburg Capacity Analysis

Given plans to provide Pioneer's initial potable water supply using the Keenesburg gathering and treatment system, our analysis will address that system first such that any shortfalls could be offset by development of the Village's system.

Section 4.1.1 – Gathering System Capacity

When master planning the system to meet the maximum daily demand, our immediate constraint will be the low pumping rates present in the Laramie-Fox Hills Wells. Currently, the Town of Keenesburg has five (5) wells drilled into the Laramie-Fox Hills Aquifer which have total permitted pumping rate of 460 GPM (Reference Table 2). Wright Water Engineer's has recommended a maximum pump utilization rate of 60%; or 14.4 hours per day, to allow for recharge. Therefore, the maximum daily demand that could be produced at this time is:

Table 7 – Keenesburg Blending Facility's Current Gathering System Capacity MG

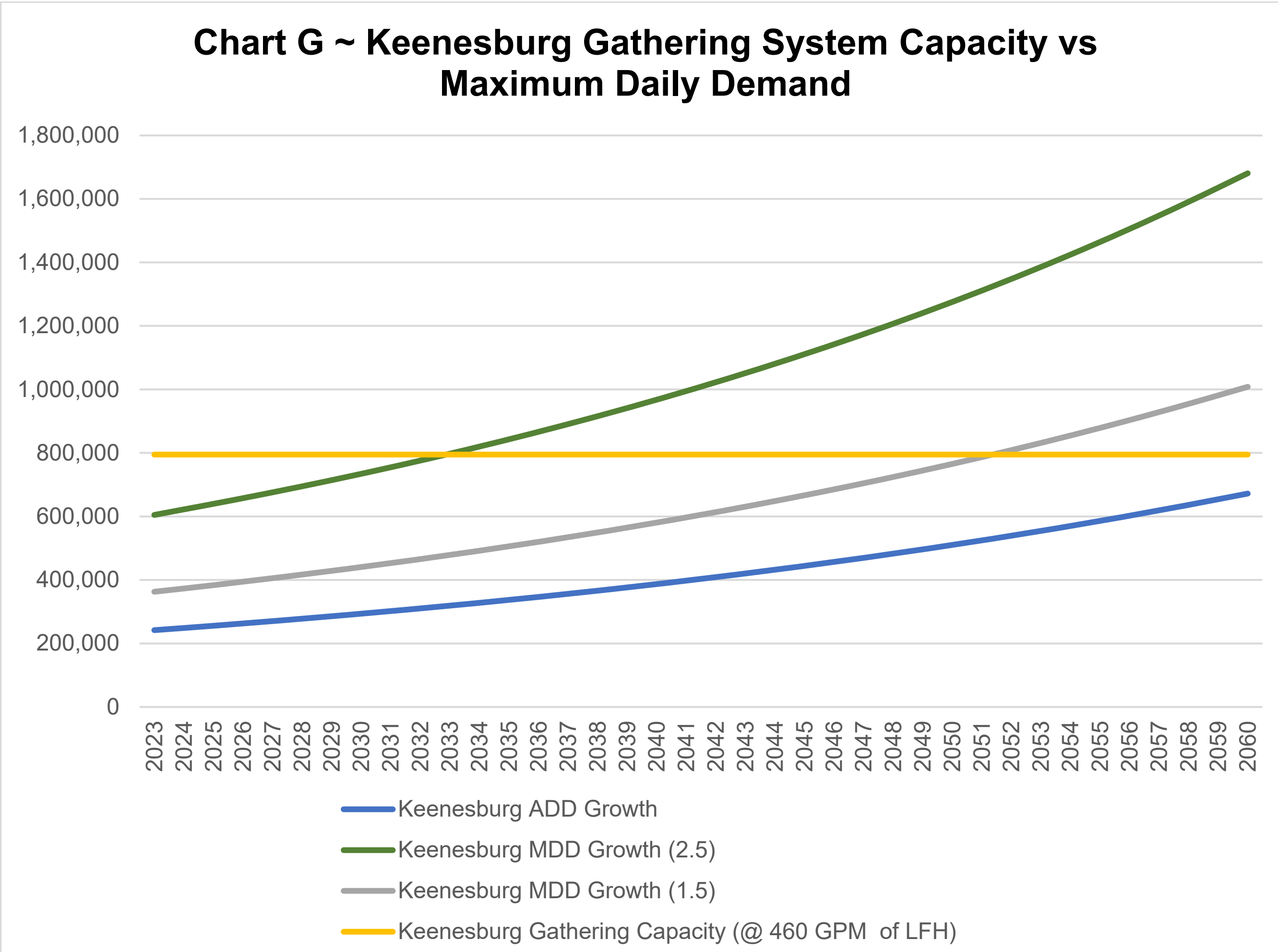
LFH Permitted Pump Rate	Pump Run	Total Volume (MGD)
410 GPM[11]	14.4 Hours	0.354 or 396 AF/Yr
LC Permitted Pump Rate	**Pump Run**	**Total Volume (MGD)**
650 GPM (Throttled to 410 GPM)	14.4 Hours	0.354 or 396 AF/Yr
Total Produced in 14.4 Hours		**0.708 or 792 AF/Year**

[10] The Town's FEI Water Master Plan derived an MDD factor of 2.5 for the Town which we have modified to 1.5 herein for reasons listed in the body of the report. Because Pioneer Village will utilize a separate non-potable irrigation system for the large, irrigated tracts, a more predictable maximum is anticipated and therefore we've utilized a more traditional value of 1.5.

[11] Based on pump rates for Wells 2, 4, 5 and 7 or 410 GPM

As shown in Table 6, the Town's gathering system has the capacity to produce 0.708 MGD based on its current gathering system connected to the blending facility. An additional 0.043 MGD or 48.4 AF/Yr can be produced by the Well No. 12 system at the Weld County High School.

Chart G on the following page represents Keenesburg's LFH gathering system capacity versus the MDD Growth.



As shown in the table above, with the MDD factor of 2.5 determined by FEI as part of the Town's Water Master Plan, the current LFH gathering system will be able to gather enough water to meet the MDD through Year 2033. If applying a more traditional 1.5 factor, the system would be enough through Year 2052. Since producing the MDD volume is more a function of pump rates and production and not appropriations, adding an additional well would be required to meet the MDD beyond 2033 at the projected growth rate. At a pumping rate of 50 GPM over 14.4 hours, the Town would need to drill and connect as many as ten (10) new LFH wells to meet the MDD at 2.5 times the ADD. Approximately three (3) wells would be required at 1.5 times the ADD.

Section 4.1.2 – Blending Facility Capacity

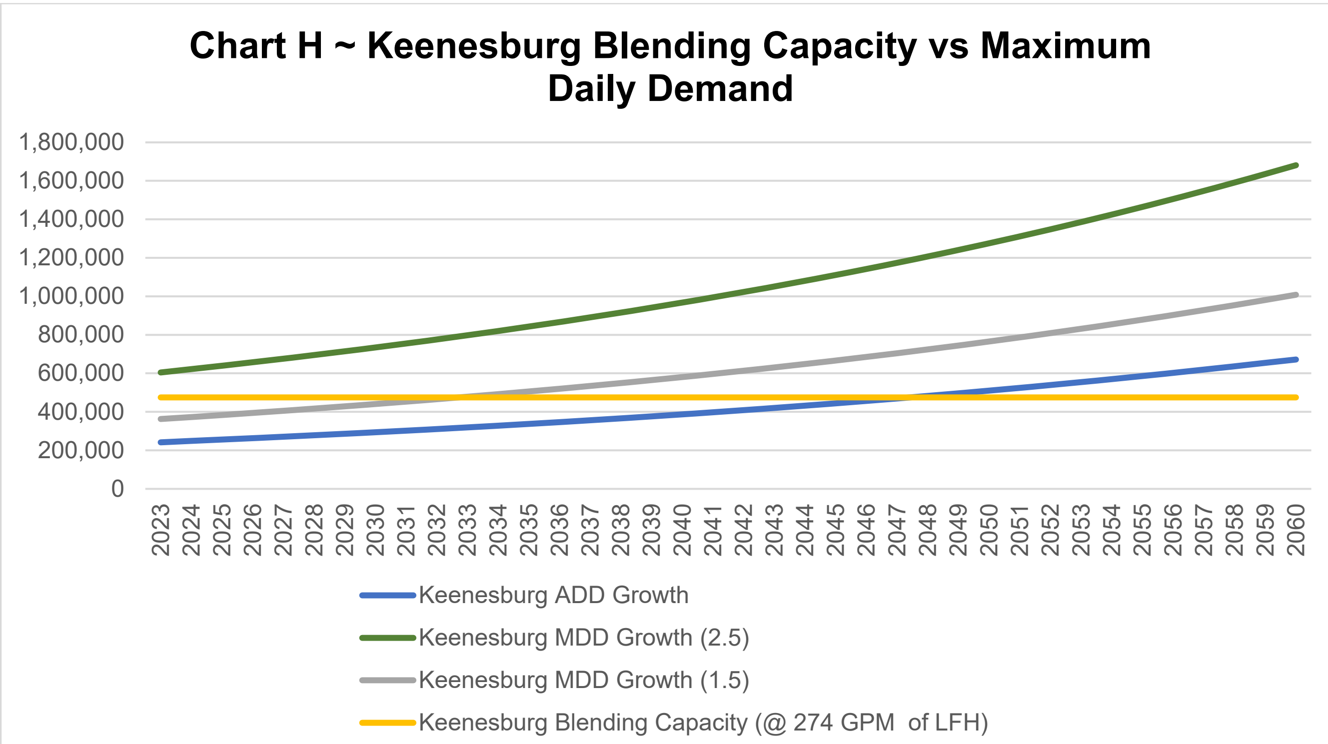
Currently, the Town of Keenesburg operates one (1) blending facility on the northeast corner of County Road 14 and 55. As outlined in Section 2.0, the blending facility contains two header pipes; one conveying LFH's water and the other LC water in equivalent rates. Due to the simple nature of the system, the capacity should be a simple calculation; Q=AV or pipe capacity or "Q" is equal to the area "A" of the pipe times the velocity "V" within the pipe. As such, we estimate the "safe" operational capacity of the current blending facility as follows:

Table 8 – Keenesburg Blending Facility Capacity MGD and AF/Yr

Station Piping Size	Velocity	Total Production
4" (Area "A" = 0.087 SF)	7 FPS[12]	274 GPM for each header or 548 GPM / 0.475 MGD / 532 AF/Year

As shown in Table 8, when maintaining a velocity of 7 FPS the blending facility can produce approximately 0.475 MGD.

As more LFH wells are constructed and the Town gains access to additional LC supply, the blending facility's capacity becomes the bottleneck in the production process.



As shown in the chart above, the Town of Keenesburg will be unable to produce their MDD at the beginning of the planning period or Year 2023. Assuming an MDD peak of 1.5 times the ADD, the MDD would be met through Year 2032. Therefore, in order to comply with Paragraph 2.1 of CDPHE's Design Criteria for Potable Water Systems requiring treatment facilities be sized to meet the MDD, a plant expansion would be required in the initial phase of the Project.

Section 4.1.3 – Storage Capacity

As the final step in our evaluation of the Town's water infrastructure, SSD will review the capacity of existing storage facilities over the planning period. As outlined in Paragraph 5.3 of the Town's Water Master Plan, the Town currently has 0.725 MG of storage available in four (4) separate tanks. Section 7.0.1 of CDPHE's design criteria dictates the minimum storage capacity be equal to the average daily consumption. Since the Town can provide fire protection, we've reduced the available storage to 665,000

[12] Pipeline and appurtenance manufacturers typically reference 7 FPS as the upper limit for velocities under normal operating conditions to prevent the effects of water hammer and mitigate a reduction in service life of ductile iron pipe due to cement lining erosion.

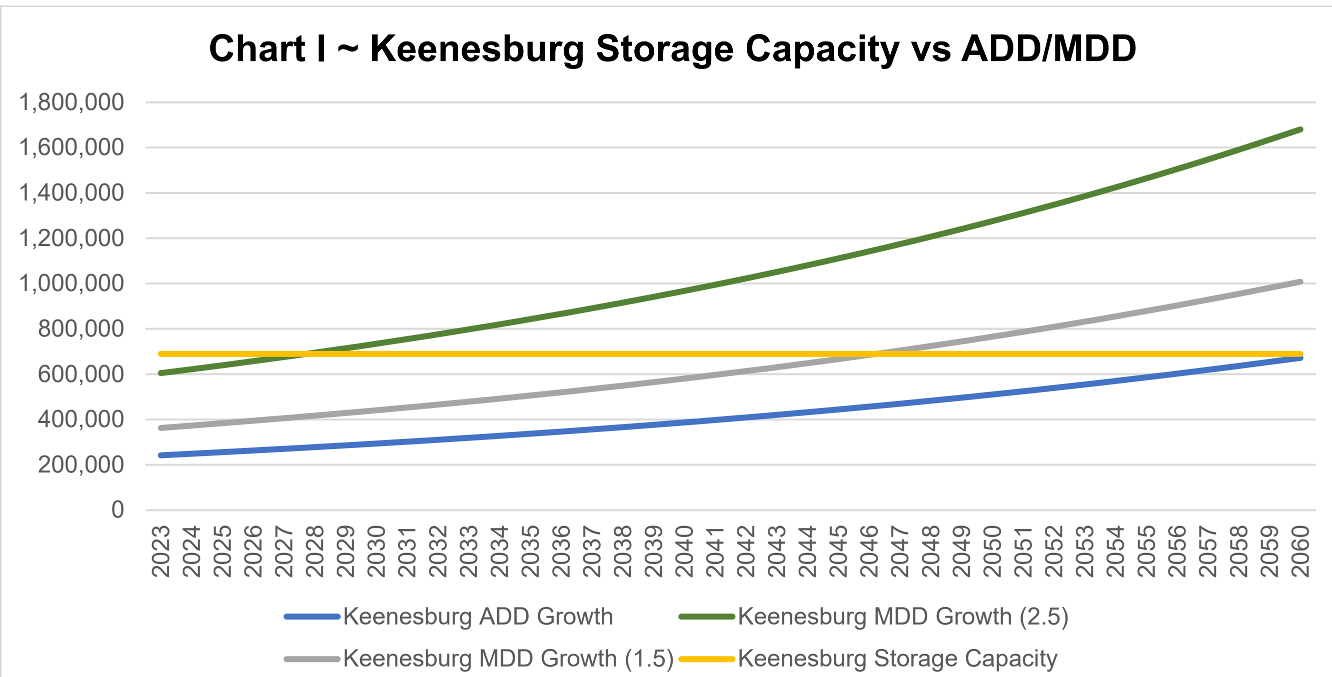
gallons[13] and compared it to the ADD and MDD previously developed. Please reference Chart I on the following page.

As shown, the Town has enough storage to meet the ADD through the planning period ending Year 2060. FEI's Plan did suggest the Town expand their capacity to store the MDD. The current storage would meet the MDD at 1.5 and 2.5 times the ADD in Years 2028 and 2047, respectively. At that time, an additional water storage tank would be required to meet the demands.

It should be noted that the Town operates the 0.20 MG tank north of I-76 as a means to provide pressure to less than ten (10) residential customers. In the coming sections, SSD will describe our planned approach to increase pressure in the north end of Town thereby allowing this tank to be taken out of service. With a reduction in storage volume of 0.20 MG, the Town will have 0.465 MG of storage available. However, to create a second zone and increase pressure north of I-76, the Town will share volume in a large tank constructed by Pioneer in the initial phase of the Project. This tank will be sized to provide the capacity lost by taking the 0.20 MG tank off-line.

Section 3.1.4 – Summary of Keenesburg's Existing System

As outlined in the three previous sections, Keenesburg's existing gathering and blending systems will experience capacity issues as their demand grows over time. As shown in Section 3.1.1, the current gathering system lacks enough pumping capacity to deliver the required raw water supply to the blending facility. Compounding the issue, the blending facility piping is insufficient to produce the MDD while limiting the system velocities to 7 fps.



Given the existing system's limitations in meeting their individual demands, our team falls back to the collaborative approach previously discussed when developing the ADD to resolve these issues.

Section 4.2 – Future System Capacity Development

As outlined previously in Section 3.1, our team will work to develop the Pioneer Water System in a collaborative approach thereby creating a mutually beneficial system for both parties. Our proposed

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[13] In our planning experience, water storage tanks are typically sized to include a flow of 500 gallons per minute for a period of 2 hours yielding 60,000 gallons.

approach for developing the gathering system, blending facilities and storage tanks are outlined in the following sections.

Section 4.2.1 – Proposed Keenesburg Gathering System

In Section 2.0, our team developed the Town and Pioneer Village's ADD as well as the framework for a two-blending facility system capable of producing 2.608 MGD based upon each entity's available supply of Laramie-Fox Hills groundwater. In Sections 4.2.1 and 4.2.2, we will begin to evolve this design to address the required MDD as required by CDPHE.

Should our two-facility plan be implemented, the first facility to come online will be the upgraded Town of Keenesburg Plant. When maximizing their LFH supply, the Town will be able to produce a total of 1,321.4 AF/year *(assumes an equitable volume of LC Water)* or 1.18 MGD per day. That supply would suffice until Year 2038 when Keenesburg and Pioneer Villages combined ADD reach 1.118 MGD. If we applied an MMD factor of 1.5 and 2.5 times the ADD, the total demand would increase to 1.677 and 2.795 MGD, respectively. Table 9 below summarizes the total anticipated flow rates required to address the MDD. Due to the limited production available from the LFH wells, our pump rates will be specific to those wells.

Table 9 – Pioneer and Keenesburg MDD and Pump Rate Summary

2038 ADD MGD (AF/Yr)	MDD at 1.5 Peak MGD (AF/Yr)	MDD at 2.5 Peak MGD (AF/Yr)	LFH Pump Rate Required (GPM & AF/Yr) at 1.5[14]	LFH Pump Rate Required (GPM & AF/Yr) at 2.5[15]
1.118 (1,252)	1.677 (1,878)	2.795 (3,131)	970.4 (940)	1,617.5 (1,565)

As shown in Table 9; with a current pumping rate of 410 GPM and an assumed yield of 50 GPM on future LFH wells, the Town would need to construct approximately ten (10) new wells to meet the combined MDD with a 60% utilization rate (14.4 hours) at 1.5 times the ADD. As many as twenty-three (23) wells would be required to meet the MDD at a peak of 2.5. Neither of these approaches are feasible given the number of wells required and the associated costs of municipal wells, not to mention to localized effects on the aquifer.

To resolve the MDD issue, our team recommends the following approach.

1. The Town and Pioneer Village aggressively manage their irrigation demands to narrow the difference between the ADD and MDD to 1.5 requiring 1.677 MGD.
2. Design and construct the Laramie-Fox Hills gathering system to deliver the ADD over 14.4 hours or 647 GPM.
3. Then, during a large demand or MDD event, operate the system at 647 GPM for approximately 21.6 hours to meet the demand. Given the characteristics of the MDD, this should not prevent any detrimental impacts to the LFH aquifer when this approach is infrequently utilized.

In order to deliver 647 GPM of LFH water to the blending facility and assuming the Town is able to achieve a pumping rate near 460 GPM on the existing wells, five (5) new wells would be required to meet the ADD if yielding 50 GPM. We also recommend the Town drill two (2) additional LFH wells to serve as backups should a well or well pump fail.

The Town's current Lost Creek well has a permitted pump rate of 650 GPM so this approach would not require an additional well, although consideration should be given since it will operate so closely to its maximum production rate. Note that the Town would need to acquire additional rights to operate the LFH gathering system at the full 650 GPM throughout the calendar year.

[14] Assumes 14.4 hour run time.
[15] Assumes 14.4 hour run time.

Section 4.2.2 – Proposed Keenesburg Blending Facility

Previous sections have detailed the ADD and MDD volumes required for blending as well as the anticipated pumping rates necessary to meet those demands. Given the process requirements at the blending facility, theoretically one would just need to size the individual header pipes to accommodate the pumping rates generated by the gathering system. Table 10 summarizes the header pipe design.

Table 10 – Keenesburg MDD Header Pipe Design

Gathering System	Pumping Rate GPM (AF/Yr)	Max Velocity (FPS)	Required Header Pipe Diameter (IN)	Header Pipe Capacity GPM (AF/Yr)
LFH	650 (630)	7.0	8”	1,096 (1,060)
LC	650 (630)	7.0	8”	1,096 (1,060)

In order to pump a flow rate of 650 GPM, each header pipe would need to be an 8-inch pipe. The anticipated velocity within the system would be 4.15 FPS which is considered acceptable.

Also, based on the Sodium Hypochlorite feed rates listed in Paragraph 6.2.2 of the Town’s Water Master Plan, Keenesburg has historically fed 9.6 gallons per 0.129 MGD of potable water produced. At the ADD peak flow of 1.118 MGD, approximately 83.2 gallons of Sodium Hypochlorite would be required. If targeting one delivery per month, a 2,500-gallon tank would be required in the new facility.

Section 4.2.3 – Proposed Keenesburg Storage

At the peak of Keenesburg’s demand, they’ll be producing an ADD of approximately 1.118 MGD. If following the CDPHE rule requiring the minimum storage volume to match the ADD; with inclusion of 60,000 gallons of additional storage for fire protection, the Town will need a total of 1.178 MG of available storage. As outlined in Section 4.1.3, this plan will strive to take the existing 0.20 MG water storage tank north of I-76 out of service. Reducing the existing storage capacity by 0.20 MG and building in an additional 60,000 gallons for fire service, a total storage volume of 0.653 MG would be required to meet the 2038 ADD.

Section 4.2.4 – Summary of Keenesburg System Upgrades

As discussed in Section 3.2.1 through 3.2.3, the following items would be required for the Town of Keenesburg to maximize their 660.7 appropriation of LFH water.

1. The Town would be required to construct five (5) new municipal wells in the Laramie-Fox Hills aquifer.
2. A new blending facility would be needed to produce the MDD. The facility’s concept would mirror the existing structure but with large piping (8”) and a larger Sodium Hypochlorite storage tank.
3. To meet CDPHE requirements, an additional 0.653 MG of storage would have to be constructed.

Additionally, an agreement would be needed between the Town and Pioneer to address bulk water sales. It is assumed that Keenesburg would be a wholesaler to Pioneer (i.e. Pioneer would purchase wholesale water from Keenesburg and retain system operation and maintenance, billing, collection, etc.) downstream of a metering station. Our initial assumption is a meter installed immediately upstream of the initial Pioneer Tank discussed in the following section. Based on Pioneer’s demand in Year 2038 of 0.753 with a Peak Hourly Factor of 4.0, an 8-inch Meter would be required.

Our team preliminarily estimates the cost of these improvements as follows:

Table 11 – Keenesburg Infrastructure Upgrades – Preliminary Cost Estimate

No.	Description	Quantity	Unit	Unit Cost	Total Cost
1	Construct New LFH Well	4	Each	$280,000	$1,120,000
2	Gathering System Piping[16]	1	LS	$1,056,000	$1,056,000
3	1,300 GPM Blending Facility	1	LS	$100,000	$100,000
				Total	**$2,276,000**

As shown, the anticipated investment in the Pioneer Village and Keenesburg gathering, blending and storage system during the initial 15-year planning period is approximately $2.3M.

Having addressed system improvements required by the Town of Keenesburg to maximize production of their Laramie-Fox Hills water supply, our team will now transition to evaluating the new Pioneer Village System.

Section 4.3 – Pioneer Village Gathering, Treatment and Storage Infrastructure

Utilizing the systemwide demands for Pioneer Village and the Town of Keenesburg generated in Section 2.0, our team has determined that two independent blending facilities with the associated infrastructure was the best alternative. Due to the simplicity and low cost required to produce potable water via blending the LFH and LC supplies together, maximizing these supplies in the early stages of development are a major benefit to both entities. However, as the developments begin to rely heavily on their groundwater sources, there will need to be a sound investment in the development of a backup source. In this case, it will be the Box Elder Creek supply. Since the Box Elder supply will require reverse osmosis (RO) treatment immediately upon implementation, the capital investment to bring that system online in the early stages of development is detrimental. The Box Elder supply only becomes feasible once Shifting away from the LFH supply would likely require reverse osmosis (RO) treatment at which time the capital investment and cost to treat water will drastically increase, not to mention the traditional water losses and brine treatment associated with RO treatment.

In Section 3.2, our team recommended an upgrade to the Keenesburg Blending Facility which would allow them to gather, treat and distribute their full LFH supply, or 660.7 AF. Translating that supply into a daily rate yields a blending facility capable of producing 1.118 MGD per day under normal ADD operation and 1.677 MGD under MDD conditions based on varied pumping timeframes. This facility will remain adequate to serve both the Town and Pioneer Village's population at the projected growth rates through 2038 *(Reference Chart F)*. As such, it is recommended that Pioneer Village undertake construction of a second blending facility in 2038 to support demands coming online in 2039. The Table below summarizes the ADD and MDD for the Pioneer Facility in 2039 and 2055. 2055 is a relevant year because it's the final year in the planning period that the Keenesburg and Pioneer blending facilities can work in tandem to meet the ADD requirements of both communities based on a full utilization of their LFH supply. Given the additional demand beyond the ADD capacity supported by LFH supply is the result of the Pioneer Development, Pioneer will need to develop their Box Elder source to address the additional demand(s) coming online in 2056 and beyond.

[16] Assumes that new LFH wells can be constructed within 4,000 feet of existing gathering system piping

Table 12 – Pioneer Village Projected MDD

Source	2039 ADD MGD (AF/Yr)	2055 ADD MGD (AF/Yr)	2039 MDD MGD (AF/Yr)	2055 MDD MGD (AF/Yr)
Pioneer Village	0.840 (940)	1.859 (2,082)	1.260 (1,411)	2.789 (3,123)
ADD Treated by Keenesburg[17]	0.743 (832)	0.534 (598)	0.548 (613)	0.902 (1,010)
Pioneer Facility	**0.097 (1,772)**	**1.325 (2,680)**	**0.712 (2,024)**	**1.887 (4,133)**

As shown in Table 12, Pioneers ADD in year 2039 is 0.840 MGD. Of the 0.840 MGD, Keenesburg has the capacity to produce 0.743 MG of that demand. By 2025, Pioneer's ADD will grow to 1.260 MGD, of which Keenesburg will only be able to supply 0.548 MGD of based upon their own system growth. As such, our design has deliberately built additional capacity into Keenesburg's expanded facility. As an example, the total ADD of 1.118 MGD in 2038, the year prior to Pioneer's facility being implemented, is considered the peak demand on the Keenesburg plant. Based on the water supply of 1.180 MGD, a surplus capacity of approximately 62,000 gallons or 5% per day will exist. For the Pioneer blending facility, our team will design that facility around the 2055 ADD and MDD, less the capacity offered by the Keenesburg facility.

At this point, it is important to establish the anticipated percentage Pioneer Villages treatment offered by the Town of Keenesburg. Through Year 2038, 100% of Pioneer Villages potable water supply will be gathered[18] and treated by the Town. Once that facility reaches 95% of its capacity based on the LFH supply, the Pioneer Village facility will come online and start treating Pioneers additional ADD from 2039 on. In addition to the ADD for new development in 2039, Pioneer will also need to transition 2.80% of its demand produced by Keenesburg's to the Pioneer facility to account for growth with the Town's service area. This ensures that as Keenesburg's projected annual growth of 2.80% can be addressed by their gathering and treatment facility. Chart J on the following page summarizes the relationship between ADD growth for the Keenesburg and Pioneer Facility.

[17] The Town's FEI Water Master Plan derived an MDD factor of 2.5 for the Town which we have modified herein to 1.5. Because Pioneer Village will utilize a separate non-potable irrigation system for the large, irrigated tracts, a more predictable maximum is anticipated and therefore we have utilized a more traditional value of 1.5.

[18] The Town will gather the total LFH Supply. Pioneer will pipe LC water for blending to the CR 14 and 55 site.

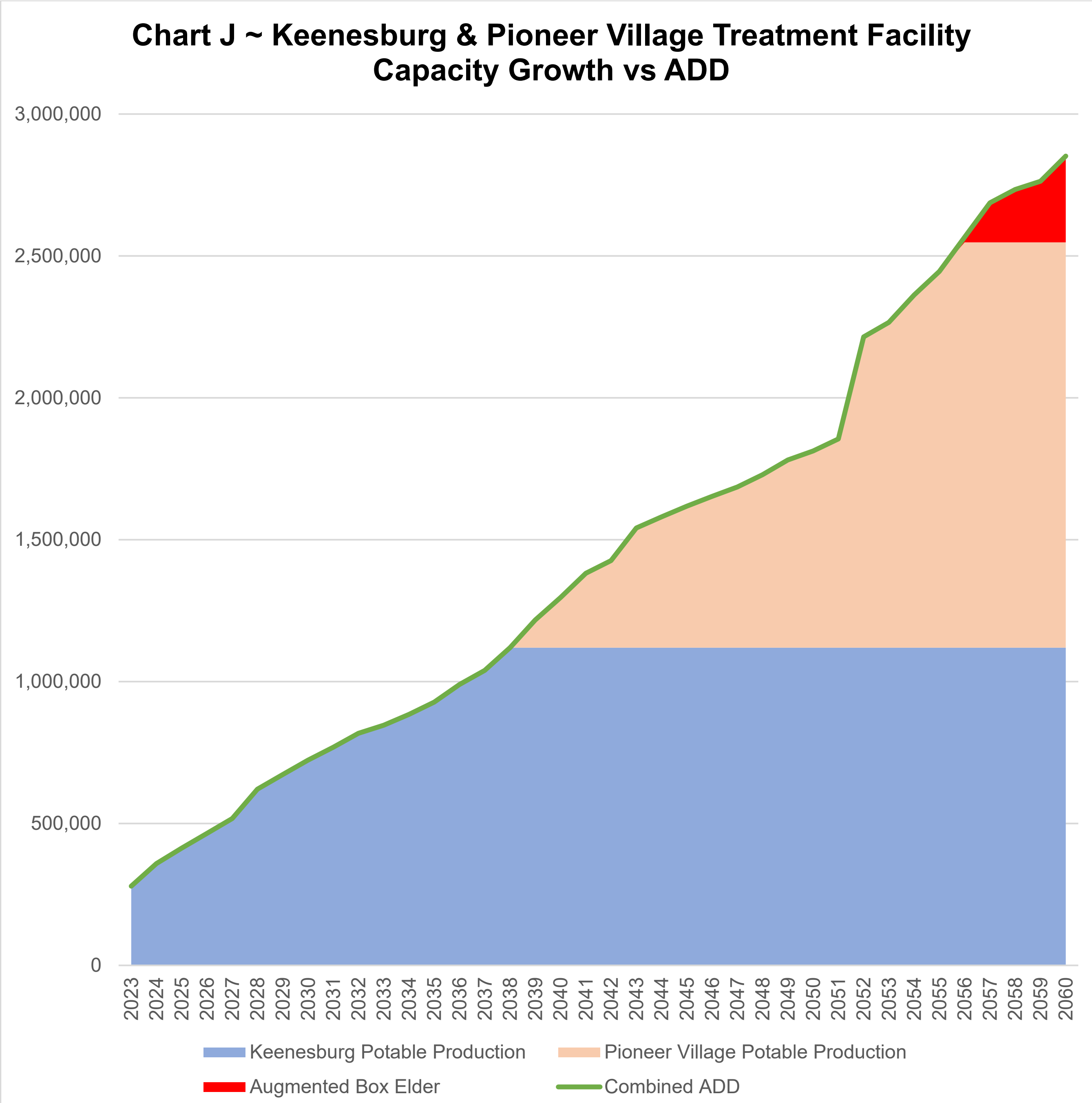
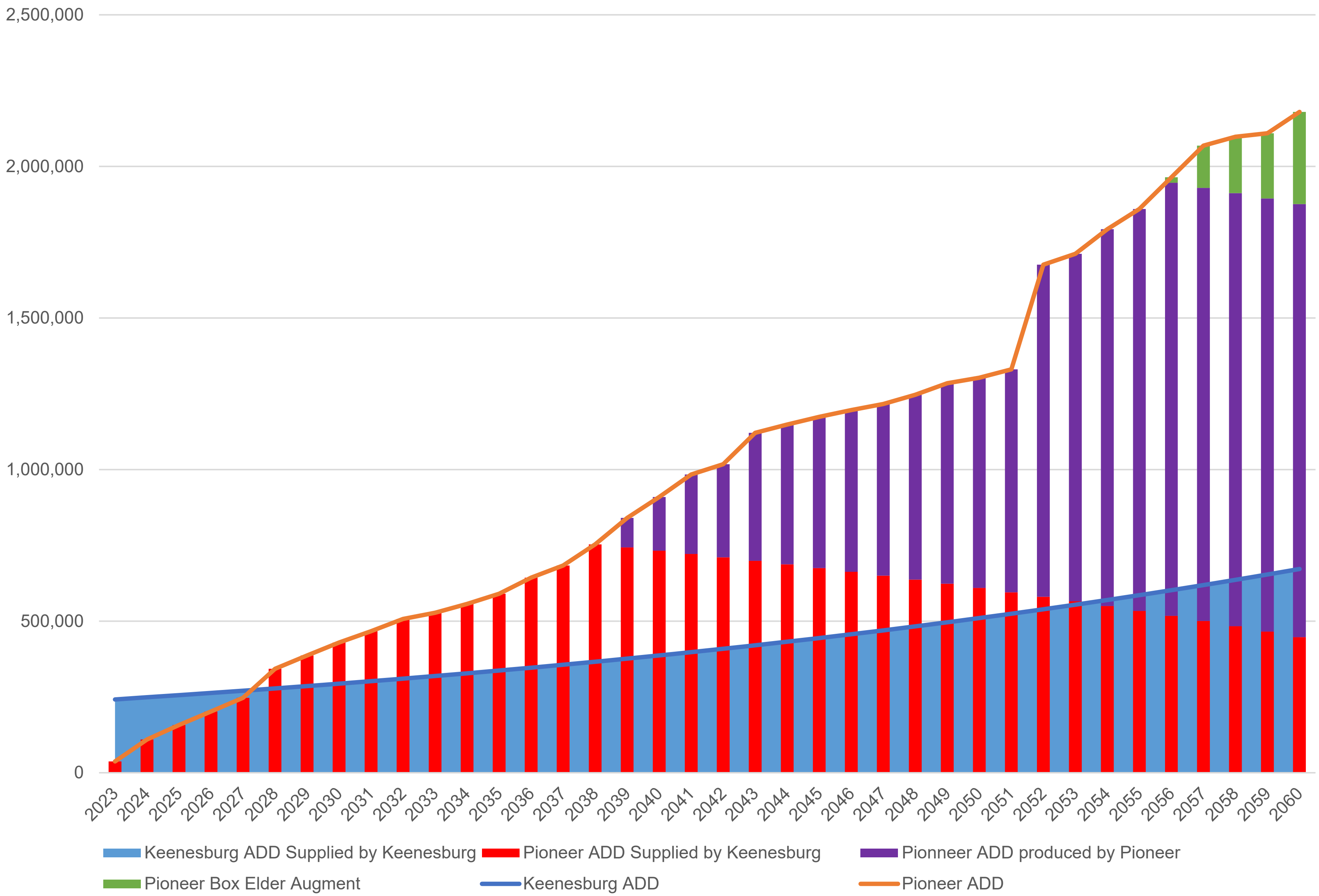


Chart K on the following page elaborates on this concept in more detail.

Chart K is valuable because it depicts how these three (3) systems will interact and address the ADD over time. It also assists in visualizing the interdependency between Pioneer's ADD produced by Keenesburg and how it must be reduced once their treatment facility reaches capacity in 2038 based upon their LFH supply. The relationship is also shown between Pioneers peak ADD capacity reached in 2055 based on their individual LFH supply and the need for raw water from Box Elder Creek to supply the ultimate demand in 2060.

In 2055, the Pioneer blending facility must be sized to produce an ADD of 1.325 MGD with a peak or MDD of 1.887 MGD. Based on these figures, our team will formulate the design approach for the Pioneer Village gathering system, blending facility and storage infrastructure in the following sections.

Chart K ~ Pioneer ADD produced by Keenesburg



Section 4.3.1 – Pioneer Village Gathering System

Being that the Laramie-Fox Hills supply available to Pioneer Village is significantly less than the available Lost Creek supply, coupled with significantly lower yields than the Lost Creek wells in the area, our principle focus for the gathering system will be structured wells.

Pioneer currently has access to an 18-inch non-potable line delivering water pumped from the Lost Creek aquifer to the Wilson Pond located on the northeast corner of County Roads 22 and 55. Given the production rates of the permitted wells associated with this system, we will briefly elaborate on that connection later in this section.

As discussed throughout this report, to maximize Pioneer Villages supply of LFH's water, an ADD of 0.670 MGD would need to be delivered to the Pioneer Village blending facility. Assuming a well pump yield of 50 GPM and utilization of 60%, or 14.4 hours, the total number of wells required would be as follows:

Table 13 – Pioneer Laramie-Fox Hills Gathering System Well Requirements

Flow Rate at full Production of LFH(MGD) (AF/Yr)	Estimated Yield per Well (GPM) (AF/Yr)	Utilization (Hr)	Production per Well (MGD) (AF/Yr)	Total Wells Required to Produce 0.67 MGD or 750 AF/Yr
0.670 (750)	50 (48.4)	14.4	0.0432 (48.4)	**16**

Based on the calculations in Table 13, Pioneer Village will require approximately 16 wells drilled into the Laramie-Fox Hills aquifer to maximize their production and meet the required ADD.

As the Pioneer Village system develops out between years 2039 and 2056, SSD will work with WWE to identify the optimal locations to drill these wells within the boundary of Pioneer Village.   The final collection system piping should range from 3-inch to 10-inch piping as the gathering system reaches the blending facility.

Based upon a blending ratio of 50/50, 0.670 MGD of Lost Creek water would need to be delivered to the blending facility. Table 14 summarizes the number of wells required to supply the ADD.

Table 14 – Pioneer Lost Creek Gathering System Well Requirements

Flow Rate at full Production of LFH MGD (AF/Yr)	Estimated Yield per Well GPM (AF/Yr)	Utilization (Hr)	Production per Well MGD (AF/Yr)	Total Wells Required to Produce 0.67 MGD or 750 AF/Yr
0.670 (750)	500 (48.4)	14.4	0.432 (48.4)	**2**

Based on an assumed yield of 500 gallons per minute per well, which is on the low end of the yield based on other wells within the aquifer that our team has reviewed, two (2) wells would be required. Given the existence of the 18-inch non-potable LC supply line that is constructed to along CR 14 and 55 to the proposed Pioneer Village Blending Facility Site; and that line is capable of delivering much more water than required based on the pump yields and flow rates of the connected wells, Pioneer Village would need to utilize a telemetry system and pumps with variable frequency drives to match the flow rate generated by the Laramie-Fox Hills gathering system.

In the initial development of Pioneer Village, the Lost Creek gathering system will be fed by Wells 1 through 11 shown in the PSI Plans in Appendix G. The permitted water supply allowed by this system is 1,018 AF. Consumption in excess of 1,018 AF per year will require construction of an additional Lost Creek Well. The total estimated Lost Creek usage for potable water production demands in Year 2060 is

1,597 AF. That means Pioneer Village would need to drill Wells 16 and 17 to increase the permitted raw water supply in the Lost Creek basin to 1,806.2 AF.

Note that Pioneer Village also plans to develop a non-potable irrigation system to address large open space areas and parks that would also draw water from the Lost Creek aquifer. Depending on the final irrigation usage from Wells 1 through 11 and 16, 17, the schedule required to permit and construct additional wells could be accelerated.

To address the MDD Scenario, SSD proposes to address maximum events with the same plan used to address the Town's pumping rate shortfall. The LFH wells simply do not yield sufficient pump rates to effectively gather the MDD within the 60% utilization period. As such, we propose a longer operational period to address periodic MDD events. To meet the 2.143 MGD MDD, the gathering system would need to run approximately 21 hours at the ADD rate to produce the MDD. This results in a utilization of 88%.

Based on eighteen (18) wells being installed over the 3,400 acres limits of Pioneer, we anticipate the costs of the system at full buildout as follows:

Table 15 – Pioneer Gathering System – Preliminary Cost Estimate

No.	Description	Quantity	Unit	Unit Cost	Total Cost
1	Construct New LFH Wells	16	Each	$280,000	$4,480,000
2	Construct LFH Backup Wells	2	Each	$280,000	$560,000
3	LFH Gathering System Piping[19]	1	LS	$1,292,900	$1,292,800
4	LC Well Connection	1	LS	$25,000	$25,000
5	Drill Wells LC Wells 16 and 17	2	Each	$280,000	$560,000
6	LC Gathering Piping	1	LS	$2,244,000	$2,244,000
7	Telemetry System	1	LS	$40,000	$40,000
8	Acquire 12" LC Supply Capacity	1	LS	$2,232,500	$2,232,500
				Total	**$11,433,500**

The total estimated cost of the Pioneer Village gathering system as required to utilize the full LFH appropriation is $11,433,500.00. Being an 18-year buildout to realize the full 1.339 MGD allowable production, it is reasonable to assume these costs will be incurred in three (3) phases with roughly 67% of the $9.2 million occurring in 2038 for demands coming online in 2039, 15% occurring in Year 2044 to meet 2045 demands and the remaining 18% in Year 2051 to meet 2052 demands. These figures are based upon initial construction of six (7) LFH wells, expanding to twelve (12) LFH wells at 90% of Phase I's capacity and a second expansion of six (6) LFH wells at 90% of the Phase II expansion capacity.. It is important to consider that this expenditure can likely be broken down even further given the low yields of the LFH wells. Pioneer Village could theoretically budget to drill one (1) well per year from the first expansion until the sixteen (16) production and two (2) backup wells are built out. We recommend constructing the first backup well in Phase I and the second in Phase II.

Having outlined the framework of the Pioneer Village gathering system, our team will now address the blending facility.

Section 4.3.2 – Pioneer Village Blending Facility

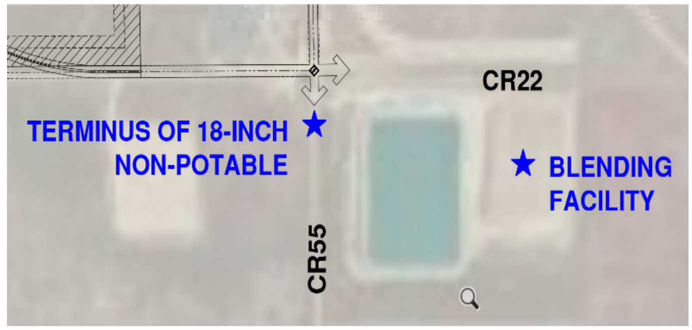
Given that Pioneer Village and the Town of Keenesburg share the same raw water sources coupled with the overall effectiveness of the Keenesburg system, our team proposes to mirror that concept with a second blending facility sized to treat Pioneer Villages ADD of 1.325 MGD and MDD of 1.887 MGD.

Our initial planning for the blending facility is based on the following components:

1. Proximity to Pioneer Village *(i.e. site the plant near the areas of highest demands)*
2. Proximity to Raw Water Sources

[19] Assumes most wells are located within Section 8 and 9 (closest to PV Blending Facility)

3. Real Property to Site the Plant
4. Elevations *(i.e. balance the elevation of the facility with the elevation of storage infrastructure to mitigate un-necessary pumping costs)*
5. System Demands (ADD and MDD)



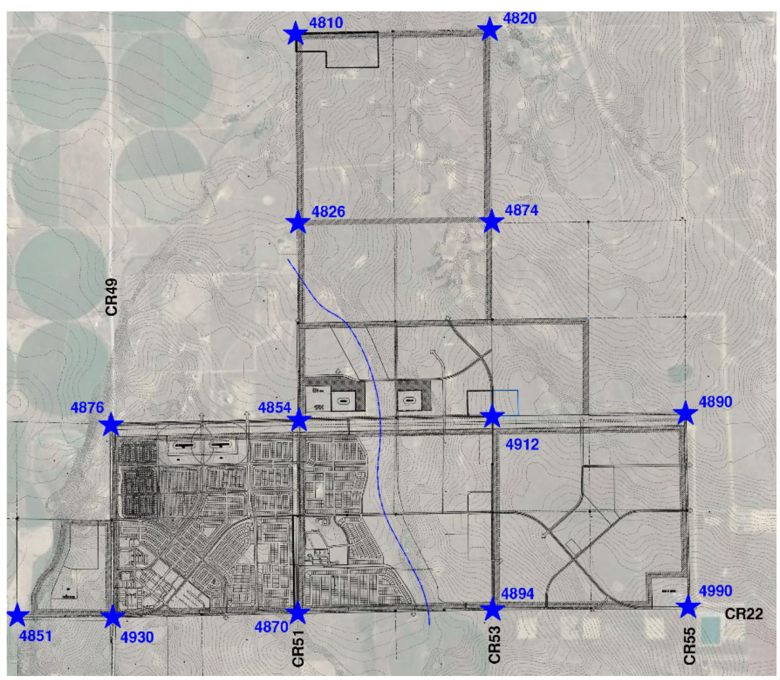
During our site selection process, our team evaluated several alternative locations for the Pioneer Village blending facility; however, only one (1) site met all our criteria. Illustration A above depicts our proposed blending facility location in relation to Pioneer Village. As shown, the location lies directly contiguous to the Pioneer community. It will also be constructed on lands District owned lands. Therefore points 1 and 3 are adequately addressed.

With respect to Point 2 relating to proximity to raw water sources; Pioneer Village has access to an existing 18-inch non-potable pipeline that delivers raw water from the Lost Creek aquifer to the storage impoundment directly adjacent to the blending facility. As discussed in the gathering system section on the previous page, Pioneer's Laramie-Fox Hills supply is anticipated to be developed within Sections 8 and 9 which lie directly northwest of the proposed blending site. Given the proximity to these two sources, point 2 is also addressed.

Pioneer also plans the extend a 20-inch potable waterline from the Town of Keenesburg's blending facility site west along County Road 49 and north along County Road 55 which will address demands through 2039. Once reaching the County Road 55 and 22 intersection, the potable main will travel west on CR 22 feeding the distribution network into the Village.

Point 4 is critical given the Pioneer Village system strives to operate via gravity flow. Our overall goal to pressurize the system with a water storage tank constructed high enough to provide a minimum system pressure of 20 PSI at the highest elevation within the Village during a fire flow event. Secondly, we'll strive to provide 35 PSI throughout the service area in anticipation of future advances in household fixtures.

Utilizing the elevation information obtained through GIS sources and survey information provided by Aztec Consultants, the Pioneer blending site lies at an average elevation of 4,990 and is the highest point within the limits of Pioneer Village. From the blending station site, elevations slope gradually downhill to the northwest towards the floodplain central to Pioneer. Grades on the western half of Pioneer drain to the northeast towards the same floodplain.



As shown in the image to the right, the low point within Pioneer is elevation 4,810 located at the far northwest corner of Section 32. Given these elevations, static pressures throughout Pioneer will range from 10 to 78 PSI based solely upon elevation change when considering use of a ground storage tank. With 10 PSI following below the target pressure, an elevated water storage tank will be required to provide adequate pressures.

A further evaluation of the water storage tank(s) is outlined in the following section.

Having outlined our analysis to determine Pioneer's blending site, we now focus to sizing the facility. Given most of the flow demands were established when outlining the gathering system design, we will borrow that information to design the blending facility. If you will recall Table 12, from Section 3.3:

Table 12 – Pioneer Village & Keenesburg Projected MDD

Source	2039 ADD MGD (AF/Yr)	2055 ADD MGD (AF/Yr)	2039 MDD MGD (AF/Yr)	2055 MDD MGD (AF/Yr)
Pioneer Village	0.840 (940)	1.859 (2,082)	1.260 (1,411)	2.789 (3,123)
ADD Treated by Keenesburg[20]	0.743 (832)	0.534 (598)	0.548 (613)	0.902 (1,010)
Pioneer Facility	**0.097 (1,772)**	**1.325 (2,680)**	**0.712 (2,024)**	**1.887 (4,133)**

As shown in Table 12, the combined peak ADD in 2056 is 2.565 MGD. If we derive the Pioneer Blending Facility by subtracting the Keenesburg Plant's Capacity with a 5.0% reduction, the Pioneer facility would need to produce:

Table 16 – Pioneer Blending Facility Production Requirements

Plant Production	Capacity MGD (AF/Yr))
Keenesburg	0.534 (598)
2055 ADD	1.859 (2,082)
Pioneer (Required)	**1.325 (2,680)**

Results from Table 15 suggest that the Pioneer facility would need to produce up to 1.325 MGD to meet the communities required ADD in 2055. If using the same methodology used to size the Keenesburg header pipes, our flows would be based upon the LFH water supply, withdrawn over a 14.4-hour period per day; or in the case of Pioneer, 1.339 MGD. Since the allowable pump rate exceeds the ADD required pump rate, the allowable pump rate has been used to size the facility.

From Table 13 and 14, the pump rate for the LFH and LC gathering systems to produce 1.339 MGD is approximately 775 GPM.

Table 17 – Pioneer MDD and Pump Rate Summary

Gathering System	Pumping Rate GPM (AF/Yr)	Max Velocity (FPS)	Required Header Pipe Diameter (IN)	Header Pipe Capacity GPM (AF/Yr)
LFH	775 (750)	7.0	8”	1,096 (1,060)
LC	775 (750)	7.0	8”	1,096 (1,060)

As outlined in the gathering system section, the gathering system will not be able to produce the MDD rates with a 60% utilization period. To address the MDD demand, the facility will need to operate 21 hours per day to produce the required 1.887 MG.

Again, assuming equivalent water quality and the Sodium Hypochlorite feed rates listed in Paragraph 6.2.2 of the Town's Water Master Plan, Pioneer would feed 9.6 gallons per 0.129 MGD of potable water produced. At the ADD peak flow of 1.339 MGD, approximately 99.6 gallons of Sodium Hypochlorite would be required. If targeting one delivery per month, a 3,000-gallon tank would be required.

Given the proposed design, we anticipate the new treatment facility to cost as follows:

[20] The Town's FEI Water Master Plan derived an MDD factor of 2.5 for the Town which we have modified herein to 1.5. Because Pioneer Village will utilize a separate non-potable irrigation system for the large irrigated tracts, a more predictable maximum is anticipated and therefore we've utilized a more traditional value of 1.5.

Table 18 – Pioneer Blending Facility – Preliminary Cost Estimate

No.	Description	Quantity	Unit	Unit Cost	Total Cost
1	Site Work	1	LS	$256,000	$256,000
2	1,550 GPM Blending Facility	1	Each	$440,000	$440,000
2	Gathering System Connections	2	Each	$10,000.00	$20,000
				Total	**$716,000**

Having established that Pioneer Village will require a new 1,650 GPM blending facility at a total cost of $716,000.00, SSD will now address Pioneer Villages proposed storage system requirements.

Given the actual ADD used to size the facility was 1.339 MGD versus the required 1.325 MGD, the plant has an excess of capacity in Year 2055 of approximately 14,000 GPD. Given that the Box Elder Creek RO Plant is planned to come online in 2056, we feel as though this design is adequate to address the demands.

Section 4.3.3 – Pioneer Village Storage Infrastructure

Currently, CDPHE requires the storage of 1.0 times the ADD. Upon Pioneer's buildout, the total ADD for both entities is 2.852 MG. Based on SSD's hydraulic analysis of the system, an elevated tank constructed high enough within Pioneer to provide 35 PSI will be too high to be fed from the Keenesburg blending facility site via gravity. Therefore, to eliminate the need for a pump station, we are proposing construction of an elevated tank on a parcel of land with the Keenesburg facility to be acquired by the District. This allows water to be blended by Keenesburg and discharged directly into the tank.

This plan also provides beneficial use for the Town because they can utilize the elevated tank to increase fire flows and pressures north of I-76. Currently the Town operates and small booster station and a 0.20 MG tank for the sole purpose of providing sufficient pressure to approximately five (5) residents.

That said, if Pioneer intends to utilize the Town's system through Year 2038, a total storage volume of 1.12 MG will need to be provided. If the 0.20 MG tank is taken off-line upon construction of an elevated tank, the total storage available in the Town's system is 525,000 gallons less 60,000 gallons for fire protection. Therefore, the new elevated tank would need to provide the net difference between 1.12 MG and 0.465 MG, or 0.655 MG. As such, we propose to construct a new 0.75 MG elevated storage tank at the Keenesburg blending facility site.

Upon construction, the total collective storage volume will be 1.275 MG.

Once the Pioneer Village blending facility is constructed, a second elevated tank will be constructed on that site capable of storing 1.75 MG. Once constructed, the Town and Pioneer will have a collective storage capacity of 3.025 MG. At full buildout, the combined ADD for both entities is 2.852 MG and therefore the system will comply with CDPHE requirements.

Providing additional storage for the MDD is not advised based on the allowable pumping rates.

Having identified our plans for the Pioneer Water Storage Tank, we anticipate the costs as follows:

Table 19 – Pioneer Storage Tank – Preliminary Cost Estimate

No.	Description	Quantity	Unit	Unit Cost	Total Cost
1	0.75 MG Tank	1	LS	$1,550,000	$1,550,000
2	Acquire Tank Site	1	LS	$28,600	$28,600
3	1.75 MG Tank	1	LS	$3,500,000	$3,500,000
4	Gate / Altitude Valve	1	Each	$7,500	$7,500
5	Distribution System Connection	1	Each	$8,000	$8,000
6	Chlorination System	2	Each	$55,000	$110,000
7	Pressure Reducing Station	2	Each	$57,000	$114,000
				Total	**$7,600,600**

As shown in Table 18, the total cost of the Pioneer Village water storage infrastructure is estimated at $7,600,600.00.

Section 4.3.4 – Box Elder Augmentation

Returned flows from the initial use of water in Pioneer Village, both wastewater and groundwater resulting from irrigation, will add to the flow of Box Elder Creek. That added flow may be recovered and used through a set of wells under a proposed water court-approved plan for augmentation. The timing of adding the Box Elder source will be driven by many factors, including growth rates, peak demands, financial capacity, managing demand on other sources, and managing impacts to the surrounding community. The Box Elder source is a component that can be brought online when needed, which may occur far sooner than outlined previously in this report.

As shown throughout this report, if the growth rates and densities utilized to estimate the peak flows herein remain valid over the entire planning period, Pioneer Village will require an additional potable water source. We recommend any demands and associated design work associated with the Box Elder supply be re-evaluated at various stages moving forward. This allows the design team the opportunity to review the actual growth compared to the projections contained herein and make better forecasts on the applicability of that system at the final buildout.

For water supply purposes, the volumes are there to support the development; however, it is prudent for a community system of this size to have plans in place for a back-up source in the event of a catastrophic failure. As such, we recommend the system needs be re-evaluated as each Planning Area is permitted for construction to ensure that the growth rates are not outpacing the required system improvements to produce a sufficient supply of potable water. time to time. Once the additional flows are imperative, more formal design can be undertaken.

Section 4.3.5 – Pioneer Village Gathering, Treatment and Storage Summary

As shown in the previous sections, the Pioneer Village gathering, blending and storage facilities will consist of the following infrastructure constructed between Years 2023 and 2056 based on projected growth rates:

1. 16 Laramie-Fox Hills Municipal Wells
2. 2 Laramie-Fox Hills Municipal Wells serving as backups
3. 2 Lost Creek Municipal Wells
4. Well Gathering System consisting of 3-inch to 10-inch Piping
5. A 1,550 GPM Blending Facility
6. Two Elevated Water Storage Tanks: 1) 0.75 MG and 2) 1.75 MG
7. A potable 20” transmission main from Keenesburg to Pioneer Village
8. Intermediate or interim chlorination stations

The estimated cost of this system is $33,872,430.00.

Section 5.0 – Distribution System

With our analysis complete with respect to the overall gathering, treatment and storage infrastructure, our team will shift the discussion to the proposed distribution system that will serve Pioneer Village throughout the planning period and beyond.

Section 5.0.1 – Regional Potable Distribution Mains

As discussed in the previous sections in detail, the initial phases of Pioneer will be supplied potable water blended by Keenesburg and pumped into the Village’s 0.75 MG elevated tank located at the Keenesburg blending facility. This elevated tank will create “Pioneer Village Pressure Zone 1”.

Water from the storage tank will be conveyed to Pioneer via a new 20” PVC waterline constructed within the public right of way in County Roads 14, 55 and 22. The distribution system on-site distribution mains will be fed from the 20” north into the development.

Our original plan contemplated a connection to the Town’s existing system at the intersection of Cedar Street and County Road 18; however, hydraulic modeling determined that the existing system was too small to small Pioneer’s demand north while also serving the Town’s existing and future customers. By bypassing the Town’s system, Pioneer can deliver the domestic demand while achieving 1,500 gallons per minute of fire flow throughout the Village. This approach also benefits the Town in a couple of ways:

1. SSD contracted with FireTest Company to perform a fire hydrant flow test at the Cedar Street and County Road 18 Hydrant. Based on the flow test, the static pressure at that location was 38 PSI and the available fire flow at that point was calculated to be 823 GPM at a residual system pressure of 20 PSI. Note that the required fire flows under Appendix B of the International Fire Code is 1,000 GPM for one and two family dwellings and 1,500 GPM for all other uses.
    a. Based on this Criteria, the fire hydrant tested does not comply with current IFC requirements.
2. As discussed in prior sections, the Town currently operates a small booster station and the 0.20 MG tank north of Town to provide pressure for approximately five (5) residential customers.

To mitigate these issues, SSD proposes to construct a 16-inch interconnection from the new 20” transmission main to the Town’s existing main at County Road 18 and Cedar Street. This will provide the Town with a second pressure zone to utilize north of I-76 which will provide fire flows and adequate pressure. This solution allows the existing booster and 0.20 MG tank to be decommissioned. To create the pressure zone, a Pressure Reducing Valve will need to be installed on the existing main going south from County Road 18 into two to ensure that the new pressure isn’t excessive in the downtown area creating damage to aged infrastructure and danger to existing customers.

To size this line and validate our distribution layout, SSD has built a multiple scenario WaterCAD model capable of analyzing the distribution systems pressure, flow rates and velocities. The scenarios utilized to evaluate the system’s design include: 1) The Maximum Hourly Flow (MHF) conditions for Pioneer at buildout, 2) MHF conditions for Pioneer Phases 1-15, 3) MHF conditions plus fire flow for Pioneer at buildout, and 4) MHF conditions plus fire flow for Pioneer Phases 1-15. All these conditions were also modeled with and without the Keenesburg’s demand present in the pressure zone.

Based on our modeling, the transmission pipeline and sizes and material quantities outlined in Table 20 below will be required.

Table 20 – Pioneer New Potable Water Distribution Main Line Sizes and Lengths

Distribution Main Location	Line Diameter (in)	Length of Pipe (ft)
Blending Facility west to CR 55	24	2,564
North along CR 55 to CR 22	20	20,099
North along N. Cedar St to CR 18	10	1,563
West along CR 18 from N. Cedar St to CR 55	16	6,609

Given the Town’s current requirements for watermain sizing, our team utilized the criteria outlined in the following section to size the regional infrastructure concurrently with the on-site system.

Section 5.0.2 – On-Site Water Mains

To size the on-site watermains, SSD utilized the same WaterCAD models outlined in the previous section evaluate system performance under varying conditions. All mains were sized using South Adams County

Water and Sanitation District's (SACWSD) *Design and Construction Standards for Water and Wastewater Facilities* design criteria as a reference. Mains were sized to achieve a minimum system pressure of 40 psi and a maximum system velocity of 5 ft/s during MHF conditions. The system was also sized to achieve a minimum system pressure of 30 psi during MDF plus fire flow conditions. All calculations were completed using the Hazen-Williams method with a C Value of 130. In addition to the variable listed above, other design considerations include a minimum fire flow of 1,500 GPM while maintaining a maximum velocity of 10 FPS, a minimum distribution system line size of 8" and the requirement to provide water from at least two directions at all locations through looping.

With these constraints driving the design process, the final distribution system piping within Pioneer Village totals that shown in Table 21 below:

Table 21 – Pioneer On-site Potable Water Main Line Sizes and Lengths

Line Diameter (in)	Pipe Length Required (ft)
8	81,605
12	2,641
14	4,100
16	6,609
20	34,890
24	2,500

Section 5.0.3 - Elevated Water Storage Tank

As elaborated on previously, Pioneer will ultimately be served by two tanks, or pressure zones. Until Pioneer's blending facility is constructed, the system will be feed by the tank (hereafter "Tank 1") located at the Keenesburg blending facility creating the first pressure zone. Once the Village's blending facility is constructed along with the second water storage tank (hereafter "Tank 2"), Tank 2 will be the primary vehicle for pressurizing the system and addressing demands. A secondary connection will be provided from Tank 1 regulated by an altitude valve which will trigger Tank 1 to fill Tank 2 during high demand situations when the Pioneer Blending Facility cannot produce enough water.

As outlined in Section 5.0.1, this approach also creates opportunities for Keenesburg to improve their system hydraulics as well.

Phasing of the tanks as well as cost information has been provided previously.

Section 5.0.4 – System Hydraulics

As previously mentioned, this distribution system was sized based off a minimum system pressure of 40 psi during MHF conditions, minimum system pressure of 30 psi during MHF plus fire flow conditions, and a maximum line velocity of 5 ft/s.

Tables 22 & 23 below show the junction and pipe reports for the initial water distribution system for Pioneer. This system incorporates the 0.75 MG elevated tank at the Keenesburg blending facility and the MHF demands for Pioneer Residential Phases 1-15.

Table 22 – Junction Report for Pioneer Phases 1-15 - MHF & Fire Flow Conditions

Junction Label	Elevation (ft)	MHF Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-41	5,050.00	0	5,158.98	47
J-43	5,010.98	0	5,142.15	57
J-P13	4,931.75	94	5,121.44	82
J-P3	4,924.28	132	5,118.16	84
J-P15	4,928.65	611	5,122.75	84
J-76	4,926.36	0	5,120.82	84
J-74	4,920.39	0	5,118.47	86
J-P12	4,920.10	81	5,119.73	86
J-44	4,928.41	0	5,128.95	87
J-P10	4,917.27	113	5,117.91	87
J-P4	4,916.89	125	5,118.31	87
J-60	4,917.73	0	5,123.20	89
J-P14	4,913.87	147	5,120.99	90
J-P16	4,911.76	0	5,121.44	91
J-88	4,907.33	0	5,118.17	91
J-P11	4,906.00	56	5,117.73	92
J-P34	4,916.33	0	5,128.46	92
J-P33	4,911.43	0	5,127.91	94
J-77	4,907.01	0	5,126.71	95
J-59	4,902.96	0	5,123.50	95
J-58	4,902.09	0	5,123.98	96
J-P6	4,896.60	266	5,118.81	96
J-P31	4,904.92	0	5,127.97	96
J-P30	4,903.32	0	5,126.57	97
J-P36	4,889.75	0	5,118.18	99
J-P2	4,887.84	201	5,117.64	99
J-55	4,894.94	0	5,126.91	100
J-P5	4,885.21	125	5,118.80	101
J-P29	4,890.89	0	5,126.15	102
J-56	4,887.32	0	5,126.42	103
J-P25	4,886.59	0	5,125.77	103
J-P32	4,885.90	0	5,127.10	104
J-70	4,876.99	0	5,118.87	105
J-P26	4,879.67	0	5,126.50	107
J-57	4,877.33	0	5,125.56	107
J-P9	4,871.68	104	5,120.49	108
J-P8	4,870.42	119	5,120.11	108
J-P17	4,871.69	0	5,121.70	108
J-P24	4,875.43	0	5,125.72	108
J-P20	4,871.25	0	5,123.48	109
J-P28	4,873.39	0	5,125.88	109
J-48	4,869.27	0	5,123.67	110
J-P27	4,870.00	0	5,124.59	110
J-85	4,863.74	0	5,121.98	112
J-P31	4,861.10	0	5,122.62	113
J-80	4,860.27	0	5,121.99	113
J-P7	4,857.84	121	5,119.99	113

Junction Label	Elevation (ft)	MHF Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-79	4,861.23	0	5,123.41	113
J-P19	4,858.22	0	5,122.14	114
J-63	4,858.33	0	5,123.84	115
J-P21	4,857.49	0	5,123.64	115
J-P18	4,854.54	0	5,122.09	116
J-P23	4,856.25	0	5,124.52	116
J-P22	4,847.95	0	5,124.52	120

As shown in Table 22, all the junctions were able to maintain the minimum pressure requirement of 30 psi during MHF and fire flow conditions. During this analysis, some of the pressures (J-63, J-P18, J-P21, J-P22, J-P23) exceeded 115 psi, however, SSD does not anticipate high pressures to be an issue in this system. This model was run combining demands from MHF conditions and fire flow for an entire 24-hour cycle; these demands far exceed the actual daily demands of the community. Therefore, SSD anticipates pressures no greater than that recorded in Table 22. Additionally, the junctions that are experiencing these higher pressures in this initial model are not serving any residential demands during Phases 1-15. If pressure becomes a concern later, then pressure reducing valves will be added to mitigate those concerns.

Table 23 – Pipe Report for Pioneer Phases 1-15 - MHF & Fire Flow Conditions

Pipe label	Pipe Diameter (in)	Velocity (ft/s)	Length (ft)	Hazen-Williams C	Headloss (Friction) (ft)	Headloss Gradient (ft/ft)
P-80	8	0	1,487	130	0	0
P-39	8	0.01	690	130	0	0
P-97	8	0.08	740	130	0	0
P-84	8	0.14	742	130	0.01	0
P-66(1)	8	0.15	590	130	0.01	0
P-66(2)	8	0.15	586	130	0.01	0
P-103(1)	8	0.16	1,175	130	0.02	0
P-53	8	0.21	1,507	130	0.05	0
P-79	8	0.28	1,158	130	0.06	0
P-96	8	0.28	1,177	130	0.07	0
P-103(2)	8	0.3	1,449	130	0.09	0
P-49	8	0.32	2,612	130	0.19	0
P-86	8	0.38	464	130	0.05	0
P-52	8	0.38	1,115	130	0.11	0
P-90	8	0.38	1,179	130	0.12	0
P-29	16	0.4	6,609	130	0.32	0
P-38	8	0.46	1,829	130	0.26	0
P-59(2)	12	0.47	1,536	130	0.14	0
P-55	8	0.47	1,364	130	0.2	0
P-81	8	0.54	1,384	130	0.26	0
P-68	8	0.55	808	130	0.16	0
P-51(1)	8	0.55	1,359	130	0.27	0
P-51(2)	8	0.55	1,353	130	0.27	0
P-85	8	0.57	713	130	0.15	0
P-67	8	0.57	743	130	0.16	0
P-58	8	0.62	1,491	130	0.36	0
P-99(2)	8	0.63	715	130	0.18	0

Pipe label	Pipe Diameter (in)	Velocity (ft/s)	Length (ft)	Hazen-Williams C	Headloss (Friction) (ft)	Headloss Gradient (ft/ft)
P-36(1)	8	0.63	714	130	0.18	0
P-104	8	0.65	685	130	0.18	0
P-57	8	0.66	1,245	130	0.34	0
P-95	8	0.82	1,209	130	0.49	0
P-105	8	0.82	1,261	130	0.52	0
P-102	8	0.82	1,255	130	0.52	0
P-89	8	0.93	739	130	0.38	0.001
P-78	8	0.94	1,230	130	0.64	0.001
P-82	8	0.95	2,375	130	1.27	0.001
P-59(1)	12	0.97	1,105	130	0.38	0
P-65	8	0.98	1,220	130	0.69	0.001
P-98	8	1.04	1,455	130	0.93	0.001
P-71	8	1.05	966	130	0.63	0.001
P-60	8	1.06	1,298	130	0.85	0.001
P-54	8	1.09	2,494	130	1.72	0.001
P-87	8	1.09	2,606	130	1.80	0.001
P-72	8	1.12	1,294	130	0.94	0.001
P-37	8	1.12	1,252	130	0.92	0.001
P-56	8	1.13	1,374	130	1.02	0.001
P-48	20	1.14	1,747	130	0.45	0
P-75	8	1.15	1,851	130	1.42	0.001
P-35	8	1.17	1,163	130	0.92	0.001
P-32(2)	14	1.23	1,923	130	0.87	0
P-32(1)(1)	14	1.23	1,086	130	0.49	0
P-32(1)(2)	14	1.23	1,091	130	0.49	0
P-36(2)	8	1.25	975	130	0.87	0.001
P-83	8	1.26	706	130	0.64	0.001
P-64	8	1.26	1,236	130	1.12	0.001
P-61	8	1.27	1,307	130	1.20	0.001
P-62	8	1.27	2,635	130	2.43	0.001
P-33(1)	8	1.28	648	130	0.6	0.001
P-33(2)	8	1.28	660	130	0.61	0.001
P-73	8	1.29	1,323	130	1.25	0.001
P-91	8	1.33	1,747	130	1.75	0.001
P-47	20	1.35	859	130	0.30	0
P-77	8	1.37	1,238	130	1.31	0.001
P-101	8	1.37	525	130	0.56	0.001
P-93	8	1.40	1,341	130	1.48	0.001
P-34	8	1.45	1,108	130	1.30	0.001
P-46	20	1.53	1,079	130	0.48	0
P-94	8	1.56	1,254	130	1.69	0.001
P-74	8	1.56	829	130	1.12	0.001
P-99(1)	8	1.57	1,292	130	1.75	0.001
P-76	8	1.58	1,365	130	1.88	0.001
P-45	20	1.63	3,150	130	1.58	0.001
P-63	8	1.65	1,403	130	2.10	0.001
P-40	8	1.66	863	130	1.30	0.002
P-70	8	1.68	698	130	1.08	0

Pipe label	Pipe Diameter (in)	Velocity (ft/s)	Length (ft)	Hazen-Williams C	Headloss (Friction) (ft)	Headloss Gradient (ft/ft)
P-31	24	1.70	2,251	130	0.99	0
P-88	8	1.75	724	130	1.21	0
P-92	8	1.80	975	130	1.71	0
P-44	20	1.81	1,410	130	0.85	0
P-42(1)	20	1.85	1,651	130	1.04	0
P-42(2)	20	1.85	1,588	130	1.00	0
P-43	20	1.90	743	130	0.49	0
P-69	8	1.92	637	130	1.26	0
P-111	20	2.96	10,537	150	12.21	0
P-27	20	3.22	2,564	130	4.52	0
P-28(1)	20	3.22	9,562	130	16.84	0

As shown in Table 23 above, all the pipes within this system model were able to maintain a velocity below the maximum of 5 ft/s. There was no minimum velocity targeted in this design because it is a potable water system, and solids are not a concern.

Table 24 is the fire flow report generated for this first model of Pioneer Phases 1-15, fed exclusively off the 0.75 MG elevated tank at the Keenesburg blending facility.

Table 24 – Fire Flow Report for Pioneer Phases 1-15

Junction/Hydrant	Fire Flow Iterations	Fire Flow (Needed) (gpm)	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)
H-1	4	1,500	2,662	20
H-3	7	1,500	3,939	22
H-4	4	1,500	2,841	20
J-41	3	1,500	6,644	33
J-43	8	1,500	3,939	24
J-44	10	1,500	3,939	32
J-48	8	1,500	3,690	31
J-55	18	1,500	3,939	40
J-56	17	1,500	3,939	42
J-57	15	1,500	3,897	45
J-58	14	1,500	3,729	33
J-59	14	1,500	3,675	33
J-60	8	1,500	3,635	26
J-63	8	1,500	3,744	29
J-70	8	1,500	3,069	31
J-74	4	1,500	2,793	22
J-76	5	1,500	3,088	20
J-77	9	1,500	3,939	23
J-79	14	1,500	3,598	39
J-80	15	1,500	3,450	42
J-85	7	1,500	3,477	38
J-88	5	1,500	2,749	20
J-P2	4	1,500	2,858	20
J-P3	5	1,500	2,769	20

Junction/Hydrant	Fire Flow Iterations	Fire Flow (Needed) (gpm)	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)
J-P4	5	1,500	2,876	20
J-P5	8	1,500	3,065	34
J-P6	8	1,500	3,132	28
J-P7	8	1,500	3,259	37
J-P8	14	1,500	3,267	39
J-P9	14	1,500	3,343	40
J-P10	3	1,500	2,072	36
J-P11	4	1,500	2,493	20
J-P12	5	1,500	3,211	20
J-P13	5	1,500	3,120	20
J-P14	4	1,500	2,909	22
J-P15	7	1,500	3,575	21
J-P16	7	1,500	3,379	23
J-P17	14	1,500	3,521	37
J-P18	4	1,500	3,440	38
J-P19	14	1,500	3,462	38
J-P20	8	1,500	3,684	30
J-P21	7	1,500	3,714	35
J-P22	8	1,500	3,717	33
J-P23	14	1,500	3,707	42
J-P24	7	1,500	3,846	22
J-P25	8	1,500	3,864	27
J-P26	4	1,500	2,843	54
J-P27	8	1,500	3,765	30
J-P28	10	1,500	3,912	34
J-P29	4	1,500	2,969	36
J-P30	5	1,500	3,735	20
J-P31	14	1,500	3,596	42
J-P31	10	1,500	3,939	33
J-P32	16	1,500	3,939	38
J-P33	16	1,500	3,939	36
J-P34	10	1,500	3,939	31
J-P36	7	1,500	2,890	25

As shown in Table 24, all the hydrants and junctions within the model were able to exceed the required fire flow of 1,500 GPM during MHF conditions.

Table 22 - 24 describe the ‘day-one’ system incorporating the 0.75 MG elevated tank feeding Pioneer Phases 1-15.

Additional modeling was completed for the expanded system incorporating the 1.725 MG elevated tank (intersection of CRs 55 and 22) as well as the 0.75 MG tank feeding Pioneer at buildout and the town of Keenesburg. The junction report, pipe report, and fire flow reports are shown below in Tables 25, 26, and 27, respectively.

Table 25 – Junction Report for Pioneer at buildout – MHF & Fire Flow Conditions

Junction Label	Elevation (ft)	MHF Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-P13	4,931.75	94	5,032.58	44
J-P3	4,924.28	132	5,026.04	44
J-76	4,926.36	0	5,031.90	46
J-74	4,920.39	0	5,026.95	46
J-P15	4,928.65	111	5,037.50	47
J-P10	4,917.27	113	5,026.20	47
J-P12	4,920.10	81	5,029.20	47
J-P4	4,916.89	125	5,026.45	47
J-41	5,050.00	0	5,163.46	49
J-88	4,907.33	0	5,026.01	51
J-P14	4,913.87	147	5,033.00	52
J-P16	4,911.76	194	5,031.48	52
J-P11	4,906.00	56	5,025.88	52
J-60	4,917.73	0	5,037.90	52
J-44	4,928.41	0	5,052.70	54
J-77	4,907.01	0	5,035.11	55
J-P30	4,903.32	959	5,031.44	55
J-P6	4,896.60	266	5,026.84	56
J-P34	4,916.33	291	5,048.10	57
J-59	4,902.96	0	5,038.27	59
J-P36	4,889.75	82	5,025.98	59
J-58	4,902.09	0	5,038.99	59
J-P33	4,911.43	185	5,048.81	59
J-P2	4,887.84	201	5,025.62	60
J-P31	4,904.92	99	5,044.66	60
J-P5	4,885.21	125	5,026.63	61
J-P25	4,886.59	56	5,033.11	63
J-P29	4,890.89	77	5,038.72	64
J-70	4,876.99	0	5,026.62	65
J-55	4,894.94	0	5,045.40	65
J-43	5,010.98	0	5,163.30	66
J-P32	4,885.90	256	5,039.23	66
J-P24	4,875.43	61	5,031.44	67
J-P9	4,871.68	104	5,028.20	68
J-56	4,887.32	0	5,044.08	68
J-P26	4,879.67	84	5,036.71	68
J-P8	4,870.42	119	5,027.48	68
J-P17	4,871.69	242	5,030.29	69
J-P20	4,871.25	94	5,031.07	69
J-P27	4,870.00	106	5,031.59	70
J-P28	4,873.39	50	5,035.00	70
J-48	4,869.27	0	5,031.05	70
J-57	4,877.33	0	5,042.17	71
J-85	4,863.74	0	5,028.99	71
J-80	4,860.27	0	5,028.59	73
J-79	4,861.23	0	5,030.16	73
J-P7	4,857.84	121	5,027.17	73

Junction Label	Elevation (ft)	MHF Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-P31	4,861.10	99	5,030.43	73
J-P19	4,858.22	207	5,028.18	74
J-P18	4,854.54	191	5,027.96	75
J-P23	4,856.25	71	5,031.05	76
J-63	4,858.33	0	5,033.72	76
J-P21	4,857.49	288	5,033.24	76
J-P22	4,847.95	76	5,030.56	79

Comparing Table 25 and Table 22, the high pressures reported for Phases 1-15 fed by the 0.75 MG tank have been mitigated by this expanded system incorporating the demands at build out and the secondary elevated storage tank.

Table 26 – Pipe Report for Pioneer at Buildout – MHF & Fire Flow Conditions

Pipe label	Pipe Diameter (in)	Velocity (ft/s)	Length (ft)	Hazen-Williams C	Headloss (Friction) (ft)	Headloss Gradient (ft/ft)
P-111	20	0	10,537	150	0	0
P-103(1)	8	0.02	1,175	130	0	0
P-60	8	0.06	1,298	130	0	0
P-96	8	0.08	1,177	130	0.01	0
P-36(1)	8	0.17	714	130	0.02	0
P-27	20	0.26	2,564	130	0.04	0
P-28(1)	20	0.26	9,562	130	0.15	0
P-66(1)	8	0.27	590	130	0.03	0
P-66(2)	8	0.27	586	130	0.03	0
P-29	16	0.40	6,609	130	0.32	0
P-37	8	0.42	1,252	130	0.15	0
P-103(2)	8	0.53	1,449	130	0.26	0
P-90	8	0.65	1,179	130	0.31	0
P-102	8	0.68	1,255	130	0.36	0
P-97	8	0.68	740	130	0.22	0
P-95	8	0.73	1,209	130	0.4	0
P-80	8	0.73	1,487	130	0.49	0
P-105	8	0.74	1,261	130	0.42	0
P-55	8	0.76	1,364	130	0.48	0
P-64	8	0.86	1,236	130	0.55	0
P-86	8	0.88	464	130	0.21	0
P-79	8	0.88	1,158	130	0.54	0
P-35	8	0.88	1,163	130	0.54	0
P-104	8	0.88	685	130	0.32	0
P-78	8	0.89	1,230	130	0.58	0
P-65	8	0.94	1,220	130	0.64	0.001
P-84	8	0.96	742	130	0.4	0.001
P-67	8	0.96	743	130	0.4	0.001
P-63	8	0.98	1,403	130	0.79	0.001
P-85	8	0.99	713	130	0.41	0.001
P-93	8	1.00	1,341	130	0.79	0.001
P-68	8	1.02	808	130	0.5	0.001
P-81	8	1.05	1,384	130	0.89	0.001

Pipe label	Pipe Diameter (in)	Velocity (ft/s)	Length (ft)	Hazen-Williams C	Headloss (Friction) (ft)	Headloss Gradient (ft/ft)
P-36(2)	8	1.05	975	130	0.63	0.001
P-38	8	1.05	1,829	130	1.19	0.001
P-61	8	1.07	1,307	130	0.88	0.001
P-48	20	1.08	1,747	130	0.40	0
P-77	8	1.09	1,238	130	0.85	0.001
P-71	8	1.09	966	130	0.67	0.001
P-76	8	1.19	1,365	130	1.11	0.001
P-82	8	1.21	2,375	130	1.99	0.001
P-75	8	1.22	1,851	130	1.58	0.001
P-89	8	1.31	739	130	0.72	0.001
P-62	8	1.32	2,635	130	2.60	0.001
P-74	8	1.38	829	130	0.89	0.001
P-94	8	1.39	1,254	130	1.36	0.001
P-53	8	1.41	1,507	130	1.67	0.001
P-47	20	1.51	859	130	0.37	0
P-101	8	1.60	525	130	0.74	0.001
P-99(2)	8	1.67	715	130	1.09	0.002
P-72	8	1.68	1,294	130	2.00	0.002
P-73	8	1.69	1,323	130	2.06	0.002
P-39	8	1.71	690	130	1.10	0.002
P-98	8	1.72	1,455	130	2.35	0.002
P-52	8	1.77	1,115	130	1.89	0.002
P-58	8	1.81	1,491	130	2.65	0.002
P-46	20	1.89	1,079	130	0.71	0.001
P-56	8	1.95	1,374	130	2.80	0.002
P-83	8	1.96	706	130	1.44	0.002
P-92	8	2.10	975	130	2.28	0.002
P-49	8	2.12	2,612	130	6.17	0.002
P-33(2)	8	2.23	660	130	1.72	0.003
P-51(2)	8	2.30	1,353	130	3.72	0.003
P-88	8	2.36	724	130	2.09	0.003
P-45	20	2.38	3,150	130	3.18	0.001
P-87	8	2.43	2,606	130	7.99	0.003
P-34	8	2.44	1,108	130	3.41	0.003
P-54	8	2.57	2,494	130	8.45	0.003
P-99(1)	8	2.61	1,292	130	4.50	0.003
P-69	8	2.63	637	130	2.25	0.004
P-91	8	2.69	1,747	130	6.43	0.004
P-59(2)	12	2.75	1,536	130	3.67	0.002
P-70	8	2.77	698	130	2.71	0.004
P-33(1)	8	2.77	648	130	2.52	0.004
P-51(1)	8	2.79	1,359	130	5.36	0.004
P-44	20	2.79	1,410	130	1.91	0.001
P-57	8	3.04	1,245	130	5.75	0.005
P-43	20	3.24	743	130	1.33	0.002
P-32(2)	14	3.31	1,923	130	5.43	0.003
P-40	8	3.40	863	130	4.92	0.006
P-59(1)	12	3.49	1,105	130	4.12	0.004

Pipe label	Pipe Diameter (in)	Velocity (ft/s)	Length (ft)	Hazen-Williams C	Headloss (Friction) (ft)	Headloss Gradient (ft/ft)
P-32(1)(2)	14	3.52	1,091	130	3.44	0.003
P-42(2)	20	3.58	1,588	130	3.41	0.002
P-42(1)	20	3.77	1,651	130	3.90	0.002
P-31	24	4.02	2,251	130	4.84	0.002
P-32(1)(1)	14	4.13	1,086	130	4.60	0.004
P-112	24	4.37	234	150	0.45	0.002

As with the Phase 1-15 model, all the pipes still fall below the maximum velocity requirement of 5 ft/s with this expanded system.

Table 27 – Fire Flow Report for Pioneer at Buildout

Junction/Hydrant	Fire Flow Iterations	Fire Flow (Needed) (gpm)	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)
H-1	2	1,500	3,974	20
H-3	2	1,500	10,000	42
H-4	7	1,500	2,171	28
J-41	2	1,500	10,000	32
J-43	6	1,500	6,837	24
J-44	3	1,500	10,000	41
J-48	14	1,500	3,781	30
J-55	16	1,500	7,333	40
J-56	8	1,500	6,639	43
J-57	10	1,500	5,727	46
J-58	10	1,500	4,664	34
J-59	10	1,500	4,424	33
J-60	15	1,500	4,276	27
J-63	8	1,500	4,143	25
J-70	15	1,500	2,455	34
J-74	4	1,500	2,226	20
J-76	5	1,500	2,697	20
J-77	5	1,500	4,445	20
J-79	9	1,500	3,512	39
J-80	9	1,500	3,128	43
J-85	9	1,500	3,212	40
J-88	6	1,500	2,118	21
J-P2	7	1,500	2,172	26
J-P3	4	1,500	2,046	20
J-P4	4	1,500	2,279	20
J-P5	16	1,500	2,444	35
J-P6	14	1,500	2,560	30
J-P7	16	1,500	2,779	39
J-P8	9	1,500	2,784	40
J-P9	9	1,500	2,947	40
J-P10	4	1,500	1,858	20
J-P11	4	1,500	1,907	20
J-P12	7	1,500	2,770	21
J-P13	5	1,500	2,747	20
J-P14	4	1,500	2,650	20

Junction/Hydrant	Fire Flow Iterations	Fire Flow (Needed) (gpm)	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)
J-P15	7	1,500	4,079	21
J-P16	8	1,500	3,310	22
J-P17	9	1,500	3,383	38
J-P18	15	1,500	3,185	37
J-P19	16	1,500	3,180	38
J-P20	14	1,500	3,791	29
J-P21	8	1,500	4,091	30
J-P22	8	1,500	3,882	28
J-P23	9	1,500	3,852	40
J-P24	5	1,500	3,931	20
J-P25	7	1,500	4,481	22
J-P26	5	1,500	4,414	20
J-P27	8	1,500	4,052	26
J-P28	15	1,500	4,695	29
J-P29	4	1,500	3,426	20
J-P30	4	1,500	3,360	20
J-P31	9	1,500	3,558	42
J-P31	8	1,500	7,047	23
J-P32	11	1,500	5,755	31
J-P33	6	1,500	9,463	34
J-P34	7	1,500	8,670	20
J-P36	7	1,500	2,197	28

From Table 27, all the hydrants and junctions still meet the minimum fire flow requirements of 1500 GPM with this expanded system.

Section 5.0.5 – Hydraulic Models & System Layout

A schematic of the distribution system layout for Phases 1-15 is shown in the appendices.

A schematic of the expanded system as well as Keenesburg's distribution system can also be found in the appendices.

Section 6.0 – Water Quality

As with any community such as Keenesburg which has a localized demand that transitions into more rural customers, water quality will be a concern. This will also be the case for Pioneer Village. Being that Keenesburg will produce water and convey it to the Village via a transmission main, there will be long runs of pipe in the initial phase(s) with very little demand. We estimate a total of 35,000 linear feet of pipeline will be required between the Village's water storage tank at the Keenesburg blending station and Pioneer's Phase I in the northwest corner of Section 7. Assuming approximately 2,250 linear feet of 24-inch and 34,890 linear feet of 20-inch would net approximately 585,500 gallons of potable water stored within the main(s). To achieve our maximum recommended turnover of 48-hours, the residents along County Road 55 and Pioneer Village would need to achieve an ADD of 292,750 gallons. Both on the projected growth rate, Pioneer Village will not reach that use until Phase 6 is constructed. Given the minimal use in the initial phases, we do recommend a minimal amount of flushing. Our team plans to utilize any water flushed from the potable system to flush the sanitary sewer interceptor until sufficient units are constructed to achieve the required 2 FPS required to self-clean.

To address the water quality issue, our team plans to construct a secondary chlorine monitoring and injection system within the Village to ensure that lower limit of 0.2 mg/L of residual chlorine is maintained systemwide immediately prior to consumption. The system that SSD has opted to install is the Accu-Tab

Power Pro Chlorination unit. The unit will be installed in a 8'x8' prefabricated metal building manufactured by Shelter Works. Product information has been included in the appendices contained herein.

Section 7.0 – Phasing of Expenditures

The cost of improvements required as Pioneer Village and the Town of Keenesburg's growth occurs over the planning period are summarized throughout. In this section, our team will attempt to quantify the specific timing of the expenditures required to develop each system. Our phasing is based upon the ADD growth curve computed for each community and therefore the phasing of improvements should be continually reassessed to compare the actual growth rates to those projected and adjustments made accordingly.

Table 28 – Phasing of Expenditures

Year[21]	Improvement	Cost
2023	In the initial phases of Pioneer Village, the largest capital investment expense will occur. Pioneer Village will need to construct a 0.75 MG water storage tank at the Keenesburg blending facility, the new potable distribution main from the tank to the point of connection in Phase I, upgrade the Keenesburg Blending Facility header pipes and install a secondary chlorination system.	$8,467,930
2031	In 2031, the combined ADD reaches 0.768 MGD (860 AF) or 97% of the Keenesburg system's capacity therefore an additional LFH well is required. With an additional 50 GPM, the production will increase to 0.881 MGD (987 AF). Keenesburg will also need to construct additional storage 0.25 MGD to meet the 2031 ADD.	$544,000
2034	In 2034, the ADD will grow to 0.884 MGD (990 AF) exceeding the capacity developed in 2031. As such, an additional LFH well will be required to increase production to 560 GPM (during 14.4-hour production). The capacity by this additional well will boost total daily production to 0.967 MGD (1,083 AF) which will meet the ADD through 2036.	$544,000
2036	ADD will grow to 0.989 MGD in 2036 facilitating construction of the 8th LFH well to increase production rates to 610 GPM or 1.054 MGD (1,181 AF).	$544,000
2038	Keenesburg will drill the final LFH Well to meet the full buildout production rate of 660 GPM (650 used throughout). The Keenesburg system will also max out its LFH supply and therefore the Pioneer Village gathering and blending system will need to come online. The Village will construct a new 1,550 GPM Blending Facility, drill seven (7) new LFH wells, construct a gathering system and a new 1.75 MG elevated water storage Tank.	$10,265,500
2045	The second Phase of the Pioneer Expansion will occur in 2045 and will target an ADD of 0.825 MGD (924 AF) of capacity to meet a demand of 0.735 MGD (823 AF). The plant and tank will be initially constructed to meet the full buildout so this phased expansion will include four (4) new LFH production wells and the second LFH backup well and associated piping. Adjustments to the telemetry system will also be required in order to feed more Lost Creek water from the 18-inch line. The expansion will serve Pioneer through 2051.	$1,723,000
2051	In 2051, Pioneer will complete the Phase 3 expansion and bring the system up to the full 1.339 MGD (750 AF) production capacity allowed by its LFH supply. To complete the building, Pioneer will construct the final six (6) LFH production wells. Pioneer Village will also reach its appropriation of Lost Creek permissible with permitted Wells 1 through 11 and will need to drill and connect Wells 16 and 17. It is also assumed that the Town of Keenesburg will transition some demands over to the elevated tank at their blending	$2,060,000

[21] The Years shown are the years the improvements will need to be online and therefore actual costs will be incurred in the prior year.

	facility and therefore a second PRV would be needed south of Town to mitigate excessive pressures.	
	Continued on Next Page	
Year	**Improvement**	**Cost**
2056	In 2055, the Pioneer Village blending facility will meet it max capacity based upon its LFH appropriation. To meet future demands, the Village has the option to 1) construct a Reverse Osmosis Plant and produce potable water using Box Elder Creek water or 2) acquire more LFH rights. Given the timeline and the aggressive growth rates for both communities from 2023 through 2056, our team recommends the RO alternative be implemented in order to provide a backup water source to the existing system and also allow transition of the raw water dependence away from the non-renewable groundwater supplies.	$12,000,000
	Total Estimate of Regional Improvements	**$36,148,430**

Section 8.0 – Conclusions

As our design proposal demonstrates throughout this Report, development of the infrastructure by both the Town of Keenesburg and Pioneer Village to accommodate their full supplies of Laramie-Fox Hills groundwater will generate sufficient potable water to support the projected growth of both communities through Year 2055. In Year 2056, an additional supply in the form of Box Elder alluvial groundwater treated via Reverse Osmosis will come online to address future development in Pioneer Village and also transition some of Pioneer’s demand off of the Keenesburg System as the Town experiences growth.

To quantify the potable water production in terms of development capacity, the following table summarizes Pioneer in terms of Phases with the number of units or acres *(dependent upon land use)* and the Town of Keenesburg in terms of new water service taps superimposed on the infrastructure capacity expansions:

Table 29 – Pioneer Village Development by Phased Water System Expansion(s)

Expansion	Year	Description	PV Development Phases	PV Total Units
1	2023	Potable 24”/20” Transmission Main, 0.75 MG elevated Tank, KB Blending Station Header Replacement	Phase 1 – 125 Units Phase 2 – 242 Units Phase 3 – 159 Units Phase 4 – 150 Units Phase 5 – 151 Units Phase 6 – 321 Units Phase 7 – 146 Units Phase 8 – 143 Units Phase 9 – 125 Units	1,562 Residential Units
3	2031	Drill 6th LFH Well and construct 0.25 MG of additional Storage	Phase 10 – 136 Units Phase 11 – 17.08 Acres of Commercial	136 Residential Units and 17.08 Acres of Commercial
4	2034	Drill 7th LFH well	Phase 12 – 98 Units Phase 13 – 113 Units	211 Residential Units
5	2036	Drill 8th LFH well and construct remaining 0.25 MG of additional Storage	Phase 14 – 44.94 Acres of Commercial Phase 15 – 34.02 Acres of Commercial	78.96 Acres of Commercial
6	2038	Drill 9th LFH Well, build Pioneer Blending Facility, Construct 1.75	Phase 16 – 234 Units Phase 17 – 292 Units Phase 18 – 230 Units	1,556 Residential Units

		MG Water Storage Tank	Phase 19 – 249 Units Phase 20 – 113 Units Phase 21 – 347 Units Phase 22 – 91 Units	
Expansion	**Year**	**Description**	**PV Development Phases**	**PV Total Units**
8	2045	Drill 4 new LFH Wells	Phase 23 – 86 Units Phase 24 – 74 Units Phase 25 – 67 Units Phase 26 – 25.85 Acres of Commercial Phase 27 – 128 Units Phase 28 – 60 Units Phase 29 – 93 Units	508 Residential Units and 25.85 Acres of Commercial
9	2051	Construct final 6 LFH Wells	Phase 30 – 1,156 Phase 31 – 30.33 Acres of Institutional Phase 32 – 272 Phase 33 – 223	1,651 Residential Units and 30.33 Acres of Institutional
10	2056	Develop Box Elder Source	Phase 35 – 88.65 Acres of Industrial Phase 36 – 25.06 Acres of Industrial Phase 37 –9.74 Acres of Commercial Phase 38 – 59.86 Acres of Industrial	173.57 Acres of Industrial and 9.74 Acres of Commercial

Table 30 summarizes the unit and commercial growth rates allowable by the phased expansion of the water system. Table 22 will similarly demonstrate the Keenesburg growth by Phase. It is important to understand that we've estimated the Town's growth based on residential taps or ERU's since no information was available to trend commercial growth versus residential. As such, we've estimated taps based on 0.3 AF/Year (365 days x 3.5 Person/Unit x 76 Gal/Person/Day).

Table 30 – Town of Keenesburg ERU Growth vs Phased Water System Expansion(s)

Expansion	Year	Description	Keenesburg Capacity Growth (Phase over Phase)	Additional ERU's Available to Town beyond Pioneer resulting from Expansion
1, Pioneer Only	2023	Potable 24"/20" Waterline, Blending Facility Header Replacement, new 0.75 MG WST	Growth Rate in 2023 assumes Town has 881 Taps for 2,370 persons per Town Water Master Plan, Section 4.2.3	Tap growth assumed per Town's Water Master Plan
1.a	2023 to 2031	Town's ADD addressed by Current Operational Capacity	ADD Growth from 242.0k in 2023 to 301.8k in 2031	225 ERU's
2	2031 to 2034	Drill 6th LFH Well and construct 0.25 MG of additional Storage	ADD Growth from 301.8k in 2026 to 327.9k in 2034	98 ERU's

3	2034 to 2036	Drill 7th LFH well	ADD Growth from 327.9k in 2034 to 346.5k in 2036	70 ERU's
Expansion	**Year**	**Description**	**Keenesburg Capacity Growth (Phase over Phase)**	**Additional ERU's Available to Town beyond Pioneer resulting from Expansion**
4	2036 to 2038	Drill 8th LFH well and construct remaining 0.25 MG of additional Storage	ADD Growth from 346.5k in 2036 to 366.2k in 2038	74 ERU's
5	2038 to 2039	Drill 9th LFH Well	ADD Growth from 366.2k in 2038 to 376.4k in 2039	39 ERU's
6	2039 to 2045	Build Pioneer Blending Facility, Drill 6 LFH Wells, Construct 1.5 MG Storage	ADD Growth from 376.4k to 444.3k in 2045	255 ERU's
7	2045 to 2051	Drill 4 new LFH Wells	ADD Growth from 444.3k in 2045 to 524.3k in 2051	301 ERU's
8	2051 to 2056	Construct final 6 LFH Wells and 2 LC Wells	ADD Growth from 524.3k in 2045 to 602.0k in 2056	292 ERU's
9	2056 to 2060	Develop Box Elder Source	ADD Growth from 602.0k in 2056 to 672.3k in 2060	264 ERU's

As shown in Table 30, over the course of Pioneer's Development, the Town of Keenesburg system will accommodate an ADD growth of 242,000 GPD to 672,296 GPD in 2060, netting the Town of Keenesburg an additional 1,618 ERU's equating to 1,618 residential properties. Equated to population growth, the capacity upgrade would serve 5,663 persons, an increase of 238% over the 2,370 individuals projected in Year 2023 in Section 4.2.3 of the Town's Water Master Plan.

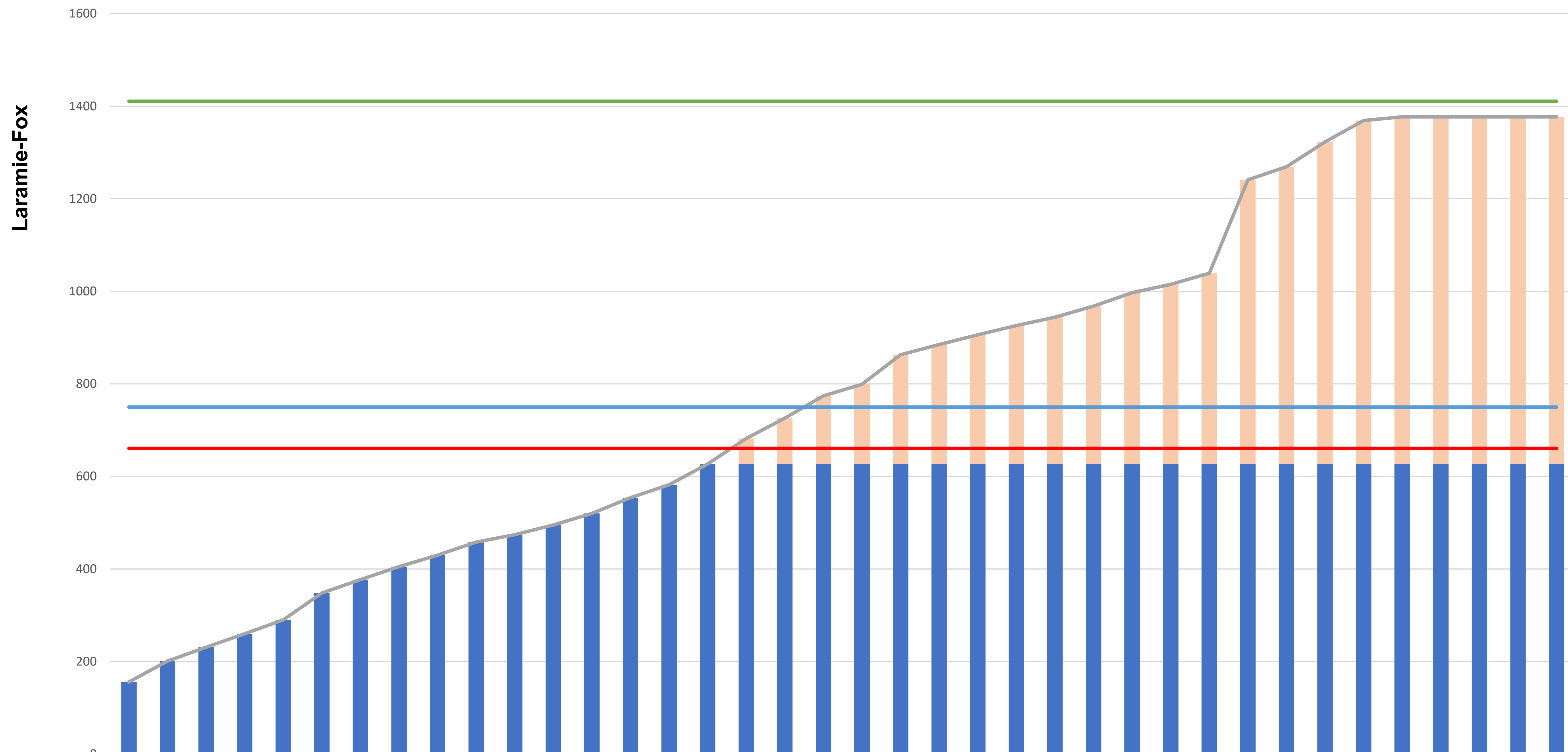
As shown in the Tables on the previous two pages, our team feels confident that this Plan; and the infrastructure proposed within it, is sufficient to address the projected growth rates for both the Town of Keenesburg and Pioneer Village. Not only will this solution benefit Pioneer tremendously, but also the Town of Keenesburg by providing infrastructure to maximize their water supplies while providing a dramatic increase in revenue growth for systemwide operation, maintenance, and any planned expansions in the future.

As shown in the Tables on the following Sheet, the Town of Keenesburg and Pioneer Village collectively have sufficient supplies of Laramie-Fox Hills, Lost Creek and Box Elder water to address the demands over the 38-year planning period. We have also summarized the phased "sharing" or "acquisition/conveyance" of appropriations in Tables 31 and 32 on Pages 53 and 54.

Pioneer also has been designed with sufficient water sources in the Project's water portfolio to address a potential disaster. Should a significant drop in yield occur within either the Lost Creek or Laramie-Fox Hills aquifers; or a disaster were to occur such as contamination, the Village (and Keenesburg if our approach is utilized) would have access to Box Elder Creek and Arapahoe basin flows. Reverse Osmosis treatment will be required on either back up source; however, the design and implementation of such a system is not un-achievable. Therefore, our team feels as though the proposed design has sufficient redundancy to mitigate any future impacts should such a situation occur.

Our analysis of the potable distribution system also suggests that the proposed distribution system improvements are sufficient to meet the required demands while factoring in constraints present in good engineering design.

Chart L ~ Laramie-Fox Hills Appropriation vs Utilization Summary

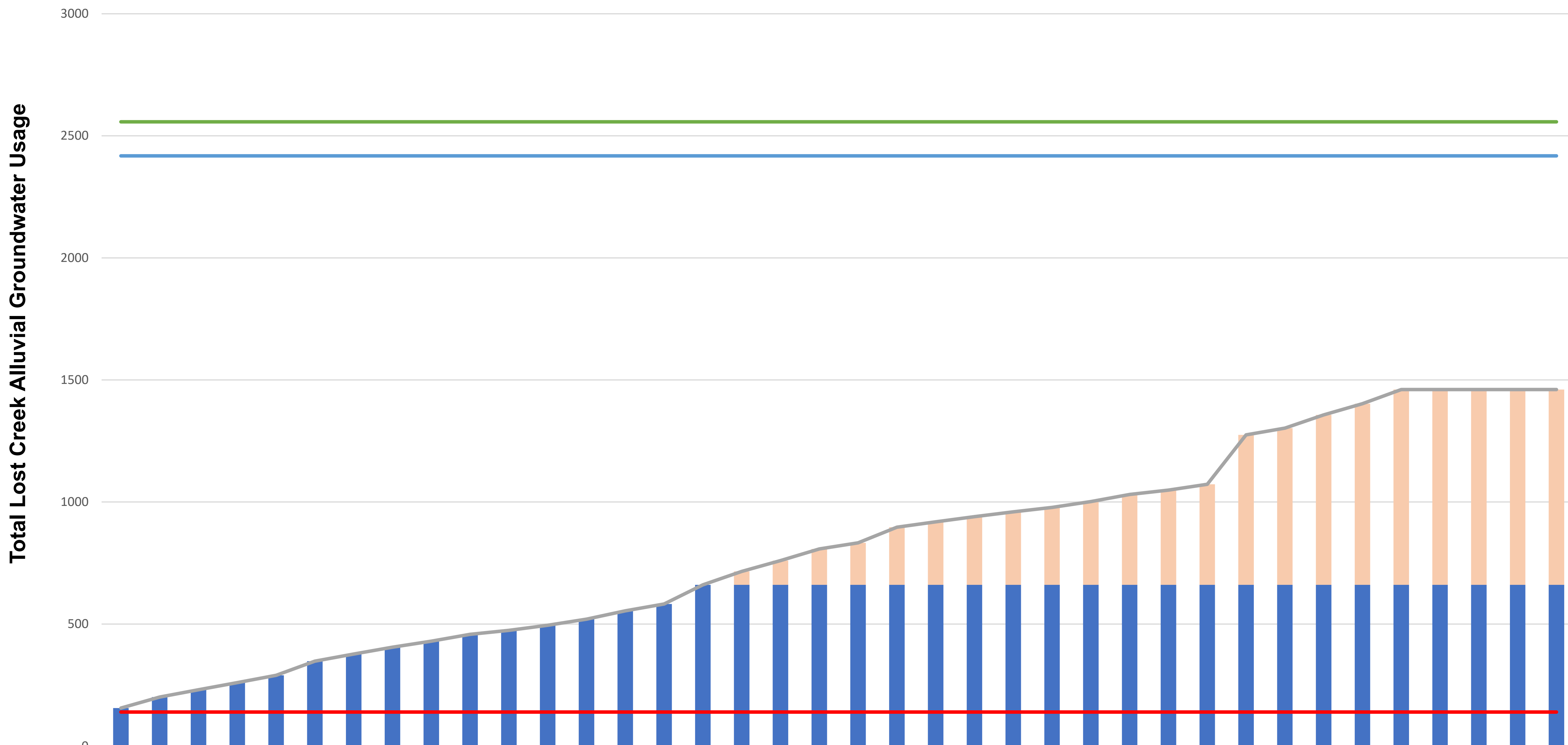


	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Pioneer LFH Utilitization																	55	99	147
Keenesburg LFH Utilization	156	201	231	260	290	348	377	405	430	458	474	495	520	554	582	627	627	627	627
Total LFH Utilization	156	201	231	260	290	348	377	405	430	458	474	495	520	554	582	627	682	726	774
Keenesburg Appropriation	660.7	660.7	660.7	660.7	660.7	660.7	660.7	660.7	660.7	660.7	660.7	660.7	660.7	660.7	660.7	660.7	660.7	660.7	660.7
Pioneer Appropriation	750	750	750	750	750	750	750	750	750	750	750	750	750	750	750	750	750	750	750
Total Appropriation	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411

	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060
Pioneer LFH Utilitization	172	236	258	279	299	317	341	370	388	412	614	642	696	742	750	750	750	750	750
Keenesburg LFH Utilization	627	627	627	627	627	627	627	627	627	627	627	627	627	627	627	627	627	627	627
Total LFH Utilization	799	863	885	906	926	944	968	997	1015	1039	1241	1269	1323	1369	1377	1377	1377	1377	1377
Keenesburg Appropriation	660.7	660.7	660.7	660.7	660.7	660.7	660.7	660.7	660.7	660.7	660.7	660.7	660.7	660.7	660.7	660.7	660.7	660.7	660.7
Pioneer Appropriation	750	750	750	750	750	750	750	750	750	750	750	750	750	750	750	750	750	750	750
Total Appropriation	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411

Laramie-Fox Hills Utilization Growth through Planning Period

Chart M ~ Lost Creek Appropriation vs Utilization Summary



	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Pioneer LC Utilitization																	55	99	147
Keenesburg LC Utilization	156	201	231	260	290	348	377	405	430	458	474	495	520	554	582	660.7	660.7	660.7	660.7
Total LC Utilization	156	201	231	260	290	348	377	405	430	458	474	495	520	554	582	660.7	715.7	759.7	807.7
Keenesburg Appropriation	139.6	139.6	139.6	139.6	139.6	139.6	139.6	139.6	139.6	139.6	139.6	139.6	139.6	139.6	139.6	139.6	139.6	139.6	139.6
Pioneer Appropriation	2418	2418	2418	2418	2418	2418	2418	2418	2418	2418	2418	2418	2418	2418	2418	2418	2418	2418	2418
Total Appropriation	2558	2558	2558	2558	2558	2558	2558	2558	2558	2558	2558	2558	2558	2558	2558	2558	2558	2558	2558

	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060
Pioneer LC Utilitization	172	236	258	279	299	317	341	370	388	412	614	642	696	742	800	800	800	800	800
Keenesburg LC Utilization	660.7	660.7	660.7	660.7	660.7	660.7	660.7	660.7	660.7	660.7	660.7	660.7	660.7	660.7	660.7	660.7	660.7	660.7	660.7
Total LC Utilization	832.7	896.7	918.7	939.7	959.7	977.7	1002	1031	1049	1073	1275	1303	1357	1403	1461	1461	1461	1461	1461
Keenesburg Appropriation	139.6	139.6	139.6	139.6	139.6	139.6	139.6	139.6	139.6	139.6	139.6	139.6	139.6	139.6	139.6	139.6	139.6	139.6	139.6
Pioneer Appropriation	2418	2418	2418	2418	2418	2418	2418	2418	2418	2418	2418	2418	2418	2418	2418	2418	2418	2418	2418
Total Appropriation	2558	2558	2558	2558	2558	2558	2558	2558	2558	2558	2558	2558	2558	2558	2558	2558	2558	2558	2558

Lost Creek Utilization Growth through Planning Period

Table 31 – LFH Water Supply "Sharing" or "Acquisition/Conveyance" through 2060

Year	Phase	PV ADD LFH AF/Yr	KB ADD LFH AF/Yr	PV & KB ADD LFH AF/Yr	KB LFH serving PV (AF)
2023	1	21	136	156	21
2024	2	61	139	201	61
2025	3	88	143	231	88
2026	4	113	147	260	113
2027	5	138	151	290	138
2028	6	192	156	348	192
2029	7	217	160	377	217
2030	8	240	164	405	240
2031	9	261	169	430	261
2032	10*	284	174	458	284
2033	11	295	179	474	295
2034	12	312	184	495	312
2035	13	331	189	520	331
2036	14	360	194	554	360
2037	15	383	200	582	383
2038	16	422	205	627	**422**
2039	17	471	211	682	416
2040	18	509	217	726	410
2041	19	551	223	774	404
2042	20	570	229	799	398
2043	21	628	235	863	392
2044	22	643	242	885	385
2045	23	658	249	906	378
2046	24	670	256	926	371
2047	25	681	263	944	364
2048	26	698	270	968	357
2049	27	720	278	997	349
2050	28	730	286	1,015	341
2051	29	745	294	1,039	333
2052	30	939	302	1,241	325
2053	31	959	310	1,269	317
2054	32	1,004	319	1,323	308
2055	33	1,041	328	1,369	299
2056	34	1,100	337	1,437	290
2057	35	1,158	347	1,505	280
2058	36	1,175	356	1,531	271
2059	37	1,181	366	1,548	261
2060	38	1,221	377	1,597	250

If each system is developed in accordance with the plans outlined herein, then Pioneer Village will utilize LFH groundwater gathered and treated by the Town of Keenesburg in the volumes shown in Column 6 above. Pioneer's Peak usage will be 422 AF in 2038 just prior to Keenesburg meeting their production capacity based upon their LFH supply and the Pioneer Village Blending Station coming online.

Table 32 – LC Water Supply "Sharing" or "Acquisition/Conveyance" through 2060

Year	Phase	PV ADD LC AF/Yr	KB ADD LC AF/Yr	PV & KB ADD LC AF/Yr	PV LC serving KB (AF)
2023	1	21	136	156	0
2024	2	61	139	201	0
2025	3	88	143	231	4
2026	4	113	147	260	8
2027	5	138	151	290	12
2028	6	192	156	348	16
2029	7	217	160	377	20
2030	8	240	164	405	25
2031	9	261	169	430	29
2032	10*	284	174	458	34
2033	11	295	179	474	39
2034	12	312	184	495	44
2035	13	331	189	520	49
2036	14	360	194	554	54
2037	15	383	200	582	60
2038	16	422	205	627	65
2039	17	471	211	682	71
2040	18	509	217	726	77
2041	19	551	223	774	83
2042	20	570	229	799	89
2043	21	628	235	863	96
2044	22	643	242	885	102
2045	23	658	249	906	109
2046	24	670	256	926	116
2047	25	681	263	944	123
2048	26	698	270	968	131
2049	27	720	278	997	138
2050	28	730	286	1,015	146
2051	29	745	294	1,039	154
2052	30	939	302	1,241	162
2053	31	959	310	1,269	171
2054	32	1,004	319	1,323	179
2055	33	1,041	328	1,369	188
2056	34	1,100	337	1,437	198
2057	35	1,158	347	1,505	207
2058	36	1,175	356	1,531	217
2059	37	1,181	366	1,548	227
2060	38	1,221	377	1,597	**237**

Conversely, as shown above, the Town of Keenesburg will utilize their full Lost Creek supply of 139.6 AF in 2024 and will need to acquire additional LC water totaling approximately 237 AF by 2060 to meet their ADD growth rate through 2060.

Appendix A

Excerpts from Town of Keenesburg
Water Master Plan by FEI

3. SERVICE AREA & RAW WATER SUPPLY

3.1. SERVICE AREA

The Town maintains and operates a municipal potable water system providing service to residents and businesses within their service area. The current service area boundary is shown on Figure 1 (See following page). Water sources and water rights are summarized within this section but evaluation of the water rights and future water sources are beyond the scope of this Master Plan.

Within the existing service area, the Town is expecting short term growth. Two separate developments are expected to provide an additional 350 to 414 additional water taps within the next 3 to 5 years as build out of these developments continue. The two planned developments are as follows: (1) a 350 lot development located north of the Burlington Northern Santa Fe (BNSF) Railroad and east of North 1st Street, and (2) a 64 lot development located in the southwest portion of the service area, west of Cedar Street and south of the BNSF Railroad. Additional intermittent growth is expected beyond these additions within the next 20 years; the existing service area will expand as necessary to accommodate the additional growth.

3.2. SUMMARY OF WATER RIGHTS

3.2.1. LARAMIE-FOX HILLS

In July 2002, TZA Consultants prepared a Water Supply Evaluation document (Appendix A) for the Town discussing secured water rights and potential future water rights allocation. At that time, based on overlying land, the Town maintained exclusive rights to pump a total of 221 AF/yr within the Laramie-Fox Hills Aquifer.

The TZA Water Supply Evaluation noted an additional 247 AF/yr of water was also available within the Laramie-Fox Hills Aquifer from Wells No. 21703-FP and 21704-FP; also known as the Roggen Wells. The wells are approximately 7 miles from the Town's boundary, but the Town does not currently extract water from the Laramie-Fox Hills Aquifer via these specific wells.

In 2015, the Town submitted an application to the Colorado Ground Water Commission (Commission) to determine additional water rights underlying 1,093 acres from additional overlying land. A summary of the adjudicated Town water rights within the Laramie-Fox Hills Aquifer is provided within the Colorado Ground Water Commissions Findings and Order (Determination No. 3174-BD); this document is included under Appendix B. Under the Commission's findings, the Town has been granted the following groundwater rights; total adjudicated water rights under the Order is no more than 192.7 AF/yr of withdrawal over the four identified areas.

The total amount of water available to the Town within the Laramie-Fox Hills Aquifer is 660.7 AF/yr.

3.2.2. LOST CREEK DESIGNATED GROUND WATER BASIN

In 2007, the Town obtained water rights associated with Well Permit No. 31652-FP within the Lost Creek Designated Ground Water Basin, which granted the Town 139.6 AF/yr of water rights within Lost Creek Basin.

3.3. CURRENT UTILIZED WATER SOURCES

The Town currently uses six groundwater wells to extract water from aquifers within the Denver Basin. Five wells extract water from the confined Laramie-Fox Hills Aquifer, which is the deepest aquifer within the Denver Basin. A single additional well (Well No. 11) extracts water from the shallow alluvial Lost Creek aquifer (Lost Creek) within the Lost Creek Designated Groundwater Basin. Permits for the wells listed below are provided in Appendix C.

3.3.1. LARAMIE-FOX HILLS GROUND WATER WELLS

The Laramie-Fox Hills Aquifer is the deepest aquifer in the Denver Basin and provides the major source of raw water for the Town. The source water from the Laramie-Fox Hills Ground Water Basin has been historically above primary and secondary maximum containment levels (MCL) for fluoride and sodium. The following wells provide the Town source water from the Laramie-Fox Hills Aquifer and details are summarized below:

1. Well No. 2:
   - Permit Number: 58990F.
   - Annual Appropriation Volume: 32 acre-feet/year (AF/yr).
   - Maximum Pumping Rate: 50 gallons per minute (gpm).
   - Year Constructed: 1960.
2. Well No. 4:
   - Permit Number: 31587F.
   - Annual Appropriation Volume: 50 AF/yr.
   - Maximum Pumping Rate: 50 gpm.
   - Depth: 850 ft.
   - Year Constructed: 1966.
3. Well No. 5:
   - Permit Number: 23522F.
   - Annual Appropriation Volume: 60 AF/yr.
   - Maximum Pumping Rate: 150 gpm.
   - Depth: 700 ft.
   - Year Constructed: 1979.
4. Well No. 7:
   - Permit Number: 23850F.
   - Annual Appropriation Volume: 65 AF/yr.
   - Maximum Pumping Rate: 160 gpm.
   - Depth: 910 ft.
   - Year Constructed: 1979.
5. Well No. 12 (Weld County High School):
   - Permit Number: 3401F.
   - Annual Appropriation Volume: 10 AF/yr.
   - Maximum Pumping Rate: 50 gpm.
   - Depth: 726 ft.
   - Year Constructed: 1962.

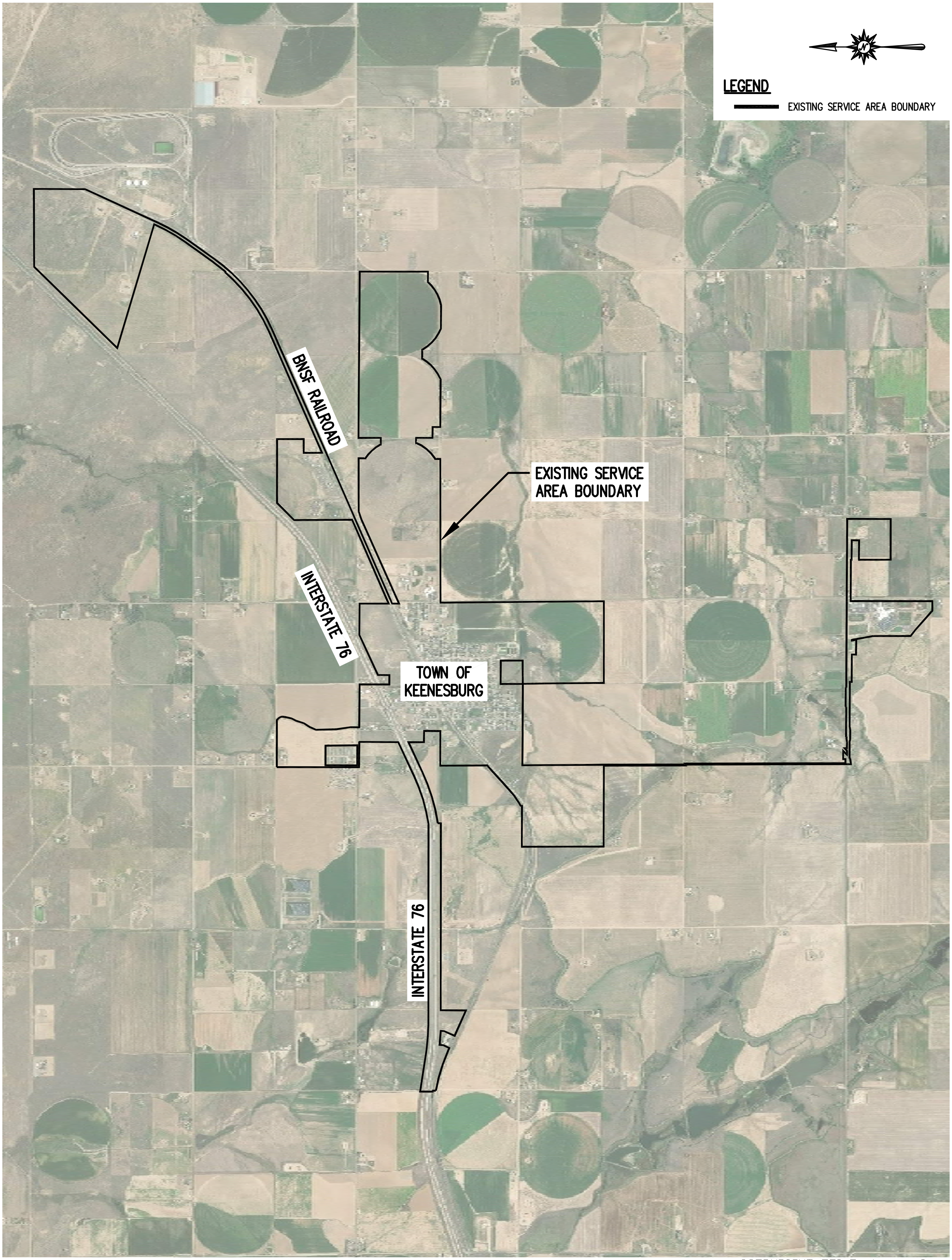


FIGURE 1

TOWN OF KEENESBURG
WATER MASTER PLAN
SERVICE AREA MAP

FEI ENGINEERS

V:\CADD DRAWINGS\FRACHETTI\KNBG-0281 – WATER MASTER PLAN\Figures\FIGURE 1 LAST SAVED:1/18/2019 8:01 AM LAST PLOTTED: 1/18/2019 10:50 AM BY: KRINDT

3.3.2. LOST CREEK AQUIFER GROUND WATER WELLS

The Lost Creek Aquifer is a shallow alluvial aquifer within the Lost Creek Basin and considered a paleo-tributary channel of the South Platte River. Due to the historically high fluoride and sodium levels within the Laramie-Fox Hills Aquifer, the Town uses the Lost Creek Aquifer water to blend and assist in treating the Laramie-Fox Hills water. Lost Creek Aquifer water from Well No. 11 is conveyed to the Well No. 7 site where it is blended with Laramie-Fox Hills water from Wells 2, 4, 5, and 7. As stated within the TZA Water Supply Evaluation, potential exists within the Lost Creek Basin to store return flows from municipal use and offset the water extracted from the basin.

1. Well No. 11:
   - Permit Number: 31652F.
   - Annual Appropriation Volume: 139.6 AF/yr.
   - Maximum Pumping Rate: 650 gpm.
   - Depth: 94 ft.
   - Year Constructed: 1939.

4. WATER SUPPLY REQUIREMENTS

4.1. POPULATION PROJECTIONS AND GROWTH AREAS

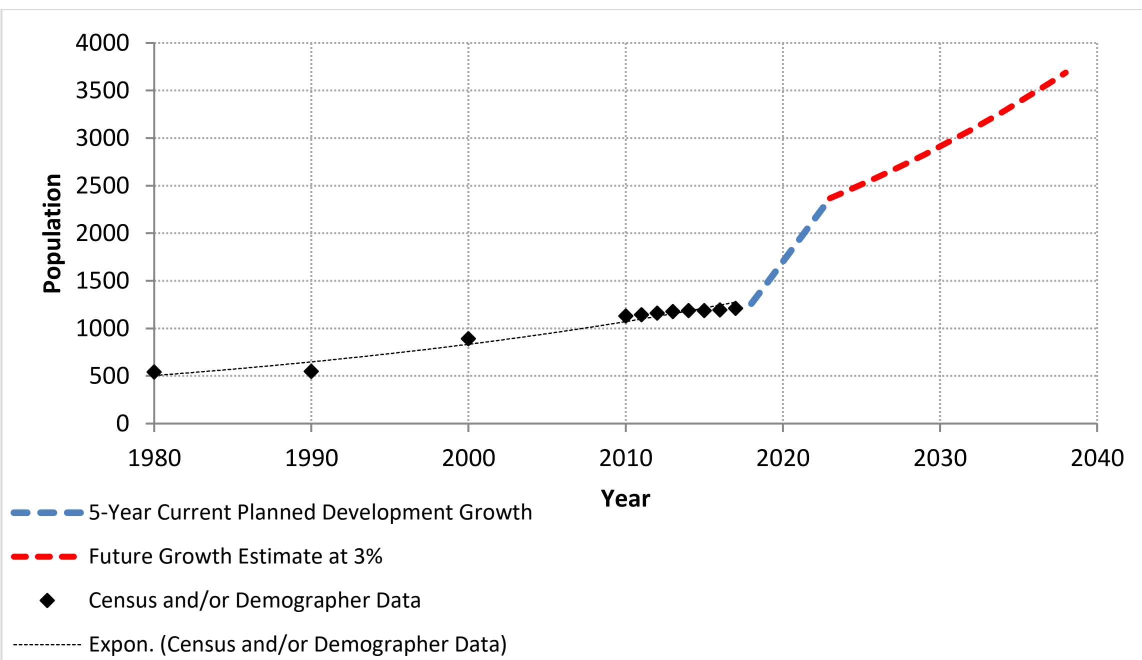
The Town's population has grown significantly since the 1990s. The 1990 census recorded just over 500 people, with the Town's population in 2017 was estimated to be 1,212 (source: United States Census Bureau and State Demographer). Estimated growth since the 2010 census has slowed to approximately 1.5 percent. As previously mentioned in Section 1, most of the short-term planning and growth for the Town is expected to be concentrated in the two areas within the existing service area. The two developments are expected to provide an additional 360 to 410 residential water taps within the next 5 years.

4.1.1. 20-YEAR PLANNING PERIOD

The 20-year planning period extends into 2038. The Colorado State Demographer's Office estimates the population in Weld County to increase at a 3.3 percent rate until 2020, then reduce to a 2.5 to 3.0 percent increase over the remaining 20-year projection. Due to the very strong short-term growth planned for the next 5 years, the planning projections in this Section will utilize the slower 3.0 percent growth rate for the remaining 15 years to match the State Demographer's Office estimates.

With the additional 410 taps planned within the next 5 years, and assuming 2.7 persons per tap, the Town's population is expected to increase 10 percent in each of the next 5 years to approximately 2,370 people by 2023. Figure 2 depicts both the historic and projected population for the Town. United States Census Bureau data is included for the four previous U.S. Census cycles (1980, 1990, 2000, and 2010). Colorado State Demographer estimates are included for the years between US census cycles. The predicted future population projections are based upon the short-term increase until 2023, then assumes the slower 3.0 percent growth rate to 2038.

Figure 2. Town of Keenesburg Historical and Predicted Future Population



4.2. HISTORICAL WATER USE

4.2.1. TOTAL SOURCE WATER DEMAND

The average monthly source water demand (2014 – 2017) from the groundwater sources is shown in Figure 3. Average annual source water demand is shown in Figure 4.

Figure 3. Average Monthly Source Water Demand (2014 – 2017)

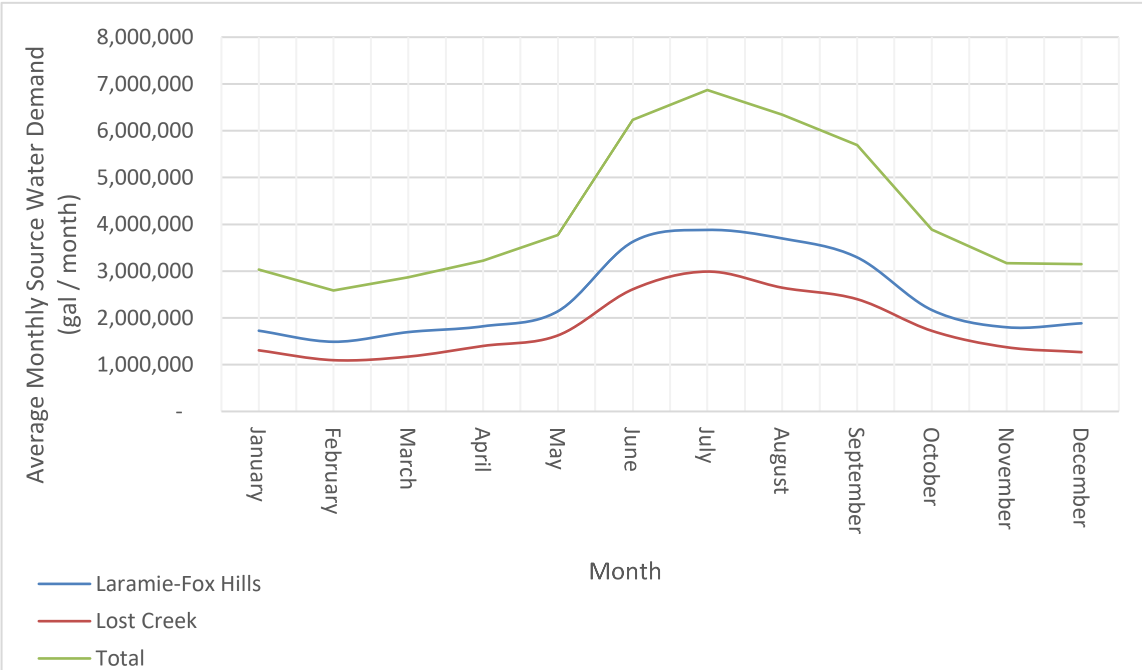
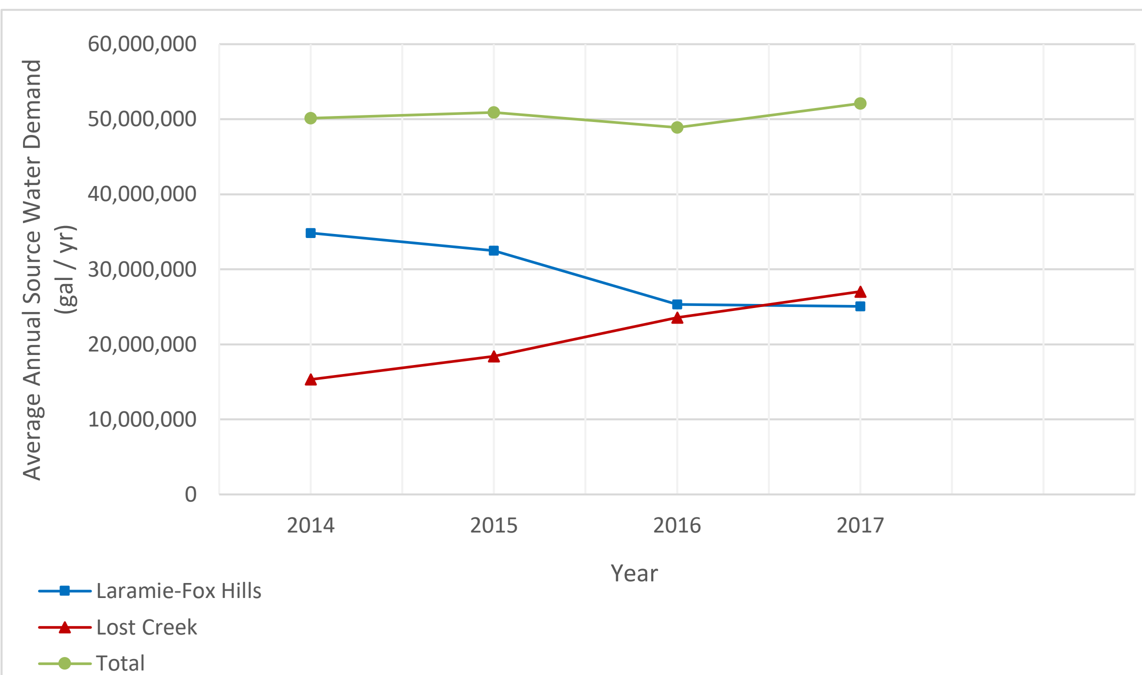


Figure 4. Average Annual Source Water Demand (2014 – 2017)



4.2.2. ANNUAL WATER CONSUMPTION

As expected, a notable difference exists between the average water demand during the summer and winter months due to no irrigation during the winter. During the previous four years, the average daily use during winter months (November through February) is approximately 0.10 MGD. The summer months average demand is 0.21 MGD for June and July. Figure 5 shows the average day demand (ADD) and maximum day demand (MDD) for each month; data shown is the average for 2014 through June of 2018. Note, Town records for bulk water storage were compiled on a monthly basis; daily records are not available. Average daily bulk water storage in Figures 5 and 6 are estimated by monthly totals divided by number of days in the month.

Figure 5. Average Daily Water Demands per Month (January 2014 – June 2018)

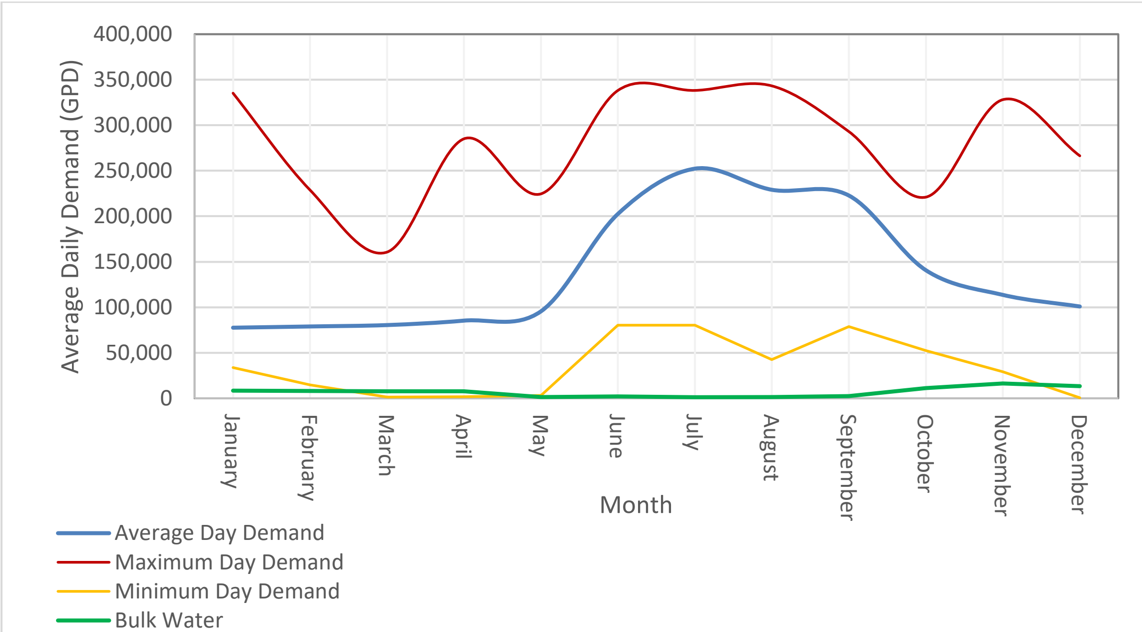
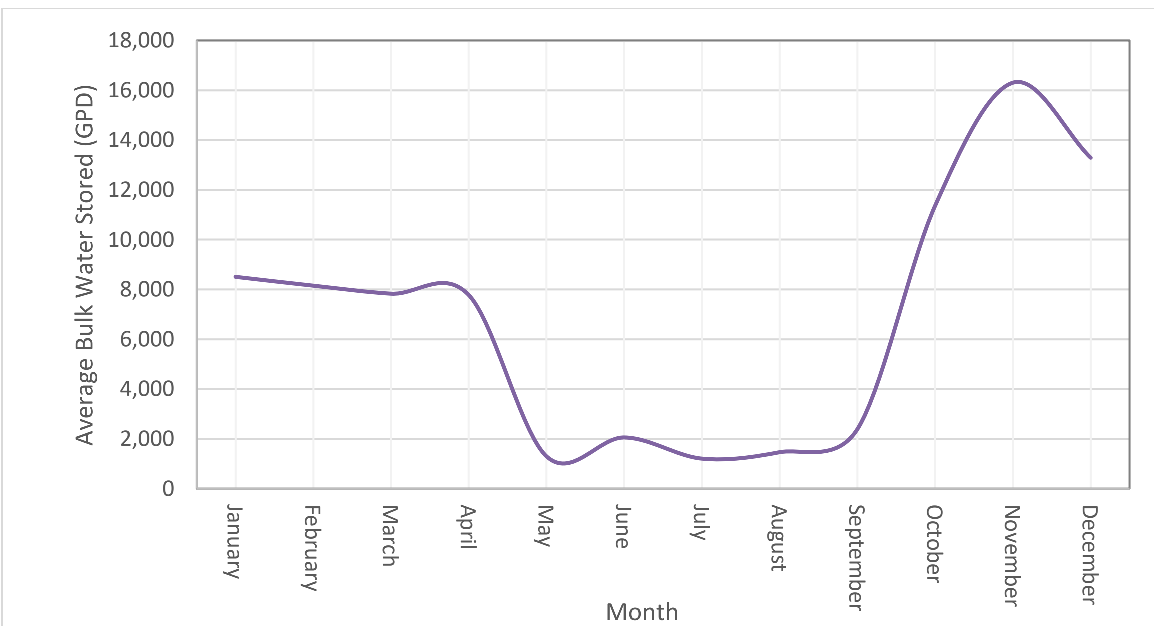
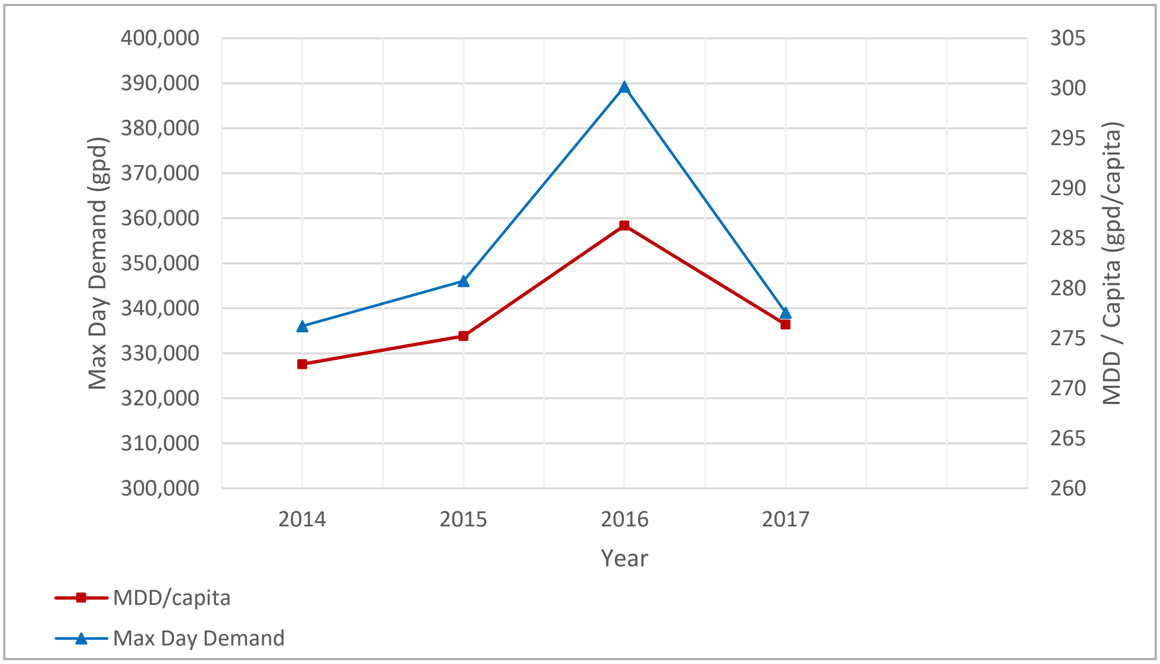


Figure 6. Average Bulk Water Stored per Month (January 2014 – June 2018)



The maximum daily demand for each year is typically experienced during June or July. Over the previous four years, the MDD usage has averaged 0.34 MGD (Figure 7) in the summer months. This data includes bulk water.

Figure 7. Annual Maximum Day Demand



4.2.3. HISTORICAL CONNECTIONS

Historical population data and future growth predictions are summarized above. Below, Table 1 summarizes the current and predicted number of service taps in relation to population estimates; the number of billed accounts reflects the number of billed meters in 2017, which correlates with the Demographers estimate of 2017 population. The existing ratio between population to billed accounts is 2.69, which is slightly higher than the national average of 2.5. The 2038 prediction uses the national average to predict future service connections.

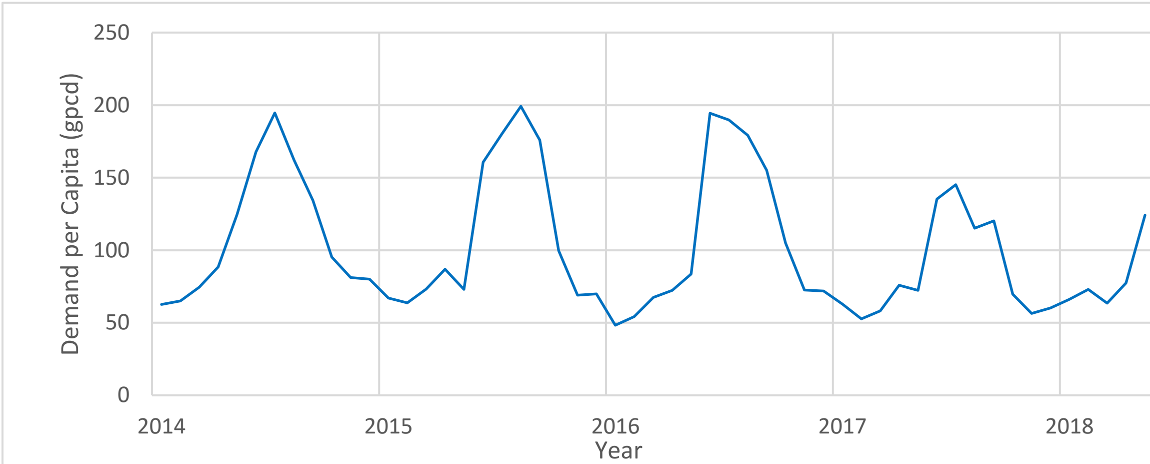
Table 1. Population and Billed Accounts Prediction

Description	Existing Service Area (2018)	Future Service Area (2023)	Future Service Area (2038)
Population	1,212	2,370	3,688
Billed Accounts	451	881	1,371

4.2.4. PER CAPITA WATER USAGE

The annual average usage (consumption exclusive of bulk water) per capita from 2014 to May of 2018 (Figure 8) indicates approximately 102 gallons per capita per day (gpcd). The winter months (October through April) show a long-term average of 72 gpcd, while the summer months (May through September) reveal an average consumption rate of 147 gpcd. In August 2015, the Town recorded a total water use high of 7,342,400 gallons; equaling a maximum average annual use of 200 gpcd for the month.

Figure 8. Average Daily Demand per Capita



4.3. WATER DEMAND PEAKING FACTORS

Peaking factors and average demand calculations provide a means to estimate future water usage based on projected population growth. Average demand per capita is projected to be fairly consistent with time, allowing estimation of future water use as a linear relation to population growth. Average daily demand is then used to calculate MDD and peak hour demand (PHD) by the application of peaking factors. These factors are multipliers used to adjust ADD and provide estimates of MDD or PHD flow rates. The peaking factors are best developed for each system based on recorded water usage rates. For this study, peaking factors have been developed using records spanning from 2014 to early 2018.

The average ADD during the study years is 0.122 MGD (exclusive of bulk water). Due to the lack of daily records for bulk water, the MDD peaking factor was derived by taking the actual MDD divided by the actual ADD, both inclusive of bulk water. The average maximum month usage during the period (MDD) is 0.339 MGD, with an ADD, inclusive of bulk water, of 0.139 MGD. This reveals an MDD:ADD peaking factor of 2.5. Published studies show a national range of 1.5 to 3.0 for MDD peaking factors. MDD usage is the standard engineering reference for sizing water treatment plants; sizing implications will be discussed in Section 7.

Peak hour demands are more difficult to quantify than ADD or MDD usage; the latter two can be directly measured through water plant production, while the former would require extensive monitoring throughout the distribution system. PHD consumption rate is commonly used to determine minimum sizing of distribution system components. The Town does not currently have a monitoring program that would accurately quantify the PHD. Published literature indicates the ratio of PHD/ADD ranging from 2.5 to 5.0. Thus, for the purposes of this Master Plan, a PHD of 4.0 is assumed. Table 2 summarizes the peaking factors determined for the Town's water system.

Table 2. Summary of Peaking Factors

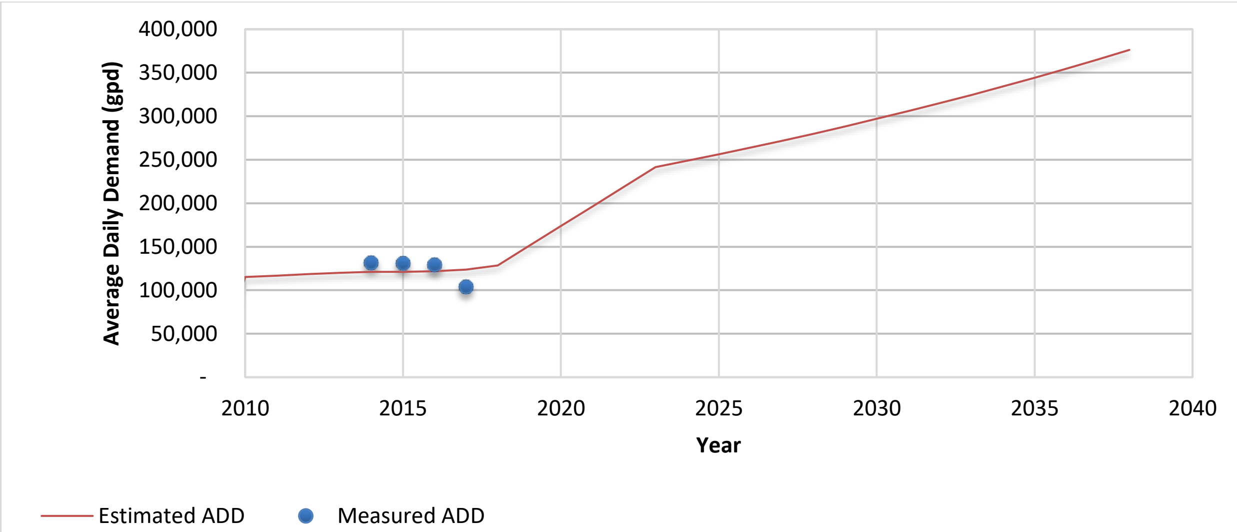
Description	Peak Factor
Average Daily Demand (ADD)	1.0
Maximum Daily Demand (MDD)	2.5
Peak Hour Demand (PHD)	4.0*(1)*

(1) Historic data not available. Assumed 4.0 typical PHD:ADD value for small communities

4.4. PROJECTED FUTURE WATER DEMAND

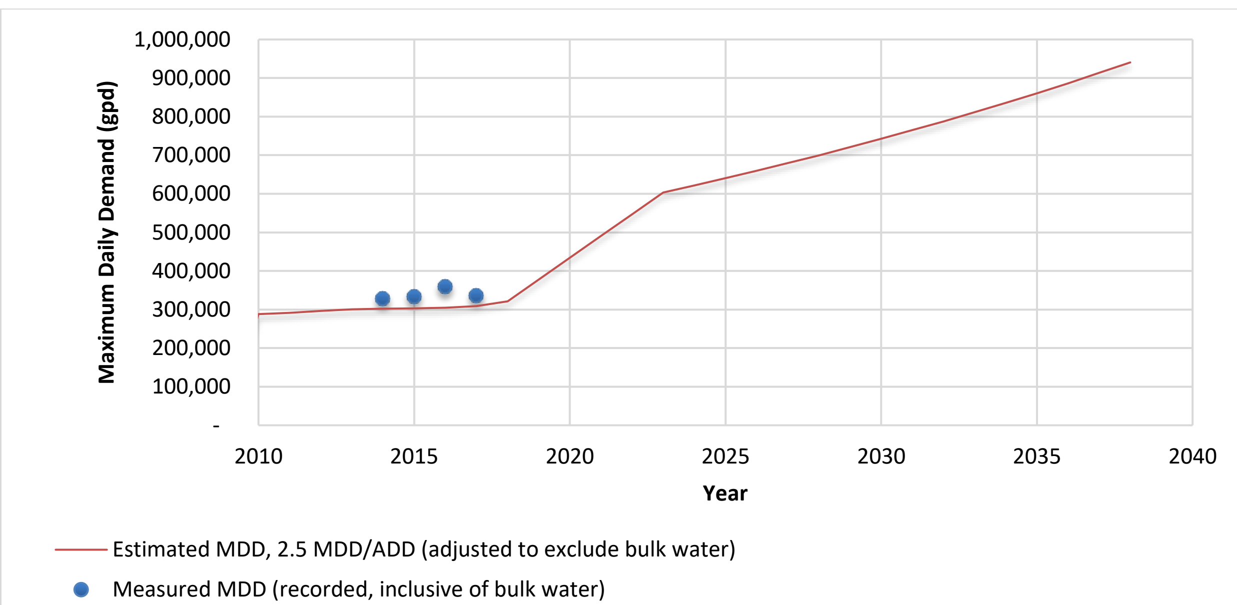
Future water demand predictions combine the demand data and peaking factor estimates with estimates of future population growth. Future water demand predictions are useful for planning infrastructure growth to maintain dependable water service. The population estimate for 2018 shows 1,260 persons in the service area. The population is predicted to increase to 3,688 persons by 2038. Figure 9 presents the measured and estimated ADD usage through the planning period; the 2038 ADD is predicted to be 0.38 MGD.

Figure 9. Estimated Average Daily Demand



The measured MDD has varied between 0.327 and 0.359 MGD over the previous four years. By using the anticipated growth rate and the 2.5 MDD peaking factor, the estimated MDD in 2038 is 0.941 MGD. Figure 10 presents the measured and predicted MDD usage during the 20-year planning period. The MDD predictions utilize the factor developed in Section 4.3 and the ADD estimate presented above.

Figure 10. Estimated Maximum Daily Demand



A summary of the water system demands is provided below in Table 3.

Table 3. Projected Water Distribution Demand Summary

Description	Service Area (2019)	Future Service Area (2023)	Future Service Area (2038)
Average Daily Demand (ADD, 102 gpcd)	0.151 MGD	0.242 MGD	0.377 MGD
Winter Average Daily Demand (72 gpcd)	0.107 MGD	0.171 MGD	0.266 MGD
Summer Average Daily Demand (147 gpcd)	0.218 MGD	0.348 MGD	0.543 MGD
Maximum Daily Demand (MDD, 2.5 ADD)	0.378 MGD	0.604 MGD	0.941 MGD
Peak Hour Demand (PHD, 4.0 ADD)[(1)]	420 gpm	671 gpm	1,045 gpm

(1) Historic data not available. Assumed 4.0 typical PHD:ADD value for small communities.

(2) All data inclusive of bulk water storage demand.

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5. TREATMENT, STORAGE, AND DISTRIBUTION

The Town's source and potable water system consists of raw water supply wells, well chlorination, and a primary blending and chlorination system at the Well No. 7 site, multiple storage facilities, and a booster system. These locations are shown on Figure 11 (see following page). The following section reviews the Town's water quality regulations, treatment system, available storage, and distribution system.

5.1. WATER QUALITY REGULATIONS

As medical knowledge and technological capability change, so does our understanding of pathogens and the ability to prevent harm; the EPA continues to develop new regulations to address drinking water quality. The following sections discuss the applicable portions of the Federal Safe Drinking Water Act (SDWA); each of the listed rules will be summarized below:

- Groundwater Treatment Rule.
- Stage 1 and Stage 2 Disinfectant and Disinfection By-Products Rules.
- Lead and Copper Rule.
- Total Coliform Rule.

5.1.1. GROUNDWATER TREATMENT RULE

The Town's source water supply is from groundwater wells. This rule requires systems using groundwater to comply with the following requirements:

- Systems serving fewer than 10,000 persons must achieve a 4-Log virus inactivation.

5.1.2. STAGE 1 AND STAGE 2 DISINFECTANT AND DISINFECTION BY-PRODUCTS RULES

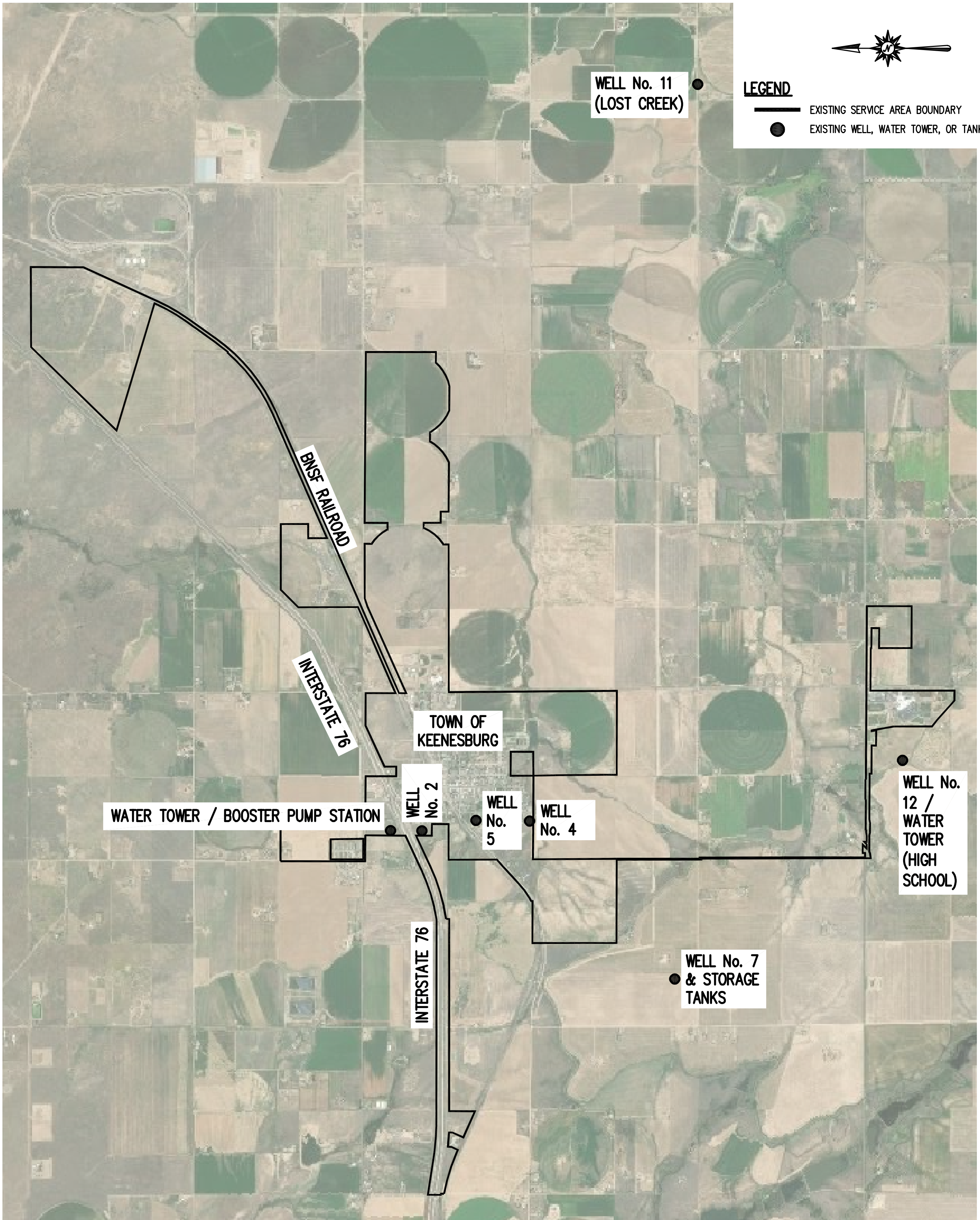
The Disinfectant and Disinfection By-Products (DBP) Rules were implemented in two stages beginning in 1998. The Stage 1 and Stage 2 DBP Rules provide protection of public health through the regulation of disinfection by-products (DBP). Long-term risks (associated with chronic exposure) are managed by providing treatment to reduce the potential of forming DBPs.

Stage 1 was promulgated in December 1998 and supersedes the 1979 regulations regarding total trihalomethanes (TTHM). Maximum contaminant levels (MCL) for DBP concentrations were established for specific disinfection by-products including individual trihalomethanes (THM), haloacetic acids (HAA), chlorite and bromate. In addition, maximum residual disinfectant levels (MRDL) were established for chlorine, chlorine dioxide, and chloramines.

Stage 2 was promulgated in January 2006 and builds upon the requirements of the Stage 1 Rule. The main requirements of the Stage 2 Rule are increased monitoring of THM and HAA at specific locations within the distribution system. Compliance with the Stage 2 Rule requires completion of a distribution system evaluation and establishment of standard sampling sites at representative locations throughout the system. For systems serving fewer than 50,000 persons, both the LT2 and Stage 2 Rule monitoring requirements became effective in October 2013.

5.1.3. LEAD AND COPPER RULE

The Lead and Copper Rule requires water suppliers to monitor lead and copper concentrations at customer taps and to control corrosion in the distribution system if necessary. Several models (i.e. Langlier Index) have been developed to evaluate water for its tendency to be a scale forming corrosive. In general, scale forming waters are not associated with lead and copper issues; however, corrosive waters do tend to cause elevated levels of lead and copper. Treatment techniques are typically used to maintain finished water pH above levels that are considered corrosive. Such techniques may include the addition of a basic chemical to finished water to prevent corrosive water leaching of lead and copper into customers' piping.



V:\CADD DRAWINGS\FRACHETTI\KNBG-0281 – WATER MASTER PLAN\Figures\FIGURE 11 LAST SAVED:1/18/2019 8:03 AM LAST PLOTTED: 1/18/2019 10:49 AM BY: KRINDT

FIGURE 11

TOWN OF KEENESBURG
WATER MASTER PLAN
WATER FACILITY LOCATIONS

FEI ENGINEERS

5.1.4. TOTAL COLIFORM RULE

The Total Coliform Rule established a maximum contaminant level goal (MCLG) of zero for total coliform, which are considered representative of the bacteria population within the distribution system. Total coliform is used as a gross surrogate for evaluating overall treatment effectiveness. Compliance with this rule requires regular testing at various points around the distribution system.

5.2. SOURCE WATER TREATMENT

5.2.1. WELL NO. 7 TREATMENT SYSTEM

The Town's primary raw water treatment and storage system is located at the Well No. 7 site. As identified on Figure 11, the site is located outside and southwest of the Town's service area. The site consists of the Well No. 7 well head, two at-grade bolted steel storage tanks, and a treatment building.

As discussed previously, the entirety of the Town's source water is drawn from groundwater wells. Water from the Laramie-Fox Hills Aquifer is extracted from Wells No. 2, 4, and 5; then conveyed to the Well No. 7 site via 8-inch pipe for treatment. At the Well No. 7 site, water is also extracted from the Laramie-Fox Hills Aquifer via Well No. 7. In efforts to reduce contaminant concentrations (namely fluoride and sodium) from the Laramie-Fox Hills source water, Laramie-Fox Hills water is conveyed into the treatment building where it is blended with source water from the Lost Creek via Well No. 11.

Prior to blending, each water source is metered. The metering determines the required dose of sodium hypochlorite for disinfection, as well as, determines the amount of blending required. After metering, and prior to blending, sodium hypochlorite is injected into each respective well source header pipe. Chlorinated water is then conveyed into on-site storage where final disinfection from contact time is achieved. The disinfection process is discussed in more detail below.

5.2.2. BLENDING

Raw water from the Laramie-Fox Hills Aquifer and Lost Creek Aquifer enter the treatment building via independently metered supply pipelines. The individual metering determines the blending rate to provide initial treatment of the Laramie-Fox Hills Aquifer water. The blending is achieved by regulation of water via an automatic electric operated butterfly valve on the Lost Creek supply line.

5.2.3. DISINFECTION

Sodium hypochlorite is the primary (residual) disinfectant for the Well No. 7 treatment system. As raw water enters the treatment building and is pushed through the blending header, it is injected with sodium hypochlorite before entering the storage tanks for the required contact time. The rate of hypochlorite injection is flow paced to the measured flow for each respective raw water supply line. The chlorine dosing equipment is provided by peristaltic metering pumps. The sodium hypochlorite is stored within a single 1,500 gallon container recessed within a concrete secondary containment area. Disinfection (viral inactivation) with chlorine is dependent on concentration and contact time. The contact time required is achieved in the downstream on-site storage tanks.

There are no mechanical means of baffling within the storage tanks, thus the baffling factor used for the contact time calculation is 0.1. The available storage for contact time is included in both on-site tanks, and at worst-case, assumed each tank is half full. Thus, the available storage for contact time to approximately 250,000 gallons. At 2019 demands, the log credits potentially achieved by the storage tanks are shown in Table 4 (using peak hour flow, a pH of 8.0, and residual of 1.0 mg/L). At the end of the planning period, using a peak hour flow of 1,045 gpm, 8 log credits can be achieved. A minimum credit of 4 log inactivation and removal is required by regulation.

Table 4 lists the total disinfection (inactivation) achieved by each treatment process used for calculating the overall disinfection.

Table 4. Summary of Overall Disinfection Required and Achieved

Description	2019 Demand Virus Credits	2038 Demand Virus Credits
Peak Hour Flow (gpm)	420	1045
Log Credits Required	4	4
Total log credits achieved *(removal and inactivation)*	20	8

(1) Assumed pH of 8.0.
(2) Assumed chlorine residual concentration of 1.0 mg/L.
(3) Assumed 250,000 gallons available for contact volume.
(4) Baffle factor of 0.1.

5.2.4. WELL NO. 12 (WELD COUNTY HIGH SCHOOL)

Additional source water is extracted from the Laramie-Fox Hills Aquifer via Well No. 12, located adjacent to the Weld County High School. The Well No. 12 site contains its own sodium hypochlorite injection, storage, and residual monitoring system. The sodium hypochlorite treatment and residual monitoring system is installed within the base of a 25,000 gallon composite steel water storage tank. Water stored within this storage tank is connected to the Town's distribution system and available for consumption.

5.3. STORAGE FACILITIES

There are four active potable water storage tanks that serve the Town; providing a total storage capacity of 725,000 gallons.

Table 5. Finished Water Storage Capacity

Finished Water Storage Tank	Total Capacity (gal)
Town Water Town Welded Steel Tank	200,000
Well No. 7 Welded Steel Tank (restoration 2018)	250,000
Well No. 7 Bolted Steel Tank (constructed 2016)	250,000
Weld Central High School Elevated Welded Steel Tank*(1)*	25,000
Total Available Storage Capacity	**725,000**

At the Well No. 7 site, two 250,000 gallon bolted steel water storage tanks provide the primary potable water storage for the Town. The older of the two tanks (construction date unknown) is an at-grade bolted steel storage tank (epoxy coated) which recently underwent restorative repair work in 2018. During the Town's previous water system evaluation, it was determined that the Town needed additional storage capacity. In 2016, a second 250,000 gallon at-grade bolted steel storage tank (glass fused to steel) was constructed adjacent to the existing tank.

An additional water storage and booster pump site is located within the Town's northwest portion of the service area adjacent to North Cedar Street and Pippin Lane. This site contains a steel water storage tank with 200,000 gallons of available storage.

The smallest storage tank is located at the Weld County High School. This elevated composite style steel tank provides an additional 25,000 gallons of water.

5.4. PUMP STATION

The northwest tank site includes a pump station used to boost pressures to the northern portions of the Town's service area. Two Aurora end suction pumps are enclosed within a small masonry block building. Each pump has a nameplate horsepower of 20 hp and rated duty point of 300 gpm at 106 feet of total dynamic head. In 2017, a throttling device was installed to assist in maintaining pressures and to reduce the start/stop cycles of the pumps.

5.5. DISTRIBUTION SYSTEM

The Town currently has approximately 7 miles of water distribution lines that supply potable drinking water to the Town's residents. The distribution system is organized by separate pressure zones. The pressure zones are separated by a single booster pump station providing additional pressure in the northern portion of the service area.

5.5.1. PIPELINES

Buried pipeline materials vary within the Town depending on the installation timeframe. Preferred materials for pipe have changed over time; with some older areas still containing AC distribution pipe. Most of the pipe, and the currently preferred pipe material, is polyvinyl chloride (PVC). Pipe sizes generally range from 4 inch to 12 inch; with 6 and 8 inch being the most common sizes throughout the distribution system.

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6. WATER SYSTEM ANALYSIS

The following water system analysis utilizes the information presented in the previous sections. The existing systems were discussed in Section 4. Current and predicted potable water supply requirements are reviewed in Section 5. All analyses presented below are the result of the cumulative understanding developed through the previous sections of this Master Plan.

6.1. WATER SUPPLY ANALYSIS

Section 3 identified the different water sources that encompass the Town's water rights appropriation. Table 6 summarizes the total water rights appropriation and Table 7 summarizes the individual adjudication permitted for each well source.

Table 6. Annual Water Rights Appropriation and Use Summary (Average 2014 – 2017)

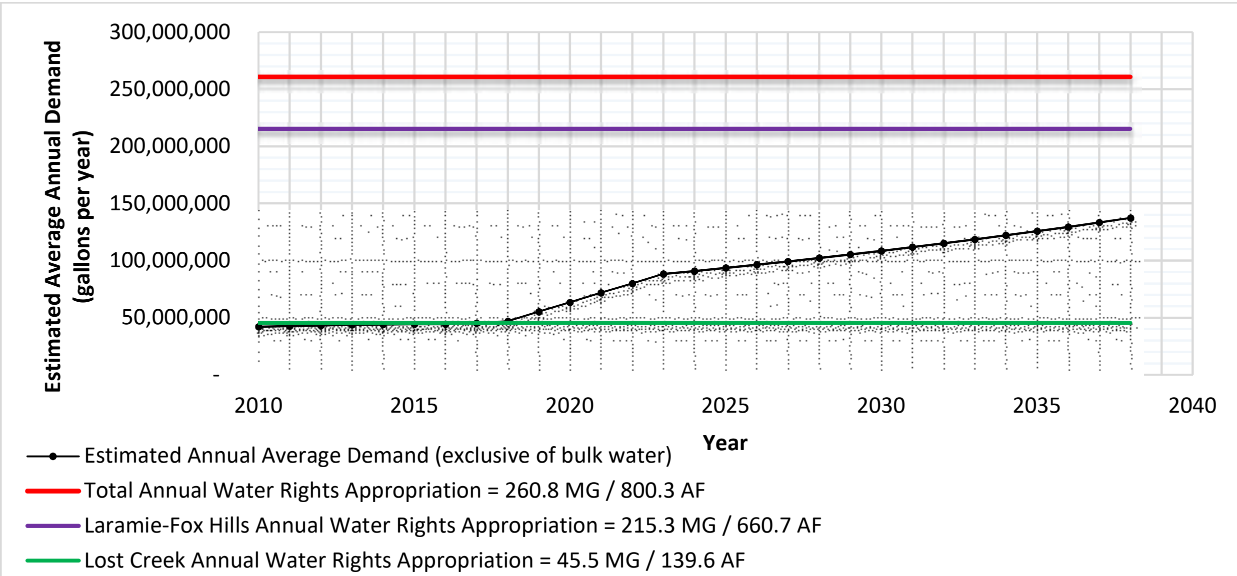
Aquifer	Aquifer Appropriation	Average Annual Historic Use (2014 – 2017)	% of Appropriation Used	Net Remaining Appropriation
Laramie-Fox Hills	660.7 AF (215.3 MG)	90.3 AF (29.5 MG)	14%	570.4 AF (185.8 MG)
Lost Creek Aquifer	139.6 AF (45.5 MG)	64.7 AF (21.1 MG)	47%	74.9 AF (24.4 MG)
Totals	**800.3 AF (260.8 MG)**	**155 AF (50.6 MG)**	**20%**	**645.3 AF (210.2 MG)**

Table 7. Annual Well Adjudication and Use Summary (Average 2014 – 2017)

Well No.	Well Adjudication (Permitted)	Average Annual Historic Use (2014 – 2017)	% of Adjudication Used	Net Remaining Adjudication
Laramie-Fox Hills Aquifer (660.7 AF / 215.3 MG Total Water Rights)				
Well 2	10.4 MG	5.0 MG	48%	5.4 MG
Well 4	19.6 MG	4.2 MG	22%	15.4 MG
Well 5	16.3 MG	13.4 MG	82%	2.9 MG
Well 7	21.2 MG	5.6 MG	26%	15.6 MG
Well 12	3.3 MG	1.3 MG	40%	2.0 MG
Total	**70.8 MG**	**29.5 MG**	**42%**	**41.3 MG**
Lost Creek Aquifer (139.6 AF / 45.5 MG Total Water Rights)				
Well 11	45.5 MG	21.1 MG	47%	24.4 MG
Total	**45.5 MG**	**21.1 MG**	**47%**	**24.4 MG**

Tables 6 and 7 show the Town has adequate water rights to meet the total raw water demand throughout the 20-year planning period. Currently, if any of the wells within the Laramie-Fox Hills Aquifer dry up, the other wells have enough combined adjudication and capacity to supplement. Figure 12 compares the total annual water supply appropriation with the future estimates annual average raw water use.

Figure 12. Annual Water Supply Appropriation

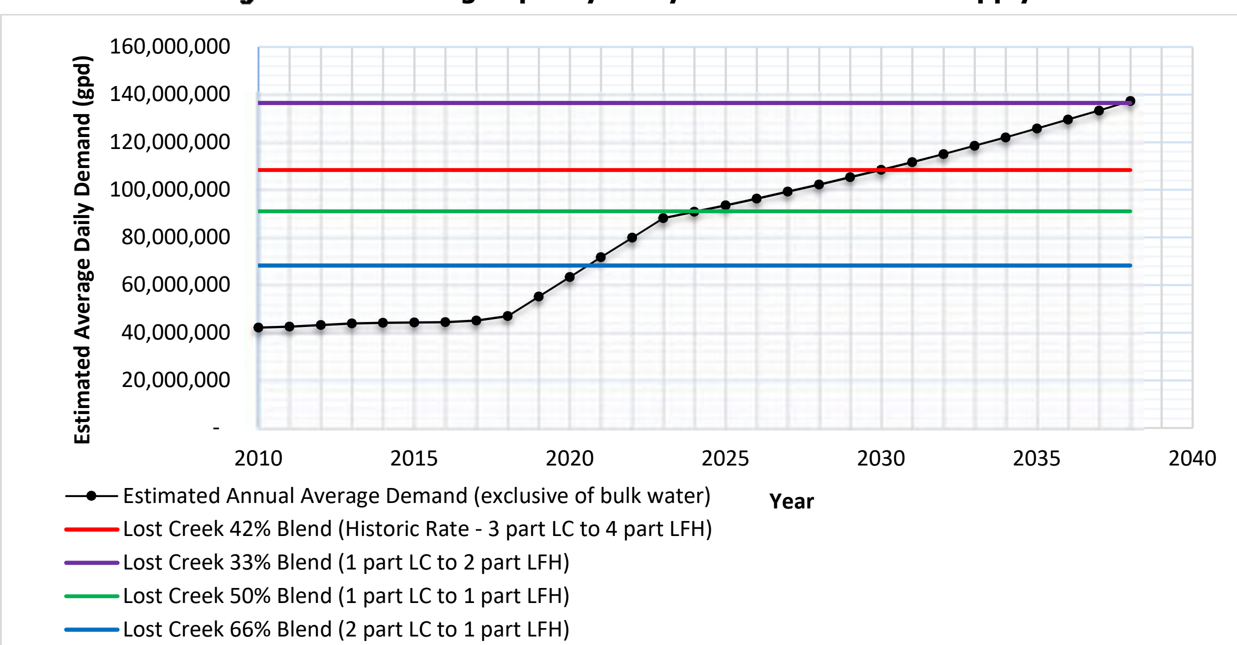


6.2. TREATMENT CAPACITY ANALYSIS

6.2.1. BLENDING CAPACITY

As previously discussed, the Town requires continuous draw from the Lost Creek Aquifer as the water is required for blending treatment of the Laramie-Fox Hills Aquifer water. Without the Lost Creek water supply, the Town would require additional treatment systems to reduce high sodium and fluoride concentrations. Historically, the Town has blended at a volume of approximately 42 percent of Lost Creek water to the total volume of raw water used (or 3 parts Lost Creek to 4 parts Laramie-Fox Hills). Figure 13 shows that at the current blending rate, the Town will require an additional blending source or alternate treatment by year 2030. If blending is increased to 50 percent (1 part Lost Creek to 1 part Laramie-Fox Hills), the milestone year is closer to 2024.

Figure 13. Blending Capacity Analysis with Lost Creek Supply



6.2.2. SODIUM HYPOCHLORITE DISINFECTION

The Well No. 7 site is the primary treatment site where disinfection occurs via sodium hypochlorite injection and contact time within onsite storage. This treatment system has historically treated and provided 0.129 MGD of potable water while using approximately 287 gallons of sodium hypochlorite per month and 9.6 gallons per day. Thus, the 1,500 gallon storage tank currently provides about 155 days or just over 5 months of storage. At the future ADD of 0.377 MGD (year 2038) and using similar dosing rate, approximately 28 gallons of sodium hypochlorite will be consumed per day; resulting in 54 days of storage.

6.3. STORAGE CAPACITY ANALYSIS

The Town currently has a total storage capacity of 0.725 MG within its service area. As stated within the CDPHE Design Criteria for Potable Water Systems, the minimum design factor for sizing storage requirements (not including fire flow needs) is to provide the direct potable ADD as the minimum equalization storage capacity. Based on this criterion and the growth projections, the future direct potable use storage requirement by year 2038 is 0.377 MGD. By combining the ADD volume with an assumed fire suppression volume of 0.180 MG (1,500 gallons per minute for 2 hours), a total storage volume required within the direct service area is 0.577 MGD. Therefore, the existing 0.725 MG storage capacity is projected to be adequate throughout the 20-year planning period.

The average MDD for the past four study years was 0.321 MGD. The Town currently has just over two days of storage capacity under MDD conditions. Using the projected growth rates, it is expected the Town will have less than a day of MDD storage as the year 2030 approaches (Figure 10).

6.4. DISTRIBUTION SYSTEM ANALYSIS

Distribution system analysis relating to condition and capacity evaluation are beyond the scope of this Master Plan. However, it is known that distribution system contains sections of older 4, 6, and 10 inch AC pipe that are aged and deteriorating. The Town has reported the sections of 4 inch pipe have deteriorated at the highest rate and should be the highest priority for replacement.

Table 8. Estimated Lengths of Asbestos-Cement (AC) Distribution Pipe in Use

Pipe Size	Length (ft)
4 inch	1,620
6 inch	16,475
10 inch	1,080
Total	**19,175**

APAI recommends a hydraulic and capacity analysis be performed for pipe replacement as future demands will lead to higher velocities and higher head losses in the distribution system.

6.4.1. TELEMETRY INFRASTRUCTURE

The distribution system utilizes a radio-based telemetry system to control the wells based on storage tank levels. A MTU polls each site and provides start/stop commands to the wells running on automatic. Well status, faults, runtime, and other process parameters, such as storage tank levels, are collected from the MTU and stored in a Human Machine Interface (HMI). Operators can change operating setpoints, as well as, view operating conditions through the HMI or via remote access from their phones or tablets.

The HMI has been recently upgraded; however, there is no software support agreement in place. APAI recommends the Town purchase a software support agreement from the HMI software company to ensure that new releases of the software can be installed and to ensure compatibility with new versions of the Microsoft operating system. The cost for an annual support contract is approximately $700 per year.

In addition, the MTU is antiquated as the programmable logic controller (PLC) and main radios are obsolete and no longer available from the manufacturer. The Town should budget to replace the MTU components before the unit fails to avoid manual operation of the SCADA system while a new MTU is procured and configured. A new MTU could be furnished for $25,000. Many of the radios at the remote sites are also obsolete but can be replaced over time. A shelf spare radio could be procured to minimize the downtime occurring from failure at a single site, and once utilized, another shelf spare would be purchased to backup the rest of the remote sites. The cost for a replacement serial radio is approximately $2,000.

Appendix B

Pioneer Water Demand Summary

Pioneer Village
Water/Wastewater Demand Estimate

			Potable Water Demand Estimate				Irrigation Water Demands				Wastewater Flows											Summary (Cumulative MGD)		
											Residential Uses			Commerical Uses										
Land Use	Sections 7 & 8 Phase	Units/Acres	P WATER ADD (Gallons)	P WATER MDD (Gallons)	P Water (ADD) Cumulative (Gal)	P WATER (ADD) Cumulative (MGD)	IRR WATER ADD (Gallons)	IRR WATER MDD (Gallons)	IRR WATER ADD Cumulative (Gal)	IRR Water (Cumulative) (MGD)	Person/DU	Res Flow (GPD/Person)	Total ADF Res (GPD)	Comm Flow (GPD/Acre)	Total ADF Com (GPD)	Peaking Factor (Calculated)	Peaking Factor (User Defined)	Peak WW Flow (GPD)	Peak WW Flow (MGD)	Cumulative Flows (GPD)	Cumulative Flows (MGD)	Irrigation	Potable	Wastewater
Residential	1	125	33,250	49,875	33,250	0.033	4,099	6,149	4,099	0.004	3.5	76	33,250			6.25	2.5	83,125	0.083	83,125	0.083	0.004	0.033	0.083
	2	242	64,372	96,558	97,622	0.098	7,936	11,904	12,035	0.012	3.5	76	64,372			5.60	2.5	160,930	0.161	244,055	0.244	0.012	0.098	0.244
	3	159	42,294	63,441	139,916	0.140	5,214	7,821	17,249	0.017	3.5	76	42,294			6.01	2.5	105,735	0.106	349,790	0.350	0.017	0.140	0.350
	4	150	39,900	59,850	179,816	0.180	4,919	7,379	22,168	0.022	3.5	76	39,900			6.06	2.5	99,750	0.100	449,540	0.450	0.022	0.180	0.450
	5	151	40,166	60,249	219,982	0.220	4,952	7,428	27,120	0.027	3.5	76	40,166			6.06	2.5	100,415	0.100	549,955	0.550	0.027	0.220	0.550
	6	321	85,386	128,079	305,368	0.305	10,527	15,790	37,647	0.038	3.5	76	85,386			5.34	2.5	213,465	0.213	763,420	0.763	0.038	0.305	0.763
	7	146	38,836	58,254	344,204	0.344	4,788	7,182	42,435	0.042	3.5	76	38,836			6.09	2.5	97,090	0.097	860,510	0.861	0.042	0.344	0.861
	8	143	38,038	57,057	382,242	0.382	4,689	7,034	47,124	0.047	3.5	76	38,038			6.11	2.5	95,095	0.095	955,605	0.956	0.047	0.382	0.956
5974	9	125	33,250	49,875	415,492	0.415	4,099	6,149	51,223	0.051	3.5	76	33,250			6.25	2.5	83,125	0.083	1,038,730	1.039	0.051	0.415	1.039
	10	136	36,176	54,264	451,668	0.452	4,460	6,690	55,683	0.056	3.5	76	36,176			6.17	2.5	90,440	0.090	1,129,170	1.129	0.056	0.452	1.129
Commerical	11	17.08	12,468	18,703	464,136	0.464	7,625	11,437	63,308	0.063				600	10,248	7.62	3	30,744	0.031	1,159,914	1.160	0.063	0.464	1.160
	12	98	26,068	39,102	490,204	0.490	3,214	4,821	66,521	0.067	3.5	76	26,068			6.51	2.5	65,170	0.065	1,225,084	1.225	0.067	0.490	1.225
	13	113	30,058	45,087	520,262	0.520	3,706	5,558	70,227	0.070	3.5	76	30,058			6.36	2.5	75,145	0.075	1,300,229	1.300	0.070	0.520	1.300
Commerical	14	44.94	32,806	49,209	553,069	0.553	20,061	30,092	90,288	0.090				600	26,964	6.48	3	80,892	0.081	1,381,121	1.381	0.090	0.553	1.381
Commerical	15	34.02	24,835	37,252	577,903	0.578	15,187	22,780	105,475	0.105				600	20,412	6.79	3	61,236	0.061	1,442,357	1.442	0.105	0.578	1.442
	16	234	62,244	93,366	640,147	0.640	7,674	11,510	113,148	0.113	3.5	76	62,244			5.63	2.5	155,610	0.156	1,597,967	1.598	0.113	0.640	1.598
	17	292	77,672	116,508	717,819	0.718	9,576	14,364	122,724	0.123	3.5	76	77,672			5.42	2.5	194,180	0.194	1,792,147	1.792	0.123	0.718	1.792
	18	230	61,180	91,770	778,999	0.779	7,542	11,314	130,267	0.130	3.5	76	61,180			5.64	2.5	152,950	0.153	1,945,097	1.945	0.130	0.779	1.945
	19	249	66,234	99,351	845,233	0.845	8,166	12,248	138,432	0.138	3.5	76	66,234			5.57	2.5	165,585	0.166	2,110,682	2.111	0.138	0.845	2.111
	20	113	30,058	45,087	875,291	0.875	3,706	5,558	142,138	0.142	3.5	76	30,058			6.36	2.5	75,145	0.075	2,185,827	2.186	0.142	0.875	2.186
	21	347	92,302	138,453	967,593	0.968	11,379	17,069	153,517	0.154	3.5	76	92,302			5.27	2.5	230,755	0.231	2,416,582	2.417	0.154	0.968	2.417
	22	91	24,206	36,309	991,799	0.992	2,984	4,476	156,501	0.157	3.5	76	24,206			6.60	2.5	60,515	0.061	2,477,097	2.477	0.157	0.992	2.477
	23	86	22,876	34,314	1,014,675	1.015	2,820	4,230	159,322	0.159	3.5	76	22,876			6.66	2.5	57,190	0.057	2,534,287	2.534	0.159	1.015	2.534
	24	74	19,684	29,526	1,034,359	1.034	2,427	3,640	161,748	0.162	3.5	76	19,684			6.83	2.5	49,210	0.049	2,583,497	2.583	0.162	1.034	2.583
	25	67	17,822	26,733	1,052,181	1.052	2,197	3,296	163,945	0.164	3.5	76	17,822			6.94	2.5	44,555	0.045	2,628,052	2.628	0.164	1.052	2.628
Commerical	26	25.85	18,871	28,306	1,071,052	1.071	11,539	17,309	175,485	0.175				600	15,510	7.11	3	46,530	0.047	2,674,582	2.675	0.175	1.071	2.675
	27	128	34,048	51,072	1,105,100	1.105	4,198	6,296	179,682	0.180	3.5	76	34,048			6.23	2.5	85,120	0.085	2,759,702	2.760	0.180	1.105	2.760
	28	60	15,960	23,940	1,121,060	1.121	1,968	2,951	181,650	0.182	3.5	76	15,960			7.07	2.5	39,900	0.040	2,799,602	2.800	0.182	1.121	2.800
	29	93	24,738	37,107	1,145,798	1.146	3,050	4,575	184,700	0.185	3.5	76	24,738			6.57	2.5	61,845	0.062	2,861,447	2.861	0.185	1.146	2.861
Land Use	**Section 9 Phase**	**Units/Acres**	**P WATER ADD (Gallons)**	**P WATER MDD (Gallons)**	**P Water Cumulative (Gal)**	**P WATER Cumulative (MGD)**	**NP WATER ADD (Gallons)**	**NP WATER MDD (Gallons)**	**NP WATER Cumulative (Gal)**	**NP Water (Cumulative) (MGD)**	**Person/DU**	**Res Flow (GPD/Person)**	**Total ADF Res (GPD)**	**Comm Flow (GPD/Acre)**	**Total ADF Com (GPD)**	**Peaking Factor (Calculated)**	**Peaking Factor (User Defined)**	**Peak WW Flow (GPD)**	**Peak WW Flow (MGD)**	**Cumulative Flows (GPD)**	**Cumulative Flows (MGD)**	**Non-Potable**	**Potable**	**Wastewater**
	30	1156	307,496	461,244	1,453,294	1.453	37,909	56,864	222,609	0.223	3.5	76	307,496			4.30	2.5	768,740	0.769	3,630,187	3.630	0.223	1.453	3.630
School	31	30.33	22,141	33,211	1,475,435	1.475	13,539	20,309	236,148	0.236				600	18,198	6.92	3	54,594	0.055	3,684,781	3.685	0.236	1.475	3.685
	32	272	72,352	108,528	1,547,787	1.548	8,920	13,380	245,068	0.245	3.5	76	72,352			5.49	2.5	180,880	0.181	3,865,661	3.866	0.245	1.548	3.866
	33	223	59,318	88,977	1,607,105	1.607	7,313	10,969	252,381	0.252	3.5	76	59,318			5.67	2.5	148,295	0.148	4,013,956	4.014	0.252	1.607	4.014
	34	350	93,100	139,650	1,700,205	1.700	11,478	17,217	263,859	0.264	3.5	76	93,100			5.26	2.5	232,750	0.233	4,246,706	4.247	0.264	1.700	4.247
Land Use	**Section 5 Phase**	**Acres**	**P WATER ADD (Gallons)**	**P WATER MDD (Gallons)**	**P Water Cumulative (Gal)**	**P WATER Cumulative (MGD)**	**NP WATER ADD (Gallons)**	**NP WATER MDD (Gallons)**	**NP WATER Cumulative (Gal)**	**NP Water (Cumulative) (MGD)**	**Person/DU**	**Res Flow (GPD/Person)**	**Total ADF Res (GPD)**	**Comm Flow (GPD/Acre)**	**Total ADF Com (GPD)**	**Peaking Factor (Calculated)**	**Peaking Factor (User Defined)**	**Peak WW Flow (GPD)**	**Peak WW Flow (MGD)**	**Cumulative Flows (GPD)**	**Cumulative Flows (MGD)**	**Non-Potable**	**Potable**	**Wastewater**
Industrial	35	88.65	64,715	97,072	1,764,919	1.765	39,573	59,360	303,432	0.303				600	53,190	5.78	3	159,570	0.160	4,406,276	4.406	0.303	1.765	4.406
Industrial	36	25.06	18,294	27,441	1,783,213	1.783	11,187	16,780	314,619	0.315				600	15,036	7.15	3	45,108	0.045	4,451,384	4.451	0.315	1.783	4.451
Commerical	37	9.74	7,110	10,665	1,790,323	1.790	4,348	6,522	318,967	0.319				600	5,844	8.37	3	17,532	0.018	4,468,916	4.469	0.319	1.790	4.469
Industrial	38	59.86	43,698	65,547	1,834,021	**1.834**	26,722	40,082	345,688	0.346				600	35,916	6.17	3	107,748	0.108	4,576,664	**4.577**	0.346	**1.834**	**4.577**

Pioneer Village
Sourcewater Development and Implementation Strategy

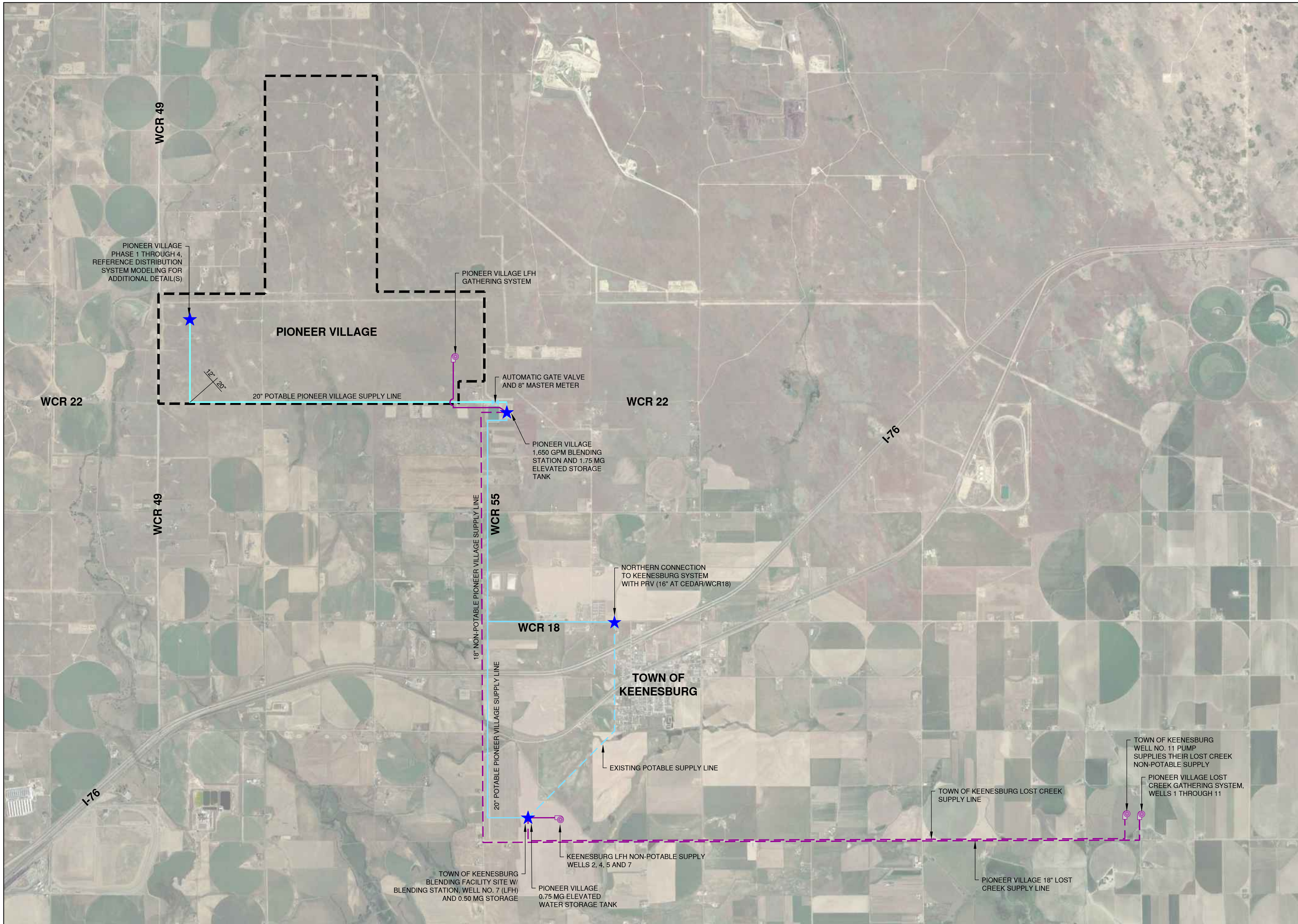
Year	Phase	PV Potable (ADD)	PV Irrigation (ADD)	PV Total ADD (GPD)	PV ADD LFH AF/Yr	KB Total ADD Ac-FT	KB ADD LFH AF/Yr	PV & KB ADD LFH AF/Yr	ADD PV & KB (GPD)	KB MDD (1.5xADD)	KB MDD (2.5xADD)	MDD PV & KB
2023	1	33,250	4,099	**37,349**	21	**242,000**	136	156	279,349	363,000	605,000	419,024
2024	2	64,372	7,936	**109,657**	61	**248,776**	139	201	358,433	373,164	621,940	537,650
2025	3	42,294	5,214	**157,165**	88	**255,742**	143	231	412,907	383,613	639,354	619,361
2026	4	39,900	4,919	**201,984**	113	**262,902**	147	260	464,887	394,354	657,256	697,330
2027	5	40,166	4,952	**247,102**	138	**270,264**	151	290	517,366	405,396	675,659	776,049
2028	6	85,386	10,527	**343,015**	192	**277,831**	156	348	620,846	416,747	694,578	931,269
2029	7	38,836	4,788	**386,639**	217	**285,610**	160	377	672,249	428,416	714,026	1,008,374
2030	8	38,038	4,689	**429,366**	240	**293,608**	164	405	722,974	440,411	734,019	1,084,460
2031	9	33,250	4,099	**466,715**	261	**301,829**	169	430	768,544	452,743	754,571	1,152,816
2032	10*	36,176	4,460	**507,351**	284	**310,280**	174	458	817,631	465,420	775,699	1,226,446
2033	11	12,468	7,625	**527,444**	295	**318,968**	179	474	846,412	478,451	797,419	1,269,617
2034	12	26,068	3,214	**556,726**	312	**327,899**	184	495	884,624	491,848	819,747	1,326,937
2035	13	30,058	3,706	**590,489**	331	**337,080**	189	520	927,569	505,620	842,700	1,391,354
2036	14	32,806	20,061	**643,357**	360	**346,518**	194	554	989,875	519,777	866,295	1,484,812
2037	15	24,835	15,187	**683,378**	383	**356,221**	200	582	1,039,599	534,331	890,551	1,559,398
2038	16	62,244	7,674	**753,296**	422	**366,195**	205	627	1,119,490	549,292	915,487	1,679,236
2039	17	77,672	9,576	**840,543**	471	**376,448**	211	682	1,216,992	564,672	941,120	1,825,487
2040	18	61,180	7,542	**909,266**	509	**386,989**	217	726	1,296,255	580,483	967,472	1,944,382
2041	19	66,234	8,166	**983,665**	551	**397,824**	223	774	1,381,490	596,737	994,561	2,072,235
2042	20	30,058	3,706	**1,017,429**	570	**408,963**	229	799	1,426,393	613,445	1,022,409	2,139,589
2043	21	92,302	11,379	**1,121,110**	628	**420,414**	235	863	1,541,525	630,622	1,051,036	2,312,287
2044	22	24,206	2,984	**1,148,301**	643	**432,186**	242	885	1,580,487	648,279	1,080,465	2,370,730
2045	23	22,876	2,820	**1,173,997**	658	**444,287**	249	906	1,618,284	666,431	1,110,718	2,427,426
2046	24	19,684	2,427	**1,196,107**	670	**456,727**	256	926	1,652,835	685,091	1,141,818	2,479,252
2047	25	17,822	2,197	**1,216,127**	681	**469,516**	263	944	1,685,642	704,274	1,173,789	2,528,464
2048	26	18,871	11,539	**1,246,537**	698	**482,662**	270	968	1,729,199	723,993	1,206,655	2,593,798
2049	27	34,048	4,198	**1,284,782**	720	**496,177**	278	997	1,780,959	744,265	1,240,442	2,671,438
2050	28	15,960	1,968	**1,302,710**	730	**510,070**	286	1,015	1,812,779	765,104	1,275,174	2,719,169
2051	29	24,738	3,050	**1,330,498**	745	**524,352**	294	1,039	1,854,849	786,527	1,310,879	2,782,274
2052	30	307,496	37,909	**1,675,903**	939	**539,033**	302	1,241	2,214,936	808,550	1,347,584	3,322,404
2053	31	22,141	13,539	**1,711,583**	959	**554,126**	310	1,269	2,265,709	831,190	1,385,316	3,398,564
2054	32	72,352	8,920	**1,792,855**	1,004	**569,642**	319	1,323	2,362,497	854,463	1,424,105	3,543,745
2055	33	59,318	7,313	**1,859,486**	1,041	**585,592**	328	1,369	2,445,077	878,388	1,463,980	3,667,616
2056	34	93,100	11,478	**1,964,063**	1,100	**601,988**	337	1,437	2,566,052	902,983	1,504,971	3,849,078
2057	35	64,715	39,573	**2,068,351**	1,158	**618,844**	347	1,505	2,687,195	928,266	1,547,110	4,030,793
2058	36	18,294	11,187	**2,097,832**	1,175	**636,172**	356	1,531	2,734,004	954,258	1,590,429	4,101,005
2059	37	7,110	4,348	**2,109,290**	1,181	**653,985**	366	1,548	2,763,274	980,977	1,634,961	4,144,912
2060	38	43,698	26,722	**2,179,709**	1,221	**672,296**	377	1,597	2,852,005	1,008,444	1,680,740	4,278,008

Pioneer Village
Sourcewater Development and Implementation Strategy

Year	Phase	Year	PV Total ADD (GPD)	KB Total ADD Ac-FT	ADD PV & KB (GPD)	KB Blending (Cap)	PV Blending (Cap)	PV produced by KB	Box Elder Supply
2023	1	3	**37,349**	**242,000**	**279,349**	279,349		37,349	
2024	2		**109,657**	**248,776**	**358,433**	358,433		109,657	
2025	3	5	**157,165**	**255,742**	**412,907**	412,907		157,165	
2026	4		**201,984**	**262,902**	**464,887**	464,887		201,984	
2027	5	7	**247,102**	**270,264**	**517,366**	517,366		247,102	
2028	6		**343,015**	**277,831**	**620,846**	620,846		343,015	
2029	7		**386,639**	**285,610**	**672,249**	672,249		386,639	
2030	8	9	**429,366**	**293,608**	**722,974**	722,974		429,366	
2031	9	10	**466,715**	**301,829**	**768,544**	768,544		466,715	
2032	10*		**507,351**	**310,280**	**817,631**	817,631		507,351	
2033	11	12	**527,444**	**318,968**	**846,412**	846,412		527,444	
2034	12		**556,726**	**327,899**	**884,624**	884,624		556,726	
2035	13		**590,489**	**337,080**	**927,569**	927,569		590,489	
2036	14		**643,357**	**346,518**	**989,875**	989,875		643,357	
2037	15	14	**683,378**	**356,221**	**1,039,599**	1,039,599		683,378	
2038	16		**753,296**	**366,195**	**1,119,490**	1,119,490		753,296	
2039	17	15	**840,543**	**376,448**	**1,216,992**	1,119,490	97,501	743,042	
2040	18	16	**909,266**	**386,989**	**1,296,255**	1,119,490	176,764	732,502	
2041	19		**983,665**	**397,824**	**1,381,490**	1,119,490	261,999	721,666	
2042	20	17	**1,017,429**	**408,963**	**1,426,393**	1,119,490	306,902	710,527	
2043	21	18	**1,121,110**	**420,414**	**1,541,525**	1,119,490	422,034	699,076	
2044	22	19	**1,148,301**	**432,186**	**1,580,487**	1,119,490	460,996	687,304	
2045	23	20	**1,173,997**	**444,287**	**1,618,284**	1,119,490	498,794	675,203	
2046	24	21	**1,196,107**	**456,727**	**1,652,835**	1,119,490	533,344	662,763	
2047	25	22	**1,216,127**	**469,516**	**1,685,642**	1,119,490	566,152	649,975	
2048	26	23	**1,246,537**	**482,662**	**1,729,199**	1,119,490	609,708	636,828	
2049	27	24	**1,284,782**	**496,177**	**1,780,959**	1,119,490	661,468	623,314	
2050	28	25	**1,302,710**	**510,070**	**1,812,779**	1,119,490	693,289	609,421	
2051	29		**1,330,498**	**524,352**	**1,854,849**	1,119,490	735,359	595,139	
2052	30	26	**1,675,903**	**539,033**	**2,214,936**	1,119,490	1,095,446	580,457	
2053	31	27	**1,711,583**	**554,126**	**2,265,709**	1,119,490	1,146,219	565,364	
2054	32	28	**1,792,855**	**569,642**	**2,362,497**	1,119,490	1,243,006	549,849	
2055	33	29	**1,859,486**	**585,592**	**2,445,077**	1,119,490	1,325,587	533,899	
2056	34	30	**1,964,063**	**601,988**	**2,566,052**	1,119,490	1,339,114	517,502	107,447
2057	35	31	**2,068,351**	**618,844**	**2,687,195**	1,119,490	1,339,114	500,646	228,591
2058	36	32	**2,097,832**	**636,172**	**2,734,004**	1,119,490	1,339,114	483,319	275,399
2059	37	33	**2,109,290**	**653,985**	**2,763,274**	1,119,490	1,339,114	465,506	304,670
2060	38	34	**2,179,709**	**672,296**	**2,852,005**	1,119,490	1,339,114	447,194	393,401

Appendix C

Potable Water System Overview



ENGINEER IN CHARGE:

PRELIMINARY NOT FOR CONSTRUCTION

STRATEGIC SITE DESIGNS

CONTACT INFORMATION
6924 PARRAMATTA PLACE
HIGHLANDS RANCH, CO 80130
(720) 206-6931
CPERDUE@STRATEGICSITEDESIGNS.COM
ATTENION: CHRISTOPHER PERDUE, P.E., M.B.A.

PIONEER VILLAGE
KEENESBURG, CO
WELD COUNTY

WATER DISTRIBUTION SYSTEM OVERVIEW

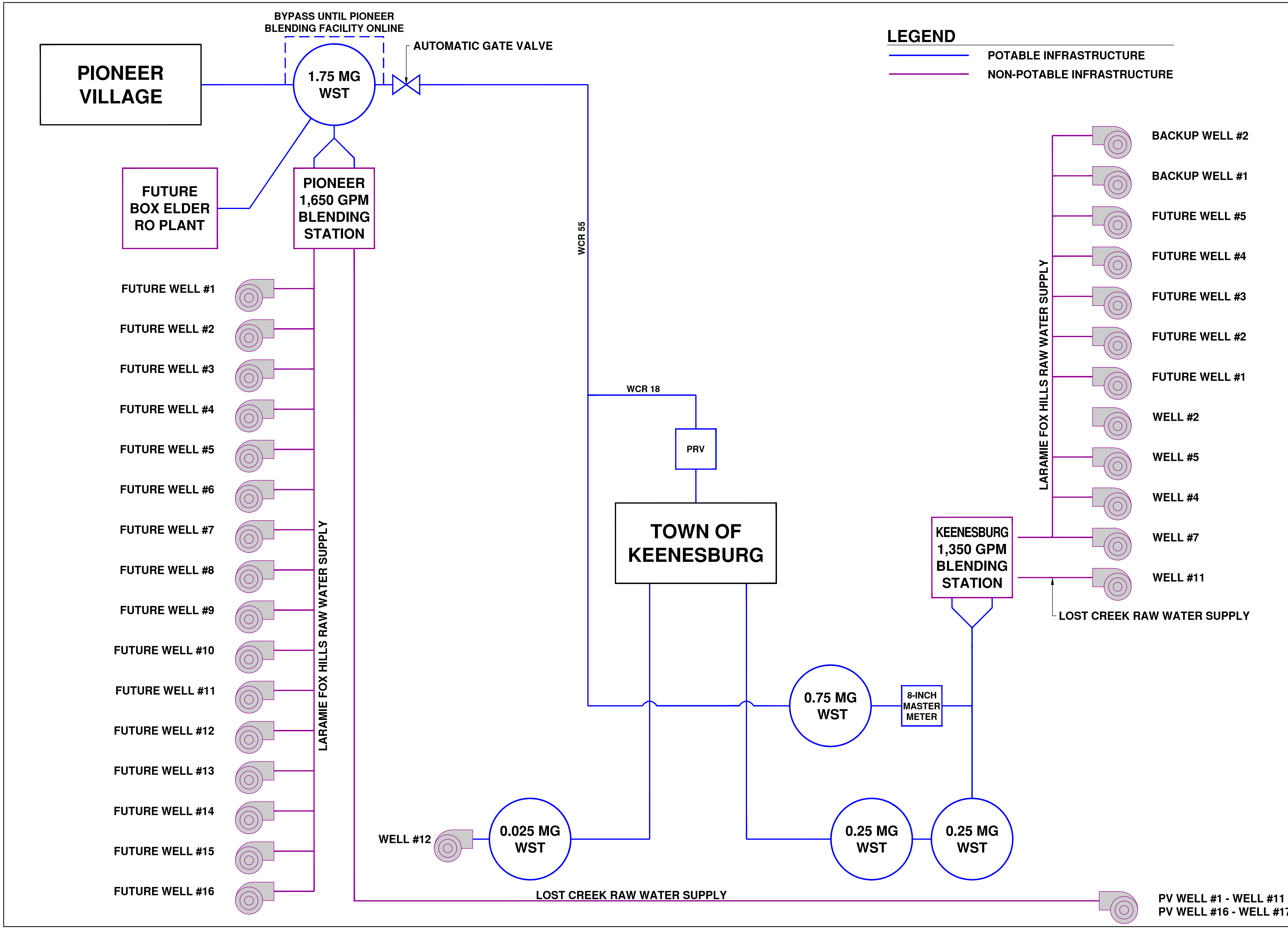
REV	DESCRIPTION	BY	DATE

JOB NO:	1919-001
ORIGINAL ISSUE:	9/19/2019
DESIGN BY:	CLP
CHECKED BY:	CLP
SCALE:	1"=600'

SHEET NUMBER
WAT - 1.0

Appendix D

Potable Water System Operational Diagram



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(720) 206-6931
CPERDUE@STRATEGICSITEDESIGNS.COM
ATTENION: CHRISTOPHER PERDUE, P.E., M.B.A.

PIONEER VILLAGE
KEENESBURG, CO
WELD COUNTY

POTABLE WATER SYSTEM OPERATIONAL DIAGRAM

REV	DESCRIPTION	BY	DATE

JOB NO:	1919-001
ORIGINAL ISSUE:	9/19/2019
DESIGN BY:	CLP
CHECKED BY:	CLP
SCALE:	1"=600'

SHEET NUMBER
WAT - 2.0

Appendix E

Water Storage Tank Information (Sample Tank Design)

CPerdue@ssdeng.com

From: theckart@ssdeng.com
Sent: Monday, August 17, 2020 8:22 AM
To: cperdue@ssdeng.com
Subject: FW: Elevated Water Storage Tank Budgets
Attachments: sample-pics-spheres.docx

Thanks,
Tori

Tori Heckart, EI
Strategic Site Designs, LLC
(408) 603-7191

From: Chuck Graber <graberc@maguireiron.com>
Sent: Friday, August 14, 2020 6:43 AM
To: theckart@ssdeng.com
Subject: RE: Elevated Water Storage Tank Budgets

Good morning Tori,

Budgets for a 750MG sphere similar to the attached pictures would be around $1,550,000 (+/-). The million gallon would be around $2,000,000 (+/-). This is for
foundation, tank, tank painting and basic electrical (conduit lights, outlets – wiring and connections by others). Assuming good soils, no over excavation, engineered fill, special foundations. Elaborate paint schemes, logos can also factor into overall cost. Depending on how far along you are at in the planning stages soils testing, if done, could help in firming up numbers. Hopefully this gives you enough to go on at this point. I will be traveling today with limited cell and internet service checking from time to time. Please reach out to me if you have any additional questions or clarifications. I reside in Windsor CO, very familiar with the area. We look forward to assisting you as things develop on your end.

Best regards, Chuck 970-744-9639

Maguire Iron, Inc.
CHUCK GRABER
WATER TOWER EXPERT
2058 Vineyard Drive | Windsor, CO 80550
C: 970-744-9639
W: 605-334-9749
SINCE 1915
MAGUIREIRON.COM

From: theckart@ssdeng.com <theckart@ssdeng.com>
Sent: Thursday, August 13, 2020 12:03 PM
To: Chuck Graber <graberc@maguireiron.com>
Subject: Elevated Water Storage Tank Quote

Hello Chuck,
I received your contact information from Guy Pence at Great Plains Structures who said that you could help me get some quotes for water storage tanks.
I am not sure if Guy reached out to you as well (if so, I spent the morning finalizing our tank sizes and quantities a little more) but I am currently looking for 2 elevated tanks:

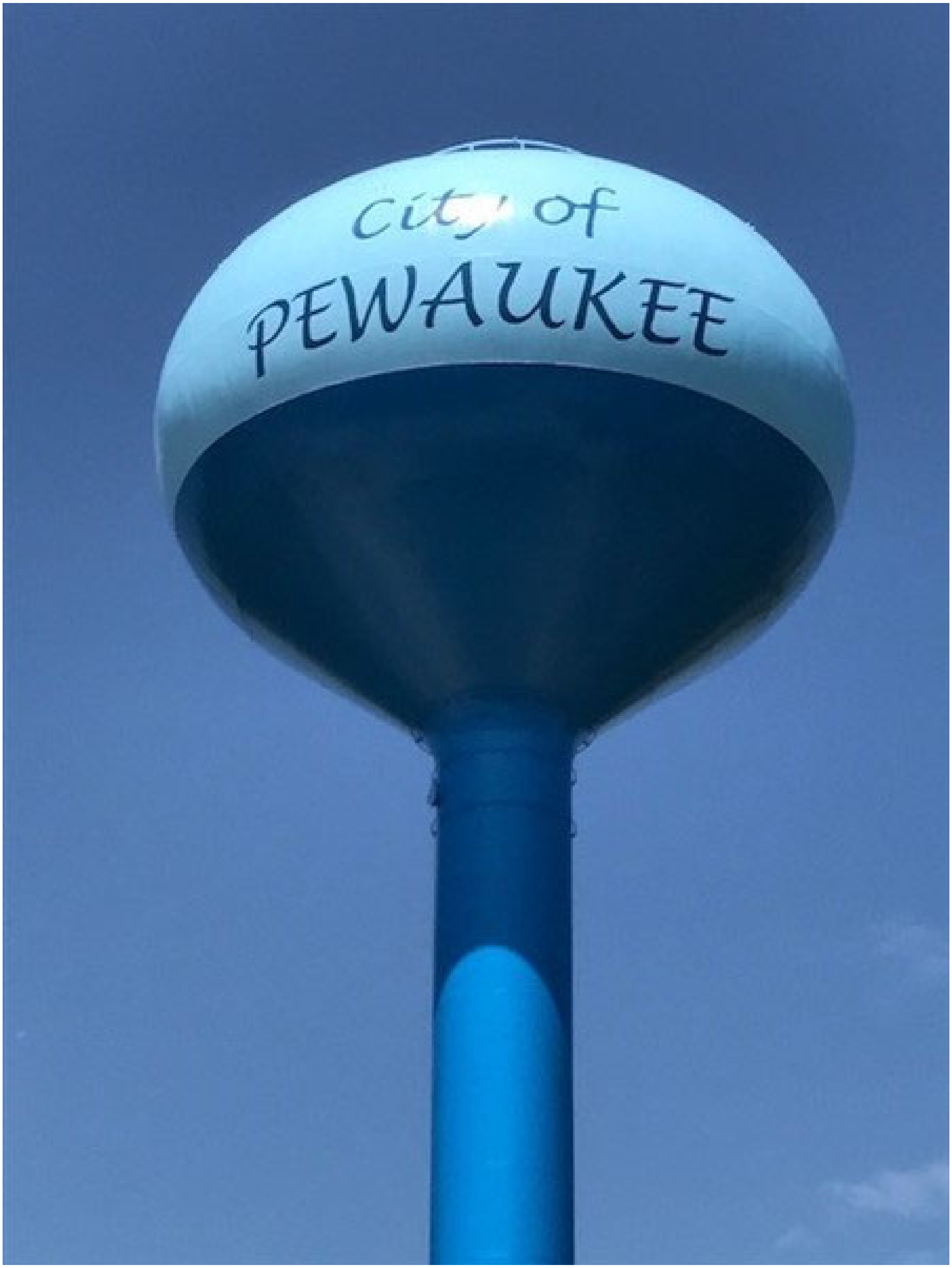
Tank 1: 750,000 gallon storage with a 60ft pedestal
Tank 2: 1 MG storage with a 100 ft pedestal

For both of these tanks we are hoping to do welded steel to keep down costs, but I understand that that may be harder for the 1 MG tank (we may need to go composite). Both tanks will be placed near Keenesburg, CO to feed a new community my firm and I are currently designing.
Hopefully this is something you can help me with.

Thanks,
Tori

STRATEGIC SITE DESIGNS
Tori Heckart, EI | **Engineer I**
88 Inverness Circle E Suite E101 Englewood CO 80112
408.603.7191 | THeckart@SSDENG.com
"Balanced Engineering for the Communities of Tomorrow"


Charter Township of
Northville


City of
PEWAUKEE

Appendix F

AccuTab Water Treatment System Information
(for PV Phases 1 through 4)

Accu-Tab® SYSTEM

PowerPro™ CHLORINATION UNIT

PPG Industries, a world leader in safe, simple and accurate chlorination systems, introduces the *PowerPro* chlorination unit incorporating the *Accu-Tab* chlorinator and tablets. This unique combination provides a better chlorination system than gas or bleach for industrial and municipal installations. And with its compact size, installation is easy.

PowerPro chlorination units are:

- Safer, easy-to-use systems
- Accurate chlorination to 720 lbs/day
- Capable of treating 0.1 MGD to more than 20 MGD
- Reliable with minimal maintenance

Features include:

- UL listed enclosure
- Grundfos vertical pumps
- Digital flow meter
- Schedule 80 PVC piping
- Corrosion-resistant Type T6061 aluminum frame
- Custom engineered systems available to meet your requirements

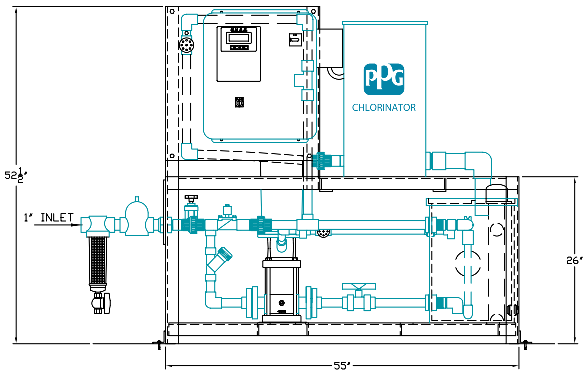
PowerPro™ chlorination unit using *Accu-Tab*® chlorinator model 3075 is shown with automated controller and weigh scale options.

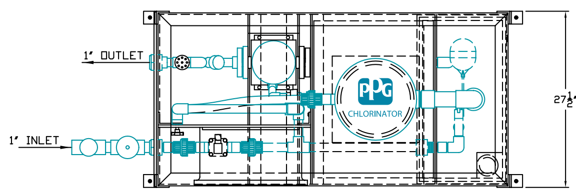
Model	Chlorine Delivery Range (lbs/hr.)	Tablet Capacity (lbs.)	Unit Dimensions (WxLxH)	Solution Tank Capacity (US gal.)	Unit Inlet/Outlet Size
3012*	Up to 0.5	12	27" x 55" x 50"	22	1"
3075*	0.3 - 2	75	27" x 55" x 50"	22	1"
3150*	1 - 12	150	27" x 55" x 52"	28	1-1/2"
3530	4 - 25	300	35" x 65" x 54"	45	1-1/2"
3550*	4 - 25	550	35" x 65" x 74"	45	1-1/2"
30600	10 - 35	600	35" x 65" x 57"	45	1-1/2"
301100	10 - 35	1100	35" x 65" x 74"	45	1-1/2"
361000	10 - 35	1000	41" x 71" x 57"	45	1-1/2"
Dual 3012	up to 1.0	24	27" x 55" x 50"	22	1"
Dual 3075	0.3 - 4	150	35" x 65" x 50"	22	1-1/2"

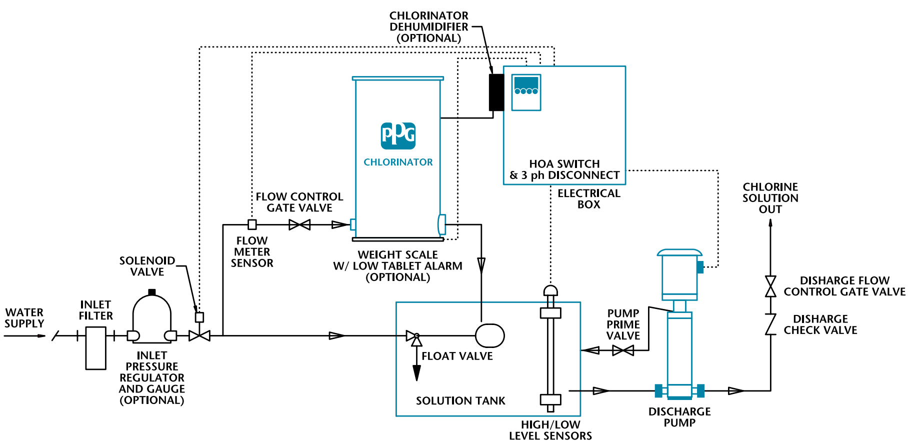
* Chlorinators are NSF Standard 61 listed.

Accu-Tab® SYSTEM

PowerPro™ CHLORINATION UNIT







Custom Engineering

PowerPro units can be easily customized to your individual requirements. For information on optional equipment and/or specialized unit configurations, contact PPG Customer Service.

PPG Customer Service: 1-800-245-2974

PowerPro's available options:

- Residual Control
- Flow Proportion Control
- Compound Loop Control
- Pressure Regulator
  (required for 70 psi or greater)
- ~~Field Installed Spare Pump~~
- Installed Weight Scale
- ~~50 Hz Power~~
- SCADA Compatible

Available exclusively from:

PPG Industries
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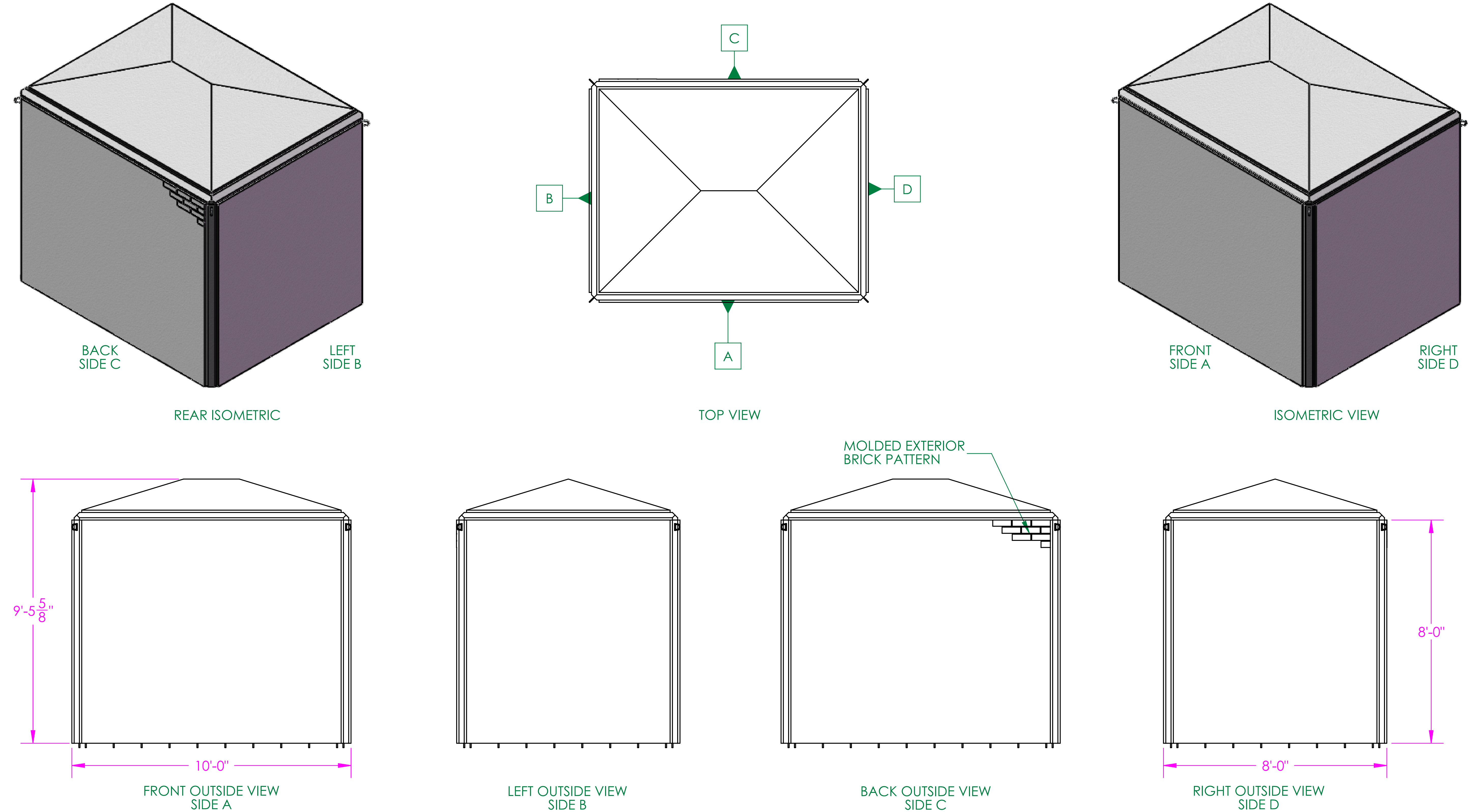
#2742 2.5M rev. 0104



REV.	DESCRIPTION	DATE	APPROVED
-	-	-	-
-	-	-	-

RATINGS:

30 PSF SNOW LOAD
100 MPH WIND LOAD
1010 LBS APPROX. WEIGHT

EXTERIOR VIEWS

MODEL:	8' x 10' x 8' Generic Assembly				
PLOT SCALE:	1:42	BY:	XX	DATE:	XX/XX/XXXX

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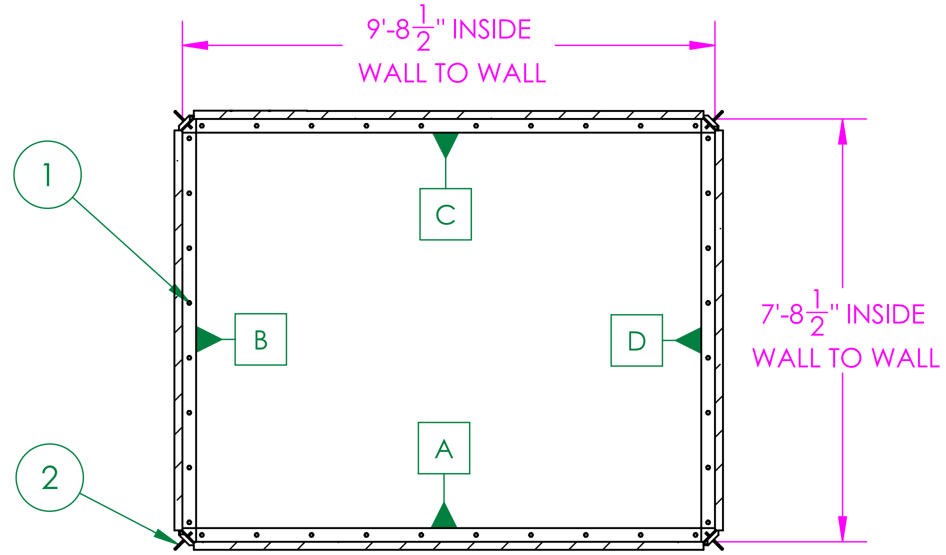
www.shelterworks.com

CUSTOMER: -		ORDER #: -
PROJECT: -		SIZE:
TITLE:	8' x 10' x 8' Freedom Series Enclosure	B
SCALE: 1:42	DWG #: 8' x 10' x 8' Generic Assembly	SHEET: 1 OF 3

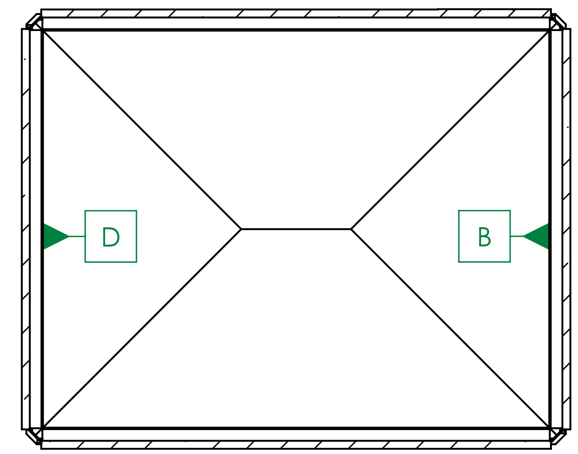
INTERIOR COLOR:	WHITE	EXTERIOR COLOR:	TBD

OPTIONAL ITEMS LIST

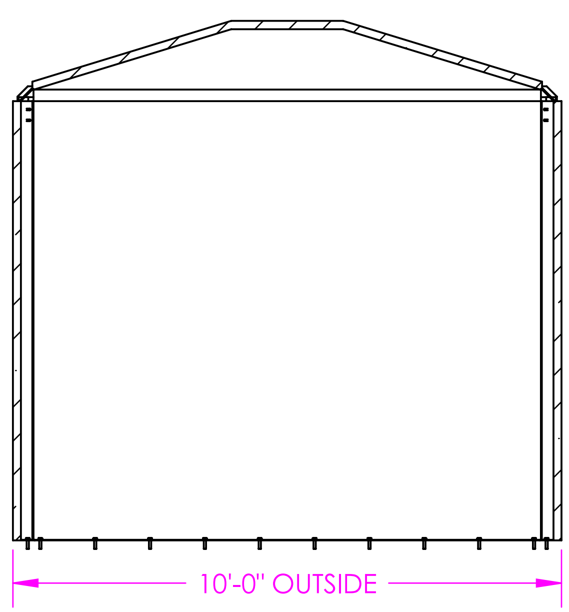
ITEM	QTY	PART NUMBER	DESCRIPTION	NOTES
1	36	52082	3/8" STAINLESS EXPANSION ANCHOR	"REDHEAD" TYPE 12" OC (BY OTHERS)
2	4	66263-1	3/8" SS U-BOLT	LIFT HOOK



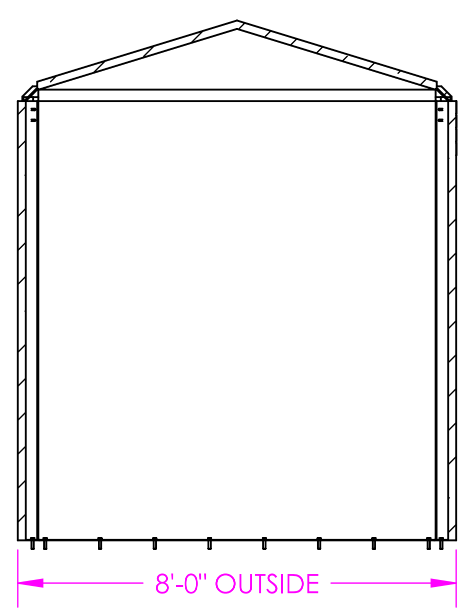
PLAN VIEW



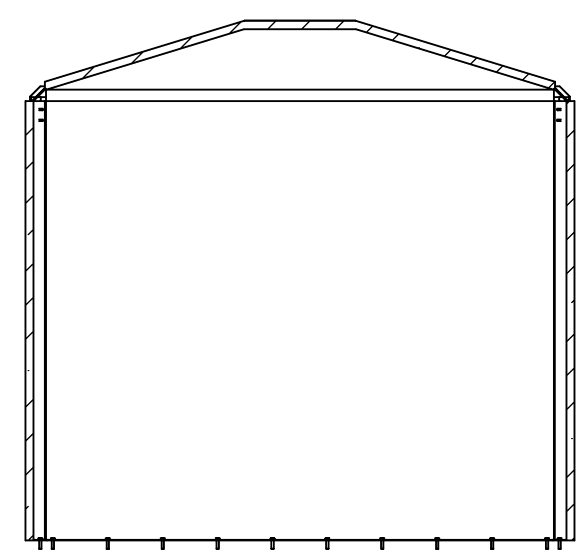
CEILING INTERIOR VIEW

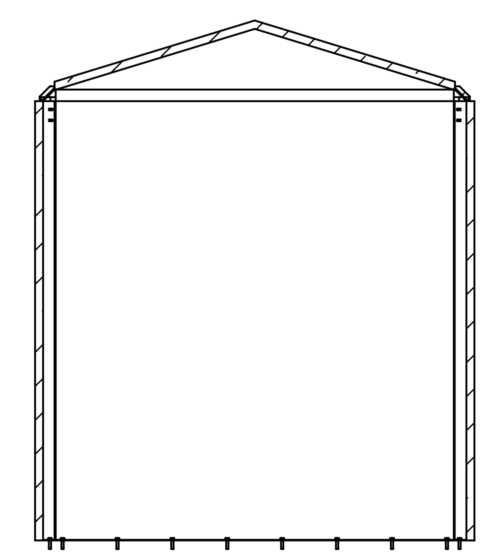


SECTION A-A
SIDE A INSIDE VIEW



SECTION B-B
SIDE B INSIDE VIEW


SECTION C-C
SIDE C INSIDE VIEW


SECTION D-D
SIDE D INSIDE VIEW

REV.	DESCRIPTION	DATE	APPROVED
-	-	-	-
-	-	-	-

RATINGS:

30 PSF SNOW LOAD
100 MPH WIND LOAD
1010 LBS APPROX. WEIGHT

INTERIOR & PLAN VIEWS

MODEL: 8' x 10' x 8' Generic Assembly

PLOT SCALE: 1:42 BY: XX DATE: XX/XX/XXXX

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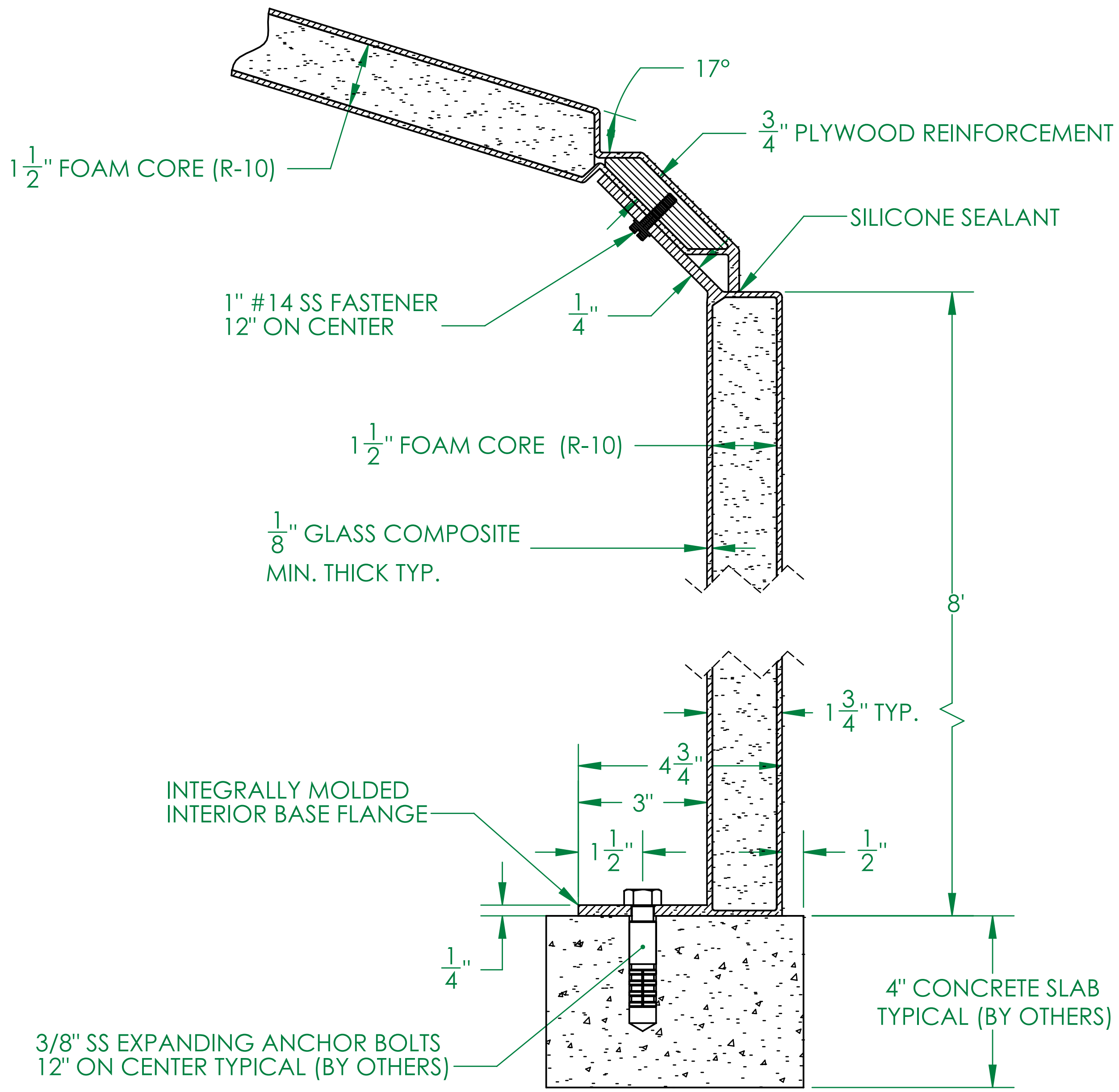
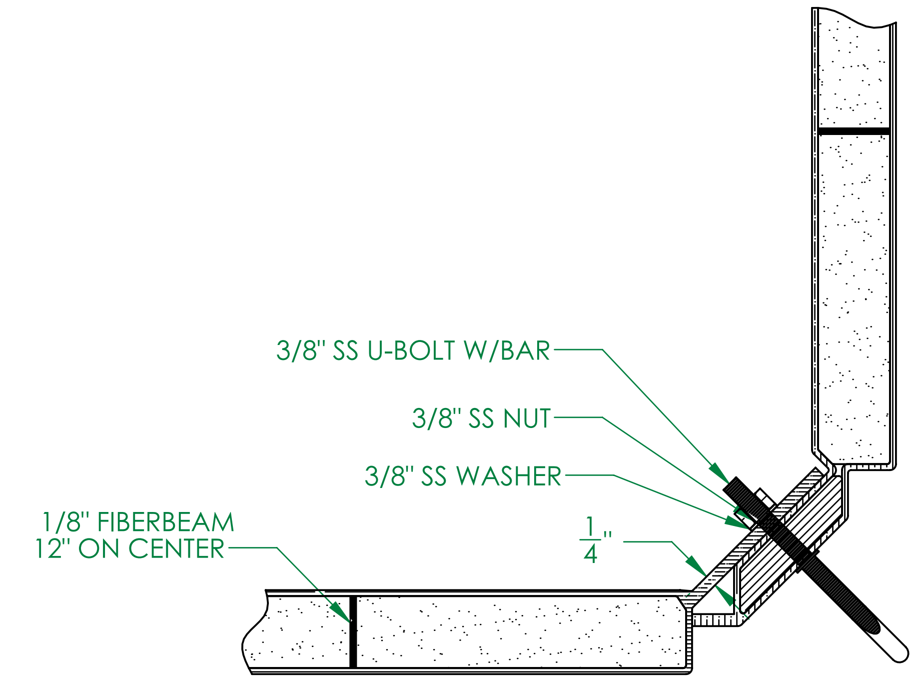
www.shelterworks.com

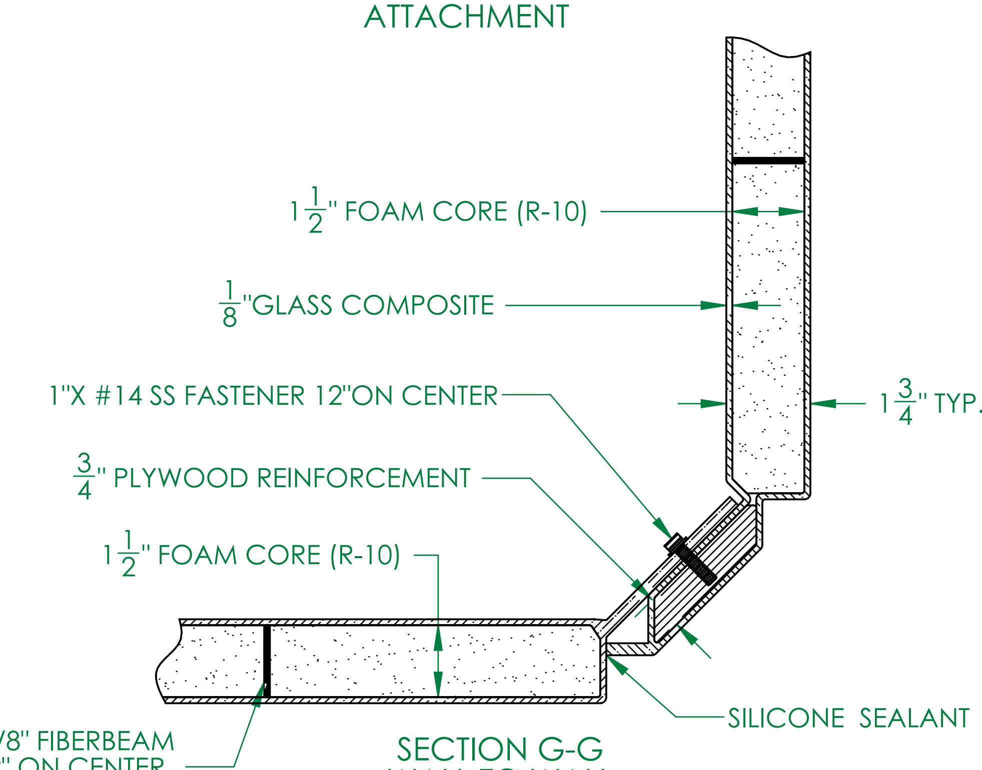
CUSTOMER: -
ORDER #: -
PROJECT: -
SIZE: B
TITLE: 8' x 10' x 8' Freedom Series Enclosure
SCALE: 1:42
DWG #: 8' x 10' x 8' Generic Assembly
SHEET: 2 OF 3



SECTION E-E
ROOF TO WALL CONSTRUCTION
AND FASTENING DETAIL



SECTION F-F
LIFT HOOK
ATTACHMENT



SECTION G-G
WALL TO WALL
CONSTRUCTION

NOTE: SHELTER WORKS ASSUMES NO RESPONSIBILITY FOR ACTUAL FOUNDATION DESIGN AND CONSTRUCTION. THE SITE CONTRACTOR IS TO VERIFY THE FINAL DIMENSIONS BASED UPON ACTUAL SITE CONDITIONS AND REQUIREMENTS.

REV.	DESCRIPTION	DATE	APPROVED
-	-	-	-
-	-	-	-

RATINGS:
30 PSF SNOW LOAD
100 MPH WIND LOAD
< 3000 LBS APPROX. WEIGHT

FASTENING & CONSTRUCTION DETAILS

MODEL:	Standard Wall Section				
PLOT SCALE:	1:4	BY:	XX	DATE:	XX/XX/XXXX

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CUSTOMER: -		ORDER #: -
PROJECT: -		SIZE: B
TITLE:	Standard 8' Freedom Series Enclosure	
SCALE: 1:4	DWG #: Standard 8' Construction Detail	SHEET: 3 OF 3

Appendix G

Pioneer Lost Creek Gathering System Plans by PSI, Inc.

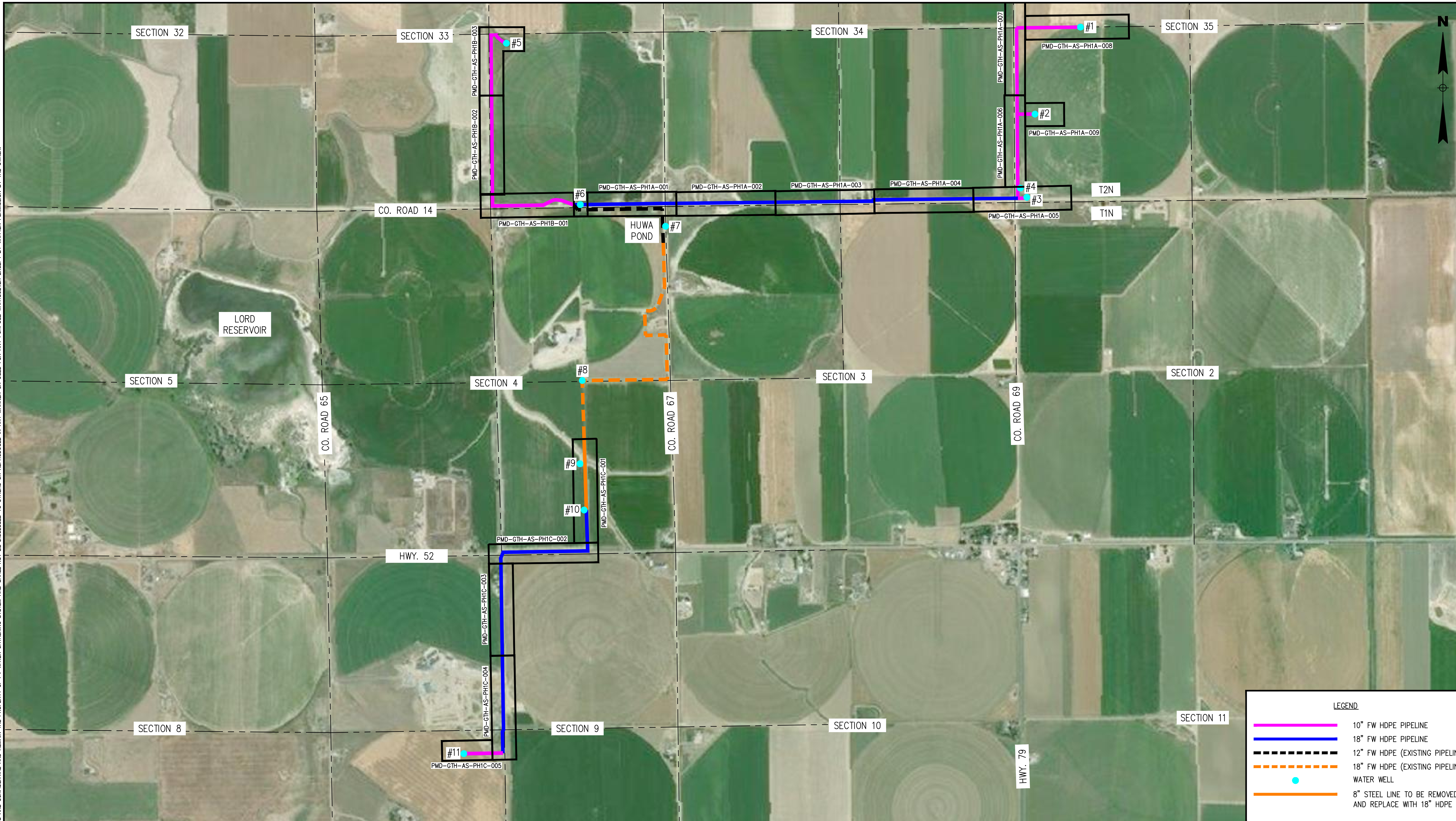
PV WATER GATHERING SYSTEM
FRESH WATER GATHERING SYSTEM–PHASE 1
DRAWING INDEX – PHASE 1B
02/16/2018

DRAWING NUMBER	DESCRIPTION	REVISION	DATE
PMD–GTH–AM–PH1–001	AREA MAP	B	02/16/2018
PMD–GTH–OS–PH1–001	OPERATIONAL SCHEMATIC (1 OF 3)	B	02/16/2018
PMD–GTH–OS–PH1–002	OPERATIONAL SCHEMATIC (2 OF 3)	B	02/16/2018
PMD–GTH–OS–PH1–003	OPERATIONAL SCHEMATIC (3 OF 3)	B	02/16/2018
PMD–GTH–BOM–PH1B–001	BILL OF MATERIALS – PHASE 1B	B	02/16/2018
PMD–GTH–AS–PH1B–001	ALIGNMENT SHEET – PHASE 1B – STATION 10+00 – 25+00	B	02/16/2018
PMD–GTH–AS–PH1B–002	ALIGNMENT SHEET – PHASE 1B – STATION 25+00 – 40+00	B	02/16/2018
PMD–GTH–AS–PH1B–003	ALIGNMENT SHEET – PHASE 1B – STATION 40+00 – 53+97	B	02/16/2018

DRAWING NUMBER	DESCRIPTION	REVISION	DATE
PMD–GTH–PID–PH1–001	PIPING AND INSTRUMENTATION DIAGRAM STANDARD SYMBOLS SHEET	A	02/02/2018
PMD–GTH–PID–PH1–002	PIPING AND INSTRUMENTATION DIAGRAM STANDARD SYMBOLS SHEET	A	02/02/2018
PMD–GTH–PID–PH1–003	PIPING AND INSTRUMENTATION DIAGRAM TYPICAL WELL WELL	B	02/16/2018
PMD–GTH–PID–PH1–004	PIPING AND INSTRUMENTATION DIAGRAM METER BUILDING HUWA POND	B	02/16/2018
PMD–GTH–PFD–PH1–001	PROCESS FLOW DIAGRAM HUWA POND	B	02/16/2018
PMD–GTH–SS–PH1B–WW5	WATER WELL #5 – PHASE 1B – PLOT PLAN, SECTION, DETAIL, ISO & BOM	B	02/16/2018
PMD–GTH–SS–PH1B–WW6	WATER WELL #6 – PHASE 1B – PLOT PLAN	B	02/16/2018
PMD–GTH–SS–PH1B–WW6A	WATER WELL #6 – PHASE 1B – SECTION, ISOMETRIC & BILL OF MATERIAL	B	02/16/2018
PMD–GTH–APS–001	ADJUSTABLE PIPING SUPPORT DETAILS	A	02/02/2018
PMD–GTH–ARV–001	3" ARV TYPICAL – ELEVATION, ISOMETRIC & BOM	A	02/12/2018
PMD–GTH–TTS–001	TRACER WIRE DETAIL	A	02/12/2018

PRELIMINARY

PLOT STYLE: PSI–PIPING.ctb
LAST SAVED: 2/15/2018 BY: BKNUDSEN
FILE LOCATION: F:\Engineering\Projects\Pioneer Metro District No.3\2017 FW Gathering System\09 Project Drawings\PMD–GTH–CVR–PH1B.dwg



NOTES:

PRELIMINARY

REFERENCE DRAWINGS

DWG NO.	TITLE

REVISIONS

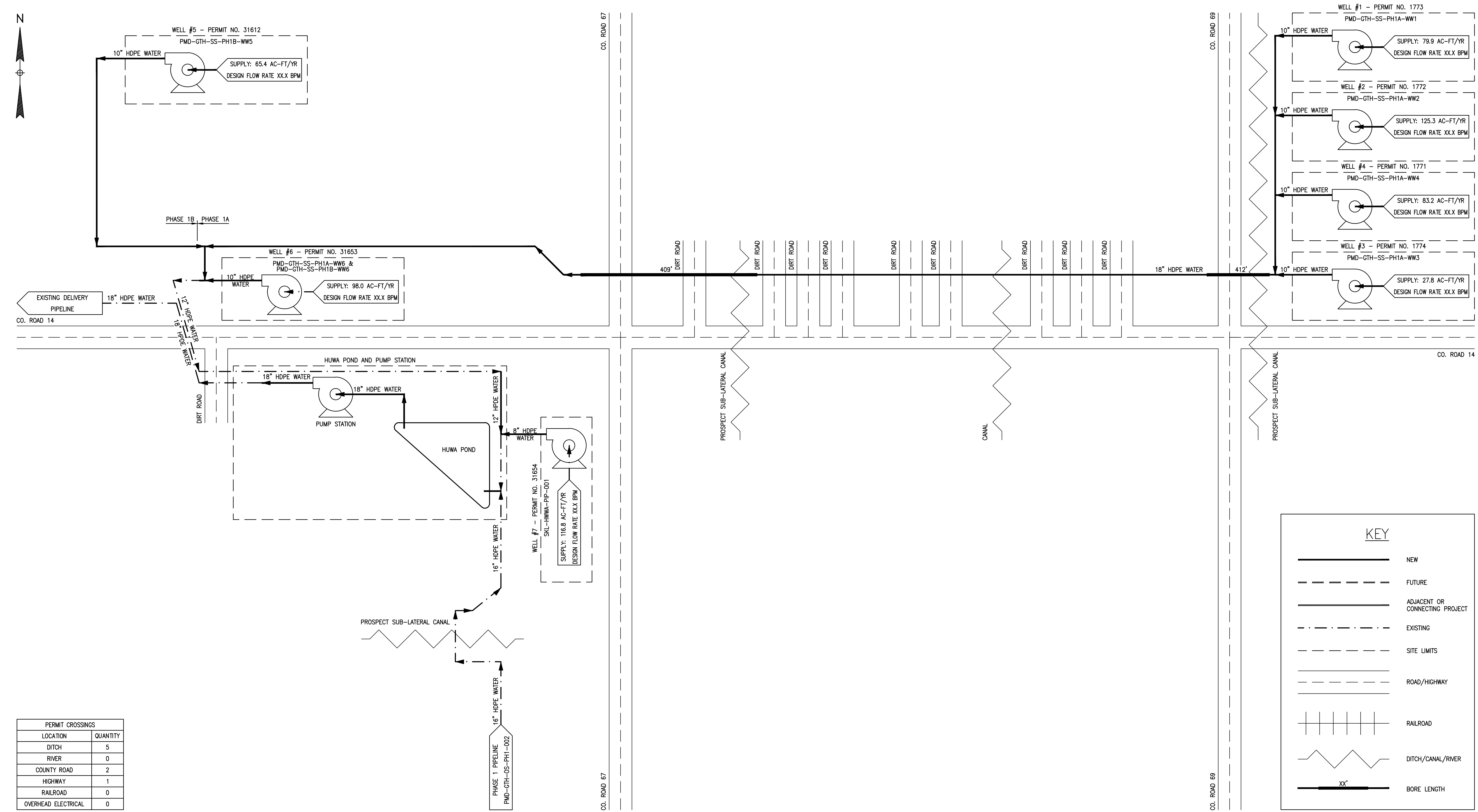
REV	DESCRIPTION	BY	DATE	CHK BY	CHK DATE	APR BY	APR DATE
B	ISSUED FOR BID	BPK	02/16/18	CRM	02/16/18		
A	ISSUED FOR BID	BPK	02/02/18	JCH	02/02/18		

PSI

PV WATER GATHERING SYSTEM
FRESH WATER GATHERING SYSTEM–PHASE 1
AREA MAP

SCALE: NTS
DRAWING NO. PMD–GTH–AM–PH1–001
REV. B

FILE PATH: P:\ENGINEERING\PROJECTS\PIONEER METRO DISTRICT NO.3\2017 FW GATHERING SYSTEM\09 PROJECT DRAWINGS\01 AREA MAP\PMD-GTH-AM-PH1-001.DWG BY:BKNUDSEN DATE:Feb 15, 2018 5:24pm PLOT STYLE: PSI Piping 11x17 COLOR.ctb



PERMIT CROSSINGS	
LOCATION	QUANTITY
DITCH	5
RIVER	0
COUNTY ROAD	2
HIGHWAY	1
RAILROAD	0
OVERHEAD ELECTRICAL	0

NOTES:

PRELIMINARY

REFERENCE DRAWINGS	
PMD–GTH–OS–PH1–002	OPERATIONAL SCHEMATIC (2 OF 3)
DWG NO.	TITLE

REVISIONS								
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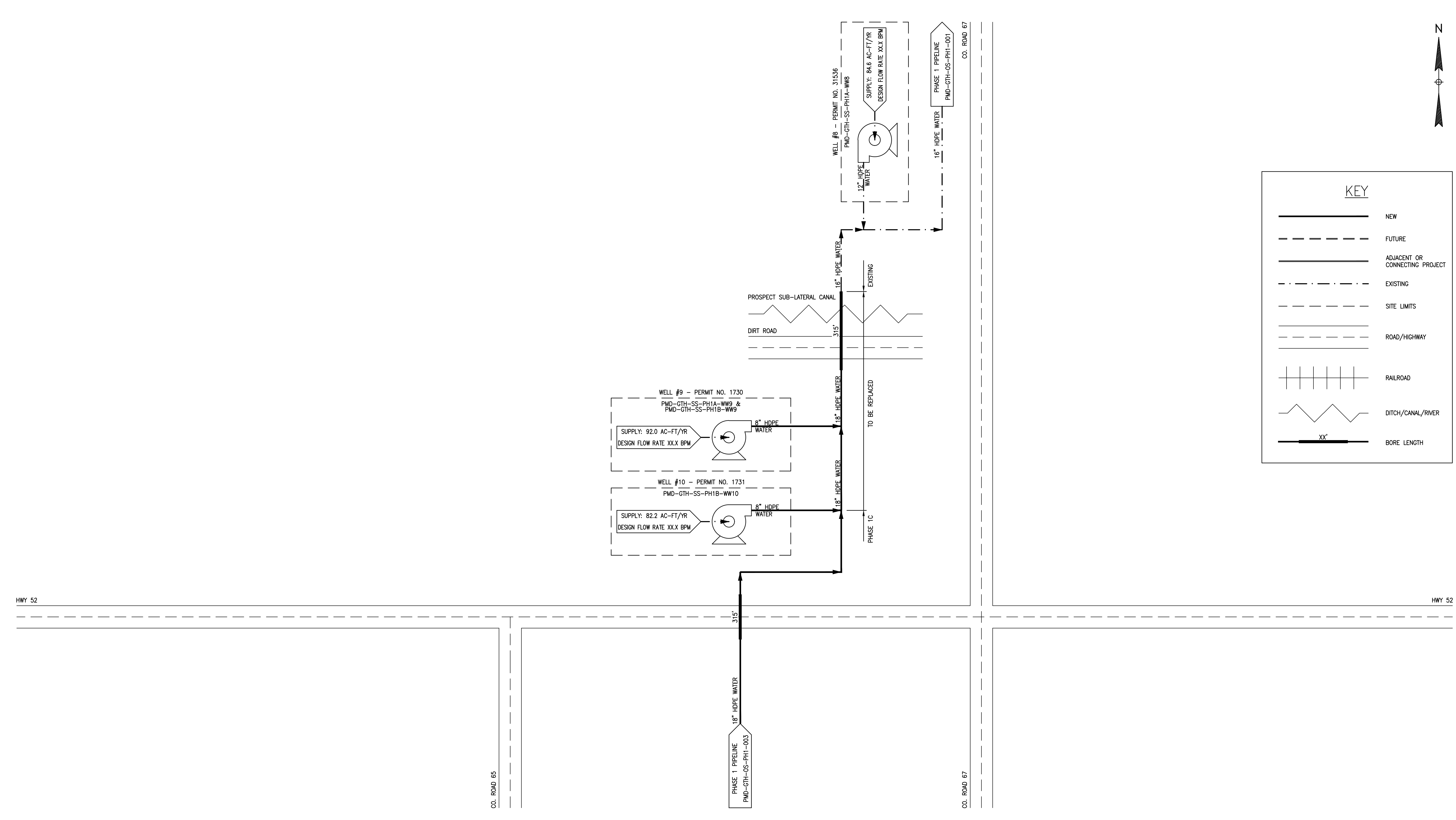
A	ISSUED FOR BID	BPK	02/02/18	JCH	02/02/18		
REV	DESCRIPTION	BY	DATE	CHK BY	CHK DATE	APR BY	APR DATE

PSI

PV WATER GATHERING SYSTEM
FRESH WATER GATHERING SYSTEM–PHASE 1
OPERATIONAL SCHEMATIC

SCALE: NTS
DRAWING NO. PMD–GTH–OS–PH1–001
REV. B

FILE PATH: P:\ENGINEERING\PROJECTS\PIONEER METRO DISTRICT NO.3\2017 FW GATHERING SYSTEM\09 PROJECT DRAWINGS\05 PFD–OPS SCH\PMD–GTH–OS–PH1–001.DWG
BY:BKNUDSEN DATE:Feb 15, 2018 5:21pm
PLOT STYLE: PSI–PIPING.ctb



NOTES:

PRELIMINARY

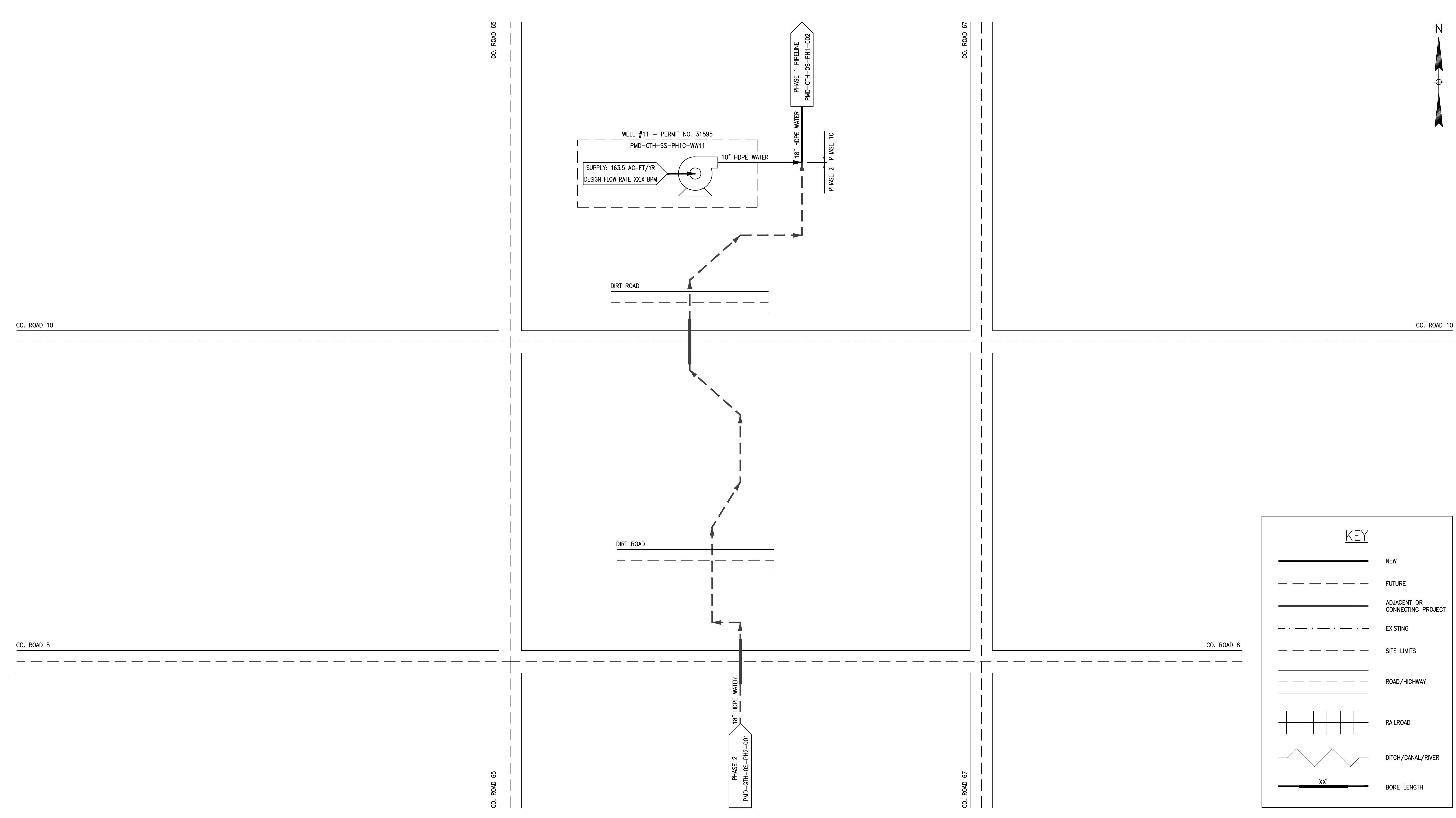
REFERENCE DRAWINGS	
PMD-GTH-OS-PH1-003	OPERATIONAL SCHEMATIC (3 OF 3)
PMD-GTH-OS-PH1-001	OPERATIONAL SCHEMATIC (1 OF 3)
DWG NO.	TITLE

REVISIONS							
B	ISSUED FOR BID	BPK	02/16/18	CRM	02/16/18		
A	ISSUED FOR BID	BPK	02/02/18	JCH	02/02/18		
REV	DESCRIPTION	BY	DATE	CHK BY	CHK DATE	APR BY	APR DATE

PV WATER GATHERING SYSTEM
FRESH WATER GATHERING SYSTEM–PHASE 1
OPERATIONAL SCHEMATIC

SCALE: NTS
DRAWING NO. PMD-GTH-OS-PH1-002
REV. B

PLOT STYLE: PSI-PIPING.ctb
BY:BKNUDSEN DATE:Feb 15, 2018 5:20pm
FILE PATH: P:\ENGINEERING\PROJECTS\PIONEER METRO DISTRICT NO.3\2017 FW GATHERING SYSTEM\09 PROJECT DRAWINGS\05 PFD-OPS SCH\PMD-GTH-OS-PH1-001.DWG



NOTES:

PRELIMINARY

REFERENCE DRAWINGS

DWG NO.	TITLE
PMD-GTH-OS-PH2-001	OPERATIONAL SCHEMATIC (1 OF 3)
PMD-GTH-OS-PH1-002	OPERATIONAL SCHEMATIC (2 OF 3)

REVISIONS

REV	DESCRIPTION	BY	DATE	CHK BY	CHK DATE	APR BY	APR DATE
B	ISSUED FOR BID	BPK	02/16/18	CRM	02/16/18		
A	ISSUED FOR BID	BPK	02/02/18	JCH	02/02/18		

PSI

PV WATER GATHERING SYSTEM
FRESH WATER GATHERING SYSTEM-PHASE 1
OPERATIONAL SCHEMATIC

SCALE: NTS
DRAWING NO. PMD-GTH-OS-PH1-003
REV. B

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BY:BKNUDSEN DATE:Feb 15, 2018 5:20pm
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PV WATER GATHERING SYSTEM
FRESH WATER GATHERING SYSTEM–PHASE 1
BILL OF MATERIALS – PHASE 1B
02/16/2018

FRESH WATER SERVICE

QUANTITY	UNIT	DESCRIPTION
4,397	FT	10.750" PIPE x SDR–17, HDPE, ASTM D3350, CL PE445474C–PE4710 TO ASTM F714
3	EA	TRI–VIEW TEST STATION/MARKER
8,794	FT	TRACER WIRE
13	EA	PIPELINE MARKER (LIQUID)
2	EA	10" ELBOW, 90–DEG, FE, HDPE, SDR–17, ASTM D3350 CL PE445474C–PE4710 TO ASTM D3261, ASTM F2206
1	EA	10" ELBOW, 55–DEG, FE, HDPE, SDR–17, ASTM D3350 CL PE445474C–PE4710 TO ASTM D3261, ASTM F2206
1	EA	3" ARV TYPICAL

NOTES:

PRELIMINARY

REFERENCE DRAWINGS

DWG NO.	TITLE

REVISIONS

REV	DESCRIPTION	BY	DATE	CHK BY	CHK DATE	APR BY	APR DATE
B	ISSUED FOR BID	BPK	02/16/18	CRM	02/16/18		
A	ISSUED FOR BID	BPK	02/12/18	CRM	02/12/18		

PV WATER GATHERING SYSTEM
FRESH WATER GATHERING SYSTEM–PHASE 1
BILL OF MATERIALS – PHASE 1B

SCALE: NTS
DRAWING NO. PMD–GTH–BOM–PH1B–001
REV. B

PLOT STYLE: PSI–PIPING.ctb
BY:BKNUDSEN DATE:Feb 15, 2018 6:04pm
FILE PATH: P:\ENGINEERING\PROJECTS\PIONEER METRO DISTRICT NO.3\2017 FW GATHERING SYSTEM\09 PROJECT DRAWINGS\02 ALIGNMENT SHEETS\PMD–GTH–BOM–PH1B–001.DWG

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OWNERS: GERALD & KELLY GRAYBILL – 1500'

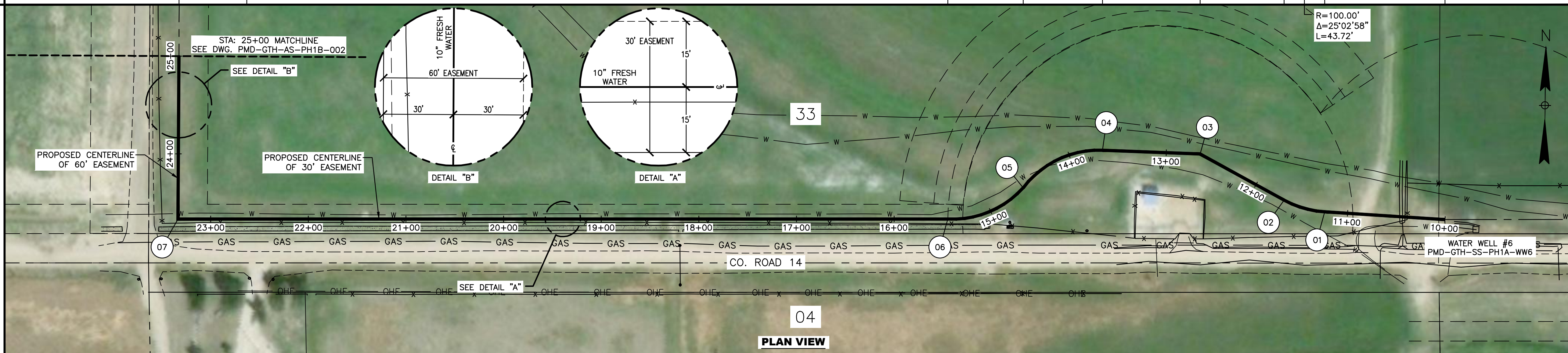
PIPELINE STATIONS AT ALIGNMENT ℄

25+00 = MATCHLINE
23+39 = EX. WATER
23+33 = PI 90°19' RT
15+45 = PI
15+30 = EX. WELL EASEMENT
14+99 = EX. WATER
14+59 = PT
14+29 = EX. WATER
13+65 = PI
12+66 = PI 26°26' LT
11+67 = PI
11+23 = PI
10+95 = EX. WELL EASEMENT
10+43 = ℄ DITCH
10+39 = EX. FENCE
10+06 = 1/4 SECTION LINE
10+00 = BEGIN

BEARING / HORIZ. DIST.

N00°29'38"W 166.57' (07) S89°11'13"W 788.38' (06) R=97.50' Δ=50°42'30" L=86.28' (05) R=97.50' Δ=54°44'41" L=93.58' (04) N88°33'06"W 99.89' (03) N62°07'25"W 98.10' (02) R=100.00' Δ=25°02'58" L=43.72' (01) N87°10'23"W 123.49'

ALIGNMENT STRIP MAP



10" FRESH WATER (FW) MOP = 125 PSIG

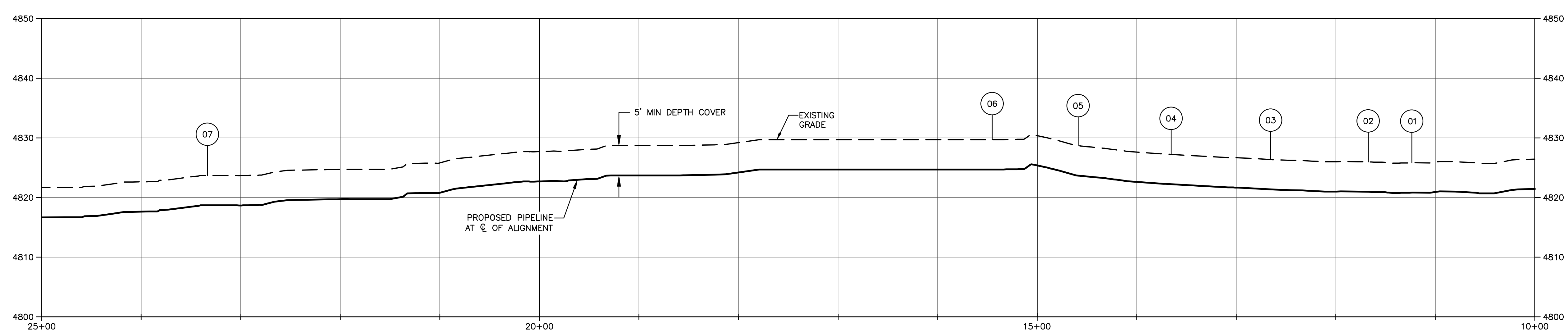
ARV 15+40

1500' 10.750" OD x SDR-17, PE4710

TS

PMD-GTH-SS-PH1A-WW6

PROFILE VERTICAL SCALE: 1" = 10'



PROFILE VIEW
PROFILE HORIZONTAL SCALE: 1" = 60'

COLORADO 811

BILL OF MATERIALS

PIPE QUANTITIES – THIS DRAWING

SERVICE	OD	WT	GR	LF	MFR
FW	10.750"	SDR-17	PE4710	1,500'	TBD

MATERIAL QUANTITIES – THIS DRAWING

DESCRIPTION	QUANTITY
TRI-VIEW TEST STATION/MARKER	1
TRACER WIRE	3000'
PIPELINE MARKER (LIQUID)	8
ELBOW, 90-DEG, FE, HDPE, SDR-17, ASTM D3350 CL PE445474C-PE4710 TO ASTM D3261, ASTM F2206	1

FIELD NOTES

1. ALL STATIONING IS TO CENTERLINE OF PIPELINE/ALIGNMENT.
2. TEST: SEE TEST FORM
3. CODES: THIS PIPELINE(S) INSTALLED UNDER THE FOLLOWING:
   A. ALL APPLICABLE PERMITS
   B. COMPANY STANDARDS
4. PIPELINE LINE MARKERS WILL BE INSTALLED AT EVERY ROAD CROSSING, ROW BOUNDARY, FENCE LINE AND PI.
5. ALL INFORMATION IS PROVIDED IN THE UTMOST GOOD FAITH BASED UPON THE BEST INFORMATION AVAILABLE AT THE TIME, INCLUDING EVERY REASONABLE EFFORT TO ENSURE THE ACCURACY AND VALIDITY OF INFORMATION PROVIDED, ERRORS AND OMISSIONS EXPECTED.
6. PSI, LLC AND PV WATER GATHERING SYSTEM, ARE NOT RESPONSIBLE FOR THE LOCATION OF FOREIGN UTILITIES, PIPELINES, OR THIRD PARTY SUBSURFACE STRUCTURES. THE INFORMATION SHOWN HEREIN IS FURNISHED WITHOUT LIABILITY ON THE PART OF PSI, LLC OR PV WATER GATHERING SYSTEM FOR ANY DAMAGES RESULTING FROM ERRORS OR OMISSIONS THEREIN.
7. CONTRACTOR SHALL BE RESPONSIBLE FOR LOCATING ALL FOREIGN UTILITIES, PIPELINES, OR THIRD PARTY SUBSURFACE STRUCTURES PRIOR TO CONSTRUCTION.
8. CONTRACTOR SHALL BE RESPONSIBLE FOR CONTACTING ONE-CALL AT 811 OR 800-922-1987, AT LEAST 72 HOURS BEFORE DIGGING.

SCALE & PROJECTION

0 60' 120'
SCALE: 1"=60'

LOCATION: SECTION 33, T2N, R63W

PROJECTION: COLORADO STATE PLANES, NAD83, NORTH ZONE, US FOOT

LEGEND

℄ OF PROPOSED PIPELINE
EXISTING PIPELINE
GAS — GAS EXISTING GAS LINE
EXISTING WATER LINE
ROW OR EASEMENT
SECTION LINE
ROAD
FENCE
DITCH
UGE UNDERGROUND ELECTRICAL
OHE OVERHEAD ELECTRICAL
RAILROAD
PI
MILE MARKER
ARV VALVE/AIR RELIEF VALVE
CLOSURE
TS TEST STATION

NOTES:

PRELIMINARY

REFERENCE DRAWINGS

DWG NO.	TITLE
PMD-GTH-TTS-001	TRACER WIRE DETAIL
PMD-GTH-ARV-001	3" ARV TYPICAL
PMD-GTH-SS-PH1B-WW6	WATER WELL #6
PMD-GTH-AS-PH1B-002	ALIGNMENT SHEET – PHASE 1B – STATION 25+00 – 40+00

REVISIONS

REV	DESCRIPTION	BY	DATE	CHK BY	CHK DATE	APR BY	APR DATE
B	ISSUED FOR BID	BPK	02/16/18	CRM	02/16/18		
A	ISSUED FOR BID	BPK	02/12/18	CRM	02/12/18		

PSI

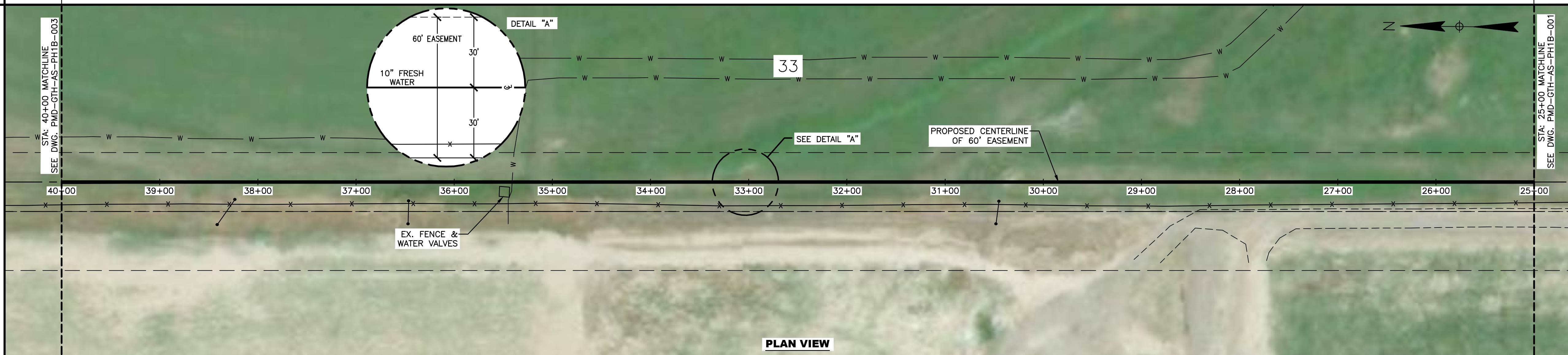
PV WATER GATHERING SYSTEM
FRESH WATER GATHERING SYSTEM–PHASE 1
ALIGNMENT SHEET – PHASE 1B
STATION 10+00 – 25+00

SCALE: AS NOTED
DRAWING NO. PMD-GTH-AS-PH1B-001
REV. B

PLOT STYLE: PSI-PIPING.ctb
BY:BKNUDSEN DATE:Feb 15, 2018 6:04pm
FILE PATH: P:\ENGINEERING\PROJECTS\PIONEER METRO DISTRICT NO.3\2017 FW GATHERING SYSTEM\09 PROJECT DRAWINGS\02 ALIGNMENT SHEETS\PMD-GTH-AS-PH1B-001.DWG

OWNERS	GERALD & KELLY GRAYBILL – 1500'
PIPELINE STATIONS AT ALIGNMENT ℄	40+00 = MATCHLINE; 35+41 = EX. WATER; 25+00 = MATCHLINE
BEARING	N00°29'38"W
HORIZ. DIST.	1500.00'

ALIGNMENT STRIP MAP



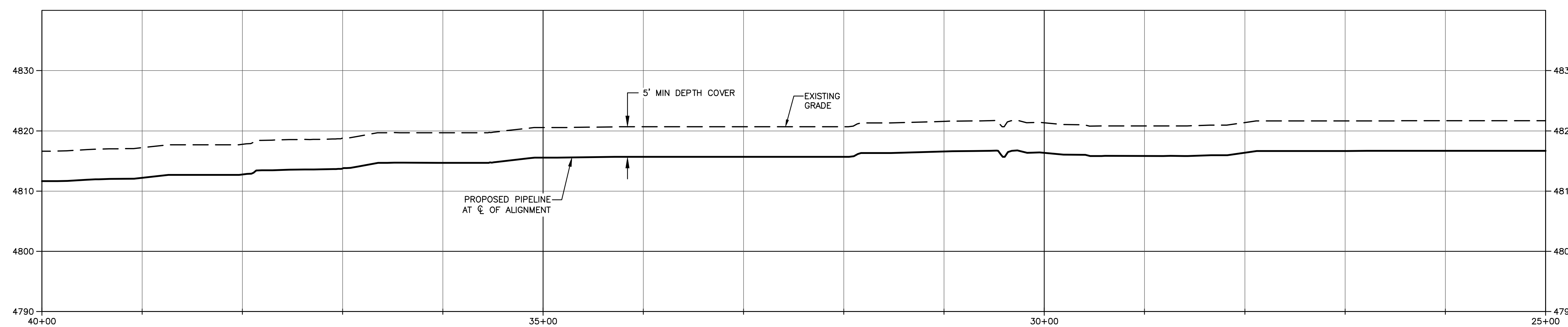
PLAN VIEW

10" FRESH WATER (FW) MOP = 125 PSIG

1500' 10.750" OD x SDR-17, PE4710

TS

PROFILE
PROFILE VERTICAL SCALE: 1" = 30'



PROFILE VIEW

PROFILE HORIZONTAL SCALE: 1" = 60'

COLORADO 811

BILL OF MATERIALS

PIPE QUANTITIES – THIS DRAWING

SERVICE	OD	WT	GR	LF	MFR
FW	10.750"	SDR-17	PE4710	1500'	TBD

MATERIAL QUANTITIES – THIS DRAWING

DESCRIPTION	QUANTITY
TRI-VIEW TEST STATION/MARKER	1
TRACER WIRE	3000'

FIELD NOTES

1. ALL STATIONING IS TO CENTERLINE OF PIPELINE/ALIGNMENT.
2. TEST: SEE TEST FORM
3. CODES: THIS PIPELINE(S) INSTALLED UNDER THE FOLLOWING:
   A. ALL APPLICABLE PERMITS
   B. COMPANY STANDARDS
4. PIPELINE LINE MARKERS WILL BE INSTALLED AT EVERY ROAD CROSSING, ROW BOUNDARY, FENCE LINE AND PI.
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8. CONTRACTOR SHALL BE RESPONSIBLE FOR CONTACTING ONE-CALL AT 811 OR 800-922-1987, AT LEAST 72 HOURS BEFORE DIGGING.

SCALE & PROJECTION

0 60' 120'

SCALE: 1"=60'

LOCATION: SECTION 33, T2N, R63W

PROJECTION: COLORADO STATE PLANES, NAD83, NORTH ZONE, US FOOT

LEGEND

- ℄ OF PROPOSED PIPELINE
- EXISTING PIPELINE
- GAS — GAS — EXISTING GAS LINE
- W — EXISTING WATER LINE
- ROW OR EASEMENT
- SECTION LINE
- ROAD
- X — X — FENCE
- DITCH
- UGE — UNDERGROUND ELECTRICAL
- OHE — OVERHEAD ELECTRICAL
- RAILROAD
- 1 — PI
- 1 MM — MILE MARKER
- ARV — VALVE/AIR RELIEF VALVE
- CLOSURE
- TS — TEST STATION

NOTES:

PRELIMINARY

REFERENCE DRAWINGS

DWG NO.	TITLE
PMD-GTH-TTS-001	TRACER WIRE DETAIL
PMD-GTH-AS-PH1B-003	ALIGNMENT SHEET – PHASE 1B – STATION 40+00 – 53+97
PMD-GTH-AS-PH1B-001	ALIGNMENT SHEET – PHASE 1B – STATION 10+00 – 25+00

REVISIONS

REV	DESCRIPTION	BY	DATE	CHK BY	CHK DATE	APR BY	APR DATE
B	ISSUED FOR BID	BPK	02/16/18	CRM	02/16/18		
A	ISSUED FOR BID	BPK	02/12/18	CRM	02/12/18		

PSI

PV WATER GATHERING SYSTEM
FRESH WATER GATHERING SYSTEM–PHASE 1
ALIGNMENT SHEET – PHASE 1B
STATION 25+00 – 40+00

SCALE: AS NOTED | DRAWING NO. PMD-GTH-AS-PH1B-002 | REV. B

FILE PATH: P:\ENGINEERING\PROJECTS\PIONEER METRO DISTRICT NO.3\2017 FW GATHERING SYSTEM\09 PROJECT DRAWINGS\02 ALIGNMENT SHEETS\PMD-GTH-AS-PH1B-002.DWG BY:BKNUDSEN DATE:Feb 15, 2018 6:04pm PLOT STYLE: PSI-PIPING.ctb

OWNERS: GERALD & KELLY GRAYBILL – 479' | GERALD & KELLY GRAYBILL – 918'

PIPELINE STATIONS AT ALIGNMENT ℄

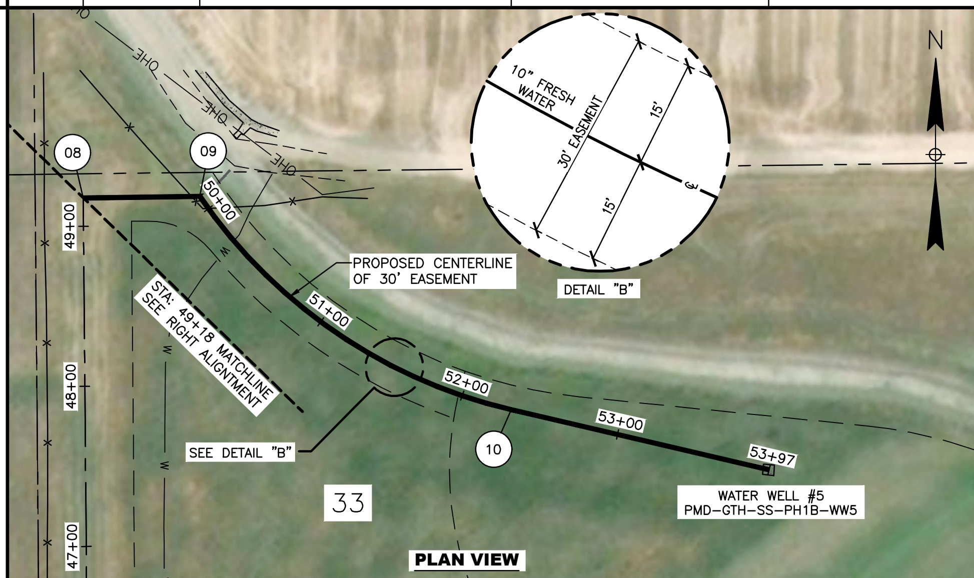
49+18 = MATCHLINE/ PI 89°48' RT
49+86 = EX. FENCE
49+91 = PI
50+00 = EX. FENCE
50+26 = EX. WATER
51+98 = EX. WELL EASEMENT
53+97 = END
49+18 = MATCHLINE
40+00 = MATCHLINE

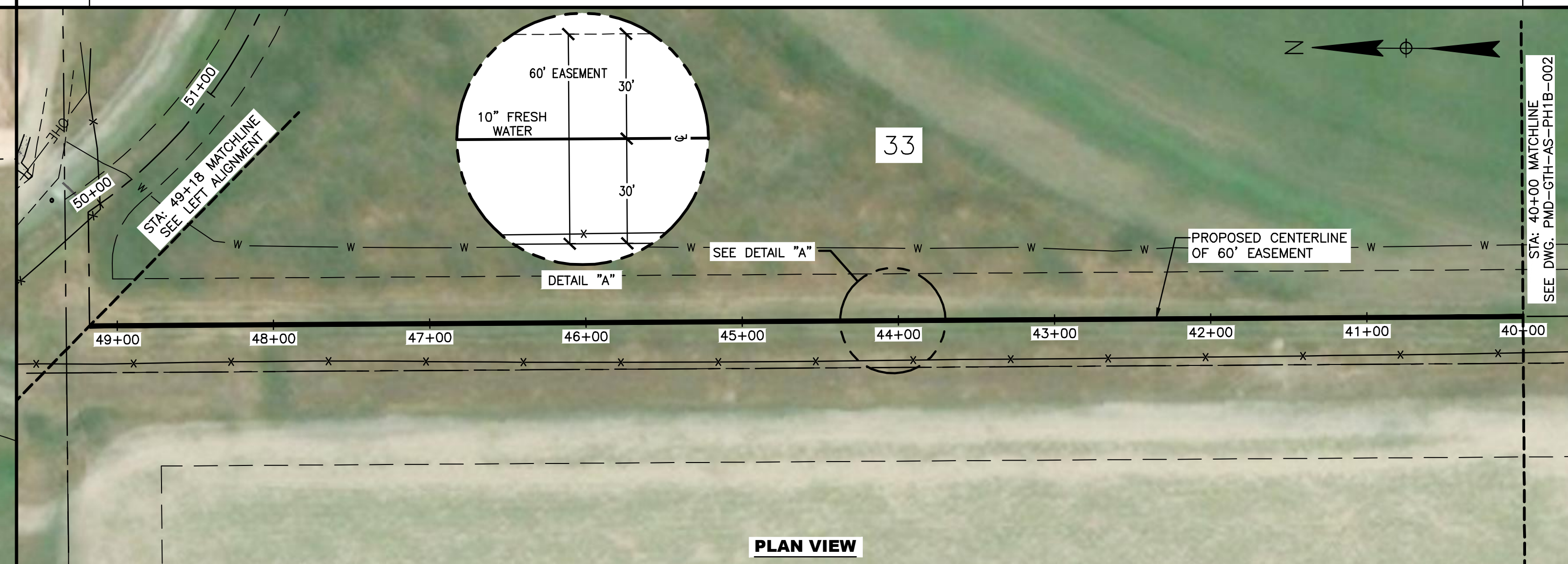
BEARING / HORIZ. DIST.

08 N89°17'53"E 72.84' 09 R=324.91' Δ=42°32'49" L=241.27' 10 S76°51'54"E 165.24'

N00°29'38"W 917.81'

ALIGNMENT STRIP MAP



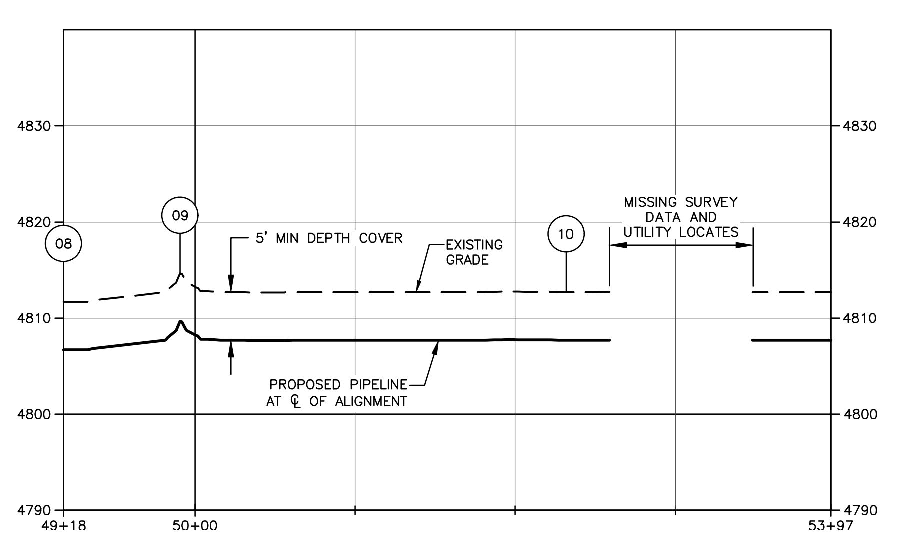


10" FRESH WATER (FW) MOP = 125 PSIG

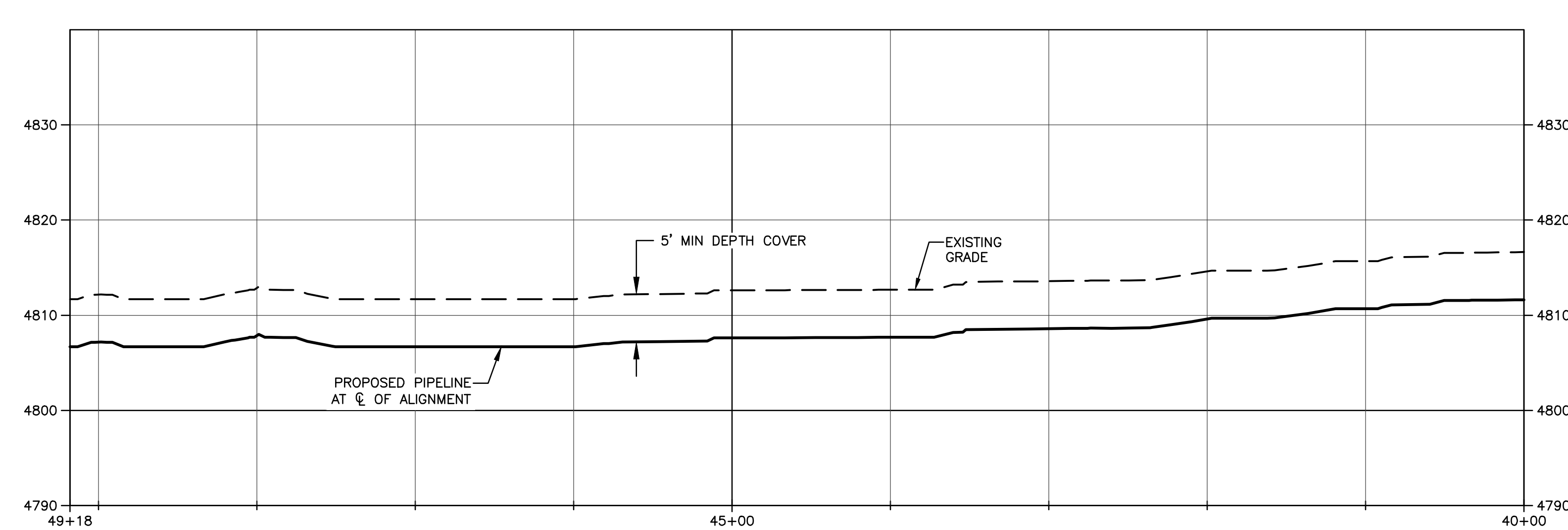
479' 10.750" OD x SDR-17, PE4710 — TS — PMD-GTH-SS-PH1B-WW5

918' 10.750" OD x SDR-17, PE4710

PROFILE
PROFILE VERTICAL SCALE: 1" = 10'



PROFILE VIEW
PROFILE HORIZONTAL SCALE: 1" = 60'



PROFILE VIEW
PROFILE HORIZONTAL SCALE: 1" = 60'

COLORADO 811

BILL OF MATERIALS

PIPE QUANTITIES – THIS DRAWING

SERVICE	OD	WT	GR	LF	MFR
FW	10.750"	SDR-17	PE4710	1397'	TBD

MATERIAL QUANTITIES – THIS DRAWING

DESCRIPTION	QUANTITY
TRI-VIEW TEST STATION/MARKER	1
TRACER WIRE	2794'
PIPELINE MARKER (LIQUID)	5
10" ELBOW, 90-DEG, FE, HDPE, SDR-17, ASTM D3350 CL PE445474C-PE4710 TO ASTM D3261, ASTM F2206	1
10" ELBOW, 55-DEG, FE, HDPE, SDR-17, ASTM D3350 CL PE445474C-PE4710 TO ASTM D3261, ASTM F2206	1

FIELD NOTES

1. ALL STATIONING IS TO CENTERLINE OF PIPELINE/ALIGNMENT.
2. TEST:SEE TEST FORM
3. CODES: THIS PIPELINE(S) INSTALLED UNDER THE FOLLOWING:
   A. ALL APPLICABLE PERMITS
   B. COMPANY STANDARDS
4. PIPELINE LINE MARKERS WILL BE INSTALLED AT EVERY ROAD CROSSING, ROW BOUNDARY, FENCE LINE AND PI.
5. ALL INFORMATION IS PROVIDED IN THE UTMOST GOOD FAITH BASED UPON THE BEST INFORMATION AVAILABLE AT THE TIME, INCLUDING EVERY REASONABLE EFFORT TO ENSURE THE ACCURACY AND VALIDITY OF INFORMATION PROVIDED, ERRORS AND OMISSIONS EXPECTED.
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SCALE & PROJECTION

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SCALE: 1"=60'

LOCATION: SECTION 33, T2N, R63W

PROJECTION: COLORADO STATE PLANES, NAD83, NORTH ZONE, US FOOT

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- EXISTING PIPELINE
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- UGE UNDERGROUND ELECTRICAL
- OHE OVERHEAD ELECTRICAL
- RAILROAD
- 1 PI
- 1 MM MILE MARKER
- ARV VALVE/AIR RELIEF VALVE
- CLOSURE
- TS TEST STATION

NOTES:

PRELIMINARY

REFERENCE DRAWINGS

DWG NO.	TITLE
PMD-GTH-TTS-001	TRACER WIRE DETAIL
PMD-GTH-SS-PH1B-WW5	WATER WELL #5
PMD-GTH-AS-PH1B-002	ALIGNMENT SHEET – PHASE 1B – STATION 25+00 – 40+00

REVISIONS

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B	ISSUED FOR BID	BPK	02/16/18	CRM	02/16/18		
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PSI

PV WATER GATHERING SYSTEM
FRESH WATER GATHERING SYSTEM-PHASE 1
ALIGNMENT SHEET – PHASE 1B
STATION 40+00 – 53+97

SCALE: AS NOTED | DRAWING NO. PMD-GTH-AS-PH1B-003 | REV. B

PLOT STYLE: PSI-PIPING.ctb
BY:BKNUDSEN DATE:Feb 15, 2018 6:05pm
FILE PATH: P:\ENGINEERING\PROJECTS\PIONEER METRO DISTRICT NO.3\2017 FW GATHERING SYSTEM\09 PROJECT DRAWINGS\02 ALIGNMENT SHEETS\PMD-GTH-AS-PH1B-003.DWG

LINE SERVICE IDENTIFICATION CODE

AD – ACID DRAIN	LF – LOW PRESSURE FLARE
AF – ACID FLARE	LG – LEAN GLYCOL
AG – ACID GAS	LH – LIQUID HYDROCARBON
AO – ABSORPTION OIL	LO – LUBE OIL
AV – ATMOSPHERIC VENT	LS – LOW PRESSURE STEAM
B – N-BUTANE	M – METHANE
BA – BREATHING AIR	MC – MEDIUM PRESSURE CONDENSATE
BD – BUILDING DRAIN	MD – MEDIUM PRESSURE DRAIN
BG – BLANKET GAS	MF – MEDIUM PRESSURE FLARE
BV – BLOWDOWN VENT	MS – MEDIUM PRESSURE STEAM
BW – BOILER FEED WATER	N – NITROGEN
C – CAUSTIC	NG – NATURAL GAS
CA – COMBUSTION AIR	O – OIL
CD – CLOSED DRAIN	OD – OPEN DRAIN
CW – COLD WATER	OV – OIL VENT
DA – DRAIN, ATMOSPHERIC	P – PROPANE
DF – DIESEL FUEL	PA – PROCESS AIR
DP – DRAIN, PRESSURED	PC – PROCESS CONDENSATE
DS – DRAIN, SOLVENT	PF – PROCESS FLARE
DW – DECHILLED WATER	PG – POWER GAS
E – ETHANE	PV – PROCESS VENT
F – FLARE	PW – POTABLE WATER
FG – FUEL GAS	RA – RICH AMINE
FW – FIRE WATER	RG – RICH GLYCOL
G – GLYCOL	RW – RAW WATER
GH – GAS HYDROCARBON	S – STEAM
H – HYDROGEN SULFIDE	SA – STARTING AIR
HC – HIGH PRESSURE CONDENSATE	SG – STARTING GAS
HD – HIGH PRESSURE DRAIN	SO – SEAL OIL
HF – HIGH PRESSURE FLARE	SW – SOUR (PRODUCED) WATER
HO – HOT OIL	TG – TREATED GAS
HS – HIGH PRESSURE STEAM	TW – TREATED WATER
HW – HOT WATER	UA – UTILITY AIR
I – ISOBUTANE	UV – UTILITY VENT
IA – INSTRUMENT AIR	UW – UTILITY WATER
IG – INSTRUMENT GAS	WS – WATER SERVICE
JW – JACKET WATER	WW – WASTE WATER
LA – LEAN AMINE	V – VENT (ATMOSPHERIC)
LC – LOW PRESSURE CONDENSATE	VG – VENT GAS
LD – LOW PRESSURE DRAIN	

NOTE: THIRD LETTER DESIGNATIONS WILL BE USED IN PLACES WHERE ADDITIONAL INFORMATION IS REQUIRED. EXAMPLE: S – SUPPLY, R – RETURN

EQUIPMENT IDENTIFICATION CODE AND NUMBERING SYSTEM

TK–(100'S)TANK ATMOSPHERE	H –(600'S)FIRED HEATERS
VA–(200'S)SPECIALTY VALVES	V –(700'S)VESSEL, PROCESS
M –(300'S)METER	F –(800'S)FILTER
P –(400'S)PUMP	S –(900'S)SLOP SYSTEM
C –(500'S)COMPRESSOR	

INSULATION AND TRACE CODE

INSULATION TYPE	TRACE TYPE
C=COLD	ET=ELECTRIC
H=HOT	G=GLYCOL
P=PROCESS	O=OIL
PP=PERSONNEL PROTECTION	S=STEAM

EQUIPMENT NUMBERING STANDARD

XX–XXX

EQUIPMENT IDENTIFICATION CODE

MAIN PROCESS LINE NO. PRECEEDING EQUIPMENT (AS SHOWN ON PROJECT MFD)

MISC GRAPHIC SYMBOLS

INDICATES PROCESS INPUT/OUTPUT & FLOW DIRECTION FROM OR TO OTHER AREAS

INDICATES INSTRUMENTATION INPUT/OUTPUT FROM OR TO OTHER AREAS

INDICATES PROCESS INPUT/OUTPUT & FLOW DIRECTION FROM OR TO OTHER AREAS

FLOW DIRECTION ARROW

FLOW SHEET LINE TYPES

- MAJOR PROCESS LINE
- EXISTING MAJOR PROCESS LINE
- FUTURE MAJOR PROCESS LINE
- MINOR PROCESS LINE
- EXISTING MINOR PROCESS LINE
- FUTURE MINOR PROCESS LINE
- SKID LIMITS
- CENTERLINE
- ELECTRIC LINE
- PNEUMATIC TUBING LINE
- CAPILLARY TUBE
- HYDRAULIC LINE
- ELECTROMAGNETIC OR SONIC LINE
- SOFTWARE LINK
- STEAM HEAT TRACING
- BATTERY LIMIT

VALVE CONNECTIONS

- FLANGED VALVE
- SOCKETWELD VALVE
- THREADED VALVE

VALVES

- BALL VALVE
- GATE VALVE
- GLOBE VALVE
- PLUG VALVE
- CHECK VALVE
- BUTTERFLY VALVE
- DIAPHRAGM VALVE
- ANGLE VALVE
- PRESSURE RELIEF VALVE
- VALVE WITH INTEGRAL BLEED
- NEEDLE VALVE
- THREE-WAY VALVE
- FOUR-WAY VALVE
- PRESSURE REDUCING REGULATOR SELF-CONTAINED
- PRESSURE REDUCING REGULATOR WITH EXTERNAL PRESSURE TAP
- BLEED RING
- CHOKE VALVE ANGLE
- CHOKE VALVE IN-LINE

VALVE ACTUATORS

- DIAPHRAGM ACTUATOR
- ELECTRIC MOTOR
- PISTON OPERATOR
- SOLENOID OPERATOR WITH MANUAL RESET
- HANDWHEEL (SHOWN ONLY FOR EXTENDED SPINDLES)
- VANE ACTUATOR
- MANUAL HANDWHEEL OVERRIDE
- DIAPHRAGM W/POSITIONER
- DIGITAL

FLOW SYMBOLS

- INSULATION
- INSULATION W/ ELEC. TRACE
- VESSEL INSULATION
- CONCENTRIC REDUCER
- ECCENTRIC REDUCER
- SWAGE REDUCER
- UNION
- HOSE CONNECTION
- TRUCK CONNECTION
- CAP OR PLUG
- PLUG
- BLIND FLANGE OR LINE TERMINATION
- BREAKOUT FLANGES
- TEST RING
- PADDLE BLIND
- SPECTACLE BLIND
- V-CONE
- FLEXIBLE HOSE
- EXPANSION JOINT OR FLEXIBLE CONNECTION
- METER TUBE WITH ORIFICE FLANGES
- METER TUBE WITH REMOVABLE PLATE
- METER TUBE WITH REMOVABLE PLATE AND STRAIGHT VANES
- ROTAMETER
- CORIOLIS METER
- TURBINE METER
- AIR VENT (AUTOMATIC)
- VORTEX METER
- MAG METER

FLOW SYMBOLS

- STREAM TRAP
- VENTURI TUBE OR FLOW NOZZLE
- PITOT TUBE OR PITOT VENTURI TUBE
- CHEMICAL SEAL
- RUPTURE DISK / PIN (PRESSURE)
- RUPTURE DISK / PIN (VACUUM)
- "Y" TYPE STRAINER
- CONICAL OR TEMPORARY STRAINER
- BASKET STRAINER
- FILTER
- CHEMICAL INJECTION
- CHANGE IN CONDITIONS PIPING SPEC ABOVE GR/BELOW GR DRAWING TYPE OWNERSHIP
- RETRACTABLE CORROSION BLOCK VALVE COUPON W/FULL OPENING
- INSULATING GASKET
- FLAME ARRESTOR
- PULSATION DAMPNER
- THIEF HATCH

INSTRUMENTATION

- LOCAL PANEL SOFTWARE FUNCTION
- MAIN PANEL SOFTWARE FUNCTION
- MAIN PANEL SOFTWARE FUNCTION OPERATOR VISIBLE
- LOCALLY MOUNTED INSTRUMENT
- FRONT PANEL MOUNTED INSTRUMENT
- BACK PANEL MOUNTED INSTRUMENT
- LOCAL FRONT PANEL MOUNTED INSTRUMENT
- LOCAL BACK PANEL MOUNTED INSTRUMENT
- HEAT TRACED INSTRUMENT
- COMBINATION INSTRUMENT
- PC – COMPUTER
- S – PC KEYBOARD FUNCTION
- OR – LOGIC OR
- I – LOGIC INTERLOCK
- RTU – REMOTE TERMINAL UNIT
- TP XX – TIE IN TO EXISTING PIPING OR PIPING BY OTHERS
- SP – SPECIALITY ITEM
- HOA – HAND OFF AUTO SWITCH
- STATION – PLC STATION
- UNIT – PLC UNIT
- SAFETY – PLC SAFETY
- PLC INPUT/OUTPUT

INSTRUMENT IDENTIFICATION

SYMBOL	FIRST LETTER	MEASURING DEVICES			CONTROLLING DEVICES			ALARMS		SWITCHES						
		I	IT	T	IC	C	CV	L LL	H HH	IS	S	SL SLL	SH SHH	Y	SO	SC
	MEASURED OR INITIAL VARIABLE	READOUT (INDICATING)	TRANSMITTER (INDICATING)	TRANSMITTER (BLIND)	CONTROLLING (INDICATING)	CONTROLLERS (BLIND)	SELF CONTAIN. CONTROL VLV.	LOW LOW LOW	HIGH HIGH HIGH	INDICATING	BLIND	LOW LOW LOW	HIGH HIGH HIGH	RELAY	POSITION (OPEN)	POSITION (CLOSED)
A	ANALYZER	AI	AIT	AT	AIC			AAL/AALL	AAH/AAHH	AIS	AS	ASL/ASLL	ASH/ASHH	AY		
B	BURNER, COMBUSTION	BI	BIT	BT	BIC	BC		BAL/BALL	BAH/BAHH	BIS	BS			BY		
D	DENSITY OR SPECIFIC GRAVITY	DI	DIT	DT	DIC	DC		DAL/DALL	DAH/DAHH	DIS	DS	DSL/DSLL	DSH/DSHH	DY		
F	FLOW	FI	FIT	FT	FIC	FC	FCV	FAL/FALL	FAH/FAHH	FIS	FS	FSL/FSLL	FSH/FSHH	FY		
H	HAND INITIATED				HIC	HC	HCV				HS			HY		
K	TIME OR TIME SCHEDULE	KI	KIT	KT	KIC	KC	KCV	KAL/KALL	KAH/KAHH	KIS		KSL/KSLL	KSH/KSHH	KY		
L	LEVEL	LI	LIT	LT	LIC	LC	LCV	LAL/LALL	LAH/LAHH	LIS	LS	LSL/LSLL	LSH/LSHH	LY		
M	MOISTURE	MI	MIT	MT	MIC	MC		MAL/MALL	MAH/MAHH	MIS		MSL/MSLL	MSH/MSHH	MY		
P	PRESSURE OR VACUUM	PI	PIT	PT	PIC	PC	PCV	PAL/PALL	PAH/PAHH	PIS		PSL/PSLL	PSH/PSHH	PY		
S	SPEED OR FREQUENCY	SI	SIT	ST	SRC	SC		SAL/SALL	SAH/SAHH	SIS		SSL/SSLL	SSH/SSHH	SY		
T	TEMPERATURE	TI	TIT	TT	TRC	TC	TCV	TAL/TALL	TAH/TAHH	TIS		TSL/TSLL	TSH/TSHH	TY		
V	VIBRATION	VI	VIT	VT	VIC	VC				VIS	VS		VSH/VSHH			
X	PROCESS SHUTDOWN*													XY		
Z	POSITION (*1)	ZI,ZIO,ZIC	ZIT	ZT		ZC				ZIS				ZY	ZSO	ZSC
PD	PRESSURE DIFFERENTIAL	PDI	PDIT	PDT	PDIC			PDAL/PDALL	PDAH/PDAHH			PDL/PDLL	PDH/PDHH			

*OTHER POSSIBLE COMBINATIONS: XI: RUN INTERLOCK XS: RUN PERMISIVE XA: RUN STATUS XY: SHUTDOWN (*1) NOTE: ZIO AND ZIC TO INDICATE FULLY OPEN/CLOSED

SPEC NAMING CONVENTION

X X X

- DESIGN CODE & SERVICE IDENTIFIER
- BASE MATERIAL (DESIGNATES STEEL, C.I., BRASS, ETC.)
- PRESSURE CLASS (DESIGNATES FLANGE RATING)

PRESSURE CLASS

SYMBOL	FLANGE RATING
A	200
B	160
C	125
D	100

SYMBOL	MATERIAL DESCRIPTION
A	ALLOYS, LOW & ITERM.
B	ALUMINUM & ALUM ALLOYS
C	CARBON STEEL, SWEET
D	DUCTILE IRON
E	CARBON STEEL, SOUR
F	LOW TEMP CARBON STL, SOUR
G	GLASS
H	HDPE
I	DUCTILE, IRON
J	LEAD
K	MAGNESIUM
L	LINED MATERIALS
M	ABRASIVE
N	NICKEL & NICKEL ALLOYS
O	
P	HDPE
Q	
R	
S	STAINLESS STEEL
T	TITANIUM
U	
V	VERTRIFIED CLAY
W	
X	CONCRETE
Y	
Z	

SYMBOL	LETTER CODE
A	PPI AWWA

RELAY FUNCTION DESIGNATIONS

(ADJACENT TO INSTRUMENTION)

- I/P – I/P CONVERTER (CURRENT TO PNEUMATIC TRANSDUCER)
- P/I – P/I CONVERTER (PNEUMATIC TO CURRENT TRANSDUCER)
- M/P – MOTOR TO PNEUMATIC TRANSDUCER
- R/I – RESISTANCE TO CURRENT TRANSDUCER
- E/H – ELECTROHYDRAULIC TRANSDUCER
- A/M – AUTO/MANUAL LOADING STATION
- Σ – TOTALIZER
- MANUAL SELECT
- < – LOW SELECTOR SIGNAL
- > – HIGH SELECTOR SIGNAL
- POS – POSITIONER
- XX (V) – VENDOR ITEM (IF APPLICABLE)

PIPE LINE NUMBERING STANDARD

XX–XX–XXXX–XXX–XXXXX

- INSULATION THICKNESS
- PIPE SIZE
- LINE IDENTIFICATION
- RANDOM NUMBER
- TRACING TYPE
- INSULATION TYPE
- PIPE SPECIFICATION

EXPLANATION OF IDENTIFICATION LETTERS

(1) ANY FIRST LETTER, IF USED IN COMBINATION WITH MODIFYING LETTERS D(DIFFERENTIAL), F(RATIO), M(MOMENTARY), K(TIME RATE OF CHANGE), Q(INTEGRATE AND TOTALIZE), OR ANY COMBINATION OF THESE IS INTENDED TO REPRESENT A NEW AND SEPARATE MEASURED VARIABLE, AND THE COMBINATION IS TREATED AS A FIRST LETTER ENTITY. THUS, INSTRUMENTS TDI AND TI INDICATE TWO DIFFERENT VARIABLES, NAMELY, DIFFERENTIAL-TEMPERATURE AND TEMPERATURE. MODIFYING LETTERS ARE USED WHEN APPLICABLE.

(2) LEVEL GUAGE NOMENCLATURE:

NUMBER OF SECTIONS (2) LG 251 48" VISIBLE GLASS LENGTH

ILLUMINATOR

(3) IDENTIFY RELAYS WITH FUNCTIONAL SUPERSCRIPT. FY T2 I/P

(4) IDENTIFY ANALYZERS AND EQUIPMENT WITH SUPERSCRIPT OUTSIDE OF CIRCLE LEL, CO_2, PH, H_2S, ETC.... ^{2} AE T2 CO

(5) FOR VACUUM OR DRAFT INSTRUMENTS – ADD SUPERSCRIPT PI T2 VAC. PI T2 DRAFT

(6) SUPPLY DESIGNATIONS:

AS = AIR SUPPLY	IA = INSTRUMENT AIR	NG = NITROGEN GAS
ES = ELECTRIC SUPPLY	IG = INSTRUMENT GAS	SS = STEAM SUPPLY
HS = HYDRAULIC SUPPLY	PA = PROCESS AIR	WS = WATER SUPPLY

(7) ELECTRICAL RELAYS, SWITCHES, AND MISC. ITEMS IDENTIFIED WITH AN INSTRUMENT TAG BALLOON AND AN (E) SHOWN IN PLACE OF THE INSTRUMENT TAG NUMBER ARE TO BE SPECIFIED AND FURNISHED BY ELEC.

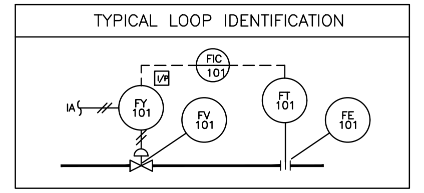
HOA (E) SPECIFIED & FURN. BY ELECTRICAL

HOA 112 SPECIFIED & FURN. BY INSTRUMENTS

(8) INDICATING AND BLIND SWITCHES ARE IDENTIFIED HIGH, LOW, HIGH HIGH OR LOW LOW THUS:

LSH T2 LSL T2 LSHH T2 LSLL T2

TYPICAL LOOP IDENTIFICATION



(9) ADDITIONAL ABBREVIATIONS

ATM = ATMOSPHERE	LP = LOW PRESSURE	SU = START UP
AV = AIR VENT (AUTOMATIC)	MIN = MINIMUM DISTANCE	TC = THERMOCOUPLE
BF = BLIND FLANGE	MM = MILLION	TS = TEMPORARY STRAINER
BP = BUCKLING PIN	MOV = MOTOR OPERATED VALVE	TSO = TIGHT SHUT OFF
CB = CONTINUOUS BLOWDOWN	MW = MANWAY	TYP = TYPICAL
CH = CHAIN OPERATED	N2 = NITROGEN	VB = VACUUM BREAKER
CO = CLEAN OUT	NC = NORMALLY CLOSED	VRV = VACUUM RELIEF VALVE
CP = CORROSION PROBE	NLL = NORMAL LIQUID LEVEL	WC = WATER COLUMN
CS = CAR SEAL CLOSED	NO = NORMALLY OPEN	
CSO = CAR SEAL OPEN	OD = OPEN DRAIN	
DC = DRAIN CONNECTION	P = PURGE	
ESD = EMERGENCY SHUTDOWN	PB = PUSHBUTTON	
FC = FAIL CLOSED	QD = QUICK DISCONNECT	
FL = FAIL LOCKED	R = RESET	
FO = FAIL OPEN	ROC = "RATE OF CHANGE" (dp/dt)	
GPH = GALLONS PER HOUR	ROV = REMOTE OPERATED VALVE	
GPM = GALLONS PER MINUTE	RP = RUPTURE PIN	
HC = HOSE CONNECTION	RTD = RESISTANCE TEMP. DETECTOR	
HHLL = HIGH HIGH LIQUID LEVEL	SC = SAMPLE CONNECTION	
HLL = HIGH LIQUID LEVEL	SCFD = STD. CU. FT. PER DAY	
HOA = HAND-OFF-AUTO SELECT SW	SCFH = STD. CU. FT. PER HOUR	
HP = HIGH PRESSURE	SCFM = STD. CU. FT. PER MINUTE	
HSD = HAND SHUTDOWN	SD = SHUTDOWN	
LC = LOCK CLOSED	SDV = SHUT DOWN VALVE	
LD = LIQUID DRAINER	SOC = STEAM OUT CONNECTION	
LLL = LOW LIQUID LEVEL	SP = SET POINT	
LLLL = LOW LOW LIQUID LEVEL	SR = STRESS RELIEF	
LO = LOCK OPEN	SS = SELECTOR SWITCH	
LOR = LOCAL-OFF-REMOTE SELECTOR SWITCH	ST = STEAM TRAP	

PRELIMINARY

REFERENCE DRAWINGS

DWG NO.	DESCRIPTION

REVISIONS

REV	DESCRIPTION	BY	DATE	CHK BY	CHK DATE	APR BY	APR DATE
A	ISSUED FOR BID	BPK	02-02-18	JCH	02-02-18		

PSI

PV WATER GATHERING SYSTEM
FRESH WATER GATHERING SYSTEM-PHASE 1
PIPING AND INSTRUMENTATION DIAGRAM
STANDARD SYMBOL SHEET

SCALE: NTS | DRAWING: **PMD-GTH-PID-PH1-001** | SHEET No. 1 OF 1 | A

LAST SAVED: 2/8/2018 BY: BKNUDSEN

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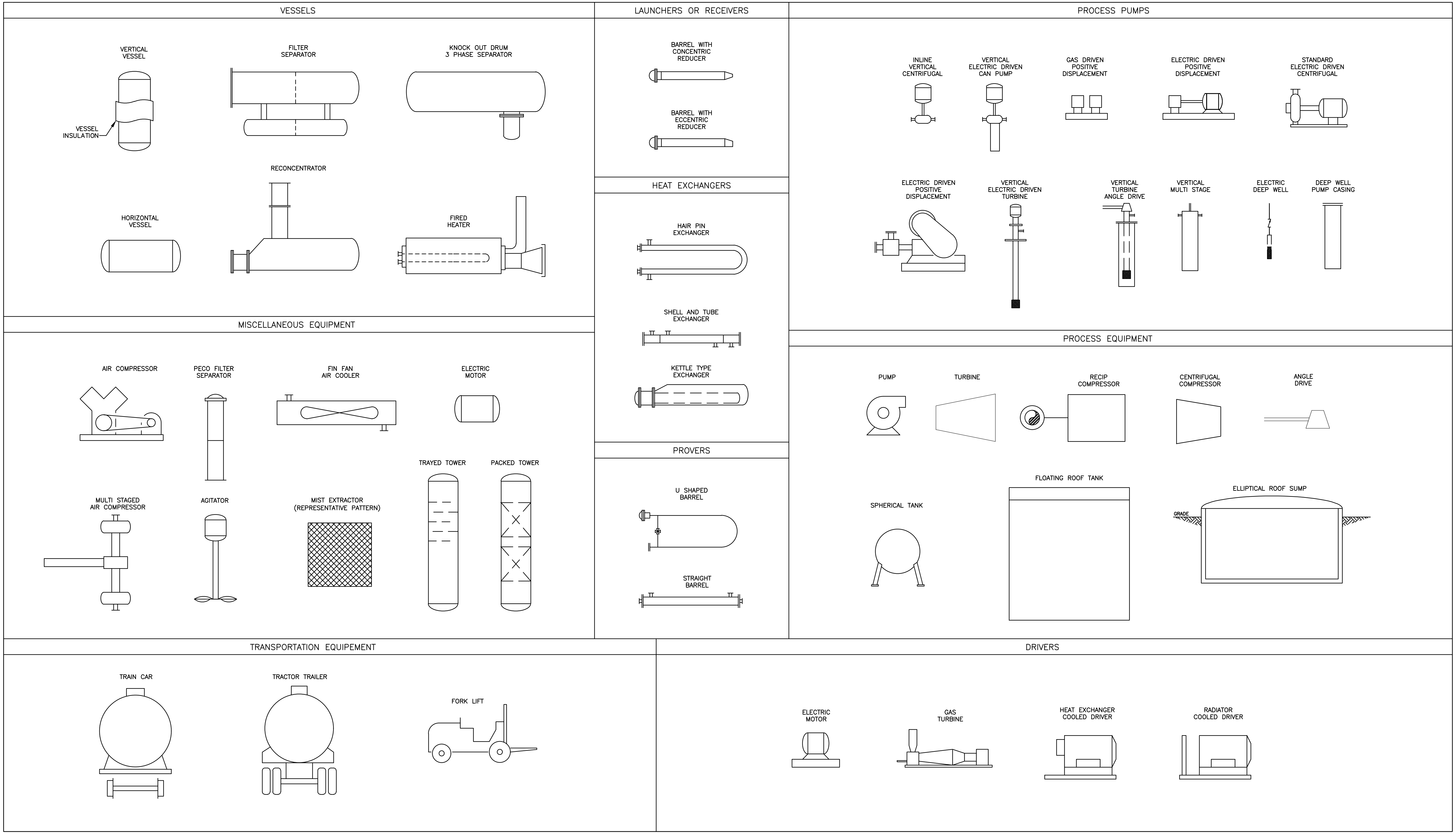


PRELIMINARY

REFERENCE DRAWINGS

DWG NO.	DESCRIPTION

REVISIONS

REV	DESCRIPTION	BY	DATE	CHK BY	CHK DATE	APR BY	APR DATE
A	ISSUED FOR BID	BPK	02-02-18	JCH	02-02-18		

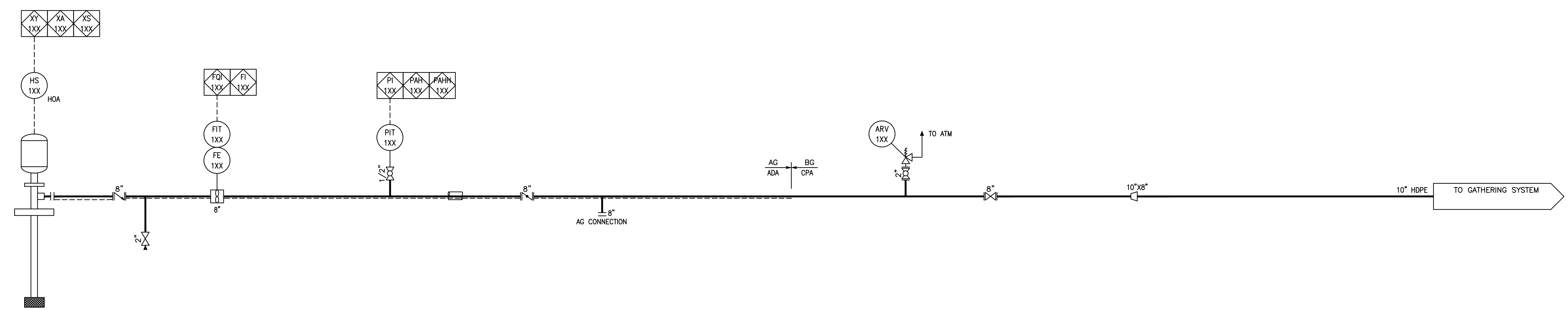
PSI

PV WATER GATHERING SYSTEM
FRESH WATER GATHERING SYSTEM-PHASE 1
PIPING AND INSTRUMENTATION DIAGRAM
STANDARD SYMBOLS SHEET

SCALE:	DRAWING:	SHEET No.	REV
NTS	PMD-GTH-PID-PH1-002	1 of 1	A

FILE LOCATION: P:\Engineering\Projects\Pioneer Metro District No.3\2017 FW Gathering System\09 Project Drawings\06 PIDs\PMD-GTH-PID-PH1-002.dwg
LAST SAVED: 2/8/2018 BY: BKNUDSEN

P-1XX
WELL PUMP
SEE PUMP TABLE



PUMP TABLE

WELL #	TAG NUMBER	PUMP FLOW (GPM)	PRESSURE ALARM HIGH (PSIA)	PRESSURE ALARM HIGH HIGH (PSIA)
1	101	500	58	64
2	102	800	65	72
3	103	1000	66	73
4	104	800	60	66
5	105	500	53	58
6	106	800	58	64
7	107	750	53	58
8	108	800	60	66
9	109	1750	85	94
10	110	1000	66	73
11	111	800	153	168

PRELIMINARY

REFERENCE DRAWINGS

DWG NO.	DESCRIPTION

REVISIONS

REV	DESCRIPTION	BY	DATE	CHK BY	CHK DATE	APR BY	APR DATE
B	ISSUED FOR BID	BPK	02-16-18	CRM	02-16-18		
A	ISSUED FOR BID	BPK	02-02-18	JCH	02-02-18		

PSI

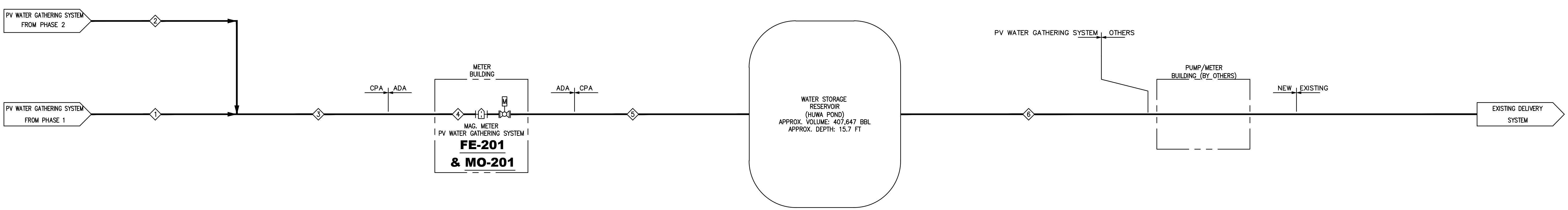
PV WATER GATHERING SYSTEM
FRESH WATER GATHERING SYSTEM–PHASE 1
PIPING AND INSTRUMENTATION DIAGRAM
TYPICAL WATER WELL

SCALE: NTS | DRAWING: PMD-GTH-PID-PH1-003 | SHEET No. 1 of 1 | B

LAST SAVED: 2/15/2018 BY: BKNUDSEN

FILE LOCATION: P:\Engineering\Projects\Pioneer Metro District No.3\2017 FW Gathering System\09 Project Drawings\06 PIDs\PMD-GTH-PID-PH1-003.dwg

FE-201
MAGNETIC FLOW METER
MFG: MCCROMETER
MODEL: ULTRA-MAG
TRANSMITTER: XXX



NO.	LINE SIZE (NPS)	SERVICE	MATERIAL SPECIFICATION	LINE MATERIAL	DESIGN PRESSURE	OPERATING PRESSURE	DESIGN TEMPERATURE	OPERATING TEMPERATURE	DESIGN FLOWRATE	OPERATING FLOWRATE
1	18	FRESH WATER	CPA	HDPE	125 PSIG	20 PSIG	73° F	65° F	5,040 GPM	VARIES
2	TBD	FRESH WATER	CPA	HDPE	125 PSIG	20 PSIG	73° F	65° F	5,040 GPM	VARIES
3	18	FRESH WATER	CPA	HDPE	125 PSIG	20 PSIG	73° F	65° F	5,040 GPM	VARIES
4	18	FRESH WATER	ADA	DUCTILE IRON	250 PSIG	20 PSIG	73° F	65° F	5,040 GPM	VARIES
5	18	FRESH WATER	CPA	HDPE	125 PSIG	20 PSIG	73° F	65° F	5,040 GPM	VARIES
6	18	FRESH WATER	CPA	HDPE	125 PSIG	ATM	73° F	65° F	5,040 GPM	VARIES

PRELIMINARY

REFERENCE DRAWINGS

DWG NO.	DESCRIPTION

REVISIONS

REV	DESCRIPTION	BY	DATE	CHK BY	CHK DATE	APR BY	APR DATE
B	ISSUED FOR BID	BPK	02-16-18	CRM	02-16-18		
A	ISSUED FOR BID	BPK	02-02-18	JCH	02-02-18		

PSI

PV WATER GATHERING SYSTEM
FRESH WATER GATHERING SYSTEM–PHASE 1
PROCESS FLOW DIAGRAM
HUWA POND

SCALE:	DRAWING:	SHEET No.	REV
NTS	PMD-GTH-PFD-PH1-001	1 of 1	B

FILE LOCATION: F:\Engineering\Projects\Pioneer Metro District No.3\2017 FW Gathering System\09 Project Drawings\05 PFD-Ops Sch\PMD-GTH-PFD-PH1-001.dwg
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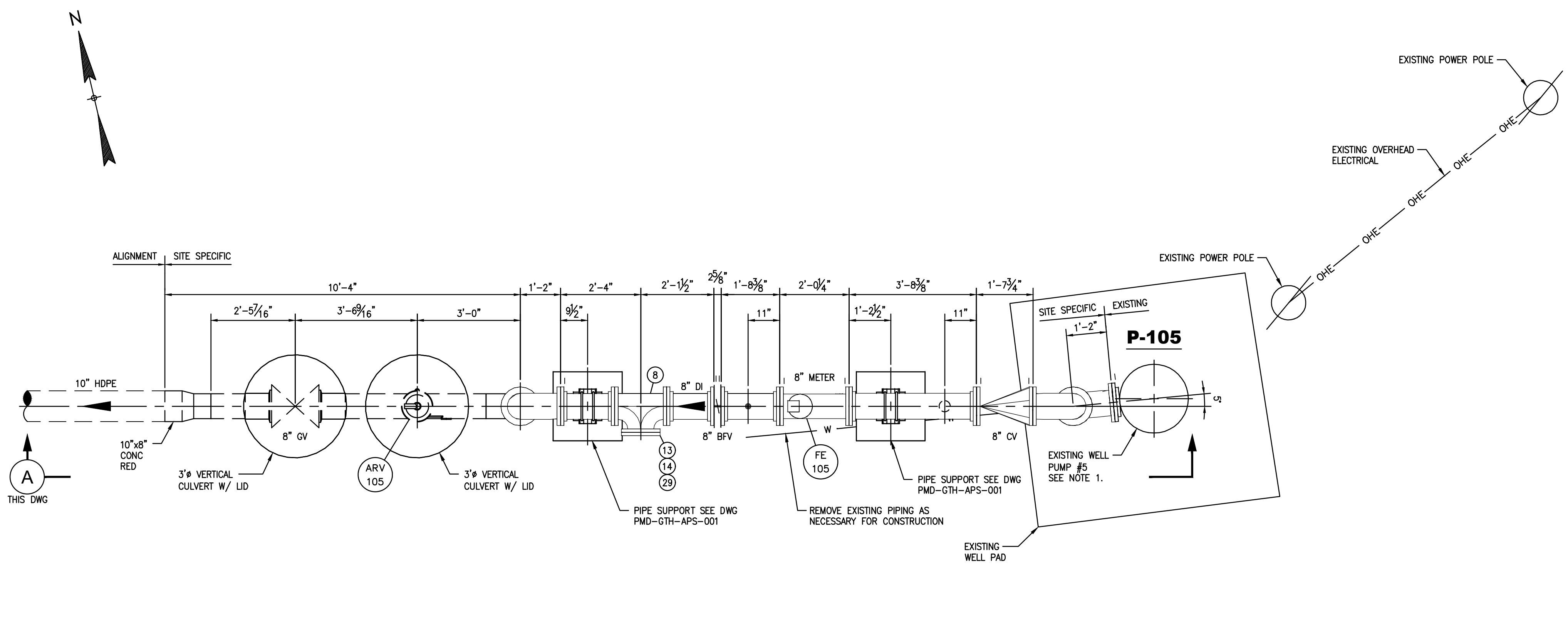
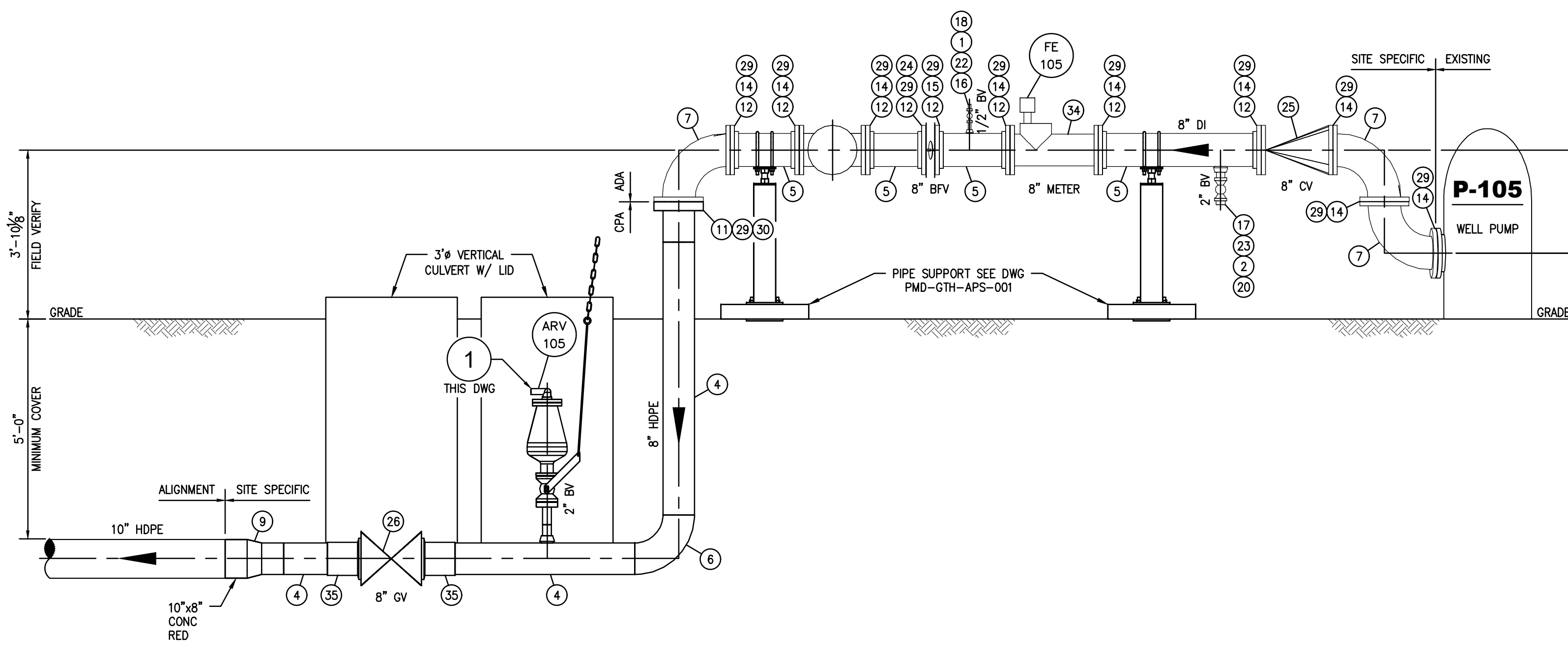


PLOT PLAN
SCALE: 1/2" = 1'-0"



SECTION A
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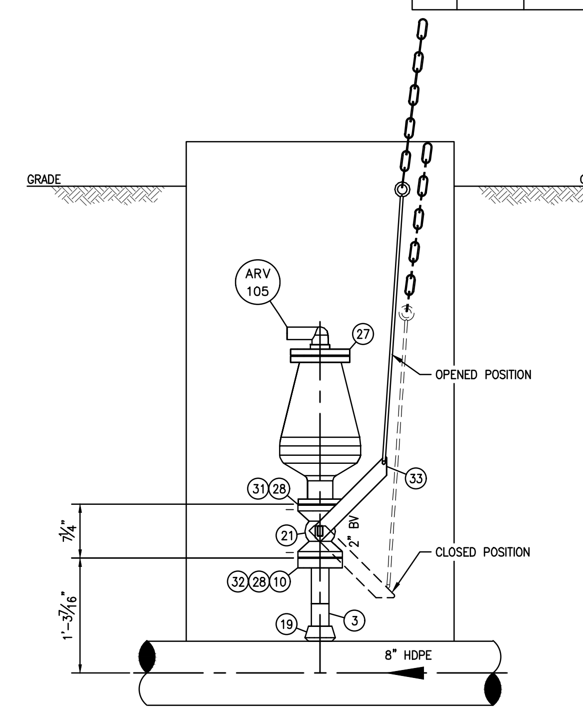
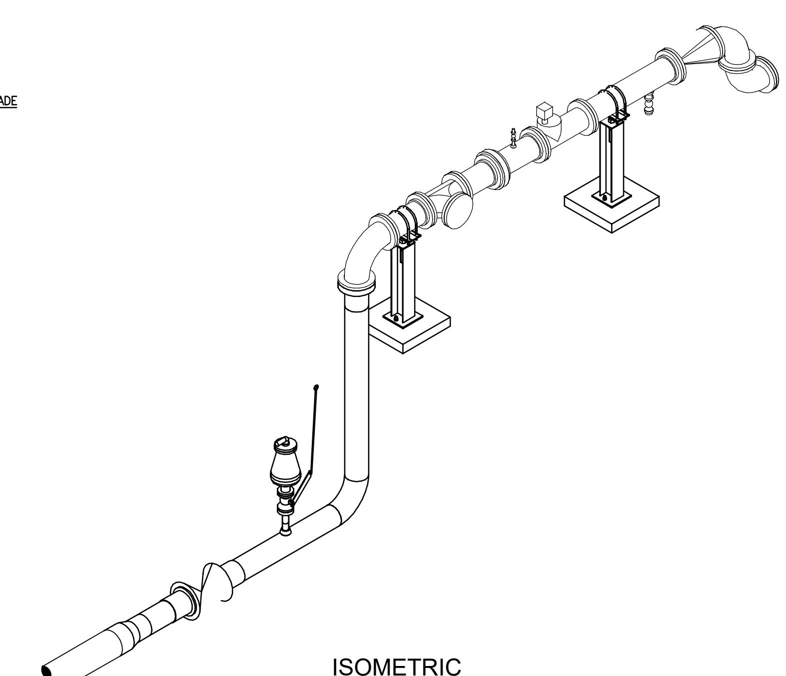


DETAIL 1
SCALE: 1" = 1'-0"
THIS DWG



ISOMETRIC
SCALE: NTS

BILL OF MATERIAL

MARK	QTY	SIZE	DESCRIPTION	LENGTH
1	1	1/2"	NIPPLE, 1/2" x 3" LG., XS, SMLS, CS, ASTM A106, GR.B, TBE	3"
2	1	2"	NIPPLE, 2" x 3" LG., XS, SMLS, CS, ASTM A106, GR.B, TBE	3"
3	1	2"	PIPE (2.375) x SDR-17, HDPE, ASTM D3350, CL PE445474C-PE4710 TO ASTM F714	3"
4	1	8"	PIPE (8.625) x SDR-17, HDPE, ASTM D3350, CL PE445474C-PE4710 TO ASTM F714	11'-8 7/16"
5	1	8"	PIPE, 9.05" OD x CL 53 (0.36"), DI, AWWA C151	6'-10 3/8"
6	1	8"	ELBOW, 90-DEG, FE, HDPE, SDR-17, ASTM D3350 CL PE445474C-PE4710 TO ASTM D3261, ASTM F2206	
7	3	8"	ELBOW, 90-DEG, FFFE, CL 53, DI, ASTM A536, AWWA C110	
8	1	8"	TEE, FFFE, CL 53, DI, ASTM A536, AWWA C110	
9	1	10"x8"	REDUCER, CONCENTRIC, HDPE, ASTM D3350 CL PE445474C-PE4710 TO ASTM D3261, ASTM F2206	
10	1	2"	FLANGE, ADAPTER, HDPE, SDR-17, ASTM D3350 CL PE445474C-PE4710 TO ASTM D3261, ASTM F2206, W/ CS CL 150 FFFE BACKING RING	6 1/8"
11	1	8"	FLANGE, ADAPTER, HDPE, SDR-17, ASTM D3350 CL PE445474C-PE4710 TO ASTM D3261, ASTM F2206, W/ CS CL 150 FFFE BACKING RING	11"
12	8	8"	FLANGE, THRDxFFFE, DI, ASTM A536, AWWA C115	
13	1	8"	FLANGE, BLIND, FFFE, GI, ASTM A126 CL.B, ASME B16.1	
14	80	3/4"	HEAVY HEX STUD BOLTS, ASTM A307 GR.B7 TO ASME B18.2.1 W/ HEAVY HEX NUTS, ASTM A563 GR.A TO ASME B18.2.2, PTFE COATED (FOR 8" CL 150 FLANGE)	4 3/4"
15	8	3/4"	HEAVY HEX STUD BOLTS, ASTM A307 GR.B7 TO ASME B18.2.1 W/ HEAVY HEX NUTS, ASTM A563 GR.A TO ASME B18.2.2, PTFE COATED (FOR 8" CL 150 FLANGE)	6 1/8"
16	1	1/2"	PLUG, THRD, CS, ASTM A105, ASME B16.11	
17	1	2"	PLUG, THRD, CS, ASTM A105, ASME B16.11	
18	1	8"x1/2"	SERVICE SADDLE, DI, ASTM A536, AWWA C800, DUAL STRAP, NYLON COATED W/ NPT THREADS	
19	1	8"x2"	BRANCH SADDLE, FE, HDPE, ASTM D3350, CL PE445474C-PE4710 TO ASTM D3261, ASTM F2206	
20	1	8"x2"	SERVICE SADDLE, DI, ASTM A536, AWWA C800, DUAL STRAP, NYLON COATED W/ NPT THREADS	
21	1	2"	VALVE, BALL, FFFE, CL 150, CS BODY W/ CS ENP BALL, RP, LO, ASME B16.34, BAFA	7"
22	1	1/2"	VALVE, BALL, THRD, CL 1500, CS BODY W/ SS TRIM, RP, SS/PTFE SEAT, LO, ASME B16.34, BFTA	2 11/16"
23	1	2"	VALVE, BALL, THRD, CL 1500, CS BODY W/ SS TRIM, RP, SS/PTFE SEAT, LO, ASME B16.34, BFTA	4 7/8"
24	1	8"	VALVE, WAFER BUTTERFLY, FFFE, DI BODY, 316 SS DISC, SS STEM, GO, AWWA C504, FOFA	2 3/8"
25	1	8"	VALVE, SWING CHECK, FFFE, DI BODY, EPDM ENCAPSULATED TRIM, AWWA C508, COFA	1'-7 1/2"
26	1	8"	VALVE, GATE, MJxMJ, 250 PSIG, DI BODY W/ SS STEM, GO, PIGGABLE, AWWA C515, GOEA	1'-4 1/2"
27	1	2"	VALVE, AIR RELEASE (SEE SPEC SHEET)	
28	2	2"	GASKET, 1/8" THICK, SPECIFICATION RUBBER PRODUCTS, TORUSEAL, NSF-61 SBR	
29	13	8"	GASKET, 1/8" THICK, SPECIFICATION RUBBER PRODUCTS, TORUSEAL, NSF-61 SBR	
30	8	3/4"	HEAVY HEX STUD BOLTS, ASTM A307 GR.B7 TO ASME B18.2.1 W/ HEAVY HEX NUTS, ASTM A563 GR.A TO ASME B18.2.2, PTFE COATED (FOR 8" CL 150 FLANGE)	5 7/8"
31	4	5/8"	HEAVY HEX STUD BOLTS, ASTM A307 GR.B7 TO ASME B18.2.1 W/ HEAVY HEX NUTS, ASTM A563 GR.A TO ASME B18.2.2, PTFE COATED (FOR 2" CL 150 FLANGE)	3 1/2"
32	4	5/8"	HEAVY HEX STUD BOLTS, ASTM A307 GR.B7 TO ASME B18.2.1 W/ HEAVY HEX NUTS, ASTM A563 GR.A TO ASME B18.2.2, PTFE COATED (FOR 2" CL 150 FLANGE)	4 1/8"
33	1	12"	2" x 3/8" FLAT IRON ACTUATOR ARM WITH 3/8" DIA. LINKAGE ROD AND CHAIN TO SURFACE.	
34	1	8"	METER, FLOW PROPELLER (SEE SPEC SHEET)	2'-0"
35	2	8"	MJ MALE ADAPTER WITH GLAND KIT, HDPE (TO DI), SDR-17, ASTM D3350 CL PE445474C-PE4710 TO ASTM D3261, ASTM F2206, W/ RETAINING PACK TO AWWA C110	

NOTES:
1. ROTATE PUMP HEAD TO MATCH BOLT PATTERN OF FLANGE CONNECTION.

PRELIMINARY

REFERENCE DRAWINGS

DWG NO.	DESCRIPTION
PMD-GTH-APS-001	ADJUSTABLE PIPING SUPPORT DETAILS

REVISIONS

REV	DESCRIPTION	BY	DATE	CHK BY	CHK DATE	APR BY	APR DATE
B	ISSUED FOR BID	BPK	02/16/18	CRM	02/16/18		
A	ISSUED FOR BID	BPK	02/12/18	CRM	02/12/18		

PSI

PV WATER GATHERING SYSTEM
FRESH WATER GATHERING SYSTEM-PHASE 1
WATER WELL #5 - PHASE 1B
PLOT PLAN, SECTION, DETAIL, ISO & BOM

SCALE: AS NOTED
DRAWING: PMD-GTH-SS-PH1B-WW5
SHEET No. 1 of 1
REV: B

PLOT STYLE: PSI-PIPING.ctb
LAST SAVED: 2/12/2018 BY: DIRSIK
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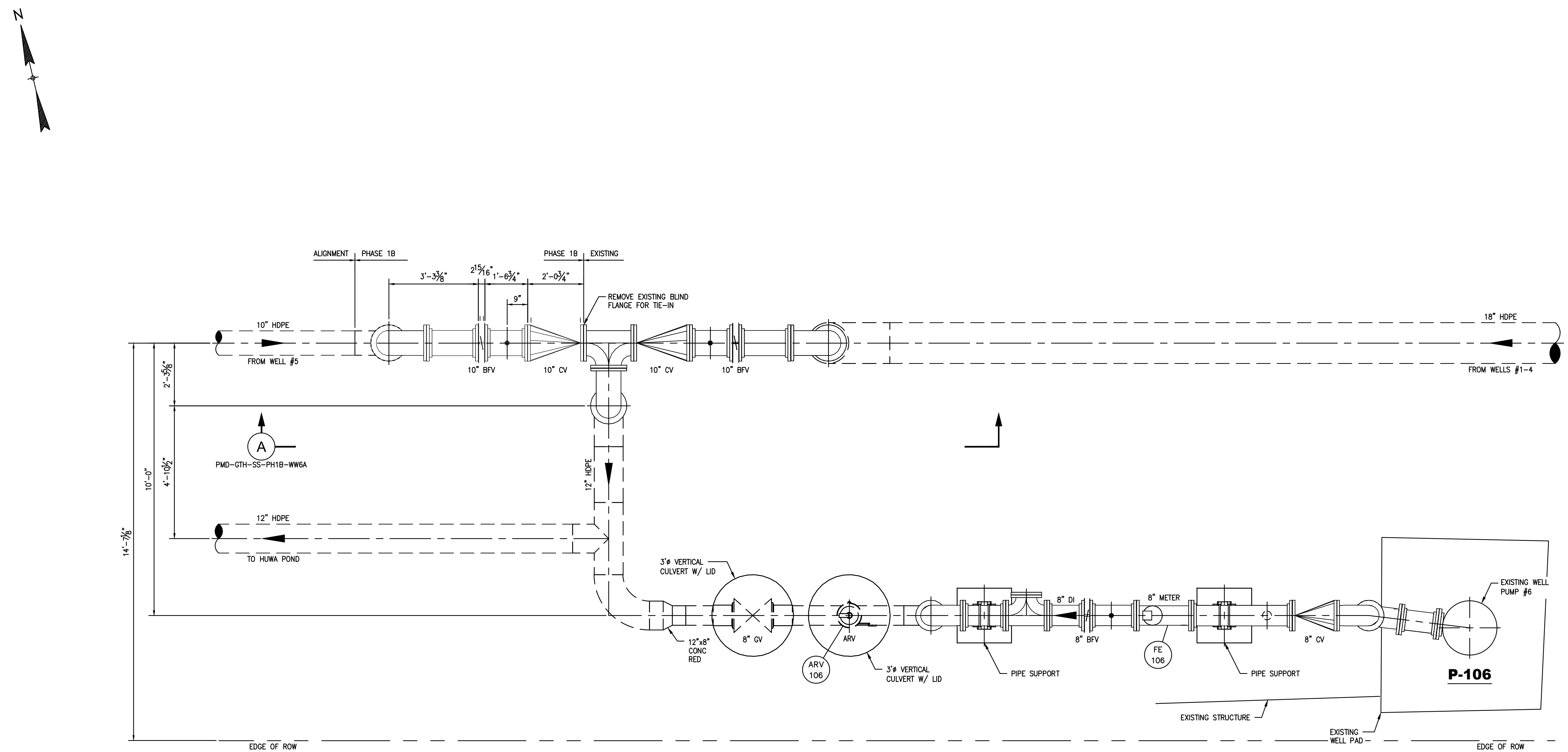


PLOT PLAN

SCALE: 1/2" = 1'-0"

PRELIMINARY

REFERENCE DRAWINGS

DWG NO.	DESCRIPTION
PMD-GTH-SS-PH1B-WW6A	SECTION, ISOMETRIC & BILL OF MATERIAL

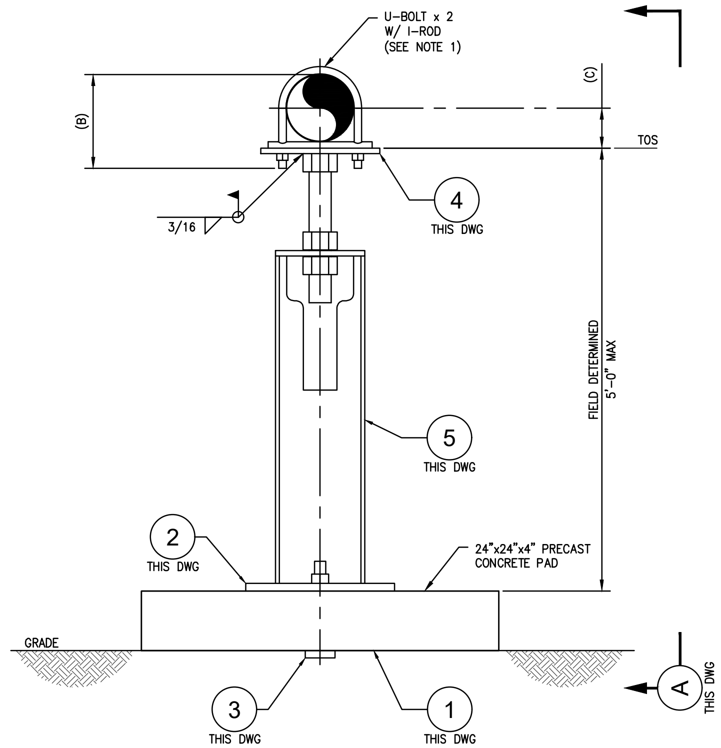
REVISIONS

REV	DESCRIPTION	BY	DATE	CHK BY	CHK DATE	APR BY	APR DATE
B	ISSUED FOR BID	BPK	02/16/18	CRM	02/16/18		
A	ISSUED FOR BID	BPK	02/12/18	CRM	02/12/18		

PSI

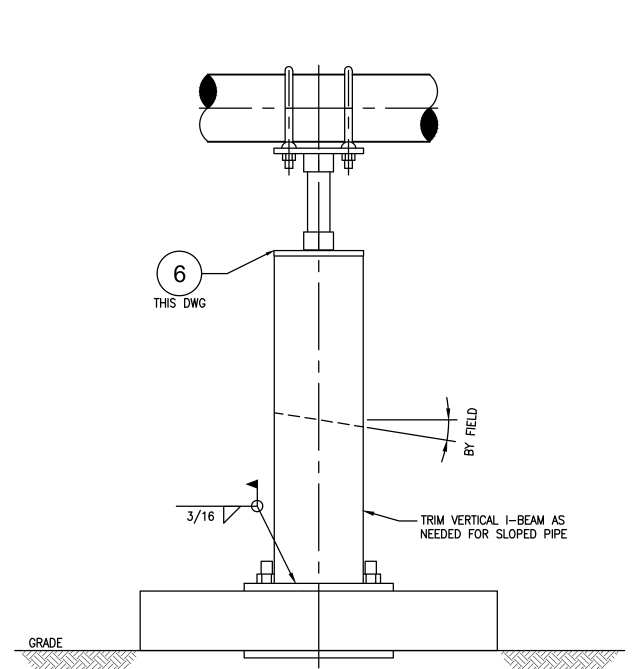
PV WATER GATHERING SYSTEM
FRESH WATER GATHERING SYSTEM–PHASE 1
WATER WELL #6 – PHASE 1B
PLOT PLAN

SCALE:	DRAWING:	SHEET No.	
AS NOTED	PMD-GTH-SS-PH1B-WW6	1 OF 1	B



TEMPORARY PIPE SUPPORT ELEVATION

SCALE: 2" = 1'-0"



SECTION (A)

SCALE: 2" = 1'-0"
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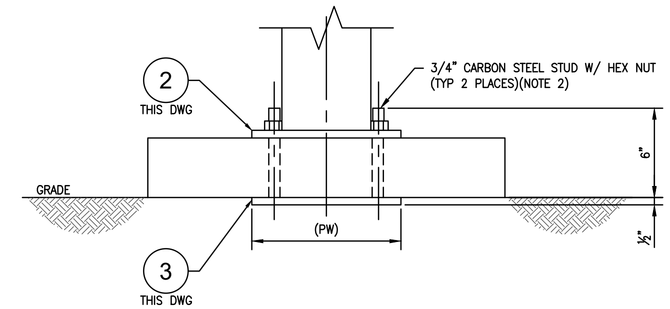

CONCRETE PAD DETAIL (1)

SCALE: NTS
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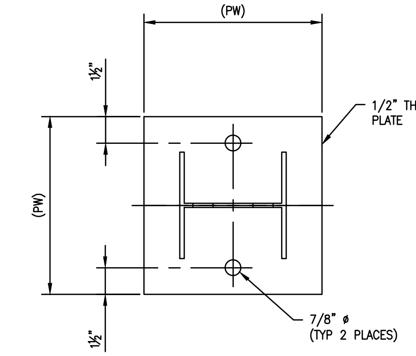

BASE PLATE DETAIL (2)

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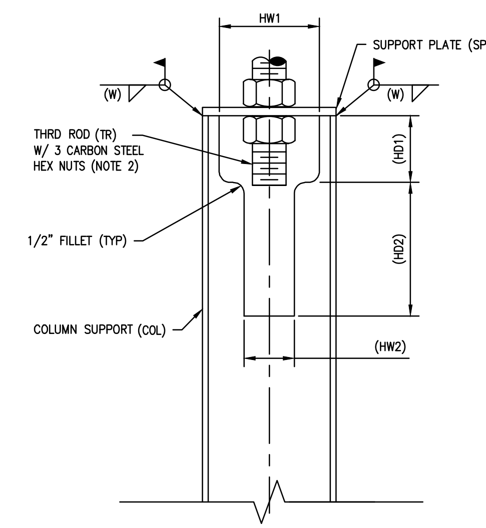

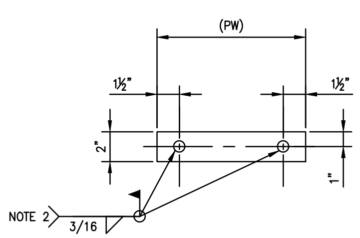

BOTTOM PLATE DETAIL (3)

SCALE: NTS
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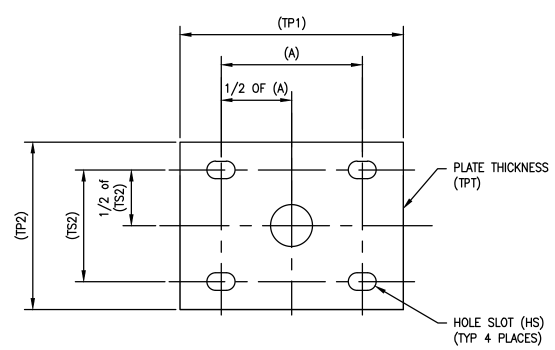

TOP PLATE DETAIL (4)

SCALE: NTS
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SUPPORT DETAIL (5)

SCALE: NTS
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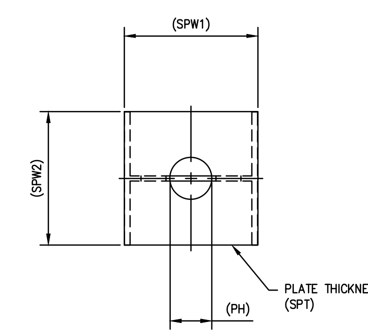


SUPPORT PLATE DETAIL (6)

SCALE: NTS
THIS DWG

PIPE SUPPORT (ALL SIZES IN INCHES)

NPS	U-BOLT BOLT DIA x (A) x (B)			(C)	TOP PLATE (TP) (TPT) x (TP1) x (TP2) x (TS2)				SUPPORT HOLE SIZE (HW1) x (HW2) x (HD1) x (HD2)				SUPPORT PLATE (SP) (SPT) x (SPW1) x (SPW2)			W	PLATE HOLE (PH)	THRD ROD (TR) (DIA) X (LTH)		HOLE SLOT (HS)		I-ROD (THK) X (LENGTH)		COLUMN SUPPORT (COL)	PLATE WIDTH (PW)
8	5/8	9 3/8	11 1/2	4 3/4	3/8	12	6	4	4 1/2	2 1/4	3	6	1/2	6	6	3/16	1 7/8	1 1/2	10	3/4	1 1/4	11/16	11	W6x15	10

NOTES:
1. U-BOLT TO BE CS STEEL COATED POLYOLEFIN WITH HALF ROUND I-ROD THERMOPLASTIC W/ FOUR NUTS. DEEPWATER NU-BOLT OR EQUAL.
2. STAINLESS OR ALLOY STEEL SHALL NOT BE USED WITHOUT WRITTEN COMPANY APPROVAL.

PRELIMINARY

REFERENCE DRAWINGS

DWG NO.	DESCRIPTION

REVISIONS

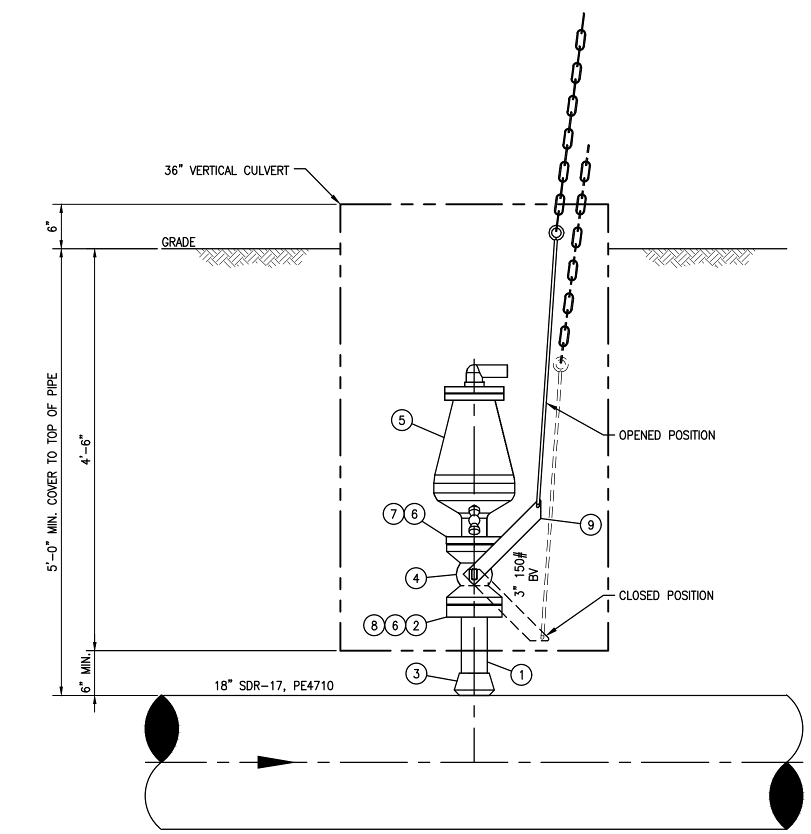
REV	DESCRIPTION	BY	DATE	CHK BY	CHK DATE	APR BY	APR DATE
A	ISSUED FOR BID	BPK	02-02-18	JCH	02-02-18		

PV WATER GATHERING SYSTEM
FRESH WATER GATHERING SYSTEM-PHASE 1
ADJUSTABLE PIPING SUPPORT DETAILS

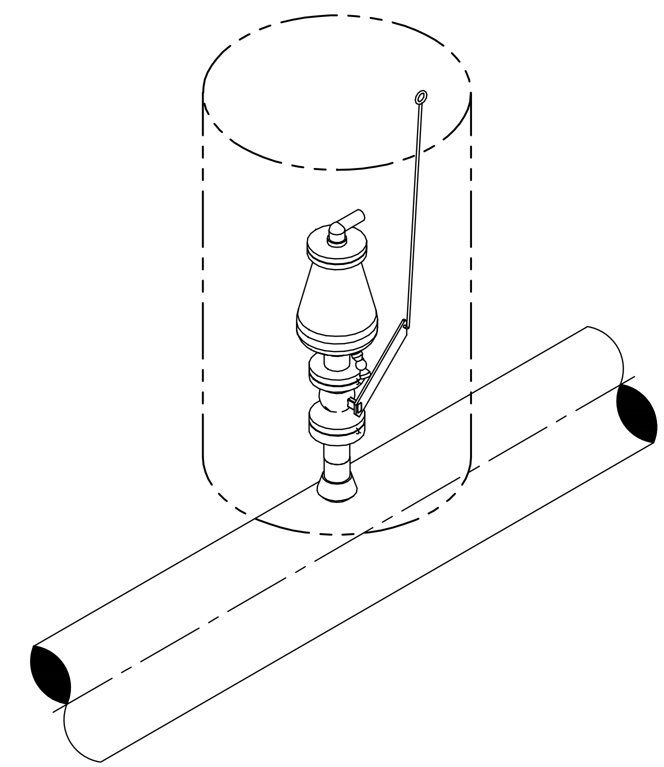
SCALE: AS NOTED | DRAWING: PMD-GTH-APS-001 | SHEET No. 1 of 1 | A

PLOT STYLE: PSI-PIPING.ctb
LAST SAVED: 2/8/2018 BY: DIRSIK
FILE LOCATION: P:\Engineering\Projects\Pioneer Metro District No.3\2017 FW Gathering System\09 Piping\09 Project Drawings\09 Piping\PMD-GTH-APS-001.dwg

BILL OF MATERIAL				
MARK	QTY	SIZE	DESCRIPTION	LENGTH
1	1	3"	PIPE (3.5) x SDR-17, HDPE, ASTM D3350, CL PE445474C-PE4710 TO ASTM F714	3"
2	1	3"	FLANGE, ADAPTER, HDPE, SDR-17, ASTM D3350 CL PE445474C-PE4710 TO ASTM D3261, ASTM F2206, W/ CS CL 150 FFFE BACKING RING	6 1/8"
3	1	18"x3"	BRANCH SADDLE, FE, HDPE, ASTM D3350, CL PE445474C-PE4710 TO ASTM D3261, ASTM F2206	
4	1	3"	VALVE, BALL, FFFE, CL 150, CS BODY W/ CS ENP BALL, RP, LO, ASME B16.34, BAFA	8"
5	1	3"	VALVE, AIR RELEASE (SEE SPEC SHEET)	
6	2	3"	GASKET, 1/8" THICK, SPECIFICATION RUBBER PRODUCTS, TORUSEAL, NSF-61 SBR	
7	4	5/8"	HEAVY HEX STUD BOLTS, ASTM A307 GR.B7 TO ASME B18.2.1 W/ HEAVY HEX NUTS, ASTM A563 GR.A TO ASME B18.2.2, PTFE COATED (FOR 3" CL 150 FLANGE)	3 3/4"
8	4	5/8"	HEAVY HEX STUD BOLTS, ASTM A307 GR.B7 TO ASME B18.2.1 W/ HEAVY HEX NUTS, ASTM A563 GR.A TO ASME B18.2.2, PTFE COATED (FOR 3" CL 150 FLANGE)	4 1/2"
9	1	12"	2" x 3/8" FLAT IRON ACTUATOR ARM WITH 3/8" DIA. LINKAGE ROD AND CHAIN TO SURFACE.	0"



ELEVATION
SCALE: 1" = 1'-0"



ISOMETRIC
SCALE: NTS

PRELIMINARY

REFERENCE DRAWINGS	
DWG NO.	DESCRIPTION

REVISIONS							
A	ISSUED FOR BID	BPK	02-12-18	CRM	02-12-18		
REV	DESCRIPTION	BY	DATE	CHK BY	CHK DATE	APR BY	APR DATE

PSI

PV WATER GATHERING SYSTEM
FRESH WATER GATHERING SYSTEM-PHASE 1
3" ARV TYPICAL
ELEVATION, ISOMETRIC & BOM

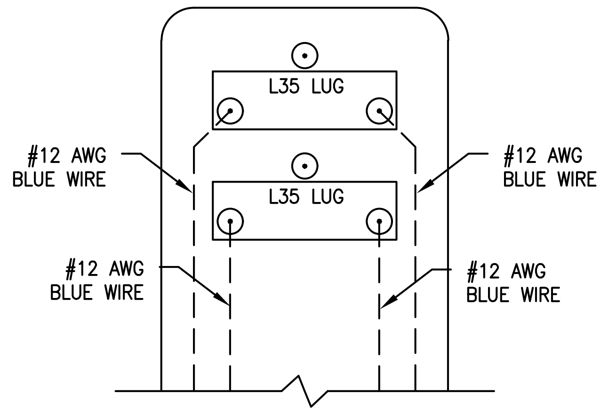
SCALE:	DRAWING:	SHEET No.	
AS NOTED	PMD-GTH-ARV-001	1 OF 1	A

PLOT STYLE: PSI-PIPING.ctb
LAST SAVED: 2/15/2018 BY: DIRSIK
FILE LOCATION: P:\Engineering\Projects\Pioneer Metro District No.3\2017 FW Gathering System\09 Project Drawings\09 Piping\PMD-GTH-ARV-001.dwg

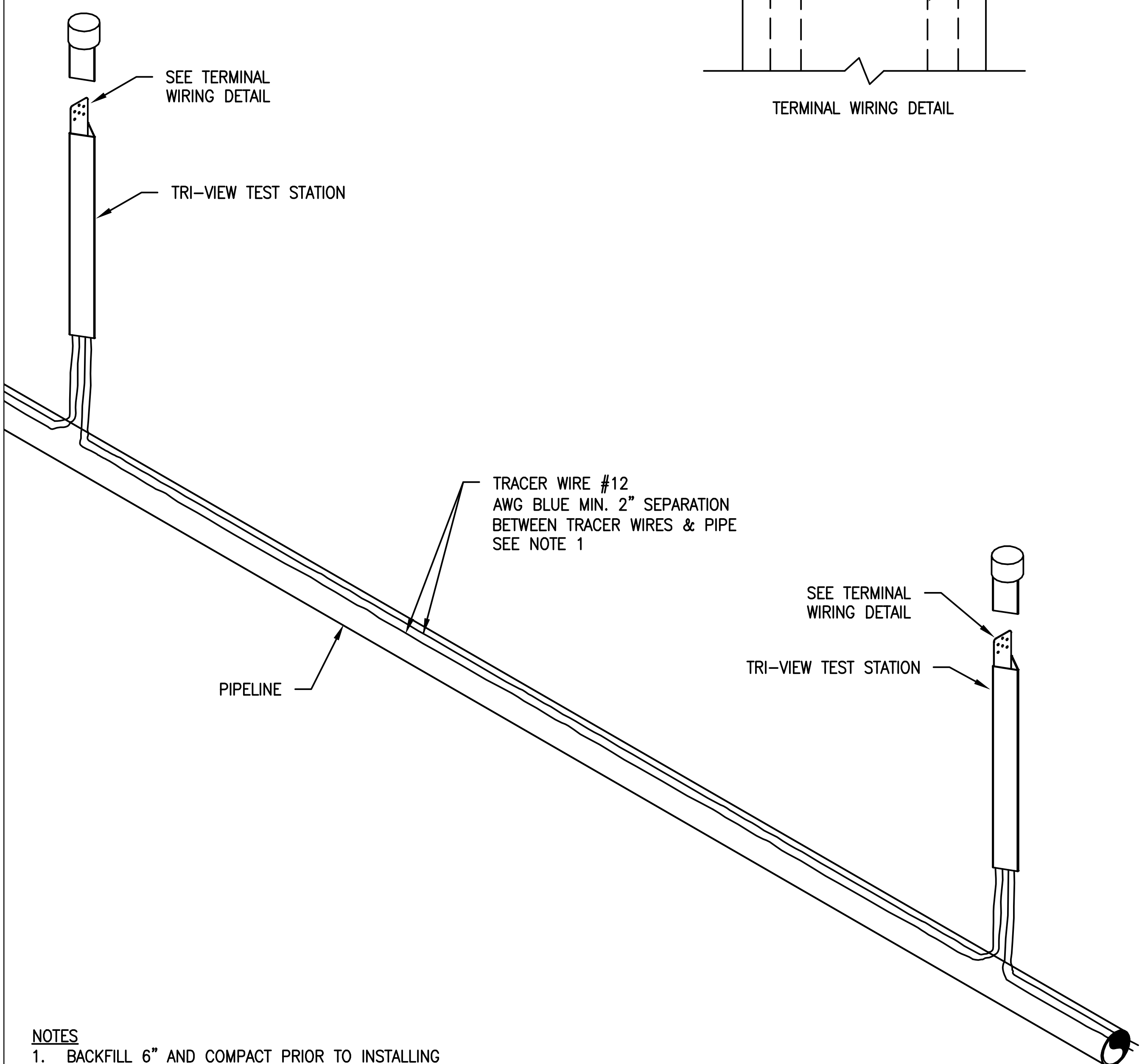
TRACER WIRE DETAIL

PMD-GTH-TTS-001

REV. DATE	REVISION
02/12/18	A



TERMINAL WIRING DETAIL



NOTES

1. BACKFILL 6" AND COMPACT PRIOR TO INSTALLING TRACER WIRE. MIN. 2" SEPARATION BETWEEN TRACER WIRES & PIPE.

Appendix H

WWE Water Supply Report

TABLE OF CONTENTS

Page

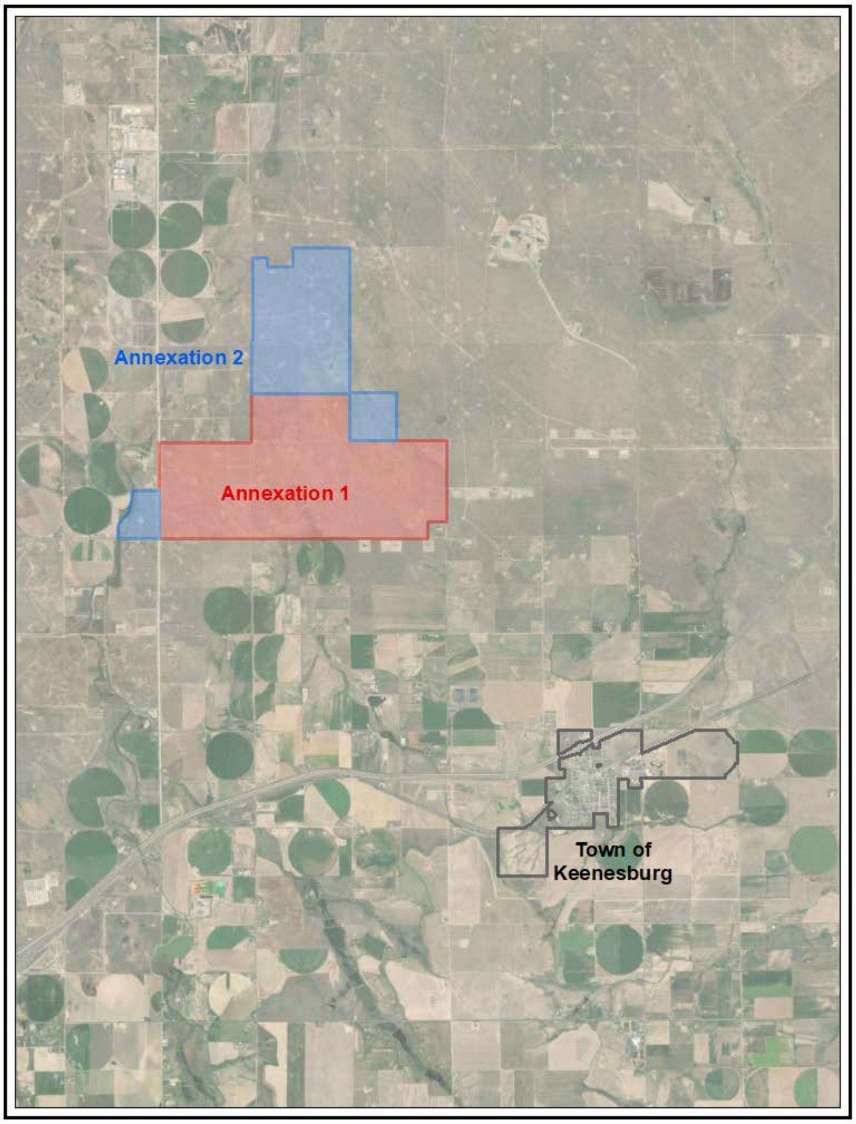
TABLES

FIGURES

1.0 LOCATION

This report describes the water rights and water supplies to serve the proposed Pioneer Village Annexation (Pioneer) to the Town of Keenesburg, Colorado (Town). Pioneer includes approximately 3,400 acres located almost entirely northeast of the intersection of Weld County Roads 49 (CR 49) and CR 22. Figure 1 shows the location of Pioneer relative to Keenesburg.

Figure 1
Location Map



Pioneer Annexation 1, shown in Figure 1, includes 2,151 acres with a total of 8,311 dwellings units plus commercial business and industrial land use and will be developed in four phases. Annexation 2 includes an additional 1,246 acres with 2,820 dwellings units and commercial business and industrial land uses.

2.0 WATER DEMAND

The unit annual water use is estimated to be 0.50 AF per single family equivalent (SFE) as outlined in Table 1. This is based upon an annual indoor water use of 0.3 AF per SFE (76 gallons per person x 3.5 persons per SFE x 365 days/yr / 325,851 gallons per AF = 0.3 AF), an annual outdoor irrigation use of 0.13 AF (30 inches annually for 2,300 square feet of turf irrigation), and a water treatment losses of 0.07 AF.

The unit annual depletion per SFE is also given in Table 1 with a depletion of 5 percent for indoor water use, a 90 percent depletion for irrigation use, and a 100 percent depletion for water treatment losses, giving a total depletion per SFE of 0.20 AF per SFE.

Table 1
Unit Water Demand

Indoor Use	76	gal per capita per day (gpcpd)
	3.5	persons/SFE
Outdoor	2,300	sf turf irrigation/SFE

										Percentage Depletion			
										5%	90%	100%	41%
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Month	Irrigation Application, Inches	Water Demand per SFE								Water Depletion per SFE			
		gallons				AF				AF			
		Indoor	Irrigation	Treatment Loss	Total	Indoor	Irrigation	Treatment Loss	Total	Indoor	Irrigation	Treatment Loss	Total
Jan		8,246		1,343	9,589	0.025	-	0.004	0.029	0.0013	-	0.004	0.0054
Feb		7,448		1,213	8,661	0.023	-	0.004	0.027	0.0011	-	0.004	0.0049
Mar		8,246		1,343	9,589	0.025	-	0.004	0.029	0.0013	-	0.004	0.0054
Apr	1.3	7,980	1,864	1,603	11,446	0.024	0.006	0.005	0.035	0.0012	0.005	0.005	0.0113
May	2.6	8,246	3,728	1,949	13,923	0.025	0.011	0.006	0.043	0.0013	0.010	0.006	0.0175
Jun	5.8	7,980	8,315	2,653	18,948	0.024	0.026	0.008	0.058	0.0012	0.023	0.008	0.0323
Jul	7.6	8,246	10,896	3,117	22,258	0.025	0.033	0.010	0.068	0.0013	0.030	0.010	0.0409
Aug	6.5	8,246	9,319	2,860	20,425	0.025	0.029	0.009	0.063	0.0013	0.026	0.009	0.0358
Sep	4.5	7,980	6,452	2,350	16,781	0.024	0.020	0.007	0.052	0.0012	0.018	0.007	0.0263
Oct	1.7	8,246	2,437	1,739	12,423	0.025	0.007	0.005	0.038	0.0013	0.007	0.005	0.0133
Nov		7,980		1,299	9,279	0.024	-	0.004	0.028	0.0012	-	0.004	0.0052
Dec		8,246		1,343	9,589	0.025	-	0.004	0.029	0.0013	-	0.004	0.0054
Total	30.0	97,090	43,010	22,810	162,910	0.30	0.13	0.07	0.50	0.01	0.12	0.07	0.20
AF/SFE	0.13	0.30	0.13	0.07	0.50								

The calculation of the number of SFEs for Annexation 1, Annexation 2 and the Pioneer total is outlined in Table 2. For Annexation 1, the total SFEs including commercial business and industrial use is 8,415 with an annual water demand of 4,183 AF and an annual depletion of 1,704 AF.

Table 2
SFEs, Water Demand and Water Depletion

Annexation 1 SFEs				41%
Annual Water Demand per SFE	0.50	Annual Depletion per SFE		0.20
Land Use	Buildout Units	SFEs	Annual Water Demand, AF	Annual Depletion, AF
Single Family, Two Family	6,686	6,686	3,343	1,362
Multi-Family (0.8 SFE/Unit)	1,625	1,300	650	265
Total Residential Demand	8,311	7,986	3,993	1,627
	Units in ft^2			
Commercial Business (0.08 gal/day/ft^2)	988,000	226	89	36
Industrial (0.18 gal/day/ft^2)	505,000	204	102	41
Total Retail/Office/Industrial*	1,493,000	429	190	78
Annexation 1 Total SFEs, Demand & Depletion		**8,415**	**4,183**	**1,704**
Annexation 2 SFEs				41%
Single Family, Two Family	2,376	2,376	1,188	484
Multi-Family (0.8 SFE/Unit)	434	347	174	71
Total Residential Demand	2,810	2,723	1,361	555
	Units in ft^2			
Commercial Business (0.08 gal/day/ft^2)	80,000	18	9	4
Industrial (0.18 gal/day/ft^2)	2,657,000	1,366	683	278
Total Retail/Office/Industrial*	2,737,000	1,385	692	282
Annexation 2 Total SFEs, Demand and Depletion		2,739	1,322	510
Pioneer Total SFEs, Demand and Depletion		**11,155**	**5,505**	**2,214**

* From historical commercial use data from Corps of Engineers 1983, AWWA RF 2000 using 50th percentile values from summary tables. Retail 0.11 gal/day/ft^2 Office 0.04 gal/day/ft^2. Use 0.08 gal/day/ft^2 for Commercial Business.

3.0 WATER SUPPLY

The water supply plan for Pioneer is based upon three sources of groundwater including: Lost Creek alluvial groundwater, nontributary Denver Basin groundwater, and Box Elder alluvial groundwater. The three water sources will be blended to provide water to meet the demands of the Pioneer annexation. The Lost Creek basin groundwater includes a total average annual historical depletion amount of 2,600 acre-feet (AF). The Denver Basin annual average Laramie-Fox-Hills Aquifer withdrawal available is 800 AF. Return flows from the Lost Creek and Laramie-Fox Hills water will augment wells pumping from the Box Elder alluvium.

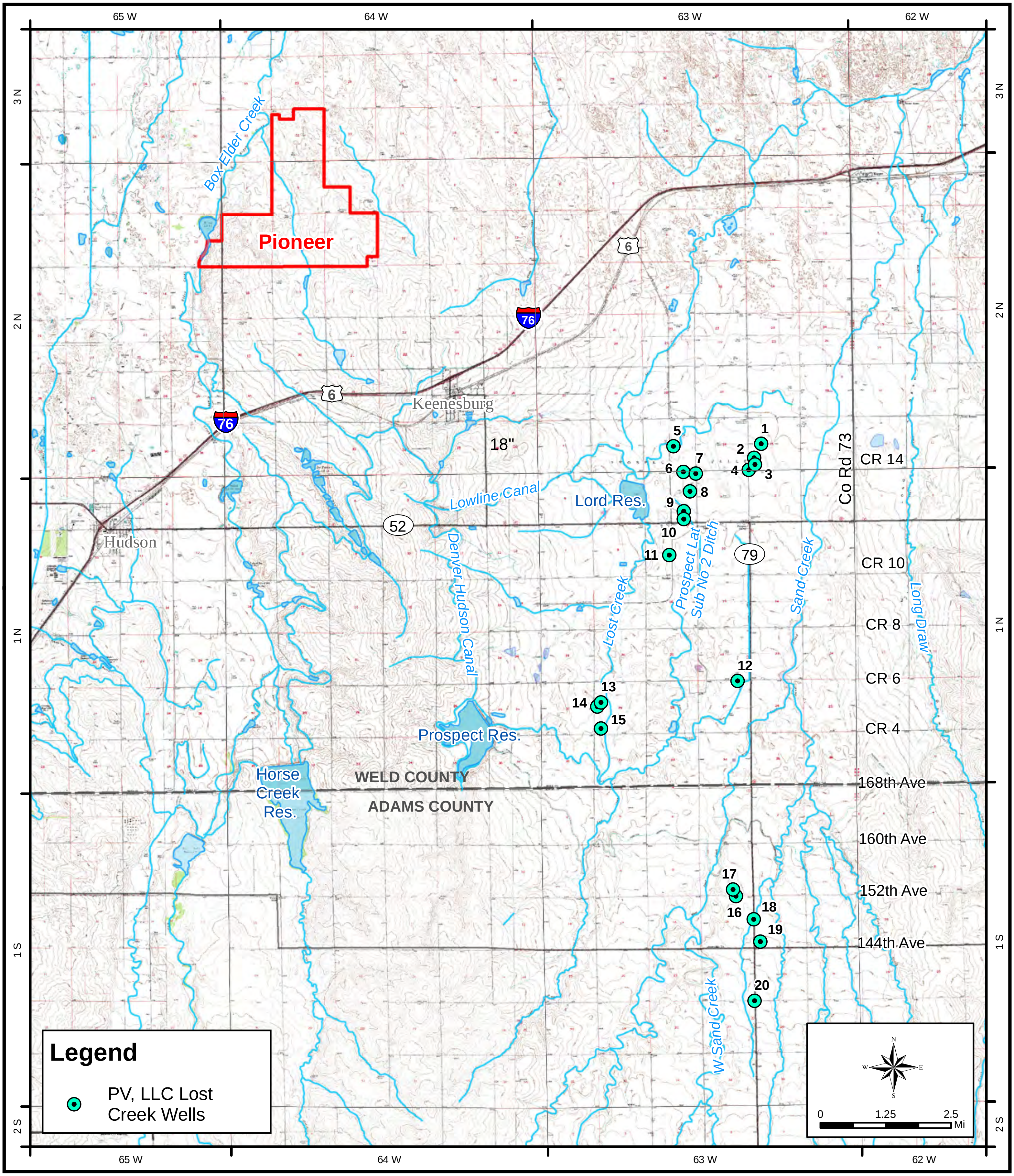
3.1 Lost Creek Alluvial Groundwater

The Lost Creek alluvial groundwater is summarized by well ID number, well permit number and the location parcel and area in Table 3 with the locations of the wells shown on Figure 2. The existing 20 wells have a total average annual historical depletion amount of 2,600 acre-feet (AF).

Table 3
Lost Creek Alluvial Groundwater

Well ID	Permit No.	Parcel	Area	Average Annual Historical Depletion (AF)
1	1773-FP	H	13	79.9
2	1772-FP	H	13	125.3
3	1774-FP	H	13	27.8
4	1771-RFP	H	13	83.2
5	31612-FP	I-1	11	65.4
6	31653-FP	I-2c	10	98.0
7	31654-FP	I-2c	10	116.8
8	31536-FP	I-3	10	84.6
9	1730-FP	I-4	10	92.0
10	1731-FP	I-4	10	82.2
11	31595-FP	G	9	163.5
12	31542-FP	L-1a & L-1b	8	193.3
13	8535-FP	A-2	5	96.9
14	8533-FP	A-2	5	84.0
15	8534-FP	A-2	5	81.5
16	6419-FP	N-2	1	347.2
17	9175-FP	N-2	1	301.4
18*	31568-FP	Helzer		152.0
19*	9430-FP	Helzer		124.7
20*	15550-FP	Hubbs		200.4
Total Lost Creek				**2,600**

* Not included in Case No. 99CV0097 and 98CV1727



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Lost Creek Alluvial Groundwater Wells

PROJECT NO. 131-037.020

FIGURE 2

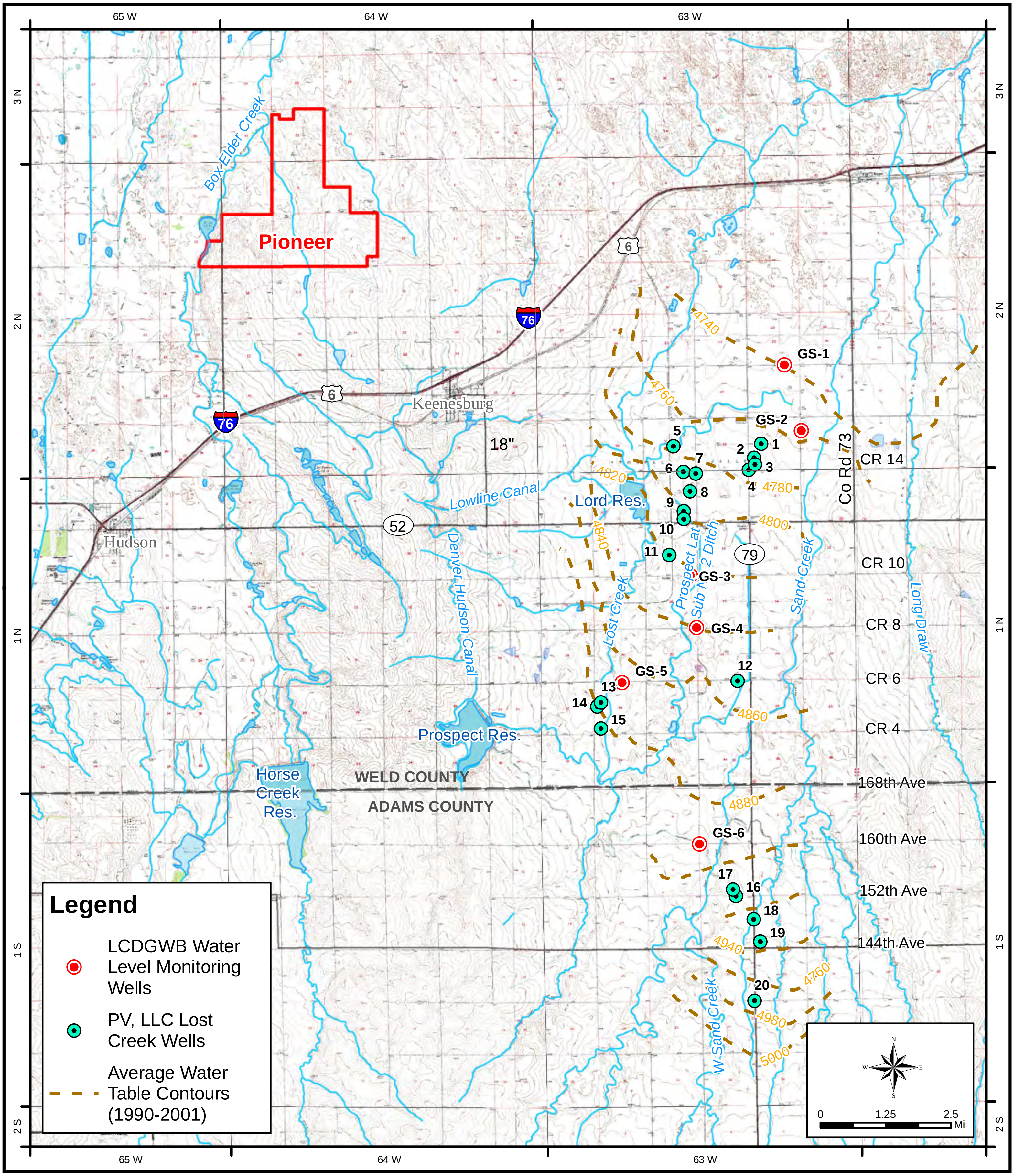
A change of use, including export for beneficial uses outside of the Lost Creek Designated Ground Water Basin (DGWB), was approved in Case Nos. 99CV0097 and 98CV1727 for 17 of the 20 existing wells. The change of use for the remaining three wells on the Helzer and Hubbs parcels was approved in the Findings and Order of the Colorado Groundwater Commission, Final Permit Nos. 31568-FP, 9430-FP, and 15550-FP. The 20 wells have an available annual historic depletion totaling 2,600 AF for changed uses and for export out of the Lost Creek DGWB.

The changed uses, allowable upon meeting notification and other requirements such as metering, include domestic, irrigation, commercial, municipal, industrial, stock watering, recreation, fish and wildlife purposes, augmentation, residential and fire protection.

Lost Creek Sustainability. The analysis of the sustainability of the Lost Creek alluvial groundwater, relied upon data from two documents: 1) Lost Creek Designated Ground Water Basin Water Level Measurement 2017 and 2) Arnold, L.R., U.S. Geological Survey Scientific Report 2010-5082, Hydrogeology and Steady-State Numerical Simulation of Groundwater Flow in the Lost Creek Designated Ground Water Basin, Weld, Adams, and Arapahoe Counties, Colorado (USGS SIR-2010-5082). Other municipal water suppliers that have analyzed and accepted Lost Creek groundwater for municipal uses include the Town of Castle Rock and the South Adams County Water and Sanitation District.

Figure 3 shows the location of the Lost Creek Alluvial Wells Nos. 1-20 and the locations of the Lost Creek Designated Ground Water Basin (LCDGWB) water level monitoring wells GS-1 through GS-6. The LCDGWB water level measurements for the GS monitoring holes have been taken over a period of 50 or more years.

Also shown on Figure 3 are water level contours taken from the USGS SIR 2010-5082 report, Figure 26 titled "Steady-state altitude and configuration of the water table simulated by the groundwater flow model, Lost Creek Designated Ground Water Basin, Colorado." The contours represent the average water table condition during the period 1990 through 2001.



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Lost Creek Wells and Lost Creek Designated Groundwater Basin (LCDGWB) Monitoring Wells

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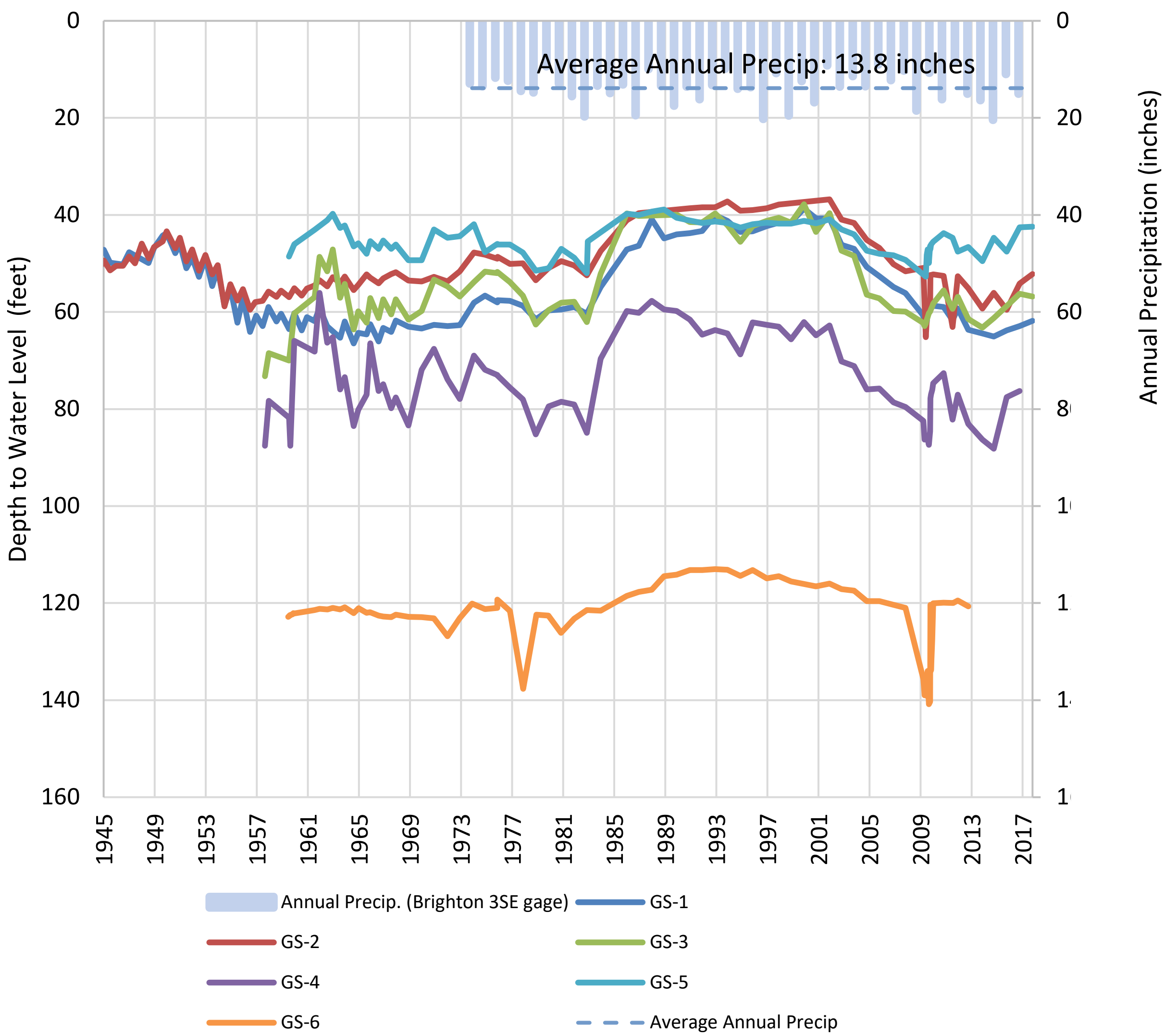
FIGURE 3

Figure 4 is a graph of the depth to water for the GS monitoring wells for years 1945 through 2017. For background purposes, at the top the graph, annual precipitation at Brighton is shown for years 1973 to 2017 with an average annual rainfall of 13.8 inches. There is variability in the water levels, with water level declines and recovery. In the last ten years, the lowest water levels considering all six GS monitoring wells occurred in the years 2009-2010.

Figure 4
Lost Creek Depth to Water and Annual Precipitation



To assess the water sustainability, an analysis was made to estimate the water column remaining in the Lost Creek wells at times of low groundwater levels. Table 4 gives the average groundwater elevation (Column 4) and the lowest groundwater elevation recorded in years 2009-2010. The lowest groundwater elevations range from 2 to 25 feet below the average water table elevation with a median decline of 21 feet.

Table 4
Lost Creek Low Groundwater Level 2009-2010

1	2	3	4	5	6
Monitoring Well	Surface Elevation, ft	Well Depth, ft	Figure 26 Groundwater Elevation	Groundwater Elevation	Difference from Average Year
GS-1	4784.73	82	4740	4721	-19
GS-2	4797.73	N.A.	4755	4733	-22
GS-3	4867.76	101	4823	4806	-17
GS-4	4902.76	150	4840	4815	-25
GS-5	4916.78	100	4868	4866	-2
GS-6	5008.80	180	4893	4869	-24
				Median	-21

Column Footnotes:

1-3	LCDGWB Water Level Measurements 2017
4	Average Water Table Contours from Figure 2-2 (Contours from Fig. 26, USGS SIR 2010-5082)
5	LCDGWB Water Level Measurements 2017, lowest water level elevation in 2009-2010
6	Difference from Average Year (Col. 5 - Col. 4)

Table 5 lists the Lost Creek wells, their depth, the bottom of well elevation, and the average water table elevation taken from Figure 2. The average water column height in the well is the average water table elevation (Col. 6) minus the well bottom elevation (Col. 5) which for all the wells averages 58 feet. The low water column height average is 37 feet. There are two wells, No. 6 and No. 14 that have water column heights of 13 and 17 feet, respectively, which could reduce the physical availability from these wells. The annual historical depletion from these two wells of 182 AF is deducted from the 2,600 AF per year for all the wells giving an estimated annual sustainable yield of 2,418 AF.

Table 5
Lost Creek Alluvial Groundwater Sustainabilty

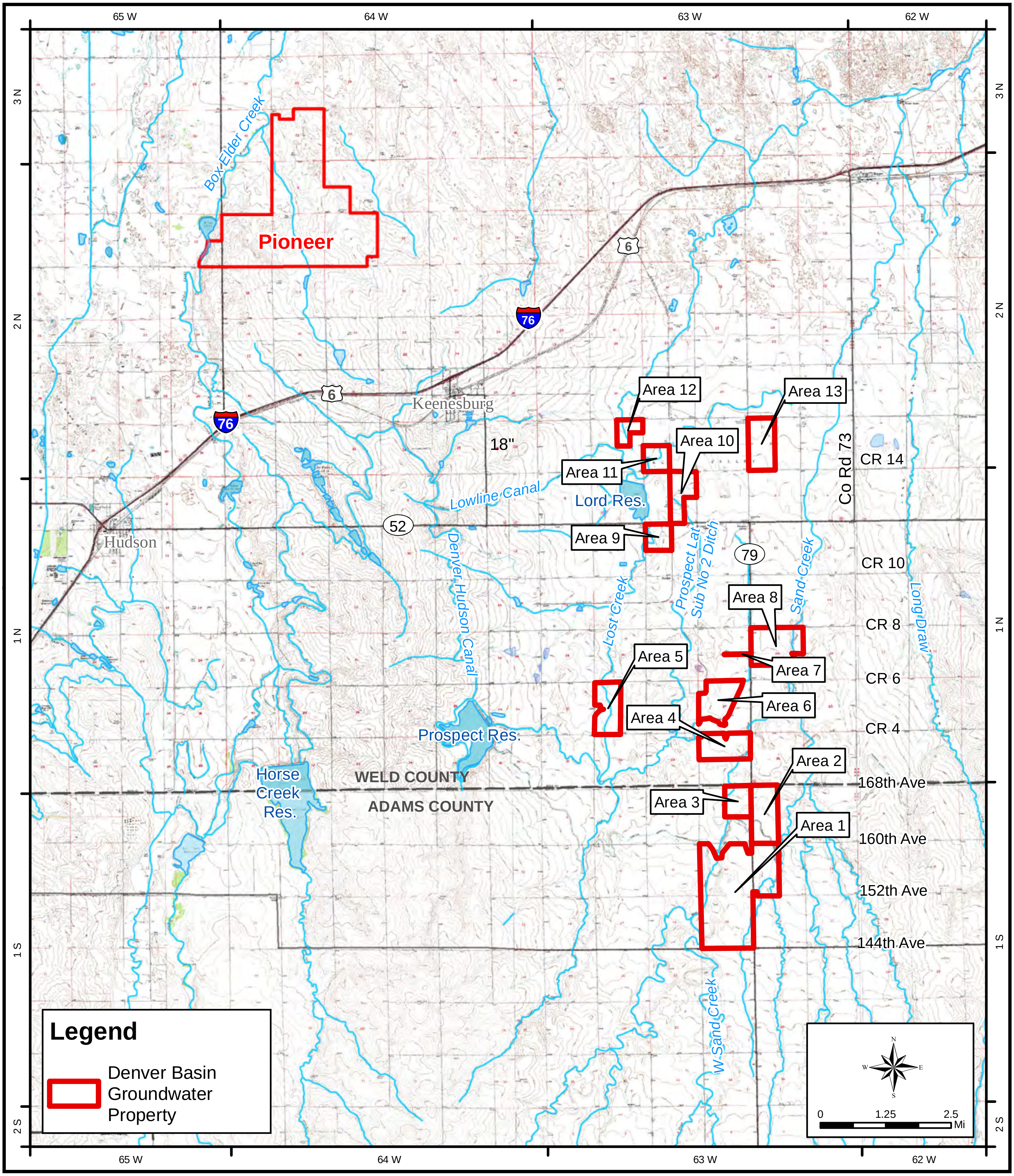
1	2	3	4	5	6	7	8	9
		All Values in feet						
Well No.	Permit No.	Ground Surface Elevation	Well Depth	Well Bottom Elevation	USGS Average Water Table Elevation	Average Year Water Column Available	Dry Year Water Column Available	Average Annual Historic Depletion (AF)
1	1773-FP	4819	133	4686	4765	79	58	79.9
2	1772-FP	4825	136	4689	4770	81	60	125.3
3	1774-FP	4829	116	4713	4772	59	38	27.8
4	1771-RFP	4833	115	4718	4775	57	36	83.2
5	31612-FP	4815	85	4730	4775	45	24	65.4
6	31653-FP	4831	84	4747	4785	38	**17**	**98.0**
7	31654-FP	4836	97	4739	4785	46	25	116.8
8	31536-FP	4844	110	4734	4793	59	38	84.6
9	1730-FP	4849	129	4720	4800	80	59	92.0
10	1731-FP	4850	124	4726	4800	74	53	82.2
11	31595-FP	4869	134	4735	4820	85	64	163.5
12	31542-FP	4932	168	4764	4853	89	68	193.3
13	8535-FP	4937	107	4830	4878	48	27	96.9
14	8533-FP	4949	103	4846	4880	34	**13**	**84.0**
15	8534-FP	4947	98	4849	4890	41	20	81.5
16	6419-FP	5042	179	4863	4915	52	31	347.2
17	9175-FP	5041	175	4866	4912	46	25	301.4
18	31568-FP	5045	170	4875	4928	53	32	152.0
19	9430-FP	5059	160	4899	4940	41	20	124.72
20	15550-FP	5093	176	4917	4975	58	37	200.37
					Average or Total	**58**	**37**	**2,600**
						Wells 6 and 14		-182
						Sustainable Yield		**2,418**

Column Footnotes

3 Ground surface elevation from Google Earth and well UTM coordinates
4 From well permit
5 Col. 3 - Col 4
6 From Figure 2-2, average year water table contours taken from USGS SIR 2010-5082
7 Col. 6 - Col. 5
8 Average Water Column - 21 feet (Table 4)
9 Average Annual Historic Depletion (Table 3)

3.2 Denver Basin Groundwater

The Pioneer Metropolitan District No. 3 Denver Basin groundwater was quantified in the LCDGWB in Determination No. 2037-BD for the Laramie-Fox Hills Aquifer and in Determination No. 2038-BD for the Arapahoe Aquifer. Figure 5 shows Areas 1-13 with the underlying Denver Basin groundwater underlying a total of approximately 4,053 acres. Table 6 gives the average annual withdrawal by parcel area and aquifer.



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Laramie-Fox Hills Aquifer Designated Groundwater

PROJECT NO. 131-037.020

FIGURE 5

Table 6
Denver Basin Groundwater

Area	Acres	Average Annual Withdrawal, AF/year	
		Nontributary Laramie-Fox Hills Aquifer*	Not-Nontributary Arapahoe Aquifer
1	1,437	292.5	148.0
2	323	62.9	25.6
3	176	35.6	14.8
4	278	50.1	20.9
5	300	60.8	26.8
6	290	52.2	20.1
7	1	0.18	0.05
8	412	75.8	19
9	126	26.5	5.52
10	199	44.3	3.5
11	133	29.9	0
12	92	18.6	0.0
13	286	50.9	0
Total	4,053	800	284

The Laramie-Fox Hills Aquifer groundwater is classified as nontributary and includes the right of reuse and successive use subject to a 2 percent relinquishment requirement. No more than 98 percent of the nontributary groundwater withdrawn may be consumed. To extend the life of the Laramie-Fox Hills Aquifer, one-half of the annual allowable withdrawal is used in analyzing the water supply for Pioneer.

The Arapahoe Aquifer groundwater is classified as not-nontributary. The use of the Arapahoe Aquifer groundwater requires a replacement plan to replacements to the affected stream system. While the Arapahoe Aquifer groundwater would be available for Pioneer's use, its use would be as a backup supply and is not considered in the water rights operation model.

4.0 WATER RIGHTS OPERATION PLAN

Table 7 provides an operation model of the water demand, return flows and depletion. The Lost Creek and Laramie-Fox Hills groundwater is supplied in an amount such that the fully consumable return flows equal or exceed the depletion of Box Elder groundwater (comparison of Cols. 9 and 14). For Annexation 1, the annual water supply totals 4,207 AF with 1,964 AF per year of Box Elder Creek alluvial water augmented by the Lost Creek and Laramie-Fox Hills return flows. There is 536 AF of reusable credit in the months of October through May.

Table 8 is an operation study for Annexations 1 and 2 with a total of 10,440 SFE (approximately 94 percent of the entire Pioneer SFEs). There is 665 AF of reusable Box Elder credit in the months of October through May. To supply the remaining 715 SFEs, Pioneer could store the excess the Box Elder credits and exchange for use during the irrigation season. A storage volume of approximately 300 AF would be required.

	Water Demand					Water Delivery				Reusable Water					Pumping rate		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Month	Indoor Use	Outdoor Use	Total Use Indoor & Outdoor Use	Treatment Loss	Raw Water Reqt.	Raw Water Lost Creek	Raw Water Laramie-Fox Hills	Raw Water Box Elder	Total Raw Water Delivered	WW Return Flow (Lost Creek)	WW Return Flow (LFH)	Irrigation Return Flow	Total Reuse Credit (Lost Creek & LFH)	Box Elder WW Return Reusable Credit	Raw Water Lost Creek	Raw Water Laramie-Fox Hills	Raw Water Box Elder
Jan	213	-	213	35	248	93	33	121	248	89	32	-	120	82	1.5	0.5	2.0
Feb	192	-	192	31	224	85	30	109	224	80	29	-	109	74	1.5	0.5	2.0
Mar	213	-	213	35	248	93	33	121	248	89	32	-	120	82	1.5	0.5	2.0
Apr	206	48	254	41	296	116	32	147	296	111	31	5	146	55	2.0	0.5	2.5
May	213	96	309	50	360	145	33	181	360	138	32	10	179	33	2.4	0.5	2.9
Jun	206	215	421	69	489	240	32	217	489	165	31	21	217	-	4.0	0.5	3.6
Jul	213	281	494	80	575	311	33	231	575	171	32	28	230	-	**5.1**	**0.5**	**3.8**
Aug	213	241	454	74	528	267	33	227	528	171	32	24	226	-	4.3	0.5	3.7
Sep	206	167	373	61	433	189	32	212	433	165	31	17	212	0	3.2	0.5	3.6
Oct	213	63	276	45	321	128	33	160	321	121	32	6	159	50	2.1	0.5	2.6
Nov	206	-	206	34	240	90	32	117	240	86	31	-	117	79	1.5	0.5	2.0
Dec	213	-	213	35	248	93	33	121	248	89	32	-	120	82	1.5	0.5	2.0
Total	2,507	1,111	3,618	589	**4,207**	1,851	392	**1,964**	**4,207**	1,474	372	111	**1,957**	536			

Column Footnotes

2 Indoor water use per SFE of 0.3 AF/yr. * Number SFE

3 Irrigation use of 0.13 AF per SFE * Number SFE

4 Total Use Indoor & Outdoor Use = Indoor Use + Outdoor Use (Col. 2 + Col. 3)

5 Water Treatment Loss = SFEs x 0.05 AF distributed by monthly water use pattern

6 Raw Water Requirement = Indoor Use + Outdoor Use + Treatment Loss (Col. 2 + Col. 3 + Col. 4)

7 Lost Creek to match depletion

8 Laramie-Fox Hills annual withdrawal *0.5 evenly distributed throughout year.

9 Raw Water Box Elder select such that Col. 14 = or > Col. 9 and Col. 7 = or > Col. 8

10 Col. 7 + Col. 8 + Col. 9

11 Waste Water Return flow for Lost Creek indoor use only (0.95*Col 7)

12 Waste Water Return flow for Laramie-Fox Hills indoor use only (0.95*Col 8)

13 Minimum of Col 3 * 0.10 and Col. 7 + Col. 8 - Col. 2 * 0.05

14 Col. 11 + Col. 12 + Col. 13

15 Col. 2 * 95% - Col 12 -Col. 13

16 Conversion from acre-feet per month to cfs. (Col. 7/(no. days in month * 1.9835))

17 Conversion from acre-feet per month to cfs. (Col. 8/(no. days in month * 1.9835))

18 Conversion from acre-feet per month to cfs. (Col. 9/(no. days in month * 1.9835))

Table 8 Annexation 2— Water Demand, Return Flow and Depletion Study

Water Use per SFE	AF/yr	10,440	SFE
Indoor	0.30		
Outdoor	0.13		
Total Indoor & Outdoor	0.43		
Treatment Loss	0.07		
Total Raw Water	0.50		

	AF/Yr	Supply %	Loss	AF	AF Loss/SFE
Lost Creek	2,395	46%			
Laramie-Fox Hills	392	8%			
Box Elder	2,433	47%	30%	730	0.07
	5,220				

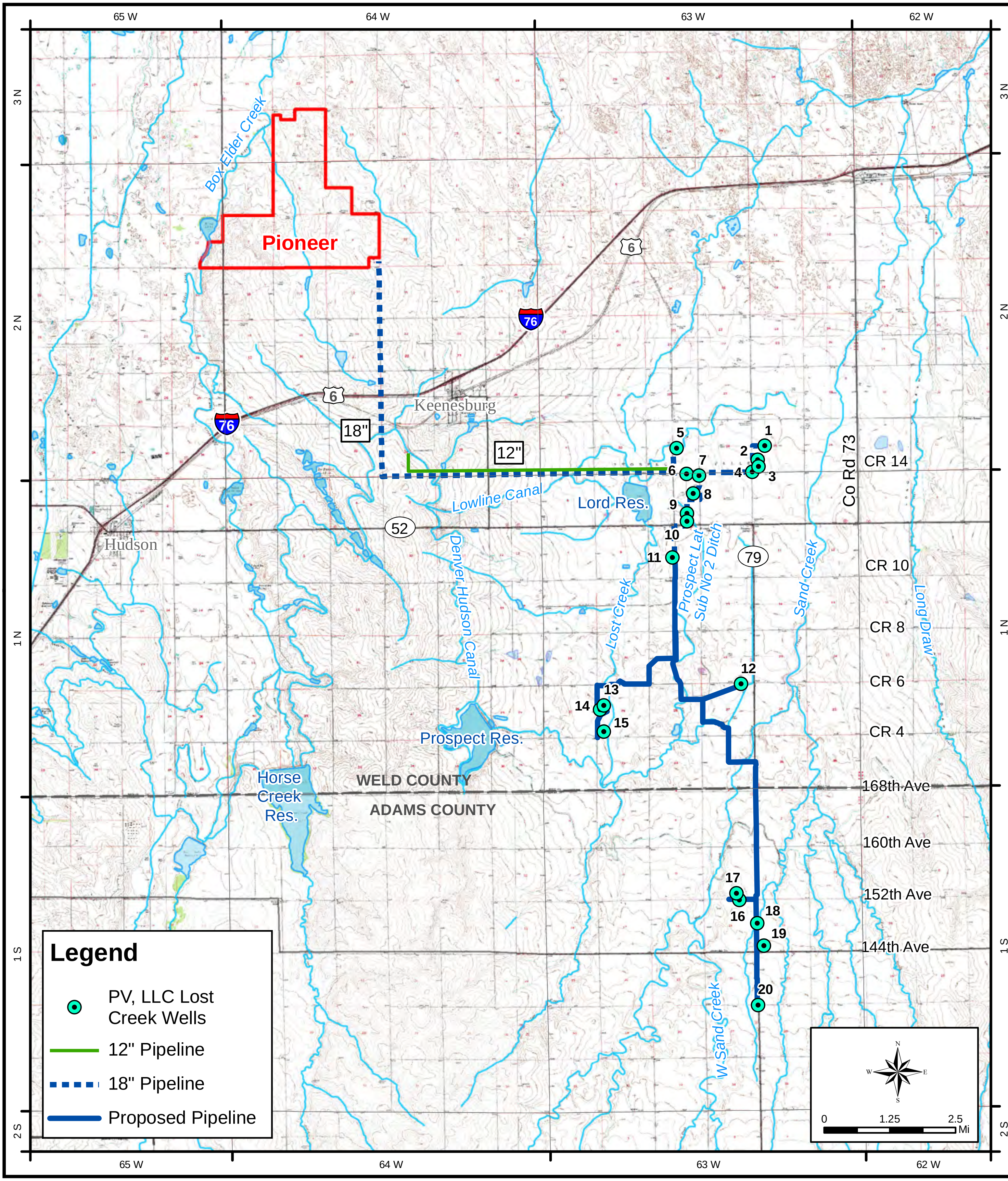
	Values in AF									95%					Values in cfs		
	Water Demand					Water Delivery				Reusable Water					Pumping rate		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Month	Indoor Use	Outdoor Use	Total Use Indoor & Outdoor Use	Treatment Loss	Raw Water Reqt.	Raw Water Lost Creek	Raw Water Laramie-Fox Hills	Raw Water Box Elder	Total Raw Water Delivered	WW Return Flow (Lost Creek)	WW Return Flow (LFH)	Irrigation Return Flow	Total Reuse Credit	Box Elder WW Return Reusable Credit	Raw Water Lost Creek	Raw Water Laramie-Fox Hills	Raw Water Box Elder
Jan	264	-	264	43	307	124	33	150	307	118	32	-	149	102	2.0	0.5	2.4
Feb	239	-	239	39	277	112	30	135	277	107	29	-	135	91	2.0	0.5	2.4
Mar	264	-	264	43	307	124	33	150	307	118	32	-	149	102	2.0	0.5	2.4
Apr	256	60	315	51	367	153	32	182	367	145	31	6	181	67	2.6	0.5	3.1
May	264	119	384	62	446	189	33	224	446	179	32	12	223	40	3.1	0.5	3.6
Jun	256	266	522	85	607	305	32	270	607	212	31	27	270	-	5.1	0.5	4.5
Jul	264	349	613	100	713	394	33	286	713	219	32	35	286	-	**6.4**	**0.5**	**4.7**
Aug	264	299	563	92	654	340	33	281	654	219	32	30	281	-	5.5	0.5	4.6
Sep	256	207	462	75	538	243	32	262	538	210	31	21	261	2	4.1	0.5	4.4
Oct	264	78	342	56	398	167	33	198	398	158	32	8	198	61	2.7	0.5	3.2
Nov	256	-	256	42	297	120	32	145	297	114	31	-	145	98	2.0	0.5	2.4
Dec	264	-	264	43	307	124	33	150	307	118	32	-	149	102	2.0	0.5	2.4
Total	3,111	1,378	4,489	731	**5,220**	**2,395**	392	**2,433**	**5,220**	1,918	372	138	**2,428**	**665**			
					Available	2,418											

The location of the Lost Creek wells and the gathering system is shown on Figure 6. Laramie-Fox Hill wells will be constructed on the areas shown on Figure 5. Pioneer will blend the Laramie-Fox Hills water with the Lost Creek groundwater on a 50-50 basis and deliver the water to Pioneer with the existing water pipeline or construct a parallel pipeline in the existing easements.

The Box Elder system wells will be located west of Box Elder Creek and will have a peak month demand of 3.8 cfs (1,700 gpm). There are many existing irrigation wells constructed in the Box Elder alluvium that have reported yields ranging from 500 to 1,000 gpm. New municipal type wells will be constructed. A portion of the Lost Creek and Box Elder will be treated, likely by reverse osmosis (RO), and will be blended to meet drinking water standards. Pioneer may consider the installation of a dual distribution system with a non-potable irrigation system to minimize the need for RO treatment.

5.0 SUMMARY WATER RIGHTS AND WATER SUPPLY

The Pioneer Lost Creek alluvial groundwater with an average annual historical depletion of 2,600 AF has an estimated sustainable annual yield of 2,418 AF of fully consumable water. The projected average annual withdrawal from the Pioneer Laramie-Fox Hills Aquifer is 400 AF of the 800 AF allowable. The Lost Creek water and the Laramie-Fox Hills water will augment pumping from Box Elder Creek providing sufficient reusable water to augment the entire proposed Pioneer project.



Path: Z:\Project Files\13\131-037\131-037.020\CAD-GIS\GIS\01_MXD\KeenesburgAnnexation\Figure6_KeenesburgAnnexation_Pipelines.mxd

WRIGHT WATER ENGINEERS, INC.
2490 W 26TH AVE 100A
DENVER, CO. 80211
(303) 480-1700

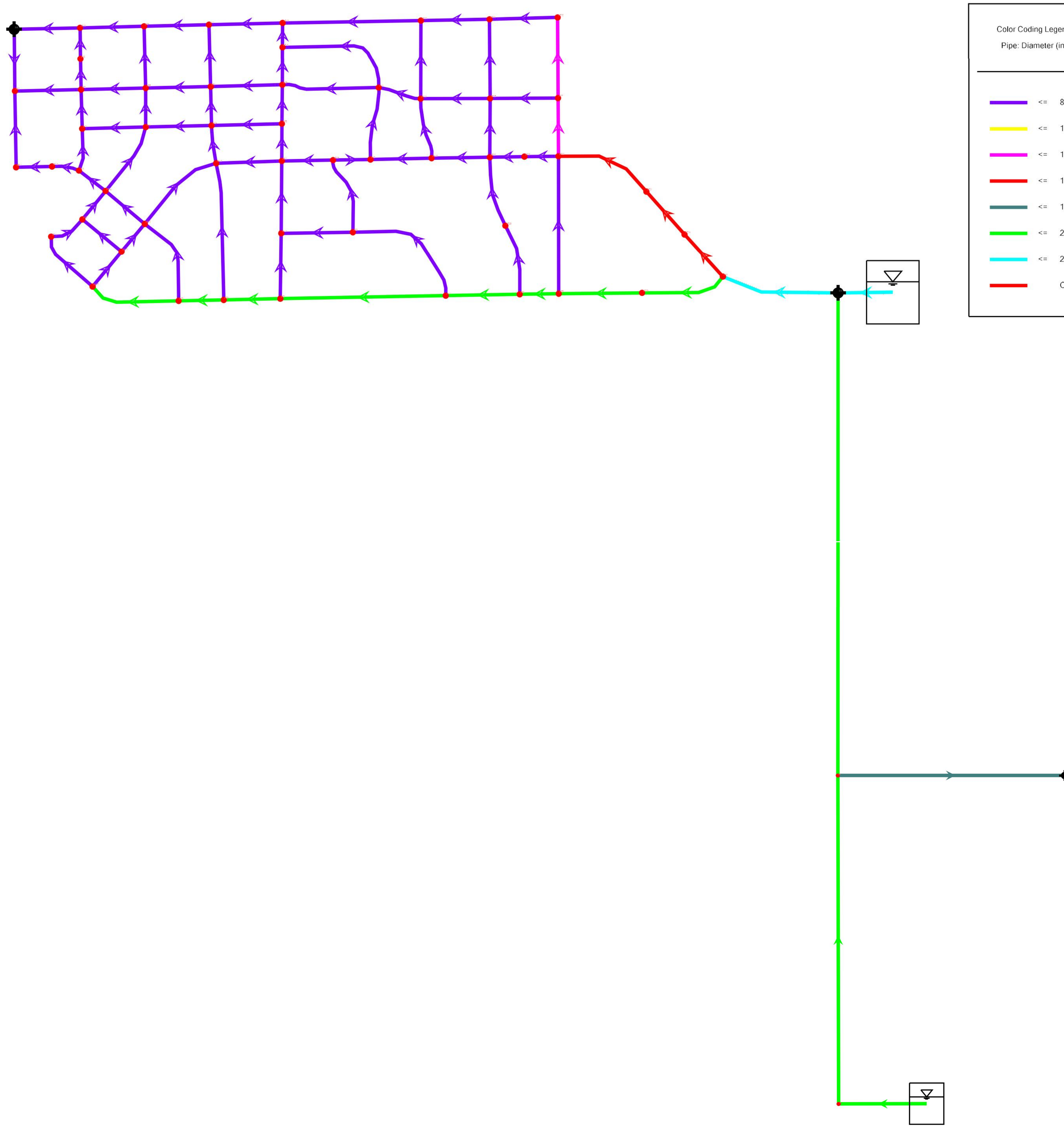
Well Gathering System

PROJECT NO.
131-037.020

FIGURE
6

Appendix I

Water System Schematics



Color Coding Legend
Pipe: Diameter (in)

Color		Diameter
Purple	<=	8.0
Yellow	<=	10.0
Magenta	<=	12.0
Red	<=	14.0
Dark green	<=	16.0
Green	<=	20.0
Cyan	<=	24.0
Red		Other

ENGINEER IN CHARGE:

PRELIMINARY
NOT FOR CONSTRUCTION

CONTACT INFORMATION
88 INVERNESS CIRCLE EAST, SUITE E-101
ENGLEWOOD, CO 80112
(720) 206-6931
CPERDUE@STRATEGICSITEDESIGNS.COM
ATTENTION: CHRISTOPHER PERDUE, P.E., M.B.A.

STRATEGIC SITE DESIGNS

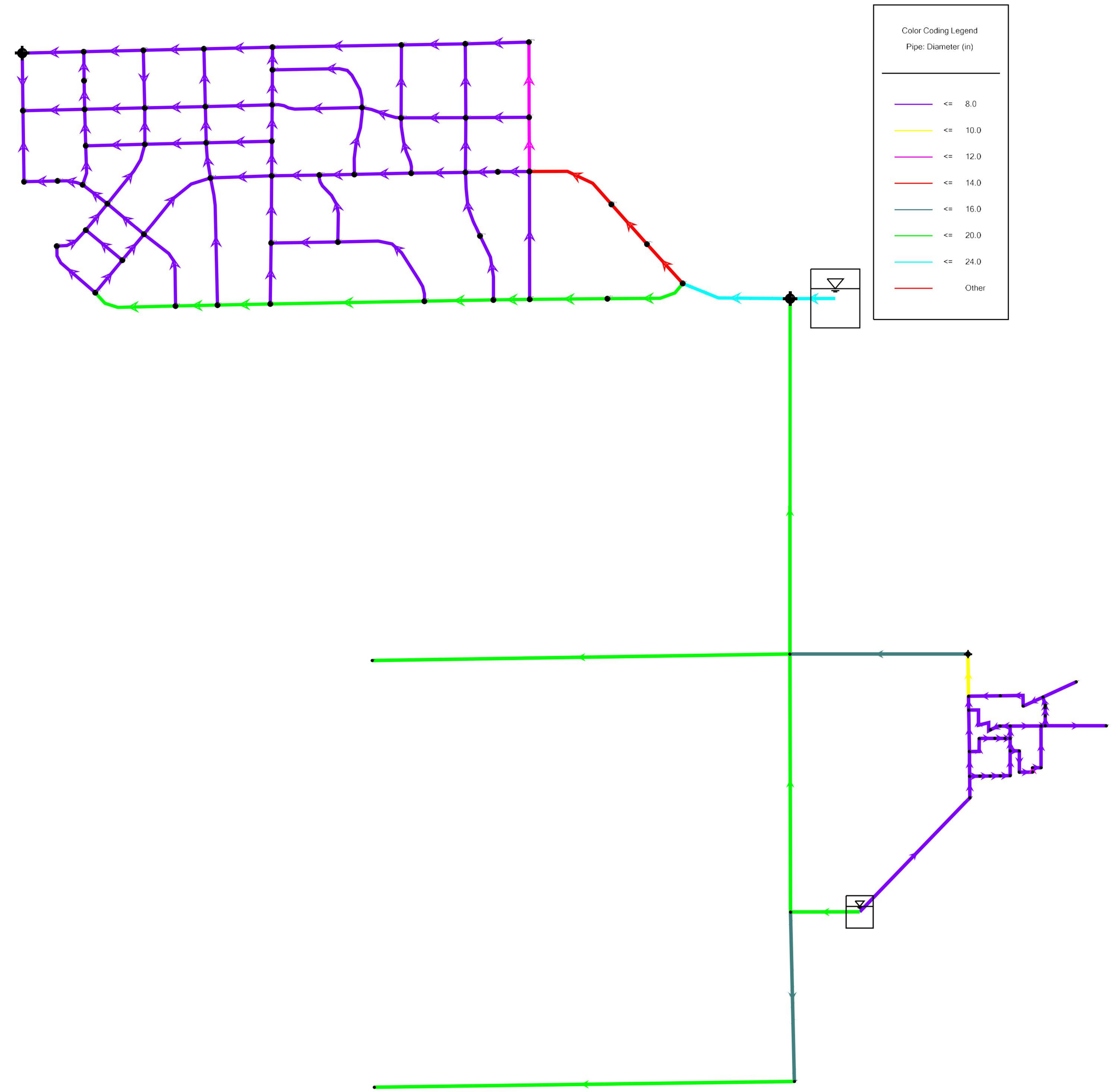
PIONEER VILLAGE

KEENESBURG, COLORADO
WELD COUNTY

POTABLE DISTRIBUTION SCHEMATIC AT BUILDOUT - TWO TANKS

REV	DESCRIPTION	BY	DATE

JOB NO:
ORIGINAL ISSUE:
DESIGN BY:
CHECKED BY:
SCALE: NOT TO SCALE
SHEET NUMBER



ENGINEER IN CHARGE:

PRELIMINARY NOT FOR CONSTRUCTION

CONTACT INFORMATION
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ENGLEWOOD, CO 80112
(720) 206-6931
CPERDUE@STRATEGICSITEDESIGNS.COM
ATTENTION: CHRISTOPHER PERDUE, P.E., M.B.A.

STRATEGIC SITE DESIGNS

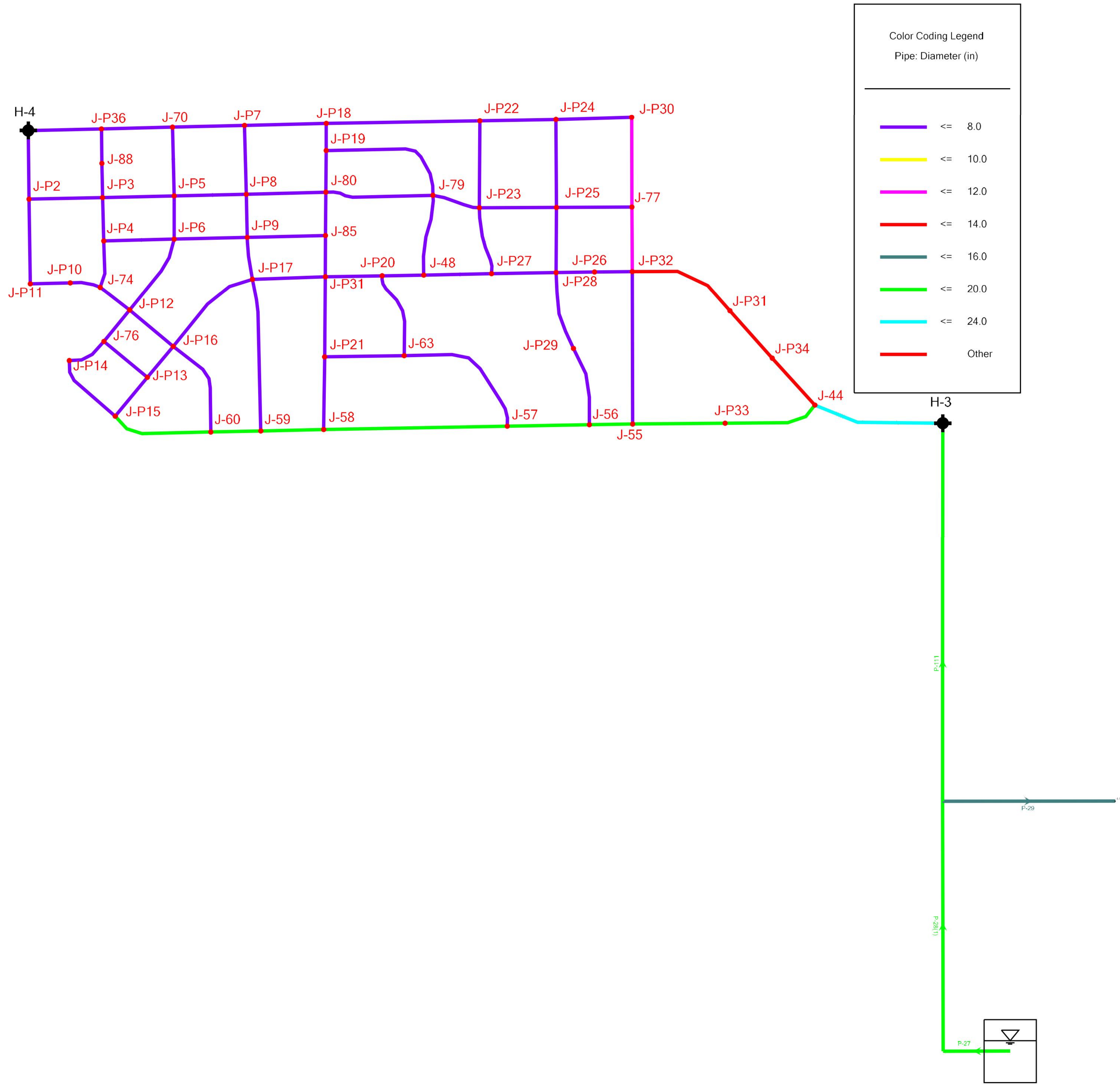
PIONEER VILLAGE

KEENESBURG, COLORADO
WELD COUNTY

POTABLE DISTRIBUTION SCHEMATIC AT BUILDOUT INCLUDING KEENESBURG

REV	DESCRIPTION	BY	DATE

JOB NO:
ORIGINAL ISSUE:
DESIGN BY:
CHECKED BY:
SCALE: NOT TO SCALE
SHEET NUMBER



ENGINEER IN CHARGE:

PRELIMINARY NOT FOR CONSTRUCTION

CONTACT INFORMATION
88 INVERNESS CIRCLE EAST, SUITE E-101
ENGLEWOOD, CO 80112
(720) 206-6931
CPERDUE@STRATEGICSITEDESIGNS.COM
ATTENTION: CHRISTOPHER PERDUE, P.E., M.B.A.

STRATEGIC SITE DESIGNS

PIONEER VILLAGE

KEENESBURG, COLORADO
WELD COUNTY

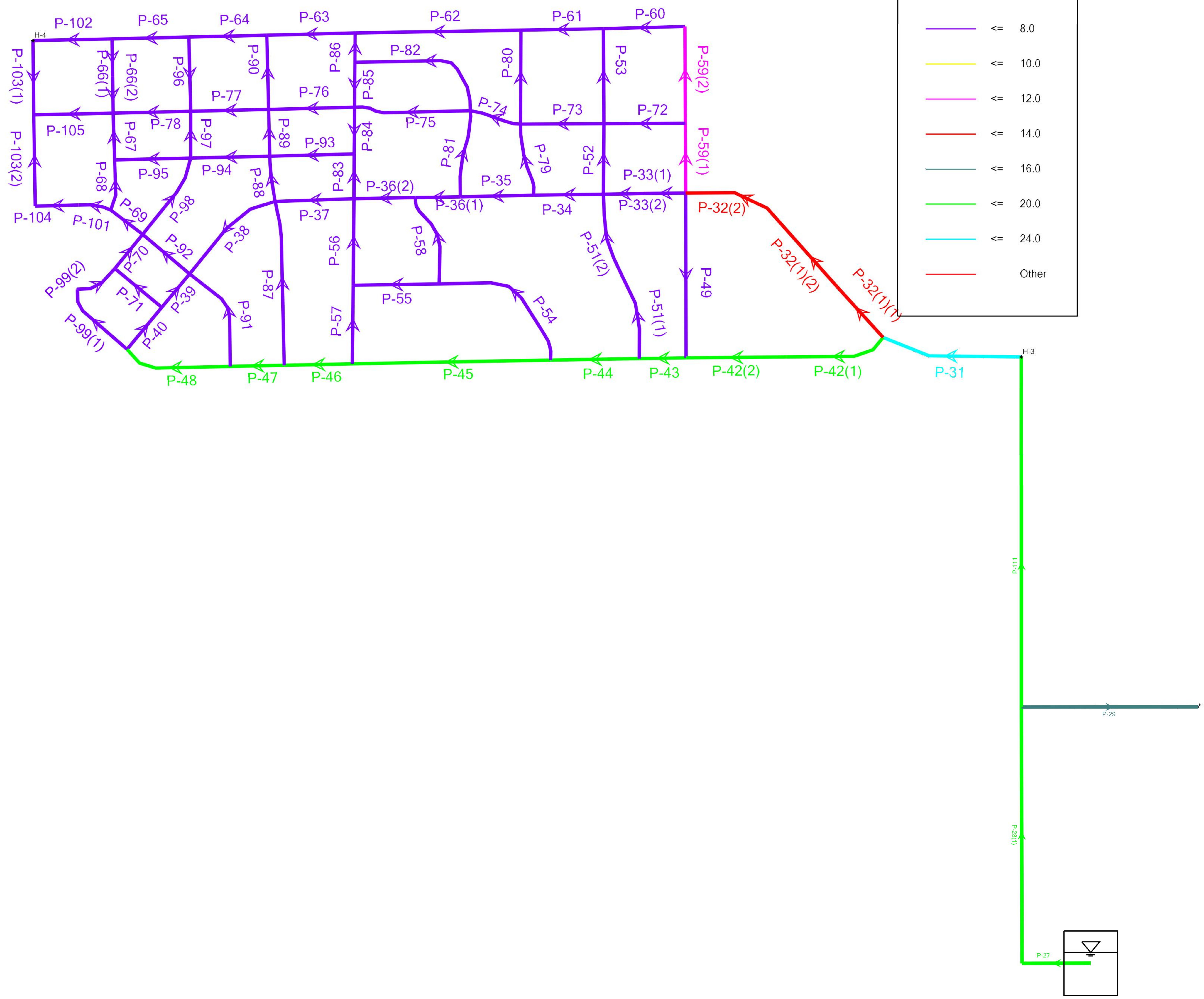
POTABLE DISTRIBUTION SCHEMATIC PHASES 1-15 (0.75 MG TANK) JUNCTION LABELS

REV	DESCRIPTION	BY	DATE

JOB NO:
ORIGINAL ISSUE:
DESIGN BY:
CHECKED BY:
SCALE: NOT TO SCALE
SHEET NUMBER

ENGINEER IN CHARGE:

PRELIMINARY
NOT FOR CONSTRUCTION



Color Coding Legend

Pipe: Diameter (in)

(purple)	<=	8.0
(yellow)	<=	10.0
(magenta)	<=	12.0
(red)	<=	14.0
(teal)	<=	16.0
(green)	<=	20.0
(cyan)	<=	24.0
(red)		Other

CONTACT INFORMATION
88 INVERNESS CIRCLE EAST, SUITE E-101
ENGLEWOOD, CO 80112
(720) 206-6931
CPERDUE@STRATEGICSITEDESIGNS.COM
ATTENTION: CHRISTOPHER PERDUE, P.E., M.B.A.

STRATEGIC SITE DESIGNS

PIONEER VILLAGE

KEENESBURG, COLORADO
WELD COUNTY

POTABLE DISTRIBUTION SCHEMATIC PHASES 1-15 (0.75 MG TANK) PIPE LABELS

REV	DESCRIPTION	BY	DATE

JOB NO:

ORIGINAL ISSUE:

DESIGN BY:

CHECKED BY:

SCALE: NOT TO SCALE

SHEET NUMBER

ENGINEER IN CHARGE:

PRELIMINARY NOT FOR CONSTRUCTION

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ENGLEWOOD, CO 80112
(720) 206-6931
CPERDUE@STRATEGICSITEDESIGNS.COM
ATTENTION: CHRISTOPHER PERDUE, P.E., M.B.A.

STRATEGIC SITE DESIGNS

PIONEER VILLAGE

KEENESBURG, COLORADO
WELD COUNTY

POTABLE DISTRIBUTION SCHEMATIC PHASES 1-15 (0.75 MG TANK) PIPE LABELS

REV	DESCRIPTION	BY	DATE

JOB NO:
ORIGINAL ISSUE:
DESIGN BY:
CHECKED BY:
SCALE: NOT TO SCALE
SHEET NUMBER

Color Coding Legend

Pipe: Diameter (in)

<=	8.0
<=	10.0
<=	12.0
<=	14.0
<=	16.0
<=	20.0
<=	24.0
	Other

ENGINEER IN CHARGE:

PRELIMINARY NOT FOR CONSTRUCTION

CONTACT INFORMATION
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ENGLEWOOD, CO 80112
(720) 206-6931
CPERDUE@STRATEGICSITEDESIGNS.COM
ATTENTION: CHRISTOPHER PERDUE, P.E., M.B.A.

STRATEGIC SITE DESIGNS

PIONEER VILLAGE

KEENESBURG, COLORADO
WELD COUNTY

POTABLE DISTRIBUTION SCHEMATIC PHASES 1-15 (0.75 MG TANK)

REV	DESCRIPTION	BY	DATE

JOB NO:

ORIGINAL ISSUE:

DESIGN BY:

CHECKED BY:

SCALE: NOT TO SCALE

SHEET NUMBER

Flow Test Information Report

Date: 08/03/20 Time: 10:30 AM

Project Name: KEENESBURG

Address: CR18 and N. CEDAR LANE, KEENESBURG, CO

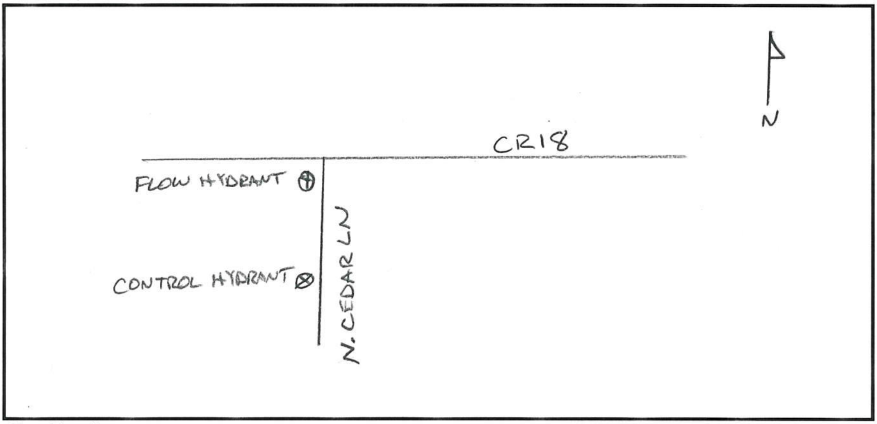
Test conducted by: FireTest Company Jim and Kami (303) 697-7377

Test witnessed by: Jeremy Muse - KEENESBURG PUBLIC WORKS

Source of water supply: KEENESBURG

Name of Water District: KEENESBURG

Area Map:



Flow Test Data:

Hose size: 2.5 Number of Hoses: 1

Flow at Hydrant No.	Static at Hydrant No.	Static PSIG	Residual PSIG	Pressure Drop	Flow GPM	Elevation of Flow Hydrant	Elevation of Control Hydrant
1	2	38	30	8	531	5013	5013

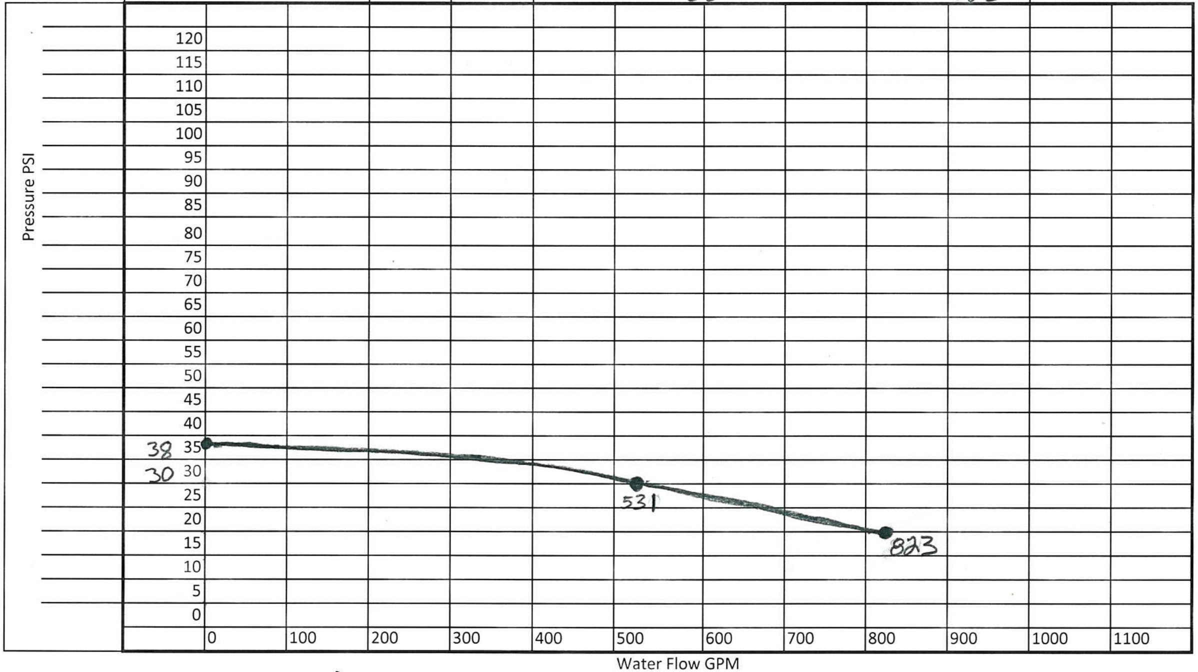
See second page for graph

Signed James R. Maxwell

Jim Maxwell 8/3/20

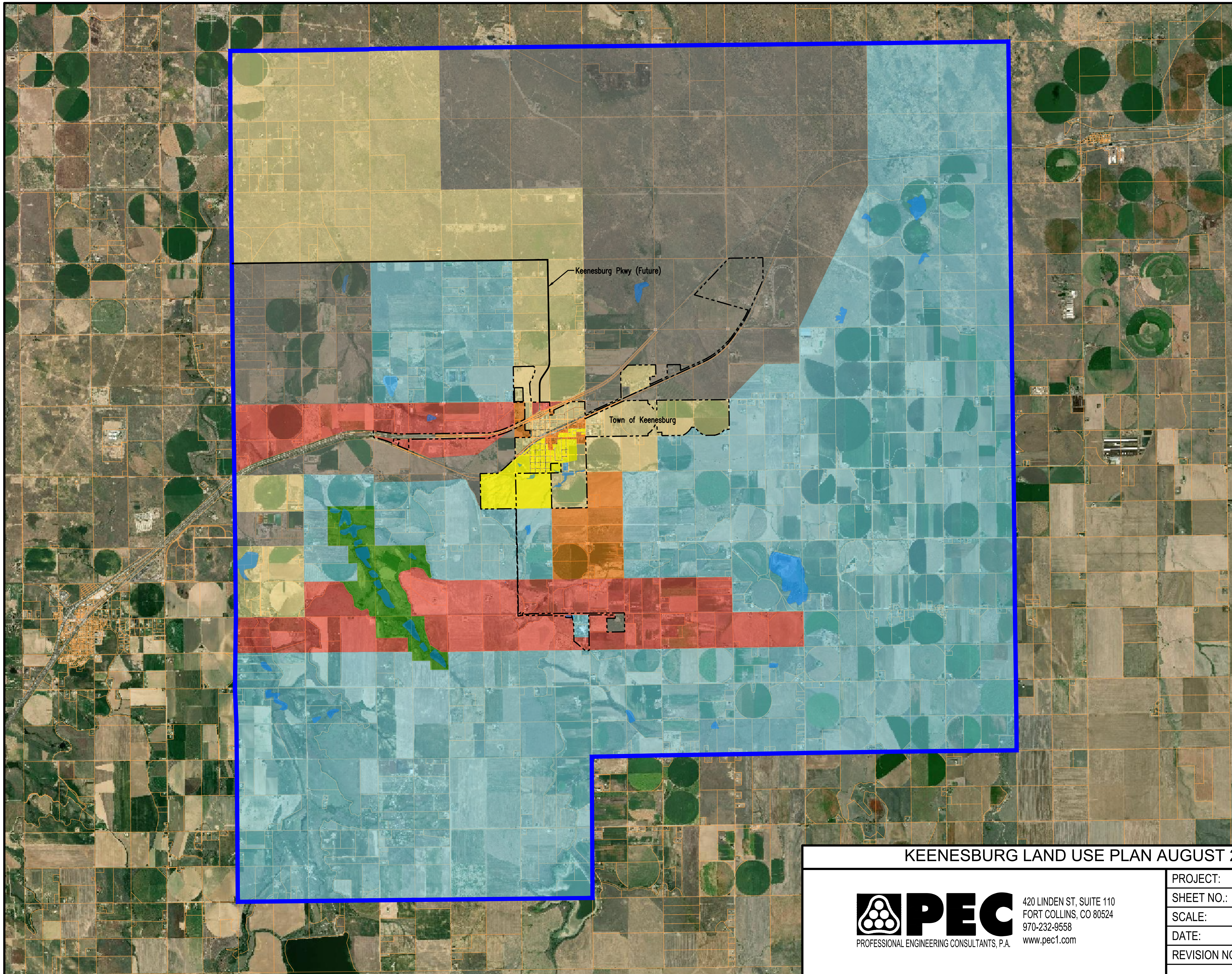
Water Flow Test Summary & Graph

Hydrant No.	Outlet I.D> Inches	Pitot or Gauge Pressure	Flow GPM	Residual PSI	**FireTest** Company 13724 W. Auburn Ave. Lakewood, CO 80228 (303) 697-7377
1	2.5	10	531	30	Date: AUG 3, 2020 Time: 10:30 AM
					Name: KEENESBURG
					Address: N CEDAR AND CR 18
					KEENESBURG, CO
Total Flow					Static Presure PSI: 38 Flow GPM @ 20 PSI 823



Appendix J

Keenesburg Growth Map



LEGEND

- AGRICULTURAL (AG)
- RESIDENTIAL (R)
- MIXED USE (MU)
- HIGHWAY COMMERCIAL (HC)
- INDUSTRIAL (ID)
- OPEN SPACE (OS)
- COMMERCIAL BUSINESS DISTRICT
- KEENESBURG TOWN BOUNDARY
- GROWTH BOUNDARY
- TOWN, COUNTY, STATE ROADS AND INTERSTATES
- PARCEL LINE
- RAILROAD
- LAKES, PONDS & RESERVOIRS

DATA SOURCES: WELD COUNTY GIS, UNITED STATES DEPARTMENT OF AGRICULTURAL (USDA).

KEENESBURG LAND USE PLAN AUGUST 2019

PEC
PROFESSIONAL ENGINEERING CONSULTANTS, P.A.
420 LINDEN ST, SUITE 110
FORT COLLINS, CO 80524
970-232-9558
www.pec1.com

PROJECT:	197056-000
SHEET NO.:	1 of 1
SCALE:	1"=7,000'
DATE:	09/27/2019
REVISION NO.:	

TOWN OF KEENESBURG INCORPORATED STATE OF COLORADO

Appendix K

Wastewater Supplement

Wastewater System

Hydraulic calculations were performed to ensure that sufficient flows and velocities are met within this new system to prevent the settling of solids, while still accounting for future growth in the area.

Calculated Wastewater Flow Rates

Average daily flow (ADF) predictions for wastewater were calculated using design flow values obtained from South Adam's County Design and Construction Standards. Weld County, the local jurisdiction for this project, does not have their own water and sanitary sewer design guidelines, therefore, we adopted South Adam's County's Design guidelines due to their geographic proximity to this site. The design flows utilized are listed below:

Land Use	Unit Rate
Residential	76 gpd/capita (x3.5 persons per dwelling)
Non-Residential (Commercial, School)	600 gpd/acre (x180 days of irrigation per year)

An overall goal for this development is to create a correlation between potable water demand and anticipated wastewater flows for the eventual augmentation of potable water supplies utilizing treated wastewater effluent. To create this correlation, the population density and generation rates used for wastewater flow projections are the same as those used in the potable water study.

Peak flow rates are determined by multiplying the ADF by the peaking factor (PF). The PF used per CDPHE Figure 3.1 of the Design Criteria for Domestic Wastewater Treatment Works requirements was 3.0.

The following design requirements were met in the proposed system were applicable:

- Minimum velocity of 2 ft/sec
- Maximum velocity of 12 ft/sec
- Pipes shall be sized to convey the projected peak flow rate while flowing no more than 80% full

For some lines within this system, achieving the minimum velocity requirement of 2ft/s during the initial phases of this project is unachievable while maintaining a minimum line size of 8". In these instances, the sanitary sewer main will need to be flushed with water occasionally to help remove any settled solids. However, flushing the lines will benefit the development in the early stages by increasing the flow rates at the wastewater treatment plant, allowing the selected process to operate more efficiently.

Existing Water System

There is currently no existing sanitary sewer network at this project location.

Proposed Wastewater System

The proposed wastewater collection system consists of two gravity networks and one pressure network. The first, smaller, gravity system will collect wastewater from Planning Areas 1 and 2 with 8" PVC laterals which will drain by gravity to a pump station located in the Northwest corner of Planning Area 1 (in the SE1/4 of the NE1/4 of Section 7). This pump station will then pump the wastewater from Planning Areas 1 and 2 to the primary gravity system. This point of convergence will occur at a manhole located at the intersection of Collector D and Local Road G. The remaining sewage will be collected through the primary gravity network which generally flows North and East through the development. All wastewater from the development will gravity flow to an interceptor station located North, center of Section 8. From the interceptor, all wastewater will gravity flow North towards the wastewater treatment plant in Section 32.

All laterals within the planning areas will be 8” PVC. 18” PVC will be used to convey wastewater from the manhole located at the intersection of Collector D and Local Road G (where the pressure network connects with the primary gravity network) to WCR 24. 10”, 12”, and 15” PVC will be used for the line running North from Planning Area 21 to account for anticipated future growth along Local Road 21-10. 18”, 21”, 24”,, and 30” PVC will be used to convey wastewater flowing eastward down WCR 24 to account for current and future flow rates.

Line sizes were calculated using the spreadsheets provided at the end of this document as well as Studio Express.

Conclusion

Wastewater from this proposed development will be collected and gravity fed to a single interceptor before gravity flowing the wastewater North to the wastewater treatment plant. All pipes included in this design meet the velocity and slope requirements of South Adams County’s Design and Construction Standards were applicable and were designed with future growth in mind. Areas that will not meet the minimum velocity requirements in the early stages of the development have been identified and will require occasional flushing to help remove any settled solids.

References

1. “Design and Construction Standards for Water and Wastewater Facilities”, South Adams County Water and Sanitation District (May 2020)

2. StudioExpress

3. “State of Colorado Design Criteria for Domestic Wastewater Treatment Works”, Colorado Department of Public Health and Environment (September 2012)

	Gravity Lines to Pump Station (PAs 1 and 2)														
Planning Area	Main Line	MH Start	MH End	Pipe	Total Number of Units contributing (cumulative on that line)	Contributing/ Interceting Pipes	Slope	ADF (GPD)	PDF (GPD)	ADF (cfs)	PDF (cfs)	Velocity at ADF (ft/s)	Velocity at PDF (ft/s)	Normal Depth at PDF (%)	Line Size (in)
PA 1	5	5.1	1.8	5.1	10		1.25	2660	7980	0.0041	0.0123	0.73	1.03		8
	4	4.1	1.7	4.1	12		1.60	3192	9576	0.0049	0.0148	0.88	1.24		8
	3	3.1	1.6	3.1	12		1.39	3192	9576	0.0049	0.0148	0.88	1.24		8
	6	1.3	6.1	6.1	26		4.09	6916	20748	0.0107	0.0321	1.25	1.94		8
		6.1	6.2	6.2	26		1.20	6916	20748	0.0107	0.0321	0.9	1.35	12.50%	8
		6.2	6.3	6.3	22		1.10	5852	17556	0.0091	0.0272	0.77	1.39	12.50%	8
		6.3	6.4	6.4	17		1.20	4522	13566	0.0070	0.0210	0.82	1.35	10.00%	8
		6.4	6.5	6.5	12		1.10	3192	9576	0.0049	0.0148	0.57	0.95	8.75%	8
		6.5	6.6	6.6	5		1.00	1330	3990	0.0021	0.0062	0.38	0.73	6.25%	8
	2	1.11	2.5	2.6	4		0.40	1064	3192	0.0016	0.0049	0.29	0.57	6.25%	8
		2.5	2.4	2.5	6		0.40	1596	4788	0.0025	0.0074	0.45	0.62	6.25%	8
		2.4	2.3	2.4	14		0.92	3724	11172	0.0058	0.0173	0.68	1.11	8.75%	8
		2.3	2.2	2.3	21		1.69	5586	16758	0.0086	0.0259	1.01	1.66	12.50%	8
		2.2	2.1	2.2	22		0.94	5852	17556	0.0091	0.0272	0.77	1.15	12.50%	8
		2.1	1.5	2.1	35		1.44	9310	27930	0.0144	0.0432	1.21	1.82	15.00%	8
	1	1.11	1.10	1.10	4		3.89	1064	3192	0.0016	0.0049	0.52	0.88	6.25%	8
		1.10	1.9	1.9	6		0.40	1596	4788	0.0025	0.0074	0.45	0.62	6.25%	8
		1.9	1.8	1.8	11	Pipe 5.1	0.66	5586	16758	0.0086	0.0259	0.72	1.09	12.50%	8
		1.8	1.7	1.7	13	Pipe 4.1	1.33	9310	27930	0.0144	0.0432	1.21	1.53	15.00%	8
		1.7	1.6	1.6	15	Pipe 3.1	1.33	13034	39102	0.0202	0.0605	1.3	1.84	17.50%	8
		1.6	1.5	1.5	19	Pipe 2.1	1.33	23408	70224	0.0362	0.1087	1.53	2.27	23.75%	8
		1.5	1.4	1.4	21		1.70	23408	70224	0.0362	0.1087	1.86	2.54	95.00%	8
		1.4	1.3	1.3	21		1.50	23408	70224	0.0362	0.1087	1.53	2.27	23.75%	8
		1.3	1.2	1.2	21		1.50	23408	70224	0.0362	0.1087	1.53	2.27	23.75%	8
		1.2	1.1	1.1	21	Pipe 7.1	0.20	166364	499092	0.2574	0.7722	1.39	1.94	28.00%	15
PA 2	17	17.1	11.2	17.1	6		0.75	1368	4104	0.0021	0.0063	0.38	0.74	6.25%	8
	16	16.1	9.4	16.1	6		0.85	1368	4104	0.0021	0.0063	0.38	0.74	6.25%	8
	15	15.1	10.2	15.1	6		0.60	1368	4104	0.0021	0.0063	0.38	0.74	6.25%	8
	14	14.1	8.2	14.1	6		0.75	1368	4104	0.0021	0.0063	0.38	0.74	6.25%	8
	13	13.1	9.6	13.1	8		1.85	1824	5472	0.0028	0.0085	0.5	0.99	7.50%	8
	12	12.1	9.6	12.1	6		1.75	1368	4104	0.0021	0.0063	0.69	0.74	6.25%	8
	11	11.3	11.2	11.3	12		1.20	2736	8208	0.0042	0.0127	0.75	1.07	8.75%	8
		11.2	11.1	11.2	18	Pipe 17.1	1.65	5472	16416	0.0085	0.0254	0.99	1.63	12.50%	8
		11.1	7.11	11.1	24		1.65	6840	20520	0.0106	0.0317	1.24	1.62	13.75%	8
	10	10.3	10.2	10.3	12		2.10	2736	8208	0.0042	0.0127	0.75	1.07	8.75%	8
		10.2	10.1	10.2	16	Pipe 15.1	2.10	5016	15048	0.0078	0.0233	0.91	1.5	10.00%	8
		10.1	7.9	10.1	24		1.80	6840	20520	0.0106	0.0317	1.24	1.62	13.75%	8
	9	9.8	9.7A	9.8	0		0.40	0	0	0.0000	0.0000	0	0	0.00%	8
		9.7A	9.7	9.8(1)	0		0.40	0	0	0.0000	0.0000	0	0	0.00%	8
		9.7	9.6	9.7	0		0.40	0	0	0.0000	0.0000	0	0	0.00%	8
		9.6	9.5	9.6	6	Pipes 12.1 & 13.1	0.85	4560	13680	0.0071	0.0212	0.83	1.09	10.00%	8
		9.5	9.4	9.5	12	Pipe 16.1	0.85	7296	21888	0.0113	0.0339	0.95	1.41	13.75%	8
		9.4	9.3	9.4	16		2.00	8208	24624	0.0127	0.0381	1.07	1.95	13.75%	8
		9.3	9.2	9.3	23		2.00	9804	29412	0.0152	0.0455	1.28	1.92	15.00%	8
		9.2	9.1	9.2	24		1.50	10032	30096	0.0155	0.0466	1.36	1.73	15.00%	8
		9.1	7.10	9.1	24		1.50	10032	30096	0.0155	0.0466	1.3	1.65	15.00%	8
	8	8.6	8.5	8.6	5		1.50	1140	3420	0.0018	0.0053	0.59	0.95	6.25%	8
		8.5	8.4	8.5	7		0.40	1596	4788	0.0025	0.0074	0.45	0.62	6.25%	8
		8.4	8.3	8.4	10		1.80	2280	6840	0.0035	0.0106	0.62	1.24	7.50%	8
		8.3	8.2	8.3	23	Pipe 14.1	2.10	6612	19836	0.0102	0.0307	1.19	1.57	12.50%	8
		8.2	8.1	8.2	35		2.30	9348	28044	0.0145	0.0434	1.22	1.83	100.00%	8
		8.1	7.6	8.1	39		1.67	10260	30780	0.0159	0.0476	1.34	1.9	15.00%	8
	7	7.19	7.18	7.19	3		0.72	684	2052	0.0011	0.0032	0.36	0.57	5.00%	8
		7.18	7.17	7.18	4		0.50	912	2736	0.0014	0.0042	0.25	0.49	5.00%	8
		7.17	7.16	7.17	12		0.50	2736	8208	0.0042	0.0127	0.49	0.82	8.75%	8
		7.16	7.15	7.16	20		0.75	4560	13680	0.0071	0.0212	0.83	1.09	10.00%	8
		7.15	7.14	7.15	27		1.60	6156	18468	0.0095	0.0286	1.11	1.47	12.50%	8
		7.14	7.13	7.14	36		1.80	8208	24624	0.0127	0.0381	1.07	1.61	13.75%	8
		7.13	7.12	7.13	38		0.40	8664	25992	0.0134	0.0402	0.69	1.07	15.00%	8
		7.12	7.11	7.12	44	Pipe 11.1	1.20	16872	50616	0.0261	0.0783	1.34	1.83	20.00%	8
		7.11	7.10	7.11	48	Pipe 9.1	1.71	27816	83448	0.0430	0.1291	1.81	2.69	25.00%	8
		7.10	7.9	7.10	52	Pipe 10.1	1.20	35568	106704	0.0550	0.1651	1.68	2.56	28.75%	8
		7.9	7.8	7.9	58		1.00	36936	110808	0.0571	0.1714	1.74	2.44	28.75%	8
		7.8	7.7	7.8	60		0.40	37392	112176	0.0579	0.1736	1.21	1.73	30.00%	8
		7.7	7.6	7.7	60	Pipe 8.1	0.68	47652	142956	0.0737	0.2212	1.54	2.2	32.50%	8
		7.6	7.5	7.6	60		0.60	47652	142956	0.0737	0.2212	1.54	2.07	32.50%	8
		7.5	7.4	7.5	60		1.2	47652	142956	0.0737	0.2212	1.96	2.7	32.50%	8
		7.4	7.3	7.4	60		0.4	47652	142956	0.0737	0.2212	1.38	1.85	32.50%	8
		7.3	7.2	7.3	60		0.4	47652	142956	0.0737	0.2212	1.38	1.85	32.50%	8
		7.2	7.1	7.2	60		0.4	47652	142956	0.0737	0.2212	1.38	1.85	32.50%	8
		7.1	1.2	7.1	60		0.4	47652	142956	0.0737	0.2212	1.38	1.85	32.50%	8

ADF 1 &2: 995030
PHF 1&2: 2985090

	Primary Gravity Line to Main Interceptor																		
Planning Area	Main Line	MH Start	MH End	Pipe	Total Number of Units contributing (cumulative on that line)	Contributing/ Interceting Pipes	Slope	ADF (GPD)	PDF (GPD)	ADF (cfs)	PDF (cfs)	Future Demand? (Y/N)	Demand Source	Adjusted ADF (cfs)	Adjusted PDF (cfs)	Velocity at ADF (ft/s)	Velocity at PDF (ft/s)	Normal Depth at PDF (%)	Line Size (in)
PA 4	22	22.6	22.5	22.6	8		2.5	2128	6384	0.003293	0.009878	N				0.59	1.16	7.50%	8
		22.5	22.4	22.5	16		2.8	4256	12768	0.006585	0.019755	N				1.18	1.66	10.00%	8
		22.4	22.3	22.4	20		2.5	5320	15960	0.008231	0.024694	N				0.96	1.59	12.50%	8
		22.3	22.2	22.3	24		3	6384	19152	0.009878	0.029633	N				1.16	1.9	12.50%	8
		22.2	22.1	22.2	30		2.5	7980	23940	0.012347	0.037041	N				1.44	1.9	13.75%	8
		22.1	21.1	22.1	30		0.4	7980	23940	0.012347	0.037041	N				0.79	1.13	13.75%	8
	28	28.1	21.4	28.1	7		2.81	1862	5586	0.002881	0.008643	N				0.94	1.014	7.50%	8
	27	27.3	27.2	27.3	16		3.5	4256	12768	0.006585	0.019755	N				1.18	1.66	10.00%	8
		27.2	27.1	27.2	17		1.49	4522	13566	0.006997	0.02099	N				0.82	1.35	10.00%	8
		27.2	27.1	27.1	21		1.25	5586	16758	0.008643	0.025928	N				1.01	1.33	12.50%	8
	21	21.11	21.1	21.11	2		0.75	532	1596	0.000823	0.002469	N				0.27	0.44	5.00%	8
		21.2	21.9	21.1	3		0.75	798	2394	0.001235	0.003704	N				0.4	0.66	5.00%	8
		21.9	21.8	21.9	3		0.75	798	2394	0.001235	0.003704	N				0.4	0.66	5.00%	8
		21.8	21.7	21.8	11		1.77	2926	8778	0.004527	0.013582	N				0.81	1.14	8.75%	8
		21.7	21.6	21.7	25		3.2	6650	19950	0.010289	0.030867	N				1.2	1.98	12.50%	8
		21.6	21.5	21.6	28		2.15	7448	22344	0.011524	0.034571	N				1.35	1.77	13.75%	8
		21.5	21.4	21.5	31	Pipe 27.1	0.49	13832	41496	0.021401	0.064204	N				0.9	1.34	17.50%	8
		21.4	21.3	21.4	37	Pipe 28.1	0.5	17290	51870	0.026752	0.080255	N				0.95	1.51	20.00%	8
		21.3	21.2	21.3	37		0.4	17290	51870	0.026752	0.080255	N				0.95	1.37	20.00%	8
		21.2	21.1	21.2	38		0.4	17556	52668	0.027163	0.081489	N				0.96	1.39	20.00%	8
		21.1	20.4	21.1	38	Pipe 22.1	0.6	25536	76608	0.03951	0.11853	N				1.2	1.69	23.75%	8
	26	26.3	26.2	26.3	15		3	3990	11970	0.006173	0.01852	N				1.11	1.56	10.00%	8
		26.2	26.1	26.2	29		0.8	7714	23142	0.011935	0.035806	N				1	1.27	13.75%	8
		26.1	20.3	26.1	34		0.8	9044	27132	0.013993	0.041979	N				0.9	1.49	15.00%	8
PA 3	25	25.2	25.1	25.2	16		2	4256	12768	0.006585	0.019755	N				0.7	1.27	10.00%	8
		25.1	23.2	25.1	28		2	7448	22344	0.011524	0.034571	N				1.35	1.77	13.75%	8
	24	24.4	24.3	24.4	16		1.75	4256	12768	0.006585	0.019755	N				0.77	1.27	10.00%	8
		24.3	24.2	24.3	29		1.75	7714	23142	0.011935	0.035806	N				1	1.83	13.75%	8
		24.2	24.1	24.2	30		1	7980	23940	0.012347	0.037041	N				1.04	1.31	13.75%	8
		24.1	23.1	24.1	33		1	8778	26334	0.013582	0.040745	N				1.14	1.45	15.00%	8
	23	23.8	23.7	23.8	8		1	2128	6384	0.003293	0.009878	N				0.59	0.83	7.50%	8
		23.7	23.6	23.7	10		0.5	2660	7980	0.004116	0.012347	N				0.48	0.79	7.50%	8
		23.6	23.5	23.6	24		2	6384	19152	0.009878	0.029633	N				1.16	1.52	12.50%	8
		23.5	Str. 385	23.5	37		0.5	9842	29526	0.015228	0.045683	N				0.78	1.21	15.00%	8
		23.4	23.3	23.4	39		0.4	10374	31122	0.016051	0.048153	N				0.82	1.13	15.00%	8
		23.3	23.2	23.3	42	Pipe 25.1	1	18620	55860	0.028809	0.086428	N				1.21	1.8	21.25%	8
		23.2	23.1	23.2	42	Pipe 24.1	0.5	27398	82194	0.042391	0.127173	N				1.12	1.67	25.00%	8
		23.1	20.1	23.1	42		1	27398	82194	0.042391	0.127173	N				1.5	2.16	25.00%	8
	19	19.29	19.28	19.28	0		1.8	0	0	0	0	N				0	0	0.00%	8
		19.28	19.27	19.27	0		2	0	0	0	0	N				0	0	0.00%	8
		19.27	19.26	19.26	0		0.07	0	0	0	0	N				0	0	0.00%	8
		19.26	19.25	19.25	0		0.5	0	0	0	0	N				0	0	0.00%	8
		19.25	19.24	19.24	0		0.5	0	0	0	0	N				0	0	0.00%	8
		19.24	19.23	19.23	15		0.6	3990	11970	0.006173	0.01852	N				0.72	0.95	10.00%	8
		19.23	19.22	19.22	20		1.3	5320	15960	0.008231	0.024694	N				0.96	1.27	12.50%	8
		19.22	19.21	19.21	31		0.7	8246	24738	0.012758	0.038275	N				0.82	1.36	13.75%	8
		19.21	19.20	19.20	42		0.5	11172	33516	0.017286	0.051857	N				0.89	1.21	16.25%	8
		19.20	19.19	19.19	48	All 1 and 2	1.2	1007798	3023394	1.559294	4.677882	N				4.64	6.38	60.56%	18
		19.19	19.18	19.18	55		2.97	1009660	3028980	1.562175	4.686525	N				6.31	8.86	60.56%	18
		19.18	19.17	19.17	61	Pipe 20.1	1.43	1124306	3372918	1.739558	5.218675	N				5.11	7.02	63.33%	18
		19.17	19.16	19.16	61		1	1124306	3372918	1.739558	5.218675	N				4.48	6.06	63.33%	18
		19.16	19.15	19.15	61		1.38	1124306	3372918	1.739558	5.218675	N				4.91	6.58	58.89%	18
		19.15	Str. 219	19.14	61		0.4	1124306	3372918	1.739558	5.218675	N				3.24	4.23	63.33%	18
		Str. 219	9.14	19.14 (1)	61		0.4	1124306	3372918	1.739558	5.218675	N				3.24	4.23	63.33%	18
		19.14	19.13	19.13	61		0.4	1124306	3372918	1.739558	5.218675	N				3.24	4.23	63.33%	18
		19.13	19.12	19.12	61		0.75	1124306	3372918	1.739558	5.218675	N				4.1	5.48	63.33%	18
		19.12	19.11	19.11	61		0.75	1124306	3372918	1.739558	5.218675	N				4.1	5.48	63.33%	18
		19.11	19.10	19.10	61	Future	0.75	1124306	3372918	1.739558	5.218675	Y	PAs 5 and 6	1.902126	5.706377	4.19	5.56	66.11%	18
		19.10	19.09	19.09	61		0.75	1124306	3372918	1.739558	5.218675	Y	Carry over	1.902126	5.706377	4.19	5.56	66.11%	18
		19.09	19.08A	19.08	61		0.75	1124306	3372918	1.739558	5.218675	Y	Carry over	1.902126	5.706377	4.19	5.56	66.11%	18
		19.08A	19.08	19.08 (1)	61	Future	0.4	1124306	3372918	1.739558	5.218675	Y	Carry over	1.902126	5.706377	3.35	4.28	66.11%	18
		19.8	19.7	19.7	61		0.2	1124306	3372918	1.739558	5.218675	Y	PAs 7,16, central + Carry over	2.205448	6.616343	2.64	3.33	57.62%	21
		19.7	19.6	19.6	61		0.2	1124306	3372918	1.739558	5.218675	Y	Carry over	2.205448	6.616343	2.64	3.33	57.62%	21
		19.6	19.4A	19.5	61		0.12	1124306	3372918	1.739558	5.218675	Y	Carry over	2.205448	6.616343	2.21	2.83	48.33%	24
		19.4A	19.5	19.5 (1)	61		0.12	1124306	3372918	1.739558	5.218675		Carry over	2.205448	6.616343	2.21	2.83	48.33%	24
		19.5	19.4	19.4	61		1.15	1124306	3372918	1.739558	5.218675	Y	Carry over	2.205448	6.616343	4.8	6.75	48.33%	24
		19.4	19.3	19.3	61	Pipe 29.1	0.1	1254570	3763710	1.941107	5.82332	Y	18,19,20 & carry over	2.684898	8.054694	2.13	2.83	40.00%	30
		19.3	19.2	19.2	61		0.1	1254570	3763710	1.941107	5.82332	Y	Carry over	2.684898	8.054694	2.13	2.83	40.00%	30
		19.2	19.1	19.1	61		0.1	1254570	3763710	1.941107	5.82332	Y	Carry over	2.684898	8.054694	2.13	2.83	40.00%	30
PA 17	33	33.2	33.1	33.2	16		2.3	4256	12768	0.006585	0.019755	N				1.18	1.66	10.00%	8
		33.1	31.3	33.1	22		2.06	5852	17556	0.009054	0.027163	N				1.06	1.75	12.50%	8
	35	35.2	35.1	35.2	14		1.8	3724	11172	0.005762	0.017286	N				1.03	1.45	8.75%	8
		35.1	32.2	35.1	26		1.4	6916	20748	0.010701	0.032102	N				0.9	1.64	13.75%	8
	36	36.2	36.1	36.2	14		1.6	3724	11172	0.005762	0.017286	N				1.03	1.45	8.75%	8
		36.1	32.1	36.1	26		1.4	6916	20748	0.010701	0.032102	N				0.9	1.4	13.75%	8
	37	37.2	37.1	37.2	14		1.5	3724	11172	0.005762	0.017286	N				0.67	1.11	8.75%	8
		37.1	30.2	37.1	26		1.3	6916	20748	0.010701	0.032102	N				0.9	1.35	13.75%	8
	30	31.9	30.9	30.10	6		1.5	1596	4788	0.002469	0.007408	N				0.44	0.62	6.25%	8
		30.9	30.8	30.9	13		0.75	3458	10374	0.00535	0.016051	N				1.33	1.88	8.75%	8
		30.8	30.7	30.8	19		0.75	5054	15162	0.00782	0.023459	N				1.4	1.97	10.00%	8
		30.7	30.6	30.7	20		0.28	5320	15960	0.008231	0.024694	N				0.96	1.59	12.50%	8
		30.6	30.5	30.6	33		0.83	8778	26334	0.013582	0.040745	N				1.59	2.62	15.00%	8
		30.5	30.4	30.5	44		0.9	11704	35112	0.018109	0.054326	N				2.12	2.78	16.25%	8
		30.4	30.3	30.4	46		0.7	12236	36708	0.018932	0.056796	N				1.59	2.39	16.25%	8
		30.3	30.2	30.3	51	Pipe 37.1	0.6	20482	61446	0.03169	0.095071	N				2.04	2.9	22.50%	8
		30.2	30.1	30.2	52	Pipe 32.1	0.6	50806	152418	0.078608	0.235825	N				2.79	4.01	22.50%	8
		30.1	29.30	30.1	52		2.5	50806	152418	0.078608	0.235825	N				4.03	6.26	35.00%	8
	31	31.9	31.8	31.9	10		1.03	2660	7980	0.004116	0.012347	N				1.35	1.44	7.50%	8
		31.8	31.7	31.8	12		1.3	3192	9576	0.004939	0.014816	N				0.89	1.25	8.75%	8
		31.7	31.6	31.7	23		1.3	6118	18354	0.009466	0.028398	N				1.11	1.56	13.75%	8
		31.6	31.5	31.6	30		1.3	7980	23940	0.012347	0.037041	N				1.04	1.56	13.75%	8
		31.5	31.4	31.5	32		1.86	8512	25536	0.01317	0.03951	N				1.11	1.67	13.75%	8
		31.4	31.3	31.4	37	Pipes 33.1 & 34.1	1.24	16758	50274	0.025928	0.077785	N				1.33	2.06	20.00%	8
		31.3	31.2	31.3	37		1.04	16758	50274	0.025928	0.077785	N				1.32	1.82	20.00%	8
		31.1	29.34	31.1	37		0.35	16758	50274	0.025928	0.077785	N				0.92	1.32	20.00%	8
	32	31.9	32.4	32.5	12		2.59	10108	30324	0.015639	0.046918	N				1.31	1.98	15.00%	8
		32.4	32.3	32.4	23		2.1	13034	39102	0.020167	0.0605	N				1.3	2.15	17.50%	8
		32.3	32.2	32.3	28	Pipe 35.1	0.6	21280	63840	0.032925	0.098775	N				1.17	1.68	22.50%	8
		32.2	32.1	32.2	33	Pipe 36.1	0.6	29526	88578	0.045683	0.13705	N				1.21	1.8	25.00%	8
		32.1	30.1	32.1	35		1.7	30058	90174	0.046507	0.13952	N				1.96	2.62	27.50%	8
	34	34.2	34.1	34.2	2		0.4	532	1596	0.000823	0.002469	N				0.27	0.44	5.00%	8
		34.1	31.3A	34.1	4		0.4	1064	3192	0.001646	0.004939	N				0.29	0.58	6.25%	8
		31.3A	31.3	34.1(1)	4		0.39	1064	3192	0.001646	0.004939	N				0.29	0.58	6.25%	8
	53	53.2	53.1	53.2	14		0.6	3724	11172	0.005762	0.017286	N				0.67	0.89	8.75%	8
		53.1	39.4	53.1	26		0.6	6916	20748	0.010701	0.032102	N				0.69	1.14	13.75%	8
	52	52.2	52.1	52.2	14		0.75	3724	11172	0.005762	0.017286	N				0.67	1.11	8.75%	8
		52.1	39.3	52.1	26		0.75	6916	20748	0.010701	0.032102	N				0.9	1.14	13.75%	8
	51	51.2	51.1	51.2	14		0.65	3724	11172	0.005762	0.017286	N				0.67	0.89	8.75%	8
		51.1	39.2	51.1	25		0.65	6650	19950	0.010289	0.030867	N				0.87	1.1	12.50%	8
	50	50.2	50.1	50.2	12		0.7	3192	9576	0.004939	0.014816	N				0.58	0.95	8.75%	8
		50.1	39.1	50.1	25		0.7	6650	19950	0.010289	0.030867	N				0.87	1.3	12.50%	8
	49	48.1	45.4	49.1	14		1.2	3724	11172	0.005762	0.017286	N				0.67	1.11	8.75%	8
	48	48.1	38.13	48.1	10		0.4	2660	7980	0.004116	0.012347	N				0.48	0.79	7.50%	8
	47	46.1	45.5	47.1	12		0.75	3192	9576	0.004939	0.014816	N				0.58	0.95	8.75%	8
	46	46.1	38.12	46.1	12		0.62	3192	9576	0.004939	0.014816	N				0.58	0.95	8.75%	8
	44	44.2	44.1	44.2	16		0.5	4256	12768	0.006585	0.019755	N				0.55	0.83	10.00%	8
		44.1	38.11	44.1	24		0.5	6384	19152	0.009878	0.029633	N				0.63	1.05	12.50%	8
	42	42.2	42.1	42.2	5		0.75	1330	3990	0.002058	0.006173	N				0.37	0.72	6.25%	8
		42.1	40.4	42.1	7		0.75	1862	5586	0.002881	0.008643	N				0.52	0.72	7.50%	8

	43	42.2	38.10	43.1	9		0.93	2394	7182	0.003704	0.011112	N				0.66	0.93	7.50%	8
		41.2	41.10	41.2	6		1.5	1596	4788	0.002469	0.007408	N				0.44	0.87	6.25%	8
	41	41.1	38.60	41.1	6		1.5	1596	4788	0.002469	0.007408	N				0.44	0.87	6.25%	8
		38.18	38.17	38.18	4		0.5	1064	3192	0.001646	0.004939	N				0.29	0.58	6.25%	8
		38.17	38.16	38.17	9		0.5	2394	7182	0.003704	0.011112	N				0.43	0.71	7.50%	8
		38.16	38.15	38.16	13		0.4	3458	10374	0.00535	0.016051	N				0.63	0.82	8.75%	8
		38.15	38.14	38.15	19		0.4	5054	15162	0.00782	0.023459	N				0.66	0.83	10.00%	8
		38.14	38.13	38.14	24		0.4	6384	19152	0.009878	0.029633	N				0.63	1.05	12.50%	8
		38.13	38.12	38.13	28	Pipe 48.1	0.4	10108	30324	0.015639	0.046918	N				0.8	1.1	15.00%	8
		38.12	38.11	38.12	33	Pipe 46.1	0.4	13376	40128	0.020696	0.062087	N				0.87	1.3	17.50%	8
PA 21		38.11	38.10	38.11	38	Pipe 44.1	0.4	20900	62700	0.032337	0.097011	N				0.98	1.38	22.50%	8
		38.10	38.09	38.1	48	Pipe 43.1	0.4	25574	76722	0.039569	0.118706	N				1.05	1.56	23.75%	8
	38	38.9	38.8	38.9	50		0.4	26030	78090	0.040274	0.120823	N				1.08	1.59	23.75%	8
		38.8	38.7A	38.8	51		0.4	26258	78774	0.040627	0.121881	N				1.08	1.49	23.75%	8
		38.7A	38.8	38.8	53		0.4	26714	80142	0.041333	0.123998	N				1.09	1.51	25.00%	8
		38.7	38.6	38.7	57		0.4	27626	82878	0.042744	0.128231	N				1.13	1.56	25.00%	8
		38.6	38.5	38.6	57	Pipe 41.1 and 40.1	0.4	34504	103512	0.053386	0.160157	N				1.25	1.7	28.75%	8
		38.5	38.4	38.5	57		0.4	34504	103512	0.053386	0.160157	N				1.25	1.7	28.75%	8
		38.4	38.3	38.4	57		0.4	34504	103512	0.053386	0.160157	N				1.25	1.7	28.75%	8
		38.3	38.2	38.3	57		0.4	34504	103512	0.053386	0.160157	N				1.25	1.7	28.75%	8
		38.2	38.1	38.2	57		0.4	34504	103512	0.053386	0.160157	N				1.25	1.7	28.75%	8
		38.1	29.21	38.1	57		0.4	34504	103512	0.053386	0.160157	N				1.25	1.7	28.75%	8
		40.7	40.6	40.7	3		0.75	684	2052	0.001058	0.003175	N				0.35	0.57	5.00%	8
		40.6	40.5	40.6	4		0.75	912	2736	0.001411	0.004233	N				0.46	0.72	5.00%	8
	40	40.5	40.4	40.5	7		1	1596	4788	0.002469	0.007408	N				0.44	0.87	6.25%	8
		40.4	40.2	40.4	8	Pipe 42.1	1	3686	11058	0.005703	0.017109	N				0.67	1.1	8.75%	8
		40.2	40.1	40.2	9		1	3914	11742	0.006056	0.018168	N				0.71	1.17	10.00%	8
		40.1	38.6	40.1	15		1	5282	15846	0.008172	0.024517	N				0.96	1.26	12.50%	8
		38.18	39.8	39.9	1		0.6	228	684	0.000353	0.001058	N				0.112	0.35	2.50%	8
		39.8	39.7	39.8	14		0.6	3192	9576	0.004939	0.014816	N				0.58	0.95	8.75%	8
		39.7	39.6	39.7	28		0.6	6384	19152	0.009878	0.029633	N				0.83	1.05	12.50%	8
		39.6	39.5	39.6	30		0.4	6840	20520	0.010583	0.031749	N				0.68	0.97	13.75%	8
	39	39.5	39.4	39.5	34		0.6	7752	23256	0.011994	0.035982	N				0.77	1.25	13.75%	8
		39.4	39.3	39.4	40	Pipe 53.1	0.6	16036	48108	0.024811	0.074434	N				1.05	1.55	20.00%	8
		39.3	39.2	39.3	44	Pipe 52.1	0.6	23864	71592	0.036923	0.110769	N				1.12	1.72	23.75%	8
		39.2	39.1	39.2	49	Pipe 51.1	1	28196	84588	0.043626	0.130877	N				1.55	2.23	25.00%	8
		39.1	29.25	39.1	49		1	28196	84588	0.043626	0.130877	N				1.55	2.23	25.00%	8
		20.11	20.10	20.11	0		2.75	0	0	0	0	Y	Southwest	0.115597	0.346791	3.07	4.23	42.50%	8
		20.10	20.09	20.10	0		2.75	0	0	0	0	Y	Carry over	0.115597	0.346791	3.07	4.23	42.50%	8
		20.09	20.08	20.09	0		2.75	0	0	0	0	Y	Carry over	0.115597	0.346791	3.07	4.23	42.50%	8
		20.08	20.07	20.08	0		2	0	0	0	0	Y	Carry over	0.115597	0.346791	2.71	3.68	42.50%	8
		20.07	20.06	20.07	0		2	0	0	0	0	Y	Carry over	0.115597	0.346791	2.71	3.68	42.50%	8
	20	20.06	20.05	20.06	0		0.4	0	0	0	0	Y	Carry over	0.115597	0.346791	1.52	2.09	42.50%	8
		20.05	20.04	20.05	0		1	0	0	0	0	Y	Carry over	0.115597	0.346791	2.17	2.9	42.50%	8
		20.4	20.3	20.4	0	Pipe 21.1	0.4	76608	229824	0.11853	0.35559	Y	Carry over	0.234127	0.702382	1.86	2.45	60.00%	8
		20.3	20.2	20.3	0	Pipe 26.1	0.4	85652	256956	0.132523	0.39757	Y	Carry over	0.24812	0.744361	1.87	2.46	61.25%	8
		20.2	20.1	20.2	0		0.4	85652	256956	0.132523	0.39757	Y	Carry over	0.24812	0.744361	1.87	2.46	61.25%	8
		20.1	19.17	20.1		Pipe 23.1	1.13	113050	339150	0.174914	0.524743	Y	Carry over	0.290511	0.871534	2.89	3.87	67.50%	8
		20.11	29.42	29.43	0		1.4	0	0	0	0	N				0	0	0.00%	8
		29.42	29.41	29.42	0		1.4	0	0	0	0	N				0	0	0.00%	8
		29.41	29.40	29.41	0		1.4	0	0	0	0	N				0	0	0.00%	8
		29.40	29.39	29.40	0		1.4	0	0	0	0	N				0	0	0.00%	8
		29.39	29.38	29.39	0		1.2	0	0	0	0	N				0	0	0.00%	8
		29.38	29.37	29.38	0		1.2	0	0	0	0	N				0	0	0.00%	8
		29.37	29.36	29.37	0		1.2	0	0	0	0	N				0	0	0.00%	8
		29.36	29.35	29.36	0		1.8	0	0	0	0	Y	PA 13	0.046507	0.13952	1.96	2.62	27.50%	8
		29.35	29.34	29.35	0		1.8	0	0	0	0	Y	Carry over	0.046507	0.13952	1.96	2.62	27.50%	8
		29.34	29.33	29.34	0	Pipe 31.1	0.8	16758	50274	0.025928	0.077785	Y	Carry over	0.072435	0.217305	1.69	2.31	32.50%	8
		29.33	29.32	29.33	0		0.7	16758	50274	0.025928	0.077785	Y	Carry over	0.072435	0.217305	1.51	2.31	32.50%	8
		29.32	29.31	29.32	0		0.6	16758	50274	0.025928	0.077785	Y	Carry over	0.072435	0.217305	1.5	2.16	32.50%	8
		29.31	29.30	29.31	0		0.7	16758	50274	0.025928	0.077785	Y	Carry over	0.072435	0.217305	1.5	2.3	32.50%	8
		29.30	29.29	29.30	0	Pipe 30.1	0.4	67564	202692	0.104537	0.313611	Y	Carry over	0.151044	0.453131	1.6	2.28	47.50%	8
		29.29	29.28	29.29	0		0.4	67564	202692	0.104537	0.313611	Y	Carry over	0.151044	0.453131	1.6	2.28	47.50%	8
		29.28	29.27	29.28	0		0.4	67564	202692	0.104537	0.313611	Y	Carry over	0.151044	0.453131	1.6	2.28	47.50%	8
		29.27	29.26	29.27	0		0.4	67564	202692	0.104537	0.313611	Y	Carry over	0.151044	0.453131	1.6	2.28	47.50%	8
		29.26	29.25	29.26	0		0.4	67564	202692	0.104537	0.313611	Y	Carry over	0.151044	0.453131	1.6	2.28	47.50%	8
		29.25	29.24	29.25	0	Pipe 39.1	0.4	95760	287280	0.148163	0.444488	Y	Carry over	0.194669	0.584008	1.82	2.39	53.75%	8
		29.24	29.23	29.24	0		0.4	95760	287280	0.148163	0.444488	Y	Carry over	0.194669	0.584008	1.82	2.39	53.75%	8
		29.23	29.22	29.23	0		0.4	95760	287280	0.148163	0.444488	Y	Carry over	0.194669	0.584008	1.82	2.39	53.75%	8
	29	29.22	29.21	29.22	0		2	95760	287280	0.148163	0.444488	Y	Carry over	0.194669	0.584008	3.02	4.41	53.75%	8
		29.21	29.20	29.21	0	Pipe 38.1	0.4	130264	390792	0.201548	0.604645	Y	Carry over	0.248055	0.744164	1.87	2.46	61.25%	8
		29.20	29.19	29.20	0		0.4	130264	390792	0.201548	0.604645	Y	Carry over	0.248055	0.744164	1.87	2.46	61.25%	8
		29.19	29.18	29.19	0		0.71	130264	390792	0.201548	0.604645	Y	Carry over	0.248055	0.744164	2.32	3.13	61.25%	8
		29.18	29.17	29.18	0		0.85	130264	390792	0.201548	0.604645	Y	Carry over	0.248055	0.744164	2.47	3.4	61.25%	8
		29.17	29.16	29.17	0		0.3	130264	390792	0.201548	0.604645	Y	Southeast	0.328818	0.986455	1.86	2.43	54.00%	10
		29.16	29.15	29.16	0		0.28	130264	390792	0.201548	0.604645	Y	Carry over	0.328818	0.986455	1.78	2.35	67.50%	10
		29.15	29.14	29.15	0		0.28	130264	390792	0.201548	0.604645	Y	Carry over	0.328818	0.986455	1.78	2.35	67.50%	10
		29.14	29.13	29.14	0		0.28	130264	390792	0.201548	0.604645	Y	Carry over	0.328818	0.986455	1.78	2.35	67.50%	10
		29.13	29.12	29.13	0		0.28	130264	390792	0.201548	0.604645	Y	Carry over	0.328818	0.986455	1.78	2.35	67.50%	10
		29.12	29.11	29.12	0		0.28	130264	390792	0.201548	0.604645	Y	Carry over	0.328818	0.986455	1.78	2.35	67.50%	10
		29.11	29.10	29.11	0		0.28	130264	390792	0.201548	0.604645	Y	Carry over	0.328818	0.986455	1.78	2.35	67.50%	10
		29.10	29.9	29.10	0		0.28	130264	390792	0.201548	0.604645	Y	Carry over	0.328818	0.986455	1.78	2.35	67.50%	10
		29.9	29.8	29.9	0		0.28	130264	390792	0.201548	0.604645	Y	Carry over	0.328818	0.986455	1.78	2.35	67.50%	10
		29.8	29.7	29.8	0		0.28	130264	390792	0.201548	0.604645	Y	Carry over	0.328818	0.986455	1.78	2.35	67.50%	10
		29.7	29.6	29.7	0		0.28	130264	390792	0.201548	0.604645	Y	PA 19	0.443644	1.330933	1.97	2.55	49.17%	12
		29.6	29.5	29.6	0		0.28	130264	390792	0.201548	0.604645	Y	Carry over	0.443644	1.330933	1.97	2.55	49.17%	12
		29.5	29.4	29.5	0		0.28	130264	390792	0.201548	0.604645	Y	Carry over	0.443644	1.330933	1.97	2.55	49.17%	12
		29.4	29.3	29.4	0		0.28	130264	390792	0.201548	0.604645	Y	Carry over	0.443644	1.330933	1.97	2.55	49.17%	12
		29.3	29.2 A	29.3	0		0.28	130264	390792	0.201548	0.604645	Y	Carry over	0.443644	1.330933	1.97	2.55	49.17%	12
		29.2A	29.2	29.3 (1)	0		0.28	130264	390792	0.201548	0.604645	Y	Carry over	0.443644	1.330933	1.97	2.55	49.17%	12
		29.2	29.1	29.2	0		0.1	130264	390792	0.201548	0.604645	Y	PA 18	0.525957	1.577871	1.36	1.82	40.00%	15
		29.1	19.4	29.1	0		0.1	130264	390792	0.201548	0.604645	Y	Carry over	0.525957	1.577871	1.36	1.82	40.00%	15

Pioneer Village
Water/Wastewater Demand Estimate

Land Use	Phase	Units/Acres	Person	Use/Person	Total	Peak Used	Total Flow	P WATER ADD (Gallons)	P WATER MDD (Gallons)	P Water (ADD) Cumulative (Gal)	P WATER (ADD) Cumulative (MGD)	PHF (GPM)
		Sections 7 & 8						Potable Water Demand Estimate				
Residential	1	138	3	76	31464	2.5	78660	36,708	55,062	36,708	0.037	114.537
	2	249	3	76	56772	2.5	141930	66,234	99,351	102,942	0.103	206.665
	3	152	3	76	34656	2.5	86640	40,432	60,648	143,374	0.143	126.157
	4	123	3	76	28044	2.5	70110	32,718	49,077	176,092	0.176	102.088
	5	127	3	76	28956	2.5	72390	33,782	50,673	209,874	0.210	105.408
	6	268	3	76	61104	2.5	152760	71,288	106,932	281,162	0.281	222.435
	7	162	3	76	36936	2.5	92340	43,092	64,638	324,254	0.324	134.457
	8	138	3	76	31464	2.5	78660	36,708	55,062	360,962	0.361	114.537
5903	9	140	3	76	31920	2.5	79800	37,240	55,860	398,202	0.398	116.197
	10	136	3	76	31008	2.5	77520	36,176	54,264	434,378	0.434	112.878
Commerical	11	**17.08**	600		10248	2.5	25620	12,468	18,703	446,846	0.447	55.814
	12	98	3	76	22344	2.5	55860	26,068	39,102	472,914	0.473	81.338
	13	113	3	76	25764	2.5	64410	30,058	45,087	502,972	0.503	93.788
Commerical	14	**44.94**	600		26964	2.5	67410	32,806	49,209	535,779	0.536	146.854
Commerical	15	**34.02**	600		20412	2.5	51030	24,835	37,252	560,613	0.561	111.170
	16	297	3	76	67716	2.5	169290	79,002	118,503	639,615	0.640	246.505
	17	233	3	76	53124	2.5	132810	61,978	92,967	701,593	0.702	193.386
	18	200	3	76	45600	2.5	114000	53,200	79,800	754,793	0.755	165.996
	19	279	3	76	63612	2.5	159030	74,214	111,321	829,007	0.829	231.565
	20	113	3	76	25764	2.5	64410	30,058	45,087	859,065	0.859	93.788
	21	337	3	76	76836	2.5	192090	89,642	134,463	948,707	0.949	279.704
	22	91	3	76	20748	2.5	51870	24,206	36,309	972,913	0.973	75.528
	23	86	3	76	19608	2.5	49020	22,876	34,314	995,789	0.996	71.378
	24	74	3	76	16872	2.5	42180	19,684	29,526	1,015,473	1.015	61.419
	25	67	3	76	15276	2.5	38190	17,822	26,733	1,033,295	1.033	55.609
Commerical	26	**25.85**	600		15510	2.5	38775	18,871	28,306	1,052,166	1.052	84.472
	27	128	3	76	29184	2.5	72960	34,048	51,072	1,086,214	1.086	106.238
	28	60	3	76	13680	2.5	34200	15,960	23,940	1,102,174	1.102	49.799
	29	93	3	76	21204	2.5	53010	24,738	37,107	1,126,912	1.127	77.188
				Section 9								
Land Use	**Phase**	**Units/Acres**	**Person**	**Use/Person**	**Total**		**Total Flow**	**P WATER ADD (Gallons)**	**P WATER MDD (Gallons)**	**P Water Cumulative (Gal)**	**P WATER Cumulative (MGD)**	
	30	1156	3	76	263568	2.5	658920	307,496	461,244	1,434,408	1.434	959.459
School	31	**30.33**	1000	15	15000	2.5	37500	22,141	33,211	1,456,549	1.457	99.112
	32	272	3	76	62016	2.5	155040	72,352	108,528	1,528,901	1.529	225.755
	33	223	3	76	50844	2.5	127110	59,318	88,977	1,588,219	1.588	185.086
	34	350	3	76	79800	2.5	199500	93,100	139,650	1,681,319	1.681	290.494
				Section 5								
Land Use	**Phase**	**Acres**	**Person**	**Use**	**Total**		**Total Flow**	**P WATER ADD (Gallons)**	**P WATER MDD (Gallons)**	**P Water Cumulative (Gal)**	**P WATER Cumulative (MGD)**	
Industrial	35	**88.65**	600		53190	2.5	132975	64,715	97,072	1,746,033	1.746	289.689
Industrial	36	**25.06**	600		15036	2.5	37590	18,294	27,441	1,764,327	1.764	81.891
Commerical	37	**9.74**	600		5844	2.5	14610	7,110	10,665	1,771,437	1.771	31.828
Industrial	38	**59.86**	600		35916	2.5	89790	43,698	65,547	1,815,135	**1.815**	195.609

Phase	IRR WATER ADD (Gallons)	IRR WATER MDD (Gallons)	IRR WATER ADD Cumulative (Gal)	IRR Water Cumulative) (MGD	Person/DU	Res Flow (GPD/Person)	Total ADF Res (GPD)	Comm Flow (GPD/Acre)	Total ADF Com (GPD)
	Irrigation Water Demands				Wastewater Flows: Residential Uses			Commerical Uses	
1	4,525	6,788	4,525	0.005	3.5	76	36,708		
2	8,166	12,248	12,691	0.013	3.5	76	66,234		
3	4,985	7,477	17,676	0.018	3.5	76	40,432		
4	4,034	6,050	21,709	0.022	3.5	76	32,718		
5	4,165	6,247	25,874	0.026	3.5	76	33,782		
6	8,789	13,183	34,663	0.035	3.5	76	71,288		
7	5,313	7,969	39,975	0.040	3.5	76	43,092		
8	4,525	6,788	44,501	0.045	3.5	76	36,708		
9	4,591	6,887	49,092	0.049	3.5	76	37,240		
10	4,460	6,690	53,552	0.054	3.5	76	36,176		
11	7,625	11,437	61,176	0.061				600	10,248
12	3,214	4,821	64,390	0.064	3.5	76	26,068		
13	3,706	5,558	68,096	0.068	3.5	76	30,058		
14	20,061	30,092	88,157	0.088				600	26,964
15	15,187	22,780	103,343	0.103				600	20,412
16	9,740	14,609	113,083	0.113	3.5	76	79,002		
17	7,641	11,461	120,724	0.121	3.5	76	61,978		
18	6,559	9,838	127,282	0.127	3.5	76	53,200		
19	9,149	13,724	136,432	0.136	3.5	76	74,214		
20	3,706	5,558	140,137	0.140	3.5	76	30,058		
21	11,051	16,577	151,189	0.151	3.5	76	89,642		
22	2,984	4,476	154,173	0.154	3.5	76	24,206		
23	2,820	4,230	156,993	0.157	3.5	76	22,876		
24	2,427	3,640	159,420	0.159	3.5	76	19,684		
25	2,197	3,296	161,617	0.162	3.5	76	17,822		
26	11,539	17,309	173,157	0.173				600	15,510
27	4,198	6,296	177,354	0.177	3.5	76	34,048		
28	1,968	2,951	179,322	0.179	3.5	76	15,960		
29	3,050	4,575	182,371	0.182	3.5	76	24,738		
	NP WATER ADD (Gallons)	**NP WATER MDD (Gallons)**	**NP WATER Cumulative (Gal)**	**NP Water Cumulative) (MGD**	**Person/DU**	**Res Flow (GPD/Person)**	**Total ADF Res (GPD)**	**Comm Flow (GPD/Acre)**	**Total ADF Com (GPD)**
30	37,909	56,864	220,281	0.220	3.5	76	307,496		
31	13,539	20,309	233,820	0.234				600	18,198
32	8,920	13,380	242,740	0.243	3.5	76	72,352		
33	7,313	10,969	250,053	0.250	3.5	76	59,318		
34	11,478	17,217	261,530	0.262	3.5	76	93,100		
	NP WATER ADD (Gallons)	**NP WATER MDD (Gallons)**	**NP WATER Cumulative (Gal)**	**NP Water Cumulative) (MGD**	**Person/DU**	**Res Flow (GPD/Person)**	**Total ADF Res (GPD)**	**Comm Flow (GPD/Acre)**	**Total ADF Com (GPD)**
35	39,573	59,360	301,104	0.301				600	53,190
36	11,187	16,780	312,291	0.312				600	15,036
37	4,348	6,522	316,638	0.317				600	5,844
38	26,722	40,082	343,360	0.343				600	35,916

Phase	Peaking Factor (User Defined)	Peak WW Flow (GPD)	Peak WW Flow (MGD)	Cumulative Flows (GPD)	Cumulative Flows (MGD)	Irrigation	Potable	Wastewater
	Wastewater Flows					Summary (Cumulative MGD)		
1	3	110,124	0.110	110,124	0.110	0.005	0.037	0.110
2	3	198,702	0.199	308,826	0.309	0.013	0.103	0.309
3	3	121,296	0.121	430,122	0.430	0.018	0.143	0.430
4	3	98,154	0.098	528,276	0.528	0.022	0.176	0.528
5	3	101,346	0.101	629,622	0.630	0.026	0.210	0.630
6	3	213,864	0.214	843,486	0.843	0.035	0.281	0.843
7	3	129,276	0.129	972,762	0.973	0.040	0.324	0.973
8	3	110,124	0.110	1,082,886	1.083	0.045	0.361	1.083
9	3	111,720	0.112	1,194,606	1.195	0.049	0.398	1.195
10	3	108,528	0.109	1,303,134	1.303	0.054	0.434	1.303
11	3	30,744	0.031	1,333,878	1.334	0.061	0.447	1.334
12	3	78,204	0.078	1,412,082	1.412	0.064	0.473	1.412
13	3	90,174	0.090	1,502,256	1.502	0.068	0.503	1.502
14	3	80,892	0.081	1,583,148	1.583	0.088	0.536	1.583
15	3	61,236	0.061	1,644,384	1.644	0.103	0.561	1.644
16	3	237,006	0.237	1,881,390	1.881	0.113	0.640	1.881
17	3	185,934	0.186	2,067,324	2.067	0.121	0.702	2.067
18	3	159,600	0.160	2,226,924	2.227	0.127	0.755	2.227
19	3	222,642	0.223	2,449,566	2.450	0.136	0.829	2.450
20	3	90,174	0.090	2,539,740	2.540	0.140	0.859	2.540
21	3	268,926	0.269	2,808,666	2.809	0.151	0.949	2.809
22	3	72,618	0.073	2,881,284	2.881	0.154	0.973	2.881
23	3	68,628	0.069	2,949,912	2.950	0.157	0.996	2.950
24	3	59,052	0.059	3,008,964	3.009	0.159	1.015	3.009
25	3	53,466	0.053	3,062,430	3.062	0.162	1.033	3.062
26	3	46,530	0.047	3,108,960	3.109	0.173	1.052	3.109
27	3	102,144	0.102	3,211,104	3.211	0.177	1.086	3.211
28	3	47,880	0.048	3,258,984	3.259	0.179	1.102	3.259
29	3	74,214	0.074	3,333,198	3.333	0.182	1.127	3.333
	Peaking Factor (User Defined)	**Peak WW Flow (GPD)**	**Peak WW Flow (MGD)**	**Cumulative Flows (GPD)**	**(MGD)**	**Non-Potable**	**Potable**	**Wastewater**
30	3	922,488	0.922	4,255,686	4.256	0.220	1.434	4.256
31	3	54,594	0.055	4,310,280	4.310	0.234	1.457	4.310
32	3	217,056	0.217	4,527,336	4.527	0.243	1.529	4.527
33	3	177,954	0.178	4,705,290	4.705	0.250	1.588	4.705
34	3	279,300	0.279	4,984,590	4.985	0.262	1.681	4.985
	Peaking Factor (User Defined)	**Peak WW Flow (GPD)**	**Peak WW Flow (MGD)**	**Cumulative Flows (GPD)**	**(MGD)**	**Non-Potable**	**Potable**	**Wastewater**
35	3	159,570	0.160	5,144,160	5.144	0.301	1.746	5.144
36	3	45,108	0.045	5,189,268	5.189	0.312	1.764	5.189
37	3	17,532	0.018	5,206,800	5.207	0.317	1.771	5.207
38	3	107,748	0.108	5,314,548	**5.315**	0.343	**1.815**	**5.315**

Figure 3.1 Ratio of Peak Hourly Flow to Design Average Flow

[Source: Washington 98-37WQ, Figure C1-1 with note originally extracted from
“Recommended Standards for Wastewater Facilities, 1990 Edition (10 States Standards)]